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Resonant Inc
Form 10-K
March 14, 2019
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UNITED STATES
SECURITIES AND EXCHANGE COMMISSION
Washington, D.C. 20549

FORM 10-K

(Mark One)

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

For the fiscal year ended December 31, 2018

OR

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

For the transition period from _____ to _____

Commission file number 001-36467

RESONANT INC.

(Exact Name of Registrant as Specified in Its charter)

Delaware 45-4320930

(State or Other Jurisdiction of (I.R.S. Employer

Incorporation or Organization) Identification No.)

175 Cremona Drive, Suite 200, Goleta, California 93117

(Address of Principal Executive Offices) (Zip Code)

(805) 308-9803

(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, \$0.001 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 15(d) of the Act. Yes No

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

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

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

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

Large accelerated filer Accelerated filer

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Non-accelerated filer
(Do not check if smaller reporting company) Smaller reporting company

Emerging growth company

If an emerging growth company, indicate by check mark if the registrant has elected not to use the extended transition period for complying with 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

As of June 30, 2018, the aggregate market value of the voting and non-voting common equity held by non-affiliates was \$103 million, based on the closing price on that date. As of March 12, 2019, the registrant had 27,728,387 shares of common stock issued and outstanding.

DOCUMENTS INCORPORATED BY REFERENCE

Portions of the registrant's Proxy Statement for the registrant's 2019 Annual Meeting of Stockholders are incorporated by reference in Part III of this Annual Report on Form 10-K. Such Proxy Statement will be filed with the Securities and Exchange Commission within 120 days of December 31, 2018, the last day of the fiscal year covered by this Annual Report on Form 10-K.

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SPECIAL NOTE REGARDING FORWARD-LOOKING STATEMENTS

This Annual Report on Form 10-K contains forward-looking statements within the meaning of Section 27A of the Securities Act of 1933, as amended, and Section 21E of the Securities Exchange Act of 1934, as amended, or the Exchange Act. The words “believe,” “may,” “will,” “potentially,” “estimate,” “continue,” “anticipate,” “intend,” “could,” “would,” “plan,” “expect” and similar expressions that convey uncertainty of future events or outcomes are intended to identify forward-looking statements. These forward-looking statements include, but are not limited to, statements concerning the following:

- our ability to fund our planned operations and implement our business plan;
- the status of filter designs under development;
- the prospects for licensing filter designs upon completion of development;
- plans for other filter designs not currently in development;
- potential customers for our designs;
- the timing and amount of future royalty streams;
- our plans regarding the use of proceeds from our financings and the expected duration of our capital resources;
- our plans regarding future financings;
- our hiring plans;
- the impact of our designs on the mobile device market;
- our business strategy;
- our intentions, expectations and beliefs regarding anticipated growth, market penetration and trends in our business;
- the timing and success of our plan of commercialization;
- our dependence on growth in our customers’ businesses;
- our customers’ success in marketing products incorporating our designs to their customers;
- the effects of market conditions on our stock price and operating results;
- our ability to maintain our competitive technological advantages against competitors in our industry and the related costs associated with defending intellectual property infringement and other claims;
- our ability to timely and effectively adapt our existing technology and have our technology solutions gain market acceptance;
- our ability to introduce new filter designs and bring them to market in a timely manner;
- our ability to maintain, protect and enhance our intellectual property;
- our expectations concerning our relationships with our customers and other third parties and our customers’ relationships with their manufacturers and customers;
- the attraction and retention of qualified employees and key personnel;
- future acquisitions of or investments in complementary companies or technologies; and
- our ability to comply with evolving legal standards and regulations, particularly concerning requirements for being a public company and United States export regulations.

These forward-looking statements speak only as of the date of this Form 10-K and are subject to uncertainties, assumptions and business and economic risks. As such, our actual results could differ materially from those set forth in the forward-looking statements as a result of the factors set forth below in Part I, Item 1A, “Risk Factors,” and in our other reports filed with the Securities and Exchange Commission, or SEC. Moreover, we operate in a very competitive and rapidly changing

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environment, and new risks emerge from time to time. It is not possible for us to predict all risks, nor can we assess the impact of all factors on our business or the extent to which any factor, or combination of factors, may cause actual results to differ materially from those contained in any forward-looking statements we may make. In light of these risks, uncertainties and assumptions, the forward-looking events and circumstances discussed in this Form 10-K may not occur, and actual results could differ materially and adversely from those anticipated or implied in our forward-looking statements.

You should not rely upon forward-looking statements as predictions of future events. Although we believe that the expectations reflected in our forward-looking statements are reasonable, we cannot guarantee that the future results, levels of activity, performance or events and circumstances described in the forward-looking statements will be achieved or occur. Moreover, neither we nor any other person assumes responsibility for the accuracy and completeness of the forward-looking statements. We undertake no obligation to update publicly any forward-looking statements for any reason after the date of this Form 10-K to conform these statements to actual results or to changes in our expectations, except as required by law.

You should read this Annual Report on Form 10-K and the documents that we reference in this Annual Report on Form 10-K and have filed with the SEC as exhibits thereto with the understanding that our actual future results and circumstances may be materially different from what we expect.

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PART I

ITEM 1. BUSINESS

Overview

Resonant is a late-stage development company that has created an innovative software, intellectual property, or IP, and services platform that has the ability to increase designer efficiency, reduce the time to market and lower unit costs in the designs of filters for radio frequency, or RF, front-ends for the mobile device industry. The RF front-end, or RFFE, is the circuitry in a mobile device responsible for analog signal processing and is located between the device's antenna and its digital circuitry. The software platform we continue to develop is based on fundamentally new technology that we call Infinite Synthesized Networks®, or ISN®, to configure and connect resonators, the building blocks of RF filters. Filters are a critical component of the RF front-end used to select desired radio frequency signals and reject unwanted signals. Our ISN® platform allows us to develop unique, custom designs that address the increasing complexity of the RFFE due to increasing bandwidth requirements, such as by using carrier aggregation (the combining of multiple frequencies into a single data stream to increase throughput through higher data rates), or CA, by both reducing the size of the filter and improving performance. Our goal is to utilize our ISN® platform to support our customers in reducing their time to develop complex filter and module designs, to access new classes of filter designs, and to do it more cost effectively. Additionally, our ISN® platform has allowed us to expand our customer focus beyond just filter manufacturers by enabling a new class of customer - fabless filter manufacturers. These companies do not have their own internal filter fabrication facility, or Fab, and typically already would be supplying other products in the RFFE to the original equipment manufacturers (OEMs), and, as a result do not require a protracted new vendor qualification process in order to supply parts. Through our existing customer relationships, we are able to leverage our ISN® tools to deliver cutting edge filter designs to these fabless filter manufacturers. In the second quarter of 2018, we deployed the first-ever module of our ISN® tool for evaluation, the PMTx®, designed to significantly improve design and fabrication turn times by improving fabrication process control.

We are commercializing our technology through the creation of filter designs that address the problems in the high growth RFFE industry created by the growing number of frequency bands in mobile devices. The worldwide adoption of Long Term Evolution, or LTE, as the global standard, and the use of mobile devices to access the Internet, has resulted in massive proliferation of frequency bands which, when combined with CA for higher data rates and multiple input multiple output, or MIMO, has resulted in an ever-increasing number and complexity of filters in the RFFE. We have developed and continue to expand a series of single-band designs for frequency bands presently dominated by larger and more expensive bulk acoustic wave, or BAW, filters. We are also developing multiplexer filter designs for two or more bands to address the CA requirements of our customers. We are using our ISN® platform to efficiently integrate these designs into RF modules for our module customers. Finally, we are developing unique filter designs, enabled by ISN®, to replace multiple filters and associated componentry for many bands, with higher performance. Currently, we are leveraging ISN® to develop these designs targeted for either the Surface Acoustic Wave (SAW) or Temperature Compensated, Surface Acoustic Wave (TC-SAW) manufacturing processes. In 2018 we further extended ISN® for BAW designs, which has resulted in our invention of a unique resonator structure that we call XBAR™, which exhibits performance parameters suitable for 5G applications - high frequency operation, large bandwidth and high power reliability. Our success with XBAR™ is dependent on our ability to develop high frequency filters utilizing these resonator structures that are successfully adopted by our targeted customers, which will be determined by our ability to show improved performance over competing products or significantly reduce the size and cost of their products.

We believe licensing our designs is the most direct and effective means of validating our ISN® platform and related IP libraries to address this rapidly growing market. Our target customers make part or all of the RFFE. We intend to retain ownership of our designs, and we expect to be compensated through license fees and royalties based on sales of RFFE filters that incorporate our designs and leverage our ISN® platform.

Our typical customer engagement process begins with the execution of a Joint Development Agreement, or JDA, and License Agreement, or LA, for specific bands. Depending on the complexity of the design, we estimate that initial samples of products to OEMs, will occur typically within nine to thirty-six months following execution of a license

agreement. We classify these new designs as either ISN[®] Ready (9-12 months), ISN[®] Pilot (12-18 months), ISN[®] Advanced (18-36 months) or ISN[®] Development (Custom). Following these development cycles, designs are manufactured, qualified by our customers and sampled to OEM customers. Our customers can take from three to six months to qualify a design and then the OEMs can take an additional three to six months, or longer, to qualify a design as fit for use, reliable and ready for mass production. The point at which an OEM begins taking product from our customers in mass production is typically when royalty revenues would begin. Our customer agreements typically provide for upfront design fees and royalty payments for each unit sold using our filter designs and typically last for a minimum of two years, but may be renewed for a longer period.

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We began 2016 with no customers under contract and no license agreements and we ended the year with six customers and more than 25 designs contracted. These included a wide range of complex designs ranging from sophisticated "WiFi Co-existence" filters to high frequency duplexers and quadplexers. In late 2016, we expanded our customer focus beyond filter manufacturers operating their own Fab to include fabless filter manufacturers. During 2017, we continued to expand our engagements with existing customers while identifying and contracting with new customers and ended the year with a total of eight customers and more than double the number of designs contracted. In many cases the expansion in the number of contracted designs came from customers who already had a significant investment in working with Resonant and confidence in the capabilities of the ISN[®] platform, IP and design team.

Also, in 2017, in order to further facilitate our fabless filter program, and to provide manufacturing stability across the supply chain, we embarked on the creation of our ISN[®] Foundry Program. Foundries joining Resonant's program first complete a foundry evaluation process to ensure alignment with our customers for filter performance, manufacturing quality and capacity, and business practices. Once the evaluation is completed, the foundry runs a characterization lot, used to create a foundry process design kit, after which we are ready to start designs for manufacture in the foundry. Packaging/Back-end vendors can also join the program by completing a back-end evaluation process to match their capabilities with foundry partners and our customers. Through this program we enable a secure supply chain for all our customers.

In 2018, we hired a vice president of software development to continue the expansion and conversion of our ISN[®] platform for cloud-based delivery. Improving design efficiency with software development and enhancement to our ISN[®] platform and related modules is a top priority to maximize the effectiveness of our engineers. In addition, we hired a vice president of business operations to implement scalable business processes to improve efficiency while we grow operations. Further in 2018, we continued the development of our phone-board testing and reliability capabilities, in order to support our customers with proficiencies critical for their success. We finished 2018 with 11 customers and over 70 designs contracted to date.

We plan to continue to pursue filter design projects with existing and potential customers and other strategic partners. These types of arrangements may subsidize the expansion of our IP libraries and further the development of our ISN[®] platform, as well as offer complementary technology and market intelligence. We are also investigating the potential of licensing part or all of our ISN[®] software design suite to potential customers in the RFFE industry. However, we intend to retain ownership of our technology, software, designs and related improvements. Our goal is to establish and leverage alliances with new and existing customers, who will help grow the market for our designs by integrating them with their own proprietary technology and products, or by using our software products for their own designs, thus combining their own particular strengths with ours to provide an extensive array of solutions.

Our History

Our inception date is May 29, 2012. We commenced business on July 6, 2012 and completed our initial public offering, or IPO, on May 29, 2014.

In July 2016, we acquired GVR Trade S.A., or GVR, a Swiss-based company specializing in the consultation and design of SAW and BAW devices. GVR is a wholly-owned direct subsidiary of Resonant.

Industry Background

Glossary

The following is a glossary of useful terms:

• **4Gth**—4th Generation is a mobile communications standard intended to replace 3G, allowing wireless Internet access at a much higher speed.

• **5Gth**—5th Generation is a mobile communications standard and is the latest iteration of cellular technology, engineered to greatly increase the speed and responsiveness of wireless networks.

• **Band, channel or frequency band**—a designated range of radio wave frequencies used to communicate with a mobile device.

• **Bulk acoustic wave (BAW)**—an acoustic wave traveling through a material exhibiting elasticity.

• **Duplexer**—a bi-directional device that connects the antenna to the transmitter and receiver of a wireless device and simultaneously filters both the transmit signal and receive signal.

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Carrier Aggregation (CA)—the aggregation, or adding together, of multiple carriers (frequency bands) to meet the LTE-Advanced specification requirements, allowing for increased transmission bandwidth delivery of higher data rates, improved capacity and more efficient use of a carriers fragmented spectrum.

Filter—a series of interconnected resonators designed to pass (or select) a desired radio frequency signal and block unwanted signals.

Resonator—a device that naturally oscillates (or resonates) at specific frequencies. The oscillations in a resonator can be either electromagnetic or mechanical (including acoustic). Resonators are the building blocks for filters.

RF front-end (RFFE)—the circuitry in a mobile device responsible for the analog signal processing which is located between the antenna and the digital baseband.

Surface acoustic wave (SAW)—an acoustic wave traveling along the surface of a material exhibiting elasticity, with an amplitude that typically decays exponentially with depth into the substrate.

Temperature-Compensated SAW (TC-SAW)—a SAW device which has additional material alterations to reduce its variation with changes in temperature.

The Mobile Internet

The need for duplexers and other filters in the RFFE of mobile devices continues to grow rapidly due to rising consumer demand for always-on wireless broadband. Mobile devices such as smartphones and tablets are quickly becoming the primary means of accessing the internet. According to Cisco, worldwide mobile data traffic grew 71% in 2017 and will grow at a compounded annual growth rate of 46% from 2018 to 2022. Cisco also predicted that smartphones will surpass 90 percent of mobile data traffic by 2022.

The exponential growth in mobile data traffic is testing the limits of existing wireless bandwidth. Carriers and regulators have responded by opening new RF spectrum, driving up the number of frequency bands in mobile devices, and thus pushing mobile phone designers to make more efficient use of spectrum.

According to Yole Development, the market for RFFE filters in mobile devices was 40.3 billion filters in 2017 and will grow to an estimated 104.5 billion filters by 2020.

Figure 1—Projected growth of the market for RFFE filters including duplexers and quadplexers in mobile devices from 2017 through 2022 (in billions of filters). Source: Yole Development.

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In addition to RFFE filter unit growth, filter sales growth is expected to follow and is estimated to be \$7.2 billion in 2017 and is forecasted to reach \$20.2 billion by 2022, according to Yole. By 2025 Yole estimates that filters will represent 70% of the RFFE component market.

Figure 2—Projected growth of the market for RF front-end filters, including duplexers and quadplexers, in mobile devices from 2017 through 2022 (in billions of dollars). Source: Yole Development.

Adding RF spectrum to increase capacity and data-rate is not a complete solution. The added spectrum for 4G does not come in large contiguous blocks, but rather in small channels or bands of varying size and frequency. Thus, more data means more bands, and the result is a rapid and substantial increase in the number of bands in mobile devices. 5G introduces new challenges for filter performance and complexity, by adding much larger blocks of spectrum at higher frequencies (above 3GHz).

Challenges Faced by the Mobile Device Industry

The world is progressing toward ubiquitous RF coverage in which almost all devices will be connected, most wirelessly. Technology experts predict that by 2021 there will be over 26 billion connected devices operating worldwide and we will be measuring mobile usage in Exabytes. This overwhelming demand for wireless data has driven the carriers and regulators to open new spectrum bands.

This substantial and rapid increase in bands has created several significant problems, including a corresponding increase in the number of filters and duplexers in mobile devices. Traditional RF front-end solutions typically require one duplexer for each frequency band. The most recent iPhones support coverage for 19 FDD-LTE and 5 TDD-LTE bands, in addition to support for previous wireless technology generations, 3G and 2G, with each band requiring a filter, either as an individual filter, a duplexer or a quadplexer, depending upon the spectrum and CA requirements. This increase in number and complexity of filters is dramatically driving up the cost of RF front-ends. In the latest global smartphones, filters and duplexers comprise more than half of the cost to the RF front-end, according to a Barclays' analysis. The dramatic increase in the number of filters required, which includes Chip Scale Package, or CSP, Wafer Level Package, or WLP, filters, duplexers, quadplexers, with multiple sizes and multiple packaging substrates, each requiring a new design, requires an increase in design capacity, or improved design efficiency. ISN[®] improves the design efficiency by accurately modeling the performance of acoustic wave filters.

The growing number of filters is also increasing the total size of the RF front-end. In some cases, size constraints require the OEM to fragment its product offering into multiple versions, each with a limited set of filters customized for a particular geographic region. Multiple versions of a mobile product increases manufacturing, inventory and distribution costs. In addition, consumers can find it difficult to roam between carriers and/or countries due to this splintering of bands and phone

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models. Phone OEMs would prefer to make one version of a product containing a full set of filters that can be electronically selected as required for a particular carrier network.

In addition, the new, higher frequency 4G bands tend to use relatively expensive BAW technology. Phone OEMs would prefer to use SAW technology because of its lower cost and smaller size. However, conventional filter designs using SAW technology do not perform adequately in high frequency bands or in bands with closely spaced receive and transmit channels, typical of many new bands.

Adding to the complexity of the industry, mobile devices must now be capable of receiving from two, to as many as five, downlink bands simultaneously, known as downlink CA. This CA requirement creates the need for complex multiplexing filters, or multiplexers, which are significantly more complex than duplexers and effectively require four filters for each CA combination. There will be an estimated 200 worldwide combinations of CA cases, creating increased complexity and cost to RFFE. In the case of a quadplexer, with four different frequency bands, within each band the signal loss must be minimized, while rejecting three bands often in close proximity. Duplexers must only reject a single band. Mobile Experts predicts that more than 28 billion RFFEs will be shipped supporting CA in 2022. This rising complexity in the industry is also exacerbating the constraints on design capacity and resources.

Figure 3-Projected growth of the market for mobile devices enabled for CA from 2017 through 2022 (in billions of units). Source: Mobile Experts.

In addition to the challenges described above, 5G will further exacerbate the problems of more demand for filters, filter designs, and more complexity and integration in the RFFE. 5G comprises three distinct segments:

• Enhanced mobile broadband: Increased bandwidth for extreme data-rates and capacity to support wireless video everywhere;

• Mission critical services: High reliability, low latency and high security for automotive, health and government; and

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Massive Internet of Things: Low cost, low energy, long life for wearables, smart home devices and interconnected devices

All three of these segments require filters and will further accelerate the already substantial growth in the filter market.

Our Technology

RFFE module companies currently produce filters internally or purchase filters from third-party manufacturers, such as Broadcom, Murata and RF360. These module companies and filter manufacturers design filters using their own internal resources, which we believe are proving insufficient to meet the explosive growth in both total global filter demand and unique filter designs, as well as the increasingly complex filter requirements necessitated in part by crowded spectrum and carrier aggregation. We believe that our patented ISN[®] technology will enable us to design complex filter products at approximately half the unit cost and in approximately half the time of traditional approaches. ISN[®] can be summarized as a three-step process:

We synthesize RF acoustic devices. We have developed a large suite of proprietary mathematical methods and software tools that allow us to find better solutions because we can explore a much larger set of possible solutions. Our ISN[®] tools and methods draw upon a century of network synthesis techniques. In other words, rather than rely on a single design solution (the acoustic wave ladder that is used almost solely in this industry to date), we generate, or synthesize, large numbers of unique solutions specifically for each set of requirements. This allows us to create filters using existing manufacturing methods, such as SAW manufacturing methods, that perform as well as those using the higher cost methods of BAWs. These synthesized solutions provide a framework for generating circuit models for optimization.

We use circuit models to optimize initial designs. Most of this industry models acoustic wave filters using a coupling-of-modes, or COM, model. In contrast, we use circuit models derived from the actual physics of acoustic wave filters. Circuit models are computationally much faster, which allows for very quick optimization of the many possible solutions that result from the synthesis process. We can quickly compare large numbers of different, optimized solutions before commencing the third step - lengthy but highly accurate simulations based on fundamental methods.

We use fundamental models to simulate final designs. Our highly accurate models are based entirely on fundamental material properties and dimensions, again unlike the common practice in this industry today. The precision and accuracy of our models allows for far fewer turns through the fab to reach the desired product performance. Because our models are fundamental, integration with our foundry and fab customers is eased due to the understanding of the basic material properties and dimensions of the fab.

Our Commercialization Plan

We will continue to pursue filter design projects with existing and potential customers and other strategic partners, and we believe licensing our designs is the most direct and effective means of delivering our solutions to the market and validating the technical advantages of our tools, IP and team. We intend to retain ownership of our technology, designs and related improvements and charge royalties based on sales of filters that incorporate our designs. We do not intend to manufacture or sell any physical products or operate as a contract design company developing designs for a fee. Our strategy is to establish and leverage alliances with customers, who will help grow the market for our designs by integrating them with their own proprietary technology and products, thus combining their own particular strengths with ours to provide an extensive array of solutions and to develop and license filter designs that offer improvements in the time to develop, cost, size and performance of RFFEs. The goal for our designs is to improve profit margins and increase market share for our customers.

Our customers are filter manufacturers, RFFE module manufacturers, RF active and passive component suppliers and potentially mobile handset OEMs. Currently, for most of our customers, we license specific, custom designs. In the fourth quarter of 2018 we introduced and announced the first customer for our standard IP filter library of products. In these cases we develop a standard design at one of our qualified foundries and customers can then license this design without paying for or waiting for completion of development, hence minimizing their cost and reducing time to market. We charge royalties at a fixed amount per filter or as a percentage of sales price. We expect to generate substantially all of our near-term revenues with these types of licensing arrangements. Each filter design and related royalty stream is expected to have a finite commercial life as mobile devices continue to evolve. Our plan is to offer

our customers replacement designs as existing designs become obsolete.

We anticipate that once a development and license agreement is signed and design begins, there could be 12 to 36 months before the start of royalty payments under a particular license, depending on the complexity and scope of the engagement.

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Our products will be designed for manufacture with existing high-volume fabrication processes allowing rapid time to market, but we do not plan to manufacture or sell any physical components. Unlike a manufacturing company, we intend to create designs for manufacturers, eliminating for us the costs and problems associated with manufacturing and inventory. This allows us to concentrate on our unique expertise, leaving the hardware manufacturers to drive their own economies of scale.

Single Band Designs

We continue to develop a series of SAW filter designs for RF frequency bands presently dominated by the larger and more expensive BAW filters. In 2018, we continued to develop single band, SAW filter designs for customers. Some of these filter designs are for duplexers that have historically been TC-SAWs or BAWs while others are for discrete SAW filters that may need improvements in performance, size or cost. The single band designs included WiFi Co-Existence filters, which pass licensed wireless frequencies, while protecting WiFi from interference, and designs for module applications which require wafer-level (WL) packaging and modeling of the module board. We believe that, using our ISN[®] technology, combined with our experience and know-how, we can design innovative SAW filters that meet the performance requirements for many of these bands but at significantly less cost than that of BAW filters they would replace. These single band filter designs are the earliest opportunity for royalty revenues, and represented the nominal royalty revenues in 2018. In 2018, we continued to develop single band designs using TC-SAW processes in order to take advantage of the improved temperature stability.

Multiplexer Designs

Wireless carriers worldwide are experiencing increasing demand for higher data speeds. CA allows multiple data streams from different frequencies to be added together to provide increased data rate for the mobile users. However, CA further complicates the required filter characteristics. Quadplexers, (4-RF path multiplexer) as described above, enable CA on both receive and transmit paths and reduce the RFFE complexity by reducing the number of switches, but the complexity of the filters themselves increases dramatically. During 2018, we expanded our capability to optimize the performance of quadplexers on OEM phone-boards in order to help our customers demonstrate "real world" performance. We believe that our ISN[®] technology is ideally suited to these difficult filter design problems that cover a wide frequency range with much more demanding performance requirements.

Although some band combinations for aggregation will not require multiplexers, we believe that multiplexers are the best solution for bands in close frequency proximity. We are developing high performance multiplexer designs to address this growing market.

Advance Developments

We believe that our ISN[®] technology will also enable us to design novel filters that are more than simple replacements to existing slots, but rather can enable an architecture change, or can provide a step function improvement in performance, size and cost to a handset manufacturer. These include:

High frequency, wide bandwidth filters for 5G - large instantaneous bandwidth filters at high frequency (above 3GHz) are required for 5G to support high data-rates. Filters using XBAR[™] resonators will be ideally suited for these applications

Triplexers/Multiplexers - wideband, low loss multiplexed filters which allow efficient sharing of antennas. As more spectrum becomes available above 2.5GHz the focus will be in minimizing the losses at the higher frequency.

