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productronica China & SEMICON China 2024

SPECIAL ISSUE

INDUSTRY REPORT:

**Digital Manufacturing
Alters Processing Technique**

PRODUCT HIGHLIGHT:

**SINFONIA Pitches IC Transport
Systems in China Market**

MARCH 2024

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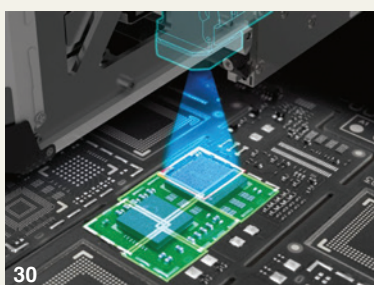
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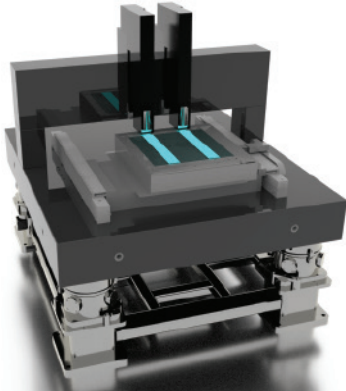
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Applied Materials, Ushio Launch New Digital Lithography Tool for AI Era



New digital lithography technology from Applied Materials and Ushio

UNITED STATES and JAPAN - Applied Materials, Inc. and Ushio, Inc. have partnered to accelerate the industry's roadmap for the heterogeneous integration (HI) of chiplets into 3D packages. Jointly, they bring to market the first digital lithography system specifically designed for patterning advanced substrates needed in the artificial intelligence (AI) era of computing.

"Applied's new Digital Lithography Technology (DLT) is the first patterning system that directly addresses the needs of our customers' advanced substrate roadmaps," said Dr. Sundar Ramamurthy, Group Vice President and General Manager of HI, ICAPS and Epitaxy, Semiconductor Products Group at Applied Materials.

The new DLT system is the only lithography technology that can achieve the resolution necessary for advanced substrate applications while delivering throughput levels required for high-volume production. It can pattern less than 2-micron line widths. Accordingly, the system enables the highest area density for chiplet architectures on any substrate, like wafers or large panels made of glass or organic materials. The DLT system is uniquely designed to solve unpredictable substrate warpage issues and achieve overlay accuracy.

Applied has shipped production systems to multiple customers and has demonstrated 2-micron patterning on glass and other advanced package substrates.

<https://appliedmaterials.com>; www.ushio.co.jp/en/

Panasonic EW Vietnam Starts Operation of New Building



Exterior view of the new building at the Vietnam Plant

VIETNAM and JAPAN - Electric Works Company (EW), Panasonic Corporation aims to expand its wiring fixtures and other electrical materials business on a global scale. Along this line, the New Production Building was constructed in the factory of Panasonic Electric Works Vietnam Co., Ltd. and started full-scale operation last January.

At the same time, Panasonic Electric Works Vietnam has optimized its production lines, including at its existing production buildings, to shorten lead times between manufacture and shipment. The company is also accelerating the introduction of automation technologies and expects to double the current automation rate by 2025. This initiative is expected to enhance production capacity to approximately 1.8 times that of 2022, thus strengthening its market responsiveness.

As additional supplement to its plant-wide energy consumption with solar power generation equipment, the company equipped the New Production Building with highly efficient LED lighting fixtures, heat pump air conditioning equipment, ventilation equipment, and other Panasonic products to promote more energy-efficient product manufacturing.

<https://holdings.panasonic/global>

Yamaha Sets Battery-Swapping Scheme for Compact EVs



ENYRING's subscription service for swappable batteries for compact electric vehicles

JAPAN - Yamaha Motor Co., Ltd. has established ENYRING GmbH that will offer swappable batteries for compact urban electric vehicles (EVs) via subscription-based services. The company aims to create a closed loop system in which recycled materials are used to create new products. ENYRING will be based in Berlin and eyes to start operation in the first half of 2025.

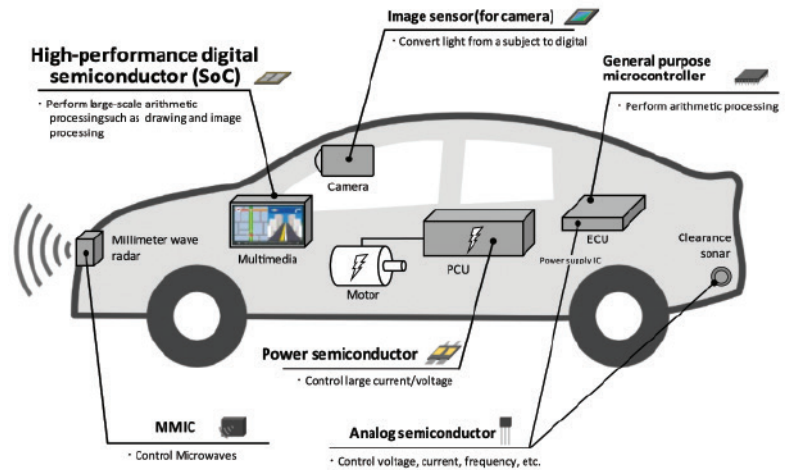
With the target of compact urban electric vehicles in the low-speed range (mainly eBikes), ENYRING's services will rent out batteries available on a subscription basis. These batteries can be easily swapped out at any of the swappable battery stations installed throughout a city at any time. Used batteries that are no longer suitable for mobility use are reused as storage batteries, disassembled into cells, recycled, and reused as new batteries.

ENYRING envisions collaborations between Yamaha Motor and strategic partner companies, and there are plans upon launching operations to expand the business in Germany-starting with Berlin-and in the Netherlands.

<https://global.yamaha-motor.com>

Car Makers Lead New Research Group on Automotive SoC

JAPAN - Twelve companies from the automotive, electrical component, and semiconductor industries had established the Advanced SoC Research for Automotive (ASRA) primarily to conduct research and develop high-performance digital semiconductors (System on Chip or SoC) for use in automobiles using chiplet technology. Accordingly, it aims to install SoC in mass-production vehicles from 2030 onward.



Semiconductors used in a car

Specifically, the participating companies include automotive manufacturers Honda Motor Co., Ltd., Mazda Motor Corp., Nissan Motor Corp., SUBARU Corp., and Toyota Motor Corp. Electrical component manufacturers, include DENSO CORP. and Panasonic Automotive Systems Co., Ltd. Meanwhile, semiconductor companies, include Cadence Design Systems, Japan; MIRISE Technologies Corp.; Renesas Electronics Corp.; Socionext Inc.; and Synopsys Japan.

Keiji Yamamoto, Senior Fellow at Toyota Motor will serve as Chairman, while Nobuaki Kawahara, Senior Advisor at DENSO, will serve as Executive Director.

Mainly, ASRA will pursue high level of safety and reliability required for automobiles by having automakers play a central role. Also, it will bring together the technological and experiential knowledge of electrical components and semiconductor companies for the practical application of cutting-edge technologies. ASRA aims to establish in-vehicle chiplet technology by 2028 and to install SoCs in mass-produced vehicles from 2030 onward.

<https://asra.jp>

MinebeaMitsumi, Cambodia Partner on Solar Power Generation

JAPAN and CAMBODIA - MinebeaMitsumi Inc. and the Cambodian Ministry of Mines and Energy (MME) have signed a memorandum of understanding (MOU) on solar power generation to realize a full vertically integrated production system by adding on-site power generation.

The MOU was signed during the recent Asian Zero Emissions Community (AZEC) Summit. Signing the agreement was H.E. Keo Rattanak, Minister of MME, Cambodia, and Yoshihisa Kainuma, Representative Director, Chairman and CEO of MinebeaMitsumi.

The company's goal is to meet all power needs of its existing factories in the country as well as for future expansions, using renewable energy sources. Working with a local government-approved power utility, the company plans to begin operating a 50MW solar power project in Krakor District, Pursat Province, in FY2025 for the next 20 years. Also, the project will enable the plant to convert all its electricity consumption to renewable energy.

<https://minebeamitsumi.com>

Emerging Trends Boost Next-Generation Materials Further

The technological development of electronic materials is gaining momentum. Meanwhile, electronic technologies enter an era of further sophistication, and the need for sustainability and decarbonization has also grown as well.

For that reason, the electronic materials industry realizes its crucial role in developing advanced materials using core technologies. Particularly, focusing on central applications, such as connected cars, autonomous driving, and shared and electric (CASE) and next-generation communications standards. Equally important are next-generation semiconductor processes and sustainable energy use.

Because of this, material companies are also increasing their investments in production capacity expansion and mergers and acquisitions.

Material Suppliers Supporting New Trends

In the IT electronics and automotive markets, new trends are advancing as drivers. Among them, are the CASE megatrend, the high-speed and large-capacity transmission in communications, as well as miniaturization of

semiconductors. There has also been an increase in demand for cloud data driven by artificial intelligence (AI) and carbon neutrality.

Thus, sophisticated and advanced materials are far more necessary now to support these trends. Electronic material companies are setting their sights on these technological advancements and strengthening their technological development, marketing, and investment strategies from a medium- to long-term perspective.

Emerging Demand in Automotive

By application, the development of power electronics materials and battery materials for BEVs (Battery Electric Vehicles) and other electrically powered vehicles has been active. Moreover, resin material manufacturers are focusing on the development of new grades of polyphenylene sulfide (PPS), polybutylene terephthalate (PBT), and polyamide, with an eye on higher voltages for EVs, among others.

In the ADAS/automatic driving application, novel materials contribute to the improved performance of ADAS components and onboard sensors. Thus, resin materials with high dimensional accuracy, heat resistance, and high rigidity, among others, are emerging to improve the performance of ADAS components and in-vehicle sensors.

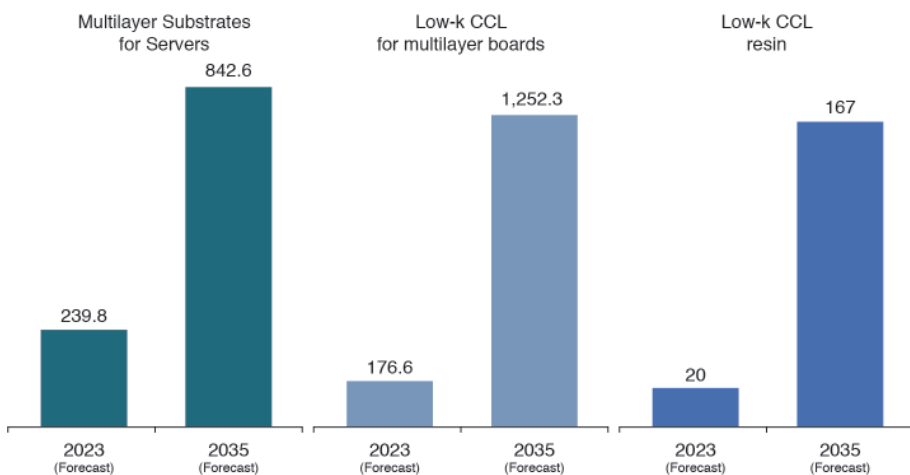
For high-performance mobile devices such as smartphones, tablets, and wearable devices, efforts are focused on the development of materials with excellent high-frequency characteristics that support high-speed, large-capacity transmission at 5G/millimeter wave, high-performance materials that contribute to high-density mounting of devices, and next-generation display materials.

In the semiconductor area, the development of next-generation semiconductor process materials will remain active. The same is true with power semiconductors,



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(Source: Fuji Chimera Research Institute (2024 High Frequency/High Speed Transmission Market Outlook))

Global electronic materials market trend

Continued on page 49

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Materials, Processes Evolve with Digital Manufacturing

As the manufacturing industry migrates to digital manufacturing, innovations flood manufacturing processes. Specifically, laser processing is gaining attention in joining technology. Meanwhile, semiconductor back-end processes are now integrated with surface-mount technology (SMT) processes. Also, the demand for more lightweight electrical vehicles (EVs) spurred new materials development and production technology updates.

Joining Technologies with Focus on Laser Processing

Joining technology has become an essential fundamental technology for the manufacturing industry. There are various joining technologies used in the manufacturing process of electronic devices. Among them include soldering, resistance welding, fusion welding, pulse heat joining, diffusion joining, and laser processing.

Amid the expansion of new industries, like EVs and robotics, the application of laser technology in the manufacturing process has been attracting attention. Accordingly, the demand for laser processing machines begins to expand.

Laser processing involves the emission of energy of electrons in gases and solids as light (laser light). Mirrors or lenses focus on laser light to increase the energy density and is irradiated onto metal or other workpieces for thermal processing. The smaller the wavelength of the laser, the greater the energy of the photons that make up the laser beam, and so on. As the wavelength changes, so does the type of laser change and the rate at which the material absorbs the laser.

A laser oscillator can be solid (YAG, semiconductor, etc.) gaseous (CO₂, excimer, etc.) or liquid (organic dye, etc.). Each has a different laser beam wavelength.

Specifically, CO₂ lasers use carbon dioxide, which is currently the most widely used in laser processing machines. In CO₂

lasers, carbon dioxide mixes with nitrogen and helium in the oscillation tube, resulting in an energy exchange. The CO₂ laser has a wavelength of 10,600nm, which is the longest wavelength of any laser beam. Thus, it achieves higher precision, higher efficiency, and faster tact time than conventional processing methods such as arc welding, resistance welding, and gas cutting.

Meanwhile, the YAG laser is a solid-state laser beam using YAG (yttrium and aluminum composite oxide crystals). It has a wavelength of 1064nm and is mainly used for engraving, welding, and marking.

Fiber lasers are solid-state lasers that use an optical fiber as the medium. Fiber lasers have high energy conversion efficiency because the light is confined within the fiber. Also, they are stable, reliable, and easy to maintain with no optical axis deviation. The beam quality is excellent because of the fiber output. It has a wavelength of 1064nm, the same as that of YAG lasers, and has an extremely small focal diameter.

Along with the spread of EVs, blue lasers, which use wavelengths in the 60 to 480nm ultraviolet region with high optical absorption efficiency, are being developed. They are commercialized as next-generation laser processing technology for copper processing of motors, batteries, and other components. Compared to infrared wavelengths, blue lasers have a higher absorption rate for copper, making them particularly suitable for processing copper materials, which are frequently used in the manufacture of EV motors.

Integration of Semiconductor Back-end, SMT Processes

In the back end of the semiconductor manufacturing process, packaging technologies such as System in Package (SiP), 3D packaging and chiplet technology, are being developed. 3D packaging technol-



Photo 1: Blue laser processing machine under development as a next-generation processing machine.

ogy is used to connect the chips to the substrate. In 3D packaging, multiple chips such as memory and microcontrollers are stacked in a package in three-dimensional orientation. Meanwhile, in chiplet technology, chips are manufactured and integrated using different process nodes.

Specifically, flip chip mounting, which uses through-silicon vias (TSVs) and bumps (solder balls) to connect to the substrate, is expanding for 3D mounting. Meanwhile, multi-chip modules (MCM), in which multiple bare chips and passive components are mounted and packaged as a single IC, are also on the rise.

Recently, the back-end semiconductor manufacturing process and the electronic component mounting process are becoming more seamless. As the mounted components become smaller and the number of semiconductor devices increases, the need for a mounting process that is close to the bonding process is also increasing. Thus, SMT is increasingly being applied to these bonding processes.

Mounting equipment manufacturers are focusing on these trends. Further, SMT companies are expanding their product lineups eyeing the integration of SMT and semiconductor manufacturing processes. Also, they pursue commercialization through mergers and acquisitions.

In August 2018, FUJI Corporation acquired all shares of FASFORD Technology Co., Ltd. (FFT), a semiconductor

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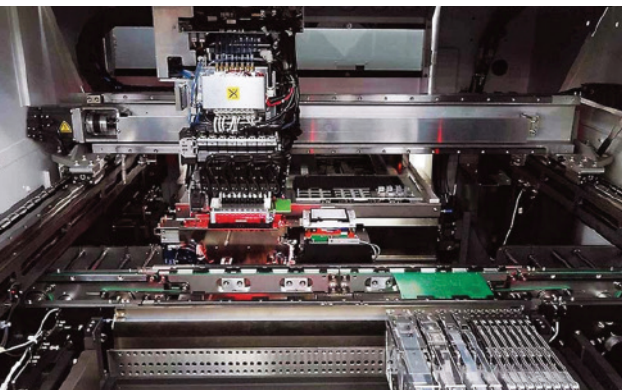


Photo 2: Integration of semiconductor processes and SMT has begun to progress.

manufacturing equipment manufacturer that focuses on die bonding equipment. The new company was created to promote collaboration between FUJI's proprietary technologies cultivated in electronic component mounting robots and FFT's semiconductor-related technologies.

Process Automation Business Division, Panasonic Connect Co., Ltd. specializes in circuit formation processes, including electronic component mounting machines, semiconductor manufacturing equipment, display manufacturing equipment, and software; thermal processing systems, like welding machines; and electronic component mounting machines, including semiconductor manufacturing equipment, display manufacturing equipment, and software. In the semiconductor manufacturing process, the company pioneered the production of dry etch systems, plasma dicers, LCD bonders, die bonders, flip chip bonders, and other products in the chip packaging industry.

Meanwhile, Yamaha Motor Co., Ltd. is the parent company of Yamaha Robotics Holdings Co., Ltd. (YRH), which handles Yamaha's semiconductor manufacturing equipment business. Launched in July 2019, YRH was created through the integration of SHINKAWA Ltd., whose main business is semiconductor bonding; APIC YAMADA Corporation, a molding equipment manufacturer; and PFA Corporation, a semiconductor inspection equipment manufacturer. YRH aims to provide a one-stop smart solution by linking semiconductor back-end processes and SMT processes.

JUKI Corporation had formed a capital and business alliance with AI Mechatec, a flat panel display (FPD) and manufacturing equipment and semicon-

ductor package manufacturing equipment company. It aims also to integrate its semiconductor back-end processes and SMT processes.

Innovations Surrounding Lightweight EVs

In response to global environmental issues, the shift to the adoption of EVs has been progressing worldwide. As EVs require less energy to run long distances, weight reduction has become important. Accordingly, manufacturers are scrambling to develop materials and processing technologies to reduce the weight of vehicles.

In terms of structural materials, high-tensile steel sheets are being used with thinner wall thicknesses to reduce weight. To manufacture high-tensile steel sheets, elements such as carbon, nickel, silicon, and manganese are added in very small quantities to iron to increase strength through microstructure control.

