How Edge AI is Powering the Next Generation of Industrial Automation

White Paper
2025 Edition

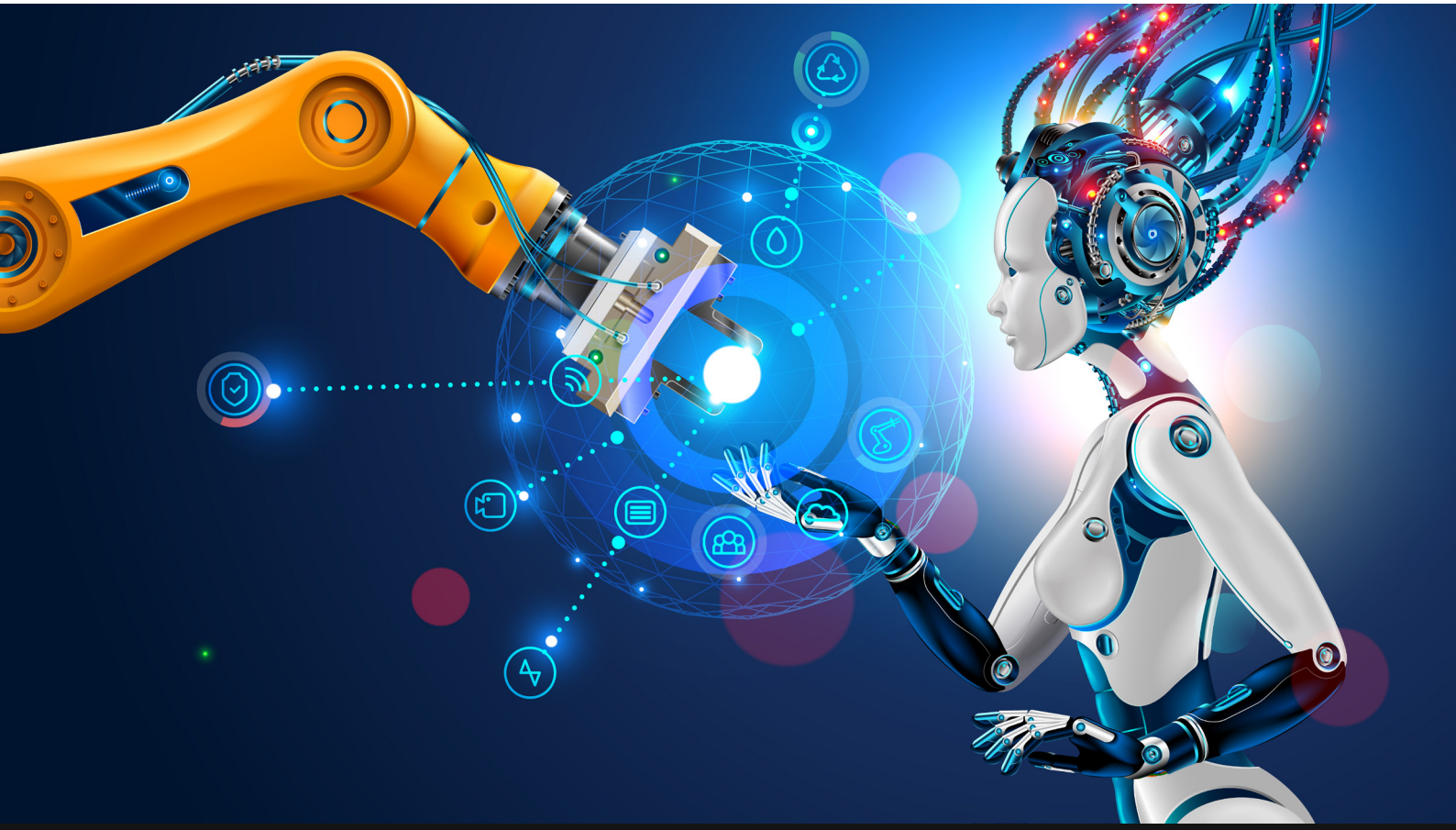
Edge AI Applied Computing
SINTRONES

Industrial operations are entering a new era of transformation. The foundations of Industry 4.0 — connectivity, automation, and data-driven intelligence — have matured into the backbone of global manufacturing. Now, the next phase of industrial digitalization is underway: AI-driven, human-centered, and sustainable automation, often referred to as Industry 5.0.