Multi-passband Filters - small size, low loss filters to maximize printed circuit board space and minimize loss, particularly suited for CA applications. The absence of switching elements further reduces size and cost for CA.

Our immediate focus is to address the problems in the RFFE with innovative single-band and multiplex designs made possible with our ISN[®] technology. These designs present the greatest near-term potential for commercialization of our ISN[®] technology. We expect the trend towards spectrum proliferation, in addition to CA and MIMO, will require complex filter multiplexing. Compounding the demands described above, large bandwidth filters for 5G will further increase the complexity. We believe our ISN[®] technology will enable cost effective designs for these applications.

We also believe that the power of Resonant ISN[®] tools and methodology will continue to enable fabless customers and filter foundries to newly enter or expand their participation in the supply chain for RF filters. In late 2016, we expanded our customer focus to include fabless filter manufacturers, which are companies that do not have their own internal filter fabrication facility. Typically, these companies already are supplying other products in the RFFE to the

OEM, and as a result, do not require a protracted new vendor qualification process in order to supply parts. In 2017, to further facilitate our fables filter

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program and to provide manufacturing stability across the supply chain to our fully integrated filter customers, we created our ISN[®] Foundry Program. Foundries joining the ISN[®] Foundry Program first complete a foundry evaluation process to ensure alignment with our customers for filter performance, manufacturing quality and capacity, and business practices. Once the evaluation is completed, the foundry runs a characterization lot, used to create a foundry process design kit, after which we are ready to start designs for manufacture in the foundry. Packaging/Back-end vendors also can join the program by completing a back-end evaluation process to match their capabilities with foundry partners and our customers. It is through this program that we can enable a secure supply chain for all our customers.

Intellectual Property

We have an active program protecting our proprietary technology. In protecting our technology, we make use of patent protection, trade secret protection, trademark protection, mask works and copyright protection. To maximize these protections, we maintain active intellectual property development and protection programs, including with respect to patents, trade secrets, trademarks, copyrights and mask works.

Our patent portfolio reflects both the initial technology originated at and contributed to us by Superconductor Technologies Inc., or STI, as well as our own patent filings since our founding, and continues to be the result of an active and ongoing program to identify, protect and commercialize our intellectual property. This program includes the development of a comprehensive patent strategy. We engage in a thorough process of patent landscaping that provides an in-depth analysis of not only the markets we are addressing, but also adjacent markets, so that we can tactically and strategically protect our position in the market through patent filings. We also routinely use specialized outside firms to assist in these endeavors. These firms assist with invention identification, intellectual property strategy and competitive landscape analysis. Through our landscaping and advanced product development processes we have plans to file additional patents in 2019.

Our patent portfolio comprises more than 165 issued and pending U.S. and foreign patents. This patent portfolio relates primarily to the following subject matters:

- Physical Implementation
- Semiconductor materials and processes
- Resonator and filter designs
- Design Synthesis and Optimization Speed
- Network Synthesis
- Image Design
- Circuit Designs
- Simulation Accuracy
- Next Generation Designs/Architectures
- Simplifying the RFFE
- Circuit Structure
- Critical Design Requirements
- Power handling and linearity
- Temperature dependence
- Yield Analysis

We have a formal trade secret program to identify and protect technologies and know-how that derive significant economic value from being secret. This program is managed to provide the optimal levels of protection and competitive advantage to us. We protect our trade secrets and other proprietary information by maintaining the secrecy of such information, including by requiring confidentiality agreements from all our employees, consultants and third parties having access to such information. We have a number of trade secrets already protected in this program and we expect to add more such trade secrets into the program in 2019.

We have also registered U.S. trademarks for “Resonant[®]”, “ISN “Infinite Synthesized Networks” and PMT[®].

There can be no assurance that our pending patent applications or any future patent applications will be approved or will not be challenged successfully by third parties, that any issued patents will protect our technology or will not be challenged by third parties, or that the patents of others will not have an adverse effect on our ability to do business. Furthermore, there can be no assurance that others will not independently develop similar or competing technology or design around any patents that have been or may be issued to us.

Despite our efforts to maintain the secrecy of our trade secrets, there also can be no assurance that others will not gain access to our trade secrets, or that we can meaningfully protect our technology. Nor can there be assurances that we will

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succeed in enforcing our trade secrets in the event others improperly gain access to them. In addition, effective trademark, copyright and trade secret protection may be unavailable or limited in certain foreign countries. Although we intend to protect our rights vigorously, there can be no assurance that such measures will be successful.

Competition

To our knowledge, we have no direct competitors in the electronic design automation or licensing business that are exclusively focused on RFFE. We have spent many years developing ISN[®], and our own patented suite of design tools created specifically for this purpose. No comparable acoustic wave filter design tool exists in the market today to our knowledge. In combination with our experienced design team, we believe we offer our customers a novel solution to the need for increasingly complex filter designs developed by an independent, stand-alone company that is not presently offered by any other company.

We have advantages that we believe present significant barriers to entry for potential competitors that desire to replicate our business model:

- a large and growing portfolio of patents and trade secrets;
- a suite of proprietary software design tools;
- a growing number of customers;
- a highly experienced design team; and
- a multi-year technology lead.

We do compete with the existing filter designs and design capabilities of the design teams at our customers and target customers and their filter manufacturers. We must demonstrate to our customers, target customers and their filter manufacturers, that switching to our designs will give them a competitive advantage by providing market entry or sufficiently improving the cost, size, and performance of their current products to justify our royalty rates.

The use of our patented ISN[®] tools, not only enables lower cost and smaller size SAW solutions for single band and multiplexer designs but also enables development of creative filter solutions for next generation RFFE architectures that, if successful will offer new, highly competitive solutions to many of the challenges facing the manufacturers of RFFE modules.

Employees

We currently have 70 employees, 50 of which are on our technical staff and 20 of which are devoted to finance, sales, marketing and administration matters. We also use several outside consultants.

Our principal executive offices are located at 175 Cremona Drive, Suite 200, Goleta, California 93117, and our telephone number is 805-308-9803. We also have development offices in Burlingame, California and Neuchatel, Switzerland and lease office space in Austin, Texas as well as Anyang, South Korea. Our website address is www.resonant.com. The information contained on, or that can be accessed through, our website is not a part of this report.

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ITEM 1A. RISK FACTORS

Investing in our common stock involves a high degree of risk. You should carefully consider the risks and uncertainties described below, together with all of the other information in this Form 10-K, including our consolidated financial statements and related notes, before investing in our common stock. If any of the following risks materialize, our business, financial condition, results of operations and prospects could be materially and adversely affected. In that event, the price of our common stock could decline, and you could lose part or all of your investment.

Risks Related to Our Business and Our Industry

We may require additional capital to continue operations in the future, which capital may not be available on terms acceptable to us, if at all.

Our consolidated financial statements account for the continuation of our business as a going concern. We are subject to the risks and uncertainties associated with a new business. Our principal sources of liquidity as of December 31, 2018 consist of existing cash, cash equivalents and investments totaling \$21.3 million. During the year ended December 31, 2018, we used \$19.6 million of cash and investments for operating activities, the purchase of property and equipment, and expenditures for patents. Due to these conditions, along with anticipated growth, substantial doubt exists as to our ability to continue as a going concern. After evaluation of these conditions, we believe our current resources, in the absence of material revenues, will provide sufficient funding for planned operations into the second half of 2019. If necessary, we will seek to raise additional capital from the sale of equity securities or the incurrence of indebtedness to allow us to continue operations. There can be no assurance that additional financing will be available to us on acceptable terms, or at all. Additionally, if we issue additional equity securities to raise funds, whether to existing investors or others, the ownership percentage of our existing stockholders would be reduced. New investors may demand rights, preferences or privileges senior to those of existing holders of common stock. Additionally, we may be limited as to the amount of funds we can raise pursuant to SEC rules and the continued listing requirements of NASDAQ. If we cannot raise needed funds, we might be forced to make substantial reductions in our operating expenses, which could adversely affect our ability to implement our business plan and ultimately our viability as a company. These consolidated financial statements do not include any adjustments relating to the recoverability and classification of recorded asset amounts or amounts and classification of liabilities that might result from this uncertainty.

We have a history of operating losses and we may never achieve or maintain profitability or positive cash flows.

We have a limited operating history and utilize planned milestones for investors to evaluate our progress. We have generated minimal revenues and we have a history of losses from operations with an accumulated deficit as of December 31, 2018 of \$92.6 million. Our operations have been funded with initial capital contributions, proceeds from the sale of equity securities and debt. We intend to continue to make investments to support our business growth and may require additional funds to respond to business challenges, including the need to refine existing technology, develop new technology, improve our operating infrastructure or acquire complementary businesses and technologies. Our ability to generate revenues and achieve profitability and, ultimately, positive cash flows, may depend on whether we can obtain additional capital when we need it and will depend on whether we continue to refine our technology and find additional customers who will license our designs. There can be no assurance that we will ever generate meaningful revenues, or that the revenues we do generate will be sufficient to achieve profitability and positive cash flows.

Initial shipments by our customers of filters produced from our designs may not result in high-volume sales and meaningful revenues.

We have had limited success in producing designs that our customers have had fabricated into filters shipped for use in mobile devices. While we believe initial shipments by customers of our designed filters represent a next step in validating our business model, initial shipments are not necessarily indicative of meaningful unit volumes or royalty revenues. Often our customers' initial filter shipments are to distributors as design kits or early stocking inventory, and high-volume sales and resulting royalty revenues may not materialize from these filters.

Our business model is based on licensing filter designs, which is unproven. Historically, our target customers have relied on their own filter designs or purchased finished filters from a manufacturer, and have not licensed third-party designs. Consequently, we may not succeed in our licensing strategy, which would require us to adopt a new business model and would have a material adverse effect on our ability to generate revenues and potentially threaten our viability.

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Our business model is based on licensing our proprietary filter designs. We do not intend to manufacture or sell any physical products or operate as a contract design company developing designs for a fee. We believe licensing our designs is the most direct and effective means of delivering our solutions to the market. We intend to retain ownership of our designs and charge royalties based on sales of filters and RFFE modules that incorporate our designs.

Our target customers either make part or all of the RFFE. These customers have historically used their own filter designs or purchased finished filters from a manufacturer. Our business model is new to the filter industry and remains unproven, as we have yet to receive meaningful royalty payments from our licensed designs. The failure to scale our business model would have a material adverse effect on our ability to generate revenues and potentially threaten our viability.

We may not be able to complete some of our designs because they do not meet our customers' expectations. Even if we succeed in developing a design that meets all of a customer's requirements, the customer could decline to use our design in their products. Further, our customer's product could fail in the marketplace. Any of these events would have a material adverse effect on our business and potentially threaten our viability.

We develop filter designs to meet our customers' stringent performance specifications. Our customers often ship pre-production samples of our designed filters to their customers for further evaluation. For some designs, mass production may commence. However, the filter qualification process is demanding and some designs will not result in volume production. If successfully developed and selected by our customer, our designs will compete against other technologies for inclusion in our customers' products. Our customers' final products will then compete against other products and technologies for inclusion in mobile devices in the marketplace. There can be no assurance that we can complete our designs, that our final designs will have acceptable performance and meet our customers' specifications, or if our pre-production sample filter shipments will be selected for production. Even if our filter designs have acceptable performance, there are a number of other considerations influencing the customer's decision whether to use our design, such as packaging type and manufacturing cost, many of which are beyond our control. The decision to use our designs is solely within our customers' discretion. Further, if our filter design is selected by a customer for inclusion in its design or product, there is no guarantee that the customer's design or product will be selected for inclusion in mobile devices. The failure of a significant number of our designs to be selected at the design stage or the device stage would have a material adverse effect on our business and potentially threaten our viability.

We are not a filter manufacturer, and thus we are reliant on filter fabricators or manufacturers to manufacture filters from our designs. For some of our customers that will not themselves manufacture filters from our designs, we may be required to have our customer approve the filter manufacturer, and the customer will not license our design unless the manufacturer can demonstrate the ability to economically produce the filter in large volumes.

Even though some of our designs have reached commercialization on a small scale, and we believe our future completed designs can be manufactured using existing technology, we remain dependent on the manufacturer's filter fabrication processes and capabilities for our filter designs. Even with a fully compliant filter design, the customer may not license our design unless the manufacturer can demonstrate the ability to economically produce the design in large volumes. We do not have any control over the manufacturer and cannot provide assurances that the manufacturer will have the necessary technology, skills and resources to successfully manufacture filters from our designs in commercial quantities.

Our designs are complex and may prove difficult to manufacture in commercial quantities. We will be relying on our customers and filter fabricators or manufacturers to build filters from our designs. Our business could fail if they encounter difficulties manufacturing filters in commercial quantities.

We develop complex filter designs, which is inherently challenging. Only a small number of our designed filters are currently in production. We rely on our customers and filter fabricators or manufacturers to manufacture our designed filters. They will need to manufacture filters in commercial quantities at an acceptable cost, and we have little or no control over the manufacturing process. They must also operate and maintain sophisticated manufacturing equipment, and equipment failures can have adverse consequences on production volumes, yields and schedules. They may encounter difficulties in scaling up production, including problems with quality control, raw material and component supply shortages, low manufacturing yields, increased costs, shortages of qualified personnel and/or difficulties associated with compliance with regulatory requirements. Any of these problems may adversely affect the timing and

amount of our future revenues. Additionally, if our customers and their suppliers encounter difficulties manufacturing filters from our designs in commercial quantities, our business could fail.

Our business success relies on manufacturers to fabricate our designs, and market acceptance of our designs could be adversely affected if the manufacturers decline to manufacture our designs.

We are a filter design company and will not commercially manufacture any products. Our business model is to license our designs to customers, who will manufacture our designs themselves or rely on third party manufacturers, commonly

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referred to as foundries, to fabricate our designs for integration into the customer's overall product. Many foundries offer potentially competitive filter technology as part of their standard product line or offer the services of in-house design teams which may consider us competition. In this case, our customers may face resistance by their foundries to manufacture our designs. We believe the economics can be structured to make it attractive to the foundries to manufacture our designs for our potential customers but we cannot be assured of the success in convincing them of the value of manufacturing our designs. The reluctance of foundries to manufacture our designs could adversely affect the market acceptance of our designs.

We develop and test our designs under laboratory conditions using low volume production samples. Once in production, our designs may not perform as well, or prove unreliable, due to manufacturing variations and operating conditions. This could adversely affect our business.

We develop and test our designs under laboratory conditions using low volume production samples. The transition from product development to commercial production requires high volume manufacturing which introduces product variations. These variations can adversely affect performance and reliability. Similarly, our designs may not perform as well or prove sufficiently reliable under actual operating conditions. This could adversely affect our business.

We perform failure analysis and reliability testing of our customers' parts that use our designs. If our analysis and testing prove to be faulty and our customers rely upon such information, our reputation could be damaged and our future business and revenues could be adversely affected.

We perform failure analysis and reliability testing of our customers' parts. In the event our analysis and testing prove to be faulty or insufficient, including due to failure of our laboratory equipment or human error, and our customers rely upon the results we provide, our reputation may be damaged, and customers may be reluctant to utilize our services or license our designs. This could harm our ability to attract customers and negatively impact our financial results, and may result in claims against us by our customers or others.

We have completed and continue to actively work on filter designs with, and expect to derive all of our revenues from, a small number of customers. Our failure to retain or expand customer relationships will have an adverse effect on our revenues.

We expect to derive our revenues from, a small number of customers. Our failure to retain or expand customer relationships, or any problems we experience in collecting receivables from them, would harm our financial condition and results of operations. Additionally, our industry is experiencing consolidation among suppliers and manufacturers of RF front-end components and modules, including activities of module suppliers who vertically integrate by acquiring component suppliers and fabs. This may lead to fewer customers, reduced demand for our designs and replacement of our designed products by the consolidated company. Any of these possibilities could adversely affect our business, financial condition and results of operations.

We are a solutions company, providing designs based on our ISN[®] software platform, intellectual property and design team. We license our designs to manufacturers of RFFE, RFFE sub-systems and components for mobile devices. If our designs do not achieve widespread market acceptance among RFFE manufacturers, we will not be able to generate the revenue necessary to support our business.

Achieving additional acceptance among RFFE manufacturers of our designs will be crucial to our continued success. We have a limited history of marketing designs and we may fail to generate significant interest in our designs. These and other factors may affect the rate and level of market acceptance, including:

- our royalty fees and the cost of our designed filters relative to other competing designs and technologies;
- perception by RF front-end manufacturers and mobile device manufacturers;
- press and blog coverage, social media coverage, and other publicity and public relations factors which are not within our control; and
- regulatory developments related to manufacturing, marketing and selling our designs.

If we are unable to achieve or maintain market acceptance, our business would be harmed.

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Our future revenue is inherently unpredictable. As a result, as our revenues increase our operating results are likely to fluctuate from period to period, and we may fail to meet the expectations of our analysts and investors, which may cause volatility in our stock price and may cause our stock price to decline.

As our revenues increase, we expect our quarterly and annual operating results to fluctuate significantly due to a variety of factors, some of which are outside of our control. Factors that could cause our quarterly or annual operating results to fluctuate include:

- a downturn in the markets for our customers' products;
- disruptions or delays in the manufacture of our designed filters, our customers' products, or the products into which our customers' products are incorporated, or in the supply of raw materials or product components used to produce such filters or products;
- a failure to anticipate changing customer product requirements;
- market acceptance of our designs;
- cancellations or postponements of previously placed orders for our customers' products;
- increased financing costs or any inability to obtain necessary financing;
- the impact on our business of any cost reduction measures;
- a loss of key personnel or the shortage of available skilled workers;
- economic conditions in various geographic areas where we or our customers do business;
- the impact of political uncertainties, such as government sequestration and uncertainties surrounding the federal budget, customer spending and demand for products incorporating our designs;
- other conditions affecting the timing of orders of our customers' products incorporating our designs;
- reductions in the royalty rates for our designs occasioned by a reduction in the prices for our customers' products, increases in the costs of raw materials used to produce our customers' products, or other factors;
- effects of competitive pricing pressures, including decreases in average selling prices of RF filters that compete with our filter designs, resulting in reduced royalty revenue;
- obsolescence of our designs;
- research and development expenses incurred with respect to new filter design introductions;
- natural disasters, such as hurricanes, earthquakes, fires, and floods;
- the emergence of new industry standards;
- the loss or gain of significant customers;
- the introduction of new designs and manufacturing processes;
- changes in technology;
- intellectual property disputes;
- customs (including tariffs imposed on products, or components thereof, into which our filter designs are incorporated, or the equipment used in the production of such products), import/export, and other regulations of the countries in which we do business;
- the occurrence of M&A activities; and
- acts of terrorism or violence and international conflicts or crises.

Our limited visibility into future demand for products incorporating our finished filter designs makes it difficult to forecast royalty revenue.

Our customers have had difficulty accurately forecasting their product sales volumes and the timing of new product introductions, which ultimately affects the royalties we expect to receive for sales of products incorporating our finished filter designs. Our limited visibility into the demand for our customers' products makes it difficult for us to accurately forecast royalty revenues, which we expect will continue for the foreseeable future.

The markets in which we compete are cyclical and any future downturn may delay or reduce the demand for our designs and resulting royalty revenue.

Historically, the markets in which we compete have experienced significant downturns, often connected with, or in anticipation of, declines in consumer demand for end-user products, the maturation of product cycles and declining

general economic conditions. These downturns have been characterized by diminished product demand, production overcapacity, high inventory levels, accelerated erosion of average selling prices, bad debt, inventory charges, restructuring charges, and asset impairment charges. Any future downturn in the markets in which we compete, or changes in demand for our designs from our customers, could result in a significant delay in our realization of or reduction in our revenue and may also increase the volatility of the price of our common stock.

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The complexity of our designs could result in unforeseen delays or expenses from latent defects that could reduce the market acceptance for our designs, damage our reputation and adversely affect our future revenues and operating costs.

We are developing highly complex filters designs using a new approach. We have produced only a limited number of designs that have gone into commercial production and therefore cannot be certain our methods and testing procedures are adequate to detect latent design defects. If any of our designs contain latent defects, we may be unable to correct these problems. Consequently, our reputation may be damaged and customers may be reluctant to buy our designs, which could harm our ability to attract customers and negatively impact our financial results. These problems may also result in claims against us by our customers or others.

Failures in the products or services of our customers, including those resulting from defects or errors, could result in decreased sales and harm our business.

Our success depends in large part on the demand for mobile wireless devices and other products that incorporate our proprietary filter designs. Our customers' products are inherently complex and may contain defects or errors unrelated to our designs that are detected only when the products are in use. Any defects or errors in the products of our customers could result in product recalls or the discontinuation of those products, which could have an adverse impact on our operating results due to a delay or decrease in demand for our designs. Further, security failures, defects or errors in mobile wireless devices, such as the issues with the Galaxy Note 7 in 2016 that caused Samsung to discontinue that product, have led to increased scrutiny of component suppliers. If our customers do not perceive our designs, or if mobile device manufacturers do not perceive the products of our customers, to be of high quality, or if we or our customers are unable or unwilling to comply with heightened quality assurance requirements of mobile device manufacturers, we may be unsuccessful in having our designed filters incorporated into finished products. Our designs may not gain widespread acceptance unless they offer greater benefits to our customers than offered by competing RF filter designs.

RF front-end manufacturers are primarily concerned with the cost, size and performance of RF filters. Our designs may not gain widespread acceptance unless, as compared to competing RF filter designs, they are smaller in size, can be fabricated at reduced cost or designed in less time, or improve performance. There can be no assurance that our SAW or TC-SAW filter designs will cost sufficiently less to manufacture than existing BAW filters, or can be designed in less time, to prove economically attractive to RF front-end manufacturers or that our filter designs will be smaller in size or perform better.

Our technologies have only limited verification in practice or on a commercial scale.

Our technologies have been subject to only limited testing on a commercial scale. There is no assurance that we will be able to fully develop designs that will transition into production or license our proposed designs on a timely basis, or at all.

Our development cycles are long and our final designs may no longer remain competitive upon completion.

We operate in an industry which is subject to rapidly evolving technologies. Because our designs are expected to have long development cycles, we must anticipate changes in the marketplace and the direction of technological innovation and customer demands. To compete successfully, we will need to demonstrate the advantages of our designs and technologies.

Our industry is subject to intense competition and rapid technological change, which may result in designs, products or new solutions that are superior to our designs under development. If we are unable to anticipate or keep pace with changes in the marketplace and the direction of technological innovation and customer demands, our designs may become less useful or obsolete and our operating results will suffer.

We operate in an industry which is subject to intense and increasing competition. Our future success will depend in large part on our ability to establish and maintain a competitive position in current and future technologies. Rapid technological development may render our designs and technologies obsolete. Many of our competitors have or may have greater engineering, sales, marketing, operational, corporate and financial resources, and more experience in research and development than we have. We cannot assure you that our competitors will not succeed in developing or marketing technologies or products that are more effective or commercially attractive than our designs or that would render our technologies and designs obsolete. We may not have or be able to raise or develop the financial resources,

technical expertise, or support capabilities to compete successfully in the future. Our success will depend in large part on our ability to maintain a competitive position with our technologies.
If our principal end markets fail to grow or experience declines, our net revenue may not meet our business plan expectations.

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Our initial designs are being incorporated into mobile wireless devices. Accordingly, demand for our designs is dependent on the ability of mobile wireless device manufacturers to successfully sell wireless devices that incorporate our designs. We cannot be certain whether these manufacturers will be able to create or sustain demand for their wireless devices that contain our designs or how long they will remain competitive in their business, if at all. The success of these mobile wireless device manufacturers and the demand for their wireless devices can be affected by a number of factors, including, but not limited to:

- market acceptance of their mobile wireless devices that contain our designs;
- the impact of slowdowns or declines in sales of mobile wireless devices in general;
- their ability to design products with features that meet the evolving tastes and preferences of consumers;
- fluctuations in foreign currency;
- relationships with wireless carriers in particular markets;
- the implementation of, or changes to, mobile wireless device certification standards and programs;
- technological advancements in the functionality and capabilities of mobile wireless devices;
- the imposition of restrictions, tariffs, duties, or regulations by foreign governments on mobile wireless device manufacturers;
- failure to comply with governmental restrictions or regulations;
- cost and availability of components for their products; and
- inventory levels in the sales channels into which mobile wireless device manufacturers sell their products.

Our intellectual property rights may not be adequate to protect our business

Our success depends significantly on our ability to obtain, maintain and protect our proprietary rights to the technologies used in products incorporating our technologies. We currently hold patents related to various elements of our technology and we also have patent applications currently pending before the United States Patent and Trademark Office and other patent offices around the world. No assurances can be given that any patent will be issued on our pending patent applications or any other application that we may file in the future or that, if such patents are issued, they will be sufficiently broad to adequately protect our technology. In addition, we cannot assure you that any patents that may be issued to us will not be challenged, invalidated, or circumvented.