Aluminum, which is lighter than steel, is also increasingly used for engine components such as cylinders, and for exterior panels such as bumper beams, doors, and roofs. The use of magnesium, which is even lighter than aluminum and is currently used in aircraft and rockets, is also expanding.

Moreover, interior parts such as instrument panels and functional parts such as motor housings are increasingly replacing metals with resins such as polypropylene to reduce weight. Polypropylene is suitable for automotive interior parts and electrical components because of its excellent balance of mechanical properties and moldability, as well as its low specific gravity. Carbon fiber reinforced plastic (CFRP), a composite material made by reinforcing resin with carbon fiber, is also expected to be used in EVs, but the processing technology is challenging, and its full-scale adoption is still in the research stage, including productivity. Research is also underway to apply plant-derived and other biomass plastics to EVs, but strength and heat resistance are issues that

need to be addressed before they can be used in EV parts.

Processing technologies are evolving in line with the development of materials for EVs.

For the adhesion of resins used in EVs, a method that improves adhesion performance by modifying the surface is attracting attention. Specifically, surface modification is a process that forms an adsorption layer with strong intermolecular forces on the surface of the adherend material. Also, other methods such as irradiating the surface with short-wavelength ultraviolet light or irradiating with plasma, both of which can be performed in the air, are also available. Plasma irradiation is a surface modification technique that utilizes the electrically neutral radical properties of plasma. Plasma has a low temperature of irradiated gas, and can remove organic contaminants, modify the surface, and improve the adhesive strength of heat-sensitive rubber and resin without causing deterioration of the materials.

Magnesium is considered a relatively weldable metal, but it easily forms oxide film, and the melting point of the oxide film is very high at 2,500°C, which hinders welding processes. For this reason, spot welding, which uses electrical resistance when pressure is applied, and intense laser beams are used for welding.

Laser processing machines are widely used in EV material processing, and blue laser processing is attracting attention in copper processing for EV motors and batteries. The spread of EVs is accelerating technological innovation in material processing. □



Photo 3: EVs use a lot of resin and other materials to reduce weight, and the development of manufacturing methods for these materials is progressing.



Twin China Events Track Future of Key IC Trends

The semiconductor industry has been undergoing drastic changes of late. Most importantly, the emergence of megatrends, such as artificial intelligence (AI), machine learning, Internet of Things (IoT), 5G/6G, and others have also brought changes to the basic foundations of packaging semiconductor chips, which are critical in powering these megatrends.

Cutting-edge semiconductor chips have become essential not only to advance microfabrication technologies but also to introduce more advanced process technologies. Hence, leading chip manufacturers have been earnestly focusing on the development of 2.5D/3D packaging technologies.

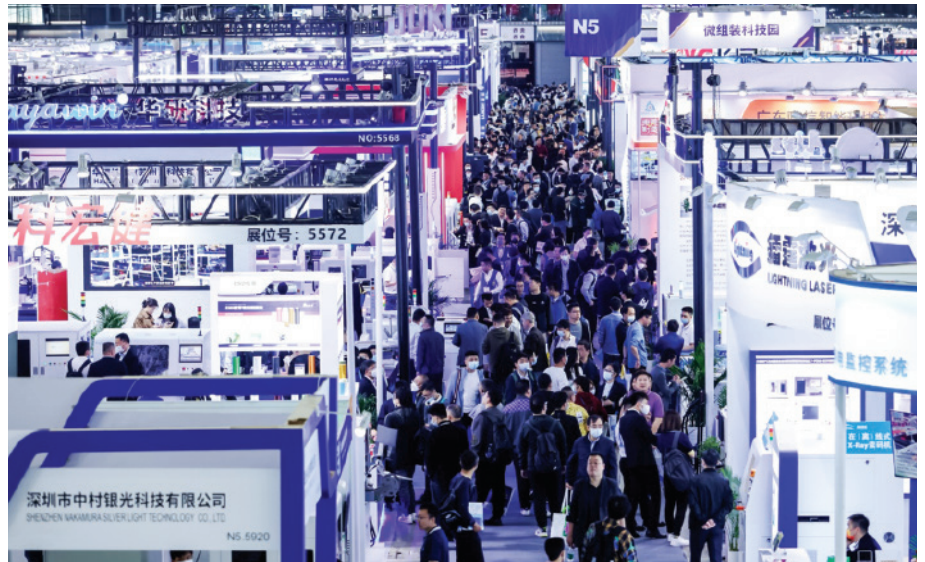
Also, IDTechEX's latest Advanced Semiconductor Packaging 2023-2033 report noted the compelling need for IC vendors to make new approaches in designing processors. This is because of the slowdown of Moore's law and significant increases in the cost of manufacturing a monolithic IC.

For that reason, report authors Dr. Yu-Han Chang, Dr. James Jeffs, and Dr. James Edmondson said a new design called "chiplet" is the key trend going forward.

Critical Foundation of Megatrends

The objective of chiplets is to split a monolithic IC into several blocks, reconstitute them into separate chiplets, and reassemble at the package level. Ideally, the IDTechEX report said a processor based on chiplet design should have the same or greater performance but lower total production costs than monolithic IC. Thus, packaging methods, particularly those used to link several chiplets, play a crucial role in chiplet design since they affect the system's performance as a whole.

Presently, industry experts classify these packaging technologies, such as 2.5D IC, 3D IC, and high-density fanout wafer level packaging, as advanced semiconductor packaging. Primarily,



productronica China show floor

because they allow for the merging of multiple chiplets at various process nodes on a single substrate. Also, to have small bump sizes to enable higher interconnect densities and higher integration capabilities.

Thus, the IDTechEX report said advanced semiconductor packaging serves as a critical foundation for next-generation ICs in four key markets. These are data centers, 5G, autonomous vehicles, and consumer electronics.

China's Vital Trade Events

As industry players track the future landscape of semiconductor packaging and design, China will be hosting two equally important trade events that will chart the technological prospects of the semiconductor industry.

One of them is SEMICON China 2024, which will be held from March 20 to 22 at the Shanghai New International Expo Centre. Since its establishment in 1988, it has developed into the largest and most comprehensive exhibition for the semiconductor industry in China. Particularly, it maps out the entire value chain from design, through development, to the finished product. The ex-

hibition will have six sections: LED, IC Applications, TSV, MEMS, Secondary Technology Applications and Fab Productivity Solutions, Smart Life. National and international exhibitors show thousands of new products, technologies, solutions and services of the industry and represent the key part of Semicon China.

Last year's edition drew a new record high of 90,000sq.m of exhibition space with about 1,100 exhibitors and over 4,200 booths.

Meanwhile, productronica China will also take place alongside Semicon China 2024. Organizers expect productronica China to draw over 800 innovative companies to nearly 70,000sq.m of exhibition floor. Exhibiting the entire electronic manufacturing industry chain, the show will cover electronic and chemical materials, dispensing, and bonding technology. Moreover, it will also electronic assembly automation, test, measurement and quality assurance, electronic manufacturing services, surface mount technology, wire harness processing, connector manufacturing, components manufacturing, motion control and drive technology, industrial sensors, robots, and intelligent warehousing. □

Japan Unix Soldering Robot & Automation Technology

■ ULD-02 Laser Soldering



The new ULD-02 laser soldering unit from Japan Unix Co., Ltd. has enhanced the control and optimization of the soldering process compared to conventional product. By adopting a unique temperature control method and by combining a radiation thermometer and laser output, it can simultaneously monitor and control the laser output and temperature during soldering. The temperature during soldering is visualized and can be saved as log data, which can later be used as soldering process management data. In addition, the personal computer software Soldering Manager enables editing laser output conditions, acquiring log data during soldering and saving video during soldering. It has achieved visualization of the soldering process.

■ UNIX-HFR SCARA Type Soldering Robot



The UNIX-HFR SCARA type soldering robot has the following features: (1) It is equipped with an Ethernet communication port to transmit the operating status to a PC or PLC; (2) The dedicated PC software "Soldering Configurator" makes it easy to edit soldering conditions; (3) It promotes easy switching between standard feeder and clean-cut feeder; (4) Available twin solder feeding as an option; (5) The monitoring software "Soldering Manager for FR" enables real-time monitoring of robot operation status.

■ Soldering Manager: Software for Controlling Soldering Robot

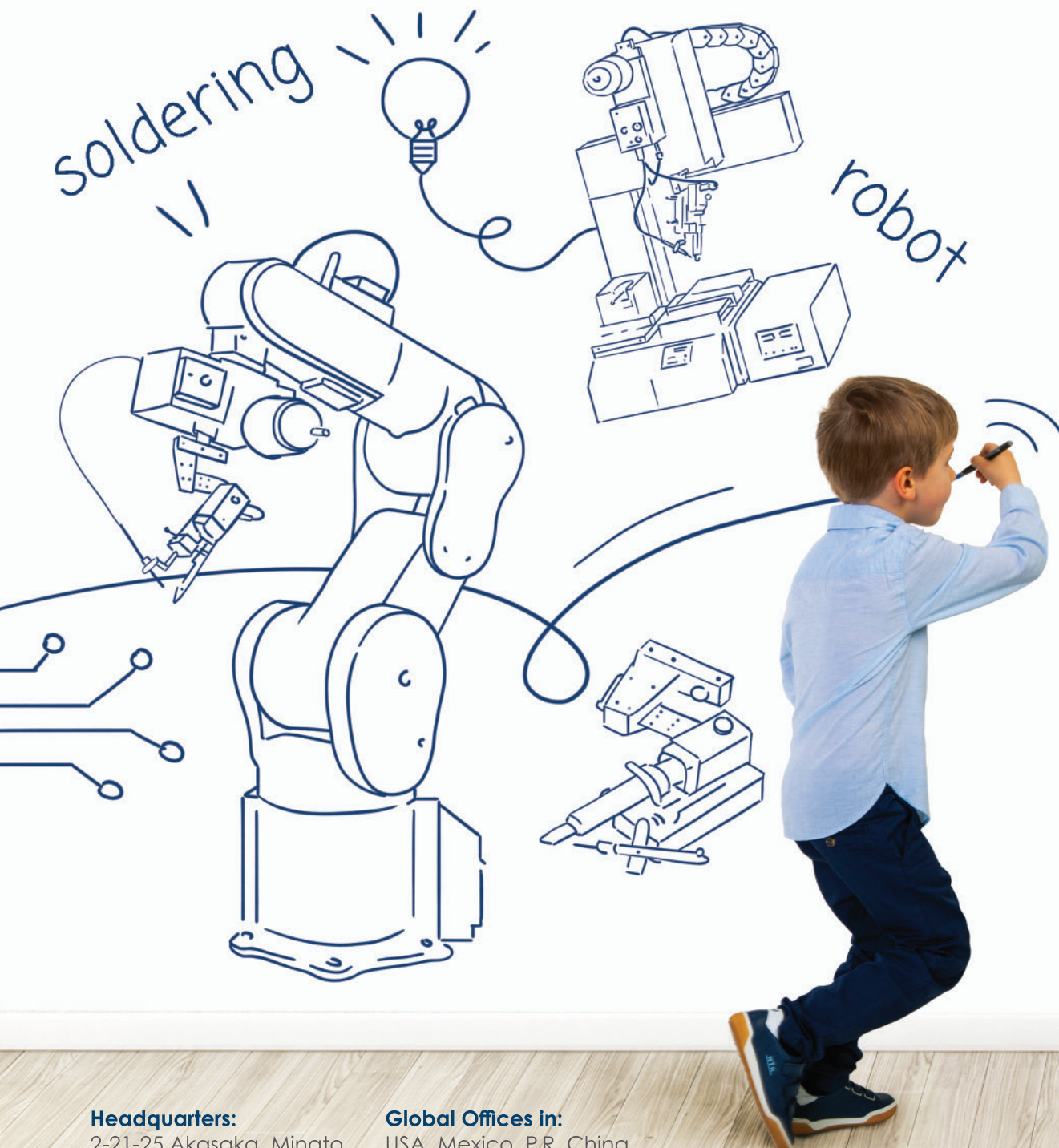
The "Soldering Manager" software for the control of soldering robots developed by Japan Unix can monitor the status of soldering equipment using a personal computer as internet of things (IoT) device for soldering. It enables automatic saving of various collected data.

The saved data can be used in various forms, such as understanding normal values for various quantities and investigating causes when a problem occurs. The main stored data include the alarm history of robots and heaters, history of tip position corrections, board codes, image of the soldering process, heater temperature, feeder feed results, number of tip shots, number of cycles, amount of solder feed per cycle and cumulative solder feed amount, robot operating time, and others. In addition, by reading the QR code on the board, the data at the time of each soldering work can be controlled on a board-by-board basis.



Care for tomorrow

Always master soldering, with cutting-edge solutions from Japan Unix – today, tomorrow, and under any circumstances.



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2-21-25 Akasaka, Minato,
Tokyo 107-0052

Global Offices in:
USA, Mexico, P.R. China,
Taiwan, South Korea, Malaysia, India

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Fasford Leads in Bonding Technology Offerings

DB850H, High-Quality and High-Productivity with Intermediate Stage

Supporting high stacked memory, DB850H is positioned as a higher-end model of the DB830plus+. The DB830plus+ has been recognized as an industry standard and has recorded high machine sales. Meanwhile, the DB850H achieves high quality and high productivity with the adoption of an intermediate stage. Also, it features the industry's highest level of mounting accuracy at $5\mu\text{m}$.

With each successive transistor generation, the vulnerability of 3D NAND chips becomes more apparent. It now requires advanced pick-up and handling technologies. For this reason, the DB850H offers various ejector options.

The DB850H contributes to yield improvement by making the inside of the equipment clean along with a new function to detect micro-cracks on the chip surface before and after bonding. This serves as a countermeasure against foreign matter between stacked chips, offering product differentiation from competitors. The system has already been adopted by several customers.

In recent years, the transportation of parts and materials to customer factories has become increasingly automated. Along this line, the DB850H leverages abundant experience with automated guided vehicles (AGVs), overhead hoist transport (OHT), and other automated transportation systems, which is another strength.



DB850 series

The industry is expected to see further expansion in demand as memory inventory adjustments run their course. In particular, the Chinese market is expected to continue to invest in memory production due to the acceleration of domestic production.

DB820 Die Bonder for Logic and CIS Applications

Fasford Technology supplies high-performance die bonders used in back-end semiconductor manufacturing processes. The company enjoys a high share of the memory die bonder market, with its low-stress die pickup technology and high-precision die stacking technology at core. In recent years, the company has also introduced a lineup of products for logic devices, contributing to improved productivity of cutting-edge devices.

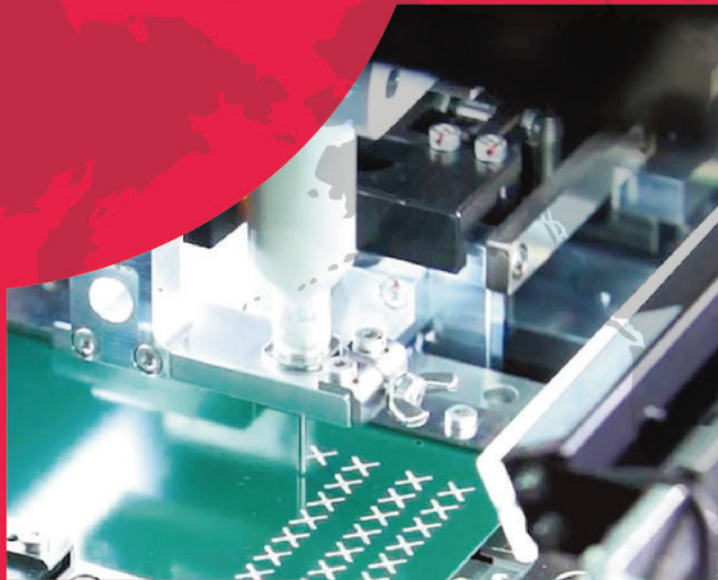
The DB820 is a die bonder optimized for logic device production. Based on the DB830plus+, which has a strong track record in memory applications, the DB820 has features such as high quality and high stability. It supports die bonding of small chips and has achieved stable die handling down to a minimum of 0.3mm square.

In addition to the paste process, it can also be produced using the die attach film (DAF) process. It supports miniaturization of packages, high-density mounting, and stacked structures. Bonding accuracy is $15\mu\text{m}$. Since its launch last year, the product has been gaining popularity in the field of consumer electronics. In the future, the company plans to



DB820

propose the product to the automotive industry and sensor assembly processes.



Providing tools that help make the world smarter.

Our die bonders for memory have the top share in the world.* It is one of the semiconductor manufacturing equipment indispensable for the production of memory chips used in smartphones, which are utilized by the majority of people worldwide, as well as in SSDs and other devices.



※According to our own research

www.fasford-tech.com

FASFORD TECHNOLOGY

FC300 Supports Bonding of Large Panels

The FC300 is a die bonder for bonding large panels used in FOPLP production. It is capable of mounting on large panels of up to 750 × 750mm, and can also handle mixed processes of multiple types of wafers. Bonding accuracy is 3 to 5 micrometers. Equipped with high-resolution optics and improved die position recognition accuracy to achieve high quality and high productivity. Switching between face-up and face-down bonding is also easy, providing a high degree of flexibility for production lines.

Several units of the FC300 have already been sold to certain customers as FOPLP mass production machines.

Compared to wafer-level FOWLP, FOPLP is expected to improve productivity, and the market is expected to expand further in the future.

Fasford Technology is also developing ultra-high-precision models for advanced packages, which are becoming increasingly miniaturized and three-dimensionally integrated. The R&D Center, which has been under construction for some time, was completed on November 29, 2023. The concentration of previously dispersed engineers in the R&D Center will speed up the development process. Equipped with a Class 1 clean room, the center aims to realize high-



FC300

precision die bonding in an environment as clean as that of the previous process.

NEDO Taps Furukawa Electric in Post 5G R&D Project

Furukawa Electric Co., Ltd. has been selected to participate in the “Research and Development Project of Enhanced Infrastructures for Post 5G Information and Communications Systems/Advanced Semiconductor Manufacturing Technologies” conducted by the New Energy and Industrial Technology Development Organization (NEDO). Using the company’s knowledge in photonics, it will work to develop next-generation optical semiconductor devices.

Around the world, 5G is increasingly being used in commercial operations. Going forward, it is expected that data will be sent, processed and used in a wide range of areas in addition to general users, particularly in smart cities, agriculture, corporate digital transformation (DX) and mobility. To realize the infrastructure for these next-generation communications environments, there is increasing need for 5G with enhanced functionality (Post 5G), including ultra-low latency and multiple simultaneous connections.