From mining to smart manufacturing, every sector is being reshaped by AIoT (Artificial Intelligence of Things), and edge computing. Yet manufacturers still face familiar challenges — minimizing downtime, managing labor shortages, and maintaining safety in harsh environments. That's why real-time edge intelligence has become essential for achieving operational excellence, resilience, and scalability in modern factories.

Edge AI computing empowers factories to make faster, smarter decisions — enabling predictive maintenance, machine vision inspection, and real-time analytics at ultra-low latency. When combined with 5G connectivity and AI inference at the edge, costs drop, safety rises, and productivity accelerates.

This transformation reflects the vision championed by the A3 Association for Advancing Automation, the leading global authority on robotics, motion control, and artificial intelligence. SINTRONES, as a proud A3 member, actively contributes to advancing automation innovation worldwide, helping industries transition from traditional control systems to intelligent, connected ecosystems.



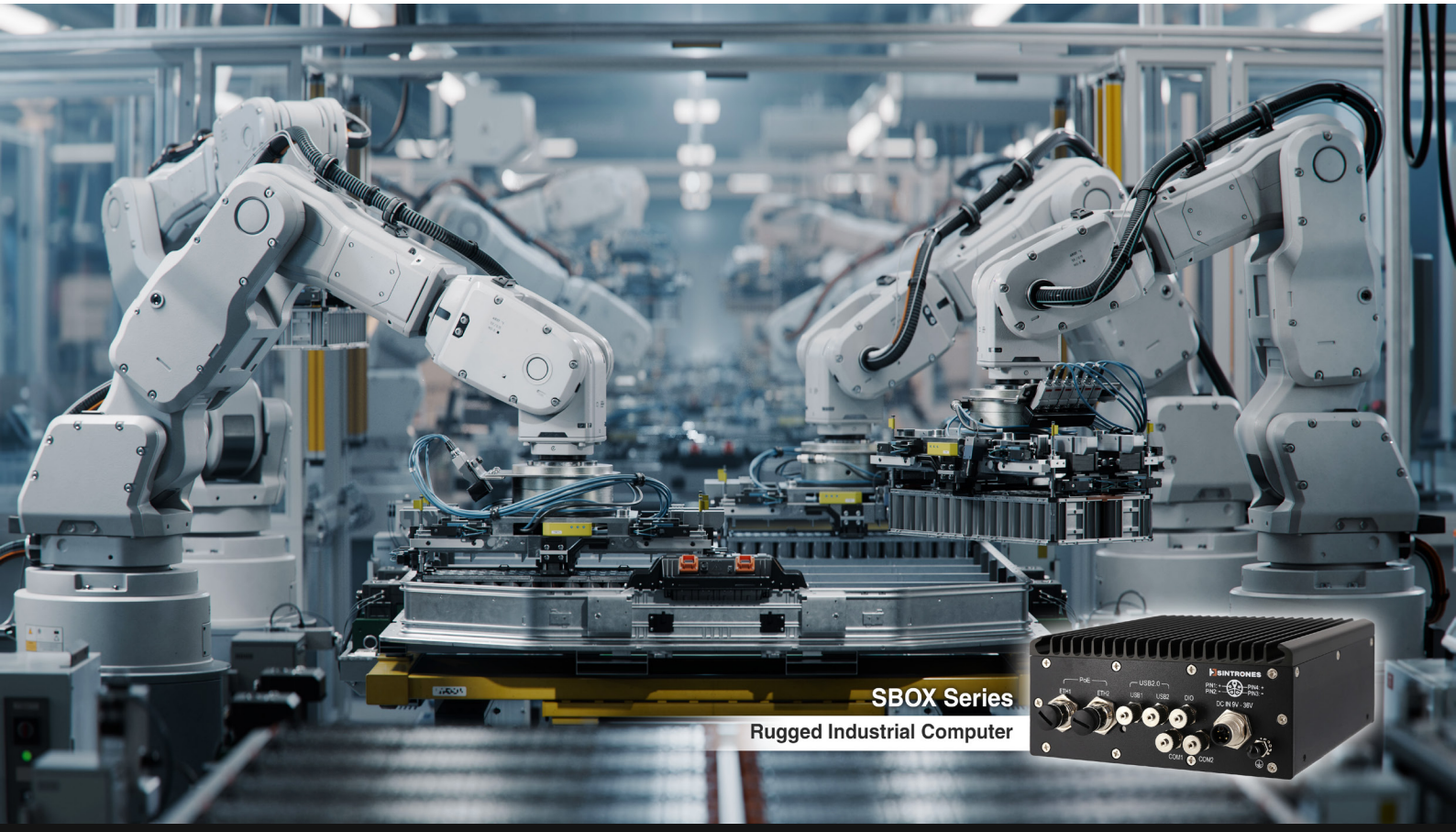
SINTRONES: Powering the Intelligent Industrial Edge

