PIXELWORKS, INC
Form 10-K
March 13, 2019
UNITED STATES
SECURITIES AND EXCHANGE COMMISSION
WASHINGTON, D.C. 20549

FORM 10-K

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x ANNUAL REPORT PURSUANT TO SECTION 13 or 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934
For the fiscal year ended December 31, 2018
or
¨ TRANSITION REPORT PURSUANT TO SECTION 13 or 15(d) OF THE SECURITIES EXCHANGE ACT OF 1934
For the transition period from to
Commission File Number: 000-30269

PIXELWORKS, INC.
(Exact name of registrant as specified in its charter)

Oregon	91-1761992
(State or other jurisdiction of incorporation or organization)	(I.R.S. Employer Identification No.)
226 Airport Parkway, Suite 595, San Jose, CA	95110
(Address of principal executive offices)	(Zip Code)

408-200-9200
(Registrant's telephone number, including area code)
Securities registered pursuant to Section 12(b) of the Act:

Title of each class	Name of each exchange on which registered
Common Stock	The Nasdaq Global Market

Securities registered pursuant to Section 12(g) of the Act:
None

Indicate by check mark if the registrant is a well-known seasoned issuer, as defined in Rule 405 of the Securities Act. Yes ¨ No x
Indicate by check mark if the registrant is not required to file reports pursuant to Section 13 or 15(d) of the Act. Yes ¨ No x
Indicate by check mark whether the registrant (1) has filed all reports required to be filed by Section 13 or Section 15(d) of the Securities Exchange Act of 1934 during the preceding 12 months (or for such shorter period that the registrant was required to file such reports), and (2) has been subject to such filing requirements for the past 90 days. Yes x No ¨
Indicate by check mark whether the registrant has submitted electronically 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 such files). Yes x No ¨
Indicate by check mark if disclosure of delinquent filers pursuant to Item 405 of Regulation S-K (§229.405 of this chapter) is not contained herein, and will not be contained, to the best of the registrant's knowledge, in definitive proxy or information statements incorporated by reference in Part III of this Form 10-K or any amendment to this Form 10-K. x

Indicate by check mark whether the registrant is a large accelerated filer, an accelerated filer, a non-accelerated filer, a smaller reporting company or an emerging growth company. See 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	x
Non-accelerated filer	¨	Smaller reporting company	x
Emerging growth company	¨		

If an emerging growth company, indicate by check mark if the registrant has elected not to use the extended transition period for complying with any new or revised financial accounting standards provided pursuant to Section 13(a) of the Exchange Act. Yes ¨ No ¨

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

The aggregate market value of the registrant's common stock held by non-affiliates at June 29, 2018 was $113,055,630 based on the closing price of $3.61 per share of common stock on the Nasdaq Global Market on June 29, 2018 (the last business day of the registrant's most recently completed second fiscal quarter). For purposes of this calculation, executive officers and directors are considered affiliates as well as holders of more than 5% of the registrant's common stock known to the registrant. This determination of affiliate status is not a conclusive determination for other purposes.

Number of shares of common stock of the registrant outstanding as of March 8, 2019: 37,535,119

Documents Incorporated by Reference

Part III incorporates information by reference to the registrant’s definitive proxy statement, to be filed with the Securities and Exchange Commission within 120 days after the close of the fiscal year ended December 31, 2018.

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Forward-looking Statements

This Annual Report on Form 10-K, including Management’s Discussion and Analysis of Financial Condition and Results of Operation in Part II, Item 7, contains "forward-looking statements" that are based on current expectations, estimates, beliefs, assumptions and projections about our business. Words such as "expects," "anticipates," "intends," "plans," "believes," "seeks," "estimates" and variations of such words and similar expressions are intended to identify such forward-looking statements. These statements are not guarantees of future performance and involve numerous risks, uncertainties and assumptions that are difficult to predict. These forward-looking statements include statements regarding: the features, benefits and applications of our technologies and products; market trends and changes, including in the video consumption, mobile, video and digital projection markets; our strategy, including regarding our products, technology, research and development, sales and marketing and acquisition and other growth opportunities; our ability to successfully integrate the business of ViXS Systems Inc. (“ViXS”) with our existing business; our expectations with respect to our restructuring plans; amortization expectations; the sufficiency of our working capital and need for, or ability to secure, additional financing; the success of our products in expanded markets; customer and distributor concentration; current global economic challenges; exchange rate risk; our competitive advantages in research and development; levels of inventory at distributors and customers; changes in customer ordering patterns or lead times; seasonality; expectations as to revenue associated with sales into certain markets in 2019, cost expectations; backlog; future contractual obligations; competition; intellectual property; insufficient, excess or obsolete inventory and variations in inventory valuation; income tax valuation allowance; net operating loss utilization; the impact of the Tax Cuts and Jobs Act ("TCJA"); changes in accounting principles; and internal controls. Factors which may cause actual results to vary materially from those contained in the forward-looking statements include, without limitation: our ability to deliver new products in a timely fashion; our new product yield rates; changes in estimated product costs; product mix; restructuring charges; the growth of the markets we serve; supply of products from third-party foundries; failure or difficulty in achieving design wins; timely customer transition to new product designs; competitive factors, such as rival chip architectures, introduction or traction by competing designs, or pricing pressures; litigation related to our intellectual property rights; our limited financial resources; economic and political challenges due to operations in Asia; exchange rate fluctuations; failure to retain or attract qualified employees; the sufficiency of our intellectual property and patent portfolio; fluctuations in foreign currencies; natural disasters; the need for additional income tax valuation allowances; limitations on net operating losses, as well as other risks identified in the risk factors contained in Part I, Item 1A of this Annual Report on Form 10-K. These forward-looking statements speak only as of the date on which they are made, and we do not undertake any obligation to update any forward-looking statement to reflect events or circumstances after the date of this Annual Report on Form 10-K. If we do update one or more forward-looking statements, you should not conclude that we will make additional updates with respect thereto or with respect to other forward-looking statements. Except where the context otherwise requires, in this Annual Report on Form 10-K, the terms "Pixelworks," the "Company," "we," "us" and "our" mean Pixelworks, Inc., an Oregon corporation, and its wholly-owned subsidiaries.

