OMRON

Sysmac Automation Platform

One control, one connection, one software

LOGIC MOTION VISION
SAFETY
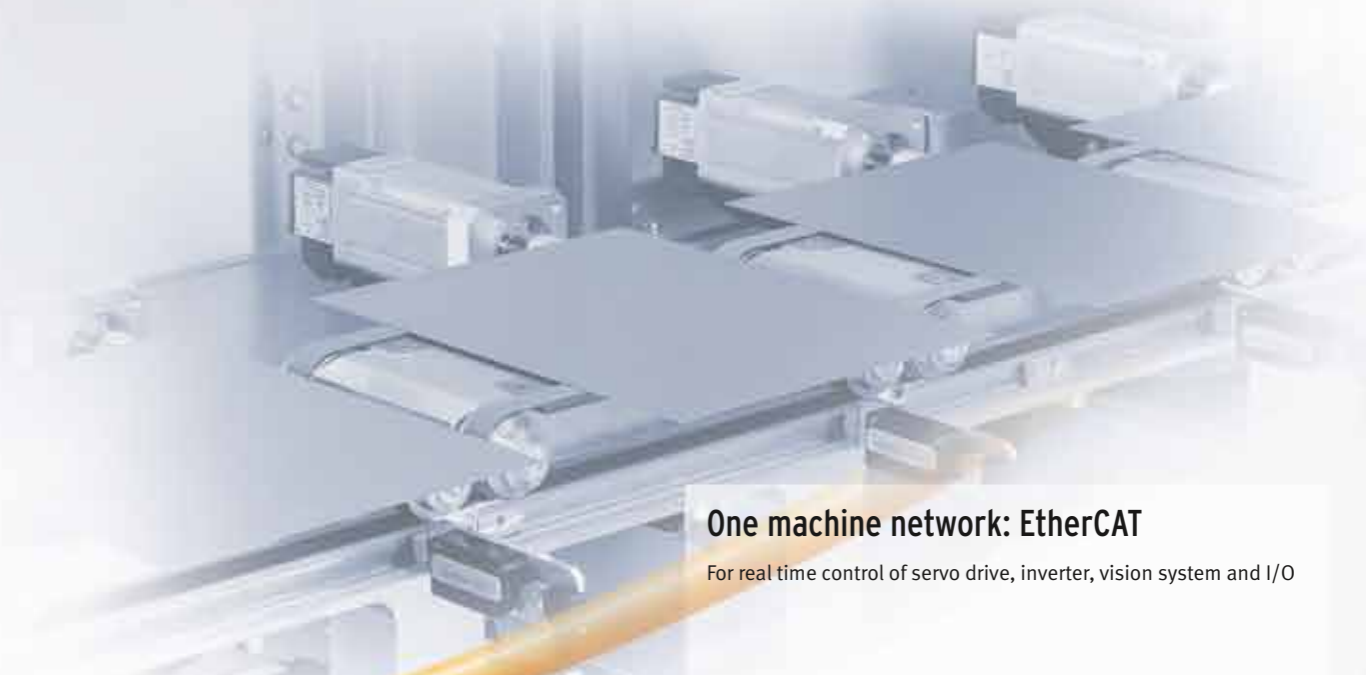EtherCAT
EtherNet/IP

omron NJ501-1500

sysmac
always in control

One Machine Control

Motion, Logic, Safety and Vision in one

One machine control through one connection and one software is how we define the new Sysmac automation platform. The new NJ machine automation controller integrates motion, logic sequencing, safety, vision and networking under one software: Sysmac Studio. This one software provides a true Integrated Development Environment (IDE) that includes a custom 3D motion simulation tool. The NJ controller comes standard with built-in EtherCAT and EtherNet/IP. The two networks with one connection purpose is the perfect match between fast real time machine control and data plant management.

One machine network: EtherCAT

For real time control of servo drive, inverter, vision system and I/O

EtherCAT®

EtherNet/IP™

One machine controller: NJ-Series

For complete control and management of your machine. Logic and advanced motion control in one

One factory automation network : EtherNet/IP

For local or remote access to the complete machine

One software: Sysmac Studio

For configuration, programming, simulation and monitoring

One connection
One machine network

One connection via the NJ-Series controller allows seamless control and communication with both the machine and the factory. The new NJ-Series controllers join the world standard factory automation network, EtherNet/IP, with the best Ethernet-based machine control network, EtherCAT.

