application GUIDE

Fluid Dispensing

Glue and Solder Paste Dispensing

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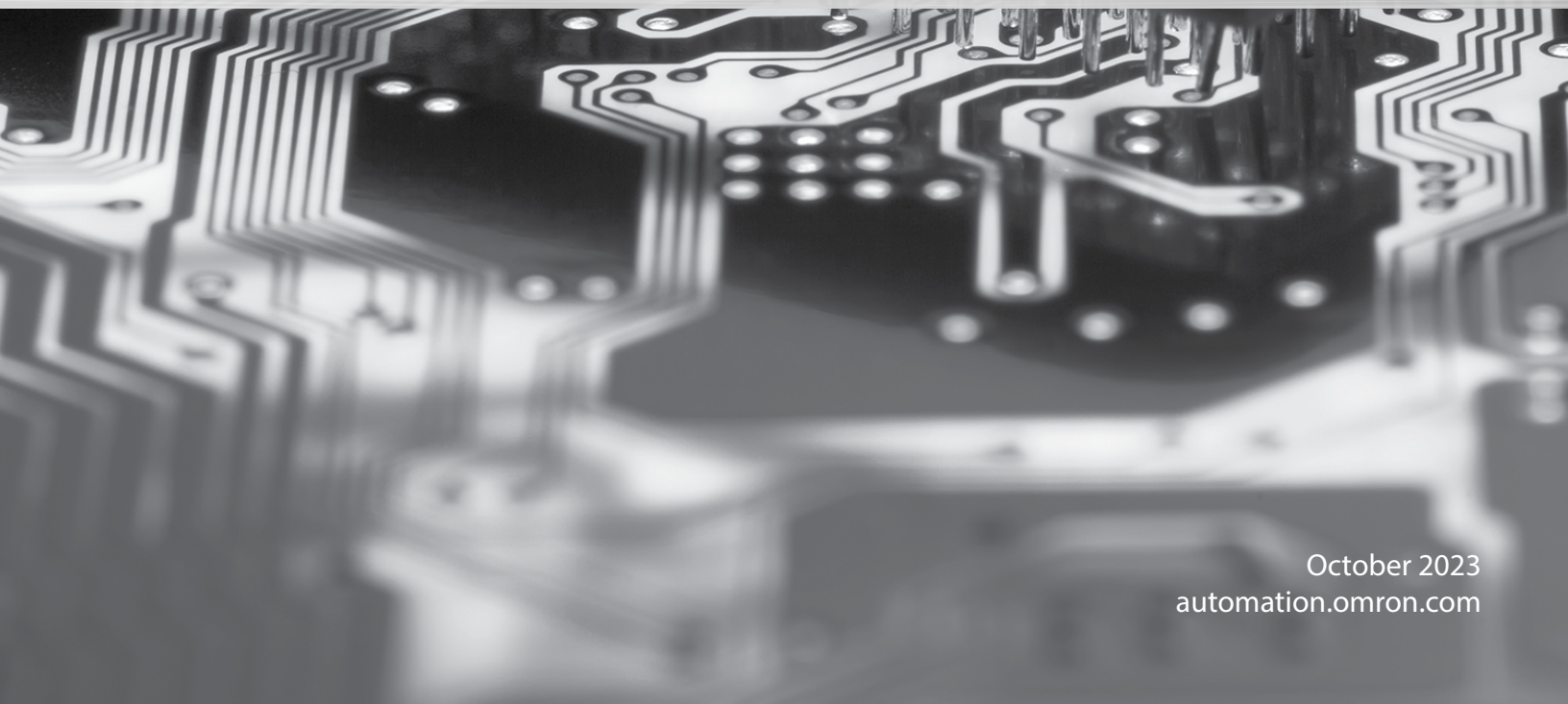