SINTRONES integrates high-performance CPUs and GPUs with advanced thermal management and rugged industrial I/O connectivity to deliver real-time edge AI computing for industrial automation. Its application-driven product portfolio accelerates digital transformation and enables smart factory ecosystems that are reliable, flexible, and ready for the future.

Beyond engineering excellence, SINTRONES follows the IEC 62443-4-1 cybersecurity standard, implementing secure-by-design development policies, processes, and lifecycle management practices that ensure every industrial computing solution is built on a foundation of cybersecurity resilience.

To meet the diverse industrial automation needs, SINTRONES offers three major product families — the SBOX Series, ABOX Series, and SPC Series — each engineered for unique automation domains, from compact embedded systems to high-performance edge AI platforms and industrial panel PCs.

SBOX is designed to be a leader in reliability, resiliency, and efficient performance, all in a compact form factor. The compact design makes SBOX ideal for integration into existing production lines, while its 2.5GbE high-speed Ethernet and USB 3.2 Gen 2 features are ready for bandwidth-intensive industrial devices, and the integrated watchdog timer enables

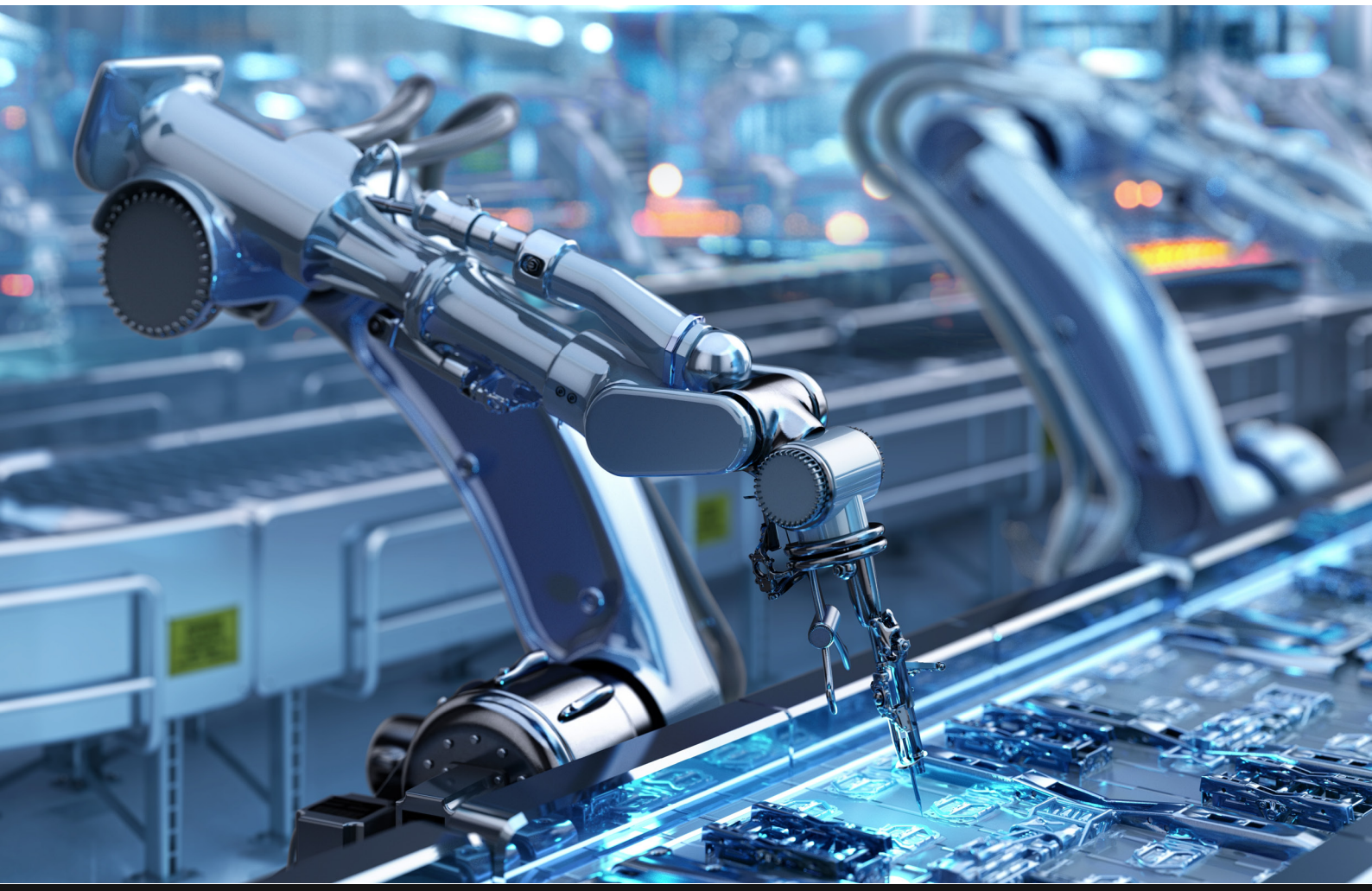


automatic recovery in case of system downtime. That reliability is paired with high-end ruggedization thanks to the fanless design and a wide operating temperature range from -30°C to 70°C, ideal for harsh industrial conditions.

ABOX is designed for Edge AI Applied Computing applications. It enables real-time monitoring, quality control, and AI-based alert systems that maintain consistent product quality and quickly address anomalies during production, avoiding downtime, and overcoming challenges of manual inspection and labor-intensive processes.

The SPC Series of rugged panel PCs is built to meet the stringent needs of smart factories. These devices are resistant to environmental hazards, reliable under industrial stress, and loaded with innovative usability features designed for PPE operation, noisy factory floors, and tough lighting conditions.