NJ-Series motion features

» Up to 64 axis control
» Complies with PLCopen Function Blocks for Motion Control
» Linear, circular and spiral (helical) interpolation
» Master slave functions: registration control, flying shear, etc.
» E-cam with on the fly change

EtherCAT

EtherNet/IP

G5 servo system

MX2 Inverter

NX I/O   **NX Safety***   **FQ-M Vision Sensor**

EtherCAT: the ONE machine network

» Up to 192 slaves
» Fastest machine network on the market
» Noise immunity to stringent Omron standards
» Embedded in Omron servo drive, inverter, vision sensor and I/O
» Uses standard STP Ethernet cable with RJ45 connectors

Integrated safety into machine automation

» FSoE – Safety over EtherCAT
» Flexible system with distributed safety I/O
» Conforms with IEC61131-3 standard programming
» PLCopen Function Blocks for Safety

NJ-Series sytem features

» System cycle: 32 axes axes/500 μs
» Programming and data types fully compliant with IEC 61131-3
» Multi-tasking program
» EtherCAT, EtherNet/IP embedded
» SD card slot and USB port built-in
» Works with most CJ-PLC modules
» 10 years maintenance free

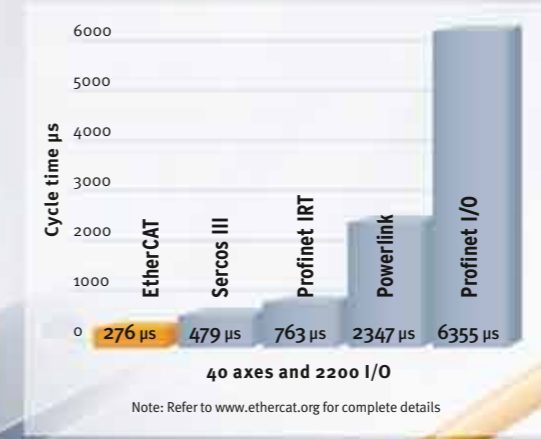### EtherNet/IP: the ONE factory automation network

» Peer-to-Peer controller communication
» Interface with NS HMI series or SCADA software
» Interface to Sysmac Studio

* Available soon

4

5

One connection
EtherCAT the optimal machine network

EtherCAT is the fastest emerging network for machine automation. It is Omron's de-facto machine network for our wide range of field and motion devices. It is Ethernet based, fast, accurate and highly efficient in terms of data transmission. All our EtherCAT devices have been designed and tested to meet Omron's stringent requirements on noise immunity.

40 axes and 2200 I/O

	Cycle time
EtherCAT	276 μs
Sercos III	479 μs
Profinet IRT	763 μs
Powerlink	2347 μs
Profinet I/O	6355 μs

Note: Refer to www.ethercat.org for complete details

Key features

- It is industrial Ethernet and uses standard IEEE 802.3 frames.
- It achieves high synchronisation accuracy by using a distributed clock mechanism.
- It is the fastest network on the market with 100 μs refresh time and less than 1 μs jitter
- It is simple to set up with automatic address assignment for nodes
- It uses standard Ethernet cables and connectors It has not only machine control but also safety control.
- It has not only machine control but also safety control.
- It offers seamless integration of the safety solution into the EtherCAT machine network

Master clock

Slave clock
Slave clock
Slave clock
Slave clock
Slave clock

"On-the-fly" data exchange

The slave devices extract and/or insert data on the fly. This method assures the highest possible throughput.

NX Safety controller*

NX Safety I/O*

Simple cabling: 100Base-TX

EtherCAT uses standard 100BASE-TX Ethernet communication very efficiently, over standard shielded Ethernet cables and connectors. No need for network switches.

EtherCAT is Industrial Ethernet

The EtherCAT Telegram is contained in the Ethernet Data section of the IEEE 802.3 Ethernet frame. The frame travels through the media at 100 Mbps in full duplex mode.

Safety over EtherCAT (FSoE)

Seamless integration of the safety into machine automation. The FSoE frame is included in the EtherCAT process data. This system provides a flexible solution with distributed safety I/O.

Distributed clocks

The EtherCAT node slave measures the time difference between incoming and returning frame - timestamp-. With these timestamps the master can determine the propagation delay offset to the individual slave accurately. This mechanism ensures accurate synchronisation between devices with less than 1 μs jitter.

Flexible topology

With two EtherCAT ports on all devices, no additional switches are required to create a linear network. EtherCAT junctions can be used to build tree and star topologies, which provides section segregation isolation.

* Available soon

One software

Sysmac Studio for machine creators

Turning machine programmers into machine creators is the driving vision behind Sysmac Studio. Cutting programming, debugging and set-up time while maximising the functionality and performance of your machine is our ultimate goal. For this Sysmac Studio aims to offer ONE software for the complete machine. A software tool that only needs to be learned once, programmed, tested and tuned as one and secured as a whole.