Our proprietary rights may be difficult to enforce, which could enable others to copy or use aspects of our intellectual property without compensating us, thereby eroding our competitive advantages and harming our business.

Our success depends, in part, on our ability to protect proprietary methods and technologies that we develop under the intellectual property laws of the United States, so that we can prevent others from using our inventions and proprietary information. If we fail to protect our intellectual property rights adequately, our competitors might gain access to our technology, and our business might be adversely affected. We rely on trademark, copyright, mask works, trade secret and patent laws, confidentiality procedures and contractual provisions to protect our proprietary methods and technologies. We currently hold patents and have pending patent applications related to our technology solutions.

Valid patents may not be issued from our pending applications, and the claims allowed on any issued patents may not be sufficiently broad to protect our technology or offerings and services. Any patents we currently hold or that may be issued to us in the future may be challenged, invalidated or circumvented, and any rights granted under these patents may not actually provide us with adequate defensive protection or competitive advantages. Additionally, the process of obtaining patent protection is expensive and time-consuming, and we may not be able to prosecute all necessary or desirable patent applications at a reasonable cost or in a timely manner.

Policing unauthorized use of our technology is difficult. Additional uncertainty may result from changes to intellectual property legislation enacted in the United States, including the America Invents Act, and other countries and from interpretations of the intellectual property laws of the United States and other countries by applicable courts and agencies. In addition, the laws of some foreign countries may not be as protective of intellectual property rights as those of the United States, and mechanisms for enforcement of our proprietary rights in such countries may be inadequate. From time to time, legal action by us may be necessary to enforce our intellectual property rights, to protect our trade secrets, to determine the validity and scope of the proprietary rights of others, or to defend against

claims of infringement. Such litigation could result in substantial costs and the diversion of limited resources and could negatively affect our business, operating results and financial condition. If we are unable to protect our proprietary rights (including aspects of our technology platform) we may find ourselves at a competitive disadvantage to others who have not incurred the same level of expense, time and effort to create and protect their intellectual property.

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Furthermore, we acquired some of the patents we currently hold from Superconductor Technologies, Inc., or STI. Although we believe we have obtained valid assignments of patent rights from STI and STI has obtained valid assignments of patent rights from all inventors, if an inventor did not adequately assign his or her patent right to STI or STI did not adequately assign its patent rights to us, a third party could obtain a license to the patent from such inventor or STI. This could preclude us from enforcing the patent against such third party. In addition, because we acquired our patents from STI, some of the inventors of our patents are not our employees and they are not obligated to assist us in prosecuting, maintaining, defending and enforcing such patents. Without the cooperation of the inventors of our patents, it may be difficult for us to prevail in any legal action involving the intellectual property rights under our patents. Additionally, the inventors may have information, trade secrets and know-how learned while at STI that is not our property and if disclosed could provide competitors with insights that allow them to invent around our patented technology.

Accordingly, despite our efforts, we may be unable to obtain adequate patent protection, or to prevent third parties from infringing upon, misappropriating or inventing around our intellectual property.

We may be subject to intellectual property rights claims by third parties, which are extremely costly to defend, could require us to pay significant damages and could limit our ability to use certain technologies.

Third parties may assert claims of infringement of intellectual property rights in proprietary technology against us for which we may be liable or have an indemnification obligation. Any claim of infringement by a third party, even those without merit, could cause us to incur substantial costs defending against the claim and could distract our management from our business.

Although third parties may offer a license to their technology, the terms of any offered license may not be acceptable and the failure to obtain a license or the costs associated with any license could cause our business, results of operations or financial condition to be materially and adversely affected. In addition, some licenses may be non-exclusive, and therefore our competitors may have access to the same technology licensed to us. Alternatively, we may be required to develop non-infringing technology, which could require significant effort and expense and ultimately may not be successful. Furthermore, a successful claimant could secure a judgment or we may agree to a settlement that prevents us from licensing certain designs or performing certain services or that requires us to pay substantial damages, including treble damages if we are found to have willfully infringed the claimant's patents or copyrights, royalties or other fees. Any of these events could seriously harm our business, operating results and financial condition.

We may be unsuccessful in monetizing our intellectual property portfolio.

We have dedicated substantial resources to the development and protection of technology innovations essential to our business, and we expect these activities to continue for the foreseeable future. We also intend to aggressively pursue monetization avenues for our intellectual property portfolio, potentially including licensing, royalty or other revenue-producing arrangements. However, our revenues are currently generated in part by licensing our technology and we may never be successful in generating a revenue stream from our intellectual property, in which case our investments of time, capital and other resources into our intellectual property portfolio may not provide adequate, or any, returns.

Our customer agreements include indemnity provisions and may expose us to substantial liability for intellectual property infringement and other losses.

Our customer agreements include indemnification provisions under which we agree to indemnify third parties for losses suffered or incurred as a result of claims of intellectual property infringement, damages caused by us to property or persons, or other liabilities relating to or arising from our designs, services, or other contractual obligations. The term of these indemnity provisions generally survives termination or expiration of the applicable agreement. Large indemnity payments could harm our business, operating results and financial condition.

We use highly specialized proprietary software as well as commercially available software pursuant to annual licenses, and the failure of this software or inability to renew any of these licenses could adversely affect our ability to design new RF filters and thus our potential for generating revenues.

We have developed and use highly specialized proprietary computer software in our design process. The failure of any of this software to perform as expected could adversely affect our ability to produce new RF filter designs and thus our potential for generating revenues. In addition to our proprietary software, we also use highly specialized but commercially available computer software in our design process. We do not own this software and use it under the terms of licenses. These licenses are made available to us at prices and on terms generally available to any customer. If we were unable to renew any of these software licenses, we would have to locate or develop alternative software. We cannot assure you that suitable alternative

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software would be available on commercially reasonable terms or could be developed by us at reasonable cost. The loss of any one of these software licenses could adversely affect our ability to produce new RF filter designs and thus our potential for generating revenues.

Our limited operating history makes it difficult to evaluate our business and prospects and may increase the risks associated with your investment.

We have only a limited operating history upon which our business and future prospects may be evaluated. We have encountered and will continue to encounter risks and difficulties frequently experienced by companies in rapidly developing and changing industries, including challenges related to recruiting, integrating and retaining qualified employees; making effective use of our limited resources; achieving market acceptance of our existing and future solutions; competing against companies with greater financial and technical resources; and developing new solutions. Our current operational infrastructure may require changes for us to scale our business efficiently with additional technical personnel and effectively to keep pace with demand for our solutions, and achieve long-term profitability. If we fail to implement these changes on a timely basis or are unable to implement them effectively, our business may suffer. We cannot assure you that we will be successful in addressing these and other challenges we may face in the future. As a company in a rapidly evolving industry, our business prospects depend in large part on our ability to:

- build a reputation for a superior solution and create trust and long-term relationships with our customers;
- distinguish ourselves from competitors in our industry;
- develop and offer competitive technologies that meet our customers' needs as they change;
- respond to evolving industry standards and government regulations that impact our business;
- expand our business internationally; and
- attract, hire, integrate and retain qualified and motivated employees.

If we are unable to meet one or more of these objectives or otherwise adequately address the risks and difficulties that we face, our business may suffer, our revenue may decline and we may not be able to achieve growth or long-term profitability.

Our management team and financial reporting group is limited in size and experience which may impact the implementation and administration of financial and reporting controls and procedures.

Although our management team makes certain representations about the financial and reporting controls and procedures in our SEC filings, our management team has limited experience in implementing and maintaining our operations and our financial processes. Financial and reporting controls and procedures implemented and maintained by our management team, now or in the future, may not be adequate, with the result that there may be substantial deficiencies that will need remediation in the future. If there are inadequate controls and procedures, our financial statements and our reporting may be inaccurate or untimely.

The loss of the services of our key management and personnel or the failure to attract additional key personnel could adversely affect our ability to operate our business.

A loss of one or more of our current officers or key employees could severely and negatively impact our operations. We have no present intention of obtaining key-man life insurance on any of our executive officers or management. Additionally, competition for highly skilled technical, managerial and other personnel is intense. As our business develops, we might not be able to attract, hire, train, retain and motivate the highly skilled managers and employees we need to be successful. If we fail to attract and retain the necessary technical and managerial personnel, our business may not grow, may suffer and might fail.

We may have difficulty managing growth in our business.

Because of our small size, growth in accordance with our business plan, if achieved, will place a significant strain on our financial, technical, operational and management resources. As we expand our activities, there will be additional demands on these resources. The failure to continue to upgrade our technical, administrative, operating and financial control systems or the occurrence of unexpected expansion difficulties, including issues relating to our research and development activities and retention of experienced scientists, managers and engineers, could have a material adverse effect on our business, financial condition and results of operations and our ability to timely execute our business plan.

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Our worldwide operations are subject to political, legal and economic risks and natural disasters, which could have a material adverse effect on us.

Our customers are located around the world, including in the United States and Asia, and we expect that international sales will comprise a significant portion of total sales in the future. In addition, products utilizing our designs will be produced, assembled and tested at third-party manufacturing facilities located primarily in Asia. Consequently, we are subject to political, legal and economic risks associated with operations in foreign countries, including, without limitation:

- expropriation;
- changes in a specific country's or region's political or economic conditions;
- changes in tax laws, trade protection measures and import or export licensing requirements;
- difficulties in protecting our intellectual property;
- difficulties in managing staffing and exposure to different employment practices and labor laws;
- changes in foreign currency exchange rates;
- restrictions on transfers of funds and other assets of our subsidiaries between jurisdictions;
- changes in freight and interest rates;
- disruption in air transportation between the United States and overseas facilities;
- loss or modification of exemptions for taxes and tariffs; and
- compliance with U.S. laws and regulations related to international operations, including export control and economic sanctions laws and regulations and the Foreign Corrupt Practices Act.

In addition, our worldwide operations (or those of our business partners) could be subject to natural disasters such as earthquakes, tsunamis, flooding, typhoons and volcanic eruptions that disrupt manufacturing or other operations. For example, our Goleta and Burlingame operations are located near major earthquake fault lines in California. Any conflict or uncertainty in the countries in which we operate, including public health issues, safety issues, natural disasters, disruptions of service from utilities, nuclear power plant accidents or general economic or political factors, could have a material adverse effect on our business. Any of the above risks, should they occur, could result in an increase in the cost of components, production delays, general business interruptions, delays from difficulties in obtaining export licenses for certain technology, tariffs and other barriers and restrictions, longer payment cycles, increased taxes, restrictions on the repatriation of funds and the burdens of complying with a variety of foreign laws, any of which could ultimately have a material adverse effect on our business.

If our estimates or judgments relating to our critical accounting policies are based on assumptions that change or prove to be incorrect, our operating results could fall below the expectations of securities analysts and investors, resulting in a decline in our stock price.

The preparation of financial statements in conformity with generally accepted accounting principles, or GAAP, requires management to make estimates and assumptions that affect the amounts reported in the consolidated financial statements and accompanying notes. We base our estimates on historical experience and on various other assumptions that we believe to be reasonable under the circumstances, as provided in Item 7--Management's Discussion and Analysis of Financial Condition and Results of Operations, the results of which form the basis for making judgments about the carrying values of assets, liabilities, equity, revenue and expenses that are not readily apparent from other sources. Our operating results may be adversely affected if our assumptions change or if actual circumstances differ from those in our assumptions, which could cause our operating results to fall below the expectations of securities analysts and investors, resulting in a decline in our stock price. Significant assumptions and estimates used in preparing our consolidated financial statements include those related to the fair values of equity instruments, other financial instruments and income taxes.

Our ability to use our net operating loss carryforwards ("NOLs") and other tax attributes to offset future taxable income may be limited.

We have significant NOLs and R&D tax credits available to offset our future United States federal and state taxable income. Under Sections 382 and 383 of Internal Revenue Code of 1986, as amended, if a corporation undergoes an

“ownership change,” the corporation’s ability to use its pre-change NOLs and other pre-change tax attributes, such as R&D tax credits, to offset its post-change income and taxes may be limited. In general, an “ownership change” occurs if there is a cumulative change in our ownership by “5% shareholders” that exceeds 50 percentage points over a rolling three-year period. Similar rules may apply under state tax laws. If we experience ownership changes as a result of future transactions in our stock, then we may be further limited in our ability to use our NOLs and other tax assets to reduce taxes owed on the net taxable income that we earn. Any such limitations on the ability to use our NOLs and other tax assets could adversely impact our business, financial condition and operating results. In addition, California and certain states have suspended use of NOLs for certain taxable years and other states are considering similar measures. As a result, we may incur higher state income tax expense in the future.

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Depending on our future tax position, continued suspension of our ability to use NOLs in states in which we are subject to income tax could have an adverse impact on our operating results and financial condition.

Changes in U.S. tax laws and regulations, including the Tax Cuts and Jobs Act of 2017, may have a material adverse effect our business, cash flow, operating results, and financial condition.

Changes in tax laws and regulations, or changes in the interpretation of tax laws and regulations by federal or state authorities, may have a material adverse effect our business, cash flows, operating results or financial condition. The federal government recently enacted the Tax Cuts and Jobs Act of 2017, which contains many significant changes to federal income tax laws, including a reduction to the U.S. Corporate income tax rate. The reduction in the tax rate impacted our deferred tax assets by \$6.8 million, which would have been recognized as tax expense if we did not have a full valuation allowance recorded against our deferred tax assets. Changes in corporate tax rates and the deductibility of expenses contained in the 2017 Tax Act or other tax reform legislation could have a material impact on the future value of our deferred tax assets, could result in significant one-time costs or expenses in the current or future taxable years, and could increase our future U.S. tax expense. In addition, foreign governments or U.S. states may enact tax laws in response to the 2017 Tax Act that could result in further changes to taxation applicable to us and materially affect our operating results and financial condition.

Security breaches and improper access to or disclosure of our proprietary information, or other hacking attacks on our systems, could adversely affect our business.

Our industry is prone to cyber-attacks, with third parties seeking unauthorized access to our proprietary information and technology. Computer malware, viruses, and hacking and phishing attacks by third parties have become more prevalent in our industry and may occur on our systems in the future. We believe such attempts are increasing in number and in technical sophistication, and in some instances we may be unable to anticipate these techniques or to implement adequate preventative measures. Additionally, we may be unaware of an incident or its magnitude and effects. Although we have developed systems and processes that are designed to protect our proprietary information and to prevent other cybersecurity breaches, we cannot guarantee that such measures will provide absolute security. Any failure to prevent or mitigate security breaches and improper access to or disclosure of our proprietary information could result in the loss or misuse of such proprietary information, which could harm our business and diminish our competitive position. Such attacks may also create system disruptions or cause shutdowns. Publicity about vulnerabilities and attempted or successful incursions could damage our reputation with customers and reduce demand for our products and services.

Affected private parties or government authorities could initiate legal or regulatory actions against us in connection with any security breaches, which could cause us to incur significant expense and liability or result in orders or consent decrees forcing us to modify our business practices. Any of these events could have a material and adverse effect on our business, reputation, and operating results.

If we choose to acquire new businesses, products or technologies, we may experience difficulty in the identification or integration of any such acquisition, and our business may suffer.

Our commercial success depends on our ability to continually enhance and broaden our product offerings in response to changing customer demands, competitive pressures and technologies. Accordingly, we may in the future pursue the acquisition of complementary businesses, products or technologies instead of developing them ourselves. We do not know if we will be able to identify or complete any future acquisitions, or whether we will be able to successfully integrate any acquired business, product or technology or retain key employees. Integrating any business, product or technology we acquire could be expensive and time consuming, disrupt our ongoing business and distract our management. Moreover, we may fail to realize the anticipated benefits of any acquisition. If we are unable to integrate any acquired businesses, products or technologies effectively, our business will suffer. In addition, any amortization or charges resulting from acquisitions could adversely affect our operating results.

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Risks Relating to the Securities Markets and Ownership of Our Common Stock

Our business could be negatively affected as a result of actions of activist stockholders, and such activism could impact the trading value of our securities.

Stockholders may, from time to time, engage in proxy solicitations or advance stockholder proposals, or otherwise attempt to effect changes and assert influence on our board of directors and management. While we strive to maintain constructive, ongoing communications with all of our stockholders, and welcome their views and opinions with the goal of enhancing value for all stockholders, activist campaigns that contest or conflict with our strategic direction or seek changes in the composition of our board of directors could have an adverse effect on our operating results and financial condition. A proxy contest would require us to incur significant legal and advisory fees, proxy solicitation expenses and administrative and associated costs and require significant time and attention by our board of directors and management, diverting their attention from the pursuit of our business strategy. Any perceived uncertainties as to our future direction and control, our ability to execute on our strategy, or changes to the composition of our board of directors or senior management team arising from a proxy contest could lead to the perception of a change in the direction of our business or instability which may be exploited by our competitors, result in the loss of potential business opportunities, and make it more difficult to pursue our strategic initiatives or attract and retain qualified personnel and business partners, any of which could adversely affect our business and operating results. If individuals are ultimately elected to our Board with a specific agenda, it may adversely affect our ability to effectively implement our business strategy and create additional value for our stockholders. We may choose to initiate, or may become subject to, litigation as a result of the proxy contest or matters arising from the proxy contest, which would serve as a further distraction to our board of directors and management and would require us to incur significant additional costs. In addition, actions such as those described above could cause significant fluctuations in our stock price based upon temporary or speculative market perceptions or other factors that do not necessarily reflect the underlying fundamentals and prospects of our business.

A securities class action lawsuit and a shareholder derivative lawsuit were filed against us in 2015 and subsequently settled. Legal proceedings of this nature could have a material adverse effect on our business, results of operations and financial condition.

In 2015, a putative class action lawsuit and shareholder derivative lawsuit were filed against us and certain of our directors and officers, which lawsuits were settled in November 2017 and August 2018, respectively. Lawsuits of this nature may divert financial and management resources that would otherwise be used to benefit our operations. Although we denied the material allegations in the lawsuits and defended ourselves vigorously, defending the lawsuits resulted in substantial costs. In addition, we may be the target of securities-related litigation in the future. Such litigation could divert our management's attention and resources, result in substantial costs, and have an adverse effect on our business, results of operations and financial condition.

We maintain director and officer insurance that we regard as reasonably adequate to protect us from potential claims; however, we cannot assure you that it will. Further, if we are subject to future litigation, the costs of insurance may increase and the availability of coverage may decrease. As a result, we may not be able to maintain our current levels of insurance at a reasonable cost, or at all, which might make it more difficult to attract qualified candidates to serve as executive officers or directors of Resonant.

The price of our common stock may be volatile and the value of your investment could decline

Technology stocks have historically experienced high levels of volatility. The trading price of our common stock may fluctuate substantially, depending on many factors, some of which are beyond our control and may not be related to our operating performance. These fluctuations could cause you to lose all or part of your investment in our common stock. Factors that could cause fluctuations in the trading price of our common stock include, but are not limited to, the following:

- the progress, completion or failure of efforts to design our commercial products;
- a customer decision regarding incorporation of our designs into a commercial product;
- the loss of any customer relationship;

the addition of a new customer relationship;
mergers and acquisitions involving us, our customers or our competitors;
price and volume fluctuations in the overall stock market from time to time;
significant volatility in the market price and trading volume of technology companies in general;
fluctuations in the trading volume of our shares or the size of our public float;
actual or anticipated changes or fluctuations in our results of operations;

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- whether our results of operations meet the expectations of securities analysts or investors;
- actual or anticipated changes in the expectations of investors or securities analysts;
- litigation involving us, our industry, or both;
- regulatory developments in the United States, foreign countries, or both;
- general economic conditions and trends;
- major catastrophic events;
- lockup releases, sales of large blocks of our common stock;
- departures of key employees; or
- an adverse impact on the company from any of the other risks cited herein.

In addition, if the market for technology stocks or the stock market in general, experience a loss of investor confidence, the trading price of our common stock could decline for reasons unrelated to our business, results of operations or financial condition. The trading price of our common stock might also decline in reaction to events that affect other companies in our industry even if these events do not directly affect us. Securities class action litigation has often been instituted against companies following periods of volatility in the overall market and in the market price of a company's securities. Two putative class action lawsuits were filed in March 2015 against the Company and certain members of the Board of Directors and executives and subsequently settled. We may be the target of securities-related litigation in the future. Such litigation could divert our management's attention and resources, result in substantial costs, and have an adverse effect on our business, results of operations and financial condition. Insiders have substantial control over us, which could limit your ability to influence the outcome of key transactions, including a change of control.

Our directors, executive officers and each of our stockholders who own greater than 10% of our outstanding common stock, in the aggregate, beneficially own approximately 29% of the outstanding shares of our common stock as of February 28, 2019. As a result, these stockholders will be able to influence or control matters requiring approval by our stockholders, including the election of directors and the approval of mergers, acquisitions or other extraordinary transactions. They may also have interests that differ from yours and may vote in a manner that is adverse to your interests. This concentration of ownership may have the effect of deterring, delaying or preventing a change of control of our company, could deprive our stockholders of an opportunity to receive a premium for their common stock as part of a sale of our company and might ultimately affect the market price of our common stock.

The requirements of being a public company may strain our resources, divert our management's attention and affect our ability to attract and retain qualified board members.

As a public company, we are subject to the reporting requirements of the Exchange Act, and are required to comply with the applicable requirements of the Sarbanes-Oxley Act and the Dodd-Frank Wall Street Reform and Consumer Protection Act, the listing requirements of The NASDAQ Stock Market and other applicable securities rules and regulations. Compliance with these rules and regulations have increased our legal and financial compliance costs, made some activities more difficult, time-consuming or costly and increased demand on our systems and resources. Among other things, the Exchange Act requires that we file annual, quarterly and current reports with respect to our business and results of operations and maintain effective disclosure controls and procedures and internal controls over financial reporting. In order to maintain and, if required, improve our disclosure controls and procedures and internal controls over financial reporting to meet this standard, significant resources and management oversight may be required. As a result, management's attention may be diverted from other business concerns, which could harm our business and results of operations. Although we have already hired additional employees to comply with these requirements, we may need to hire even more employees or retain professional service providers in the future, which will increase our costs and expenses.

In addition, we expect that these new rules and regulations will make it more expensive for us to obtain director and officer liability insurance, and we may be required to accept reduced coverage or incur substantially higher costs to obtain coverage. These factors could also make it more difficult for us to attract and retain qualified members of our board of directors, particularly to serve on our audit committee and compensation committee, and qualified executive officers.

We are an “emerging growth company,” and we cannot be certain if the reduced disclosure requirements applicable to emerging growth companies will make our common stock less attractive to investors.

For so long as we remain an “emerging growth company” as defined in the JOBS Act, we may take advantage of certain exemptions from various requirements that are applicable to public companies that are not “emerging growth companies,” including not being required to comply with the independent auditor attestation requirements of Section 404 of the

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Sarbanes-Oxley Act, reduced disclosure obligations regarding executive compensation in our periodic reports and proxy statements and exemptions from the requirements of holding a nonbinding advisory vote on executive compensation and stockholder approval of any golden parachute payments not previously approved. We may take advantage of these exemptions for so long as we are an “emerging growth company,” which could be as long as five years following the completion of our initial public offering. Investors may find our common stock less attractive because we rely on these exemptions. If some investors find our common stock less attractive as a result, there may be a less active trading market for our common stock, and our stock price may be more volatile and may decline.

In addition, Section 107 of the JOBS Act also provides that an “emerging growth company” can take advantage of an extended transition period for complying with new or revised accounting standards. However, we chose to “opt out” of such extended transition period, and as a result, we will comply with new or revised accounting standards on the relevant dates adoption of such standards is required for non-emerging growth companies. Our decision to opt out of the extended transition period for complying with new or revised accounting standards is irrevocable.

We will remain an emerging growth company until the earliest of (a) the last day of our fiscal year during which we have total annual gross revenue of at least \$1.0 billion; (b) the last day of our fiscal year following the fifth anniversary of the completion of our initial public offering (or December 31, 2019); (c) the date on which we have, during the previous three-year period, issued more than \$1.0 billion in non-convertible debt; or (d) the date on which we are deemed to be a “large accelerated filer” under the Securities Exchange Act of 1934, as amended, which would occur if the market value of our stock that are held by non-affiliates exceeds \$700 million as of the last business day of our most recently completed second fiscal quarter. Once we cease to be an emerging growth company, we will not be entitled to the exemptions provided in the JOBS Act.

We are required to evaluate our internal control over financial reporting under Section 404 of the Sarbanes-Oxley Act of 2002, and any adverse results from such evaluation could result in a loss of investor confidence in our financial reports and have an adverse effect on our stock price.

Pursuant to Section 404 of the Sarbanes-Oxley Act of 2002, we are required to furnish a report by our management on our internal control over financial reporting. Such report contains, among other matters, an assessment of the effectiveness of our internal control over financial reporting as of the end of our fiscal year, including a statement as to whether or not our internal control over financial reporting is effective. This assessment must include disclosure of any material weaknesses in our internal control over financial reporting identified by management. If we are unable to assert that our internal control over financial reporting is effective, we could lose investor confidence in the accuracy and completeness of our financial reports, which could have an adverse effect on our stock price.