Industrial enterprises need to trust that their embedded computing solutions will perform reliably and be future-proofed to minimize integration risks. SINTRONES' patented technologies and deep system integration capabilities enable the company to deliver customized industrial solutions that exceed expectations in a competitive automation market.



SBOX for IoT Smart Manufacturing and Industrial Automation

The SBOX Series of ultra compact embedded computers is engineered for compact reliability, efficiency, and edge performance in space-constrained manufacturing environments.

Modern smart factories must handle every kind of industrial automation, which requires powerful edge computing and cloud integration with technologies that make Industry 4.0 possible. These include machine vision, IoT Gateway deployment, reliable and secure high speed connectivity and data management, secure storage, and AI applications that enhance process automation and predictive maintenance.

The real-world applications are growing rapidly. Manufacturing enterprises are using the SBOX Series for factory energy management systems, leveraging sensor integrations and edge processing to enable real-time data collection and efficiency optimization. Motion control systems in coating and assembly lines use SBOX to eliminate downtime and prevent errors, while IoT gateways allow seamless integration between sensors, controllers, and cloud platforms, forming the backbone of smart manufacturing systems.

In PCBA coating machines, manufacturers require precision and uniformity at every step. Components must maintain consistent thickness and surface coverage; even small deviations cause defects. These processes operate under harsh conditions such as high humidity, dust, solvents, and vibration, which demand rugged industrial computers. Synchronized real-time coordination among motion control, spraying, temperature, and curing systems is critical, as even slight latency can affect product quality and delivery timelines.

To address these challenges — including limited integration space, high-bandwidth connectivity, and maintenance reliability — SINTRONES developed the SBOX Series to provide industrial-grade reliability, edge AI performance, and downtime prevention through watchdog timer technology. It's the ideal AIoT edge platform for industrial automation and smart manufacturing.