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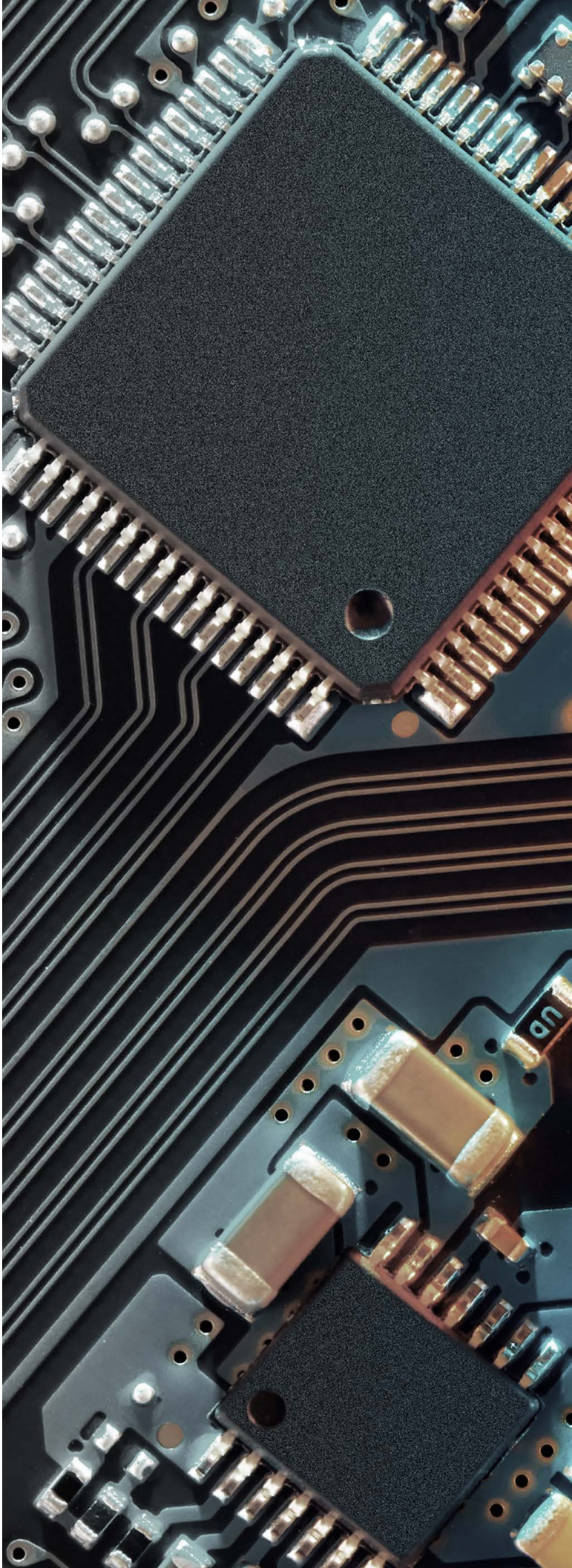
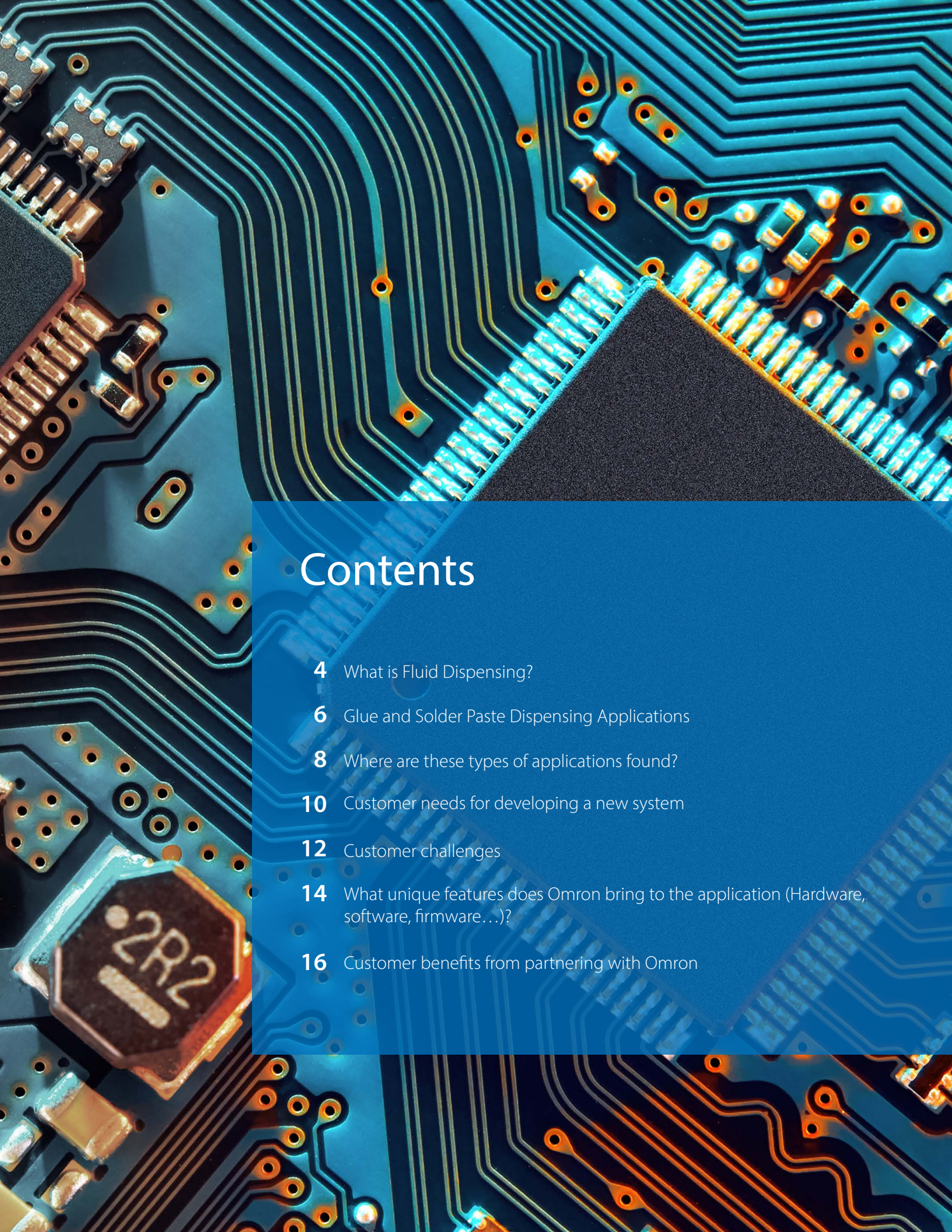
Purpose statement

This document is provided to give Omron Sales and Field Application Engineers a general understanding of Fluid Dispensing, specifically Glue and Solder Paste Dispensing applications. This should provide a better understanding of common customer challenges. As well as how Omron has created a solution to overcome these challenges.