PART I

Item 1. Business.

Overview

Pixelworks designs, develops and markets visual display processing semiconductors, intellectual property cores, software and custom application specific integrated circuits ("ASIC") solutions for high-quality energy efficient video applications. In addition, we offer a suite of solutions for advanced media processing and the efficient delivery and streaming of video.

We enable worldwide manufacturers to offer leading-edge consumer electronics and professional display products, as well as video delivery and streaming solutions for content service providers. Our core visual display processing technology intelligently processes digital images and video from a variety of sources and optimizes the content for a superior viewing experience. Pixelworks' video coding technology reduces storage requirements, significantly reduces bandwidth constraint issues and converts content between multiple formats to enable seamless delivery of video, including over-the-air (OTA) streaming, while also maintaining end-to-end content security.

Rapid growth in video-capable consumer devices, especially mobile, has increased the demand for visual display processing and video delivery technology in recent years. Our technologies can be applied to a wide range of devices from large-screen projectors to low-power mobile tablets, smartphones, high-quality video infrastructure equipment and streaming devices. Our products are architected and optimized for power, cost, bandwidth, and overall system performance, according to the requirements of the specific application. Our primary target markets include digital projection systems, tablets, smartphones, and OTA streaming devices.

As of December 31, 2018, we held an intellectual property portfolio of 361 patents related to the visual display of digital image data. We focus our research and development efforts on developing video algorithms that improve quality, and architectures that reduce system power, cost, bandwidth and increase overall system performance and device functionality. We seek to expand our technology portfolio through internal development and co-development with business partners, and we continually evaluate acquisition opportunities and other ways to leverage our technology into other high-value markets.

High-Resolution Displays

Display technologies have recently begun to transition from an era of higher resolutions, response times and frame rates, with lower power and thinner form factors, to one focused on higher contrast and more colors.

In mobile devices, Apple Inc. has brought wide color gamut to many of their devices including the iPhone, iPad Pro, MacBook Pro and iMac. These devices deliver the same color gamut used in digital cinema theatres ("DCI-P3"). Meanwhile, television ("TV") manufacturers including Samsung, Sony and LG are bringing high contrast, high brightness (High Dynamic Range or "HDR") TVs based on organic light emitting diodes ("OLED") and local-dimming liquid crystal display ("LCD") panels to the living room. Furthermore, premium smartphones and some tablets from Apple, Samsung, Sony, LG and Huawei now include HDR as a standard feature.

Hardware improvements in color and contrast are of little value without content that can take advantage of them. In fact, a significant gap now exists between the vast majority of video content available to consumers, and these emerging display devices.

- Contrast and Brightness: Almost all movies available to consumers today use the "Rec.709" ITU standard format. This format defines brightness levels up to around 100 "nits" (a standard measure of brightness), whereas HDR TVs are five to ten times brighter (from 540 nits upwards). Most mobile devices support over 400 nits and sometimes over 600 nits.
- Color Gamut: DCI-P3 has a 25% larger color gamut than Rec.709.
- Frame Rate: Most movies are available in 24 or 25 frames per second, a rate at which the human eye still perceives judder, but cannot identify individual still images or frames and sees a video instead. Mobile devices on the other hand have displays that run at 60 to 90 frames per second, and TVs commonly display 120 frames per second - frame rates at which the eye perceives smooth motion. In addition to the display frame rate discrepancy, the transmission rates vary based on various factors such as available bandwidth. Standard frame rate conversion requires the original content frames being repeated or dropped in order to match the frame rate of the display. This causes the video to

appear to judder. Judder is a common problem in video systems and occurs when there is a sudden jump or discontinuity in motion from one frame of a motion video sequence to the next. This can be caused by content being created at a frame rate per second that is too low, or the original content frames are being repeated or dropped in order to match either a transmission standard or the playback frame rate of the display.