The features and technical specs are tailored to create massive compute with minimum footprint and power use. Features include:

- 1 × 2.5GbE and 2 × USB 3.2 Gen 2 (10Gbps) ports for high-bandwidth data transmission
- Support for up to 6 × COM ports for versatile peripheral integration
- Watchdog timer to prevent sudden system failures
- 9–36V DC wide input range for industrial power flexibility
- Wide Range Operating Temperature from -30℃ ~70℃ (-22°F ~158°F)
- Certified with EN 50155, CE, FCC Class A, and UKCA

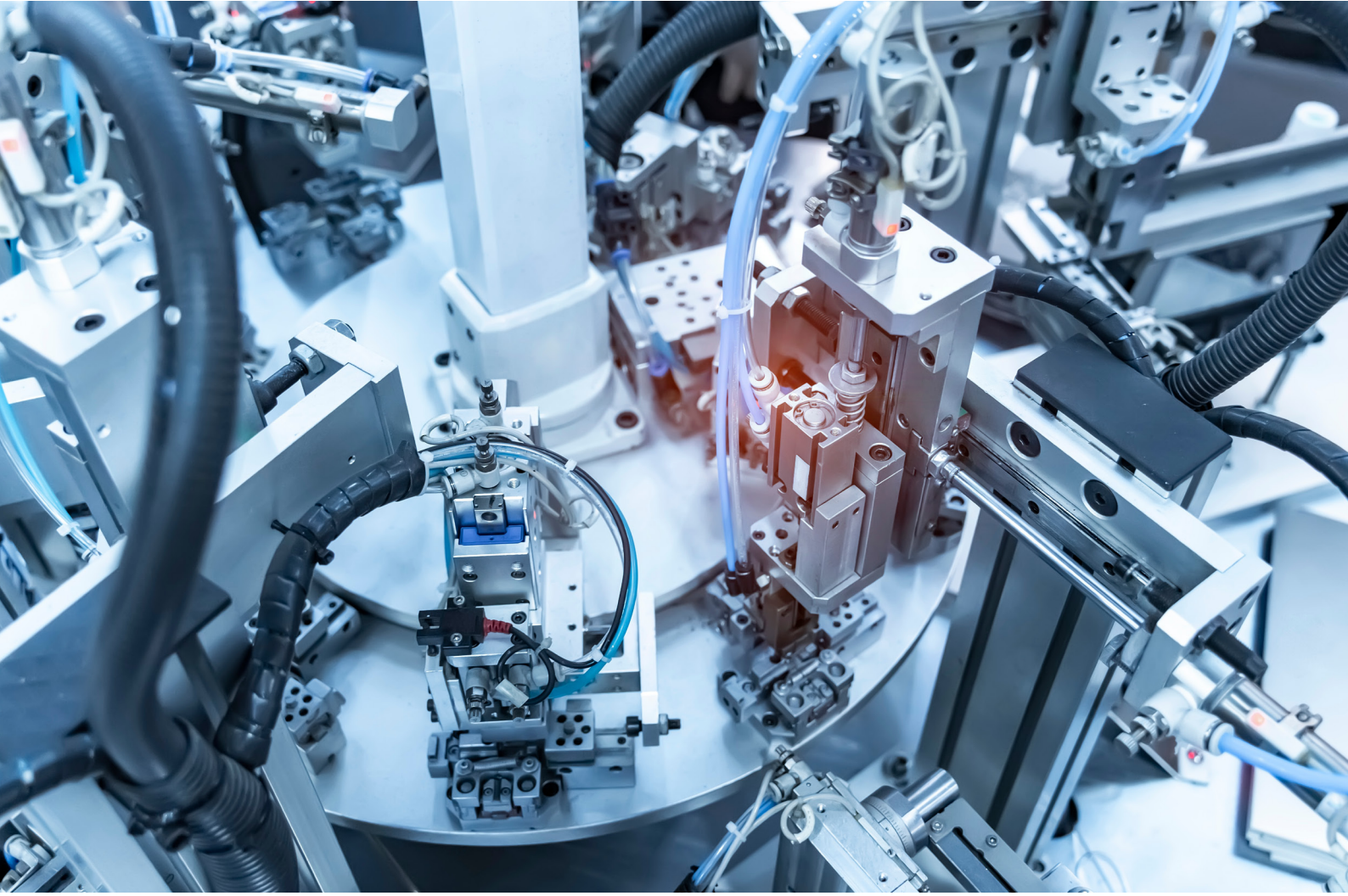
ABOX for Edge AI Machine Vision and Predictive Maintenance

Defect detection remains a crucial pillar of manufacturing quality assurance, yet manual inspections are too slow for today's high-speed production environments. Smart factories require AI-powered machine vision systems that deliver real-time defect detection, automated alerts, and predictive maintenance insights to minimize downtime.