Contents

4 What is Fluid Dispensing?

6 Glue and Solder Paste Dispensing Applications

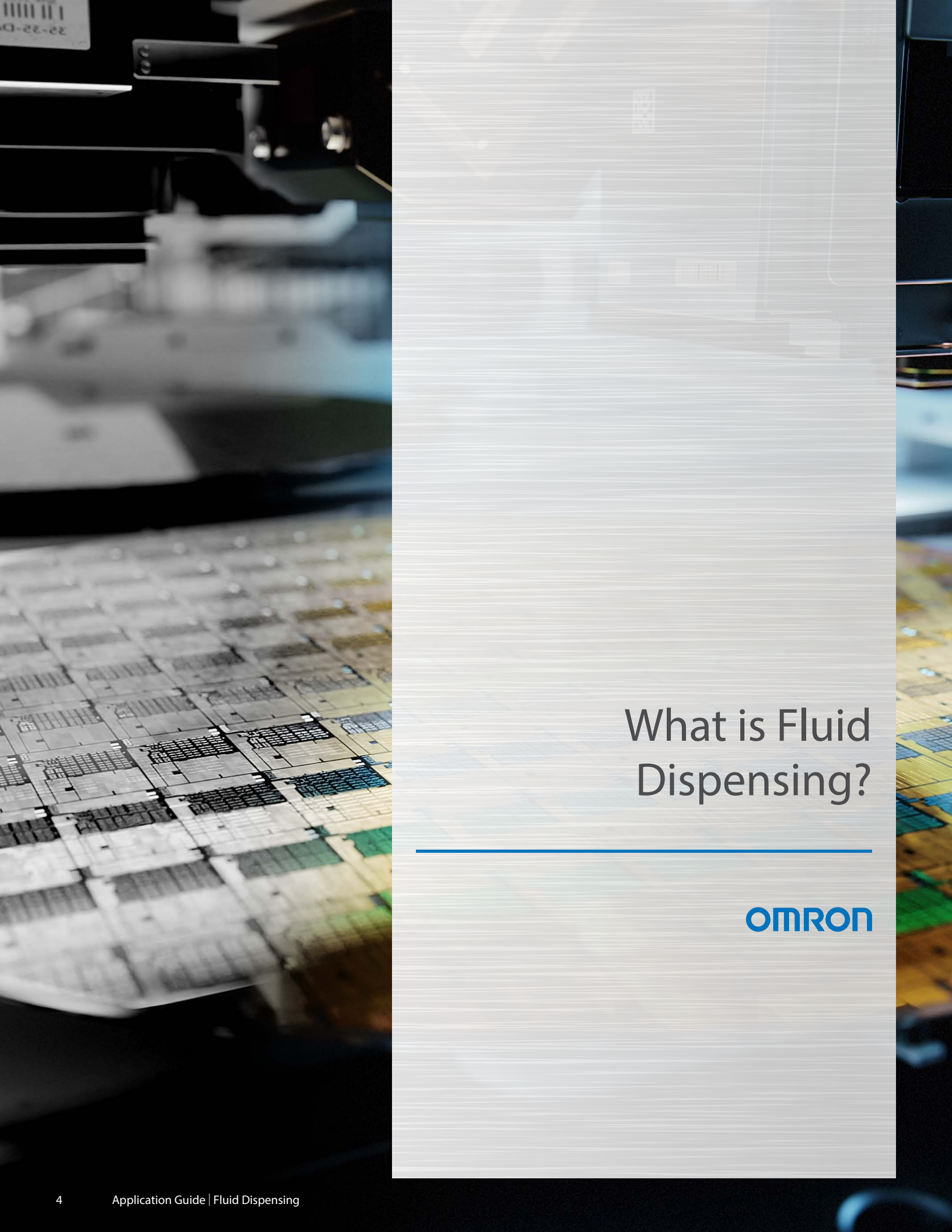
8 Where are these types of applications found?

10 Customer needs for developing a new system

12 Customer challenges

14 What unique features does Omron bring to the application (Hardware, software, firmware…)?

16 Customer benefits from partnering with Omron



What is Fluid Dispensing?

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Fluid dispensing refers to the process of accurately transferring and applying liquids or semi-liquids from one container or source to a surface.

The goal of fluid dispensing is to control the volume, flow rate, and placement of the fluid to achieve specific objectives, such as assembly, coating, sealing, lubricating, or creating precise patterns.

Specialized machines and tools are used for fluid dispensing, such as dispensing robots, syringe pumps, peristaltic pumps, dispensing valves, and pneumatic or hydraulic dispensers. These tools help control the fluid distribution to achieve accuracy, consistency, and efficiency in manufacturing processes.



Glue and Solder Paste Dispensing Applications

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Glue dispensing is a manufacturing process that involves applying adhesive (glue) onto surfaces to bond or attach various materials together.

There are various types of adhesives available, including cyanoacrylate, epoxy, silicone, polyurethane, and more, each with its own properties and applications. Specialized dispensing machine is used to apply the adhesive accurately and consistently. This machine can range from simple handheld glue guns to precision-controlled dispensing systems with robotic arms or advanced motion control.

