KENDRION



KENDRION SOLUTIONS

Robotics Safety Architecture

SIL 3/PLe Safety PLC with an advanced Robotics Safety Library

PRECISION. SAFETY. MOTION.

Open Safety Architecture for the next Generation of Robotics

New requirements under ISO 10218:2025, increasingly complex human-robot collaboration (HRC), and the limitations of proprietary safety systems are changing the way robotic applications are designed.
Safety is no longer just about monitoring individual robot movements. It requires a comprehensive approach that considers the entire application — from robot motion and tool positioning to force limitations, dynamic safety zones, and human-robot interaction. For robot manufacturers, machine builders, and system integrators, this makes functional safety a key architectural decision.

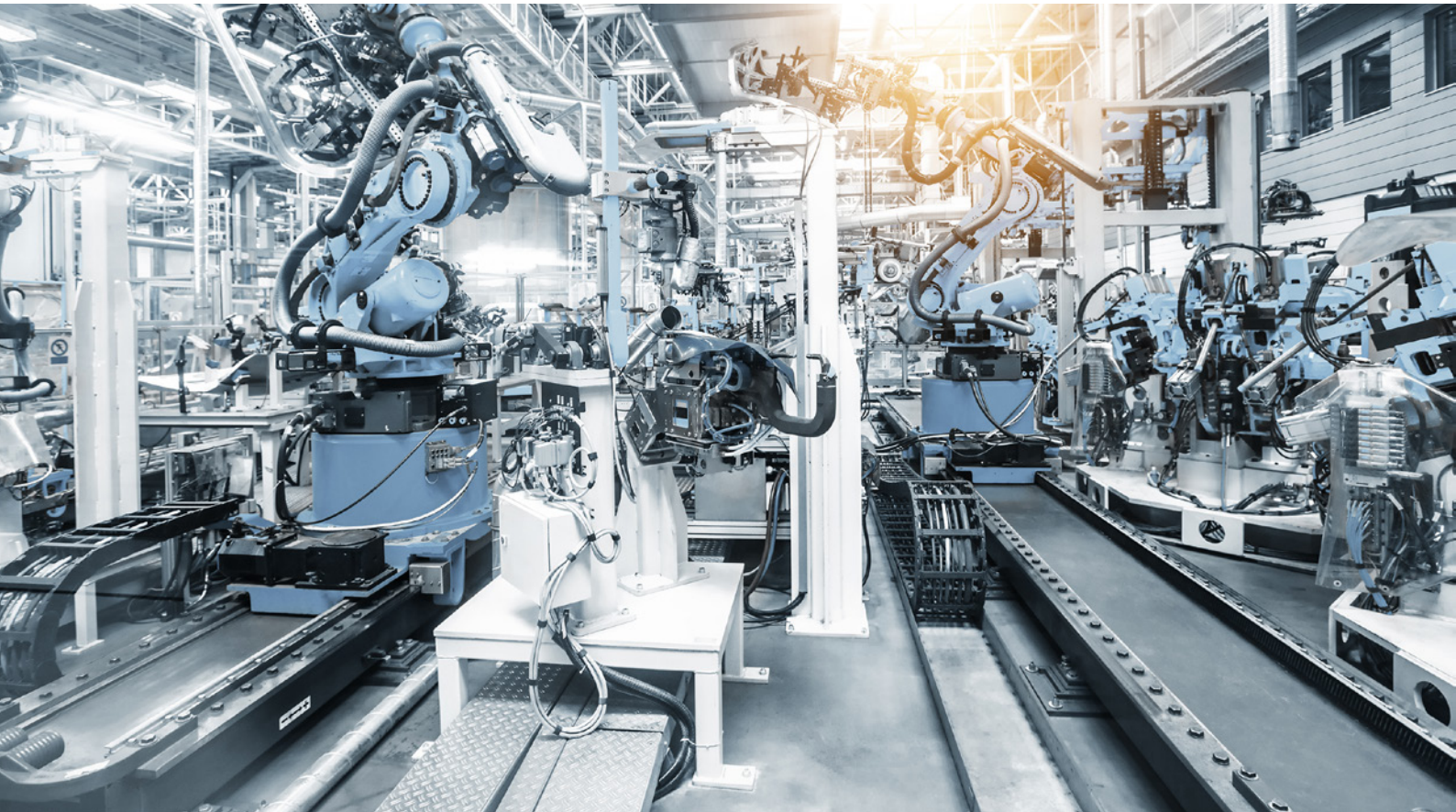
The Challenge?