- Resolution: TVs have achieved 4k resolutions (3840x2160) and mobile devices today can achieve up to 3440x1440 resolution, and while some content is available in 4k resolution, most movies are only available in FHD or HD resolutions (typically 1920x1080 and 1280x720 respectively).

This gap between display capabilities and available content brings significant challenges to video display device manufacturers. Sophisticated video processing is required to accurately reproduce the intended video on today's displays.

For example, Sony adds their proprietary "4K HDR Processor X1™" to their latest TV sets and Samsung adds their "mDNIe™" video processors to their mobile phones.

Content formats are evolving to take advantage of these display improvements. For example, Dolby introduced the "Dolby Vision™" format for movies and devices, in order to allow consumers to realize the benefits of HDR and wide color gamut. The industry standards body Society of Motion Picture & Television Engineers, released a format specification known as "HDR10" that similarly bridges the gap in contrast and color between content and devices. The Ultra-HD Blu-ray disk format and streaming services such as Netflix and Amazon Video now support 4k HDR, aided by improved compression standards such as H.265.

Managing many content formats across a rapidly evolving range of displays is a significant and growing challenge. Older content tends to not get upgraded to the newer formats, yet consumers expect all content to display correctly. As the number of content formats grow, the technology of video processing becomes increasingly complex.

Bridging the gap in color, contrast and resolution, while delivering the intent of the content creator, requires sophisticated algorithms and hardware circuits. However, frame-rate and motion incompatibilities require a significantly higher level of processing and more sophisticated algorithms in order to avoid creating new problems. Most TVs today include frame-rate conversion chips, but many reviewers complain about artifacts such as halos, breakup in the image and the so-called "soap opera effect". Unfortunately, without frame-rate conversion the video can appear to have judder and blur at levels that have increased substantially as a result of the improvements in contrast, color and detail.

In addition to judder, high-resolution displays suffer from softness and smearing in motion sequences called motion blur. There are numerous causes of motion blur. The materials used in constructing pixels on the display take a finite amount of time to transition from one state to another. If this time is too long, the image does not update swiftly and motion sequences seem to smear or blur. For example, Hollywood movies, TV shows and other premium content are usually authored at 24 frames per second or 24Hz. At this frame rate, the brain can easily notice the transition from one frame to the next. As the brain and eyes track objects in motion, they have to jump in discrete steps due to the low frame rate. This stop-start motion is perceived by the brain as motion blur, reducing the visible clarity and fidelity of objects in motion. Additionally, when a motion sequence is played on a digital display device, the new updated frame is drawn over the top of the still visible previous frame. This "hold" effect is perceived by the brain as blur.

Judder and motion blur artifacts are more noticeable on high contrast, wider gamut displays, regardless of screen size (for example, a 5-inch smartphone screen viewed from ten inches away appears to be the same size as a 60-inch large screen TV viewed from ten feet away). Pixelworks' advanced video display processing provides original equipment manufacturers ("OEMs") with solutions that avoid or minimize these artifacts and help realize the potential of their investment in high-resolution displays. We believe the most effective method for removing both judder and reducing blur is motion estimation/motion compensation ("MEMC") technology. This technology is based on complex mathematical algorithms that insert additional, interpolated frames to create a new, faster sequence of frames that has smooth, continuous motion. This technique works for virtually all types of panel technology.

Video Consumption Trend

With the advent of digital video, it has become possible to deliver video to consumers in an ever increasing number of ways. Traditional delivery mechanisms such as over the air broadcasts, cable, satellite, DVDs and Blu-ray are being supplemented with Internet streaming and download services. With these new video delivery options comes the ability to offer more services and improved quality.

According to recent studies by Cisco Systems, Inc. ("Cisco"), video will constitute 82% of all global consumer Internet traffic by 2022 and global IP video traffic will grow nearly threefold and Internet video traffic will grow four-fold from 2017 to 2022. Live Internet video will account for 17 percent of Internet video traffic by 2022. Live video will grow 15-fold from 2017 to 2022. This rapid increase in video consumption is being driven by a variety of

connected digital video devices and applications that allow consumers to easily create, share and consume video. In particular, mobile video consumption is rapidly expanding. The "always on" and ease of use of mobile devices are helping to make them the preferred choice as the "first screen" for many consumers.