Solder paste dispensing involves the accurate deposition of a specialized adhesive substance called solder paste onto a surface in specific locations. Solder paste is a mixture of tiny solder particles suspended in a flux medium. They are typically made of tin and lead, though lead-free alternatives are also used. The flux serves several purposes, including cleaning the surface, promoting solder wetting, and preventing oxidation during solder reflow. This process ensures the correct electrical connection between a component and a surface.

Where are these types of applications found?

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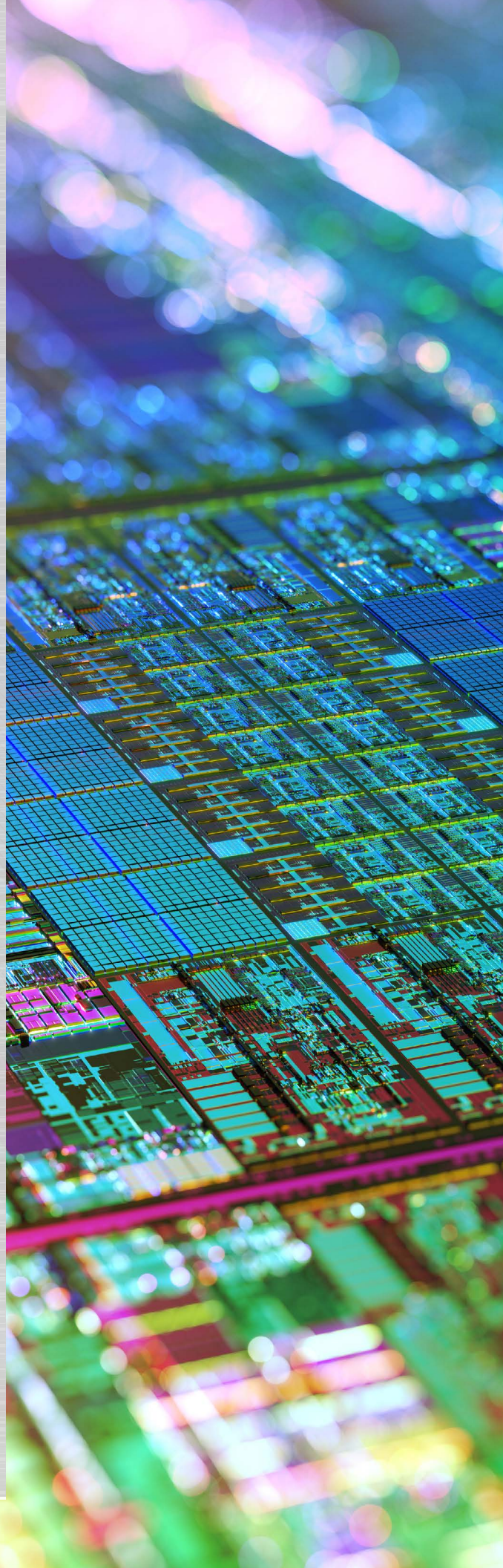
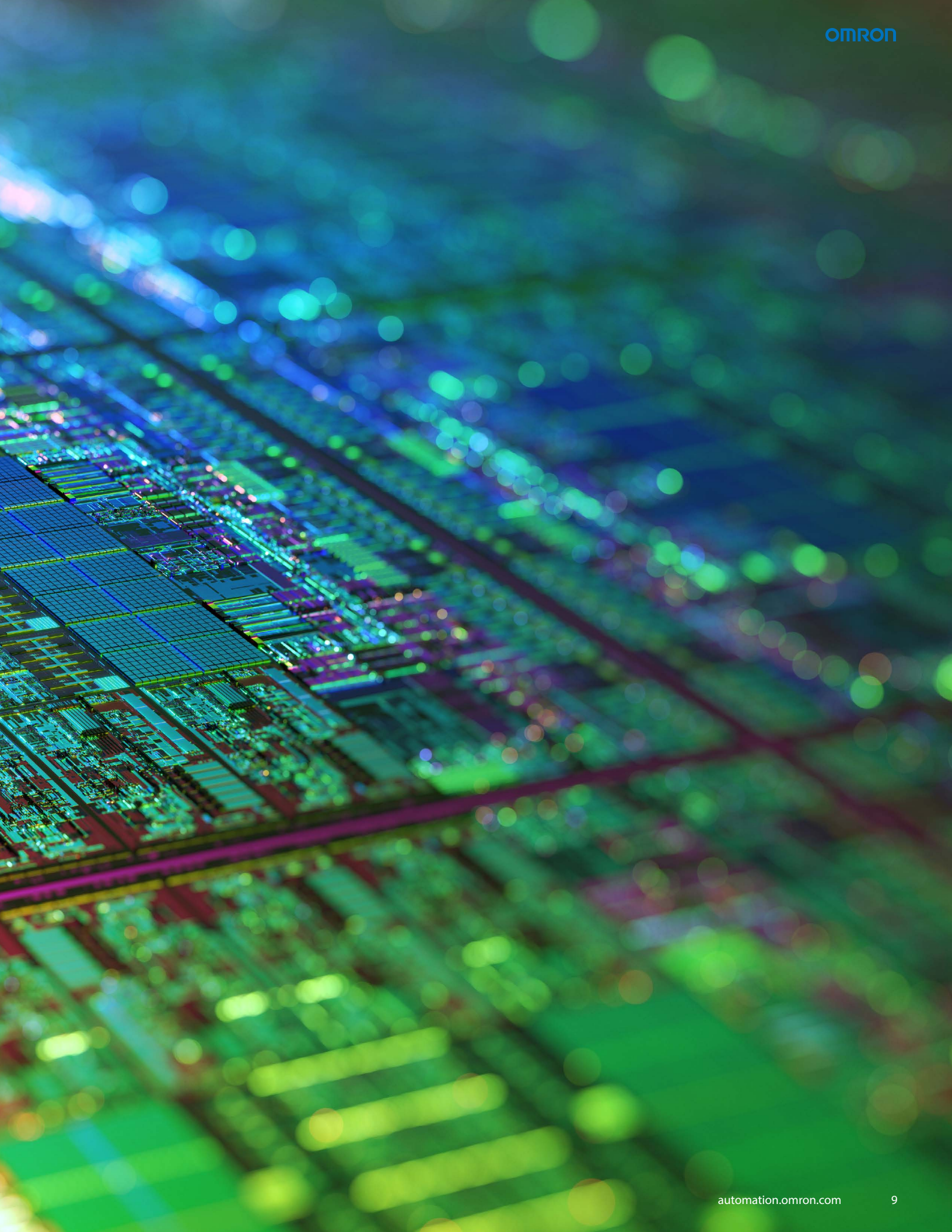
Glue and Solder Paste Dispensing are applicable mainly in PCB (Printed Circuit Board) assembly in the Electronics industry. In electronics manufacturing, glue dispensing is used to apply adhesive materials that bond components to PCBs. This includes securing surface-mount components, connectors, and other electronic parts. It is crucial for holding components in place during the soldering process and ensuring their mechanical stability.