Furthermore, the research project aims to strengthen the development and manufacturing foundation for Post 5G information and communications systems through the development of core technologies for Post 5G information and communications systems and manufacturing technology for the advanced semiconductors required by such systems.

Furukawa Electric will partner with Nippon Telegraph and Telephone Corporation, NTT Innovative Devices Corporation, NTT Devices Cross Technologies Corporation and Shinko Electric Industries Co., Ltd. to conduct research and development for the project’s “Advanced Semiconductor Manufacturing Technologies”.

Specifically, Furukawa Electric will create an optical semiconductor device that realizes photonics-electronics convergence as shown in Fig. 1. For the light source shown in Fig. 2, due to

the requirements for increased output, reduced power consumption and integration with silicon photonics, it will work to develop manufacturing technology to create an optical semiconductor device for mass production. The project is scheduled to be implemented for five years until FY2028. □

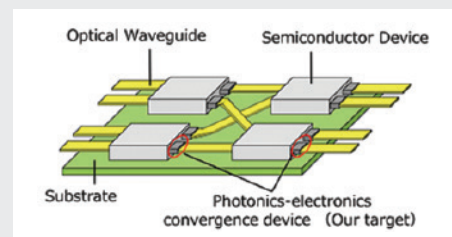


Fig. 1: Conceptual image of the photonics-electronics convergence device

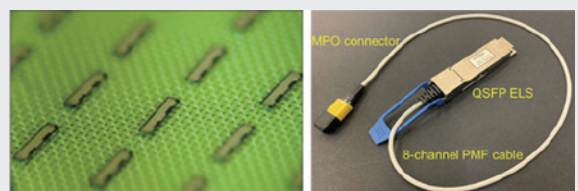


Fig. 2: High power Distributed Feedback Laser

SINFONIA Beefs up Transport Systems for Front-end IC Process

SINFONIA TECHNOLOGY (SHANGHAI) CO., a Chinese subsidiary of SINFONIA TECHNOLOGY CO., LTD. provides a variety of products as well as sales and support services to the Chinese market. It has offices in Shanghai, Guangzhou, Tianjin, and Chengdu. Specifically, the company continues to focus on semiconductor transfer systems in line with the expansion of the semiconductor market in China.

At SEMICON China 2024, SINFONIA will exhibit a rich lineup of its mainstay semiconductor transfer system products, such as the 300mm FOUP LOAD PORT and Equipment Front End Module (EFEM).

BOLTS-M 200mm SMIF LOAD PORT

In response to the growing needs for the automation of 150mm and 200mm production lines for power semiconductors, SINFONIA has developed a new SMIF load port. The company utilized the technology and know-how accumulated in the development of the 200mm SMIF Opener, which was commercialized about 20 years ago, and the 300mm FOUP LOAD PORT, which is its current main product.

This product complies with the SEMI E63 (BOLTS-M) standard. Also, it is equipped with a mapping mechanism that enables installation in 300mm production lines with SEMI E15 C2 dimensions, which is the transfer area, targeting the automatic transfer in overhead hoist transport (OHT) and automated guided vehicles (AGVs).

N2 Purge 300mm FOUP LOAD PORT

At SEMICON China 2024, the N2 Purge will be demonstrated on a 300mm EFEM.

SINFONIA will exhibit the N2 Purge 300mm FOUP LOAD PORT, one of its flagship products, for the first time. This is in response to the growing need for miniaturization in the Chinese market. In addition, a 300/200 Auto Switch LOAD PORT for front-end process will also be exhibited.

Tape Frame FOUP LOAD PORT

For the back-end process, the company has developed three



BOLTS-M 200mm SMIF LOAD PORT



N2 Purge 300mm FOUP LOAD PORT



**Tape Frame
FOUPL LOAD PORT**



No.3 Plant in Thailand



Clean Transport System Works FAB3 in Japan (Toyohashi Plant)

models, including the Tape Frame FOUPL LOAD PORT (SEMI standard). It utilized the technology and know-how accumulated in the development of load ports for the front-end process. Models for the Chinese market will be exhibited.

Reinforcement of Production System

SINFONIA sets its sights on the semiconductor-related field as the most important industry to focus on, as stated in "Made in China 2025". To respond to Chinese customers in this field, the company is currently expanding its production area and constructing a new plant.

Specifically, the Toyohashi Plant, SINFONIA's main plant, in Aichi Prefecture in Japan will increase its monthly production of EFEMs and other products by 2.4 times compared to the previous level. In addition, load ports will be increased by 1.8 times at the Thai Plant and 1.5 times at the Ise Plant in Mie Prefecture, also in Japan.

About This Article:

SINFONIA TECHNOLOGY CO., LTD. provided the contents of the article.



SINFONIA

Clean Transport System Solutions for Front-End and Back-End Processes



SMIF
Load Port

200mm



300/200mm Wafer
Auto Switching Load Port

300mm



N2 Purge 300mm
FOUP Load Port

Tape
Frame



Tape Frame FOUP
Load Port



EFEM



Sorter



Tape Frame EFEM

昕芙旎雅商贸(上海)有限公司
SINFONIA TECHNOLOGY (SHANGHAI) CO., LTD.

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<https://www.sinfo-t.jp/cn/>

ADEKA's Materials Drive Semiconductor, LCD Industries

The ADEKA Group is a global company that provides valuable products in a wide range of markets, with chemicals, foods, and life sciences as its core businesses. It was established in 1917 and is headquartered in Tokyo, Japan.

Driven by the desire to "enrich people's lives in step with the times," ADEKA is continuously taking on the challenge of creating new elemental goods while confronting social issues that change with the times. The company aims to realize a sustainable society and enriched lifestyles by developing valuable materials and goods.

Its chemicals business supports a wide range of industrial fields with a variety of products unique to the ADEKA Group. These range from inorganic and organic intermediate products to fine chemicals, such as additives for plastics and high-

performance materials for semiconductors and digital home appliances. Meanwhile, the food business provides high value-added products developed with proprietary technologies for breads and confectionery items sold in bakeries, confectionery stores, supermarkets, and convenience stores. In addition, ADEKA has been promoting new areas such as environment and energy and life science under the life science business by integrating the technologies developed in both the chemicals and food business fields.

Today, in an era of globalization as well as IT-driven changes in the industrial structure, economy, and society, ADEKA is particularly focusing on the development and supply of semiconductor-related materials. As a chemical manufacturer, it aims to become a global technology leader and a company that contributes to society.

Products on Display at SEMICON China

At SEMICON China 2024, ADEKA will be exhibiting its expertise in high-purity etching gases for semiconductor front-end processes, atomic layer deposition (ALD) and chemical vapor deposition (CVD) materials for functional films such as high-k, low-k, and inter-layer dielectric films, photopolymerization initiators used in resist materials for LCDs and ultraviolet (UV) adhesives and coating materials, and UV resin additives. Additionally, it will introduce photoacid generators for photoresists for semiconductors.

Technical Cooperation with Chinese Company

In the area of high-purity etching gases, ADEKA supplies three product lines of ADEKA HIGH-PURITY



Photo 1: ADEKA high purity gas



Photo 2: ADEKA SUPER Series and ADEKA ORCERA Series

CHLORINE, ADEKA HIGH-PURITY HYDROGEN BROMIDE, and ADEKA HIGH-PURITY BORON TRICHLORIDE from Japan to the rest of the world. In addition, to meet the strong demand for high-purity liquefied chlorine, in recent years the company has been striving to strengthen its supply capacity through a technical cooperation with Jiangsu SINOPURE Electronic Materials Co., Ltd., which has a production base in Lianyungang City, Jiangsu Province, China.

High-Quality and Stable Materials for ALD/CVD

In ALD/CVD materials, ADEKA develops the ADEKA ORCERA Series, which forms high-k dielectrics, insulating films, and other materials. The role required of ALD/CVD materials is increasing year by year due to the remarkable evolution of process nodes for memory semiconductors, which store and retain data and logic semiconductors that perform logic operations.

The company is building a manufacturing system to provide a diverse product lineup of metal complexes and high-purity products with stable and high quality. Moreover, the company is enhancing its analytical and product container management technologies to respond to semiconductor miniaturization technology.

ADEKA also offers ALD/CVD materials for image sensors for image processing and power semiconductors that are indispensable for efficient power operation. Photoinitiators, resist additives, and photoacid generators are available in the ADEKA ARKLS Series to meet a wide range of customer applications. Its photoinitiators include radical photoinitiators of the oxime ester type, which are characterized by high sensitivity, long wavelength, and high transparency, contributing to improved performance of color filters for LCDs and other applications. UV resin additives can also prevent oxidative degradation of coating films without interfering with UV

curing, thereby inhibiting coloration and peeling.

Also, its photoacid generators are compatible with a wide range of light sources, from deep-UV to i-line. Technological innovation of photoacid generators for photolithography is required in line with the miniaturization of semiconductors. ADEKA designs and develops high-quality products that contribute to miniaturization and high-density packaging by making full use of its ppb-order metallic impurity control technology.

About This Article:

ADEKA Corporation (<https://www.adeka.co.jp/en/>) provided the contents of the article.

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Hosiden Adopts Eco-Friendly Materials for High-Speed Connectors

Amid the increasing social awareness in protecting the environment, approaches that seriously implement Sustainable Development Goals (SDGs) are in great demand. Of particular concern are eco-friendly materials which are plant derived to reduce the consumption of resin materials from petroleum. Such products are already in use for everyday items such as spoons, straws, and shopping bags, and lately even vehicle interior/exterior and housings of domestic appliances. However, these eco-friendly materials are generally given less consideration for use as actual electronic components. Hosiden Corporation has started pursuing the use of these materials in high-speed connectors, an important electronic component.

Customized XecoT for High Speed Signal Connectors

While researching for such eco-friendly materials, Hosiden has identified

the suitability of XecoT by Unitika Ltd., a semi-aromatic nylon resin (PA10T) made of castor oil harvested from castor beans. As XecoT is highly heat resistant and moderately hydrophobic, it already satisfies the basic requirements for resin-based connectors. However, XecoT still needs improvement in two critical physical properties - dielectric constant and dielectric loss tangent - to make it suitable for applications in high-speed signal connectors. Thus, Hosiden and Unitika have been working together, sharing knowledge and insight to jointly develop a customized "XecoT" material that is more suitable for high-speed signal connectors.

Among the newly developed materials, Hosiden's jointly developed Customized "XecoT" has an assured high biomass content of 30% or more. This means the Biomass Mark would be applicable if the products using it were

shopping bags or cutlery. In addition to its high biomass content, impedance control is achieved from a lower dielectric constant and dielectric loss tangent as well as minimized transmission losses compared to conventional products.

The companies have already prototyped the connectors and have verified that these eco-friendly connectors are able to reproduce comparable transmission characteristics to conventional products.

"We will certainly use this Customized "XecoT" in new products, and further, we will also prepare for the future needs and requests from our customers for more eco-friendly selection of Hosiden products. As an electronic component manufacturer, we will seriously commit to sustainable development goals, offering our new "eco-friendly" product portfolio to customers along with other options as performance, quality and cost," says Hosiden. □

Automation Advances with JUKI's State-of-the-Art Solutions

At productronica China 2024, JUKI Corporation will introduce state-of-the-art machine solutions that promote automation with the theme of "JUKI Smart Solutions - Solving problems together with customers and improving productivity through DX of production processes!". The company will introduce state-of-the-art machine solutions that promote automation and improve productivity through digital transformation.

■ Automated Solutions for Parts Management

JUKI will introduce its Intelligent Storage Management System "ISM Series" as a solution for parts management that flexibly responds to changes in factory layouts and increasing automation requirements.

The ISM3600 automated warehouse is a free-location, high-capacity design that saves space in the parts management process.

Furthermore, by utilizing the "Incoming Material Station," a material receipt registration system, the ISM3600 automates and streamlines each process of parts management, from parts receiving to parts warehousing and shipping.

In addition, the AMR automatic transfer robot can be used to link the line with the SMT process, the ISM3900 expansion unit can be used to increase the number of parts stored, and existing shelves can be used to build a parts management process that meets customer needs.

Accurate parts management is possible by linking with



Intelligent Storage Management System "ISM series"



Material receipt registration system "Incoming Material Station"

business management systems such as manufacturing enterprise system (MES)/enterprise resource planning (ERP), which also improves the efficiency of inventory operations.

The ISM Series is an innovative solution that improves productivity and efficiency of overall parts management.

■ Automated Inspection Solution

The Visual Inspection Machine "SE1000" is an automated inspection machine that applies JUKI's unique image recognition inspection technology, which features high accuracy. It inspects parts for dimensional measurements, scratches, dents, flatness, and other defects currently inspected visually or by sampling inspection using measuring instruments.

In response to the recent demand for more sophisticated quality requirements, this machine quantifies visual and sensory inspections; thereby eliminating variations in inspection quality and enabling total inspection, reduction of inspection tact time, reduction of inspection personnel and management man-hours, and traceability of inspections.

JUKI proposes automated inspection solutions that solve problems in inspection and measurement processes at factories and lead to a smart factory that improves quality and productivity.



Visual inspection machine "SE1000"

■ Optimization Solution for the Entire SMT Line

The SMT optimization solutions optimize the entire SMT line and improve productivity throughout the production floor.

The High-Speed Compact Modular Mounter "RX-8" is a compact design that achieves a high speed of 100,000CPH and highlights the highest area productivity in its class.

Furthermore, the ultimate all-in-one mounter "RS-1R," combines versatility and high speed for a wide range of components. The combination of the "RS-1R" and the 3D board visual inspection machine "RV-2-3DH" enables the construction of high-speed, high-production mounting lines.



High-Speed Compact Modular Mounter "RX-8"



Multitask Platform "JM-100"

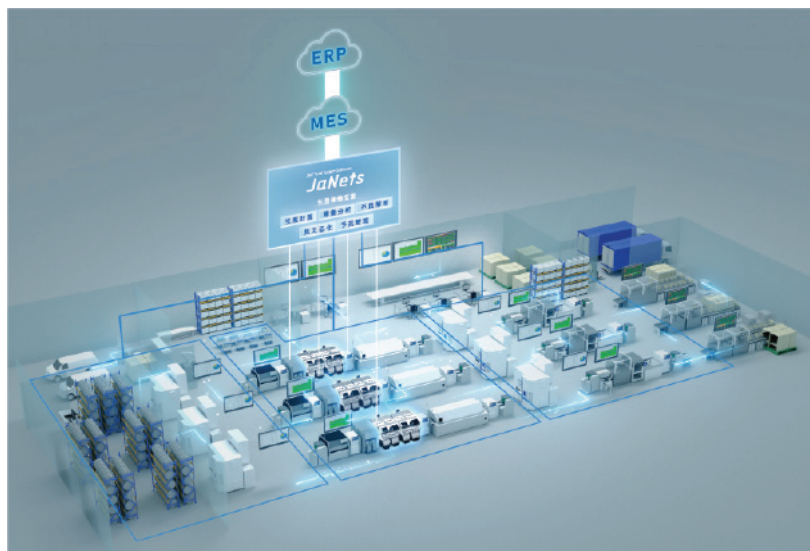


The latest SMT line centered on the High-Speed Compact Modular Mounter "RX-8"

In addition, for component insertion in the back-end process, the "JM Series" Multitask Platform, which features the industry's top installation record, proposes high-speed, high-precision automation of the insertion process.

In terms of systems, the JM Series will be linked with "JaNets" and "IFS-NX," which streamlines the entire SMT floor, to support further high-quality production. It visualizes production progress and equipment operation status, provides traceability, and prevents incorrect part insertion.

JUKI proposes SMT process optimization solutions that optimize not only the mounting process, but also the entire SMT line by integrating pre- and post-mounting processes and production control systems to improve productivity.



"JaNets" for streamlining the entire SMT floor

JUKI Booth: E5.5542

YR Series Embodies Yamaha's Smart Manufacturing Platform

THE YR SERIES NEW GENERATION PLATFORM INCLUDES NEWLY DEVELOPED PRINTERS, MOUNTERS, AND AOI SYSTEMS, ENABLING SUPPORT FOR BOTH SINGLE-LANE AND DUAL-LANE PRODUCTION, THUS RESPONDING TO A WIDE VARIETY OF PRODUCTION FORMATS.

In the rapidly changing world of recent years, further evolution of electronics is required to pursue and sustain the security and happiness of society and people. One of the key technologies supporting this is surface mount technology (SMT).

Creating Value that Exceeds Market Expectations

Providing innovation to production sites

Yamaha Motor Co. has developed SMT devices using state-of-the-art robotics technology. It has proposed a unique concept, "1 STOP SMART SOLUTION," in order to contribute to the future of electronics.

This 1 STOP SMART SOLUTION is,

(1) The company has the know-how and resources to develop and manufacture all the main equipment for SMT production lines under a single brand name.

(2) Each piece of equipment must have top-level performance as a stand-alone product.

(3) The synergistic effect of linking each piece of equipment together as a production line can realize advanced solutions and added value that only one-brand collaboration can provide.

The three conditions must be met to be successful.

Yamaha Motor has a complete lineup of high-performance major SMT equipment. The "Intelligent Factory" IoT/M2M integrated system based on the latest IT technology is an ideal concept to link these equipment with each other using advanced M2M without a black box to achieve a high synergistic effect. The ideal concept of 1 STOP SMART SOLUTION is realized.

The YR Series is a new generation platform that embodies the further evolution of this concept, with printers, mounters, and automated optical inspection (AOI) all newly developed. The YR Series supports not only single-lane production, but also dual-lane production, making it possible to respond to a wide variety of production formats.

Support for dual lane production

The new-generation YR Series lineup includes the following products:

(1) The YRP10 premium printing press offers the world's highest level of printing performance and fully automated setup changeover and is capable of dual-lane production.

(2) Our unique 3S head, which employs a new 3SR squeegee

with revised materials and shape, allows the squeegee attack angle during printing to be freely adjusted by a servomotor, enabling optimal control of solder filling force and through-hole printing. In addition, the single squeegee

feature reduces the quality difference between the outward and return paths during printing. The squeegee is easy to attach, detach, and maintain when replacing the squeegee.

While providing the industry's top-level high-speed printing performance with a core cycle time of 6 seconds, the new system achieves high printing accuracy of $\pm 6\sigma: \pm 16\mu\text{m}$ ($\text{Cpk} \geq 2.0$) (based on CeTaQ's measuring machine under our optimal conditions).

Also, focusing on the reduction of man-hours in the printing process, the new system includes "automatic program changeover" and "PSC (Print Stability Control) system," which is compatible with a new 12 oz. syringe and improves non-stop operation time.