As more content becomes increasingly available via the Internet, consumers have more choices for how and where they can enjoy content. According to Cisco, by 2020 there will be 5.5 billion connected mobile users across the globe, amounting to 70% of the world's population.

Mobile Video

There has been continued growth in the share of online video viewed by mobile devices. The Q2 2018 Global Video Index report from Ooyala, Inc. showed more than 62% of all video views are now on mobile devices and that since 2011, mobile video views have increased more than 4000%, outpacing the growing penetration rate of mobile devices globally as viewers spend more time watching video on the small screen.

Mobile display systems pose a number of unique challenges. Power is of primary importance, impacting form factor, cost and performance. As these systems have added more functionality, new features have had to compete for battery life, internal bandwidth and space. The addition of high-resolution displays has further increased the burden on these resources.

Using the same technology developed for large screen TVs is neither feasible nor desirable. The video display processing pipelines used in TVs consume many watts of power and would be unsuitable for battery powered systems. In TVs, the size constraints on electronics are significantly less stringent when compared to mobile systems. To furnish the mobile market with appropriate solutions, Pixelworks has taken a holistic, system-wide view and re-invented its video display processing technology to fit within the mobile constraints of battery life, bandwidth, form factor and performance. This approach has enabled us to create technology that meets the power and size requirements of mobile as well as offering additional benefits such as reducing the bandwidth burden of high-resolution video and freeing up more bandwidth for the CPU and GPU.

The mobile market today is primarily comprised of smartphones and tablets. Our technology addresses both of these markets.

- Smartphones. Smartphones have become a popular choice for many consumers. Business Insider estimates that 2.1 billion smartphones will be sold in 2021. The resolution of smartphone displays is growing, while the color gamut and contrast is moving toward DCI-P3 and HDR. These improvements in displays actually exacerbate the quality issues of video playback, a growing problem as users increasingly use their smartphones as their primary form of video consumption.
- Tablets. The line between tablets and smartphones is becoming increasingly indistinct as more tablets are offering mobile connectivity and are now available in sizes similar to those of smartphones. Tablets offer broad appeal to consumers. With the display being the salient component of smartphones and tablets, and the rapidly increasing use of these devices for video consumption, we believe that the incorporation of video display processing is the next logical step.

As 5G capability finds its way into cellular infrastructure and smartphones starting modestly in the second half of 2019, and more robustly in 2020, this should reinvigorate market growth given the increased speed and lower latency of the wireless connections. In addition, service providers in some countries will also utilize 5G networks to provide fixed wireless broadband. We further believe our compelling mobile display processing functionality, combined with 5G capability, will help motivate consumers to replace their 3G and 4G phones at a faster rate than occurred in 2018. Finally, a new smartphone category has emerged as two of the top three vendors have previewed foldable smartphones which serve as a phone, and a mini tablet when unfolded. As prices for this capability inevitably come down, and further competition emerges, we believe this new category, along with the rollout of 5G networks, can strengthen the mobile device market.

Digital Projection Market

Increasingly affordable price points are driving continued adoption of digital projectors in business and education, as well as among consumers. Technology improvements are helping to reduce the size and weight of projection devices while increasing their performance. Projector models range from larger units designed to be permanently installed in a conference hall or other venue, to ultra-portable devices weighing fewer than two pounds for maximum portability. According to PMA Research Limited, the worldwide front projector market shipped 9.8 million units in 2018 and is forecasted to reach 11.1 million units by 2022.

The feature set of projection systems differs from that of a typical large-screen flat panel display such as a TV. This is primarily because the projector is a sharing and collaboration device while the TV is designed for direct consumption

of content.

The front projection market serves several different areas such as business, education and home theater. Business users employ multimedia projectors to display both still and video presentation materials from PCs and other sources. Requirements for the business market include portability, compatibility with multiple software and hardware applications, and features that ensure simple operation. In education environments ranging from elementary schools to university campuses, projectors help teachers integrate media-rich instruction into classrooms. Home theater projector systems can drive large-screen displays for content consumption where flat panel displays are either economically not viable or physically incompatible for use.

Consistent with the trends of other consumer products, digital projectors are increasingly incorporating networking capabilities that enable the sharing of video and other content among multiple devices. This, in turn, is enabling new use models for digital projection in both the education and business environments. For example, one teacher can present the same material simultaneously in multiple classrooms, and students in different classrooms can display and discuss their work. Such connectivity allows instant access to content and sharing of content, which promotes interaction and collaboration among dispersed groups. In the business setting, this connectivity enables teleconferencing and the seamless sharing of content for more effective meetings.

Video Delivery

With the acquisition of ViXS Systems Inc. in August 2017, Pixelworks has expanded both our market presence and product portfolio. The video industry continues to evolve and adopt new video standards such as High Efficiency Video Coding, 4K Ultra HD and HDR. The technical and processing demands of these standards are complex, and play directly into Pixelworks' core competencies. Our technologies for video delivery are highly integrated, low power and provide high quality video processing, allowing seamless connectivity between devices while maintaining end-to-end content security.