Our independent registered public accounting firm is not required to formally attest to the effectiveness of our internal control over financial reporting until the later of the date we are an accelerated filer or large accelerated filer, or the date we are no longer an “emerging growth company.” At such time, our independent registered public accounting firm may issue a report that is adverse in the event it is not satisfied with the level at which our controls are documented, designed or operating. Our remediation efforts may not enable us to avoid a material weakness in the future.

If securities or industry analysts do not publish research or reports about our business, or publish inaccurate or unfavorable research reports about our business, our share price and trading volume could decline.

The trading market for our common stock will, to some extent, depend on the research and reports that securities or industry analysts publish about us or our business. We do not have any control over these analysts. If one or more of the analysts who cover us should downgrade our shares or change their opinion of our business prospects, our share price would likely decline. If one or more of these analysts ceases coverage of our company or fails to regularly publish reports on us, we could lose visibility in the financial markets, which could cause our share price or trading volume to decline.

We do not intend to pay dividends for the foreseeable future and, consequently, your ability to achieve a return on your investment will depend on appreciation in the price of our common stock.

We have never declared or paid any dividends on our common stock. We intend to retain any earnings to finance the operation and expansion of our business, and we do not anticipate paying any cash dividends in the future. As a result, you may only receive a return on your investment in our common stock if the market price of our common stock increases.

Our charter documents and Delaware law could discourage takeover attempts and lead to management entrenchment.

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Our amended and restated certificate of incorporation and amended and restated bylaws contain provisions that could delay or prevent a change in control of our company. These provisions could also make it difficult for stockholders to elect directors that are not nominated by the current members of our board of directors or take other corporate actions, including effecting changes in our management. These provisions include:

- the ability of our board of directors to issue shares of preferred stock and to determine the price and other terms of those shares, including preferences and voting rights, without stockholder approval, which could be used to significantly dilute the ownership of a hostile acquirer;
- the exclusive right of our board of directors to elect a director to fill a vacancy created by the expansion of our board of directors or the resignation, death or removal of a director, which prevents stockholders from being able to fill vacancies on our board of directors;
- a prohibition on stockholder action by written consent, which forces stockholder action to be taken at an annual or special meeting of our stockholders;
- the requirement that a special meeting of stockholders may be called only by the chairman of our board of directors, the chief executive officer, the president (in the absence of a chief executive officer) or a majority vote of our board of directors, which could delay the ability of our stockholders to force consideration of a proposal or to take action, including the removal of directors;
- the requirement for the affirmative vote of holders of at least 66-2/3% of the voting power of all of the then-outstanding shares of the voting stock, voting together as a single class, to amend the provisions of our amended and restated certificate of incorporation relating to the management of our business or our amended and restated bylaws, which may inhibit the ability of an acquirer to effect such amendments to facilitate an unsolicited takeover attempt;
- the ability of our board of directors, by majority vote, to amend our amended and restated bylaws, which may allow our board of directors to take additional actions to prevent an unsolicited takeover and inhibit the ability of an acquirer to amend our amended and restated bylaws to facilitate an unsolicited takeover attempt; and
- advance notice procedures with which stockholders must comply to nominate candidates to our board of directors or to propose matters to be acted upon at a stockholders' meeting, which may discourage or deter a potential acquirer from conducting a solicitation of proxies to elect the acquirer's own slate of directors or otherwise attempting to obtain control of us.

In addition, as a Delaware corporation, we are subject to Section 203 of the Delaware General Corporation Law. These provisions may prohibit large stockholders, in particular those owning 15% or more of our outstanding voting stock, from merging or combining with us for a certain period of time.

If our stockholders fail to approve an increase in the number of authorized shares of our common stock at our next stockholders' meeting, we may not have a sufficient number of authorized but unissued shares of common stock to finance our operations and meet our other equity issuance requirements.

Our authorized capital stock consists of 47,000,000 shares of common stock, \$0.001 par value, and 3,000,000 shares of preferred stock, \$0.001 par value. As of February 28, 2019, there were 27,648,287 shares of common stock outstanding and no shares of preferred stock outstanding. In addition, we have reserved for future issuance 7,494,366 shares of common stock issuable upon the exercise of outstanding options and warrants and the vesting of outstanding restricted stock units, and for issuance or future grant pursuant to our equity incentive plan, leaving 11,857,347 shares available for other purposes, including future capital raises. We intend to seek approval of our stockholders to amend our certificate of incorporation to increase the total number of authorized shares of common stock at our next stockholders' meeting. If our stockholders do not approve the amendment, we may not have sufficient authorized but unissued shares of common stock for use in the ongoing operation of our business, including for financing future operations, employee benefit and incentive plans and employment arrangements, acquiring other businesses, forming strategic partnerships and alliances, and stock dividends, among other possible transactions. Our inability to issue these securities could have a material adverse effect on our business, results of operations or financial condition.

Risks Related to Government Regulation

Our failure to comply with U.S. laws and regulations relating to the export and import of goods, technology, and software could subject us to penalties and other sanctions and restrict our ability to license and develop our filter designs.

We are obligated by law to comply with all U.S. laws and regulations governing the export and import of goods, technology, and services, including the International Traffic in Arms Regulations, or ITAR, the Export Administration Regulations, or EAR, regulations administered by the Department of Treasury's Office of Foreign Assets Control, and

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regulations administered by the Bureau of Alcohol Tobacco Firearms and Explosives governing the importation of items on the U.S. Munitions Import List. Pursuant to these regulations, we are responsible for determining the proper licensing jurisdiction and export classification of our filter designs, and obtaining all necessary licenses or other approvals, if required, for exports and imports of technical data, and software, or for the provision of technical assistance or other defense services to or on behalf of foreign persons. We are also required to obtain export licenses, if required, before employing or otherwise utilizing foreign persons in the performance of our contracts if the foreign person will have access to export-controlled technical data or software. The violation of any of the applicable laws and regulations could subject us to administrative, civil, and criminal penalties.

These regulations could restrict our ability to license existing filter designs and develop new designs. For example, as a result of ITAR requirements, we are unable to supply certain products to China satellite companies or end users, which comprise a significant part of the overall satellite market. Changes in our designs or changes in export and import regulations may create delays in the introduction of our designs in international markets, prevent our customers with international operations from deploying products incorporating our designs throughout their global systems or, in some cases, prevent the export or import of product including our designs to certain countries altogether. Any change in export or import regulations or related legislation, shift in approach to the enforcement or scope of existing regulations, or change in the countries, persons, or technologies targeted by such regulations, could result in decreased use of our designs by, or our ability to export or license our designs to, existing or potential customers with international operations and decreased revenue. Additionally, failure to comply with these laws could result in sanctions by the U.S. government, including substantial monetary penalties, denial of export privileges, and debarment from government contracts.

If we fail to comply with anti-bribery laws, including the U.S. Foreign Corrupt Practices Act, or FCPA, we could be subject to civil and/or criminal penalties.

As a result of our international operations, we may be subject to anti-bribery laws, including the FCPA, which prohibits companies from making improper payments to foreign officials for the purpose of obtaining or keeping business. If we fail to comply with these laws, the U.S. Department of Justice, the SEC, or other U.S. or foreign governmental authorities could seek civil and/or criminal sanctions, including monetary fines and penalties against us or our employees, as well as additional changes to our business practices and compliance programs, which could have a material adverse effect on our business, results of operations, or financial condition.

Developments stemming from changes in Government administrations, both foreign and domestic, could adversely affect our business.

Changes in Government administration could result in changes to political, regulatory and economic laws, policies and conditions that could severely and negatively impact our business. For example, the Trump administration negotiated a new North American trade pact to replace the North American Free Trade Agreement, withdrew the United States from the Trans-Pacific Partnership (TPP), and has imposed tariffs on goods imported into the United States, including from China, which has imposed retaliatory tariffs affecting certain products manufactured in the United States. Our customers are located around the world, and we expect that international sales will comprise a substantial portion of total sales in the future. In addition, we expect that products utilizing our designs will be produced, assembled and tested at third-party manufacturing facilities located primarily in Asia. Changes in U.S. political, regulatory and economic conditions or laws and policies governing U.S. tax laws, foreign trade, manufacturing, and development and investment in the countries where we or our customers operate could adversely affect our operating results and our business.

Changes in current laws or regulations or the imposition of new laws or regulations could impede the license of our designs or otherwise harm our business.

Wireless networks can only operate in the frequency bands, or spectrum, allowed by regulators and in accordance with rules governing how the spectrum can be used. The Federal Communications Commission, or the FCC, in the United States, as well as regulators in foreign countries, have broad jurisdiction over the allocation of frequency bands for wireless networks. We therefore will rely on the FCC and international regulators to provide sufficient spectrum and usage rules. For example, countries such as China, Japan or Korea heavily regulate all aspects of their wireless communication industries, and may restrict spectrum allocation or usage. If this were to occur, it would make it

difficult for us to license our designs for use in mobile devices in that region.

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ITEM 1B. UNRESOLVED STAFF COMMENTS

None.

ITEM 2. PROPERTIES

We maintain our principal office, totaling approximately 27,000 square feet of office and laboratory space, in Goleta, California under a lease that expires in August 2024 and provides us with one option to renew for an additional five years. We lease an additional 5,250 square feet of office space in Burlingame, California under a lease that expires in January 2022 and provides us with an option for an additional two years. This facility is used by members of our technical team resident in the San Francisco Bay area. We also lease space for our domestic and international operations in Austin, Texas, Neuchatel, Switzerland and Anyang, South Korea. We believe our current facilities are sufficient for our current operations, and that suitable additional space will be available to accommodate our anticipated growth.

ITEM 3. LEGAL PROCEEDINGS

We are not party to any legal proceedings. We may, from time to time, be party to litigation and subject to claims incident to the ordinary course of business. As our growth continues, we may become party to an increasing number of litigation matters and claims. The outcome of litigation and claims cannot be predicted with certainty, and the resolution of any future matters could materially affect our future financial position, results of operations or cash flows.

ITEM 4. MINE SAFETY DISCLOSURES

Not applicable.

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PART II

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

Market Information for Common Stock

Our common stock is listed on the NASDAQ Capital Market under the symbol "RESN".

Holders of Record

As of December 31, 2018, we had 45 holders of record of our common stock. The actual number of stockholders is greater than this number of record holders and includes stockholders who are beneficial owners but whose shares are held in street name by brokers and other nominees.

Dividend Policy

We have never declared or paid cash dividends on our common stock. We currently intend to retain all available funds and any future earnings for use in the operation of our business and do not anticipate paying any dividends on our common stock in the foreseeable future, if at all. Any future determination to declare dividends will be made at the discretion of our board of directors and will depend on our financial condition, results of operations, capital requirements, general business conditions and other factors that our board of directors may deem relevant.

Purchases of Equity Securities by the Issuer and Affiliated Purchasers

On November 26, 2018, we announced that our board of directors had authorized a program to repurchase up to \$4 million of our common stock over a 12-month period. Our stock repurchase program does not obligate us to acquire any specific number of shares. Under this program, shares may be repurchased in privately negotiated and/or open market transactions. All shares repurchased by us will be canceled and will become authorized but unissued shares of common stock.

Share repurchase activity during the three months ended December 31, 2018 is set forth in the following table. All shares for the periods presented were repurchased in open market transactions.

Period	Total Number of Shares Purchased	Average Price Paid Per Share	Total Number of Shares Purchased as Part of Publicly Announced Plans or Programs	Approximate Dollar Value of Shares that May Yet be Purchased Under the Plans or Programs
October 1, 2018 to October 31, 2018	N/A	N/A	N/A	N/A
November 1, 2018 to November 30, 2018	65,100	\$ 1.90	65,100	\$ 3,875,000
December 1, 2018 to December 31, 2018	15,000	1.78	15,000	3,848,000
Total	80,100	\$ 1.88	80,100	\$ 3,848,000

Recent Sale of Unregistered Securities

None.

Use of Proceeds

Not applicable.

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ITEM 6. SELECTED FINANCIAL DATA
Not applicable.

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

You should read the following discussion and analysis of our financial condition and results of operations in conjunction with the consolidated financial statements and the related notes to the consolidated financial statements included later in this Annual Report on Form 10-K. In addition to historical financial information, the following discussion contains forward-looking statements that reflect our plans, estimates, beliefs and expectations that involve risks and uncertainties. Our actual results and the timing of events could differ materially from those discussed in these forward-looking statements. Factors that could cause or contribute to these differences include those discussed below and elsewhere in this Annual Report on Form 10-K, particularly in "Risk Factors" and "Special Note Regarding Forward-Looking Statements."

Overview

We are a late-stage development company that designs filters for the mobile device industry. We have not yet realized material revenues and our focus is on continuing to engage new customers, expand the number of contracts for filter designs and build the necessary infrastructure to support anticipated growth. Consequently, our expenses will continue to increase.

We plan to expand our IP libraries and further the development of our ISN[®] platform. While we remain a filter design licensing company, we are also investigating the potential of licensing part or all of our ISN[®] software design suite to potential customers in the RFFE industry. However, we intend to retain ownership of our technology, software, designs and related improvements. Our goal is to establish and leverage alliances with new and existing customers, who will help grow the market for our designs by integrating them with their own proprietary technology and products, or by using our software products for their own designs, thus combining their own particular strengths with ours to provide an extensive array of solutions.

Our costs include employee salaries and benefits, compensation paid to consultants, capital costs for research and other equipment, costs associated with development activities including travel and administration, legal expenses, sales and marketing costs, general and administration expenses, and other costs associated with a late-stage development, publicly-traded technology company. We continue to add employees to support the development of our ISN[®] platform, applications and system test, research and development, as well as sales, marketing and administration functions, to support our efforts.

The amounts that we actually spend for any specific purpose may vary significantly and will depend on a number of factors including, but not limited to, our expected cash resources, the pace of progress of our commercialization and development efforts, actual needs with respect to product testing, research and development, market conditions, and changes in or revisions to our marketing strategies. In addition, we may invest in complementary products, technologies or businesses.

Results of Operations

Comparison of the Years Ended December 31, 2017 and 2018

Revenues. Revenues consist of the recognized portion of amounts received from customers for the development of our filter designs, milestone payments based on the achievement of specific milestones and royalties from shipments of our licensed designs. The revenues related to upfront payments associated with our filter design development contracts are recognized ratably over the estimated development period associated with that upfront payment. As of January 1, 2018, we adopted Financial Accounting Standards Board, or FASB, Accounting Standards Codification, or ASC, Topic 606, Revenues from Contracts with Customers, which requires a change in the method of recognizing revenue from contracts with customers. We recorded an adjustment to accumulated deficit for the cumulative effect as of the date of adoption. For the year ended December 31, 2018, under the new guidance, revenues consisted of the recognized portion of the transaction price associated with our contracts from customers recognized over time as the obligations under the terms of the contract are satisfied. Generally, the transaction price includes both upfront and milestone payments that we expect to receive in exchange for providing services. Additionally, we recognized royalty revenue related to sales by our customers of our licensed designs. For the years ended December 31, 2017 and 2018, we recognized \$653,000 and \$524,000, respectively, of revenue. The adoption of ASC Topic 606 negatively impacted

our revenue by \$71,000 for the year ended December 31, 2018. Under the guidance in effect for 2017, our revenue would have been \$595,000 for the year ended December 31, 2018. We have recorded \$271,000 of deferred revenue as of December 31, 2018, which we expect to recognize over the next year. Additionally, we expect to continue to recognize royalty revenue from our license agreements.

Research and Development. These expenses relate to direct engineering and other costs associated with the development and commercialization of our technology, including the development of filter designs for our customers and consist primarily of the compensation costs of employees and consultants, including stock-based compensation, and to a lesser extent development related costs for equipment, software and supplies. We also include the costs for our intellectual property development program under research and development. This program focuses on patent strategy and invention extraction.

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Research and development expenses increased \$4.3 million from \$10.0 million in 2017 to \$14.3 million in 2018. The increase was primarily related to higher compensation expense of \$2.9 million associated with increased headcount, as well as higher development costs of \$570,000 related to our ISN[®] software development and expanded activity on our filter designs under development. During the year ended December 31, 2018, we expanded our research and development employees from 37 at the beginning of the year to 46 at the end of the year. We anticipate that our research and development expenses may continue to increase as a result of anticipated growth.

Sales, Marketing and Administration Expenses. These expenses relate to our sales and marketing efforts and our back-office support and include compensation costs of employees and consultants, including stock-based compensation. They also include expenses for facilities, travel expenses, telecommunications, investor relations, insurance and professional fees.

Sales, marketing and administration expenses increased \$1.9 million, from \$9.6 million in 2017 to \$11.5 million in 2018. The increase included \$2.3 million of increased compensation expense associated with increased headcount and consultants, offset by lower senior transition costs of \$400,000 incurred in 2017. During the year ended December 31, 2018, we expanded our sales, marketing and administration employees from 12 at the beginning of the year to 21 at the end of the year. We anticipate that our sales, marketing and administration expenses may continue to increase as a result of anticipated growth.

Interest and Investment Income. Interest and investment income increased by \$414,000 from \$67,000 in 2017 to \$481,000 in 2018 primarily due to increased cash and investment balances. We expect interest income to fluctuate in proportion to our cash and investment balances.

Warrant Inducement Expense. In December 2017 we entered into warrant exercise agreements with certain holders of common stock purchase warrants in order to induce the holders to exercise their warrants in full and we paid the warrant holders an inducement fee. The inducement offer was considered a modification to the warrant and we were required to remeasure the fair value of the warrants immediately prior to, and after, the modification. The change in fair value due to modification totaled \$4.3 million, and when combined with the cash inducement of \$7.0 million paid to the warrant holders, resulted in \$2.7 million of warrant inducement expense. There was no expense for the year ended December 31, 2018 as there were no such agreements during the year.

Income Taxes. We have earned minimal revenues and are currently operating at a loss. In addition to minimum taxes in the states where we conduct business, we are also responsible for income taxes in Switzerland related to the earnings of our foreign subsidiary, GVR. The provision for (benefit from) income taxes primarily represents the net change in deferred income taxes of GVR.

Liquidity and Capital Resources

Financing Activities

We have earned minimal revenues since inception. Our operations have been funded with initial capital contributions and proceeds from the sale of equity securities and debt.

As of December 31, 2018, we have raised aggregate gross proceeds of \$85.4 million through the use of loans, convertible debt and equity through an IPO, private placement financings and secondary offerings of our common stock.

We had current assets of \$21.8 million and current liabilities of \$3.3 million as of December 31, 2018, resulting in working capital of \$18.5 million. This compares to working capital of \$17.1 million as of December 31, 2017. The change in working capital is primarily the result of proceeds from the issuance of equity offset by the use of cash in our normal business operations.

Our consolidated financial statements account for the continuation of our business as a going concern. We are subject to the risks and uncertainties associated with a new business. Our principal sources of liquidity as of December 31, 2018 consist of existing cash, cash equivalents and investments totaling \$21.3 million. During the year ended December 31, 2018, we used \$19.6 million of cash and investments for operating activities, the purchase of property and equipment, and expenditures for patents. Due to these conditions, along with anticipated growth, substantial doubt exists as to our ability to continue as a going concern. After evaluation of these conditions, we believe our current resources will provide sufficient funding for planned operations into the second half of 2019. If necessary, we will

seek to raise additional capital from the sale of equity securities or the incurrence of indebtedness to allow us to continue operations. There can be no assurance that additional financing will be available to us on acceptable terms, or at all. Additionally, if we issue additional equity securities to raise funds, whether to existing investors or others, the ownership percentage of our existing stockholders would be reduced. New investors may demand rights, preferences or privileges senior to those of existing holders of common stock. Additionally, we may be li

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mitted as to the amount of funds we can raise pursuant to SEC rules and the continued listing requirements of NASDAQ. If we cannot raise needed funds, we might be forced to make substantial reductions in our operating expenses, which could adversely affect our ability to implement our business plan and ultimately our viability as a company. These consolidated financial statements do not include any adjustments relating to the recoverability and classification of recorded asset amounts or amounts and classification of liabilities that might result from this uncertainty.

We have a Form S-3 universal shelf registration statement on file with the SEC. The universal shelf registration statement on Form S-3 permits us to sell, in one or more public offerings, shares of our common stock, shares of preferred stock or debt securities, or any combination of such securities and warrants to purchase securities, for proceeds in an aggregate amount of up to \$50.0 million, subject to potential limitations on the amount of securities we may sell in any twelve-month period. The Form S-3 will expire in November 2021. No securities have been issued pursuant to the registration statement.

Cash Flow Analysis

Operating activities used cash of \$14.5 million in 2017 and \$18.1 million in 2018. The increase is primarily the result of our increased loss.

Investing activities provided cash of \$3.6 million in 2017 and used cash of \$18.2 million in 2018. In 2017, the cash provided was a result of the redemptions of investments held to maturity, offset by the cash used to purchase property and equipment and expenditures for patents. In 2018, the cash used was a result of the purchase of investments held to maturity in excess of redemptions of investments held to maturity and cash used to purchase property and equipment and expenditures for patents.

Financing activities provided cash of \$25.3 million in 2017 and \$21.3 million in 2018. The cash provided in 2017 was the result of net proceeds from the sale of equity securities in our private placement financings completed in February 2017 and September 2017, and net proceeds from the exercise of warrants for cash. The cash provided in 2018 was the result of net proceeds from the sale of equity securities in an underwritten public offering completed in March 2018 along with the underwriter overallotment option exercised in April 2018, partially offset by cash used for the repurchase of common stock under an authorized stock repurchase program.

Off-Balance Sheet Transactions

We do not have any off-balance sheet arrangements.

Contractual Obligations and Known Future Cash Requirements

Indemnification Agreements

In the ordinary course of business, we may enter into agreements of varying scope and terms pursuant to which we agree to indemnify customers, vendors, lessors, business partners and other parties with respect to certain matters, including, but not limited to, losses arising out of breach of such agreements, services to be provided by us or from intellectual property infringement claims made by third parties. In addition, we have entered into indemnification agreements with directors and certain officers and employees that will require us, among other things, to indemnify them against certain liabilities that may arise by reason of their status or service as directors, officers or employees. No demands have been made upon us to provide indemnification under such agreements and there are no claims that we are aware of that could have a material effect on our consolidated balance sheets, consolidated statements of comprehensive loss, consolidated statements of stockholders' equity or consolidated statements of cash flows.

Purchasing Commitments

We have non-cancelable purchasing commitments that we incur in the ordinary course of business. The purchase commitments covered by these agreements are for less than one year and aggregate to \$193,000 as December 31, 2018.

Operating Leases

We lease various office facilities, including our corporate headquarters in Goleta, California and our office in Burlingame, California, under operating lease agreements. The terms of the lease agreements provide for rental payments on a graduated basis. We recognize rent expense on a straight-line basis over the lease periods.

Commitments

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As of December 31, 2018, our principal commitments consisted of obligations under our purchasing commitments and the operating leases for our offices. The following table summarizes our future minimum payments under these arrangements as of December 31, 2018:

Contractual Obligations	Payments Due by Period				
	Total	Less Than 1 Year	1-3 Years	3-5 Years	More Than 5 Years
Purchasing commitments	\$ 193,000	\$ 193,000	\$—	\$—	\$—
Operating lease commitments	\$ 3,620,000	\$ 658,000	\$ 1,474,000	\$ 1,112,000	\$ 376,000

Critical Accounting Policies and Estimates

Our critical accounting estimates are included in our significant accounting policies as described in Note 2 of the consolidated financial statements included in Item 8, Financial Statements and Supplemental Data, of this Annual Report on Form 10-K. Those consolidated financial statements were prepared in accordance with accounting principles generally accepted in the United States of America. Critical accounting estimates are those that we believe are most important to the portrayal of our financial condition and results of operations. The preparation of our consolidated financial statements requires us to make estimates and judgments that affect the reported amounts of assets, liabilities, revenues and expenses. Our estimates are evaluated on an ongoing basis and are drawn from historical operations, current trends, future business plans and other factors that management believes are relevant at the time our consolidated financial statements are prepared. Actual results may differ from our estimates. Management believes that the following accounting estimates reflect the more significant judgments and estimates we use in preparing our consolidated financial statements.

Investments—Securities held-to-maturity: Investments are classified as held-to-maturity when we have the positive intent and ability to hold the securities to maturity. When the fair value of an investment instrument classified as held-to-maturity is less than its amortized cost, management assesses whether or not: (i) we have the intent to sell the instrument or (ii) it is more likely than not that we will be required to sell the instrument before its anticipated recovery. If either of these conditions is met, we recognize an other-than-temporary impairment for the difference between the instrument's amortized cost basis and its fair value, and include such amounts in other income (expense). We continually evaluate investments and record impairment expense if needed.