In addition to the "automatic program changeover" and the "PSC (Print Stability Control) system" that has improved non-stop operation time for 12 oz. syringes, "Automatic push-up pin exchange," "Automatic Stencil Exchange," and "Automatic Solder Paste Transfer" realize fully automated setup changes, significantly improving production efficiency and preventing human error.

Moreover, dual-lane specifications, which allow each lane to operate completely independently, can be selected, enabling flexible and highly efficient response to a wide variety of products and production formats.

(3) The premium high-efficiency modular "YRM20DL" is a higher-end model of our flagship universal high-speed mounter "YRM20," which is the first to adopt the YR Series platform.

The dual-lane conveyor with a highly rigid design is installed as standard equipment, and by optimizing the substrate positions on the two lanes and the travel distance from the suction position to the mounting position, the mounter has achieved the world's fastest level of 120,000CPH (according to Yamaha



YRP10 premium printer



YRM20DL super high-efficiency dual-lane modular

Motor, February 1, 2023) in the 2-beam, 2-head class and a $\pm 25\mu\text{m}$ (Cpk) capacity. High-precision mounting of $\pm 25\mu\text{m}$ (Cpk ≥ 1.0) is achieved simultaneously. In high-precision mode, it achieves ultra-high precision of $\pm 15\mu\text{m}$ (Cpk ≥ 1.0) and supports mounting of 0201-size

ultra-small chip components and narrow adjacent mounting.

Three types of heads can be selected for mounting: the ultra high-speed rotary type "RM head," the high-speed general-purpose in-line type "HM head" that realizes the "1-head solution" concept at a high dimension, and the in-line type "FM head" that supports different shapes and emphasizes component compatibility.

The "eATS30" automatic tray feeder, which greatly reduces downtime with its advanced "non-stop supply" and "collective replenishment," and the compact "cATS10R" automatic tray feeder with high cost performance, are available in any combination according to the quantity of tray parts and budget. Up to two units can be installed in any combination according to the quantity of tray parts and budget.

In addition, various functions to support the creation of parts data provide powerful support for vertical start-up of new production.

(4) "YRi-V" is a high-end class 3D optical visual inspection system that achieves the industry's highest level of inspection capability by adopting a newly developed inspection head equipped with a high-speed, high-resolution camera and a high-performance GPU, as well as versatility of 2D inspection, 3D inspection, and 4-angle image inspection in one unit. The new system is equipped with a newly developed inspection head with a high-speed, high-resolution camera and a high-performance GPU.

The new 3D projector and the new $5\mu\text{m}$ resolution lens, in addition to the conventional $12\mu\text{m}$ and $7\mu\text{m}$ resolution lenses, have doubled the measurement accuracy and range compared to the previous model, enabling highly accurate and high-speed 3D inspection of 0201 ultra-small chip parts and narrow adjacent parts by high-resolution imaging that is not affected by blind spots on the parts. At the same time, the system has improved detection of scratches, cracks, and chips on mirror-finish parts, which have been difficult to detect in the past.

It also supports dual-lane production lines and large PCB up to L610 mm (OP: L1200 mm) $\times$ W610 mm. In addition, the YR Series has greatly improved ease of use by simplifying and eliminating the need for skillful creation, conversion, and tuning of inspection data through automation of functions and adoption of AI (Artificial Intelligence) deep learning.

The YRP10, YRM20DL, and YRi-V in the YR Series all

support dual-lane production, making it possible to build a full dual-lane production line with the YR series to meet diverse needs.

Advanced linkage with intelligent factory

Various supports are realized through advanced linkage with intelligent factories.

1 STOP SMART SOLUTION enables M2M linkage without a black box, enabling advanced visualization of the entire line, and a dashboard enables visualization of the entire line to provide a wide range of production support.

- i. Visualization of production (supports effective operations by visualizing the real production status at the present time)
- ii. Improvement of utilization ratio (reduces downtime and enables effective production)
- iii. Improvement of adsorption, automatic analysis (improves parts loss cost, chock stop, and production quality)
- iv. Improved quality (quick cause determination and trouble resolution through mutual coordination of printers, SPI, mounters, and AOI)
- v. Maintenance support (Enables maintenance at optimal timing and reduces man-hours)
- vi. Production result reports (enables visualization and data generation of monthly production status).

First, visualization of the production of the entire line, followed by analysis of detailed content, will lead to improvements in utilization rate, adsorption rate, and quality. Reports on production results and other information will also be available. However, in order to respond to the voices of those who say that even if they have an analysis tool, they do not know what to do with it, or that they are too occupied with their daily work to have enough time for analysis, we have developed an "automatic analysis" function as the next step.

For example, the software automatically analyzes the causes of pickup errors in free time to determine whether the nozzle or feeder is the likely cause of the error, so that production engineers and operators can perform tasks as instructed by the dashboard (e.g., "replace feeder XX" or "check recognition data of XX"). The improvement effects of these operations can be evaluated and reported.

The system is also equipped with a function that presents the results of the improvement effects of these operations. Repeated improvements based on such automatic analysis will enable the improvement of production by reducing the number of chock stops and the quality degradation caused by pickup and printing defects.

1 STOP SMART SOLUTION enables highly efficient, high-quality production through advanced coordination of superior equipment groups.

The concept of 1 STOP SMART SOLUTION, which is highly effective in SMT lines, has been further extended to the integration of processes from semiconductor back-end processes to electronic component mounting processes and product assembly, which are expected to be developed in the future. We are aiming to create value that exceeds the market's expectations. Aiming to create value that exceeds market expectations, Yamaha Motor will promote a system that enables the one-stop provision of further innovations to electronics production sites.

About This Article:

Yamaha Motor Co. provided the contents of the article.

FUJI Leads Digital Manufacturing With Smart Factory Platform

THE INTERNET OF EVERYTHING IS SET TO CHANGE THE MANUFACTURING LANDSCAPE AND FUJI AIMS TO LEAD THE TRANSFORMATION TO DIGITAL MANUFACTURING AND LEVERAGE ON ITS TECHNOLOGICAL STRENGTHS.

FUJI is committed to future-oriented technological innovations as the leading brand for factory automation processes in semiconductors and beyond. Internet of Things (IoT) technology has brought innovations into our daily lives and industrial fields. Nonetheless, there is still plenty of room for future evolution to realize the Internet of Everything (IoE).

The evolution from IoT to IoE requires building more advanced systems by integrating a wide range of elements such as people, processes and data beyond just things, and having coordination between each of them. As illustrated by the realization of the CASE concept - the ongoing transformation of automobiles - and the use of VR and AI technologies, IoE will give life to smart societies filled with new possibilities, leading us into our future. Automotive boards supporting automatic driving technologies and base station boards allowing for high-speed communication are important elements of IoE.

Moreover, by applying the IoE concept to industries, factories become smarter. Smarter factories require data linkage and autonomous systems. Sharing data between devices and systems that autonomously detect and solve problems will contribute to increased productivity. This article introduces the role FUJI has to play in realizing smarter factories, by sharing new perspectives through technological innovations. The development of IoE is transforming every aspect of our lives, from individuals

to industries. FUJI will lead this transformation and pave the way to the future with its technological strength and vision.

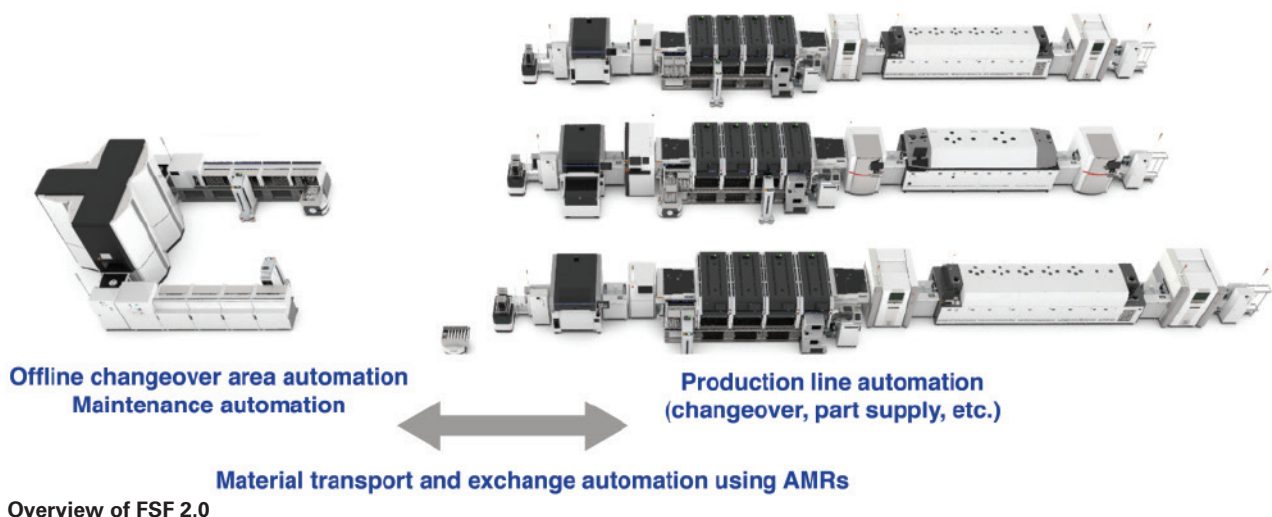
Smart Factory – Next Stage of Factory Processes

Overview of FUJI Smart Factory (FSF)

FUJI launched the FUJI Smart Factory project in 2017 and formed an alliance with companies that supply equipment and systems before and after the SMT process. Named "FUJI Smart Factory members", this alliance is working together to solve issues at user factories.

FUJI Smart Factory is continuously evolving, with development in three phases; FSF 1.0 to 3.0.

- **FSF 1.0** is designed to solve issues by connecting some of equipment and systems at production factories through machine-to-machine and host system collaboration.
- **FSF 2.0** aims to automate not only production lines but also preparation work in warehouses and other areas as well as material transport.
- **FSF 3.0** aims for non-stop factories, where all the 5M + E data within the factory, collected through the use of automation and IoE technologies, is consolidated into data platforms, to facilitate gap analysis for efficiency and quality, and autonomously provide feedback.



Overview of FSF 2.0



Part supply using a Smart Loader

Current status of FSF 2.0

The following describes FSF 2.0 initiatives currently underway.

1. Improved efficiency of placement processes

The production preparation area becomes more efficient, with automatic warehouses for automated checkout and guidance for feeder locations. Moreover, autonomous mobile robots (AMR) quickly and accurately transport panels and feeders. These ensure that production runs smoothly.

With the NXTR, an SMT pick and place machine, Smart Loaders exchange feeders during production. Thus, minimizing line downtime and increasing productivity.

2. Maintaining quality by detecting errors

IPQC Expert (In Process Quality Control) detects errors in manufacturing processes at an early stage and issues alerts in real time. Taking early action can prevent production stops and defective panels.

3. Strengthening production line coordination

FSF Mobile Conductor notifies operators of machine errors and warnings in real time to prompt a quick response by sending notifications to their smart watches, PDAs, or other mobile devices. If it is difficult for the operator to respond or the warning persists, messages can be escalated to management staff. FSF Mobile Conductor also coordinates with other systems to send work guidance notifications to mobile devices. Introducing FSF Mobile Conductor will reduce work delays and improve the OEE of production lines.

4. Automation of printing processes

With the NXTR PM printer,

PM Smart Changer automatically exchanges metal stencils and backup blocks. Such automation of the printing processes has increased the efficiency of changeover.

In the SMT industry, there is a growing demand for automation within scopes that have been difficult to automate. FUJI was quick to focus on this point with the introduction of automatic feeder exchange. FUJI will continue to promote further automation.

Prospects for FSF 3.0

Autonomy and intelligence are the further goals of FSF 3.0. By integrating elements such as data aggregation, analysis, predictive forecasting, autonomous control, and self-diagnosis, FUJI is pursuing production process optimization.

1. Visualization

The placement line status, production progress, and the gap between the production plan and actual production can be visualized in real time. This allows the production status to be monitored even from remote locations, enabling workers to take appropriate action.

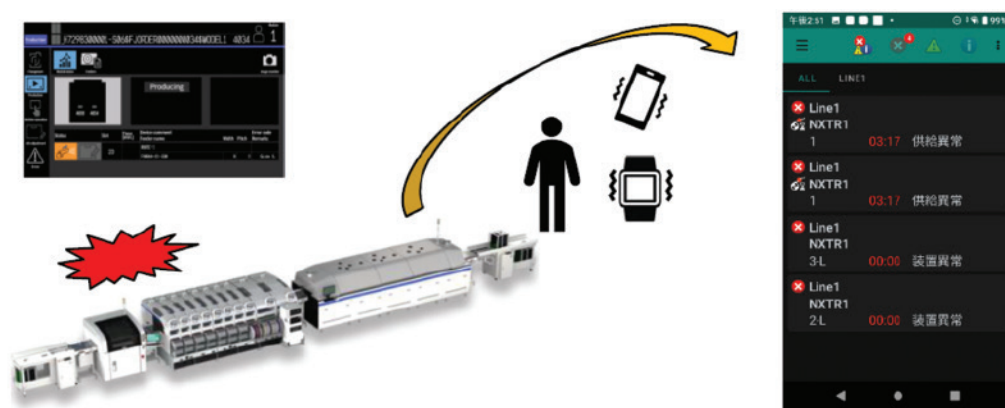
2. Intelligence

The system determines the situation in real time, detects changes, and issues prompts to perform appropriate actions. Intelligent production allows flexible adaption to changeable production environments, increasing the stability of production processes.

3. Autonomization

FUJI is promoting autonomous control that enables machines to determine procedures and decision criteria to perform processes without human intervention. This allows for continuous optimization of production lines, thus improving productivity and quality.

FSF 3.0 is expected to have a wide range of benefits, including reduced operator workloads, operation that does not require special skills, prevention of human errors, labor saving, and maximization of OEE.



Notification to FSF Mobile Conductor

Initiatives for Mounting on Automotive Boards

The realization of the CASE concept - the ongoing transformation of automobiles - also requires new responses in placements on automotive boards.

Support for high-density placements

With the advancement of automotive boards, the demand for high-density placement is increasing. The NXTR's high accuracy mode enables a placement accuracy of $\pm 15 \mu\text{m}$, even when taking into account discrepancies in part pickup and variances between nozzles. This meets the high reliability needed for complex panel designs. In addition, analysis technology for high-speed operation and high-rigidity design technology ensure stable productivity.

Support for higher quality

The MPI function (mark and parts inspection) is used to check the placement condition in the pick-and-place machine. Machines can detect the state of electronic component placement and decide whether it is good or bad. Thus, preventing panels with defective factors from continuing on to subsequent processes.

For example, before placing BGAs and shield cases, the placement area is checked for foreign matter to prevent the occurrence of defective panels, thereby reducing part waste and repair work. This contributes to cost reductions and improved production efficiency.

Support for large connectors

The need for placing large connectors on automotive panels is on the rise. The NXTR supports placement of parts up to 50 mm in height. Furthermore, the placement height adjustment function ensures reliable placements, for uniform placement quality.

Advanced Placement Technologies for Base Station Boards

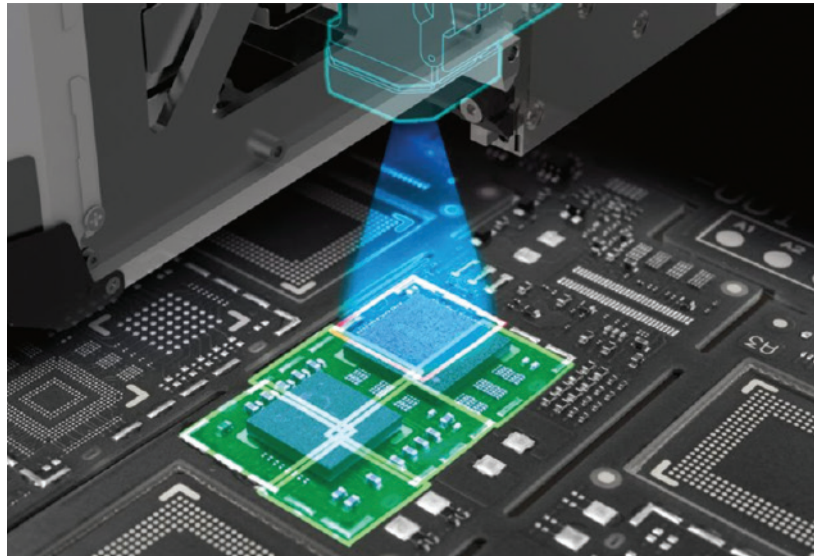
To realize a smart society, strengthening the infrastructure is imperative. This includes communications equipment that supports "being connected" and high-performance servers that support AI and other technologies.

Base station and server boards are characterized by a large number of parts and require large and heavy part placement. In response to such demands, FUJI has released AIMEXR, an advanced model of its existing AIMEX series.

Support for large panels

The AIMEXR can produce on panels with up to 7 mm upward warpage for large panels that are prone to warpage. In the same manner as with the NXTR, the placement height adjustment function recognizes the top surface of panels in real time. Thus, preventing parts from being pushed too much due to panel upward warpage, and also preventing parts from scattering in the air due to panel downward warpage.

In addition, the new calibration technology ensures consistent high accuracy and stable quality across the entire panel area.



Mark and parts inspection (MPI)

Support for large parts

The latest RH series heads with greatly enhanced vacuum flow rates are used to support BGAs such as those used for CPUs and GPUs, which are becoming larger in line with their higher performance. These heads feature up to four times the part holding power of other heads, enabling stable handling and high-speed transfer of large parts and parts with small pickup surfaces.

While it is expected that BGAs will continue to grow in size, the heads can support parts with sizes up to $200 \times 150 \text{ mm}$ and can transport weights up to 350 g. Thanks to this flexibility and high part holding power, more types of odd-shaped parts can now be handled.

The AIMEXR responds to the need for increasingly advancing base station boards and server boards, and thus contributes to improving factory productivity with its advanced placement technologies.

Future Prospects

FUJI's efforts are bringing new possibilities to production processes through M2M collaboration in factories. Going forward, the company will continue development to further improve productivity by combining autonomy, intelligence, and advanced placement technologies. FUJI believes that this advancement of placement technologies will not only improve manufacturing sites, but will also play a role in shaping the future of manufacturing and even the future of society.

FUJI will continue to open up new areas of manufacturing through technological innovations, while contributing to the development of IoE and the evolution of the SMT industry. Through this, FUJI will create new manufacturing values together with its customers.

About This Article:

FUJI Corporation provided the contents of the article.

