



Where **Analog** and **Value** Meet

Corporate and Business Overview ▶▶▶▶

2021

NASDAQ & TASE: TSEM
towersemi.com

At a glance

Our Technology

Leading the analog semiconductor ecosystem by offering the widest range of customized analog technologies such as RF and HPA, Power Management, CIS, NIS and MEMs with cutting edge, innovative market solutions for its diversified and continuously expanding customer base. Focusing on areas we can provide a real, strong competitive advantage in while driving a positive and sustainable impact on the world with **full circle value creation**.

Our Value

Trusted Long-Term Partner: Based upon unparalleled trust and collaborative road-mapping and success alignment, we provide win-win differentiated solutions, enabling our customer to lead in their market segments, through teamwork and fully open channels of communication.

Our Finance

Strong financial foundation and business model with focus on margin expansion and free cash flow generation; enabling continuous realization of growth and value-add opportunities.

Our Capabilities

Worldwide Manufacturing: strong global presence in North America, Europe and Asia, operating seven worldwide manufacturing facilities (200mm and 300mm), fulfilling growing customer demand and providing capacity assurance, operational flexibility, with geographically spread dual-sourcing capabilities.

Our People

Over 5,500 worldwide highly devoted, talented, creative and skilled employees with broad knowledge, specialized expertise and profound experience.

Excellence is embedded in everything we do.

We pursue excellence in all aspects, from ideation through product shipment, implementing the highest standards of quality and efficiency in processes, systems and procedures, attaining effectiveness in creation, implementation, and commitment for continuous improvement.

The background is a vibrant blue abstract composition. It features a series of bright, curved light streaks that sweep across the frame from the bottom left towards the top right. Overlaid on this is a perspective view of a grid of rectangular panels, possibly representing a ceiling or a data array, which recedes into the distance. The overall effect is one of dynamic energy and technological sophistication.

Where **Analog** and **Value** Meet

Executive Management



Russell Ellwanger
Chief Executive Officer



Rafi Mor
Chief Operating Officer



Dr. Itzhak Edrei
President Emeritus



Dr. Marco Racanelli
Senior Vice President
and General Manager of
Analog Business Unit and
Newport Beach Site Manager



Oren Shirazi
Chief Financial Officer
Senior Vice President
of Finance



Dr. Avi Strum
Senior Vice President
and General Manager of
Sensors & Displays
Business Unit



Dalit Dahan

Senior Vice President of
Human Resources and
Information Technology



Noit Levy

Senior Vice President of
Investor Relations and
Corporate Communications



Yossi Netzer

Senior Vice President
of Corporate Planning



Guy Eristoff

Senior Vice President
Chief Strategy Officer



Nati Somekh

Senior Vice President
Chief Legal Officer
and Corporate Secretary



Dani Ashkenazi

Senior Vice President
of Excellence

BOARD OF DIRECTORS

Mr. Amir Elstein Chairman of the Board ● **Mrs. Iris Avner** Director ● **Mr. Yoav Z. Chelouche** Director, Chairman of the Audit Committee ● **Mr. Russell Ellwanger** Director, CEO ● **Mr. Ilan Flato** Director, Chairman of the Compensation Committee ● **Mrs. Dana Gross** Director ● **Mr. Kalman Kaufman** Director, Chairman of the Nomination Committee ● **Mrs. Michal Vakrat Wolkin** Director ● **Mr. Avi Hasson** Director



Our Vision



Provide the highest value analog semiconductor solutions as validated by our customers, employees, shareholders and partners.

Our Mission



Being a trusted long-term partner with a positive and sustainable impact on the world through innovative analog technologies and manufacturing solutions.

Our Value Vectors





Our Global Operations and Manufacturing Quality

Committed to excellence in everything we do, we continuously focus on our operational performance and maintaining excellent operational indices.

With our firm reputation as a leading foundry providing unique, high-end, analog technology manufacturing capabilities. Along with our solid market alignment, we wisely invest in our worldwide manufacturing facilities to best support the ever-evolving needs and growing demand of our customer base.

Throughout our global manufacturing facilities, in Israel, US and Japan, we provide capacity assurance with high quality and flexible manufacturing capabilities serving fabless companies and IDMs looking to increase

production capacity and diversify locations. Throughout 2020 and its challenges, we successfully maintained business activity and operations in all of our seven manufacturing facilities. In addition, from the very early stages of the pandemic outbreak (in Feb-March 2020), we have taken vast measures and actions in all of our global locations, aligned with (and in many cases have even gone well beyond) relevant governmental requirements, to ensure our customers' business stability and secure a safe environment for all of our employees.



Looking ahead: Growth drivers and main activities

Increased manufacturing capabilities:

- We completed our 12" capacity expansion, addressing the rising need for our market-leading RFSOI, CMOS image sensor and 65nm BCD power management platforms.
- Expanded our 8" Fab capacity for RFSOI by 50% to support growing customers' demand in the lead 8" RFSOI technology.
- Continued cross qualification of our leading flows with main focus on our SiGe platform in both our US facilities, expected to complete qualification and ramp to full production during 2021 to best serve the growing demand by existing and potential customers.

Promoting operational excellence:

- Ongoing activities including implementation of various programs and systems company wide, resulting in improved efficiency, transparency, and manufacturing KPI's: Cycle Time (CT), On Schedule Delivery (OSD), CONQ (Cost of Non-Quality) and cost.