Solder paste dispensing is a fundamental step in SMT (Surface Mount Technology) assembly which is a method for assembling electronic circuits where components are mounted directly onto the surface of PCBs. Solder paste is applied to PCB pads to attach surface-mount components like resistors, capacitors, and integrated circuits. Accurate solder paste deposition is crucial for proper solder joint formation during reflow soldering. For that, a dispensing machine of high precision is used to accurately deposit the paste onto the PCB. This machine includes stencil printers, solder paste dispensers, and pick-and-place systems. These systems are often integrated into automated SMT assembly lines.







Customer needs for developing a new system

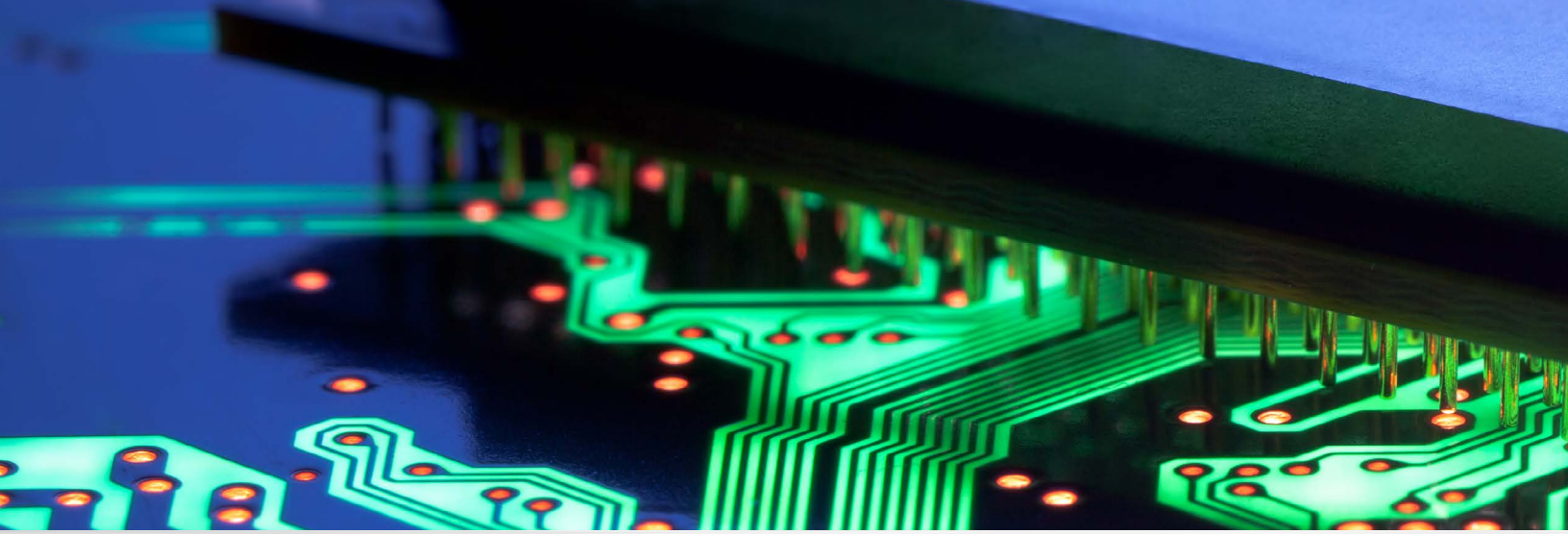
The choice of equipment, method, and fluid depends on the specific requirements of the application and the desired outcomes. The common desire of customers is to find automated systems that can provide:

Refined Motion Control:
Advanced motion control with smoother trajectories, precise positioning, and axis synchronization with faster response time. This is crucial to ensure higher quality for adhesive dispensing.