NTT Integrates Optoelectronic Fusion in IOWN Device Development

Japanese communications company NIPPON TELEGRAPH AND TELEPHONE CORPORATION (NTT) is developing devices to support its next-generation communications infrastructure, IOWN or Innovative Optical and Wireless Network. Along this line, the company will accelerate the development of devices that incorporate optoelectronic fusion technology, aiming for sales of several hundred billion yen at an early stage. Also, the company will focus on the automation of optical device manufacturing.

Specifically, IOWN utilizes optoelectronic fusion technology to replace the conventional electricity-based communications with optical-based wiring, which consumes less electricity. The goal is to achieve 125 times the transmission capacity with 1/100th the power consumption of conventional systems.

Automation of Optoelectronic Fusion Manufacturing

NTT Innovative Devices Corporation, a subsidiary of NTT, is focusing on the development of optical waveguide design technology and mass production technology for optical alignment and inspection of optoelectronic fusion devices. In particular, the company has long positioned analog ICs, logic LSIs, silicon photonics, and thin-film lasers as key devices, and is aiming to develop thinner and smaller products. In addition to the telecommunications area, it will venture into the cutting-edge computing field.

In such a situation, the challenge is to automate processes such as core alignment, which has been progressing like a domestic handicraft industry. In the past, this work required a considerable amount of manpower, but the company plans to automate it.

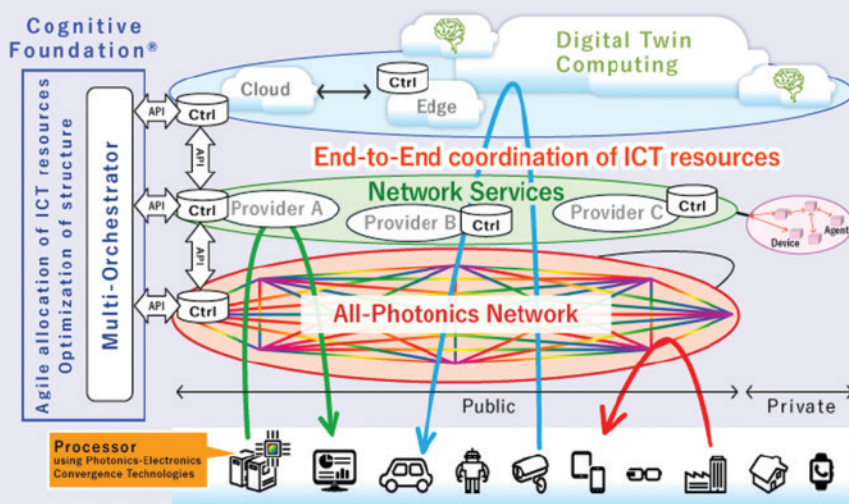
In silicon photonics and other related fields, the company is developing technologies for thin-film semiconductor lasers and silicon photonics waveguides.

In optoelectronic fusion devices, servers in data centers are expected to generate less heat and consume less power. Also, in-vehicle devices are expected to reduce weight and power consumption by replacing cables and other components. Meanwhile, smartphones are expected to require less recharging. □

What's IOWN?

Innovative Optical and Wireless Network (IOWN)

Realizing a Smart World by using the 3 elements of All Photonics Network, Digital Twin Computing and Cognitive Foundation



IOWN (Innovative Optical and Wireless Network)

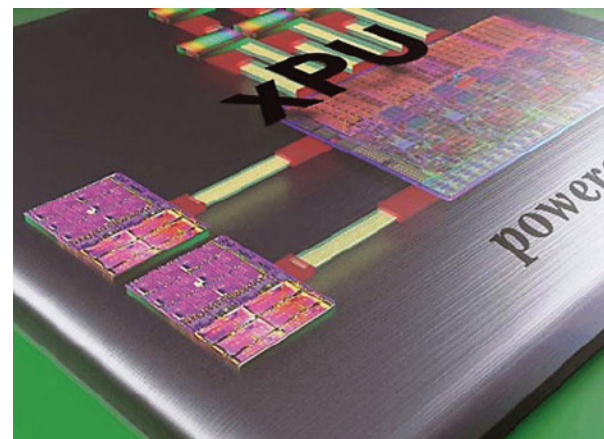


Image of the 5th-generation device (from NTT)

Conductive Polymer Hybrid Capacitors Suit Electric Mobility

Significant technology developments have emerged in the automotive and in-vehicle fields in recent years. At the core of developments in automotive electronics is CASE or Connected, Autonomous, Shared and Electric trends.

Specifically, the electrified vehicle (xEV) powertrain system has been converted to become carbon-neutral. Also, fuel-saving technologies have become widespread through the installation of various electrified units such as electric power steering (EPS), electric oil pump (EOP), and electric water pump (EWP). Meanwhile, advanced driver-assistance systems (ADAS), which promote autonomous driving, have become more advanced, and communication devices and sensors installed inside vehicles continue to evolve to have more sophisticated features.

Amid these trends, the demand for automotive electronic components is expected to grow at a faster rate than the number of automobiles produced in the future. In addition, the shift to electric vehicles (EVs) is gaining progress. Thus, the electric mobility market will spur higher demand for electronic components.

Higher demand for high-performance aluminum electrolytic capacitors will be seen for automotive applications. Primarily, aluminum electrolytic capacitors featuring smaller and larger capacitance, higher temperature, longer life, lower equivalent series resistance (ESR), and higher ripple current, will be highly in-demand. The same requirements are also common in information and telecommunications equipment such as 5G base stations. This trend is also expected in a variety of other equipment.

NICHICON Corporation focuses on the technological development of capacitors suitable for these growing markets. The company will introduce in this article the latest technological trends in conductive polymer hybrid aluminum electrolytic capacitors.

Features of Conductive Polymer Hybrid Aluminum Electrolytic Capacitors

Conductive polymer hybrid aluminum electrolytic capacitors employ two types of electrolytes: conductive polymer and electrolyte. The use of a conductive polymer (PEDOT/PSS is commonly used) with conductivity approximately 10,000 times that of the electrolyte significantly reduces the ESR of the product compared to aluminum electrolytic capacitors using only the electrolyte. Also, it reduces the watt loss due to ripple current loading. This product features lower ESR and watt loss due to ripple current load ($W=I^2R$; where W: heat generation, I: ripple current, R: product resistance). Accordingly, it results in lower self-heating and longer service life. Also, it enables the use of the product in higher value-added applications by increasing the allowable ripple current. Thus, with significantly lower ESR, higher ripple current, and longer life, conductive polymer hybrid aluminum electrolytic capacitors have more benefits than conventional aluminum electrolytic capacitors.

Meanwhile, the electrolyte in conductive polymer hybrid aluminum electrolytic capacitors is based on the reactivity with conductive polymers in high temperature environments. Additionally, general conditions such as dielectric (aluminum oxide film) restoration and low transpiration also promotes the creation of electrolytes. The characteristics of this special electrolyte have enabled NICHICON to achieve a highly reliable performance with lower leakage current than conductive polymer aluminum solid electrolytic capacitors. Also, they maintain electrical performance even after long periods of use in high temperature environments.

Expanded Capacitor Lineup

NICHICON's conductive polymer hybrid aluminum electrolytic capacitor lineup consists of the GYA Series, as standard product, guaranteed for 4,000 hours at 125°C; the GYE Series is one rank higher in capacitance than the GYA Series; and the GYF Series (Photo 1), is two ranks higher in capacitance. The GYE and GYF Series meet the requirements for smaller size and higher capacitance, while the GYE Series for longer life time. Additionally, the GYB Series is guaranteed for 10,000 hours at 105°C, the GYC Series is guaranteed for 4,000 hours at 135°C, and the GYD Series is guaranteed for 1,000 hours at 150°C and meets higher temperature needs. The lineup of each series is shown in Table 1.

The GYE and GYF Series are now available in 16V, 50V, and 63V ratings, and the GYE Series has been expanded to $\phi 10 \times 12.5L$ size. Also, the addition of the $\phi 10 \times 12.5L$ size to the GYE Series enables a higher ripple of up to 1.5 times that of the $\phi 10 \times 10L$ size and the $\phi 10 \times 12.5L$ size of the GYA Series. Table 2 shows a comparison of the rated capacitance and rated ripple current between the GYA Series and the newly



Photo 1: GYE and GYF Series of conductive polymer hybrid aluminum electrolytic capacitors

Table 1: Overview of Nichicon’s conductive polymer hybrid aluminum electrolytic capacitors

	GYA series (125°C guaranteed)	GYB series (105°C guaranteed)	GYC series (125°C/135°C guaranteed)	GYD series (150°C guaranteed)	GYE series (125°C guaranteed)	GYF series (125°C guaranteed)
Feature	Standard products	Long life products	High- temperature and high-ripple current	Ultra-high temperature product	High-capacity products	High-capacity products
Category temperature range	-55°C-125°C	-55°C-105°C	-55°C-135°C	-55°C-150°C	-55°C-125°C	-55°C-125°C
Rated voltage	16-80V	16-63V	16-63V	25-35V	16-63V	16-63V
Rated capacitance	10-470μF	10-470μF	10-470μF	100-270μF	56-680μF	68-1,000μF
Case size (mm)	φ6.3×5.8L - φ10×12.5L	φ6.3×5.8L - φ10×12.5L	φ6.3×5.8L - φ10×12.5L	φ8×10L - φ10×10L	φ6.3×5.8L - φ10×12.5L	φ6.3×5.8L - φ10×10L
Rated ripple current	700- 2,300mArms (at 125°C100kHz)	1,000- 3,500mArms (at 105°C100kHz)	1,000- 3,500mArms (at 125°C100kHz) 700-2,300mArms (at 135°C100kHz)	1,400- 1,800mArms (at 150°C100kHz)	1,100- 3,500mArms (at 125°C100kHz)	1,100- 2,800mArms (at 125°C100kHz)
Durability (Guaranteed life)	125°C 4,000 hours	105°C 10,000 hours	2,000 hours (φ6.3) 4,000 hours (φ8,φ10)	150°C 1,000 hours	125°C 4,000 hours	125°C 4,000 hours

Vibration resistant structure is available for φ6.3×7.7L, φ8×10L, φ10×10L, and φ10×12.5L.

added series. These series will contribute to space saving on circuit boards through miniaturization of capacitors and reduction in the number of capacitors.

Prospects

The markets for automotive, telecom-munications, and industrial equipment are expected to grow further, and aluminum electrolytic capacitors are regarded as one of the key parts in equipment design. The demand for high-performance aluminum electrolytic capacitors, such as the conductive polymer hybrid aluminum electrolytic capacitors described here, is expected to grow rapidly.

In particular, the in-vehicle equipment market is expected for huge growth. Specifically, the global market size is projected to reach ¥59 trillion by 2035 (Fuji Chimera Research Institute) in line with the progress of in-vehicle electrical equipment systems. Advanced systems such as ADAS/autonomous driving systems and driver monitoring systems will become more sophisticated in the future. Moreover, the demand for aluminum electrolytic capacitors with higher capacitance, lower ESR, and higher performance will increase due to enormous amount of data processing. In addition, there is a growing trend toward maintenance-free capacitors in the information and telecommunications field and in the industrial equipment field.

NICHICON will continue with its development efforts to provide optimal alu-

Table 2: Capacitance and rated ripple current comparison

Dimensions (mm)	Rated Voltage (V)	GYA Series (Existing series)		GYE Series (1 rank Higher Capacitance)		GYF Series (2 rank Higher Capacitance)	
		Capacitance (μF)	Rated Ripple Current (mArms)	Capacitance (μF)	Rated Ripple Current (mArms)	Capacitance (μF)	Rated Ripple Current (mArms)
φ6.3×5.8L	16	82	1,000	120	1,100	180	1,100
	25	56	900	82	1,100	100	1,300
	35	47	900	56	1,100	68	1,200
φ6.3×7.7L	16	150	1,500	180	1,800	270	1,800
	25	100	1,400	150	1,700	180	1,800
	35	68	1,400	100	1,700	120	1,700
φ8×10L	16	270	1,700	390	2,000	560	2,000
	25	220	1,600	270	2,000	330	2,000
	35	150	1,600	180	2,000	220	2,000
	50	68	1,250	82	1,700	100	1,700
	63	47	1,100	56	1,700	68	1,700
φ10×10L	16	470	2,100	680	2,800	1,000	2,800
	25	330	2,000	470	2,800	560	2,800
	35	270	2,000	330	2,800	390	2,800
	50	120	1,600	150	2,000	180	2,000
	63	82	1,400	100	2,000	120	2,000
φ10×12.5L	25	470	2,300	560	3,500	-	-
	35	330	2,300	390	3,500	-	-
	50	150	2,000	180	3,000	-	-
	63	100	1,900	120	3,000	-	-

*Capacitance: 120Hz at 20°C *Rated ripple current: 100kHz at 125 125°C

minum electrolytic capacitors to promptly respond to customers' needs for higher performance and reliability.

About This Article:

NICHICON Corporation provided the contents of the article.

Nascent Chiplet Gains Traction in Diverse Industries

The economic benefits derived from Moore's Law have changed, and not for the better. This shift – especially on the manufacturing side of system-on-chip (SoC) devices, has both the defense and commercial customers in the semiconductor industry wondering what will come next.

One way to extend Moore's Law's cost, feature, and size benefits is with multi-chip technology, now commonly known as chiplets. These modular die devices effectively prolong Moore's Law by replacing single silicon dies with multiple smaller dies that work together in a unified packaged device.

Integrating different physical pieces of silicon die, or chiplets, into one Lego-style device at a package level has been around for some time. However, interest in this approach was greatly accelerated when Moore's Law began to slow down at the crucial 28nm node roughly back in 2011.

Since then, many companies and industry groups have focused on the chiplet architecture, including AMD, Intel, TSMC, and the U.S. Department of Defense (DoD). These activities have aimed to reduce time to market (TTM) and the cost by integrating pre-developed and pre-tested chiplets in a package. As with past innovations in semiconductor technology development, the initial challenge was the emergence of competing proprietary designs without any agreed-upon standards. Today, new standards have emerged. This article will examine fundamental chiplet interface technology trends in aerospace and defense (A&D) and commercial spaces and promising standards.

Chiplets and Challenges

A chiplet is a die designed to be integrated into various advanced packaging with other dies (or chiplets). They can be combined into most existing package types, such as system-in-package (SiP), 2.5D (planar or vertical), or 3D-IC.

Chiplets consist of integrating separately manufactured multiple silicon components into a higher-level device, such as a SiP, that provides greater functionality and performance at a lower cost. Heterogeneous integration refers to separately manufactured parts – like chiplets – integrated into a higher-level assembly. This is opposed to the traditional monolithic chip design which is manufactured on the same die at the same time (Fig. 1).

One notable advantage of the chiplet design paradigm is enabling IP reuse across different products. Flexibility is another benefit as chiplets allow different manufacturing processes for each chiplet, in contrast to traditional SoC (system-on-a-chip) designs that are restricted to a single process technology.

Today, more chipmakers are exploring the advantages of the chiplet architectures formed around existing and even advanced packaging technology. And therein lies the key, namely, how to assemble and interconnect the chiplets to meet specific requirements.

It's not easy to use chiplets to develop multi-die designs. One major challenge is that there is no single standard die-to-die interconnect or interface approach. Instead, there are at least two competing chiplet interface technologies – Intel's Advanced Interface Bus (AIB) and the Optical Internetworking Forum's CEI-112G-XSR scheme.

Two other interface approaches have been proposed by the Open Domain-Specific Architecture (ODSA) industry group – Bunch of Wires (BoW) and Open High Bandwidth Interface (OpenHBI). There are also a few proprietary solutions. While each has its pluses and minuses, there is not yet a preferred standard approach to designing chiplet interfaces.

Chiplet development is also hindered by a lack of industry-wide design tool

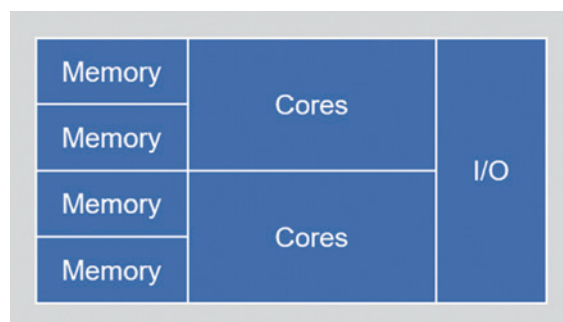


Fig. 1: Traditional monolithic chip

support and approved testing and assembly methods.

DoD and Chiplets

The DoD's research arm, known as the Defense Advanced Research Projects Agency (DARPA), has long appreciated the critical connection between defensive capabilities and semiconductor technologies. For example, in 2017, DARPA initiated a chipset-based program dubbed the Common Heterogeneous Integration and IP Reuse Strategies (CHIPS).

As with similar initiatives in the semiconductor space, DARPA's goal with CHIPS has been to drive standards and a new ecosystem in the chiplet area. Participants in the program are leading defense and chip design software and manufacturing companies.

Recently, Intel announced the completion of a multi-die chips prototype commissioned by the DoD. This prototype was built under the DoD's State-of-the-Art Heterogeneous Integrated Packaging (SHIP) program as part of the CHIPS initiative. Under the SHIP program, Intel was tasked with developing methods for placing and connecting CPUs, FPGAs, ASICs, and government-developed chiplets, all within the same processor-type packaging. Thus, while Intel might contribute certain parts (like processors), other providers would supply the other blocks, which would come together on multiple separate dies within the same chip package.

For the SHIP program prototype, Intel used its proprietary architectures to glue together its various dies, e.g., CPU and memory cores and IO controllers. One of the future DoD's goals under the program is to diversify its supply chain, meaning that the die interfaces will have to be more accommodating to other suppliers and less proprietary.

In general, the chiplet model offers several benefits specific to the US defense community, including the capability to acquire advanced chip architectures at relatively lower price points. While advanced chip designs are required for many defense applications, the volume of needed chips is much lower than in the commercial sector. This means that the defense community has little leverage with capacity and pricing at the semiconductor foundries. Additionally, the most advanced chips are manufactured by foundries outside the US, which presents a potential security risk.

These challenges can be overcome using a chiplet development strategy (Fig. 2) that allows the defense community to leverage state-of-the-art commercial technologies like FPGAs, numerous processor types, and even AI chips.

For the heterogeneous chiplet architectures to gain support in the mainstream, commercial chipmakers will need to agree on standards for die-to-die signal communications. Toward that end, several leading semiconductor vendors have come together to support an industry standard for die-to-die communications

called Universal Chiplet Interconnect Express (UCIe). The spec is intended to be a common language for chiplets. In time and perhaps combined with encryption technology, the UCIe might also find applications in DOD chipsets.