Cost savings:

- Implemented several new cost models (addressing both capex and indirect materials) achieving profound operational cost savings.

Green initiatives:

we continue to make progress with our green initiatives:

- Increased renewable energy sources by 50% expansion of the solar panels in our Israel facilities.
- Recycling of H2SO4 acid - built a plant to recycle 3000 tons/year of sulfuric acid.

Migdal Haemek, ISRAEL	Migdal Haemek, ISRAEL	Newport Beach, CA, USA	San Antonio, TX, USA
<ul style="list-style-type: none"> • 6" (150mm) • CMOS, CIS, Power, Power Discrete • 1µm to 0.35µm • Planarized BEOL, W and Oxide CMP 	<ul style="list-style-type: none"> • 8" (200mm) • CMOS, CIS, Power, Power Discrete, RF Analog, MEMS • 0.18µm to 0.13µm • Cu and Al BEOL, EPI, 193nm Scanner 	<ul style="list-style-type: none"> • 8" (200mm) • CMOS, CIS, RF Analog, MEMS • 0.18µm to 0.13µm • Al BEOL, SiGe, EPI 	<ul style="list-style-type: none"> • 8" (200mm) • Power, RF Analog • 0.18µm • Al BEOL
Agrade, Italy	Arai, JAPAN	Tonami, JAPAN	Uozu, JAPAN
<ul style="list-style-type: none"> • 12" (300mm) • Analog RF, Power, Displays • 65nm 	<ul style="list-style-type: none"> • 8" (200mm) • Analog, CIS • 0.13µm to 0.11µm 	<ul style="list-style-type: none"> • 8" (200mm) • Analog, Power Discrete, NVM, CCD • 0.35µm to 0.15µm 	<ul style="list-style-type: none"> • 12" (300mm) • Analog, CMOS, CIS, RFC-MOS/ SOI • 65nm and 45nm

Technology Leadership

From ideation through product shipment, we partner and align with our customers to deliver the best experience and performance with our world-leading analog platforms, innovative technology, and rich manufacturing capabilities.

Further to our commitment to make a positive and sustainable impact on the world, we serve our customers with our best-in-class, value-add analog solutions for a wide range of markets and end applications, such as communication, consumer, industrial, automotive, medical, aerospace and defense, among others.

Leading the analog ecosystem with our targeted, robust technology offerings, we aim to exceed our customers' needs and expectations, supporting their prominent positions in the relevant market segments. Through long-term and trusted partnerships, we remain well versed with the rapidly growing markets and exciting technological trends, aligning to our customers' current and future

wants as we continuously pursue new horizons and scale new heights.

We offer the broadest technology solutions alongside the flexibility derived from modular and customizable processes in all our platforms including SiGe, BiCMOS, and RF CMOS (SOI and bulk) for radio frequency (RF) and high-performance analog (HPA) applications; CMOS image sensor (CIS); non-imaging sensors (NIS), power management (PM), including 700V BCD; CMOS; Mixed-Signal CMOS and MEMS capabilities. Complementing our sophisticated technology offerings are the Company's world-class design enablement services that provide progressive tools supporting quick and accurate design cycles.



**Radio Frequency and
High Performance Analog**



4.5.6 / 333.4.5
SENSOR

**Power
Management**

**CMOS
Image Sensors**

**Non Imaging
Sensors**

Automotive

Our Analog Business Unit

From RF to power management and mixed-signal CMOS, our Analog Business Unit provides market-leading innovative solutions covering all major segments of the analog semiconductor market.





Radio Frequency and High Performance Analog

RF Technology for Mobile Communications

We are taking an active role in enabling a new era of enhanced communications by continuously developing industry-leading analog solutions that address this growing market's evolving needs. As was the case with the introduction of 4G wireless communications, our RF technology has helped enable higher performance products that are fueling the 5G upgrade cycle which started in 2020, has significantly accelerated with the COVID-19 pandemic, and will continue through the next several years. Specifically, our industry leading RF platform offering includes:

RF SOI

With a leading reputation for its best-in-class performance, providing exceptionally low Ron-Coff figure of merit that enables lowest insertion loss and highest linearity RF switches, antenna tuners, and low-noise-amplifiers to support high data rates and low power consumption, serving the comprehensive needs of 5G enabled handsets.

RF SiGe

With best-in class noise figure and linearity, SiGe enables not only the highest performance low-noise-amplifiers for applications that include handset receivers but also higher performance applications such as GPS and satellite receivers. Also, more cost-effective than III-V technologies, SiGe enables a class of low-power power amplifiers for WiFi, bluetooth and IoT that proliferate new communication devices. And finally, due to its inherent superb high frequency performance, SiGe is used in mmWave applications, such as automotive radar, and can help reduce power consumption in mmWave 5G wireless and other such systems.

High Performance Analog for Optical Infrastructure

We are a recognized leader in SiGe and SiPho technology for optical transceivers. Our SiGe platform is designed to provide the bandwidth and level of quality required for current high volume 100Gb/s systems, as well as the newest standards stretching to 800Gb/s. Our SiPho

technology was one of the first and still remains one of the few open foundry SiPho technologies, and as such has gained wide acceptance. Served markets include data centers as well as telecommunication networks globally.