The markets that we address via our video delivery segment fall into the following categories:

- Consumer Products - OEMs and Original Design Manufacturer ("ODMs") who design products for the consumer electronics segments.
- OTA - Over the Air applications for single, dual, and quad streaming requirements. End users who want to either "cut the cord" or supplement their service offerings.
- IP Streaming - network streaming devices capable of content portability, and support for your own screen (phone and tablet devices), deployed by service operators.

Consumer Products

High resolution (UHD/4K), sustained bitrate decoding (100Mbit) and advanced video formats (HDR10, HDR10+) are key requirements for advanced personal video recorder (PVR) products sold in the Japanese market, where the end consumers rate video quality as a key acquisition criteria. This advanced PVR market in Japan is experiencing rapid growth as products move from 2K to UHD/4K formats. In addition, as the market introduces new broadcast technologies, like ADSB (Advanced Digital Satellite Broadcast) in Japan, and ATSC 3.0 in Korea and North America, there are further growth opportunities in this market segment.

OTA

Subscribers to video content in the home are making changes and demanding choices. While content is freely available, if it is distributed over an operator network, or even simply over IP, there is a monthly re-transmit fee that is charged to the consumer. As the number of video subscribers to services such as cable TV has been declining, the monthly re-transmit fee has been increasing. These fee increases are leading more consumers to 'cut the cord' and replace their TV subscriptions with over the top ("OTT") video services and free OTA broadcast television. As part of their OTA experience, consumers are starting to require multiple stream support of concurrent channels, so various devices can view different channels at the same time.

IP Streaming

Related to OTA applications, the service operators that want to provide their own choice to their video subscribers are taking advantage of Pixelworks' IP Streaming applications. These re-use common platforms, and connect to the in-home infrastructure, either at the set top box level, or the Wi-Fi router level. This provides a centralized place where the management, and distribution of content can occur.

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For service operators, the benefits are:

- Customer retention
- Reduced use of network bandwidth for free OTA channels

For consumers:

- One menu that provides aggregation of Linear, Video-on-Demand, OTT, and OTA content
- Reduced monthly fees related to lower re-transmission fees

Core Technologies and Products

We have developed a portfolio of advanced video algorithms and IP to address a broad range of challenges in digital video. We believe our technologies can significantly improve video quality and will become increasingly important as the popularity of video content consumption grows, and pixel densities, screen size and image quality increase. Our products are designed with a flexible architecture that allows us to combine algorithms and functional blocks of digital and mixed signal circuitry. Accordingly, our technologies can be implemented across multiple products, in combinations within single products and can be applied to a broad range of applications including smartphones, tablets, and projectors. The majority of our products include one or more technologies to provide optimal high-quality video display processing solutions to our customers, regardless of screen size.

Our core Video Display Processing technologies include:

- Halo Free MEMC. Our proprietary Halo Free MEMC technology significantly improves the performance and viewing experience of any screen by addressing problems such as judder and motion blur. Unlike competitive solutions it also reduces halo effects that are a byproduct of MEMC. Halos are objectionable blurred regions that surround moving objects as the MEMC algorithms try to reconstruct missing image data caused by the concealing and revealing of objects as they pass over or behind one another. Removing halos dramatically improves image quality and is of particular importance on high-resolution displays where artifacts become more visible.
- Advanced Scaling. As display resolutions continue to increase, there is a need to convert lower resolution content to higher resolution in order to display content properly. With the latest wave of high-resolution displays, the quality and quantity demands of scaling have increased significantly. Artifacts become more noticeable on these types of displays as they distract from the realism effect. In addition, with the availability of high resolution content lagging behind the availability of high resolution displays, high-quality scaling is required to ensure high resolution displays do not suffer when compared to Full-HD displays of the same size. Our advanced scaling is designed to ensure that up-conversion of lower resolution content is of the highest quality in maintaining the fidelity of image.
- Mobile Video Display Processing. We have developed innovative video display processing solutions, that are designed to optimize power consumption for mobile devices. Beyond MEMC and advanced scaling, these mobile solutions provide the kind of improvements in color, contrast, sharpness and de-blur that are currently only found in high quality TVs today. Furthermore, this technology can reduce system power consumption and extend battery life.
- Transcoding/Decoding. Digital Delivery forms the bulk of not just video content, but all internet bandwidth today. However, throughout the entire chain from inception to consumption, there are multiple variations in bitrate, resolution, and codecs used for both audio and video. Transcoding is a fundamental technology used throughout this pipeline that leads to moving pictures viewed on TVs and mobile devices. The XCODE family of ASICs has enabled many devices within this pipeline, from the racks in some service providers all the way down to the home user watching broadcast OTA TV on a smartphone. XCODE technology provides solutions that deliver UHD Blu-ray PVRs with capability of transcoding recorded content suitable for viewing on smartphones. The technology supports today's broadcast standards, such as ATSC 1.0, DVB/T/T2/S/S2, ISDB/T/S, and ADSB and is scalable to support upcoming broadcast standards such as ATSC 3.0.
- SDR to HDR conversion. UHD video has standardized on a technology known as HDR to deliver higher dynamic range content. This has resulted in several competing HDR deployments like HDR10, HLG and HDR+ with support by multiple industry giants. Pixelworks HDR conversion technology can not only convert between SDR (Standard Dynamic Range) and HDR10, it can also convert among HDR10, HLG and HDR+ solving an interconnectivity problem between content formatted in one HDR format to Display devices that supports a different HDR standard.