Integrating advanced safety functions without increasing engineering complexity or becoming dependent on proprietary robot platforms.

Get future-ready!

To address precisely these challenges, Kendrion combines its SIL3/PLe safety controller with a safety library that includes kinematic functions for robot applications. The open safety architecture enables vendor-neutral integration into EtherCAT- and FSoE-based robotics systems and reduces dependence on proprietary robot platforms.

With an integrated safety library for motion, force, and spatial zone monitoring, a minimum cycle time of 2 ms, and support for up to 9 axes, Kendrion lays the foundation for flexible, scalable and standards-compliant robotic safety concepts up to SIL 3 / PLe.



The Solution

Kendrion combines a SIL 3 / PLe Safety PLC with an advanced safety library for robot kinematics, enabling modern safety functions to be integrated into EtherCAT- and FSoE-based robotic systems.

The architecture provides real-time monitoring of robot movements, speeds, forces, torques, and spatial safety zones. Supporting up to 9 axes, it enables flexible and scalable safety concepts designed to address the requirements of ISO 10218:2025.

Its open approach reduces dependence on proprietary robotic controllers and allows existing automation and drive concepts to be reused.

Benefits

Open Architecture
Seamless integration into EtherCAT- and FSoE-based systems without being tied to a specific robot manufacturer.

Real-Time Safety
Deterministic monitoring of complex robot kinematics with minimum cycle times of 2 ms, depending on the application.

Functional Safety up to SIL 3 / PLe
Advanced safety functions for demanding industrial and collaborative robotics applications.

Scalable by Design
Flexible safety functionality for different robot platforms, applications, and system requirements.



Seamless Integration into your existing EtherCAT / FSoE System

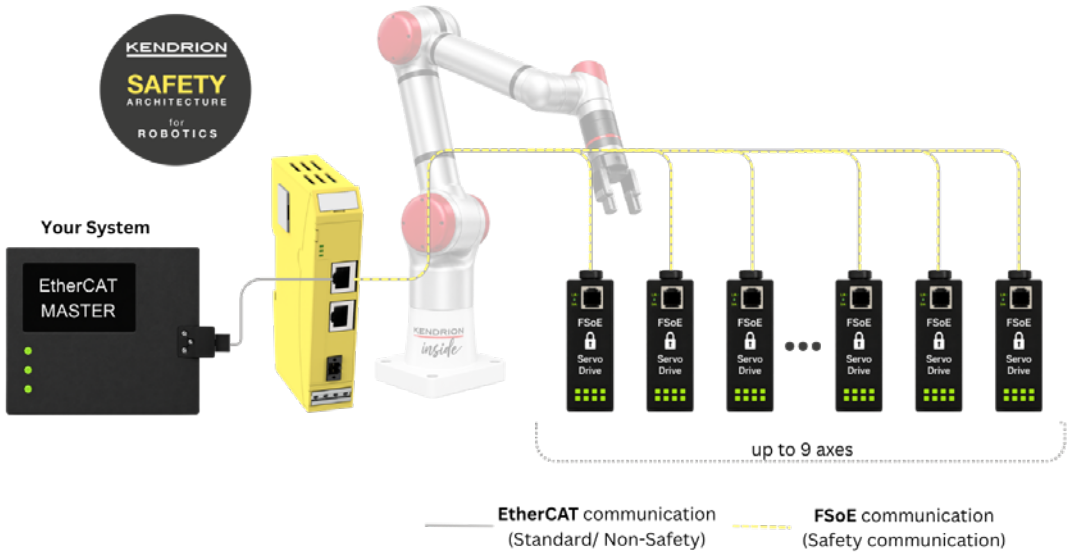
The Kendrion Robotics Safety Architecture is designed to integrate into existing EtherCAT networks with Fail Safe over EtherCAT (FSoE) communication.

The Kendrion Safety PLC works alongside the EtherCAT master and safe FSoE servo drives to provide safety-related communication throughout the robotic system.

Using safety-relevant information from the integrated axes and drives, the Safety PLC performs real-time kinematic monitoring of the entire robot movement.

Positions, speeds, forces, and spatial safety zones can be evaluated independently of the robot or drive manufacturer.