The following is a brief description of our leading technologies in this area:

High Performance SiGe

Offering superior performance of >300GHz transistor speed supporting next-generation transceivers operating up to 800Gbps. We partner with leaders in the industry to continuously update our roadmap and provide best-in-class SiGe performance to serve the optical transceiver market.

Silicon Photonics (SiPho)

Providing area-optimized solutions with integrated optical detectors, waveguides and modulators on a single die, enabling significant cost advantages due to high levels of integration and replacing the assembly of discrete components in optical modules.

*Our RF technology enable
higher performance
products that are fueling
the 5G upgrade cycle*

A New Era of Communication

Looking ahead: Growth drivers and main activities

RF Mobile

Our mobile business is experiencing heightened growth due to a combination of increased market share, ramp of our 300-millimeter RF SOI technology, and overall market content growth with state-of-the-art 5G handset rollouts. This strength is broad-based and includes advanced products running in our 300-millimeter facility in Japan and 200-millimeter facility in Israel as well as mid-range products running in our San Antonio facility.

Growth in this market is expected to continue as 5G handsets proliferate over the next several years, requiring substantially, namely 30% to 50%, more RF content.

RF Infrastructure

Our silicon germanium optical business has grown throughout 2020, driven primarily by demand for 5G infrastructure and additionally by data center demand, and tied to the increased demand for bandwidth due to enhanced work-from-home (and study-from-home)

protocols around the globe forced by the COVID-19 pandemic. In both markets, we build optical transceivers operating at 25 gigabit per second for 5G infrastructure (a market trend that is accelerating), and predominantly at 100 gigabit per second for data centers, using high-speed silicon germanium technology. We continue to see a good flow of new designs in our most advanced technologies, targeting 200, 400, and even 800 gigabit per second products. At these higher data rates, we also anticipate increased adoption of our silicon photonics platform in the 400 and 800 gigabit per second transceivers.

With data-center worldwide capex spending projected at 15% CAGR, and SiPho adoption accelerating at 400Gb and 800Gb, we expect to maintain a good growth trajectory in this market over the next several years.

Growth in silicon germanium is supported today by increased utilization of our Newport Beach facility, with additional SiGe capacity available in our San Antonio facility to support future growth.

Power Management

Our power management technology provides best-in-class power efficiency in a wide range of consumer, industrial, infrastructure, automotive and medical end-applications through modular, industry-leading BCD platforms across a wide range of voltage requirements.

We continue to develop our platform with a strong roadmap guided by market leaders. Examples include:

65nm BCD

Addressing the largest portion of the power IC market, our 65nm BCD is the leading BCD (Bipolar-CMOS-DMOS) technology for low voltage market segments providing the highest power efficiency, best digital integration capability (replacing a 'multiple chip' module) and superior cost effectiveness through both

low mask count and smallest die size. The platform offers strong competitive advantage for products up to 16V operation such as PMICs, load switches, DC-DC converters, LED drivers, motor drivers, battery management, and analog and digital controllers, among others.

180nm BCD

Offers optimized power performance with best in class low $R_{ds(on)}$ power LDMOS that is scalable from 12V to 180V operation with multiple isolation schemes enabling advanced

integration options, all with a small form factor, ideally suitable for applications across multiple markets, including automotive (for maximized hybrid/EVs capabilities, as well as motor controllers and drivers, LED headlights and LiDAR); highly efficient data centers (48V DC-DC) and industrial power applications. Our 180nm power management platform supports the gate drivers market serving a \$13B power discrete market (according to Yole) with its complementary solution to GaN, SiC, and MOSFET.

Looking ahead: Growth drivers and main activities

Our Power IC business grew strong double digits in 2020 through gains in market share enabled by competitive technology in both 200mm and 300mm across a wide range of voltages and applications. This despite a decline in automotive power business due to the industry-wide COVID-19 slowdown, an area which is now showing signs of recovery. We continue to see a strong forecast for 2021 which

promises further substantial growth as more analog semiconductors are being outsourced and our technology continues to feed a large funnel of new opportunities.

In 2020, we released a breakthrough power IC, 200mm technology, Gen6, which is now prototyping with multiple customers. The technology offers over 35% power efficiency improvement and/or equivalent amount

of die-area reduction at 24-volt operation through an innovative transistor design. This new technology complements our platform leadership at lower voltage with our previously announced 65-nanometer BCD, 300-millimeter process and at higher voltages, with our recently announced 140-volt RESURF and 200-volt SOI technologies.

We continue to see an increasing demand for

Our 65nm BCD is the leading technology for low voltage market segments providing the highest power efficiency

The (Green) Power to Lead

power management ICs in multiple applications, including hybrid, mild hybrid and electric vehicles, as well as consumer e-bikes, personal computing and industrial applications for green power and Industry 4.0. All of these applications require optimized operating voltages, power efficiency and fast time to market, which needs are best served by our advanced and diversified Power platform.

Our roadmap includes further broadening of our served low-voltage market through the addition of new features to our very popular 300mm, 65nm BCD process.

In 200mm, our focus is to bring to market

initial products in our Gen6 technology, first announced in 2020, while continuing to target battery management, industrial, and infrastructure products with our higher voltage technology.

We continue to develop our RESURF technology to support 48V systems and automotive applications and will release, during 2021, additional isolation schemes to support multiple voltages within the same chip, as well as automotive market requirements. This breadth of technology positions us well to continue to gain share in this very large segment of the analog semiconductor market.