Learn it ONCE

» One software for motion, safety, drives and vision
» Fully compliant with open standard IEC 61131-3
» One design and operation environment for configuration, programming and monitoring

Develop it FAST

» Supports Ladder, Structured Text and Function Block programming with a rich instruction set
» CAM editor for easy programming of complex motion profiles
» Intuitive editor with auto-complete assistance for Ladder and Structured Text programming

Test it as ONE

» One simulation tool for sequence and motion in a 3D environment
» Complete or partial program can be simulated and debugged
» Data trending for tuning and debugging

Secure it ALL

» Advanced security function with 32 digit security password.
» Complete project or single Function Block can be protected
» Machine cloning prevention

Learn it ONCE
Develop it FAST
Test it in ONE
Secure it ALL

PROGRAMMING

3D SIMULATION

DATA TRACE

One software
Sysmac Studio to develop machines

Created to give you complete control over your automation system, Sysmac Studio integrates configuration, programming and monitoring. Graphics-oriented configuration allows quick set-up of the controller, field devices and networks while machine and motion programming based on IEC standard and PLCopen Function Blocks for Motion Control cuts programming time. Smart Editor with On-line debugging helps quick and error free programming. Advanced simulation of sequence and motion control, and data trace reduce machine tuning and set-up.

Design and operability
Unified design environment is provided for programming, configuration and monitoring. It also offers intuitive navigation between control modes.

Configuration and monitoring for servo system
Parameter setting, monitoring and data trace for servo drive and inverter.

Motion control
The graphical CAM editor allows quick implementation of complex motion profiles. CAM tables can be modified on the fly. A PLCopen Function Blocks for the Motion Control library are available to implement general purpose motion control.

Programming
Multi-tasking and fully compliant with IEC61131-3 standard. The program editor includes smart support functions such as syntax error check and clear colour segregation of variables and symbols. ST instructions can be directly written in Ladder programs thanks to in-line ST function.

Integrated safety programming
The Function Block Diagram editor includes 46 safety FB/FN. Conforms with IEC61131-3 standard programming and PLCopen Function Blocks for Safety.

Simulation
Motion trajectories in 3D can be pre-tested with advanced simulation of sequence and motion control. Simulation of single Function Blocks, POU's (Program Organisation Unit) or the entire program can be performed. In addition all standard features such as Break & Step are available.
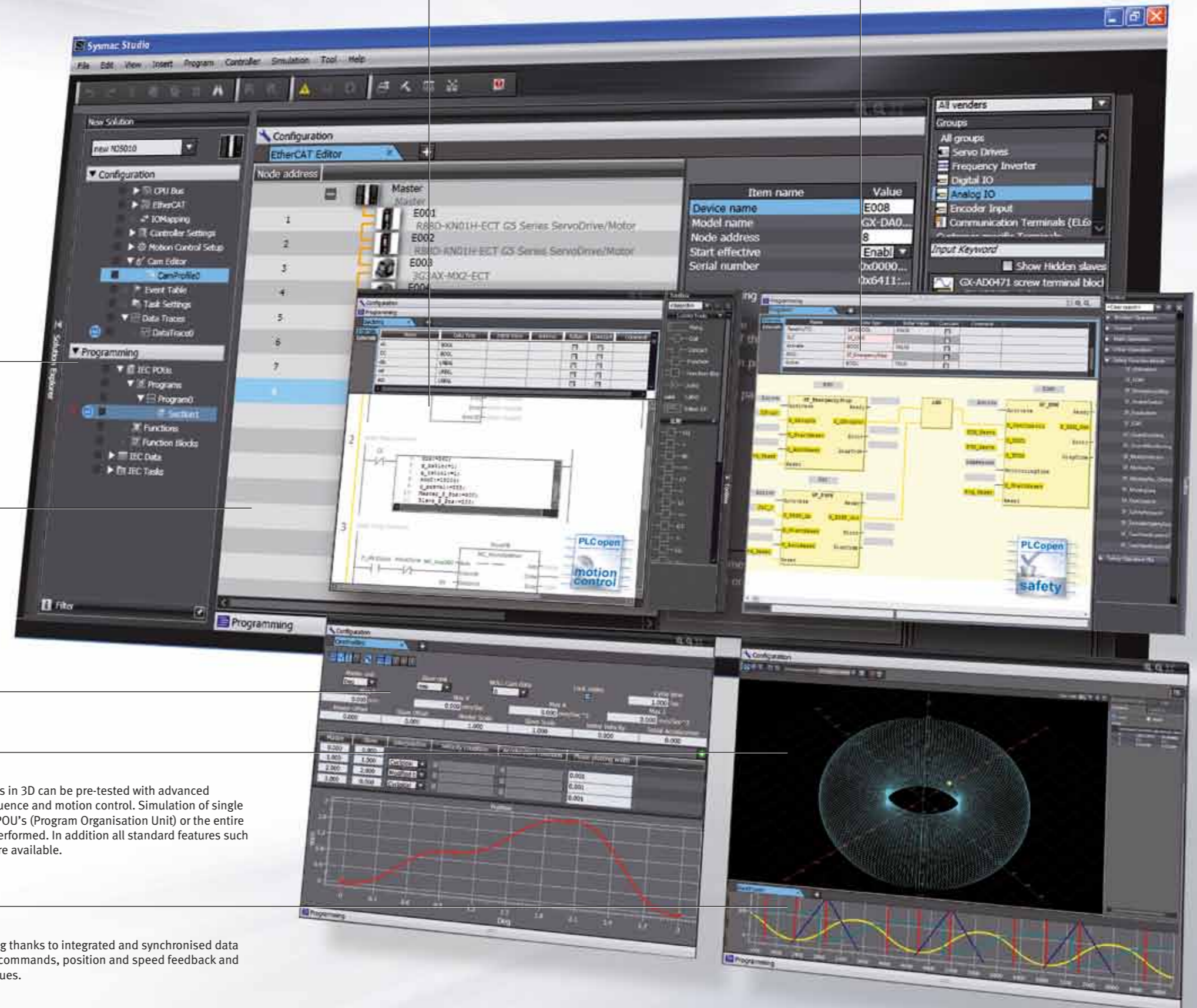
Data tracing
Easy system tuning thanks to integrated and synchronised data tracing of motion commands, position and speed feedback and I/O status and values.