Our product development strategy is to leverage our expertise in video display processing to address the evolving needs of the digital projection, mobile and video delivery markets. We plan to continue to focus our development resources to maintain our position in these markets by providing leading edge solutions for the advanced digital projection and video delivery markets and to enhance our video processing solutions for mobile markets. Additionally, we plan to leverage our research and development investment into products that address high-value markets, such as mobile and OTA, where our innovative proprietary technology provides differentiation and system power saving benefits. We deliver our technology in a variety of offerings, which take the form of single-purpose chips, highly integrated SoCs that incorporate specialized software, full solutions incorporating software and other tools and IP cores that allow our technology to be incorporated into third party solutions.

Our primary video display processor product categories include the following:

- ImageProcessor ICs. Our ImageProcessor ICs include embedded microprocessors, digital signal processing technology and software that control the operations and signal processing within high-end display systems. ImageProcessor ICs were our first product offerings and continue to comprise the majority of our business. We have continued to refine the architectures for optimal performance, manufacturing our products on process technologies that align with our customers' requirements. Additionally, we provide a software development environment and operating system that enables our customers to more quickly develop and customize the "look and feel" of their products.
- Video Co-Processor ICs. Products in this category work with an image processor to post-process video signals to enhance the performance or feature set of the overall video solution (for example, by significantly reducing judder and motion blur). Our Video Co-Processor ICs can be used with our ImageProcessor ICs or with image processing solutions from other manufacturers, and in most cases can be incorporated without assistance from the supplier of the base image processor. This flexibility enables manufacturers to augment their existing or new designs to enhance their video display products.
- Transcoder ICs. Our Transcoder ICs include embedded microprocessors, digital signal processing technology and software that control the operations and signal processing for converting multiple bitrates, resolutions and codecs to provide bandwidth efficient video transmissions based on industry standard protocols. Pixelworks' transcoder technology allows for single, dual and even quad streaming solutions for OTA products. Like our other ICs, we have continued to refine the architectures for optimal performance, manufacturing our products on process technologies that align with our customers' requirements. Additionally, we provide a software development environment that enables our customers to more quickly develop and customize their products.

Customers, Sales and Marketing

The key focus of our global sales and marketing strategy is to achieve design wins with industry leading branded manufacturers in our target markets and to continue building strong customer relationships. Once a design win has been achieved, sales and marketing efforts are focused on building long-term mutually beneficial business relationships with our customers by providing superior technology and reducing their costs, which complements our customers' product development objectives and meets their expectations for price-performance and time to market. Marketing efforts are focused on building market-leading brand awareness and preference for our solutions.

We utilize direct sales and marketing resources in China, Japan, Korea, Taiwan, and the U.S. as well as indirect resources in several regions. In addition to sales and marketing representatives, we have field application engineers who provide technical expertise and assistance to manufacturing customers on final product development.

Our global distribution channel is multi-tiered and involves both direct and indirect distribution channels, as described below:

- Distributors. Distributors are resellers in local markets who provide engineering support and stock our semiconductors in direct relation to specific manufacturing customer orders. Our distributors often have valuable and established relationships with our end customers, and in certain countries it is customary to sell to distributors. While distributor payment to us is not dependent upon the distributor's ability to resell the product or to collect from the end customer, our distributors may provide longer payment terms to end customers than those we would offer. Sales to distributors accounted for 44%, 47% and 43% of revenue in 2018, 2017 and 2016, respectively.

Our largest distributor, Tokyo Electron Device Ltd. ("TED"), is located in Japan. TED represented more than 10% of revenue in each of 2018, 2017 and 2016, and accounted for more than 10% of accounts receivable as of December 31,

2017 and 2018. No other distributor accounted for more than 10% of revenue in 2018, 2017 and 2016. We also have distributor relationships in China, Europe, Korea, Southeast Asia, Taiwan and the U.S.