Our Sensors and Displays Business Unit

Our exclusive and highly prestigious Sensors and Displays business unit serves the highly diversified image sensors, non-imaging sensors, MEMS, micro-LED and micro-OLED display markets. Offering world-leading, state-of-the-art technology, our comprehensive solutions and long-established expertise have gained a worldwide reputation of unparalleled innovative technology making us a leading partner of choice for the manufacturing of the world's next-generation sensing and silicon-based displays solutions.



CMOS Image Sensors

Cutting edge imaging and sensing solutions customized for your needs addressing the consumer, industrial, medical, high-end photography, automotive, and environmental applications.

Focused on performance-optimized pixel technology, product excellence, design flexibility and total support, our distinctive processes and established CMOS Image Sensor (CIS) technologies lead the way to frontier markets and end-applications. Our vast know-how along with the specialized in-house technology developments continue to set forth a winning platform of leading features with a competitive edge.

Our image sensors division serves a variety of market segments, including our long-term retained markets, such as high-end photography (including cinematography and broadcasting cameras), industrial (machine vision) and medical/dental x-ray large sensors, as well as multiple fast growing served markets, such as optical fingerprint sensors for mobile applications, and Time of Flight (ToF)

sensors for mobile face recognition and 3D front looking cameras, as well as AR and gaming applications.

In addition to our technology, we support customers with design services provided either by us or through our professional design house partners around the world.

Looking ahead: Growth drivers and main activities

Over the past year, we vastly invested in developing specialized technologies, along with building pixels that are designed to spec and silicon proven, enabling profound advantages and business growth opportunities.

- Developed 2 major technologies that are expected to start high-volume production in 2021:

Optical fingerprint sensors for smartphones, both lens type for under LCD and under OLED displays, and 1:1 type for under OLED displays on our well-established 0.18 micron 8-inch wafer CIS technology.

Time-of-Flight sensors based on our state-of-the-art stacking wafer technology and global shutter pixel in our 65-nanometer CIS platform. These sensors are targeted mainly for face recognition applications in the mobile market as well as in payment points, but also as front-looking cameras for gaming, commercial and AR-type applications. Working with 2 market leaders on this technology and already prototyped with one customer a state-of-the-art ToF sensor with pixel level bonding.

- Engaged in several programs of large x-ray sensors, and next-generation industrial

sensors on 65nm, using our state-of-the-art global shutter pixels and stitching technology.

- Our stacked copper-to-copper bonding back-side illumination (BSI) wafer technology formed a firm basis for many new exciting products, including time-of-flight, global shutter industrial sensors and high-end photography sensors, giving extremely low dark current values and enabling frame rate of continuous 1,000 frames per second of full 20-megapixel resolution, high-end sensors.
- Based on our SPAD (Single Photon Avalanche Diode) technology on 65nm 300mm, we are

*performance-optimized
pixel technology, product
excellence and our distinctive
processes lead the way to
frontier markets and
end-applications*

Customized for Your Needs

working extensively on the development of a direct time of flight (dToF) platform using stacked wafer technology to be used in smartphones, among other markets.

Looking at 2021, our focus is production ramp of our stacked wafers platform, with the newly released ToF sensor, and ramping into production with the high-performance lens type fingerprint sensor platform for mobile devices with our partners. We expect to see continuous growth in the industrial sensor market products on our 300mm frontside illumination platform.

In parallel, we are in advanced stages of a direct time of flight (dToF) technology development based on our Single Photon Avalanche Diode (SPAD) sensing technology, combined with our pixel level wafer stacking platform addressing the mobile market serving next-generation face recognition features, 3D front looking camera for retail as well as gaming applications, and for camera fast autofocus and artistic blurring applications.



Non Imaging Sensors, MEMS and Displays

Developing innovative sensing solutions supporting global environmental initiatives for a greener and safer world.

Non imaging sensors

We offer technological platforms for fabricating diverse sensing devices, consisting of unique ionizing radiation (including x-ray and Radon) sensors, remote temperature sensors, magnetic (TMR), UV radiation and gas sensors. In addition, we supply technology for LCOS and uOLED display backplanes, including stitching technology support for large silicon-based displays. With its proven and flexible capabilities, this diverse offering enables the manufacturing and embedding of sophisticated sensors which are highly in demand in today's 'connected' world. With our mature technologies and innovation methodology, we develop, facilitate and support a rich solution span for the sensors' arena.

- **Remote temperature sensors:** provide high sensitivity and accuracy in a broad temperature range, serving the mobile, IoT, industrial, automotive, medical and security markets;
- **Time-temperature Indicator sensors:** CMOS embedded and reusable sensors with no need for power supply, serving the food industry, agriculture, medical and pharmaceutical markets;

- **Floating gate radiation sensors:** reusable sensors with no power supply required and no scintillator, serving radiation monitors, radiation badges, sterilization and Radon detectors;
- **Magnetic sensors:** high sensitivity Tunnel Magnetoresistance (TMR) sensors for magnetic field strength sensing, serving the industrial, automotive, and consumer markets, as well as the space industry;
- **UV sensing:** solar blind, with record sensitivity and operation at high temperatures, serving applications such as skin protection, flame diagnostics, free space optical communication, sterilization, and industrial automation; and
- **Gas and humidity sensors:** operation at high temperatures, easy and fast reset and sensor fusion for multiple gases, serving automotive, industrial, medical and environmental applications.