Throughput:
Operate at high speeds, making the systems suitable for high-volume production environments. Also, dispense adhesive quickly and efficiently, increasing production throughput.

Consistency:
Eliminate variations caused by operator fatigue or inconsistency. This leads to a more consistent and uniform application of adhesive, reducing the risk of defects and improving product quality.

Reduced Material Waste:
Minimize over-application of adhesive, resulting in reduced material waste. This can lead to cost savings in adhesive usage.



Customer challenges

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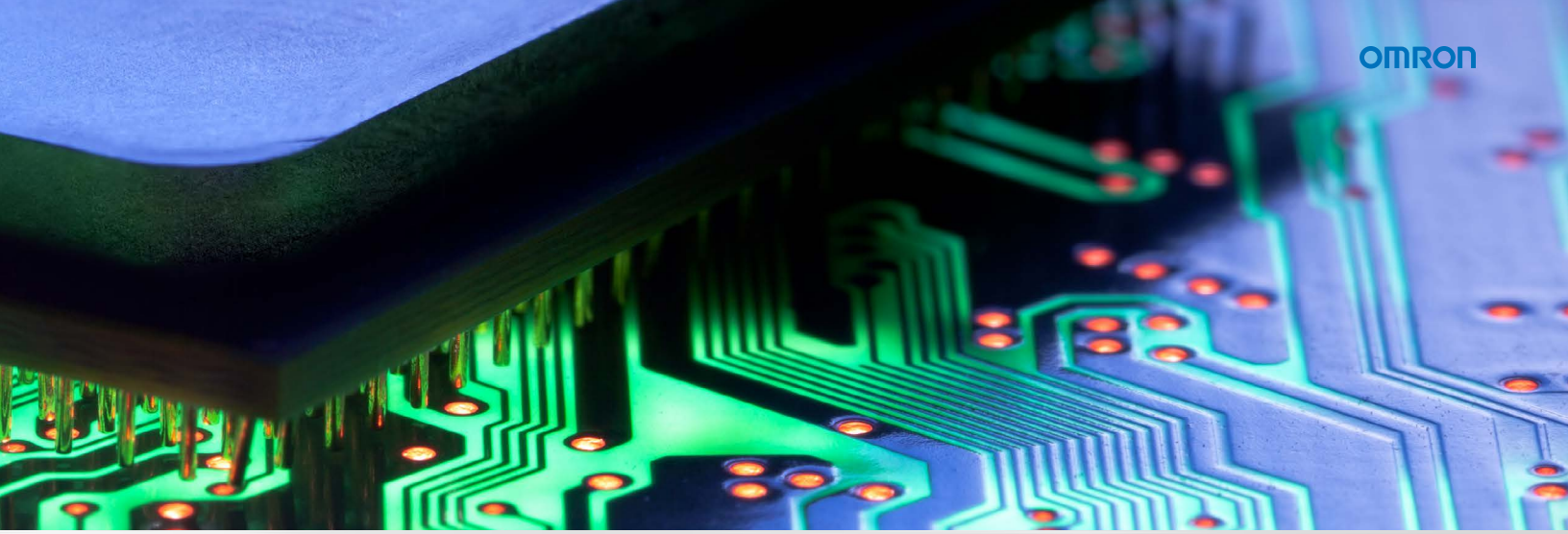
Dispensing machines are essential for accurately applying adhesive materials in various manufacturing processes, but it also faces several challenges that can impact its performance and effectiveness.



Some of the common challenges for a dispensing machine include:

1. **Dispensing Accuracy**
   Achieving precise and consistent adhesive application is critical in many industries. The equipment must be able to dispense the adhesive accurately in terms of volume and placement, especially in applications like electronics assembly.