Revenue Recognition—As of January 1, 2018, we recognize revenue in accordance with Financial Accounting Standards Board, or FASB, Accounting Standards Codification, or ASC, Topic 606, Revenue from Contracts with Customers. Revenue is recognized upon the transfer of control of promised goods or services to the customers in an amount that reflects the consideration we expect to receive in exchange for those products or services. Under the new guidance we are required to use estimates to determine the transaction price in the contract as well as the time over which we will satisfy the performance obligations. The determination of the transaction price may include estimates of amounts we expect to receive, including milestones that we may achieve which would result in additional payments upon achievement. These estimates are used for recognition of our revenue primarily related to upfront non-refundable fees received in connection with filter design projects with customers. Our performance obligation is to design a licensable filter in accordance with customer specifications. We recognize revenue over the course of the estimated design development phase based on efforts expended to date. At the end of each reporting period, we reassess our measure of progress and adjust revenue when appropriate.

Stock-Based Compensation—We account for employee stock options in accordance with ASC Topic 718, Compensation-Stock Compensation. For stock options issued to employees and directors we use the Black-Scholes option valuation model for estimating fair value at the date of grant. For stock options issued for services rendered by non-employees, we recognize compensation expense in accordance with the requirements of ASC Topic 505-50, Equity, or ASC 505-50, as amended. Non-employee option grants that do not vest immediately upon grant are recorded as an expense over the vesting period. At the end of each financial reporting period prior to performance, the value of these options, as calculated using the Black-Scholes option valuation model, is determined, and compensation expense recognized or recovered during the period is adjusted accordingly. Since the fair market value of options granted to non-employees is subject to change in the future, the amount of the future compensation expense is subject

to adjustment until the common stock options are fully vested.

We account for restricted stock units issued to employees at fair value, based on the market price of our stock on the date of grant, net of estimated forfeitures. Compensation expense is recognized for the portion of the award that is ultimately expected to vest over the period during which the recipient renders the required services to the Company generally using the straight-line single option method. The fair value of non-employee restricted stock units awarded are remeasured as the awards

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vest, and the resulting increase or decrease in fair value, if any, is recognized as an increase or decrease to compensation expense in the period the related services are rendered.

Income Taxes—We account for income taxes in accordance with ASC Topic 740, Income Taxes, or ASC 740, which requires the recognition of deferred tax assets and liabilities for the future consequences of events that have been recognized in our consolidated financial statements or tax returns. The measurement of the deferred items is based on enacted tax laws. In the event the future consequences of differences between financial reporting bases and the tax bases of our assets and liabilities result in a deferred tax asset, ASC 740 requires an evaluation of the probability of being able to realize the future benefits indicated by such asset. A valuation allowance related to a deferred tax asset is recorded when it is more likely than not that some portion or the entire deferred tax asset will not be realized. As part of the process of preparing our consolidated financial statements, we are required to estimate our income tax expense in each of the jurisdictions in which we operate. We also assess temporary differences resulting from differing treatment of items for tax and accounting differences. We record a valuation allowance to reduce the deferred tax assets to the amount of future tax benefit that is more likely than not to be realized.

Recently Issued and Adopted Accounting Pronouncements

Recent accounting pronouncements are detailed in Note 2 of the consolidated financial statements included in Item 8, Financial Statements and Supplemental Data, of this Annual Report on Form 10-K.

ITEM 7A. QUANTITATIVE AND QUALITATIVE DISCLOSURES ABOUT MARKET RISK

Not applicable.

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ITEM 8. FINANCIAL STATEMENTS AND SUPPLEMENTAL DATA

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REPORT OF INDEPENDENT REGISTERED PUBLIC ACCOUNTING FIRM

To the Stockholders and Board of Directors of Resonant Inc.
Goleta, California

Opinion on the Financial Statements

We have audited the accompanying consolidated balance sheets of Resonant Inc. (the "Company") as of December 31, 2018 and 2017, the related consolidated statements of comprehensive loss, stockholders' equity, and cash flows for the years then ended, and the related notes (collectively referred to as the "financial statements"). In our opinion, the financial statements present fairly, in all material respects, the financial position of the Company as of December 31, 2018 and 2017, and the results of its operations and its cash flows for the years then ended in conformity with accounting principles generally accepted in the United States of America.

Explanatory Paragraph - Going Concern

The accompanying financial statements have been prepared assuming that the Company will continue as a going concern. As discussed in Note 1 to the financial statements, the Company has earned minimal revenue since inception through December 31, 2018 and has incurred significant losses from operations since inception. In addition, the Company's operations have been funded with initial capital contributions and proceeds from the sale of equity securities and debt. These events and conditions raise substantial doubt about the Company's ability to continue as a going concern. Management's plans in regard to these matters are also described in Note 1. The financial statements do not include any adjustments that might result from the outcome of this uncertainty.

Basis for Opinion

These financial statements are the responsibility of the Company's management. Our responsibility is to express an opinion on the Company's financial statements based on our audits. We are a public accounting firm registered with the Public Company Accounting Oversight Board (United States) ("PCAOB") and are required to be independent with respect to the Company in accordance with the U.S. federal securities laws and the applicable rules and regulations of the Securities and Exchange Commission and the PCAOB.

We conducted our audits in accordance with the standards of the PCAOB. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement, whether due to error or fraud. The Company is not required to have, nor were we engaged to perform, an audit of its internal control over financial reporting. As part of our audits we are required to obtain an understanding of internal control over financial reporting but not for the purpose of expressing an opinion on the effectiveness of the Company's internal control over financial reporting. Accordingly, we express no such opinion.

Our audits included performing procedures to assess the risks of material misstatement of the financial statements, whether due to error or fraud, and performing procedures that respond to those risks. Such procedures included examining, on a test basis, evidence regarding the amounts and disclosures in the financial statements. Our audits also included evaluating the accounting principles used and significant estimates made by management, as well as evaluating the overall presentation of the financial statements. We believe that our audits provide a reasonable basis for our opinion.

/s/ Crowe LLP

We have served as the Company's auditor since 2015.
Sherman Oaks, California
March 14, 2019

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RESONANT INC.

Consolidated Balance Sheets

	December 31, 2017	December 31, 2018
ASSETS		
CURRENT ASSETS		
Cash and cash equivalents	\$ 19,524,000	\$ 4,394,000
Investments held-to-maturity	—	16,863,000
Accounts receivable	50,000	165,000
Prepaid expenses and other current assets	536,000	364,000
Restricted cash	100,000	—
TOTAL CURRENT ASSETS	20,210,000	21,786,000
PROPERTY AND EQUIPMENT		
Property and equipment	3,212,000	3,784,000
Less: Accumulated depreciation and amortization	(1,858,000)	(1,797,000)
PROPERTY AND EQUIPMENT, NET	1,354,000	1,987,000
NONCURRENT ASSETS		
Intangible assets, net	1,353,000	1,374,000
Restricted cash	—	211,000
Goodwill	824,000	817,000
Other assets	19,000	69,000
TOTAL NONCURRENT ASSETS	2,196,000	2,471,000
TOTAL ASSETS	\$ 23,760,000	\$ 26,244,000
LIABILITIES AND STOCKHOLDERS' EQUITY		
CURRENT LIABILITIES		
Accounts payable	\$ 708,000	\$ 695,000
Accrued expenses	314,000	464,000
Accrued salaries and payroll related expenses	1,936,000	1,835,000
Deferred revenue	143,000	271,000
TOTAL CURRENT LIABILITIES	3,101,000	3,265,000
LONG-TERM LIABILITIES		
Deferred rent	10,000	81,000
Deferred income taxes	1,000	—
TOTAL LIABILITIES	3,112,000	3,346,000
Commitments and contingencies (Note 10)		
STOCKHOLDERS' EQUITY		
Common stock, \$0.001 par value, 47,000,000 authorized and 19,511,276 outstanding as of December 31, 2017 and 27,391,290 outstanding as of December 31, 2018	20,000	27,000
Preferred stock, \$0.001 par value, 3,000,000 shares authorized and none outstanding as of December 31, 2017 and December 31, 2018	—	—
Additional paid-in capital	88,447,000	115,450,000
Accumulated other comprehensive loss	(7,000)	(15,000)
Accumulated deficit	(67,812,000)	(92,564,000)
TOTAL STOCKHOLDERS' EQUITY	20,648,000	22,898,000
TOTAL LIABILITIES AND STOCKHOLDERS' EQUITY	\$ 23,760,000	\$ 26,244,000
See Notes to Consolidated Financial Statements		

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RESONANT INC.

Consolidated Statements of Comprehensive Loss

	Year Ended December 31, 2017	Year Ended December 31, 2018
REVENUES	\$653,000	\$524,000
OPERATING EXPENSES		
Research and development	10,045,000	14,271,000
Sales, marketing and administration	9,644,000	11,546,000
TOTAL OPERATING EXPENSES	19,689,000	25,817,000
NET OPERATING LOSS	(19,036,000)	(25,293,000)
OTHER INCOME (EXPENSE)		
Interest and investment income	67,000	481,000
Warrant inducement expense	(2,688,000)	—
Other expense	(10,000)	(3,000)
TOTAL OTHER INCOME (EXPENSE)	(2,631,000)	478,000
LOSS BEFORE INCOME TAXES	(21,667,000)	(24,815,000)
Provision for (benefit from) income taxes	(14,000)	1,000
NET LOSS	\$(21,653,000)	\$(24,816,000)
Foreign currency translation adjustment, net of tax	\$44,000	\$(8,000)
COMPREHENSIVE LOSS	\$(21,609,000)	\$(24,824,000)
NET LOSS PER SHARE - BASIC AND DILUTED	\$(1.44)	\$(0.98)
Weighted average shares outstanding — basic and diluted	5,015,446	25,290,426

See Notes to Consolidated Financial Statements

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RESONANT INC.

Consolidated Statements of Stockholders' Equity

	Common Stock		Additional Paid-in Capital	Accumulated Deficit	Accumulated Other Comprehensive Loss	Total Stockholders' Equity
	Shares	Amount				
Balance, January 1, 2017	12,468,647	\$12,000	\$56,331,000	\$(46,159,000)	(51,000)	\$10,133,000
Vesting of restricted stock units	649,359	1,000	(1,000)	—	—	—
Stock-based compensation	—	—	4,136,000	—	—	4,136,000
Sale of common stock, net of offering costs	3,603,817	4,000	15,946,000	—	—	15,950,000
Exercises of warrants, cashless	147,847	—	—	—	—	—
Exercises of warrants	2,608,678	3,000	11,957,000	—	—	11,960,000
Exercises of stock options, cashless	3,758	—	—	—	—	—
Exercises of stock options	29,170	—	78,000	—	—	78,000
Net loss	—	—	—	(21,653,000)	—	(21,653,000)
Foreign currency translation adjustment, net of tax	—	—	—	—	44,000	44,000
Balance, December 31, 2017	19,511,276	20,000	88,447,000	(67,812,000)	(7,000)	20,648,000
Cumulative effect due to adoption of new accounting standard, net of tax	—	—	—	64,000	—	64,000
Vesting of restricted stock units	1,051,939	1,000	—	—	—	1,000
Stock-based compensation	—	—	5,698,000	—	—	5,698,000
Sale of common stock, net of offering costs	6,571,428	6,000	21,183,000	—	—	21,189,000
Exercises of warrants	89,142	—	260,000	—	—	260,000
Common stock issued in exchange for warrants	242,913	—	—	—	—	—
Exercises of stock options	4,692	—	14,000	—	—	14,000
Repurchase and retirement of common stock	(80,100)	—	(152,000)	—	—	(152,000)
Net loss	—	—	—	(24,816,000)	—	(24,816,000)
Foreign currency translation adjustment, net of tax	—	—	—	—	(8,000)	(8,000)
Balance, December 31, 2018	27,391,290	\$27,000	\$115,450,000	\$(92,564,000)	\$(15,000)	\$22,898,000

See Notes to Consolidated Financial Statements

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RESONANT INC.

Consolidated Statements of Cash Flows

	Year Ended December 31, 2017	Year Ended December 31, 2018
CASH FLOWS FROM OPERATING ACTIVITIES		
Net loss	\$(21,653,000)	\$(24,816,000)
Adjustments to reconcile net loss to net cash used in operating activities:		
Depreciation and amortization	721,000	840,000
Stock-based compensation	4,121,000	5,262,000
Non-cash warrant inducement expense	2,688,000	—
Non-cash interest and investment income	—	(153,000)
Non-cash patent write-off	—	96,000
(Gain) loss on sale of property and equipment	2,000	(7,000)
Changes in assets and liabilities:		
Accounts receivable	6,000	(115,000)
Prepays and other current assets	(376,000)	239,000
Other assets	(3,000)	(50,000)
Deferred taxes	(14,000)	(1,000)
Accounts payable	(143,000)	107,000
Accrued expenses	163,000	(66,000)
Accrued salaries and payroll related expenses	208,000	334,000
Deferred revenue	(184,000)	128,000
Deferred rent	(10,000)	71,000
Net cash used in operating activities	(14,474,000)	(18,131,000)
CASH FLOWS FROM INVESTING ACTIVITIES		
Proceeds from sale of property and equipment	7,000	16,000
Purchases of property and equipment	(815,000)	(1,285,000)
Expenditures for patents and domain names	(332,000)	(219,000)
Redemptions of investments held-to-maturity	4,747,000	39,590,000
Purchases of investments held-to-maturity	—	(56,300,000)
Net cash provided by (used in) investing activities	3,607,000	(18,198,000)
CASH FLOWS FROM FINANCING ACTIVITIES		
Net proceeds from the sale of common stock from private placement offerings	15,950,000	—
Net proceeds from the sale of common stock from underwritten public offering	—	21,190,000
Acquisition of common stock under Repurchase Program	—	(152,000)
Proceeds from exercises of warrants	9,272,000	260,000
Proceeds from exercises of stock options	78,000	14,000
Net cash provided by financing activities	25,300,000	21,312,000
Effects of currency translation on cash, cash equivalents and restricted cash	7,000	(2,000)
NET INCREASE IN CASH, CASH EQUIVALENTS AND RESTRICTED CASH	14,440,000	(15,019,000)
CASH, CASH EQUIVALENTS AND RESTRICTED CASH — Beginning of year	5,184,000	19,624,000
CASH, CASH EQUIVALENTS AND RESTRICTED CASH — End of year	\$ 19,624,000	\$ 4,605,000
SUPPLEMENTAL DISCLOSURE OF CASH FLOW INFORMATION		
Cash paid for taxes	\$ 1,000	\$ 3,000
SUPPLEMENTAL DISCLOSURE OF NON-CASH ACTIVITIES		
Common stock issued in settlement of accrued salaries and payroll related expenses	\$ 119,000	\$ 436,000
Stock options issued in settlement of liability	\$ 332,000	\$ —

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Property and equipment included in accounts payable	\$245,000	\$95,000
Property and equipment included in accrued liabilities	\$95,000	\$305,000
Patents included in accounts payable	\$9,000	\$39,000
Patents included in accrued liabilities	\$—	\$6,000

The following table provides a reconciliation of cash, cash equivalents and restricted cash reported within the Consolidated Balance Sheets to the total of the same such amounts shown above:

	December 31,	
	2017	2018
Cash and cash equivalents	\$19,524,000	\$4,394,000
Restricted cash	100,000	211,000
Total cash, cash equivalents and restricted cash	\$19,624,000	\$4,605,000

See Notes to Consolidated Financial Statements

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RESONANT INC.

Notes to Consolidated Financial Statements

NOTE 1—ORGANIZATION AND DESCRIPTION OF BUSINESS

Overview

Resonant Inc. is a late-stage development company located in Goleta, California. We were incorporated in Delaware in January 2012 as a wholly owned subsidiary of Superconductor Technologies Inc., or STI. Resonant LLC, a limited liability company, was formed in California in May 2012. We changed our form of ownership from a limited liability company to a corporation in an exchange transaction in June 2013, when we commenced business. We are the successor of Resonant LLC. We completed our initial public offering, or IPO, on May 29, 2014. On July 6, 2016 we acquired all of the issued and outstanding capital stock of GVR Trade S.A, or GVR. GVR is a wholly owned subsidiary of Resonant Inc.

We have created an innovative software, intellectual property, or IP, and services platform that has the ability to increase designer efficiency, reduce the time to market and lower unit costs in the designs of filters for radio frequency, or RF, front-ends for the mobile device industry. The RF front-end, or RFFE, is the circuitry in a mobile device responsible for analog signal processing and is located between the device's antenna and its digital circuitry. The software platform we continue to develop is based on fundamentally new technology that we call Infinite Synthesized Networks®, or ISN®, to configure and connect resonators, the building blocks of RF filters. Filters are a critical component of the RF front-end used to select desired radio frequency signals and reject unwanted signals. We believe licensing our designs is the most direct and effective means of validating our ISN® platform and related IP libraries. Our target customers make part or all of the RFFE. We intend to retain ownership of our designs, and we expect to be compensated through license fees and royalties based on sales of RFFE filters that incorporate our designs.

Capital Resources and Liquidity

We are using the net proceeds from the sale of our common stock for product development to commercialize our technology, research and development, the development of our patent strategy and expansion of our patent portfolio, as well as for working capital and other general corporate purposes.

We have earned minimal revenues since inception, and our operations have been funded with initial capital contributions and proceeds from the sale of equity securities and debt. At December 31, 2017 and December 31, 2018, we had incurred accumulated losses totaling \$67.8 million and \$92.6 million, respectively. The losses are primarily the result of research and development costs associated with commercializing our technology, combined with start-up, financing and public company costs. We expect to continue to incur substantial costs as we continue to engage customers, increase the number of devices under design and build the infrastructure to support our anticipated growth.

Our consolidated financial statements account for the continuation of our business as a going concern. We are subject to the risks and uncertainties associated with a new business. Our principal sources of liquidity as of December 31, 2018 consist of existing cash, cash equivalents and investments totaling \$21.3 million. During the year ended December 31, 2018, we used \$19.6 million of cash and investments for operating activities, the purchase of property and equipment, and expenditures for patents. Due to these conditions, along with anticipated growth, substantial doubt exists as to our ability to continue as a going concern. After evaluation of these conditions, we believe our current resources, in the absence of material revenues, will provide sufficient funding for planned operations into the second half of 2019. If necessary, we will seek to raise additional capital from the sale of equity securities or the incurrence of indebtedness to allow us to continue operations. There can be no assurance that additional financing will be available to us on acceptable terms, or at all. Additionally, if we issue additional equity securities to raise funds, whether to existing investors or others, the ownership percentage of our existing stockholders would be reduced. New investors may demand rights, preferences or privileges senior to those of existing holders of common stock. Additionally, we may be limited as to the amount of funds we can raise pursuant to SEC rules and the continued listing requirements of NASDAQ. If we cannot raise needed funds, we might be forced to make substantial reductions in our operating expenses, which could adversely affect our ability to implement our business plan and ultimately our viability as a

company. These consolidated financial statements do not include any adjustments relating to the recoverability and classification of recorded asset amounts or amounts and classification of liabilities that might result from this uncertainty.

We have a Form S-3 universal shelf registration statement on file with the SEC. The universal shelf registration statement on Form S-3 permits us to sell, in one or more public offerings, shares of our common stock, shares of preferred stock or debt securities, or any combination of such securities and warrants to purchase securities, for proceeds in an aggregate

amount of up to \$50.0 million, subject to potential limitations on the amount of securities we may sell in any twelve-month period. The Form S-3 will expire in November 2021. No securities have been issued pursuant to the registration statement.

NOTE 2—SUMMARY OF SIGNIFICANT ACCOUNTING POLICIES

Basis of Presentation and Use of Estimates—The accompanying financial statements have been prepared in accordance with accounting principles generally accepted in the United States, or U.S. GAAP. In the opinion of management, all adjustments (consisting of normal accruals) considered for a fair presentation have been included. Significant estimates made in preparing these financial statements include (a) assumptions to calculate the fair values of financial instruments, warrants and equity instruments and other liabilities and the deferred tax asset valuation allowance and (b) the useful lives for depreciable and amortizable assets. Actual results could differ from those estimates. In the opinion of management, all adjustments, including normal recurring accruals considered necessary for a fair presentation, have been included.

Consolidation - The accompanying financial statements include the accounts of the Company and its wholly-owned subsidiary, GVR. All significant intercompany balances and transactions have been eliminated.

Cash and Cash Equivalents—We consider all liquid instruments purchased with a maturity of three months or less to be cash equivalents.

Concentration of Credit Risk—We maintain bank accounts at one U.S. financial institution. The U.S. bank accounts are insured by the Federal Deposit Insurance Corporation (FDIC) for up to \$250,000 per account owner. GVR, our wholly owned Swiss-based subsidiary maintains checking accounts at one major national financial institution. Additionally, we maintain a checking account with a very minimal balance at one bank in South Korea, which is used to fund payroll and rent in South Korea. Management believes we are not exposed to significant credit risk due to the financial position of the depository institutions in which our deposits are held.

Restricted Cash—Restricted cash at December 31, 2017 represented cash held within a certificate of deposit with a financial institution. The certificate of deposit served as collateral for our corporate credit card program, which was terminated in 2018. The restriction was lifted upon termination of the program. As of December 31, 2018 our restricted cash balance consists of a \$211,000 pledged mutual fund account which is held as collateral against a letter of credit issued in May 2018 in connection with the lease of our corporate headquarters. Effective January 1, 2018, we adopted ASU 2016-18, Statement of Cash Flows (Topic 230): Restricted Cash, which requires that the statement of cash flows explain the change during the period in the total of cash, cash equivalents, and amounts generally described as restricted cash or restricted cash equivalents. Consequently, restricted cash is included in the beginning and ending cash balances on the statement of cash flows. See also Note 10- Commitments and Contingencies, for further details.

Investments—**Securities held-to-maturity**: Management determines the appropriate classification of debt securities at the time of purchase and reevaluates such designation as of each balance sheet date. Investment/debt securities are classified as held-to-maturity when we have the positive intent and ability to hold the securities to maturity.

Held-to-maturity securities are stated at amortized cost, adjusted for amortization of premiums and accretion of discounts to maturity computed under the effective interest method. Such amortization is included in investment income. Interest on securities classified as held-to-maturity is included in interest and investment income.

When the fair value of an investment instrument classified as held-to-maturity is less than its amortized cost, management assesses whether or not: (i) we have the intent to sell the instrument or (ii) it is more likely than not that we will be required to sell the instrument before its anticipated recovery. If either of these conditions is met, we must recognize an other-than-temporary impairment for the difference between the instrument's amortized cost basis and its fair value, and include such amounts in other income (expense).

For investment instruments that do not meet the above criteria and are not expected to be recovered at the amortized cost basis, the instrument is considered other-than-temporarily impaired. For these instruments, we separate the total impairment into the credit loss component and the amount of the loss related to other factors. In order to determine the amount of the credit loss, we calculate the recovery value by performing a discounted cash flow analysis based on the current cash flows and future cash flows management expects to recover. The discount rate is the effective interest rate implicit in the underlying instrument. The amount of the total other-than-temporary impairment related to credit

loss is recognized in earnings and is included in other income (expense). The amount of the total other-than-temporary impairment related to other factors is recognized in other comprehensive income. For investment instruments that have other-than-temporary impairment recognized through earnings, if through subsequent evaluation there is a significant increase in the cash flow expected, the difference between the amortized cost basis and the cash flows expected to be collected is accreted as interest income.

Fair Value of Financial Instruments—We measure certain financial assets and liabilities at fair value based on the exchange price that would be received for an asset or paid to transfer a liability in the principal or most advantageous market for the asset or liability in an orderly transaction between market participants. The carrying amounts of our financial instruments, including cash equivalents, restricted cash, investments held-to-maturity, accounts payable, and accrued liabilities, approximate fair value due to their short maturities.

Accounts Receivable—Trade accounts receivable are stated net of allowances for doubtful accounts. Management estimates the allowance for doubtful accounts based on review and analysis of specific customer balances that may not be collectible, customer payment history and any other customer-specific information that may impact collectability of the receivable. Accounts are considered for write-off when they become past due and when it is determined that the probability of collection is remote. There was no allowance for doubtful accounts at December 31, 2017 and December 31, 2018.

Property and Equipment—Property and equipment consists of leasehold improvements associated with our corporate offices, software purchased during the normal course of business, equipment and office furniture and fixtures, all of which are recorded at cost. Depreciation and amortization is recorded using the straight-line method over the respective useful lives of the assets ranging from three to five years. Leasehold improvements are amortized over the shorter of lease term or useful life. Long-lived assets are reviewed for impairment whenever events or circumstances indicate that the carrying amount of these assets may not be recoverable.

Intangible Assets, net—Intangible assets are recorded at cost and amortized over the useful life. In the case of business combinations, intangible assets are recorded at fair value. At December 31, 2017 and December 31, 2018, intangible assets, net, includes patents, domain name and other intangibles purchased from GVR, including customer relationships, technology and trademark. Intangible assets are reviewed for impairment whenever events or circumstances indicate that the carrying amount of these assets may not be recoverable. In certain cases, patents may expire or be abandoned as we no longer plan to pursue them. In such cases we write off the capitalized patent costs as patent abandonment costs which are included in research and development expenses.