How it works?



EtherCAT Master
Integrates the safety architecture into the overall automation and motion control system.

Kendrion Safety PLC
Processes safety-related data and executes advanced kinematic monitoring functions.

FSoE Servo Drives
Provide safety-related drive communication within the EtherCAT system.

Robot Kinematics
Monitoring of complex robotic systems with up to 9 axes.

The advantage: Existing automation platforms, servo drives, and motion control concepts can be retained and extended with advanced robotic safety functions.

A new Approach to Robotics Safety

The updated ISO 10218:2025 standard places greater emphasis on the complete robotic application.

In addition to robot axes and the Tool Center Point (TCP), safety concepts must account for tools, workpieces, forces, torques, interaction with people, and the surrounding workspace.

The result is a shift toward more adaptive safety functions that can respond to changing operating conditions.

How Robotics Safety is evolving

	ISO 10218:2011	ISO 10218:2025	Coverage provided by Kendrion Safety Architecture for Robotics
Safety focus	Focus on robot and TCP/tool path	Entire robot application considered safety-relevant	✓ Advanced application-level safety functions
Protection zones	Mainly static safety zones	Dynamic and adaptive protection zones	✓ Advanced safe zone monitoring
Safety response	Mostly fixed safety responses	Context-dependent safety responses	✓ Adaptive safety logic
Collaboration	Basic collaboration functions	Advanced PFL and SSM safety functions	✓ Safe collaboration functions
Force monitoring	Limited requirements for safe force evaluation	Validated safe force and power limitation	✓ Safe force monitoring
Zone monitoring	Simple safe areas	Advanced safe space and distance zones	✓ Safe space and distance zone monitoring

Complex Robot Kinematics. Precise Real-Time Monitoring

Modern robotics applications demand more than individual axis monitoring. They require the continuous evaluation of complex kinematic relationships, movements, external forces, and spatial safety conditions.

The Kendrion Robotics Safety Architecture combines high-performance kinematic calculations with deterministic real-time processing.

Robot positions, speeds, movements, and external forces can be evaluated at the link level. Configurable 3D safety zones enable spatial monitoring of robot links and the Tool Center Point (TCP), including defined in- and out-of-zone areas.

Technical Highlights

2 ms Minimum Cycle Time

Kinematic Safety Functions

Supports up to 9 axes & 20 safety zones.

External Force Per Link

Force Calculation

Safe joint torque minus calculated model torque. Jacobian-based force calculation.

20 Safety Zones

In/Out Monitoring

Capsule geometry configurable for each link and TCP. Speed & force limits configurable for each zone.

Enabling more flexible Human-Robot Collaboration

In collaborative robotics, strict speed and force limits can reduce productivity, while physical enclosures restrict flexibility.

Kendrion‘s scalable safety functions support dynamic monitoring of robot motion, forces, and workspaces. This allows safety responses to be adapted to the specific application and helps create more productive human-robot collaboration concepts.

The result: greater design freedom for industrial robots, cobots, and complex robotic cells.

Scalable Safety for every Robotics Application

From conventional industrial robots to advanced collaborative applications, Kendrion offers three levels of safety functionality to meet different requirements.



MOTION

Reliable Position and Speed Monitoring

- ✓ Position monitoring using forward kinematics
- ✓ Speed monitoring
- ✓ Position and speed limits

Ideal for: Industrial robotics

FORCE

Advanced Force and Torque Monitoring

- ✓ All Motion functions
- ✓ Cartesian force monitoring
- ✓ Force and torque limits
- ✓ Model-based torque evaluation

Ideal for: Human-robot collaboration (HRC) and cobots

ZONE

Flexible 3D Safety Zone Monitoring

- ✓ 3D in-zone and out-of-zone monitoring
- ✓ Capsule geometry for robot links and TCP
- ✓ Configurable speed and force zones
- ✓ Advanced spatial safety monitoring

Ideal for: Complex HRC cells and dynamic robotic workspaces

Are you future-ready? Let‘s shape the future of safe Robotics together.

Every robotic application has its own requirements for motion, functional safety, and integration.
Whether you are developing a new robot platform, upgrading an existing automation system, or designing advanced human-robot collaboration, Kendrion can support you with open, scalable safety solutions tailored to your application.
Talk to our experts and discover how the Kendrion Robotics Safety Architecture can support your next project.

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