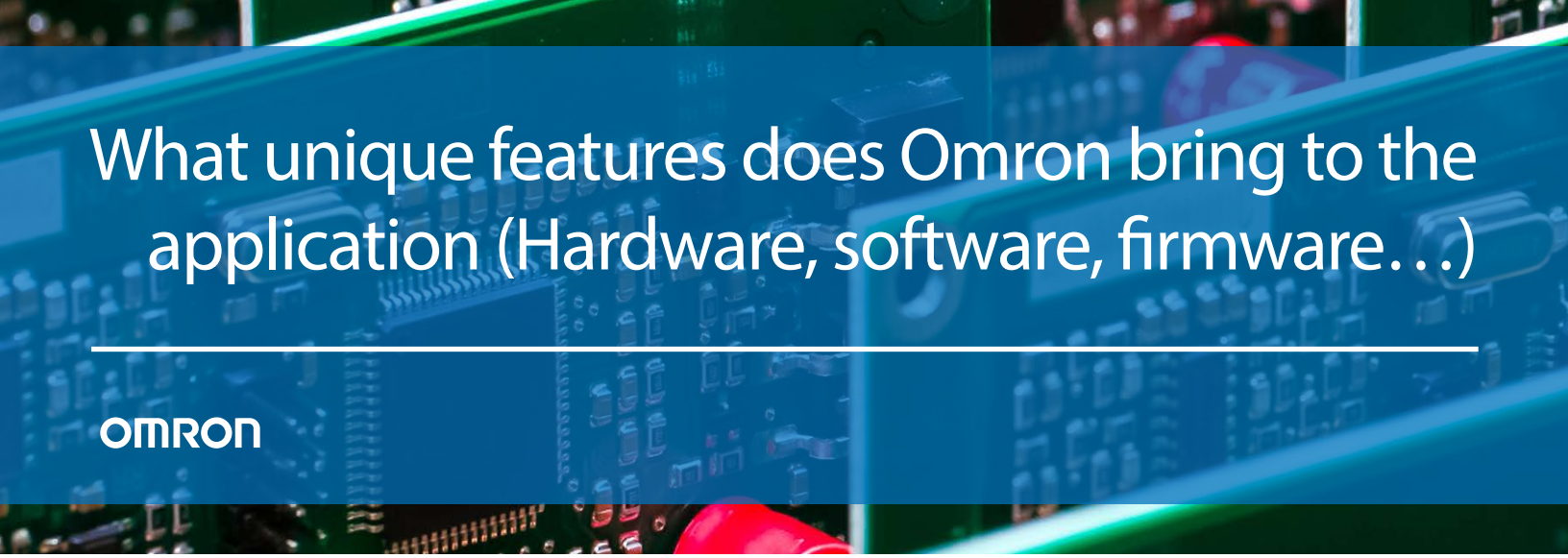
2. **Quality Assurance**
   Ensuring that adhesive application meets quality standards is vital. Implementing quality control measures, such as visual inspection or testing, can be challenging and time-consuming.

3. **Changeover Time**
   Switching between different adhesives or dispensing patterns can be time-consuming. Reducing changeover times is crucial to maintaining production efficiency.

4. **Cleaning and Maintenance**
   Regular cleaning and maintenance of dispensing equipment are essential to prevent clogs, material buildup, and equipment wear. Downtime for maintenance can impact production schedules.

5. **Sustainability**
   Developing efficient recycling and recovery processes for electronic components and materials is challenging but necessary for reducing e-waste and promoting a circular economy.

Addressing these challenges often requires a combination of selecting the right dispensing machine, material management practices, process control, operator training, and maintenance protocols. Manufacturers must carefully consider their specific application requirements and invest in equipment and processes that can meet those demands while minimizing downtime and waste.



What unique features does Omron bring to the application (Hardware, software, firmware…)

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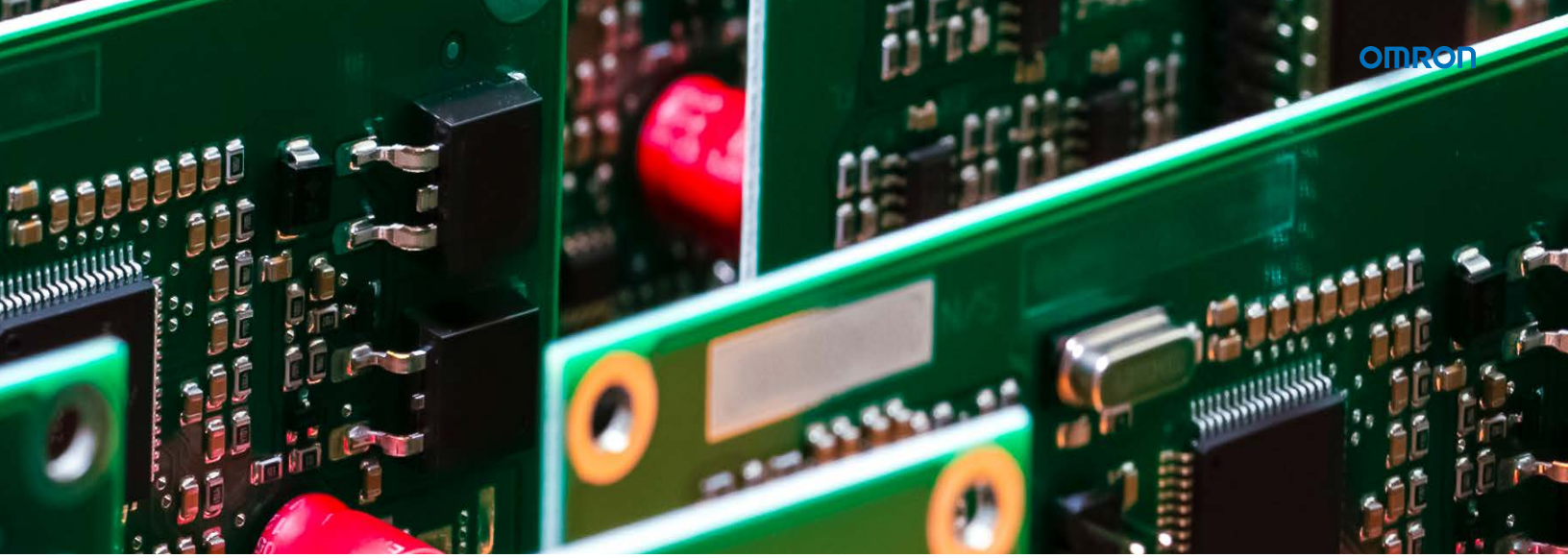
Omron PMAC (Programmable Multi-Axis Controller) offers advanced motion control capabilities that are essential for industries that demand precise, high-speed, and reliable automation and positioning solutions. It has capabilities that make it a valuable tool for engineers and manufacturers when combined in the same solution, such as:

High-Speed Control and Real-Time Processing:
PMAC is capable of high-speed and high-precision motion control, making it ideal for applications requiring rapid and accurate positioning, such as ultra-fast pick and place, bonding and dispensing machines for Electronics and Semiconductor manufacturing. These real-time processing capabilities allow for immediate response to changing conditions, and external events, ensuring precise control in the most dynamic environments even with the presence of unexpected disturbances.