Goodwill—At December 31, 2017 and December 31, 2018, goodwill represents the difference between the price paid to acquire GVR and the fair value of the assets acquired, net of assumed liabilities. We review goodwill for impairment annually and whenever events or circumstances indicate that the carrying amount of these assets may not be recoverable.

Revenue Recognition—As of January 1, 2018, we recognize revenue in accordance with Financial Accounting Standards Board, or FASB, Accounting Standards Codification, or ASC, Topic 606, Revenue from Contracts with Customers.

Revenue is recognized upon the transfer of control of promised goods or services to the customers in an amount that reflects the consideration we expect to receive in exchange for those products or services. Revenue consists primarily of upfront non-refundable fees received in connection with filter design projects with customers and royalties. Our performance obligation is to design a licensable filter in accordance with customer specifications. The license of the completed design is considered part of this performance obligation as the design and licensing of the filter are highly interdependent. We recognize revenue over the course of the design development phase as our customers are able to benefit from our design services as they are provided, primarily by marketing the in-process design to their customers. We recognize revenue from our design services based on efforts expended to date. At the end of each reporting period, we reassess our measure of progress and adjust revenue when appropriate.

In most cases, upfront non-refundable payments are recognized over a period of 12 to 18 months. Contracts generally include upfront non-refundable fees, intended to support our initial engineering product development efforts, and may include milestone payments based upon the successful completion of certain deliverables. Milestone payments represent variable consideration, and we use the "most likely amount" approach to determine the amount we ultimately expect to receive. At contract inception, we assess the likelihood of achieving milestones to estimate the total consideration we believe we will receive for our services. Our design service contracts also include a functional license over the completed design, which enables our customer to use our design in products marketed to their customers. We also earn royalties for each product shipped by our customer that incorporates one of our designs.

Royalty fees are recorded upon shipment by our customer, and payment is generally due within 30 days.

We record the expenses related to these projects in the periods incurred and they are generally included in research and development expense.

Research and Development—Costs and expenses that can be clearly identified as research and development are charged to expense as incurred in accordance with ASC Topic 730-10, Research and Development.

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Operating Leases—We lease office space and research facilities under operating leases. Certain lease agreements contain free or escalating rent payment provisions. We recognize rent expense under such leases on a straight-line basis over the term of the lease. Lease renewal periods are considered on a lease-by-lease basis in determining the lease term.

Stock-Based Compensation—We account for employee stock options in accordance with ASC Topic 718, Compensation-Stock Compensation. For stock options issued to employees and directors we use the Black-Scholes option valuation model for estimating fair value at the date of grant. For stock options issued for services rendered by non-employees, we recognize compensation expense in accordance with the requirements of ASC Topic 505-50, Equity, or ASC 505-50, as amended. Non-employee option grants that do not vest immediately upon grant are recorded as an expense over the vesting period. At the end of each financial reporting period prior to performance, the value of these options, as calculated using the Black-Scholes option valuation model, is determined, and compensation expense recognized or recovered during the period is adjusted accordingly. Since the fair market value of options granted to non-employees is subject to change in the future, the amount of the future compensation expense is subject to adjustment until the common stock options are fully vested.

We account for restricted stock units issued to employees at fair value, based on the market price of our stock on the date of grant, net of estimated forfeitures. Compensation expense is recognized for the portion of the award that is ultimately expected to vest over the period during which the recipient renders the required services to the Company generally using the straight-line single option method. The fair value of non-employee restricted stock units awarded are remeasured as the awards vest, and the resulting increase or decrease in fair value, if any, is recognized as an increase or decrease to compensation expense in the period the related services are rendered.

In the case of award modifications, we account for the modification in accordance with ASU No.

2017-09, Compensation-Stock Compensation (Topic 718): Scope of Modification Accounting, whereby we recognize the effect of the modification in the period the award is modified.

Stock-based compensation expense is included in research and development expenses and sales, marketing and administration expenses.

Earnings Per Share, or EPS—EPS is computed in accordance with ASC Topic 260, Earnings per Share, and is calculated using the weighted average number of common shares outstanding during each period. Diluted EPS assumes the conversion, exercise or issuance of all potential common stock equivalents unless the effect is to reduce a loss or increase the income per share. Potential common shares consist of the incremental common shares issuable upon the exercise of stock options (using the treasury stock method), the exercise of warrants (using the if-converted method) and the vesting of restricted stock unit awards.

Income Taxes—We account for income taxes in accordance with ASC Topic 740, Income Taxes, or ASC 740, which requires the recognition of deferred tax assets and liabilities for the future consequences of events that have been recognized in our consolidated financial statements or tax returns. The measurement of the deferred items is based on enacted tax laws. In the event the future consequences of differences between financial reporting bases and the tax bases of our assets and liabilities result in a deferred tax asset, ASC 740 requires an evaluation of the probability of being able to realize the future benefits indicated by such asset. A valuation allowance related to a deferred tax asset is recorded when it is more likely than not that some portion or the entire deferred tax asset will not be realized. As part of the process of preparing our consolidated financial statements, we are required to estimate our income tax expense in each of the jurisdictions in which we operate. We also assess temporary differences resulting from differing treatment of items for tax and accounting differences. We record a valuation allowance to reduce the deferred tax assets to the amount of future tax benefit that is more likely than not to be realized. For the period when we were organized as a limited liability company, we were treated as a partnership for federal and state income tax purposes under the entity classification domestic default rules. As of December 31, 2017 and December 31, 2018, no liability for unrecognized tax benefits was required to be reported. We recognize interest and penalties related to income tax matters in income taxes, and there were none for the years ended December 31, 2017 and December 31, 2018, respectively.

We have filed, or are in the process of filing, tax returns that are subject to audit by the respective tax authorities.

Although the ultimate outcome is unknown, we believe that any adjustments that may result from tax return audits are not likely to have a material, adverse effect on our consolidated results of operations, financial position or cash flows.

Business Combinations—We record business combinations using the acquisition method of accounting and, accordingly, allocate the fair value of purchase consideration to the assets acquired and liabilities assumed based on their fair values at the acquisition date. The excess of the fair value of the purchase consideration over the fair value of the assets acquired and liabilities assumed is recorded as goodwill. The results of operations of the business acquired are included in our consolidated results of operations beginning on the date of acquisition.

Foreign Currency Translation—The Swiss Franc has been determined to be the functional currency for the net assets of our Swiss-based subsidiary. We translate the assets and liabilities to U.S. dollars at each reporting period using exchange rates in effect at the balance sheet date and record the effects of the foreign currency translation in accumulated other comprehensive income (loss) in shareholders' equity. We translate the income and expenses to U.S. dollars at each reporting period using the average exchange rate in effect for the period and record the effects of the foreign currency translation as other comprehensive income (loss) in the consolidated statements of comprehensive loss. Gains and losses resulting from foreign currency transactions are included in net loss in the consolidated statements of comprehensive loss.

Recent Accounting Pronouncements

Leases—In February 2016, the FASB issued ASU No. 2016-02, Leases (Topic 842), a comprehensive new leases standard that amends various aspects of existing accounting guidance for leases. It will require recognizing lease assets and lease liabilities on the balance sheet and disclosing key information about leasing arrangements. The main difference between previous U.S. GAAP and the amended standard is the recognition of lease assets and lease liabilities by lessees on the balance sheet for those leases classified as operating leases under previous U.S. GAAP. The accounting applied by a lessor is largely unchanged from that applied under previous U.S. GAAP. As a result, we will have to recognize a liability to make lease payments (the lease liability) and a right-of-use asset representing our right to use the underlying asset for the lease term on the balance sheet. In July 2018, the FASB issued ASU 2018-10, Codification Improvements to Topic 842, Leases, which provides clarity to certain narrow aspects of the new standard and ASU 2018-11, Leases (Topic 842): Targeted Improvements, which provides an optional transition method for adopting the new leases guidance that eliminates comparative period reporting under the new guidance in the year of adoption. The guidance is effective for fiscal years beginning after December 15, 2018, including interim periods within those fiscal years. Early adoption is permitted. We plan to adopt the standard, as well as the practical expedients included therein, utilizing the optional transition method as of January 1, 2019. Therefore, we will not restate comparative periods in our 2019 financial statements. We have reviewed our leases and other agreements in order to determine the effects of the new guidance on our consolidated financial statements. We have determined that we have two facility leases that meet the criteria for recognition of lease assets and lease liabilities on the balance sheet under the new guidance. We are not party to any leases for which we are the lessor. We believe the adoption will cause us to recognize approximately \$3.0 million in each, right-of-use assets and lease liabilities, in our consolidated financial statements.

Intangibles-Goodwill and Other—In January 2017, the FASB issued ASU No. 2017-04, Intangibles-Goodwill and Other (Topic 350): Simplifying the Test for Goodwill Impairment, which simplifies the accounting for goodwill impairments by eliminating step 2 from the goodwill impairment test. The amended guidance will become effective for us commencing in the first quarter of fiscal 2019. We plan to adopt the standard as of January 1, 2019 and we do not believe there will be any material impact to our consolidated financial statements.

Compensation-Stock Compensation—In June 2018, the FASB issued ASU No. 2018-07, Compensation-Stock Compensation (Topic 718): Improvements to Non-employee Share-Based Payment Accounting, which intends to align the accounting of share-based payment awards issued to employees and non-employees. This update will be effective for annual periods, and interim periods within those annual periods, beginning after December 15, 2018. Early adoption is permitted. We plan to adopt the standard as of January 1, 2019 and we do not believe there will be any material impact to our consolidated financial statements as we have very few share-based payment arrangements with non-employees.

NOTE 3—REVENUE RECOGNITION

On January 1, 2018, we adopted ASC Topic 606, Revenue from Contracts with Customers, and all of the related amendments and applied it to all contracts using the modified retrospective method. We recognized the cumulative effect of the initial adoption as an adjustment to the opening balance of retained earnings. Comparative financial

information has not been restated and continues to be reported under the accounting standards in effect for those periods.

The adoption of the guidance resulted in a change in the accounting for milestone payments. Previously, we recognized revenue upon the achievement of a milestone. Under ASC Topic 606, milestone payments are treated as variable consideration and included in the transaction price for our design services. The cumulative effect of the changes made to our consolidated balance sheet as of January 1, 2018 for the adoption of the new standard was as follows:

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BALANCE SHEET	Balance as of December 31, 2017	Adjustments Due to ASC 606	Balance as of January 1, 2018
ASSETS			
Prepaid expenses and other current assets	\$536,000	\$ 67,000	\$603,000
LIABILITIES AND STOCKHOLDERS' EQUITY			
Deferred revenue, current	\$143,000	\$ 3,000	\$146,000
Accumulated deficit	\$(67,812,000)	\$ 64,000	\$(67,748,000)

The following table summarizes the impact of the adoption on our Consolidated Balance Sheet and Consolidated Statement of Comprehensive Loss as of and for the year ended December 31, 2018:

BALANCE SHEET	As of December 31, 2018		
	As Reported	Balances Without Adoption of ASC 606	Effect of Change Increase/(Decrease)
ASSETS			
Prepaid expenses and other current assets	\$364,000	\$364,000	\$ —
LIABILITIES AND STOCKHOLDERS' EQUITY			
Deferred revenue, current	\$271,000	\$264,000	\$ 7,000
Accumulated deficit	\$(92,564,000)	\$(92,557,000)	\$ (7,000)

STATEMENT OF COMPREHENSIVE LOSS	Year Ended December 31, 2018		
	As Reported	Activity Without Adoption of ASC 606	Effect of Change Increase/(Decrease)
Revenue	\$524,000	\$595,000	\$ (71,000)
Net loss	\$(24,816,000)	\$(24,745,000)	\$ 71,000

Our contracts with customers primarily relate to the design of filters for radio frequency, or RF, front-ends for the mobile device industry. Design service contracts generally include a modest upfront payment for the design services and a license over the completed design. We retain ownership of our designs, and therefore are also compensated for our design services through royalties based on sales of RFFE filters that incorporate our designs. We currently do not manufacture or sell any physical products or operate as a contract design company developing designs for a fee. Except for the royalty fees that are recognized as revenue upon use of one of our designs, we recognize revenue related to our design services over the estimated design development period, based on the level of effort expended, as the services are performed, which in most cases is 12 to 18 months but can vary depending upon the difficulty of the design.

Other Judgments and Assumptions - We apply the practical expedients available in ASC 606 to not disclose information about 1) remaining performance obligations that have original expected durations of one year or less and 2) variable consideration that is a sales-based or usage-based royalty.

Royalty Revenue - Upon completion of design services, our customers retain a license over the completed design. The license will typically last for a minimum of two years, and in many cases for the life of the design. Royalties are sales-based, and we recognize royalty revenue upon shipment, by our customer, of products that include our licensed design.

Contract Assets - Contract assets, other than accounts receivable, consist of unbilled revenue and generally arise when revenue is recognized on a contract whose transaction price includes an estimate of variable consideration from milestone payments. We do not have material amounts of contract assets as we have relatively few contracts, only modest design service fees and a small number of contracts containing milestone payments. Contract asset balances are included in Prepaid expenses and other current assets in our Consolidated Balance Sheet.

Contract Liabilities - Our contract liabilities consist of customer deposits and deferred revenue. We classify contract liabilities as current or noncurrent based on the timing of when we expect to recognize revenue. Generally, our contract liabilities are expected to be recognized in one year or less. Customer deposits and deferred revenue are separately stated in our Consolidated Balance Sheet.

Summary of changes in contract assets and liabilities for the period from January 1, 2018 to December 31, 2018:

Contract assets	
Contract assets, January 1, 2018	\$67,000
Contract assets at beginning of year transferred to accounts receivable	(43,000)
Reversal of contract assets due to changes in transaction price	(24,000)
Contract assets recorded on contracts during the period	36,000
Contract assets, December 31, 2018	\$36,000
Contract liabilities	
Contract liabilities, January 1, 2018	\$146,000
Recognition of revenue included in beginning of year contract liabilities	(138,000)
Contract liabilities, net of revenue recognized on contracts during the period	263,000
Contract liabilities, December 31, 2018	\$271,000

The following table presents our disaggregated revenue by geographic region and source:

	Year Ended	
	December 31,	
	2017	2018
Revenue by geographic region:		
United States	\$574,000	\$447,000
Switzerland	79,000	77,000
Total revenue	\$653,000	\$524,000
Revenue by source:		
Design services	\$613,000	\$365,000
Royalties	40,000	159,000
Total revenue	\$653,000	\$524,000

NOTE 4—INVESTMENTS HELD-TO-MATURITY

We classify investments as held-to-maturity when we have the positive intent and ability to hold the securities to maturity.

During 2017, we invested in commercial papers and certificates of deposit that were classified as investments held-to-maturity. As of December 31, 2017, all of our investments held-to-maturity had matured and we had no investments classified as held-to-maturity.

During 2018, we invested in U.S. Treasury bills, commercial papers and a certificate of deposit that were classified as investments held-to-maturity. As of December 31, 2018, both amortized cost value and fair value were \$16.9 million with zero unrealized gain or loss. U.S. Treasury bills totaling \$25.0 million matured in April 2018 and certain commercial papers totaling \$14.6 million matured during the year ended December 31, 2018. Remaining commercial papers totaling \$16.9 million mature in January 2019, and the certificate of deposit for \$100,000 matures in January 2019. We did not recognize an other-than-temporary impairment or a comprehensive gain or loss for the year ended December 31, 2018.

We recorded interest and investment income of \$67,000 and \$481,000 for the years ended December 31, 2017 and 2018, respectively, associated with our cash and investment accounts.

NOTE 5—PROPERTY AND EQUIPMENT, NET

Property and equipment, net, consists of the following:

	As of December 31, 2017	As of December 31, 2018
Cost:		
Computers, peripheral and scientific equipment	\$ 1,016,000	\$ 1,350,000
Software	1,367,000	1,749,000
Leasehold improvements	502,000	294,000
Office furniture and equipment	327,000	391,000
	3,212,000	3,784,000
Less: Accumulated depreciation and amortization	(1,858,000)	(1,797,000)
Property and equipment, net	\$ 1,354,000	\$ 1,987,000

Depreciation for the years ended December 31, 2017 and December 31, 2018 was \$595,000 and \$704,000, respectively. Cost basis of assets disposed for the years ended December 31, 2017 and December 31, 2018 was \$21,000 and \$773,000, respectively. The disposals in 2018 were primarily a result of relocating our corporate offices and writing off the fully amortized leasehold improvements related to our former office.

NOTE 6—INTANGIBLE ASSETS, NET, AND GOODWILL

Intangible assets include patents, domain name and other intangibles purchased from GVR, including customer relationships, technology and a trademark. Certain patents were acquired from STI as a result of an asset contribution and were recorded at their carryover basis. The fair value of the patents remained substantially the same as their carrying value at the exchange date. In addition, we acquired other patents and the domain name www.resonant.com through the normal course of business. Intangibles acquired as part of the purchase of GVR were initially recorded at their fair value. Issued patents are amortized over their approximate useful life of 17 years, or 20 years in the case of new patents, once they are approved by their respective regulatory agency. For the patents acquired from STI, we are amortizing them over the remaining useful life of 1 to 11 years as of December 31, 2018. The domain name is amortized over the approximate useful life of 10 years. The other intangibles acquired from GVR are amortized over their useful life of three to five years.

Intangible assets, net, consists of the following:

	As of December 31, 2017	As of December 31, 2018
Cost:		
Patents	\$ 1,349,000	\$ 1,507,000
Domain name	22,000	22,000
Client Base ⁽¹⁾	143,000	142,000
Trademark ⁽¹⁾	17,000	17,000
Backlog ⁽¹⁾	13,000	13,000
Technology	77,000	77,000
	1,621,000	1,778,000
Less: Accumulated amortization	(268,000)	(404,000)
Intangible assets, net	\$ 1,353,000	\$ 1,374,000

⁽¹⁾ Includes the impact of foreign currency translation. The total impact at December 31, 2017 was \$2,000 and the total impact at December 31, 2018 was \$1,000.

During the year ended December 31, 2017 and 2018, we wrote-off \$8,000 and \$96,000, respectively, of patents we are no longer pursuing. The write-offs are included in research and development expense. There were no impairments to any other intangibles.

Amortization of intangible assets was \$126,000 and \$136,000 for the years ended December 31, 2017 and 2018, respectively. The following table summarizes the estimated amortization expense relating to the intangible assets as of December 31, 2018:

Years ending December 31,	
2019	\$ 112,000
2020	85,000
2021	76,000
2022	65,000
2023	63,000
2024 and thereafter	466,000
Total amortization expense	\$ 867,000

Goodwill represents the excess of the purchase price over the fair value of the net assets acquired from GVR Trade.

Goodwill is not amortized, but is subject to impairment tests on at least an annual basis and whenever circumstances suggest that goodwill may be impaired.

The following table summarizes goodwill arising from the acquisition of GVR Trade:

	Goodwill
Balance at January 1, 2017	\$ 789,000
Effect of currency translation	35,000
Balance at December 31, 2017	\$ 824,000
Effect of currency translation	(7,000)
Balance at December 31, 2018	\$ 817,000

NOTE 7—WARRANTS

From time to time, we have issued warrants to purchase shares of common stock. These warrants have been issued in connection with financing transactions and for consulting services. Our warrants are subject to standard anti-dilution provisions applicable to shares of our common stock.

Bridge Warrants

In connection with and as an inducement to make the bridge loans in January and March 2013, Resonant LLC issued to each of our three founders 5-year warrants to purchase Class B units of Resonant LLC at an exercise price of \$0.40 per unit, which we refer to as the Bridge Warrants. The Bridge Warrants were issued in two tranches, at the same time the bridge loan was funded, with each founder receiving warrants for 20,833 Class B units on each of January 31, 2013 (for a total of 62,499 Class B units) and March 19, 2013 (for a total of 62,499 Class B units). The founders paid an aggregate of \$1,000 in cash for the Bridge Warrants.

On June 17, 2013, in connection with our acquisition of all of the outstanding membership interests of Resonant LLC in an exchange transaction, the founders exchanged their Bridge Warrants to purchase an aggregate of 124,998 Class B units of Resonant LLC for Bridge Warrants to purchase an aggregate of 249,999 shares of our common stock at an exercise price of \$0.20 per share. All other terms of the Bridge Warrants remained the same.

In January 2018, we entered into an agreement with our founders to exchange all of the warrants for an amount of shares that would equal the number of shares they would have received if exercised under a cashless exercise. The effect of exchanging the warrants for shares of our common stock was considered a modification of the award which required us to record expense for the excess of the fair value of the common stock issued over the fair value of the exchanged warrants. On the date of the exchange the fair value of the warrants was determined to be \$1.6 million and the fair value of the shares of

common stock issued were \$1.6 million. There was a difference in fair value of \$2,000 which was recorded to sales, marketing and administration expenses during the year ended December 31, 2018.

Consulting Warrant, Financing Warrant and Underwriting Warrant

Upon consummation of our Senior Convertible Note financing in June 2013, we issued warrants for business consulting services provided by MDB Capital Group, LLC, or MDB. We issued a 7-year warrant to purchase 222,222 shares of our common stock at an exercise price of \$0.01 per share, which we refer to as the Consulting Warrant. The Consulting Warrant is exercisable six months after the completion of our initial public offering, or IPO, in 2014 and expires June 17, 2020.

In addition, for placement agent services provided by MDB in connection with our Senior Convertible Note financing, we issued to MDB a 7-year warrant to purchase 208,763 shares of our common stock at an exercise price of \$3.35 per share, which we refer to as the Financing Warrant. The Financing Warrant is exercisable six months after the completion of our IPO and expires June 17, 2020.

In connection with the closing of our IPO, we also issued a third warrant to MDB related to their role as the sole underwriter for our IPO, which we refer to as the Underwriting Warrant. We issued them a 5-year warrant to purchase 310,500 shares of common stock at an exercise price of \$7.50 per share. The warrant was not exercisable until November 24, 2014 (180-days from the date of the underwriting agreement) and expires May 28, 2019.

Investor Relations Warrant

In August 2014 and October 2014, we entered into agreements with our investor relations firm, or IR Firm, and an IR consultant to provide us with investor relations services. Pursuant to the IR Firm agreement, in addition to monthly cash compensation, we issued to the IR Firm a 3-year consulting warrant, or IR Consulting Warrant, for the purchase of 42,000 shares of common stock that became fully vested on July 21, 2015. The IR Consulting Warrant had an exercise price of \$8.31 and expired, unexercised, on July 17, 2017.

Pursuant to our agreement with the IR consultant, in addition to monthly cash compensation, we issued to the IR consultant a 4-year consulting warrant, or IR Warrant, for the purchase of 6,000 shares of common stock that became fully vested on September of 2015. The IR Warrant had an exercise price of \$6.50 and expired on September 30, 2018.

There was no expense recorded for the years ended December 31, 2017 or 2018 related to the investor relations warrants as they had been fully expensed as of December 31, 2015.

Private Placement Warrants - 2016

In April 2016, we issued warrants to purchase 1,996,880 shares of our common stock at an exercise price of \$2.86 in connection with our private placement sale of 1,996,880 shares of common stock. The warrants are exercisable for a period

commencing October 2016 and expire on April 25, 2019. We also issued to the placement agents in the financing, warrants to purchase an aggregate of 99,844 shares of our common stock at an exercise price of \$2.86 for a period commencing 6 months and ending 36 months after the closing. We refer to these warrants as Private Placement Warrants - 2016. We estimated the fair value of the Private Placement Warrants - 2016 at \$2,500,000 using the Black-Scholes option valuation model with the following assumptions: market prices of the stock of \$2.90 per share, time to maturity of 3 years, volatility of 60%, zero expected dividend rate and risk free rate of 0.97%. The allocation of the fair value of these warrants was included in additional paid-in capital on the consolidated balance sheet.

In December 2017, we entered into Warrant Exercise Agreements with certain holders of Private Placement Warrants - 2016 to induce the exercise of 836,780 warrants in full. Pursuant to the agreements, the warrant holders exercised in full the warrants and purchased an aggregate of 836,780 shares of our common stock at an exercise price of \$2.86 per share, for an aggregate exercise price of approximately \$2.4 million and we paid the warrant holders aggregated inducement fees of approximately \$239,000, which resulted in net proceeds to us of \$2.2 million. The inducement offer included in the Warrant Exercise Agreements was considered a modification to the warrants upon acceptance by the warrant holders. Upon modification of the warrants we were required to remeasure the fair value of the warrants. We estimated the fair value of the Private Placement Warrants - 2016 immediately prior to modification at \$3.8

million using the Black-Scholes option valuation model with the following assumptions: market prices of the stock of \$6.96 to \$7.42 per share, time to maturity of 1.42 years, volatility of 60%, zero expected dividend rate and risk free rates of 1.70% to 1.74%. We estimated the fair value of the Private Placement Warrants - 2016 upon modification at \$3.9 million using the Black-Scholes option valuation model with the following assumptions: market prices of the stock of \$6.96 to \$7.42 per share, time to maturity of 1 day, volatility of 10%, zero expected dividend rate and risk free rates of 1.14% to 1.21%. The change in fair value was \$166,000, and when combined with the cash inducement of \$239,000, resulted in \$73,000 of expense, which was recorded as warrant inducement expense.