All sensor technologies described above are based on unique platforms developed in-house such as embedded non-volatile floating gate solutions, GaN-based devices, and MEMS-based membranes, alongside our internal design

capabilities that provide embedded electronics to perform full sensor on chip.

MEMS

In the MEMS area, we focus on MEMS devices that can be fabricated and scalable to mass volume in a CMOS foundry. We have developed a unique cost-effective platform for MEMS microphones and for MEMS speakers, as well as a platform for high end accelerometers. We continue to enrich our platform offering by adding more capabilities to serve additional MEMS markets.

Displays

Through our Display division, we are co-developing with leading partners next-generation micro-LED and micro-OLED silicon-based displays ranging from very large TV screens, through laptop and tablet screens to VR goggles very high-resolution screens. This market, even though at its development stage, is expected to substantially grow to very high volume from 2023 onwards, where we are already well positioned with a strategic signature market share.

Looking ahead: Growth drivers and main activities

- We have ramped to mass production with GMEMS's highly advanced market-leading MEMS microphones family and will continue to expand capacity this year while developing in parallel the next-generation family of very high dynamic range microphones.
- Partnered with Aledia, the technology leader of micro-LED technology worldwide, on the development and preparation for mass production of their unique GaN nanotube based micro-LEDs. These uLED displays are considered as the future of displays, allowing unparalleled brightness, dynamic range and contrast with "true black" capabilities and are expected to take the lion's share of the display market in the future. This project is expected to reach mass production in 2023.
- We are working with an industry leader on silicon based micro-OLED back planes for monolithic solutions, utilizing our well-known stitching technology.



Automotive

Our mature and modular platforms offer comprehensive and advanced analog technology solutions designed to best support the entire automotive ecosystem.

The Company's technology offerings and long-term roadmap strategy are aligned with the three main trends that are driving rapid growth in the automotive market: ubiquitous connectivity, ever-growing automation and total powertrain electrification. By partnering with the market segment leaders, we develop best-in-class technologies, supporting the widest range of automotive market customers from OEMs and Tier-1 integrators to IDMs and fabless.

With our leading-edge analog technologies, best-in-class design expertise, flexible foundry engagement model and strong culture of quality in all of our IATF16949 certified manufacturing facilities, we provide comprehensive solutions for advanced technological automotive needs based on the Company's advanced CMOS image sensor, radio frequency & high performance analog, mixed-signal and power management platforms:

- Advanced power management platforms offer the lowest R_{ds(on)} with superior voltage and current handling capability for a wide range of applications, such as motor drivers,

DC-DC converters, battery management ICs, PMICs, load switches, voltage regulators, LED drivers and more.

- CMOS image sensor technology offers superior SPADs for LiDAR. The Company's global shutter (GS) technology provides unparalleled imaging capability in applications that require Time-of-Flight (ToF) sensing, minimal LED flicker sensitivity, ultra-low-light sensitivity, as well as thermal imaging. The GS technology is a go-to choice for the most advanced textured light applications, such as gesture control and passenger monitoring.
- High-performance SiGe technology is already deployed in high volume radar and is ready to enable V2X and 5G communications. With its best-in-class RFSOI and RFCMOS technologies, Tower is a supplier of choice to market leaders in every high-performance RF and analog market segment.

We continue to expand and gain market share in different market segments by delivering innovative current and next-generation technological solutions for the rapidly evolving automotive world.



Innovative Analog Solutions for Smarter Automobiles



Your Number
80213648
access permission

/Autonomous
/Sensing
/Communication
/Better
/Navigation
/Interactless
/Ecology

Aerospace and Defense

Bringing a broad range of extensive capabilities and commercially available technologies and services to the A&D community.

Through our Newport Beach facility, we are partnering with a variety of companies in the Aerospace and Defense arena, holding a firm market position that continues to grow year over year. By leveraging the wide range of the Company's high-volume commercial technology portfolio, we provide the vast A&D community with advanced and sophisticated solutions, including large format ROICs (readout integrated circuits) in support of numerous IR applications and systems, visible imaging,

and SiGe for radar, radio, and high-speed data communications. As an ITAR certified facility with trusted foundry access, we also support various critical US government projects and needs. We are the number one foundry of choice for ROICs and hold a leading position in SiGe and Silicon Photonics (SiPho) in the DoD fabrication space.

Aimed to best serve our customers' needs and development processes, our platform-rich features include:

- 180nm, 130nm and 65nm ROIC & CIS with stitching supporting ITAR protocol;
- 3DIC integration at the 180 and 130nm nodes;
- Technical teams and program management specifically dedicated to the A&D customer base; and
- World class design enablement environment leveraging Tower Semiconductor's commercial offerings, to enable an efficient and accurate design process and first-time silicon success.

Looking ahead: Growth drivers and main activities

Our main accomplishments, focuses and new developments throughout 2020 include:

- AS9100 certification for our Newport Beach facility;
- Delivery of production wafers to a customer in support of the F-35 Aerodas system builds;
- Isolated deep silicon vias supporting 3DIC integration at the 180nm and 130nm nodes;
- 65nm ROIC and CIS ITAR support through the Company's 300mm facility in Japan (TPSCo); and

- Continue to win and support multiple DARPA programs, Army NVESD efforts and Naval Warfare initiatives.