- Direct Relationships. We have established direct relationships with companies that manufacture high-end display systems. Some of our direct relationships are supported by commission-based manufacturers' representatives, who are independent sales agents that represent us in local markets and provide engineering support but do not carry inventory. Revenue through direct relationships accounted for 56%, 53% and 57% of total revenue in 2018, 2017 and 2016, respectively.

We have direct relationships with companies falling into the following three classifications:

- Integrators. Integrators are OEMs who build display devices based on specifications provided by branded suppliers.
- Branded Manufacturers. Branded manufacturers are globally recognized manufacturers who develop display device specifications, and manufacture, market and distribute display devices either directly or through resellers to end-users.
- Branded Suppliers. Branded suppliers are globally recognized suppliers who develop display device specifications and then source them from integrators, typically in Asia, and distribute them either directly or through resellers to end-users.

Revenue attributable to our top five end customers together represented 82%, 79% and 82% of revenue in 2018, 2017 and 2016, respectively. End customers include customers who purchase directly from us as well as customers who purchase products indirectly through distributors. Sales to Seiko Epson Corporation represented more than 10% of revenue in each of 2018, 2017 and 2016, and accounted for more than 10% of accounts receivable as of December 31, 2018 and 2017. Sales to Hitachi Ltd. represented more than 10% of revenue in 2018. No other end customer accounted for more than 10% of revenue in 2018, 2017 or 2016.

Seasonality

Our business is subject to seasonality related to the markets we serve and the location of our customers. We have historically experienced higher revenue from the digital projector market in the third quarter of the year, and lower revenue in the first quarter of the year, as our Japanese customers reduce inventories in anticipation of their March 31 fiscal year end.

Geographic Distribution of Sales

Sales outside the U.S. accounted for approximately 98%, 98% and 100% of revenue in 2018, 2017 and 2016, respectively.

Financial information regarding our domestic and foreign operations is presented in "Note 14: Segment Information" in Part II, Item 8 of this Annual Report on Form 10-K.

Backlog

Our sales are made pursuant to customer purchase orders for delivery of standard products. The volume of product actually purchased by our customers, as well as shipment schedules, are subject to frequent revisions that reflect changes in both the customers' needs and product availability. In light of industry practice and our own experience, we do not believe that backlog as of any particular date is indicative of future results.

Competition

The semiconductor industry is intensely competitive. Further, the markets for higher performance display and projection devices, including the markets for mobile devices, digital projectors and other applications demanding high quality video, are characterized by rapid technological change, evolving industry standards, compressed product life cycles and declining average selling prices. We believe the principal competitive factors in our markets include product performance, time to market, cost, functional versatility provided by software, customer relationships and reputation, patented innovative designs, levels of product integration, compliance with industry standards and system design cost. We believe we compete favorably with respect to these factors.

Our current products face competition from specialized display controller developers and in-house display controller ICs designed by our customers and potential customers. Additionally, new alternative display processing technologies and industry standards may emerge that compete with technologies we offer.

We also compete with specialized and diversified electronics and semiconductor companies that offer display processors or scaling components including: Actions Microelectronics Co., Ltd., ARM Holdings PLC, Dolby Laboratories, Inc., Hisilicon Technologies Co., Ltd., i-Chips Technologies Inc., Lattice Semiconductor Corporation, MediaTek Inc., Novatech Co., Ltd. Inc., NVIDIA Corporation, QUALCOMM Incorporated, Realtek Semiconductor Corp., Renesas Electronics America, Solomon Systech (International) Ltd., Spreadtrum Communications, Inc, STMicroelectronics N.V., Sunplus Technology Co., Ltd., Synaptics Incorporated, Texas Instruments Incorporated, and other companies. Potential and current competitors may include diversified semiconductor manufacturers and the semiconductor divisions or affiliates of some of our customers, including: Apple Inc., Broadcom Corporation, LG Electronics, Inc., MegaChips Corporation, Mitsubishi Digital Electronics America, Inc., NEC Corporation, Panasonic Corporation, Samsung Electronics Co., Ltd., Socionext, Inc., ON Semiconductor Corporation, Seiko Epson Corporation, Sharp Electronics Corporation, Sony Corporation, and Toshiba America, Inc. In addition, start-up companies may seek to compete in our markets.

Research and Development

Our research and development efforts are focused on the development of our solutions for the mobile device, digital projector and video delivery markets. Our development efforts are focused on pursuing higher levels of video performance, integration and new features in order to provide our customers with solutions that enable them to introduce market leading products and help lower final systems costs.

We have invested, and expect to continue to invest, significant resources in research and development activities. Our research and development expenses were $22.9 million, $21.4 million and $19.0 million in 2018, 2017 and 2016, respectively. During 2018 and 2017, we received reimbursements related to a co-development arrangement with a customer for costs incurred in connection with our development of an integrated circuit ("IC") product. As a result of the reimbursements, our overall research and development expense was reduced by $4.0 million in 2018 and $4.0 million in 2017. There were no reductions to research and development expense related to co-development arrangements in 2016.