Smooth Trajectory Generation:
In addition to high-speed and real-time processing, PMAC generates motion trajectories precisely and effectively, minimizing vibrations, jerk, and other undesirable effects. This is possible thanks to the built-in multi-polynomial move modes such as linear, fine circular interpolation, S-spline, PVT (Position-Velocity-Time), and PVTA (Position-Velocity-Time-Acceleration) profiles. This is especially valuable in complex motion, high accuracy placement, robotics, on-the-fly centering, and specialty CNC applications.

Advanced Algorithms:
Additionally, PMAC is equipped with advanced control algorithms and signal processing techniques that help optimize motion trajectories and reduce settling times. The following are two key features that contribute to the success and superiority of PMAC in Glue and Paste Dispense applications.

- **Real-time Cascaded Loops** refer to a control architecture where multiple feedback loops are nested (or cascaded) to control one or more axes by virtue of an external sensor device. Typically, this technique is applied in combination with distance, or force sensor (e.g. laser, load cell) or vision cameras measuring uneven glue or paste surfaces in real time during the dispensing process. Additionally, PMAC allows for automatic dispensing modulation on-the-fly. Updating all these loops at multiple kHz, PMAC then locks the dispenser height and ensures extremely accurate distance, and even density resulting in supreme dispensing quality.
- **Multi-block Dynamic Look-ahead** is a feature that automatically anticipates and plans for upcoming changes in the motion path, allowing optimum path execution with little to no user (programming) intervention. PMAC receives a series of position points or blocks (usually generated by a CAD/CAM software) that describe the desired path. Then, it dynamically pre-computes hundreds of blocks ahead while



executing the motion, preventing the tooltip from ever exceeding the mechanical speed and acceleration (jerk is universally governed separately) limitations of the machine, resulting in the smoothest possible path at maximum possible speeds.

Multi-Axis Control:
PMAC is designed to control multiple axes simultaneously. This is particularly valuable in applications where coordinated motion of multiple components or axes is essential, such as 3D printing, dispensing machines, and other multi-axis systems.

Flexibility:
PMAC is highly flexible and customizable. It can be configured to support various types of motors, encoders, and feedback devices. This flexibility allows them to adapt to a wide range of motion control systems.

High Resolution:
PMAC can interface with a wide range of feedback systems, enabling the selection of high-resolution and precision feedback devices, even at the micrometer or sub-micrometer levels.

Diagnostics and Monitoring:
PMAC includes diagnostics and monitoring features that allow users to detect issues in real-time, reducing downtime and maintenance costs.

PMAC provides a diverse range of hardware options, ensuring compatibility with a wide array of project architectures, from compact controller to modular rack system. PMAC is equipped with a powerful CPU and a variety of axis modules, enabling it to achieve rapid cycle times as short as 15 µs for locally controlled motors. Additionally, it can control up to 128 synchronized axes through EtherCAT, ensuring highly responsive motion control. The seamless integration of servo drives, I/O modules, and other devices via EtherCAT simplifies system connectivity and reduces wring.

The Power PMAC IDE (Integrated Development Environment) is the software used for programming, configuring, and optimizing PMAC. It provides tools for creating and editing motion profiles, configuring axes and I/Os, and monitoring real-time data. The PML (Power Motion Language), G-Code, and ANSI C programming languages incorporated in the software support users to customize their development environment by creating custom scripts and macros to streamline repetitive tasks and tailor the IDE to their specific needs.

Customer benefits from partnering with Omron

With Omron as a solution partner, the machine manufacturer has stood out as offering a high level of precision and speed performance in Motion and Control systems to achieve end users' goals. Obtaining a complete solution from a single supplier brings greater flexibility to the project as it facilitates connectivity between different components and systems. OEMs can select controllers that precisely align with their application requirements, ensuring cost-effectiveness by not overpaying for unnecessary capabilities once Omron is able to provide multiple options of motion control platforms.

The advanced algorithm and high-precision control of PMAC empowers OEMs to enhance machine performance and gain a competitive advantage by offering solutions to end users to improve their quality process, boost productivity, enhance Overall Equipment Effectiveness (OEE) and reduce waste resulting from inefficient motion control. Additionally, reliability is guaranteed even in critical processes where high motion control performance on complex trajectories is required. The embedded EtherCAT communication protocol is also an important contributor to improve performance of axis synchronization due to its capacity to exchange data in real time which guarantees stability and smoothness in the movement of the machine's mechanical systems.

Omron has an engineering team with 90 years of experience, as well as a variety of Proof of Concept Centers across the Americas. Constantly striving to help our partners find the best solutions to differentiate themselves in the market and optimize project development time. Our partners have access to the various training offered by Omron to expand their knowledge of



Empowering people through automation

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