Enhancing our leading foundry position and ensuring our continuous support of the A&D community, we are engaged in various strategic and specialized activities addressing market-specific applications such as: satellite, radar, high speed data transmissions, multiple

infrared and visible imager applications, as well as optical data applications meeting the requirements of the broad Military/Governmental customer base.

Our A&D division, in alignment with the Company's technology roadmap (in RFCMOS, SiGe and SiPho), is well situated to take advantage of new market growth drivers:

We are partnering with a variety of companies in the Aerospace and Defense arena, holding a firm market position that continues to grow

Advanced Solutions Supporting A&D Application Needs

- Developments and moving into initial production of DoD night vision systems which is expected to show significant wafer volume growth in 2021;
- Major DoD fighter aircraft IR applications in 2021-2025;
- SiGe based high-speed high-altitude transmit/receive chipset supporting Boeing's M25 Stingray (Naval aircraft refueling drone) moving into initial production;
- Company's SiGe roadmap (SBC18S5, S6, SBC13S4) is ideal for:
 - Supporting and enabling strategic solutions to a number of Military/Government key primes;
 - Well aligned with the major satellite, radar, and high-speed data transfer needs of the DoD community.
- 130nm ROIC process for DoD aircraft strategic needs in the digital ROIC arena.
- New and performance-enhanced solutions in the DoD IR spectrum with our 130nm and 65nm RFCMOS technologies.



Worldwide Design Enablement

Our distinctive design enablement platform provides a robust design ecosystem, which together with our advanced analog technologies, promotes the highest level of collaboration driving our customers' innovative ideas into value.

We offer the most accurate and elite electronic design automation (EDA) tools and design intellectual property (IP), as well as dedicated expert design services through our worldwide design center.

We focus on enabling an effective and successful design cycle as well as first time working silicon so that our customers meet the advanced requirements for smart IC's in diverse markets, such as connectivity, consumer, industrial, and automotive, among others. Through long-term collaboration with the world's major EDA, IP and design partners, we offer differentiated and inclusive design capabilities, these allow for competitive market advantage, top performance and shortest time to market.

Excellence and innovation are values that we continuously drive in the development of new and advanced solutions to serve today's IC markets' rigorous needs.

Throughout 2020, we have further expanded our capabilities and design support through distinctive activities including:

- Expanded our SiPho design kits allowing full design flow coverage from simulation to physical verification. This, first of its kind for foundries, is already allowing faster design cycle and faster ramp to production.
- Expanded our power management platforms' PDK support to include higher voltages and compatibility in multiple design platforms, allowing our customers to further utilize the exclusive advantages of our diverse power

processes, while reducing their cost and improving performance.

- Further enhanced our design capabilities and tools to include non-imaging sensors to enable faster time to market in leading key markets, such as fingerprint ICs, as well as temperature, humidity, radiation and other sensors.
- Established our unique and exclusive partnership with top Ukraine Technical university (KPI) and Cadence. Throughout 2020, the prestige program has expanded and now includes a 'hands-on' lab used by many students in their studies. This unique collaboration will further expand and diversify our design kit offerings, providing our customers with an even broader design tool set without increasing cost.

A close-up photograph of a person's hands interacting with a laptop. The person is wearing a grey striped shirt and a black watch. They are using a black stylus to point at a specific area on the laptop screen. The screen displays a detailed, colorful circuit board design with various components and traces. Another person's hand, wearing a blue shirt, is visible at the bottom, typing on the laptop keyboard. The laptop is white and sits on a light-colored surface. In the bottom right corner, a portion of a blue folder or clipboard is visible.

Design it once. Design it right.

Looking ahead: Growth drivers and main activities

We continue to expand our design services, tools and support to meet the evolving markets' needs and provide customers with the most advanced solutions and services to enable design of next-generation ICs and drive innovation and high performance in the broadest market spread.

Research and Development

Promoting a global environment of innovation and progress, Tower Semiconductor continuously drives major activities promoting the development of sophisticated analog platforms providing value-add, breakthrough solutions for a diversity of world-leading markets such as wireless and optical communications, industrial, consumer and medical electronics.

The Company's recent research activities address the emerging fields of high-frequency devices, including RF switches, smart power management, silicon photonics, various visible and near infrared image sensors, non-imaging sensors, including ionizing radiation, and artificial intelligence for data processing. These devices and technologies being developed are targeting our initiatives in emerging markets such as 5G and 6G, data center network traffic at 100G, 400G and beyond, smart power and battery control, industrial and commercial sensors, and aerospace & defense.

2020 New technological platforms, achievements and novel devices

• In the past year Tower Semiconductor drove several R&D activities (based on original

patented ideas of its engineers) enhancing its technological offerings with the development of new production platforms and specialized solutions. Distinctly correlated with the emerging demands and roadmap of the industry, those include:

- Low-cost solar UVA/UVB sensors and solar blind UV sensors, embedded in SOI and standard CMOS platforms, both solutions based on Tower Semiconductor patents.
- Prototypes of Radon sensors and single photon gamma sensors based on patented FG arrays.
- BioFETs of original design (based on Si and GaN structures) suitable for a variety of medical applications.
- TMR magnetic field sensors integrated in 300mm/65nm technology platform.
- Updated releases of best-in-class silicon photonics process offering, including process, devices and modeling design environments with multiple leading EDA vendors.
- New release to manufacturing of RF SOI technology for leading switch and LNA products.
- New release to manufacturing of next-generation high-speed SiGe HBT device process for datacenter.