Manufacturing

Within the semiconductor industry we are known as a "fabless" company, meaning that we do not manufacture the semiconductors that we design and develop, but instead contract with a limited number of foundries and assembly and test vendors to produce all of our wafers and for completion of finished products. The fabless approach allows us to concentrate our resources on product design and development where we believe we have greater competitive advantages.

See "Risk Factors" in Part I, Item 1A of this Annual Report on Form 10-K for information on risks related to our manufacturing strategy and processes.

Intellectual Property

We protect our intellectual property with a combination of nondisclosure agreements and patent, copyright, trademark and trade secret laws to protect the algorithms, design and architecture of our technology. As of December 31, 2018, we held 361 patents and have 33 patent applications pending, compared to 536 patents and 100 patent applications pending as of December 31, 2017. The decrease in patents from December 31, 2017 to December 31, 2018 is due to the abandonment or sale of patents received as part of the acquisition of ViXS in August 2017. The patents that were sold or abandoned were non-strategic or held in geographic regions where we do not do business. These patents relate generally to improvements in the visual display of digital image data including, but not limited to, improvements in image scaling, image correction, automatic image optimization and video signal processing for digital displays. Our U.S. and foreign patents are generally enforceable for 20 years from the date they were filed. Accordingly, our issued patents have from approximately 1 to 18 years remaining in their respective term, depending on their filing dates. We believe that the remaining term of our patents is adequate relative to the expected lives of our related products.

We intend to seek patent protection for other significant technologies that we have already developed and expect to seek patent protection for future products and technologies as necessary. Patents may not be issued as a result of any pending applications and any claims allowed under issued patents may be insufficiently broad to protect our technology. Existing or future patents may be invalidated, diluted, circumvented, challenged or licensed to others. Furthermore, the laws of certain foreign countries in which our products are or may be developed, manufactured or sold, including various countries in Asia, may not protect our products or intellectual property rights in the same

manner and to the same extent as do the laws of the U.S. and, thus, make the possibility of piracy of our technology and products more likely in these countries.

The semiconductor industry is characterized by vigorous protection of intellectual property rights, which have resulted in significant and often protracted and expensive litigation. We, our customers or our foundries from time to time may be notified of claims that we may be infringing patents or other intellectual property rights owned by third parties. Litigation by or against us relating to patent infringement or other intellectual property matters could result in significant expense to us and divert the efforts of our technical and management personnel, whether or not such litigation results in a determination favorable to us. In the event of an adverse result in any such litigation, we could be required to pay substantial damages, cease the manufacture, use and sale of infringing products, expend significant resources to develop non-infringing technology, discontinue the use of certain processes or obtain licenses to the infringing technology. We may not be able to settle any alleged patent infringement claim through a cross-licensing arrangement. In the event any third party made a valid claim against us, our customers or our foundries, and a license was not made available to us on terms that are acceptable to us or at all, we would be adversely affected.

See "Risk Factors" in Part I, Item 1A, and "Note 11: Commitments and Contingencies" in Part II, Item 8 of this Annual Report on Form 10-K for information on various risks related to intellectual property.

Environmental Matters

Environmental laws and regulations are complex, change frequently and have tended to become more stringent over time. We have incurred, and may continue to incur, significant expenditures to comply with these laws and regulations and we may incur additional capital expenditures and asset impairments to ensure that our products and our vendors' products are in compliance with these regulations. We would be subject to significant penalties for failure to comply with these laws and regulations.

See "Risk Factors" in Part I, Item 1A of this Annual Report on Form 10-K for information on various environmental risks.

Employees

As of December 31, 2018, we had a total of 215 employees, all of which were full-time, consistent with 215 employees as of December 31, 2017.

Corporate Information

Pixelworks was founded in 1997 and is incorporated under the laws of the state of Oregon. Our stock is traded on the Nasdaq Global Market under the symbol "PXLW".

Availability of Securities and Exchange Commission Filings

We make available through our website our annual report on Form 10-K, quarterly reports on Form 10-Q, current reports on Form 8-K and amendments to those reports and any filings filed or furnished pursuant to Section 13(a) or 15(d) of the Exchange Act of 1934, free of charge as soon as reasonably practicable after we electronically file or furnish such material with the Securities and Exchange Commission ("SEC"). Our Internet address is www.pixelworks.com. The content on, or that can be accessed through our website is not incorporated by reference into this filing. Our committee charters and code of ethics are also available free of charge on our website.

The SEC maintains an Internet site at http://www.sec.gov that contains our Annual Report on Form 10-K, quarterly reports on Form 10-Q, current reports on Form