Underwriting Warrants - Public Offering 2016

In September 2016, we issued warrants to purchase 135,750 shares of our common stock at an exercise price of \$4.25 to the underwriter of our public offering of 2,715,000 shares of common stock. The warrants are exercisable for a 2 year period commencing September 9, 2017. We refer to these warrants as Underwriting Warrants - Public Offering 2016. We estimated the fair value of the Underwriting Warrants -Public Offering 2016 at \$475,000 using the Black-Scholes option valuation model with the following assumptions: market prices of the stock of \$6.54 per share, time to maturity of 3 years, volatility of 60%, zero expected dividend rate and risk free rate of 0.90%. The allocation of the fair value of these warrants was included in additional paid-in capital on the consolidated balance sheet.

Private Placement Warrants - February 2017

In February 2017, we issued warrants to purchase 1,626,898 shares of our common stock at an exercise price of \$8.25 in connection with our private placement sale of 1,626,898 shares of common stock. The warrants were exercisable for a period commencing 6 months and ending 30 months after the closing of the financing. We refer to these warrants as Private Placement Warrants - February 2017. We estimated the fair value of the Private Placement Warrants - February 2017 at \$2,084,000 using the Black-Scholes option valuation model with the following assumptions: market prices of the stock of \$4.91 per share, time to maturity of 3 years, volatility of 60%, zero expected dividend rate and risk free rate of 1.50%. The allocation of the fair value of these warrants was included in additional paid-in capital on the consolidated balance sheet.

On December 19, 2017, we entered into a Warrant Exercise Agreement with the holder of Private Placement Warrants - February 2017 to induce the exercise of the 1,626,898 warrants in full. Pursuant to the agreement, the warrant holder exercised in full the warrant and purchased 1,626,898 shares of our common stock at an exercise price of \$8.25 per share, for an aggregate exercise price of approximately \$13.4 million and we paid the warrant holder an inducement fee of approximately \$6.7 million, which resulted in net proceeds to us of \$6.7 million. The inducement offer included in the Warrant Exercise Agreement was considered a modification to the warrant upon acceptance by the warrant holder. Upon modification of the warrant we were required to remeasure the warrant. We estimated the fair value of the Private Placement Warrants - February 2017 immediately prior to modification at \$4.1 million using the Black-Scholes option valuation model with the following assumptions: market prices of the stock of \$8.18 per share, time to maturity of 1.67 years, volatility of 60%, zero expected dividend rate and risk free rate of 1.78%. We estimated the fair value of the Private Placement Warrants - February 2017 upon modification at \$6.7 million using the Black-Scholes option valuation model with the following assumptions: market prices of the stock of \$8.18 per share, time to maturity of 1 day, volatility of 10%, zero expected dividend rate and risk free rate of 1.25%. The change in fair value was \$4.1 million, and when combined with the cash inducement of \$6.7 million, resulted in \$2.6 million of expense, which was recorded as warrant inducement expense.

Private Placement Warrants - September 2017

In September and October 2017, we issued warrants to purchase an aggregate of 1,976,919 shares of our common stock at an exercise price of \$4.85 in connection with our private placement sale of 1,976,919 shares of common stock. The sale was completed in two tranches with the first tranche, which closed on September 28, 2017, including 1,745,581 warrants, and the second tranche, which closed on October 2, 2017, including 231,338 warrants. The warrants are exercisable for a period commencing 6 months after the closing of the financing and expire on September 28, 2020. Collectively, we refer to these warrants as Private Placement Warrants - September 2017. We estimated the total fair value of the Private Placement Warrants - September 2017 at \$3.6 million using the Black-Scholes option valuation model with the following assumptions: market prices of the stock of \$4.49 for the first tranche and \$4.69 per share for the second tranche, time to maturity of 3 years, volatility of 60%, zero expected dividend rate and risk free

rates of 1.59% for the first tranche and 1.63% for the second tranche. The allocation of the fair value of these warrants was included in additional paid-in capital on the consolidated balance sheet.

Placement Agent Warrants - 2017

In addition to the Private Placement Warrants - September 2017 issued in connection with our private placement sale of 1,976,919 shares of our common stock, we also issued to the placement agent, warrants to purchase a total of 98,846 shares of our common stock at an exercise price of \$4.85 per share. Upon closing of the first tranche on September 28, 2017, we issued 87,279 warrants, and upon closing the second tranche, we issued 11,567 warrants. The warrants are exercisable for a period commencing 6 months after the closing of the financing and expire on September 28, 2020. Collectively, we refer to these warrants as Placement Agent Warrants - 2017. We estimated the fair value of the Placement Agent Warrants - 2017 at \$174,000 using the Black-Scholes option valuation model with the following assumptions: market prices of the stock of \$4.49

per share for the first tranche and \$4.69 per share for the second tranche, time to maturity of 3 years, volatility of 60%, zero expected dividend rate and risk free rates of 1.59% for the first tranche and 1.63% for the second tranche. The allocation of the fair value of these warrants was included in additional paid-in capital on the consolidated balance sheet.

A roll-forward of warrant activity from January 1, 2017 to December 31, 2017 is shown in the following table:

	Issued and Outstanding Warrants as of January 1, 2017	Warrants Issued	Warrants Exercised/ Expired	Issued and Outstanding Warrants as of December 31, 2017
Bridge Warrants	249,999	—	—	249,999
Consulting Warrant	98,000	—	(85,777) ⁽¹⁾	12,223
Financing Warrant	78,186	—	(15,656) ⁽²⁾	62,530
Underwriting Warrant	310,500	—	—	310,500
IR Consulting Warrant	48,000	—	(42,000) ⁽³⁾	6,000
Private Placement Warrants - 2016	1,995,124	—	(1,104,061) ⁽⁴⁾	891,063
Underwriting Warrants - Public Offering 2016	135,750	—	(13,575) ⁽⁵⁾	122,175
Private Placement Warrants - February 2017	—	1,626,898	(1,626,898) ⁽⁶⁾	—
Private Placement Warrants - September 2017	—	1,976,919	—	1,976,919
Placement Agent Warrants - 2017	—	98,846	—	98,846
	2,915,559	3,702,663	(2,887,967)	3,730,255

(1) During the year ended December 31, 2017, there were 85,777 warrants that were exercised through cashless exercises, which netted 85,620 shares being issued.

(2) During the year ended December 31, 2017, there were 15,656 warrants that were exercised through cashless exercises, which netted 6,842 shares being issued.

(3) During the year ended December 31, 2017, 42,000 warrants expired.

(4) During the year ended December 31, 2017, there were 122,281 warrants that were exercised through cashless exercises, which netted 49,063 shares being issued. Additionally, there were 981,780 warrants that were exercised for cash, which included 836,780 warrants exercised subject to inducement, which offered the warrant holder an inducement fee of \$0.29/share to exercise the warrant in full for cash immediately.

(5) During the year ended December 31, 2017, there were 13,575 warrants that were exercised through cashless exercises, which netted 6,322 shares being issued.

(6) During the year ended December 31, 2017, there were 1,626,898 warrants that were exercised for cash. The warrants were exercised subject to inducement, which offered the warrant holder an inducement fee of \$4.13/share to exercise the warrant in full for cash immediately.

A roll-forward of warrant activity from January 1, 2018 to December 31, 2018 is shown in the following table:

	Exercise Price	Expiration Date	Issued and Outstanding Warrants as of January 1, 2018	Warrants Exercised/ Expired	Issued and Outstanding Warrants as of December 31, 2018
Bridge Warrants	NA	NA	249,999	(249,999) ⁽¹⁾	—
Consulting Warrant	\$0.01	6/17/2020	12,223	(5,556) ⁽²⁾	6,667
Financing Warrant	\$3.35	6/17/2020	62,530	—	62,530
Underwriting Warrant	\$7.50	5/28/2019	310,500	—	310,500
IR Consulting Warrant	NA	NA	6,000	(6,000) ⁽³⁾	—
Private Placement Warrants - 2016	\$2.86	4/25/2019	891,063	(73,000) ⁽⁴⁾	818,063
Underwriting Warrants - Public Offering 2016	\$4.25	9/9/2019	122,175	—	122,175
Private Placement Warrants - September 2017	\$4.85	9/28/2020	1,976,919	(10,600) ⁽⁵⁾	1,966,319
Placement Agent Warrants - 2017	\$4.85	9/28/2020	98,846	—	98,846
			3,730,255	(345,155)	3,385,100

- During the year ended December 31, 2018, there were 249,999 warrants that were exchanged for 242,913 shares of common stock in an exchange transaction where the warrant holders exchanged the warrants for the same number of shares they would have been entitled to in a cashless exercise.
- (1) During the year ended December 31, 2018, there were 5,556 warrants that were exercised through a cashless exercise, which netted 5,542 shares being issued.
- (2) During the year ended December 31, 2018, 6,000 warrants expired.
- (3) During the year ended December 31, 2018, there were 73,000 warrants exercised for cash.
- (4) During the year ended December 31, 2018, there were 10,600 warrants exercised for cash.
- (5)

NOTE 8—STOCKHOLDERS' EQUITY AND EARNINGS PER SHARE

Common Stock

Pursuant to our amended and restated certificate of incorporation, we are authorized to issue 47,000,000 shares of common stock. Holders of our common stock are entitled to dividends as and when declared by the board of directors, subject to rights and holders of all classes of stock outstanding having priority rights to dividends. There have been no dividends declared to date. Each share of common stock is entitled to one vote.

On February 22, 2017, we completed the private placement sale of 1,626,898 units at a price of \$4.61 per unit to one investor. Each unit consists of one share of our common stock and one warrant to purchase one share of our common stock at an exercise price of \$8.25 for a period commencing 6 months and ending 30 months after the closing of the financing. Gross proceeds were \$7.5 million. We incurred \$29,000 of legal expenses in connection with the financing. We registered for resale by the investor the shares of common stock, and the shares of common stock issuable upon exercise of the warrants, purchased by the investor in the financing pursuant to a registration statement that was declared effective by the SEC in April 2017.

On October 2, 2017, we completed the private placement sale of 1,976,919 units. Each unit consisted of one share of our common stock and one warrant to purchase one share of our common stock at an exercise price of \$4.85 per share for a period commencing 6 months and ending 36 months from September 28, 2017, the date of the first closing of the offering. The sale closed in two rounds with the first closing on September 28, 2017 which included the private placement sale of 1,745,581 units at a price of \$4.70 per unit to institutional and individual investors. Gross proceeds in the first closing were \$8.2 million with net proceeds of \$7.5 million after deducting placement agent fees and offering expenses. The second closing, completed on October 2, 2017, was for 231,338 units and gross proceeds of \$1.1 million with net proceeds of \$1.0 million after deducting placement agent fees and offering expenses. We also issued to the placement agent, warrants to purchase an aggregate of 98,846 shares of our common stock at an exercise

price of \$4.85 per share for a period commencing 6 months and ending 36 months from September 28, 2017.

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On March 27, 2018, we completed the sale of 5,714,286 shares of common stock at a price of \$3.50 per share in an underwritten public offering. Gross proceeds were \$20.0 million with net proceeds of \$18.4 million after deducting underwriter fees and offering expenses. The shares were issued pursuant to a shelf registration statement that we filed with the SEC, which became effective in May 2016. On April 6, 2018, following exercise by the underwriter of its overallotment option, we sold an additional 857,142 shares at a price of \$3.50, resulting in gross proceeds of \$3.0 million and net proceeds of \$2.8 million after deducting underwriter fees and offering expenses.

We have a Form S-3 universal shelf registration statement on file with the SEC. The universal shelf registration statement on Form S-3 permits us to sell, in one or more public offerings, shares of our common stock, shares of preferred stock or debt securities, or any combination of such securities and warrants to purchase securities, for proceeds in an aggregate amount of up to \$50.0 million, subject to potential limitations on the amount of securities we may sell in any twelve-month period. The Form S-3 will expire in November 2021. No securities have been issued pursuant to the registration statement.

Preferred Stock

Pursuant to our amended and restated certificate of incorporation, we are authorized to issue 3,000,000 shares of preferred stock. The board of directors has the authority, without action by our stockholders, to designate and issue shares of preferred stock in one or more series and to fix the rights, preferences, privileges and restrictions thereof. To-date, no preferred shares have been issued.

Stock Repurchase Program

On November 26, 2018, we announced that our board of directors had authorized a program to repurchase up to \$4.0 million of our common stock over a 12-month period, either in the open market or through privately negotiated transactions. During the year ended December 31, 2018, we repurchased and retired 80,100 shares of common stock, at an aggregate cost of approximately \$152,000, including commissions, or an average price of \$1.88 per share.

Earnings Per Share

The following table presents the number of shares excluded from the calculation of diluted net loss per share attributable to common stockholders for the periods below:

	Year Ended December 31, 2017	Year Ended December 31, 2018
Common stock warrants	3,730,255	3,385,100
Common stock options	1,082,490	1,255,280
Non-vested restricted stock unit awards	1,476,858	1,921,594
Total shares excluded from net loss per share attributable to common stockholders	6,289,603	6,561,974

NOTE 9— STOCK-BASED COMPENSATION

2014 Omnibus Incentive Plan

In January 2014, our board of directors approved the 2014 Omnibus Incentive Plan and amended and restated the plan in March 2014. Our stockholders approved the Amended and Restated 2014 Omnibus Incentive Plan, or the 2014 Plan, in March 2014. Our 2014 Plan initially permitted the issuance of equity-based instruments covering up to a total of 1,400,000 shares of common stock. In June 2016, our board of directors and stockholders approved an increase of 1,300,000 shares and in June 2017 approved an additional increase of 3,250,000 shares of common stock bringing the

total shares allowed under the plan to 5,950,000. As of December 31, 2018, there were 1,189,389 shares available to issue under the 2014 Plan.

Option Valuation

We have computed the fair value of options granted to employees and non-employees using the Black-Scholes option valuation model. The compensation costs of non-employee arrangements are subject to re-measurement at each reporting period over the vesting terms as earned. Option forfeitures are estimated at the time of valuation and reduce expense ratably over the vesting period. This estimate will be adjusted periodically based on the extent to which actual option forfeitures differ, or are expected to differ, from the previous estimate, when it is material. The expected term used for options issued to non-employees is the contractual life and the expected term used for options issued to employees is the estimated period of time that options granted are expected to be outstanding. We have estimated the expected life of our employee stock options using the “simplified” method, whereby, the expected life equals the arithmetic average of the vesting term and the original contractual term of the option due to our lack of sufficient historical data. For non-employees we use an estimated expected life of the remaining term of the stock option grant, which is initially ten years. Since our stock has not been publicly traded for a sufficiently long period of time, we are utilizing an expected volatility figure based on a review of the historical volatilities, over a period of time, equivalent to the expected life of the instrument being valued, of similarly positioned public companies within our industry. The risk-free interest rate was determined from the U.S. Treasury's Daily Treasury Yield Curve Rate with a term that best approximates the expected term of the instrument being valued.

Stock Options to Employees and Non-Employees

During the years ended December 31, 2017 and 2018, we granted incentive stock options for the purchase of 488,300 and 252,500 shares, respectively, of our common stock to our employees and non-employees. The options granted in 2017 have an exercise price range of \$4.36 to \$7.80 per share with a term of ten years. The options granted in 2018 have an exercise price range of \$1.80 to \$5.96 per share with a term of ten years. The options vest over various periods, generally quarterly over sixteen quarters. The options granted in 2017 had an aggregate grant date fair value of \$1.4 million and the options granted in 2018 had an aggregate grant date fair value of \$779,000 utilizing the Black-Scholes option valuation model.

We estimated the fair value of stock options awarded during the years ended December 31, 2017 and 2018 using the Black-Scholes option valuation model. The fair values of stock options granted for the years were estimated using the following assumptions:

	Option Grants Awarded During the Year Ended December 31, 2017	Option Grants Awarded During the Year Ended December 31, 2018
Stock Price	\$4.36 - \$7.80	\$1.80 - \$5.96
Dividend Yield	0%	0%
Expected Volatility	60.0%	70.0%
Risk-free interest rate	1.95% - 2.37%	2.50% - 3.09%
Expected Term	7 to 10 years	7 years

Stock-based compensation expense related to stock options for employees was \$435,000 and \$469,000 for the years ended December 31, 2017 and 2018, respectively. We estimate forfeitures at the time of grant and revise those estimates in subsequent periods if actual forfeitures differ from our estimates. We use historical data to estimate pre-vesting option forfeitures and record stock-based compensation expense only for those awards that are expected to vest. To the extent that actual forfeitures differ from our estimates, the difference is recorded as a cumulative adjustment in the period the estimates were revised. For the years ended December 31, 2017 and 2018, we applied a forfeiture rate of six percent, which is reflected in our stock-based compensation expense related to stock options. In January 2017, we modified certain stock options previously granted to a former executive. The modification was made in connection with the executive's termination. The modification included accelerated vesting of stock options to purchase 8,752 shares of common stock as well as an extension of the exercise period for all vested shares, including stock options to purchase 17,504 shares of common stock. As a result of the modification, additional stock

compensation expense of \$19,000 was recognized for the year ended December 31, 2017. There was no expense related to the modification for the year ended December 31, 2018.

For stock options paid in consideration of services rendered by non-employees, we recognize compensation expense in accordance with the requirements of ASC 505-50. Non-employee stock option grants that do not vest immediately upon grant are recorded as an expense over the vesting period. At the end of each financial reporting period prior to performance, the value of these stock options, as calculated using the Black-Scholes option valuation model, is determined, and compensation expense recognized or recovered during the period is adjusted accordingly. Since the fair market value of stock options granted to non-employees is subject to change in the future, the amount of the future compensation expense is subject to adjustment until the common stock options are fully vested. Stock-based compensation expense related to stock options for non-employees was \$9,000 and \$7,000 for the years ended December 31, 2017 and 2018, respectively.

Stock Option Award Activity

The following is a summary of our stock option activity during the year ended December 31, 2017:

	Number of Options	Weighted Average Exercise Price	Weighted Average Grant Date Fair Value	Weighted Average Remaining Life In Years
Outstanding, January 1, 2017	801,690	\$ 5.25	\$ 3.32	7.40
Granted	488,300	4.62	2.79	9.51
Exercised	(32,928)	2.37	1.41	—
Canceled/Forfeited	(174,572)	6.40	4.18	—
Outstanding, December 31, 2017	1,082,490	\$ 4.87	\$ 3.00	8.38

	Number of Options	Weighted Average Exercise Price	Weighted Average Grant Date Fair Value	Weighted Average Remaining Life In Years
Exercisable, January 1, 2017	419,174	\$ 5.94	\$ 3.86	6.00
Vested	457,338	4.57	2.77	8.65
Exercised	(32,928)	2.37	1.41	—
Canceled/Forfeited	(139,281)	6.65	4.38	—
Exercisable, December 31, 2017	704,303	\$ 5.08	\$ 3.17	8.15

The following is a summary of our stock option activity during the year ended December 31, 2018:

	Number of Options	Weighted Average Exercise Price	Weighted Average Grant Date Fair Value	Weighted Average Remaining Life In Years
Outstanding, January 1, 2018	1,082,490	\$ 4.87	\$ 3.00	8.38
Granted	252,500	4.54	3.09	9.16
Exercised	(4,692)	2.10	1.75	—
Canceled/Forfeited	(75,018)	4.72	2.89	—
Outstanding, December 31, 2018	1,255,280	\$ 4.82	\$ 3.03	7.75

	Number of Options	Weighted Average Exercise Price	Weighted Average Grant Date Fair Value	Weighted Average Remaining Life In Years
Exercisable, January 1, 2018	704,303	\$ 5.08	\$ 3.17	8.15
Vested	161,404	4.69	2.89	7.56
Exercised	(4,692)	2.10	1.75	—
Canceled/Forfeited	(17,996)	4.72	2.84	—
Exercisable, December 31, 2018	843,019	\$ 5.02	\$ 3.13	7.23

The following table presents information related to stock options outstanding and exercisable at December 31, 2018:

Options Outstanding Exercise Price	Options Exercisable		
	Outstanding Number of Options	Weighted Average Remaining Life In Years	Exercisable Number of Options
\$1.80 - \$2.00	161,183	7.09	99,637
\$3.25 - \$4.92	652,297	8.41	393,944
\$5.01 - \$6.00	281,500	5.87	214,115
\$6.18 - \$7.20	70,000	5.97	55,004
\$7.54 - \$7.80	67,800	6.09	58,749
\$8.06 - \$12.98	22,500	6.05	21,570
	1,255,280	7.23	843,019

As of December 31, 2018, there was \$1.1 million of unrecognized compensation expense related to unvested stock options, which is expected to be recognized over a weighted average vesting period of approximately 2.8 years. The aggregate intrinsic value of outstanding options and options vested as of December 31, 2017 were \$2.9 million and \$1.7 million, respectively, representing options whose exercise price was less than the closing fair market value of our common stock of \$7.47 per share. The aggregate intrinsic value of outstanding options and options vested as of December 31, 2018 were zero as there were no options whose exercise price was less than the closing fair market value of our common stock of \$1.33 per share. There were no excess tax benefits realized for tax deductions from stock options exercised during the years ended December 31, 2017 and 2018 as we have recorded a full valuation allowance against our deferred income taxes.

Restricted Stock Units Activity

We account for restricted stock units (RSUs) issued to employees at fair value, based on the market price of our stock on the date of grant, net of estimated forfeitures. The fair value of non-employee restricted stock units awarded are re-measured as the awards vest, and the resulting increase in fair value, if any, is recognized as expense in the period the related services are rendered. RSUs issued in connection with our employee incentive programs typically vest within 10 days of grant. All other RSUs, primarily issued as long term incentives, generally vest annually over three to four years. During the years ended December 31, 2017 and 2018 we recorded \$3.6 million and \$4.8 million, respectively, of stock-based compensation related to the restricted stock units that have been issued to-date.

A summary of restricted stock unit activity for the year ended December 31, 2017 is as follows:

	Number of Restricted Share Units	Weighted-Average Grant-Date Fair Value Per Share
Outstanding at January 1, 2017	1,455,558	\$ 3.64
Granted	722,400	5.37
Vested	(649,359)) 4.26
Forfeited	(51,741)) 5.40
Outstanding at December 31, 2017	1,476,858	\$ 4.96

A summary of restricted stock unit activity for the year ended December 31, 2018 is as follows:

	Number of Restricted Share Units	Weighted-Average Grant-Date Fair Value Per Share
Outstanding at January 1, 2018	1,476,858	\$ 4.96
Granted	1,661,750	4.60
Vested	(1,051,939)) 4.68
Forfeited	(165,075)) 5.17
Outstanding at December 31, 2018	1,921,594	\$ 4.78

As of December 31, 2018, there was \$6.3 million of unrecognized compensation expense related to unvested restricted stock unit agreements which is expected to be recognized over a weighted-average period of approximately 2.1 years. For restricted stock unit awards subject to graded vesting, we recognize compensation cost on a straight-line basis over the service period for the entire award.

Market-based Awards

In August 2016, we granted 250,000 market-based restricted stock units to an executive. The restricted stock units are subject to market-based vesting requirements, measured quarterly, based on the average of (a) the average high daily trading price of our common stock for each trading day during the last month of the applicable calendar quarter and (b) the average low daily trading price of our common stock for each trading day during the last month of the applicable calendar quarter, each as reported by The Nasdaq Stock Market, LLC. The restricted stock units are eligible to be earned on a quarterly basis based on a linear interpolation of the applicable share price, or in the case of a liquidation event, on the day of (or in connection with) such liquidation event based on the applicable transaction price. Once earned, the restricted stock units vest 50% on the date such restricted stock units become earned and 50% on September 30, 2019. We recognize compensation expense for restricted stock units with market-based conditions using a graded vesting model, based on the probability of the performance condition being met, net of estimated pre-vesting forfeitures. The share price on the date of issuance was \$5.06 per share. To determine the fair value of the award, we used a Monte Carlo simulation, which simulates future stock prices for the Company and, hence, shares vested, pursuant to the award. A key input into the model is the expected volatility for our stock. This estimate considered the historical volatility of our stock as well as the stock price volatility of guideline public companies. The fair value was determined to be \$74,000. For each of the years ended December 31, 2017 and 2018, we recognized \$24,000 of stock compensation expense in connection with this award, which is included in sales, marketing and administration expenses. The unamortized expense related to this award is \$18,000 and is expected to be recognized over 0.8 years.