- Publications on best-in-class RF switches with record figures of merit in sub-10fs figure of merit, and reliability.

Tower Semiconductor Ongoing Innovation Partnerships

- H2020 Madein4 Consortium - development of specialized CIS camera application for AI enabled systems and IIoT was continued (funded by EC).
- New consortium on gas sensing with Fraunhofer Institute (Germany) and Tel Aviv University (funded by Israeli Innovation Authority).
- Continued collaboration within CC-SENS (German-Israeli consortium) on CMOS compatible nano-devices for gas sensing.
- Partnership on edge sensors enabled with artificial intelligence with the Technion - Israeli Institute of Technology.
- Continued support from US DoD (DARPA, AFRL, Army, NRL/NASA, etc.) on novel technology.
- Partnership with US universities (e.g. UCSD) and consortia (e.g. CADAIC) in the areas of RF device circuit and advanced electro-magnetic circuit concepts, medical devices, and photonic circuits.

Patents

In 2020, more than 60 patents were granted and more than 20 filed, a new highpoint for the corporation. These patents spanned the breadth of Tower technology.

- **For the sensors market**, the patents included new CMOS imagers and methods, new UV solar sensors based on silicon, matrix radiation detectors, in addition to programmable fuses (with TPSCo).
- **For high-speed communications markets** such as data center and 400G, patents addressing silicon photonics as well as novel methods for high speed SiGe HBT devices.
- **For the 5G in analog and RF switch related markets**, several patents on novel phase change materials (PCM) devices as well as RF SOI devices, methods and circuits for LNA and switch were filed and granted.

Talks and Publications

- Invited talk at EC seminar on emerging NVM (IMEC, Leuven, February) and several talks within online seminars organized by Israeli Innovation Authority (IIA).
- Two papers and presentations at IEEE conferences (virtual, DATE and MELECON). Topics: Modelling of memristors for AI system; and FG radiation dosimeters.
- Paper by Dr. Amos Fenigstein in collaboration with the Technion in Scientific Reports Nature. Topic: CIS with organic diodes.
- IMS 2020, presented two talks on phase change material switches with sub-10 fs RonxCoff, and more than ten papers were presented using Tower Semiconductor's technology.

Tower Semiconductor engineering experts continued to serve as members of technical/scientific committees and reviewers of leading international journals and scientific conferences: IEEE IMW, Electronics Letters, Microelectronics, IEEE ED and EDL, IISW, IEEE IMW, EMRS, MEMRYSIS, Nano IL. Numerous research papers/book chapters were published in well-known international journals including Nature Electronics and IEEE ED. Internally, jubilee Vol. 10 of the Tower Semiconductor Technical Journal (TJ2) was published featuring 17 technical papers by engineering experts from the Company's various technological platforms and R&D division.



Our Partnerships

Over the past several years, we have announced our strong and valuable long-term partnerships with some of the world's market-leading companies. From joint technology developments through roadmap alignment, these partnerships set ground for profound leadership and growth in these market segments for both parties.



Our partnership with Infinera to deliver an advanced 800 gigabit per second optical transceiver using **our advanced silicon germanium technology** representing a 2 generation advancement in technology as compared to what most of our customers are building today, hence, maintaining our long-term road map leadership position.



Our long-term partnership with Inphi Corporation, the leading supplier of advanced platform solutions for data center operators, is set to address the ever-growing data movement needs. on the **production of SiPho ICs for data center interconnects** using Inphi's innovative Silicon Photonics PAM4 technology resulted in the industry's first low power, cost effective 100G DWDM platform solution in QSFP28 form factor for between data center interconnects.



Our partnership with Renesas brought to market advanced satellite terminals with **our silicon germanium technology**.



Continuous collaboration with HP Indigo utilizing **our 180nm Power Management modular technology platform** for their next-generation high-resolution industrial presses providing cutting-edge presses resolution, higher than any other available commercial solution in this market segment.



Our partnership with Opix attained the successful development of a state-of-the-art Time of Flight (ToF) Imager which will be embedded in smartphones and other devices for face recognition and 3D imaging applications. This platform development is based on **our state-of-the-art, pixel level wafer stacking BSI technology in our 300mm facility in Japan**. This advanced achievement features unparalleled performance of accuracy and sensitivity (including multiple depth sensing and distance measurement applications) suitable for a broad range of fast-growing markets such as mobile, AR/VR, retail, robotics, automation, and industrial inspection.



Our licensing with Xperi for 3D stacked image sensor technology complements **our state-of-the-art stacked wafer BSI sensor platforms for Time of Flight (ToF), industrial global shutter and other CMOS image sensors on 300mm and 200mm wafers**. This further enhances our outstanding pixel performance and significant competitive advantages supporting manufacturing of time of flight (ToF) and advanced sensors for consumer electronics, machine vision, autonomous vehicles, smart devices, and a broader range of applications, including memories and MEMS devices.



Our partnership with GMEMS developing a platform for its MEMS based microphone products addressing the rapidly growing demands of the earbuds and cellphone markets, has successfully ramped to mass production. The joint development is based on **a custom-developed process for GMEMS's product line** providing both capacity assurance, meeting their high-volume production needs, as well as the technology roadmap for their next-generation products.



Our partnership with Aledia, announced last year, is moving along with the **development of several platforms of their novel nanotube Gallium Nitride micro-LEDs on silicon**. We are progressing with the development and tools installation according to the plan. This breakthrough technology is expected to ramp to high volume in 2023.