Complexity at the Interconnect

Current chip interconnect trends and standards roughly fall into two categories: low-speed parallel versions for chiplets and high-speed serial versions between separate chips.

What differentiates the parallel and serial standards tends to be high-level parameters such as higher protocol layers, locations of signals on packages, and the technical voltages and slew rates. What is similar between these two signaling strategies is that both share many of the same physical signaling approaches.

Regardless of whether the challenge is a relatively low-speed, parallel signal bus between different semiconductor dies or a high-speed serial structure between two or more chips like the PCIe physical interface and related protocols, the overall system solution is complex. The physical layer components can use several different protocols to handle data communication on a network.

For the chiplet architecture to succeed, there must be standard interfaces to allow the global chipmaker ecosystem to participate. Intel has licensed its Advanced Interface Bus (AIB) technology to the UCIe program to enable heterogeneous integration of multiple die into a

single package. Similarly, the CXL (compute express link) has emerged as the leading chip-to-chip protocol layer.

The AIB interconnect scheme aims to provide a high-speed and flexible way of interconnecting chips and chiplets. It's important to note that this is a different approach from device-to-device interfaces over the last 25 years, whose aim was to use complex circuits to push high speed through a few wires, such as PCI Express. Instead, the AIB uses a very wide parallel interface supported by new high-density packaging technology. By running each wire of the interface at a relatively low speed, the circuitry for each transmitter and receiver is greatly simplified and uses minimal silicon area. There will be more discussion on this point later in the article.

Interestingly, some have argued that the UCIe physical layer (Fig. 3) is superior to PCIe if bandwidth is considered over power. The first version of UCIe appears several times faster than PCIe over the same distance within a limited number of physical interfaces. UCIe has the potential to be even faster than PCIe relative to distance. The key word here is "distance," as UCIe is designed for a very short distance on a chip's substrate, while PCIe is implemented at the motherboard level. On the board level, data runs over a longer distance and has different electrical requirements.

Universal Chiplet Interconnect Express (UCIe)

Several years ago, a consortium of leading industry chipmakers announced the UCIe (Universal Chiplet Interconnect Express) as a new die-to-die interconnect to provide an open, multivendor chiplet ecosystem. In March 2022, the ratified UCIe 1.0 specification was released, covering the physical I/O layer, die-to-die adapter layer, and a software protocol stack that leverages the existing PCIe and CXL industry interconnect standards:

- Physical Layer: The electrical interface to the package media, including the transmitter and receiver components.
- Die-to-Die Adapter Layer: The mechanism handles link management, protocol arbitration, and negotiations.
- Protocol: This layer governs data transmissions by implementing one or more UCIe-supported protocols, including PCIe and CXL.

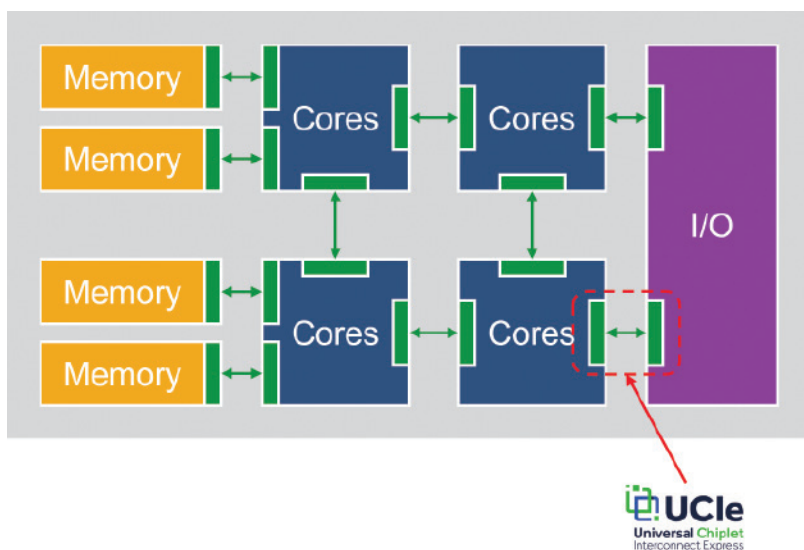


Fig. 2: Chiplet diagram with UCIe interconnect highlighted

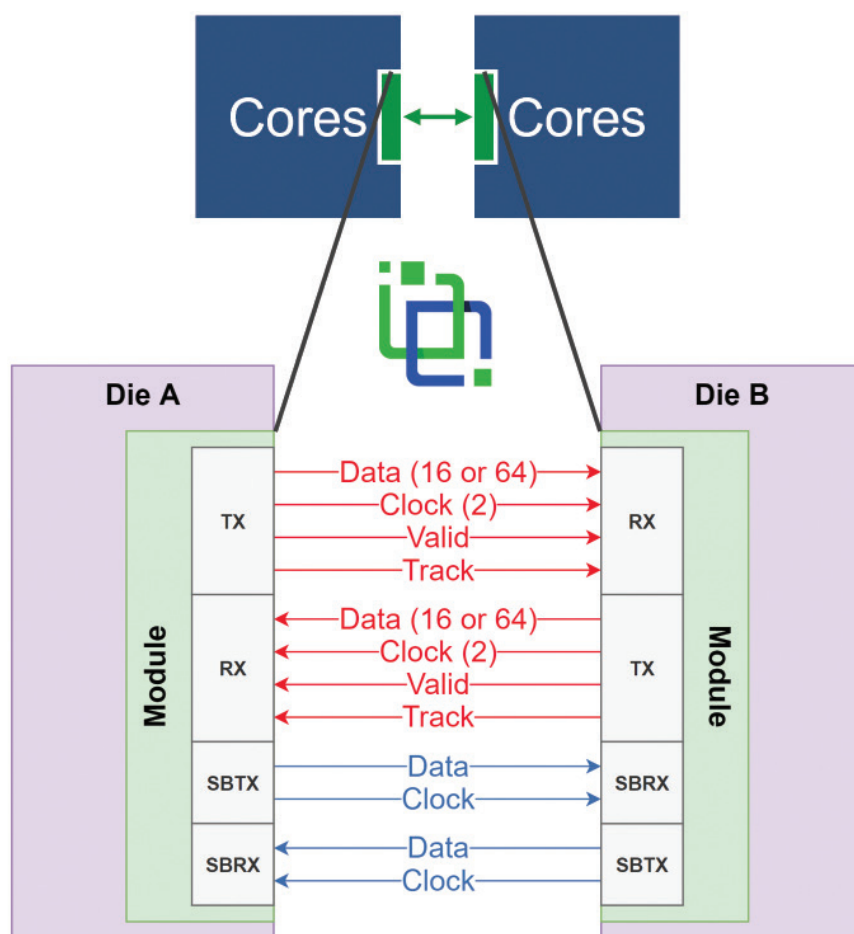


Fig. 3: UCle physical layer detail

Both the PCIe and CXL protocols – the latter built on top of PCIe 5.0 – run on the UCle physical interconnect. One goal of the UCle is to accomplish at the chip package level what the PCIe interconnect has achieved for decades at the printed circuit board (PCB) level. The advantage of interconnecting systems and IP at the chip package level rather than the board level is to significantly reduce power consumption, improve bandwidth performance, and eventually lower the cost of the device.

Even though Intel donated its AIB PHY to the UCle standard, the latter is meant to be package-technology agnostic. But this will not be an easy goal to achieve, given the wide range of different packaging technologies. For this to work, chiplets must be interoperable, meaning they can communicate and share data with one another. In addition to the UCle standard, the CXL has emerged as a possible standard for the chip-to-chip protocol layer.

Other organizations have focused on the UCle architecture. For example, the Open Compute Project (OCP) has a working group called the Chiplet Design Exchange (CDX). The charter of that group is an open ecosystem to help answer questions between vendors providing chiplet IPs into an integrated package and their ultimate delivery approach. It is the delivery models that need to be defined into a standard, such as thermal packaging models and test patterns for the packaged chiplets.

Design and Testing Challenges

Designing for chiplet architectures is a more diverse engineering exercise than preparing for a single-chip SoC system. Early-stage design space explorations require simulators, especially for multi-chiplet devices, largely due to a lack of chiplet interconnect models. Existing advanced circuit design tools and circuit simulation software are needed to help development teams



Ben Miller, Product Marketing Manager for Digital Products, Keysight Technologies

address signal complexity, the inherent density of chiplet structures, and heterogeneous interface technologies.

In addition to testing the parallel interfaces of the chiplet, testing of serial PCIe 4.0 and 5.0 transmitter (Tx), receiver (Rx), and channel physical layers and protocols are also needed to speed up the post-silicon validation. Advanced PCIe 6.0 input/output (I/O) signal technology will deliver even higher-performance I/O interfaces. The next-generation PCIe will also enable additional innovations, including accelerator interconnects like CXL and on-chip communications like UCle. PCIe 6.0 capable protocol analyzer and exerciser test equipment are critical to accelerating the development, deployment, and dissemination of high-performance I/O technologies throughout the chip-making industry.

Summary

Until recently, only the largest chip-makers had the budget and interest in exploring the advantages of chiplet architectures, using in-house approaches, proprietary interconnect intellectual property (IP), and assembly techniques. However, the rise of interconnect standards such as UCle and OCP's Bunch-of-Wires lowers the barriers of entry for smaller firms – in both the defense and commercial markets – to contribute to the chiplet ecosystem.

About This Article:

The author is Ben Miller, Product Marketing Manager for Digital Products, Keysight Technologies.

Ultra-Thin Organic Solar Cell Shows Operability Underwater

An international joint research group that includes RIKEN, Japan's National Research and Development Agency, has improved the water resistance of ultra-thin organic solar cells that use organic semiconductors as power generation layer. As a result, the group succeeded in developing an element that can be operated even underwater.

In the future, the development of power generation layer materials that combine high energy conversion efficiency and water resistance will progress. By combining them with this new technology, the group expects to realize high-efficiency ultra-thin organic solar cells with even improved water resistance.

The development of ultra-thin organic solar cells with water resistance and ultra-flexibility is expected to contribute to applications in wearable devices and as durable and stable power source for e-textiles.

Development Process

Conventional organic solar cells are vulnerable to water. Water resistance in everyday activities, like walking in the rain, condensation, washing of hands or doing the laundry has been an issue.

Thus, it is necessary to prevent moisture to protect the organic cells. Due to their flexibility and lightness, ultra-thin organic solar cells are expected to be used as power sources for wearable devices and other applications.

Recently, the international joint research group has developed a technology to strengthen the interface adhesion between the anode and the power generation layer. To achieve this, the group put silver oxide at the interface between the silver that makes up the anode and the power generation layer. This resulted in an organic solar cell that is both water-resistant and ultra-flexible.

High Energy Conversion Efficiency

The ultra-thin organic solar cell with a thickness of $3\mu\text{m}$ retains 89% of its energy conversion efficiency after immersion in water for 4 hours. Even after 300 cycles of mechanical deformation in water with repeated compression strain and restoration of 30%, the cell showed high stability, retaining 96% of its energy conversion efficiency.

Furthermore, while immersed in water, the ultra-thin organic solar cell generates electricity through an incident light. The group demonstrated that the solar cell could operate continuously for more than 60 minutes.

Candidate for Wearable Power Source

If wearable sensors can be combined with energy harvesting technology, it is possible to continuously monitor biological information such as blood pressure and body temperature, leading to early detection of diseases such as stroke and cold.

Among energy harvesting technologies, organic solar cells are attracting attention as power for wearable sensors leveraging ability to supply high power source on the milliwatt order and excellent flexibility.

The research results were published in the scientific journal "Nature Communications". (<https://www.nature.com/articles/s41467-024-44878-z>) □



Ultra-thin organic solar cells that can be operated underwater for long periods of time.

FUJI 3D Printer Boosts Additive Manufacturing of Electronics

The FPM-Trinity 3D printer enables three unique functions of resin 3D modeling, circuit formation, and component mounting of electronic substrates in all-in-one machine.

FUJI Corporation is developing FPM-Trinity, an electronics 3D printer that uses an additive manufacturing process. Mainly, FPM-Trinity enables three functions of resin 3D modeling, circuit formation, and component mounting of electronic substrates in an all-in-one process.

In manufacturing electronic substrates, the excess copper and resin are removed by a liquid process to form the substrate. In contrast, the additive manufacturing process is a technique characterized by 3D printers. This advanced process minimizes material loss and waste fluid because it selectively applies only the necessary materials to the appropriate locations. The application of this technique to electronics is called Additive Manufacturing of Electronics (AME), which has been attracting attention in recent years.

Promotes Full Additive Manufacturing

Currently under development, the FPM-Trinity is the first device capable of manufacturing electronic devices based on a completely new concept utilizing

the full additive manufacturing process. It performs resin 3D modeling, electronic circuit printing, and component mounting functions in an all-in-one system.

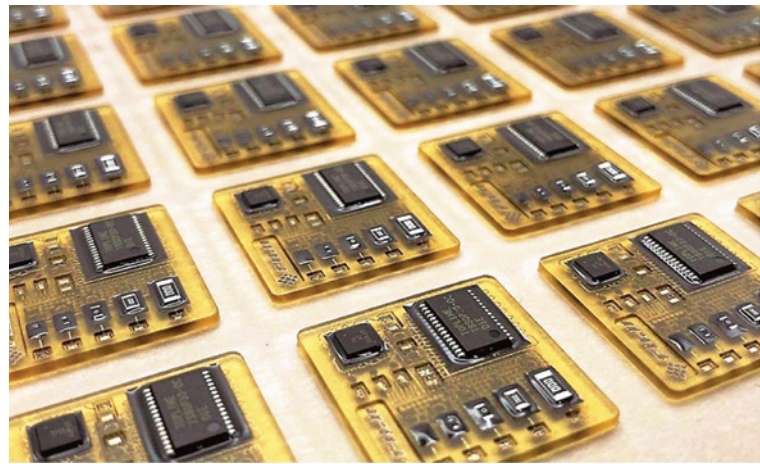
FPM-Trinity consists of an inkjet unit for resin modeling and circuit printing, a dispenser unit for printing conductive paste and epoxy resin, and a mounting machine for mounting components. With this new 3D printer, it is possible to fully automate the manufacture of electronic substrates with mounted electronic components simply by inputting design data and materials.

The full additive process eliminates the need to prepare masks and jigs for manufacturing in FPM-Trinity. Electronic devices can be manufactured in a single day, thus accelerating prototyping.

The manufacturing process in conjunction with 3D data enables reproduction of ideally shaped devices that cannot be achieved with ordinary electronic substrates.

Moreover, it reduces liquid waste by 95% or more compared to ordinary electronic substrate manufacturing.

FPM-Trinity uses FUJI's proprietary advanced process to produce high-quality electronic devices. The resin has a higher glass transition point than general ultraviolet (UV) curable resins and has a



Sample of an electronic board mounted with FPM-Trinity

lower rate of volume expansion in high temperature environments. Circuit patterns are formed by repeated printing and drying using silver nano ink that can be sintered at low temperatures. It connects layers with a structure that forms circuits along the slope of the holes. Low-temperature curable silver paste is used for conduction instead of solder. The underfill is filled around the component to ensure mechanical strength.

The company is developing a fully automated process to manufacture multi-layered boards, which is currently in the process verification stage.

Partner Agreement

To promote AME, a partner agreement was signed between FUJI and J.A.M.E.S. GmbH of Germany in May 2023. J.A.M.E.S. was established to promote the development of AME and to develop AME into a technology that everyone can use. It will operate the J.A.M.E.S. community - a place for real-time communication where related manufacturers and users can come together to collaborate and mutually share knowledge across company boundaries. □



FUJI's FPM-Trinity electronics 3D printer (under development)

Japan Unix Propels Automation With New Systems

Focusing on area laser technology, Japan Unix has reinforced its position as one of the vanguards of manufacturing automation with the introduction of new soldering systems.

Japan Unix Co., Ltd. exhibited at the recent NEPCON Japan 2024 at Tokyo Big Sight in Tokyo, Japan. Particularly, the company introduced new soldering robot technology, new products, and a variety of soldering solutions.

The company is expanding its global business focusing on soldering robots as its mainstay.

The world's exit from the COVID-19 pandemic in 2023 also marked the resumption of face-to-face trade events. In fact, Japan Unix participated in SMT-related exhibitions outside of Japan. Namely, these exhibitions included PC APEX EXPO in San Diego, United States; NEPCON in Southeast Asia; and productronica in Munich, Germany.

Supplements Increasing Need for Automation

At NEPCON Japan, the company exhibited the Dual Area Soldering System, which enables laser soldering from the

underside. In addition, it also showed the UNIX-DF Series desktop soldering robot and the FR Series horizontal multiple-joint soldering robot.

Kentaro Kono, Managing Director of the company, said, "Automation is attracting more and more attention due to the shortage of labor in the manufacturing industry. In addition, as cars become more sophisticated, there is an increasing number of companies that now venture into the assembly of electronic devices. Thus, exhibiting at the NEPCON has been a good opportunity for us to make face-to-face proposals directly to industry players in the ecosystem."

The dual-area soldering system employed the company's proprietary new area laser technology. Particularly, it enables simultaneous soldering of two soldering points within a 2mm square, as well as laser irradiation from both the top and bottom surfaces.

Especially, the ability to laser solder from the underside eliminates the need



Kentaro Kono,
General
Manager,
Japan Unix

to flip the board in the transfer line. Hence, requiring no jig. Compared to reflow ovens, the UNIX-DF series saves space in terms of equipment footprint and contributes to carbon neutrality due to its low CO₂ emissions.

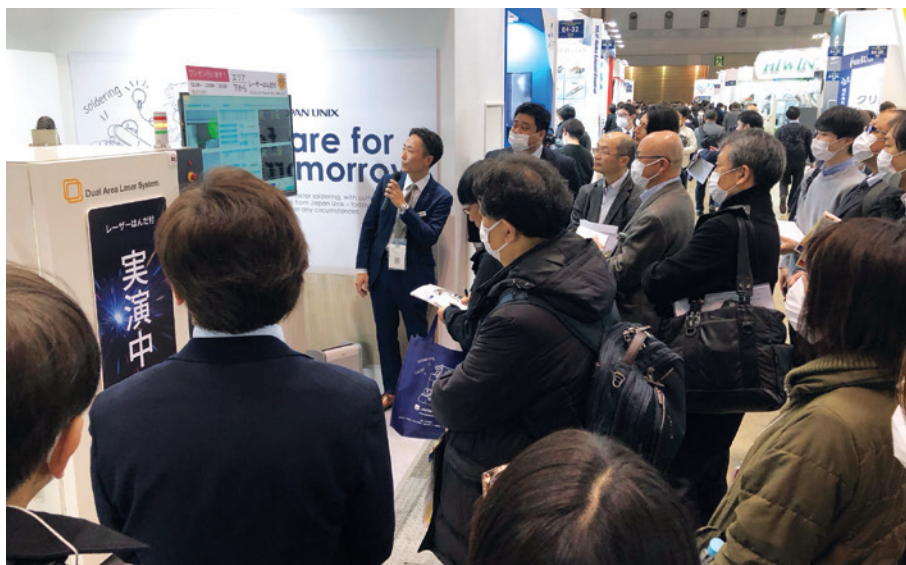
The UNIX-DF series is capable of connecting to the factory network. Thus, the company's unique soldering robot management software, Soldering Manager, enables real-time visualization and automation.