Reducing downtime directly enhances profitability. In food and beverage manufacturing, for instance, unplanned downtime can account for up to 20% of productivity losses, costing thousands per day — or millions annually in larger facilities. Factory operators are therefore turning to AI-enabled automation that simplifies inspection through edge AI computing.

The ABOX Series from SINTRONES addresses these challenges with a unique combination of rugged reliability and AI-ready performance. Its integrated Backup Battery Unit (BBU) protects against sudden power interruptions — a major source of production downtime — while its fanless design and discrete NVIDIA RTX™ embedded GPU deliver AI acceleration for real-time computer vision.

With up to 8 PoE GbE ports, ABOX simplifies cabling and supports IP camera integration, enabling faster deployment of industrial machine vision systems and AIoT gateways.



Beyond visual inspection, ABOX also powers autonomous mobile robots (AMR/AGV) requiring low-latency computing and real-time perception, as well as AIoT data hubs for smart factory data collection and edge processing.

Technical specifications:

- 14th Gen Intel Core Processors
- Discrete NVIDIA RTX™ Embedded GPU options for AI acceleration
- 8 × GbE ports with optional PoE for simplified IP camera integration
- 2 × TSN-ready 2.5GbE controllers for time-sensitive networking
- 9–60V DC wide range power input with integrated backup battery unit
- Certified with CE, FCC, and E-Mark, compliant with EN 50155 and EN 45545-2 R25 standards

As an A3 member, SINTRONES aligns with the global standards of the automation industry, advancing AI-based automation ecosystems and helping manufacturers achieve data-driven productivity across industrial networks.

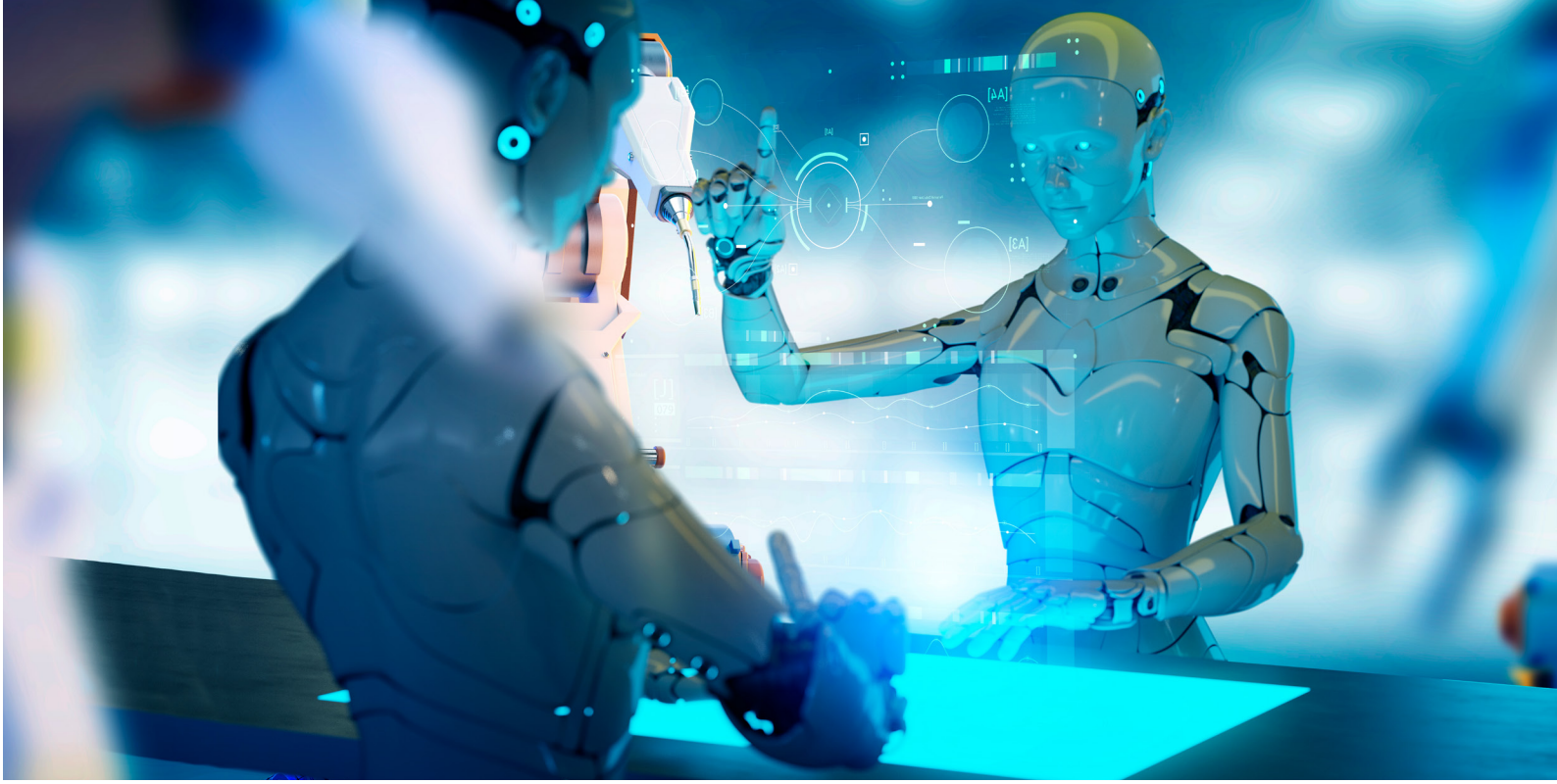
SPC Panel PC for Smart Factory HMI and Industrial Control