Incentive Bonus Awards

We provide eligible employees, including executives, the opportunity to earn bonus awards upon achievement of predetermined performance goals and objectives. The purpose is to reward attainment of company goals and/or

individual performance objectives, with award opportunities expressed as a percentage of base salary. Bonuses can be measured and paid quarterly and/or annually, and are paid in cash, equity or a combination of cash and equity, at the discretion of our compensation committee.

Total stock-based compensation recorded in the consolidated statements of comprehensive loss is allocated as follows:

	Year Ended December 31, 2017	Year Ended December 31, 2018
Research and development		
Employees	\$ 1,937,000	\$ 2,479,000
Non-employees	181,000	77,000
Total research and development	2,118,000	2,556,000
Sales, marketing and administration		
Employees and directors	1,824,000	2,604,000
Non-employees	179,000	102,000
Total sales, marketing and administration	2,003,000	2,706,000
Total stock-based compensation	\$ 4,121,000	\$ 5,262,000

NOTE 10—COMMITMENTS AND CONTINGENCIES

Purchase Commitments—We have non-cancelable purchasing commitments that we incur in the ordinary course of business. The purchase commitments covered by these agreements are for less than one year and aggregate to \$193,000 as of December 31, 2018.

Operating Leases—We lease facilities under non-cancelable operating leases. The leases expire between January 2022 and August 2024 and include renewal provisions for two to five years, provisions which require us to pay taxes, insurance, maintenance costs or provisions for minimum rent increases. Minimum lease payments, including scheduled rent increases, are recognized as rent expenses on a straight-line basis over the applicable lease term. One lease requires us to maintain a cash security deposit of \$50,000 and also a \$200,000 letter of credit in favor of the lessor. The letter of credit steps down \$50,000 at each anniversary date if there have been no monetary defaults. The letter of credit is secured by a pledge in favor of the issuing bank of a \$211,000 mutual fund account which is classified as restricted cash in our balance sheet.

Rent expense related to our facilities was \$477,000 and \$663,000, respectively, for the years ended December 31, 2017 and 2018.

Future minimum rent payments are as follows:

Years ending December 31,	
2019	\$ 658,000
2020	726,000
2021	748,000
2022	557,000
2023	555,000
2024 and thereafter	376,000
Total future minimum rent payments	\$3,620,000

Legal Proceedings—We are not party to any legal proceedings. We may, from time to time, be party to litigation and subject to claims incident to the ordinary course of business. As our growth continues, we may become party to an increasing number of litigation matters and claims. The outcome of litigation and claims cannot be predicted with certainty, and the resolution of any future matters could materially affect our future financial position, results of operations or cash flows.

Legal fees and other costs associated with such actions are expensed as incurred. We assess, in conjunction with our legal counsel, the need to record a liability for litigation and contingencies. Litigation accruals are recorded when and if it is determined that a loss related matter is both probable and reasonably estimable. Material loss contingencies that are reasonably possible of occurrence, if any, are subject to disclosure. We will evaluate developments in legal

proceedings and other matters on a quarterly basis. As of December 31, 2017 and 2018, there was no litigation or contingency with at least a reasonable

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possibility of a material loss. No losses have been recorded during the years ended December 31, 2017 and 2018, respectively, with respect to litigation or loss contingencies.

Intellectual Property Indemnities—We indemnify certain customers and manufacturers against liability arising from third-party claims of intellectual property rights infringement related to our products. These indemnities may appear in license agreements, development agreements and manufacturing agreements, may not be limited in amount or duration and generally survive the expiration date of the contract. Given that the amount of any potential liabilities related to such indemnities cannot be determined until an infringement claim has been made, we are unable to determine the maximum amount of losses that we could incur related to such indemnifications.

Director and Officer Indemnities and Contractual Guarantees—We have entered into indemnification agreements with our directors and executive officers, which require us to indemnify such individuals to the fullest extent permitted by Delaware law. Our indemnification obligations under such agreements are not limited in amount or duration. Certain costs incurred in connection with such indemnifications may be recovered under certain circumstances under various insurance policies. Given that the amount of any potential liabilities related to such indemnities cannot be determined until a lawsuit has been filed, we are unable to determine the maximum amount of losses that we could incur relating to such indemnities.

We have also entered into severance and change in control agreements with certain of our executives. These agreements provide for the payment of specific compensation benefits to such executives upon the termination of their employment with us.

Guarantees and Indemnities—In the normal course of business, we are occasionally required to undertake indemnification for which we may be required to make future payments under specific circumstances. We review our exposure under such obligations no less than annually, or more frequently as required. The amount of any potential liabilities related to such obligations cannot be accurately determined until a formal claim is filed. Historically, any such amounts that become payable have not had a material negative effect our business, financial condition or results of operations. We maintain general and product liability insurance which may provide a source of recovery to us in the event of an indemnification claim.

NOTE 11—INCOME TAXES

The provision for (benefit from) income taxes by jurisdiction consists of the following:

	Year Ended December 31, 2017	Year Ended December 31, 2018
U.S. federal:		
Current	\$ —	\$ —
Deferred	—	—
Total U.S. federal	—	—
U.S. state and local:		
Current	1,000	2,000
Deferred	—	—
Total U.S. state and local	1,000	2,000
Foreign:		
Current	—	—
Deferred	(15,000)	(1,000)
Total foreign	(15,000)	(1,000)
Provision for (benefit from) income taxes	\$(14,000)	\$ 1,000

Income taxes differ from the amounts computed by applying the U.S. federal income tax rate to pretax income (loss) before income taxes as a result of the following:

	Year Ended December 31, 2017	Year Ended December 31, 2018
Expected income tax benefit	\$(7,357,000)	\$(5,211,000)
State income tax (benefit), net of federal benefit	(1,176,000)	(1,997,000)
Valuation allowance	7,398,000	7,372,000
Permanent differences:		
Stock options	95,000	285,000
Warrants	914,000	—
Research & development credit	(263,000)	(405,000)
Adjustment to deferred taxes	267,000	(68,000)
Foreign rate differential	19,000	2,000
Other	89,000	23,000
Provision for (benefit from) for income taxes	\$(14,000)	\$1,000

For the years ended December 31, 2017 we recorded a net income tax benefit of \$14,000 and for the year ended December 31, 2018 we recorded a tax provision of \$1,000. The net income tax benefit recorded in 2017 included \$1,000 of income tax expense offset by \$15,000 for the change in deferred foreign taxes. Deferred income tax reflects the tax effects of temporary differences that gave rise to significant portions of our deferred tax assets and liabilities.

Deferred income tax consists of the following:

	As of December 31, 2017	As of December 31, 2018
U.S. federal and state deferred tax assets—long term:		
Accrued payroll	\$ 376,000	\$ 102,000
Accrued expenses	21,000	45,000
Fixed assets	111,000	—
Intangibles	457,000	418,000
Research & development credit	1,464,000	2,239,000
Net operating loss	13,204,000	20,140,000
Stock compensation	539,000	612,000
New jobs credit	8,000	8,000
Total long-term assets	16,180,000	23,564,000
Total deferred tax assets	16,180,000	23,564,000
U.S. federal and state deferred tax liabilities—long term:		
Fixed assets	—	(16,000)
Total deferred tax liabilities	—	(16,000)
Net deferred tax assets - long term	16,180,000	23,548,000
Less: Valuation allowance	(16,180,000)	(23,548,000)
Net deferred tax assets	\$ —	\$ —
Foreign deferred tax assets—long term:		
Net operating loss	\$ 12,000	\$ 9,000
Total foreign deferred tax assets	12,000	9,000
Foreign deferred tax liabilities—long term:		
Intangibles	(13,000)	(4,000)
Total foreign deferred tax liabilities	(13,000)	(4,000)
Net foreign deferred tax assets (liabilities)	(1,000)	5,000
Less: Valuation allowance	—	(5,000)
Net deferred tax assets (liabilities)	\$(1,000)	\$ —

In December 2017, the Tax Cuts and Jobs Act (the “2017 Tax Act”) was enacted. The 2017 Tax Act represents major tax reform legislation that, among other provisions, reduced the U.S. corporate tax rate. The reduction in the tax rate reduced our federal and state net deferred tax assets by \$6.1 million, primarily related to our net operating loss carryforwards. Due to the full valuation allowance recorded against our federal and state net deferred tax assets, there was no impact to our income tax expense for the year ended December 31, 2018.

We recorded a full valuation allowance against our U.S. federal and state net deferred tax assets at December 31, 2017 and December 31, 2018. In determining the need for a valuation allowance, we reviewed all available evidence pursuant to the requirements of FASB ASC Topic 740, Income Taxes. Based upon our assessment of all available evidence, we have concluded that it is more likely than not that the net deferred tax assets will not be realized. For the year ended December 31, 2017, the valuation allowance increased by \$1.3 million. For the year ended December 31, 2018, the valuation allowance increased by \$7.4 million.

As of December 31, 2018, we had federal net operating loss carryforwards of approximately \$71.6 million, state net operating loss carryforwards of approximately \$72.9 million and foreign net operating loss carryforwards of \$61,000 in Switzerland. In accordance with the 2017 Tax Act, the \$24.9 million federal net operating loss carryforwards generated on or after January 1, 2018 will not expire and will be limited to 80% usage. The federal net operating loss

carryforwards generated prior to January 1, 2018 will begin to expire in 2033, and the state net operating loss carryforwards will begin to expire in 2033.

Our ability to utilize net operating loss carryforwards may be limited in the event that a change in ownership, as defined in Section 382 of the Internal Revenue Code, occurs in the future. In the event a change of ownership occurs, it will limit the annual usage of the carryforwards in future years. Management believes that certain changes in control have occurred which resulted in limitations on our net operating loss carryforwards; however, management has determined that these limitations will not impact the ultimate utilization of the net operating loss carryforwards. We recognize interest and penalties related to income tax matters in income taxes, and there were none during the years ended December 31, 2017 and 2018.

The adoption of ASC 740 guidance required us to identify, evaluate and measure all uncertain tax positions taken or to be taken on tax returns and to record liabilities for the amount of these positions that may not be sustained, or may only partially be sustained, upon examination by the relevant taxing authorities. Although we believe that our estimates and judgments were reasonable, actual results may differ from these estimates. Some or all of these judgments are subject to review by the taxing authorities. We have no significant uncertain tax positions for the years ended December 31, 2017 and 2018.

Our annual income taxes and the determination of the resulting deferred tax assets and liabilities involve a significant amount of judgment. Our judgments, assumptions and estimates relative to current income taxes take into account current tax laws, their interpretation of current tax laws and possible outcomes of future audits conducted by domestic tax authorities. We operate within federal and state taxing jurisdictions and are subject to audit in these jurisdictions. These audits can involve complex issues which may require an extended period of time to resolve. We are currently not being examined by any tax authorities. We are subject to taxation in the United States, California, Massachusetts and Switzerland. As of December 31, 2018, our tax years remain open to examination by the taxing authorities for all years since our incorporation in 2013.

NOTE 12—RELATED PARTY TRANSACTIONS

In August 2016, we entered into a consulting agreement with a member of our board of directors. Under the agreement, the board member would provide engineering design and fabrication advisory services for an hourly rate, with total payments not to exceed \$120,000 during any twelve-month period. During the year ended December 31, 2017, we incurred expenses of \$26,000 in connection with the consulting agreement. The agreement was terminated effective April 1, 2017. There was no expense for the year ended December 31, 2018.

NOTE 13—EMPLOYEE BENEFIT PLAN

We have a 401(k) Savings Retirement Plan that covers substantially all domestic employees who meet the plan's eligibility requirements and provides for an employee elective contribution and employer matching contributions. We recorded matching contributions to the retirement plan of \$284,000 and \$372,000 for the years ended December 31, 2017 and 2018, respectively.

NOTE 14—SUBSEQUENT EVENTS

In February 2019 we received approximately \$400,000 from the exercise of Private Placement Warrants - 2016, which resulted in the issuance of 140,000 shares of our common stock.

ITEM 9. CHANGES IN AND DISAGREEMENTS WITH ACCOUNTANTS ON ACCOUNTING AND FINANCIAL DISCLOSURE

None.

ITEM 9A. CONTROLS AND PROCEDURES

Evaluation of Disclosure Controls and Procedures

The phrase “disclosure controls and procedures” refers to controls and procedures designed to ensure that information required to be disclosed in our reports filed or submitted under the Securities Exchange Act of 1934, as amended, or the Exchange Act, such as this Annual Report on Form 10-K, is recorded, processed, summarized and reported within the time periods specified in the rules and forms of the U.S. Securities and Exchange Commission, or SEC. Disclosure controls and procedures are also designed to ensure that such information is accumulated and communicated to our management, including our chief executive officer, or CEO, and chief financial officer, or CFO, as appropriate to allow timely decision regarding required disclosure.

Our management, with the participation of our CEO and CFO, has evaluated the effectiveness of our disclosure controls and procedures (as defined in Rules 13a-15(e) and 15d-15(e) under the Exchange Act), as of December 31, 2018, the end of the period covered by this Annual Report on Form 10-K. Based on such evaluation, our CEO and CFO have concluded that as of December 31, 2018, our disclosure controls and procedures were designed at a reasonable assurance level and were effective to provide reasonable assurance that information we are required to disclose in reports that we file or submit under the Exchange Act is recorded, processed, summarized, and reported within the time periods specified in the rules and forms of the SEC, and that such information is accumulated and communicated to our management, including our CEO and CFO, as appropriate, to allow timely decisions regarding required disclosure.

Management’s Report on Internal Control over Financial Reporting

Our management is responsible for establishing and maintaining adequate internal control over financial reporting as defined in Rules 13a-15(f) and 15d-15(f) under the Exchange Act. Our internal control over financial reporting is designed to provide reasonable assurance regarding the reliability of financial reporting and the preparation of consolidated financial statements for external purposes in accordance with generally accepted accounting principles. Our management, with the participation of our CEO and CFO, has assessed the effectiveness of the internal control over financial reporting as of December 31, 2018. In making this assessment, our management used the criteria set forth by the Committee of Sponsoring Organizations of the Treadway Commission (“COSO”) in Internal Control - Integrated Framework (2013 Framework). Based on this evaluation, our management has concluded that our internal control over financial reporting was effective as of December 31, 2018.

This Annual Report on Form 10-K does not include an attestation report of our registered public accounting firm on our internal control over financial reporting due to an exemption established by the JOBS Act for “emerging growth companies.”

Changes in Internal Controls over Financial Reporting

There was no change in our internal control over financial reporting identified in management’s evaluation pursuant to Rules 13a-15(d) or 15d-15(d) of the Exchange Act during the quarter ended December 31, 2018 that materially affected, or is reasonably likely to materially affect, our internal control over financial reporting.

Limitations on Effectiveness of Controls and Procedures

In designing and evaluating the disclosure controls and procedures, management recognizes that any controls and procedures, no matter how well designed and operated, can provide only reasonable assurance of achieving the desired control objectives. In addition, the design of disclosure controls and procedures must reflect the fact that there are resource constraints and that management is required to apply judgment in evaluating the benefits of possible controls and procedures relative to their costs.

ITEM 9B. OTHER INFORMATION

None.

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PART III

ITEM 10. DIRECTORS, EXECUTIVE OFFICERS AND CORPORATE GOVERNANCE

The information required by this item is incorporated by reference to the disclosure appearing under the headings "Election of Directors", "Executive Officers", "Board of Directors and Corporate Governance" and "Other Matters" in our Proxy Statement for our 2019 Annual Meeting of Stockholders to be filed with the SEC within 120 days of the fiscal year ended December 31, 2018.

ITEM 11. EXECUTIVE COMPENSATION

The information required by this item is incorporated by reference to the disclosure appearing under the heading "Executive Compensation" in our Proxy Statement for our 2019 Annual Meeting of Stockholders to be filed with the SEC within 120 days of the fiscal year ended December 31, 2018.

ITEM 12. SECURITY OWNERSHIP OF CERTAIN BENEFICIAL OWNERS AND MANAGEMENT AND RELATED STOCKHOLDER MATTERS

The information required by this item is incorporated by reference to the disclosure appearing under the headings "Security Ownership of Certain Beneficial Owners and Management" and "Equity Compensation Plan Information" in our Proxy Statement for our 2019 Annual Meeting of Stockholders to be filed with the SEC within 120 days of the fiscal year ended December 31, 2018.

ITEM 13. CERTAIN RELATIONSHIPS AND RELATED TRANSACTIONS, AND DIRECTOR INDEPENDENCE

The information required by this item is incorporated by reference to the disclosure appearing under the headings "Certain Relationships and Related Party Transactions" and "Board of Directors and Corporate Governance - Director Independence" in our Proxy Statement for our 2019 Annual Meeting of Stockholders to be filed with the SEC within 120 days of the fiscal year ended December 31, 2018.

ITEM 14. PRINCIPAL ACCOUNTANT FEES AND SERVICES

The information required by this item is incorporated by reference to the disclosure appearing under the heading "Ratification of Appointment of Independent Registered Public Accounting Firm" in our Proxy Statement for our 2019 Annual Meeting of Stockholders to be filed with the SEC within 120 days of the fiscal year ended December 31, 2018.

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PART IV

ITEM 15. EXHIBITS AND FINANCIAL STATEMENT SCHEDULES

We have filed the following documents as part of this Annual Report on Form 10-K:

1. Consolidated Financial Statements

Our consolidated financial statements are listed in the “Index to Consolidated Financial Statements” under Part II, Item 8 of this Annual Report on Form 10-K.

2. Financial Statement Schedules

All schedules have been omitted because they are not required, not applicable, not present in amounts sufficient to require submission of the schedule, or the required information is otherwise included in our consolidated financial statements and related notes.

3. Exhibits

The following exhibits are filed as part of this Annual Report on Form 10-K.

Exhibit Number	Exhibit Description	Incorporated by Reference			Filed
		Form	File Number	Exhibit	Filing Date
3.1	<u>Amended and Restated Certificate of Incorporation of the Registrant</u>	8-K	001-36467	3.1	6/5/2014
3.2	<u>Amended and Restated Bylaws of the Registrant</u>	8-K	001-36467	3.2	6/5/2014
4.1	<u>Form of the Registrant’s common stock certificate</u>	S-1/A	333-193552	4.1	4/11/2014
4.2	<u>Form of Underwriter’s Warrant</u>	S-1/A	333-193552	4.2	5/16/2014
4.3	<u>Form of Warrant, dated April 25, 2016</u>	8-K	001-36467	10.3	4/26/2016
4.4	<u>Form of Agent Warrant, dated April 25, 2016</u>	8-K	001-36467	10.4	4/26/2016
4.5	<u>Form of Underwriter’s Warrant</u>	8-K	001-36467	1.1	9/9/2016
4.6	<u>Amended and Restated Warrant to Purchase Common Stock, dated November 15, 2013, issued by the Registrant in favor of MDB Capital Group LLC for 222,222 shares of common stock</u>	S-1	333-193552	10.25	1/24/2014
4.7	<u>Amended and Restated Warrant to Purchase Common Stock, dated November 15, 2013, issued by the Registrant in favor of MDB Capital Group LLC for a to-be-determined number of shares of common stock</u>	S-1	333-193552	10.26	1/24/2014
4.8	<u>Warrant to Purchase Common Stock, dated February 22, 2017, issued by the Registrant to Grayboard Investments, Ltd.</u>	8-K	001-36467	10.3	2/24/2017
4.9	<u>Form of Warrant issued to investors</u>	8-K	001-36467	10.3	9/29/2017
4.10	<u>Placement Agent Warrant, dated September 28, 2017</u>	8-K	001-36467	10.4	9/29/2017
4.11	<u>Placement Agent Warrant, dated October 2, 2017</u>	8-K	001-36467	10.1	10/3/2017
10.1*	<u>Form of Indemnification Agreement between the Registrant and each of its directors and officers</u>	S-1	333-193552	10.1	1/24/2014
10.2.1*	<u>Registrant’s Amended and Restated 2014 Omnibus Incentive Plan</u>	S-1/A	333-193552	10.2	4/11/2014

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Exhibit Number	Exhibit Description	Incorporated by Reference			Filed
		Form	File Number	Exhibit	Filing Date Herewith
10.2.2*	<u>Amendment No. 1 to Registrant's Amended and Restated 2014 Omnibus Incentive Plan</u>	S-8	333-211893	10.1	6/7/2016
10.2.3*	<u>Amendment No. 2 to Registrant's Amended and Restated 2014 Omnibus Incentive Plan</u>	S-8	333-218542	10.3	6/7/2017
10.3*	<u>Offer Letter between the Registrant and Robert Hammond, dated June 17, 2013</u>	S-1	333-193552	10.4	1/24/2014
10.4*	<u>Offer Letter between the Registrant and Neal Fenzi, dated June 17, 2013</u>	S-1	333-193552	10.5	1/24/2014
10.5*	<u>Offer Letter between the Registrant and George B. Holmes, dated February 9, 2016</u>	8-K	001-36467	10.1	3/4/2016
10.6*	<u>Offer Letter between the Registrant and Martin S. McDermut, dated October 14, 2018</u>	8-K	001-36467	10.1	11/5/2018
10.7*	<u>Form of Severance/Change-in-Control Agreement Restricted Stock Unit Agreement, with a grant date of February 29, 2016 between the Registrant and George B. Holmes</u>	10-K	001-36467	10.41	3/27/2015
10.8*	<u>Restricted Stock Unit Agreement, with a grant date of April 25, 2016, between the Registrant and George B. Holmes</u>	8-K	001-36467	10.2	3/4/2016
10.9*	<u>Restricted Stock Unit Agreement, with a grant date of August 8, 2016, between the Registrant and George B. Holmes</u>	S-8	333-211894	10.2	6/7/2016
10.10*	<u>Restricted Stock Unit Agreement, with a grant date of October 24, 2016, between the Registrant and Jeff A. Killian</u>	8-K	001-36467	10.1	8/12/2016
10.11*	<u>Outside Director Compensation Policy Settlement Agreement, dated April 1, 2018, among the Registrant, Park City Capital Offshore Master Ltd., Park City Capital, LLC, and Michael J. Fox</u>	S-8	333-214571	10.1	11/10/2016
10.12*	<u>Standard Commercial Lease, dated May 14, 2018, between the Registrant and University Business Center Associates</u>	10-K	001-36467	10.6	3/25/2016
10.13	<u>Standard Multi-Tenant Office Lease - Gross, dated December 16, 2016, between the Registrant and SeaBreeze I Venture - TIC.</u>	8-K	001-36467	10.1	4/2/2018
10.14	<u>Registration Rights Agreement, dated April 25, 2016</u>	8-K	001-36467	10.1	5/17/2018
10.15	<u>Registration Rights Agreement for Investors, dated June 17, 2013, by and among the Registrant and the persons listed on Schedule A thereto</u>	8-K	001-36467	10.1	1/6/2017
10.16	<u>Registration Rights Agreement for Warrants, dated June 17, 2013, by and among the Registrant and MDB Capital Group LLC</u>	8-K	001-36467	10.2	4/26/2016
10.17	<u>Registration Rights Agreement, dated February 20, 2017, between the Registrant and Grayboard Investments, Ltd.</u>	S-1	333-193552	10.23	1/24/2014
10.18		S-1	333-193552	10.24	1/24/2014
10.19		8-K	001-36467	10.2	2/24/2017

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Exhibit Number	Exhibit Description	Incorporated by Reference			Filed	
		Form	File Number	Exhibit	Filing Date	Herewith
10.20	<u>Securities Purchase Agreement, dated September 25, 2017, among the Registrant and the investors identified therein</u>	8-K	001-36467	10.1	9/29/2017	
10.21	<u>Registration Rights Agreement, dated September 28, 2017, among the Registrant and the investors identified therein</u>	8-K	001-36467	10.2	9/29/2017	
10.22	<u>Warrant Exercise Agreement, dated as of December 19, 2017, by and between the Registrant and Grayboard Investments, Ltd.</u>	8-K	001-36467	10.1	12/26/2017	
10.23*	<u>Amended and Restated Severance and Change in Control Agreement, dated as of December 21, 2017, by and between the Registrant and George B. Holmes</u>	8-K	001-36467	10.2	12/26/2017	
21.1	<u>List of Subsidiaries</u>	10-K	001-36467	21.1	3/30/2017	
23.1	<u>Consent of Crowe Horwath LLP</u>					X
24.1	<u>Power of Attorney (included on signature page)</u>					X
31.1	<u>Certification of Principal Executive Officer Pursuant to Securities Exchange Act Rules 13a-14(a) and 15d-14(a) as adopted pursuant to Section 302 of the Sarbanes-Oxley Act of 2002</u>					X
31.2	<u>Certification of Principal Financial Officer Pursuant to Securities Exchange Act Rules 13a-14(a) and 15d-14(a) as adopted pursuant to Section 302 of the Sarbanes-Oxley Act of 2002</u>					X
32.1#	<u>Certification of Principal Executive Officer and Principal Financial Officer Pursuant to 18 U.S.C. Section 1350, as adopted pursuant to Section 906 of the Sarbanes-Oxley Act of 2002</u>					X
101.INS	XBRL Instance Document					