The horizontally articulated FR series of in-line soldering robots is a new generation of soldering robots. Specifically, they suit fully automated production lines with enhanced communication network functions for the IoT era.

Realizing a Positive Response

In addition, Kono said, "The products on display comprised of new technologies and new products that convey our strengths. Particularly, in the area of lasers, laser soldering, and a new type of controller. At the booth, we highlighted soldering with demonstrations of the area laser and laser from below. These gathered the attention of visitors."

Furthermore, Kono said, "We realized that the soldering robots are easy to use and manage. Thus, we are getting a good response to the growing demand by proposing ways to improve productivity." □



Visitors flock the booth of Japan Unix and witnessed the presentation of their soldering system that uses area laser technology (NEPCON Japan 2024).

Maxell Flexes Muscle on India's Automotive Market

Maxell, Ltd. has beefed up its product portfolio for the automotive market. Particularly, the company is propelling its lineup in a bid to expand further its presence in India.

Recently, the company took part in the Bharat Mobility GLOBAL EXPO 2024 in Delhi, India in February. The three-day event brought together the entire mobility value chain under one roof. Accordingly, it's the first of its kind of scale in India and supported by the Indian government.

AEI has recently spoken with Maxell through Takashi Matsunaga, Manager, Functional Materials Sec., Global Sales Dept.; Masaki Yajima, Manager, Energy Sales Sec., Global Sales Dept.; and Yoshihiro Tamura, Manager, Sales Planning Sec., Sales Planning Dept. Specifically, they shared their experience in the exhibition and charted their initiatives in the Indian automobile market.

AEI: *Can you share with us your experience at the show?*

Tamura: Bharat Mobility GLOBAL EXPO 2024 was the first exhibition organized by the Indian government. For that reason, Prime Minister Modi even visited the venue.

The event was extremely successful, with over 800 exhibitors and more than 150,000 visitors. Visitors included not only those in the automotive industry, but also people interested in automobiles, student groups, and many others.

Maxell was one of nine companies that exhibited under the Japan Pavilion in the exhibition hall for parts suppliers.

Main Exhibit Categories

AEI: *What were the main products you highlighted in your booth?*

Matsunaga: We introduced three categories of products at our booth. First, is the coin-type CR batteries. Next are the adhesive tapes and then the lens units for in-car cameras.

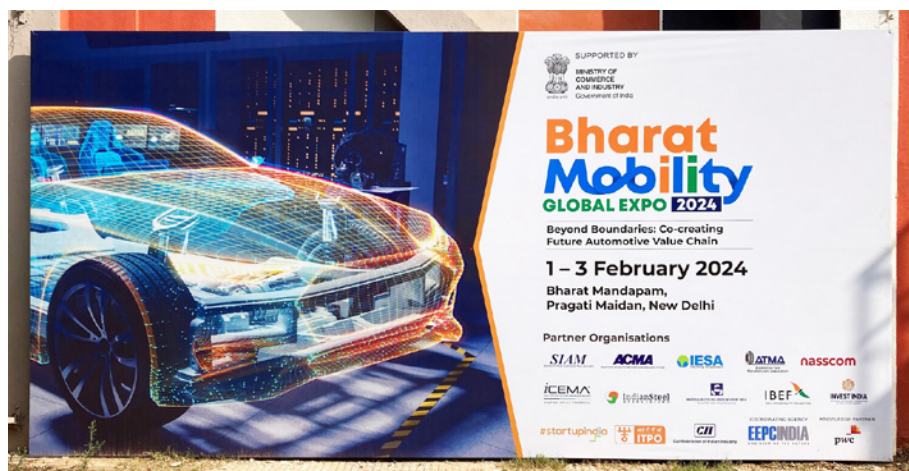
In the adhesive tape category, the company introduced butyl tape for fixing automobile door mirrors. Nonetheless, butyl tape has been receiving high regard for its strong adhesive strength and long-term reliability and has been adopted in the Indian market for fixing door mirrors. Since automobiles also require anti-vibration and soundproofing, applications of butyl tape are expanding to fix exterior and interior parts. Moreover, applications in anti-vibration measures for gasoline tanks and spare tires are also gaining ground.

Butyl tape are usually supplied in the shape of rolls. However, in the automotive field, butyl tapes are required to be punched into the shape specified by the user or laminated with other materials. Thus, the company plans to continue expanding its business with local processing companies and other partners.

AEI: *How do you plan to develop further coin-type CR batteries?*



(From left to right) Masaki Yajima, Manager, Energy Sales Sec., Global Sales Dept.; Yoshihiro Tamura, Manager, Sales Planning Sec., Sales Planning Dept.; and Takashi Matsunaga, Manager, Functional Materials Sec., Global Sales Dept.



Bharat Mobility GLOBAL EXPO 2024 at New Delhi, India

Yajima: We introduced two types of coin-type batteries. First, the heat-resistant coin-type CR batteries and the other the regular coin-type CR batteries. We promote the first for TPMS (Tire Pressure Monitoring System) and the second for keyless entry.

Maxell has approximately 70% of the global market share for coin-type batteries for TPMS. We aim to increase further our share in the Indian market as well.

Although TPMS is not yet mandatory in India, automakers themselves are installing TPMS on their own. Thus, demand for TPMS in the aftermarket is increasing. If the TPMS becomes legal requirement in the future, demand for TPMS will increase significantly.

Maxell was one of the first to commercialize coin-shaped batteries for TPMS in 2004. Particularly, the company responds to customer needs by developing products that are smaller in size.

AEI: Can you share with us your plans in developing in-car camera lens units?

Tamura: We have a high global market share for in-car camera lens units and we are boosting further our marketing in India. For that reason, we took part for the first time at Bharat Mobility GLOBAL EXPO and exhibited our products. We have a lineup of products for front-view cameras, rear-view cameras, and sensing cameras. All of which feature excellent resolution performance.

Emphasizing the Indian Market

AEI: What prospects do you have in the Indian automobile market?

Matsunaga: In 2023, we expect full-year new vehicle sales in India will increase 7% to 5,079,985 units. Particularly, the sales cover shipments of passenger cars and commercial vehicles. Thus, India maintains its third position after China and the United States for two consecutive years.

According to one research organization, the market will expand to 7.5 million units by 2030. Accordingly, the number of automobiles produced in India will continue growing. We believe that the Indian automobile market is attractive.

AEI: What are the trends in the Indian EV market?

Matsunaga: The EV market is rapidly expanding. In India, air pollution in

urban areas is particularly serious. Thus, the shift to EVs complements the need to protect the environment. The Indian government has set a goal of 30% of new passenger car sales to be EVs by 2030.

AEI: What is the general outlook that you see on your business in India?

Matsunaga: We are placing importance on the Indian market as part of our policy to expand overseas sales. Currently, the mainstay of our business is silver oxide batteries "SR" for watches and CR coin-shaped batteries for consumers. In addition, the company plans to further expand business-to-business, particularly focusing on business for the automotive market.

AEI: How do you position your overseas business and what will be your business direction in this regard in the future?

Matsunaga: We have set healthcare, 5G/IoT, and mobility as priority fields for business expansion in the medium term. Moreover, we will expand these fields overseas. In June 2023, the company also announced its policy of tripling the number of overseas sales engineers and marketing and development staff compared to FY2022.

The sales organization in Asia includes a headquarters in Hong Kong, sales companies and liaison offices in China, Taiwan, Singapore, Thailand, Vietnam and India. In India, we have a liaison office in Chennai. □



Maxell presents its latest lineup of products for the automotive market.

Aerotech Sees AI, 5G Driving Motion Control Momentum

Despite the market volatility and challenges, Aerotech Inc. was able to demonstrate remarkable resiliency and adaptability in the past year. Richard Teo, APAC Director for Aerotech Inc., gave credit to the company's robust portfolio and presence in various industries. Moreover, the emergence of megatrends has been propelling the demand for the company's motion control technologies.

"It has been advantageous for Aerotech that more companies are recognizing the value of precision, accuracy, and high throughput. The growing adoption of digital, high-end solutions, coupled with the increasing emphasis on artificial intelligence, has not only created new opportunities but also spurred a surge in demand for our cutting-edge motion control technologies," said Teo. "This positions Aerotech favorably for continued growth."

Aerotech has three major application fields. First, the semiconductor industry, where its motion control solutions enhance the efficiency and accuracy of manufacturing processes. Next is electronics manufacturing for electronic components production. Third is the medical devices, where Aerotech's solutions enable medical and laboratory equipment manufacturers to enhance throughput quality.

In this interview with AEI, Teo charted the landscape of high-precision motion control technologies and their crucial role across application fields, particularly in semiconductor fabrication and packaging.

AEI: Can you discuss the trends driving high-precision motion control?

Teo: A pivotal trend is the demand for smaller,

more compact motion control systems. This surge in demand results from increasingly sophisticated and space-constrained applications, leading to the development of seamlessly integrated miniature components like motors, drives, and sensors.

In addition, the integration of artificial intelligence and machine learning is another major driver in high-precision motion control. These technologies enable the development of intelligent motion control systems that adapt to changing parameters, enhancing accuracy, efficiency, and safety by optimizing performance and learning from real-time data. This reflects a transformative shift towards smart and adaptive motion control solutions.

Lastly, the advent of Industry 4.0 and the widespread adoption of IoT have ushered in a new era for high-precision motion control. Accordingly, this trend creates remote monitoring, diagnostics, and predictive maintenance opportunities. Industry 4.0 and IoT connectivity facilitate real-time insights. Thus, enabling proactive measures to ensure optimal performance, reduce downtime, and enhance the overall reliability of motion control systems.

AEI: How about the specific trends in the semiconductor and microelectronics industry?

Teo: Continued node miniaturization is a cornerstone trend in the semiconductor sector, demanding precision in manufacturing processes. Aerotech leads in providing motion control solutions crucial for fabricating and validating microscopic circuitry on modern chips.

Furthermore, another significant trend involves the shift to advanced packaging techniques or novel packaging methods to enhance chip performance and functionality.

The deployment of Photonic Integrated Circuits (PICs), facilitating high-speed, energy-efficient data transfer, is another pivotal industry development.



Photo 1: Richard Teo, APAC Director, Aerotech Inc.



Photo 2: Aerotech's Automation1 platform

The manufacturing and testing of PICs demand precision motion control, crucial for accurate optical component alignment.

AEI: *What are the critical elements necessary to optimally serve the automation demands of this industry?*

Teo: Central to our commitment is the recognition that the industry demands high precision, throughput, yield, and accuracy. Thus, Aerotech aligns its solutions with these prerequisites. In addition, understanding the critical role these play in ensuring our customers' success.

Scalability is a key principle in our approach. Our solutions are designed to be inherently scalable, facilitating seamless transitions from research applications to full-fledged production. This flexibility supports the seamless transition from applications in laboratories to large-scale fabrication. Hence, offering a cost-effective and efficient path for clients.

Our Automation1 controller platform encapsulates all essential elements for high-precision automation. Thus, meeting the most demanding criteria that our clients may have and reflecting our commitment to providing a unified solution across diverse applications.

AEI: *How does the global supply chain issue impacted Aerotech and what measures are you taking to address this challenge?*

Teo: In recent years, global supply chain challenges have significantly im-

pacted various industries, prompting Aerotech to take decisive steps to mitigate these effects. One primary strategy involves exploring and establishing alternative sources for crucial components, fostering resilience, and reducing our vulnerability to single-supplier reliance.

This proactive approach ensures a robust supply chain, enhancing our ability to navigate disruptions effectively. Nonetheless, Aerotech's continuous efforts to diversify our sources and to closely monitor the situation will position us to respond swiftly to changes.

Moreover, by maintaining flexibility and adaptability in our supply chain strategies, Aerotech aims to navigate the current challenges and contribute to a more stable and resilient global supply network in the long run.

AEI: *Can you share Aerotech's business outlook for the coming year?*

Teo: In the coming year, Aerotech expects positive business performance driven by key industry trends, including an increase in the integration of AI and 5G technologies that will fuel demand for high-precision motion control solutions.

Controlled inflation is anticipated to boost consumer purchasing behavior. Particularly, in consumer

electronics, computing, and communication, generating greater demand and positioning Aerotech for growth. To capitalize on these dynamics, the company is focusing on optimizing our processes, enhancing our supply chain resilience, and increasing our investment in research and development to stay ahead in technological advancements. Aerotech is dedicated to maintaining its agility and adaptability in order to navigate changing market dynamics and deliver innovative solutions to meet the evolving needs of its clientele. □

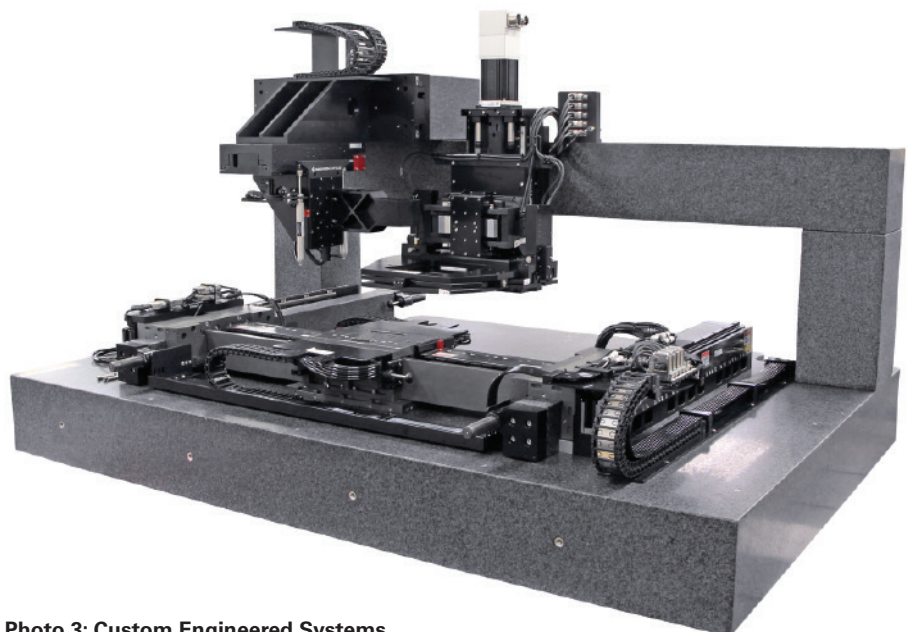


Photo 3: Custom Engineered Systems

FUJI Braces for AI-Equipped Smart Machines with FSF 3.0

FUJI Corporation operates two business groups for the global market: the robotic solutions business and the machine tool business. The robotic solutions business focuses on mounting machines and accounts for about 90 percent of the company's net sales. Meanwhile, the machine tools business handles machine tools. In this interview with AEI, Joji Isozumi, President and Chief Operating Officer of FUJI Corporation, shares the company's business prospects and strategies for 2024 amid industry challenges.

AEI: *2023 was a difficult year for the mounting industry mainly due to sluggish investment environment in manufacturing. How did the overall industry climate affect FUJI's business?*

Isozumi: In 2023, the mounting machine business (robotic solutions business) remained relatively firm in the United States and Europe especially for automotive and industrial equipment fields. However, overall, the business in the first half was affected by the movements in orders received in advance, particularly in 2022. Meanwhile, in the second half, capital investments in smartphone and in-vehicle equipment fields, particularly in China, and of electronic manufacturing service (EMS) providers emerged. Accordingly, we received higher requests for the evaluation and introduction of equipment. Generally, I expect capital investment to begin to recover in 2024.

AEI: *What are the future development directions amid the continuing evolution of FUJI Smart Factory (FSF)?*

Isozumi: It has been more than 10 years since Industry 4.0 was proposed. In relation, our FSF has been evolving over the past 10 years. The first step (FSF 1.0) was to link equipment. The second step (FSF 2.0) was to link the entire surface-mount technology (SMT) line, including data management and utilization, and remote management; and now, the third

step (FSF 3.0) is to make equipment and SMT lines intelligent, including the use of artificial intelligence (AI).

At the same time, FUJI has commercialized the new AIMEXR, a flexible all-in-one mounting machine that meets diverse on-site needs and caters to a wide range of FSF.

This FSF enables an automated production environment in which people work harmoniously with machines.

AEI: *How do you position the China market in your overall global strategy?*

Isozumi: There is a certain amount of demand in China, and there have been recent signs of investment recovery in domestic smartphone and automotive applications. We will continue to respond to these trends. On the other hand, an increasing number of manufacturers are expanding and shifting their production bases from China to Southeast Asia and other regions.

Rather than concentrating on a single region, we are targeting a wide range of demand while strengthening horizontal integration. India has an abundant labor force, but it is also a country with high IT skills, and interest in cutting-edge equipment is high. Even if production shifts from China to India, there is no longer a regional difference in acceptable technology. Our basic policy is to provide the same quality and service worldwide. From the perspective of assisting customers' board production business in India, we have begun to offer packaged SMT equipment and production processes.

We will also offer packaged solutions for SMT introduction in Indonesia, Vietnam, and other countries where demand is expected to increase in the future.

AEI: *Can you share the latest developments in FUJI's production system?*

Isozumi: Our new Okazaki Plant, which is under construction, aims to expand the mounting machine business. It will start operation in Sept. 2024. It will be a state-of-the-art factory equipped



Joji Isozumi,
President and
Chief Operating
Officer of FUJI
Corporation

with robotics and internet of things (IoT) technologies. Upon completion, it will result in a production capacity increase of 50%. The implementation of digital manufacturing will enable the factory to operate with less risk in the face of fluctuating demand.

Meanwhile, the Kunshan Plant in China will produce SMT printing machines, production line transport equipment, and products for the machine tool business. Also, it is in the process of doubling its production capacity.