The SPC series of rugged industrial panel PCs from SINTRONES is built to the needs and constraints of Smart Factory HMI interfaces and industrial automation tasks. SPC Panel PCs integrates a durable touch panel with a computing platform that can handle even the most rigorous applications with well-engineered user experience.

The SPC line is designed with a variety of features to make it easy to use and rugged enough to handle rough industrial conditions. Starting with where it can be mounted, it's got options for wall mount, VESA mount, and open-frame configurations to adapt to different needs. To keep it useful no matter where it is mounted, the glove-friendly touch screen, anti-glare coating, and anti-smudge coating keep it functional for every user and visible, clean, and responsive in the roughest industrial facility or outdoor environment.

It's of course vibration resistant and tested to withstand continuous machine vibration without performance degradation, and the front panel is IP66 rated when wall-mounted to ensure dustproof and waterproof performance. It's impact resistant up to IK10, or 20 joules with the right customizations, has a single touch with rain mode that prevents false touches in the wet, and is tested for reliable operation in temperatures from -20°C to 60°C for extreme outdoor climates.

This makes the SPC Series a true all-in-one solution for industrial computing, automation, and factory HMI operations, enabling seamless human-machine collaboration — a cornerstone of Industry 5.0.



Advancing Industrial Automation Beyond Industry 4.0

Industrial automation is advancing rapidly, unlocking new potential in this Fourth Industrial Revolution and beyond. The dream of fully automated manufacturing is now within reach, driven by edge computing, AIoT, and machine vision.

As an A3 member, SINTRONES is shaping the future of intelligent industrial automation by providing edge AI computing solutions that power the transition beyond Industry 4.0 toward sustainable, human-centric Industry 5.0.

Through its innovative SBOX, ABOX, and SPC Panel PC product families, SINTRONES enables manufacturers to achieve real-time visibility, predictive reliability, and data-driven control across the full automation lifecycle.

While these innovations are proven in industrial environments, they are paving the way for the next generation of smart cities, smart transportation, and connected infrastructure, wherever real-time intelligence meets industrial reliability.

Through its adherence to IEC 62443-4-1 development process standards, SINTRONES ensures that security is integrated from concept to deployment — aligning with Industry 5.0's vision of safe, sustainable, and human-centric automation.

To learn more about how SINTRONES' IEC 62443-4-1–certified development process and Edge AI computing solutions enable secure, intelligent, and sustainable industrial automation, visit sintrones.com.

Where Edge AI Powers the World in Motion

Founded in 2009, SINTRONES is a global leader in rugged edge AI computing platforms. Guided by our vision to power every moving industry with reliable edge AI and make smart cities safer, greener, and smarter, we deliver modular, certified solutions that accelerate intelligence at the edge. Our portfolio—from in-vehicle computers to wide-temperature embedded systems—serves transportation, automation, military, and healthcare applications, where reliability and innovation must meet.

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