Our Corporate Social Responsibility ▶▶▶▶

At Tower Semiconductor, social responsibility is an essential part of the corporate culture, with an ethical and moral focus in every aspect, providing all employees an opportunity to grow as individuals and to thrive.

Tower Semiconductor aims to enrich and improve not only individuals' lives, but enhance society as a whole and believe social responsibility is essential for a healthy and balanced corporate culture.

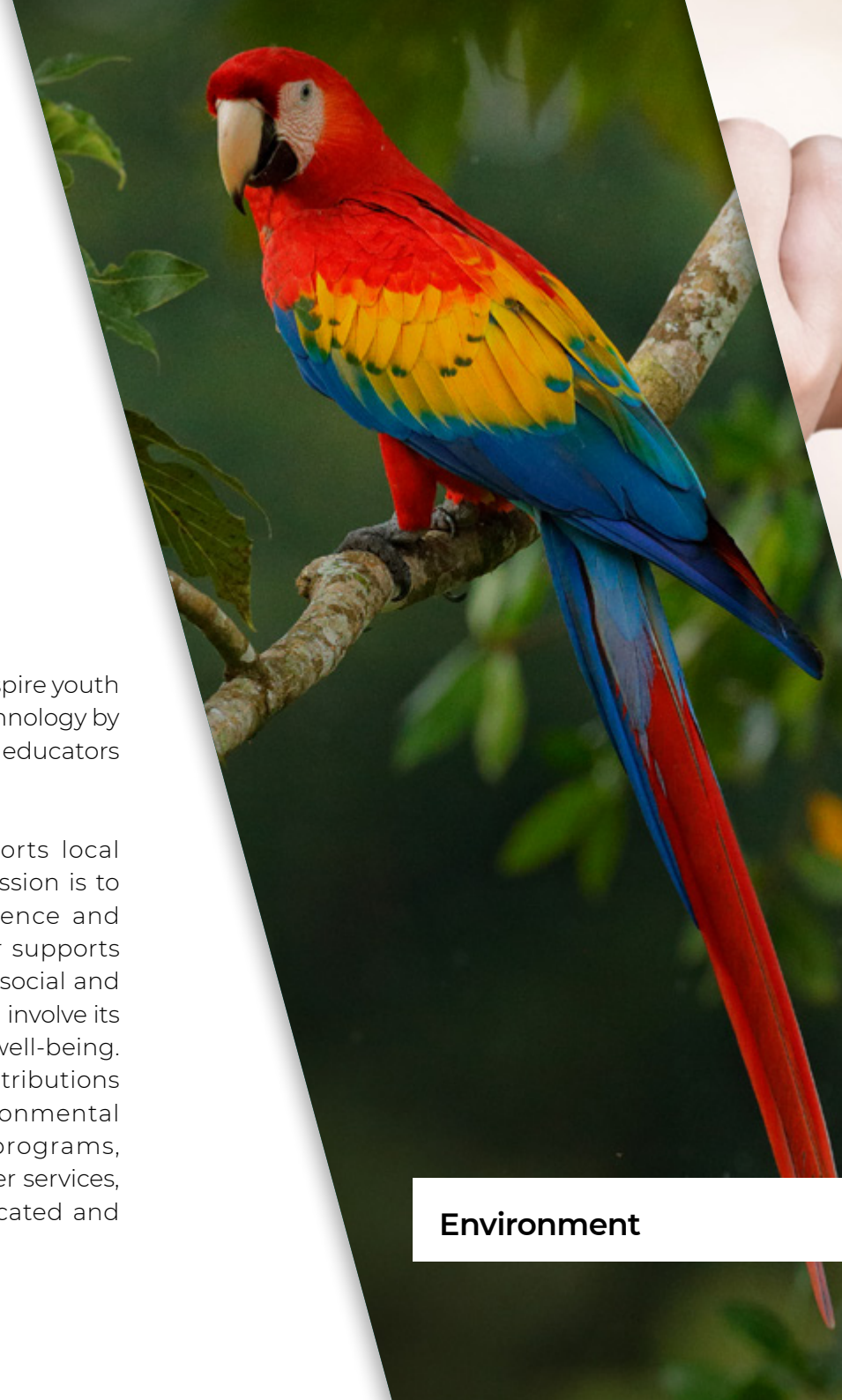
Tower is a partner of the Responsible Business Alliance ("RBA") for many years and has a corporate social responsibility ("CSR") program to ensure implementation and enforcement throughout our organization.

Lead with a Social Purpose

Realizing corporate social responsibility as an integral building block of our success, Tower Semiconductor aims to enrich and improve not only individuals' lives, but enhance society as a whole. We believe that social responsibility is essential for a healthy and balanced corporate

culture. The Company's goal is to inspire youth to pursue careers in science and technology by creating a synergy between current educators and corporate resources.

Tower Semiconductor also supports local educational institutions whose mission is to improve public awareness of science and technology. Tower Semiconductor supports a wide range of health, education, social and community activities that affect and involve its employees and the community's well-being. Tower Semiconductor's social contributions are focused on education, environmental preservation, funding various programs, donating goods, and providing other services, with the involvement of our dedicated and caring employee volunteers.





Social



Responsible Supply Chain Program



Governance



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Tower
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Where **Analog** and **Value** Meet