Although local production for local consumption in the manufacturing industry is progressing, we will prioritize production in Japan to cope with the outflow of intellectual property. We will use local inventories through our worldwide network of distributors and other means to shorten delivery times.

AEI: *Can you describe recent developments in Fasford Technology Co., Ltd. (FFT)?*

Isozumi: FFT became part of the FUJI Group in 2018. It develops, manufactures, and sells semiconductor manufacturing equipment, mainly die bonders for memory. FFT's R&D building was completed in Nov. 2023.

Now, FUJI is jointly working with FFT to develop products in new fields that combine the semiconductor mounting process, which takes advantage of FFT's advanced expertise, with the versatility of electronic component mounting machines. □

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IMI Taps New Opportunities to Sustain Grit in China

Manufacturing activities in China continue to face uncertainties sans a favorable breakthrough in the geopolitical tensions it is currently facing. Despite these concerns, several manufacturers believe the region can sustain its grit as a market and as a manufacturing hub, especially if the trade conflicts yield beneficial outcomes.

Integrated Micro-Electronics, Inc. (IMI) is one of the global manufacturers that maintains a huge visibility in China. However, the trade tensions hounding the region took a toll on most EMS in the region, including IMI. Particularly, the Philippine-headquartered EMS company's 2023 sales in China declined 12 percent versus the forecast.

Nonetheless, IMI said its 2023 revenue haul from its four factory sites in China is approximately US\$270 million, which is 24 percent share of the company's global core business revenue.

"Our (China) team found many opportunities to improve our cost controls and operational efficiency to better align with the actual incoming revenue. Thus, our 2023 numbers are even better than our previous 2022 profitability performance," said Joey S. Bantatua, IMI China Head of Operations. Bantatua is also the General Manager – Jiaxing Integrated Micro-Electronics Inc. and Speedy-Tech Electronics Co., Ltd.

Bantatua said the automotive segment remains the company's stronghold in the region. In fact, its share in IMI China's total revenue has been increasing for the past five years from 25.8 percent in 2019 to 52.7 percent in 2023. The industrial customer segment's share has also been consistently high during the period.

Despite the challenges in the market, Bantatua said the resilient and empowered IMI China team understands the need to accomplish critical tasks to honor customer commitments and quality on-time deliverables. Thus, adhering to IMI's core values, which are Integrity, Customer Focus, Concern for Others, and Excellence.

In this interview with **AEI**, Bantatua tracked the prospects of China both as a market and a production hub as well as the measures the company has employed in mitigating any challenges.

AEI: *Can you discuss the importance of the China operations to IMI's overall business in 2023?*

Bantatua: Our regional operations team plays an important role in terms of supporting several market segments with world-class brands that are major players globally. We serve 72 percent of our finished goods for local China consumption while 28 percent are for exports.

Our 2023 sales is around US\$270 million, which is 24 percent share of the company's global core total business revenue.



Joey S. Bantatua, IMI China Head of Operations and General Manager - Jiaxing Integrated Micro-Electronics Inc. and Speedy-Tech Electronics Co., Ltd.

We consider ourselves a dependable supplier and partner as we are the sole EMS provider to some major global brand customers. Especially, those who require complex assemblies and stricter requirements, such as ASIL D safety level in automotive applications. We can say that it is almost zero tolerance for IMI China to fail our customers or it will be too costly for us and our customers. It disrupts OEM operations as well as the availability of their products in the market.

AEI: *Which specific segment do you consider as your stronghold in China?*

Bantatua: IMI China's stronghold in 2023 is coming from our automotive customers followed by the industrial customer segment. For the last five years, our automotive sales have grown from 25.8 percent share in 2019 to 52.7 percent share in 2023 while our industrial customers follow at 29.9 percent share.

AEI: *Demand in the automotive segment is growing. How do you keep up with the competition in this segment?*

Bantatua: Yes, the momentum in the automotive sector remains high in China. According to China Daily (www.china-daily.com.cn), retail sales of passenger cars reached 21.7 million units in 2023, up 5.6% year-on-year. Exports of passenger cars rose 62 percent from a year ago to 3.83 million units in 2023. Meanwhile, sales and exports of new energy passenger vehicles registered robust expansion in China last year with 7.74 million vehicles



IMI's factory locations in China



IMI China assembly line



IMI China team

sold, surging 36.2 percent year-on-year. Vehicles exported reached 1.05 million, jumping 72 percent.

Our IMI China team is keeping up with the competition by staying resilient towards achieving all our customer commitments and satisfying or exceeding our customers' expectations. While we understand the stronger competition in China, we are working our way to be even more flexible in terms of different business concepts or customized arrangements to better serve and win more local China customers according to their needs.

AEI: *What kind of outlook do we expect to see in 2024 and what challenges do you see coming?*

Bantatua: Our IMI China team can sustain that positive momentum towards 2024, as already shown in our January 2024 actual financial performance. The majority of our Key Process Indicator results have improved and exceeded the month's set targets.

The only uncertain factor moving forward will be the impact of the geopolitical situation in China wherein customer production demands are dropping. Overseas requirements, especially those that are affected by the United States-China Trade war, are moving their production out of China due to higher taxes. What is left in China manufacturing will just be for local China consumption and for those few customers who cannot leave immediately due to only having the factory inside China as their only supplier. This factor slows down the momentum of the 2024 EMS business in China.

However, there can still be a possibility for a sudden shift or changes in the momentum depending on the global and political events that can happen within this year such as the United States-China trade war developments, upcoming presidential elections in the United States,

and the outcome of the armed conflicts in some parts of the world.

AEI: *How does IMI see China in the long term?*

Bantatua: China already has a proven track record in terms of its manufacturing capability in the past decade or so. Those who have moved out of China and have started to manufacture somewhere else have struggles in terms of achieving the required consistent quality and on-time delivery of their product. Furthermore, others have also experienced high costs of production due to logistics, transport, and importation of the needed materials. If these countries who have absorbed these transfer loads from China are not able to perform at an acceptable standard, then eventually there is a big possibility that these global brands will go back to having their products manufactured in China once again. Especially, if the geopolitical situation has changed for the better.

AEI: *What strategies do you think will be critical in sustaining your momentum in the region?*

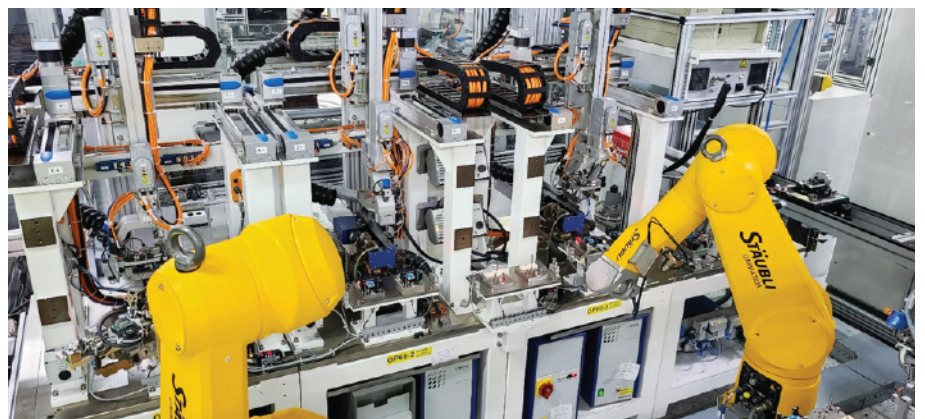
Bantatua: We see prospects of more potential local China customers who are creating new products and new technology innovations. These will be big oppor-

tunities for our future operations. Moreover, while our load versus our capacity is not at its peak, we will use this opportunity to expedite our four locations sites to execute the applicable IMI Global Best Practices and further optimization.

In addition, we will also upgrade and explore new opportunities to make significant improvements results in our Quality, Cost, Delivery, Service, and Efficiency. This is critical in sustaining our momentum and adapting to the new level of competition in China.

AEI: *Amidst market challenges, how are you able to empower your employees to take accountability and foster an environment of teamwork?*

Bantatua: We practice our IMI Core Values (Integrity, Customer Focus, Concern for Others, and Excellence). We live these values and make them our way of life. Such culture even breaks the typical department silos, wherein every employee can find ways and given flexibility in accomplishing our common goal. Furthermore, rewards and recognition are given to the team and individuals. As such, our employees are well motivated and are willing to go the extra mile to continuously win for IMI. □



IMI China assembly line



Fasford Technology's New R&D Advances IC Manufacturing



Hiroyuki Ao, Managing Director,
Fasford Technology

Fasford Technology Co., Ltd. is strengthening its development system to meet the needs of cutting-edge semiconductor manufacturing. For that reason, the company has constructed a new research and development (R&D) facility to accelerate product development.

Recently, the advancement of semiconductor packaging technology has been progressing drastically. Hence, Fasford Technology wants to contribute to the further evolution of packaging technologies with the new R&D center.

The company supplies high-performance die bonders used in back-end processes. Furthermore, the company has a large share of the memory die bonder market, thanks to its low-stress die pick-up technology and high-precision die stacking technology. In recent years, the company has also added logic die bonder products to its product lineup to support a variety of package technologies.

The R&D building is a three-story steel-frame structure with a total floor

area of approximately 6,172sq.m. Fasford Technology invested approximately ¥2.5 billion (US\$16.75 million) in the R&D center.

Previously, the company conducts R&D in one of its manufacturing facilities but has reached full capacity. Initially, the company decided R&D engineers had to work across the company's facilities. Thus, pooling them together under one facility would further improve their efficiencies.

Clean Room

The R&D center's first floor houses durability testing and debugging while the third floor has office spaces. Meanwhile, Fasford Technology dedicates the second floor to a US Standard Class 1 (equivalent to ISO Standard Class 3) clean room. Thus, enabling product development in an environment comparable to front-end processes.

Hiroyuki Ao, Managing Director at Fasford Technology noted how semiconductor manufacturing processes have become more complex. "It is necessary to develop die bonders in an environment similar to the front-end process. (This will) accommodate advanced new technologies such as hybrid bonding."

The new R&D building will enable the company to develop next-generation models of existing products and new products. Particularly, to complement the demand in cutting-edge device manufacturing.

The development of next-generation models requires higher bonding accuracy and lower stress on devices. Thus, the company's high precision model DB850H has achieved a high precision of 5 μ m with the Die Attach Film (DAF) process. Moreover, the company is aiming for 3 μ m for the next-generation model.

In the future, the company is



Exterior view of the new R&D building



Inside the R&D building equipped with a clean room

also looking to develop an ultra-high-precision model with bonding accuracy of $1\mu\text{m}$ or less.

Utilize Know How, Capabilities

In the assembly process for both memory and logic devices, where 3D integration is progressing, the risk of ultra-thin die defects is increasing. Hence, low stress is essential.

In the development of new areas, the company will work on products for high-bandwidth memory (HBM). Its main application areas include artificial intelligence (AI) semiconductors. The company is also looking at chiplet and other dissimilar bonding technologies and will promote support for advanced packaging technologies such as hybrid bonding.

As added, "We have the world's leading share of the die bonder market for memory devices. We remain steadfast in developing new products by utilizing the know-how and technical capabilities we have cultivated over the years." □

Emerging Trends ...

Continued from page 08

where technological innovation is progressing. Thus, there is active development and production capacity expansion of SiC and GaN materials as next-generation semiconductor materials. These suffice the need for energy conservation and higher efficiency in the automotive and industrial equipment markets. In addition, the technological development of gallium oxide as a wide bandgap material with better cost performance than SiC and GaN is also underway.

Semiconductor-Related Processes

In the semiconductor lithography field, manufacturers are into the development of process materials and expansion of supply system for ArF and EUV lithography.

Meanwhile, the miniaturization of circuit patterns on semiconductor chips will continue to advance due to faster processing speeds and higher integration of semiconductors. For that reason, semiconductor process material manufacturers will continue to aim to expand their market share by developing materials that meet next-generation needs. At the same time, demand for older process materials, such as those for i-line, is also on the rise due to the recent expansion of the semiconductor market base.

In the area of decarbonization, there have been bigger focus on developing materials for next-generation solar cells, storage batteries, and all-solid-state batteries.

Recently, electronic materials saw a favorable outlook

in the first half of 2022 due to the solid expansion of the electronic components and semiconductor markets. However, demand stagnated in the second half due to a decline in demand for electronic components. Particularly, caused by sluggish demand for IT equipment and a slowdown in the semiconductor market.

In 2023, conditions remained harsh throughout the year due to deteriorating semiconductor market conditions. Thus, a further decline in ICT-related demand and stagnant capital investment demand. Despite this, demand from the automotive industry remained relatively firm.

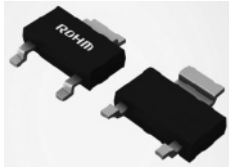
Expectations for Increased Demand

In 2024, the electronic materials market is likely to see continued growth in automotive-related demand. Moreover, the consumer- and industrial equipment-related demand will likely experience gradual recovery as well. Specifically, demand for electronic materials will feel a boost from the progress of digitization and electrification of automobiles. In addition, the increase in demand related to 5G and expanding investments in the environment and new energy will also serve as tailwinds.

There has been huge progress as well in efforts to improve productivity through digital innovation using AI, among others. Thus, a growing number of companies are introducing material informatics (MI) to improve efficiency and speed up R&D. □

Semiconductors & Modules

ROHM's R600xxND4 Super Junction MOSFETs



ROHM Co., Ltd. has added a lineup of compact 600V Super Junction MOSFETs - the R6004END4/R6003KND4/R6006KND4/R6002JND4/R6003JND4 in the SOT-223-3 package (6.50×7.00×1.66mm). The new models offer smaller, lower profile form factor without compromising on high breakdown voltage and low ON resistance of conventional products. Offering distinctive features, three of the models are optimized for compact power supplies. The R6004END4, characterized by low noise, is suitable for applications where

noise is a concern, while the R6003KND4 and R6006KND4, capable of high-speed switching, are ideal for sets requiring low loss, high efficiency operation. The R6002JND4 and R6003JND4 utilize proprietary PrestoMOS technology to achieve significantly lower switching losses by speeding up reverse recovery time (trr), making them well-suited for motors-equipped devices.

ROHM Co., Ltd.

<https://www.rohm.com>

ALPS ALPINE HSLCMB Series ICs

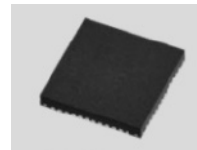
ALPS ALPINE Co., Ltd. has developed the HSLCMB Series ICs that incorporate a capacitance measurement circuit and 32-bit CPU to enable capacitive sensing with higher sensitivity and noise robustness than conventional products. The HSLCMB Series is applicable to a wide range of applications, including touchless

operation, automotive touch panels, and liquid level sensors. The signal-to-noise (S/N) ratio is higher than

conventional products, even under a noisy environment, allowing for sensing distant objects. The same distance can be covered by smaller sensor electrodes. Automotive specifications can be satisfied even in the vehicle cabin full of signals, such as road noise, engine noise, and radio waves. Also, it features absolute self-capacitance sensing, sensing only the capacitance of the target. It has an operating voltage range of 4.75 to 5.5V and operating current of 14.5mA (typ.). It features SPI and UART as interfaces and is compliant with reliability AEC-Q100 grade2 (-40 to 105°C).

ALPS ALPINE Co. Ltd.

<https://www.alpsalpine.com>



Components and Devices

TDK's B84742A*R725 Series EMI Filters

TDK Corporation B84742A*R725 series single-phase EMC filters serve both AC and DC applications up to 250V and rated currents from 6 to 30A. Available in five versions, the 97×60×34.5mm (L×W×H) single-phase filters, weigh no more than 310g, can be snapped quickly and conveniently onto the TH35 DIN rail. They feature very high insertion loss (depending on the model), for example, 40dB for common mode and over 80dB for differential mode noise at frequencies between 70kHz and 10MHz. Also, leakage currents are very low at <2mA. For short periods of time, the EMC filters can handle higher currents; 150% of the rated current is allowed for 3min/hr and even 250% for 30sec/hr, which makes them useful in drive applications when starting electric motors.

All types of this product family are UL-approved and specified for a rated temperature of up to 55°C.



TDK Corporation

<https://www.tdk.com>

JAE's KW07C Series Connector

Japan Aviation Electronics Industry, Ltd. (JAE) has released the KW07C Series CHAdeMO Standard-compliant EV charging connector. It comes with superior ease of handling while accommodating a capacity for 200A of current. During development, a strong focus was placed on minimizing size and weight of the connector as well as the flexibility of the cable. Two contacts are available for the power, while seven are for the signal. It also features 750V DC of power and 16V DC (max) for the signal. In terms of safety, the series has successfully passed stringent waterproofing evaluation required to receive UL recognition. In addition, it adopted proven technology from existing KW Series products, such as the Release Button Electromagnetic Locking Device and an Emergency Unmating Mechanism. It lasts up to 10,000 cycles with insertion force of up to 100N and operates from -30 to +40°C.

Japan Aviation Electronics Industry, Ltd.

<https://www.jae.com>



Murata's SCH16T-K01 Sensor



The SCH16T-K01 from Murata Manufacturing Co., Ltd. is an inertial 6DoF XYZ-axis gyroscope and XYZ-axis accelerometer that enables high precision machine control and positioning applications ideal for material handling equipment. It includes a sophisticated gyro with typical bias instability of 0.5dph and up to 0.3mdps/√Hz noise density. The accelerometer has a dynamic range of up to 26g, which provides resistance against saturation and vibration. The component exhibits excellent linearity and offset stability through the whole temperature range. The component's output is also internally cross-axis compensated, eliminating the need for extensive calibration at the user's end.

Murata Manufacturing Co., Ltd.

<https://www.murata.com>

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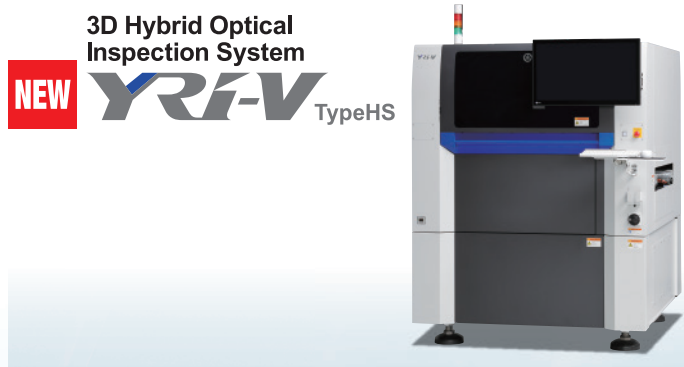
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SMT process

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