NJ-Series Machine Automation Controller
Complete and robust machine automation

The NJ-Series Machine Automation Controller is at the heart of the new Sysmac platform. One integrated machine controller that offers speed, flexibility and scalability of software centric architecture without compromising on the traditional reliability and robustness that you have come to expect from Omron PLCs. The NJ-Series is designed to meet extreme machine control requirements in terms of motion control speed and accuracy, communication, security and robust system. You just create…

(intel)

Hardware design
- Architecture based on new Intel CPU
- The most compact controller in its class
- Built-in USB port and SD card slot
- Fan-less cooling
- Specific power supply design: safe shutdown, boot-up time < 12 s

Motion control
- Up to 64 axis control
- Single axis moves and axes interpolation
- 32 axes / 500 µs cycle time
- Electronic cams and gearboxes
- E-cam with on-the-fly change
- Full control of Axes Group Position
- Control of up to 8 Delta robots in 2 ms/ 4 Delta robots in 1 ms
- Integrated robotics FB library for Delta-3 control

Standard Factory network
- Programming
- Other Machine controllers
- HMI / SCADA
- IT systems

EtherNet/IP™

System robustness
- One event log for controller, field devices and networks
- Standard PLC system check: Watch-Dog Timer, memory check, network topology check, etc.

Standard Machine network
- Servos
- Inverters
- Robotics
- Vision systems
- Distributed I/O

EtherCAT®

NJ-Series controller features

- System cycle: 32 axes / 500 µs
- Motion controller supporting up to 64 servo axes
- EtherNet/IP and EtherCAT ports embedded
- Up to 192 EtherCAT Slaves (64 axes)
- Standard IEC 61131-3 programming
- Certified PLCopen Function Blocks for Motion Control
- Linear and circular interpolation
- Linear and infinite axes management
- Electronic Gear and CAM synchronisation
- Global standards CE, cULus, NK, LR

Scalable control
- NJ3 CPU units for 4 and 8 axes
- NJ5 CPU units for 16, 32 and 64 axes
- NJ5 CPU units with robotics for 16, 32 and 64 axes

Machine control
- Complete integration of Logic, Motion, Safety and Vision
- Synchronous control of all machine network devices
- Multi-tasking programs
- In-line ST, Structured Text and Ladder mixed in one program
- I/O Capacity: 2,560 local points plus 192 EtherCAT slaves

Standard programming
- Fully conforms with IEC 61131-3 standards
- PLCopen Function Blocks for Motion Control

PLCopen motion control

NX I/O
## Speed and accuracy for machine performance

Based on an internal high-speed bus running in synchronisation with the EtherCAT network and using the time-stamp function, the NX I/O can be controlled with microsecond accuracy and with nanosecond resolution. The I/O range consists of over 70 models including position control, temperature inputs and integrated safety.

EtherCAT connectivity
- Distributed clock to ensure I/O response with less than 1 μs jitter
- Safety over EtherCAT (FSoE)

NsynX technology

The NsynX technology is provided by the internal high-speed bus synchronised with the EtherCAT network. This technology is designed for machine control and includes:

- I/O units with distributed clock
- High-speed I/O units synchronised with the EtherCAT cycle
- I/O units with time-stamping function* (accuracy < 1 μs)
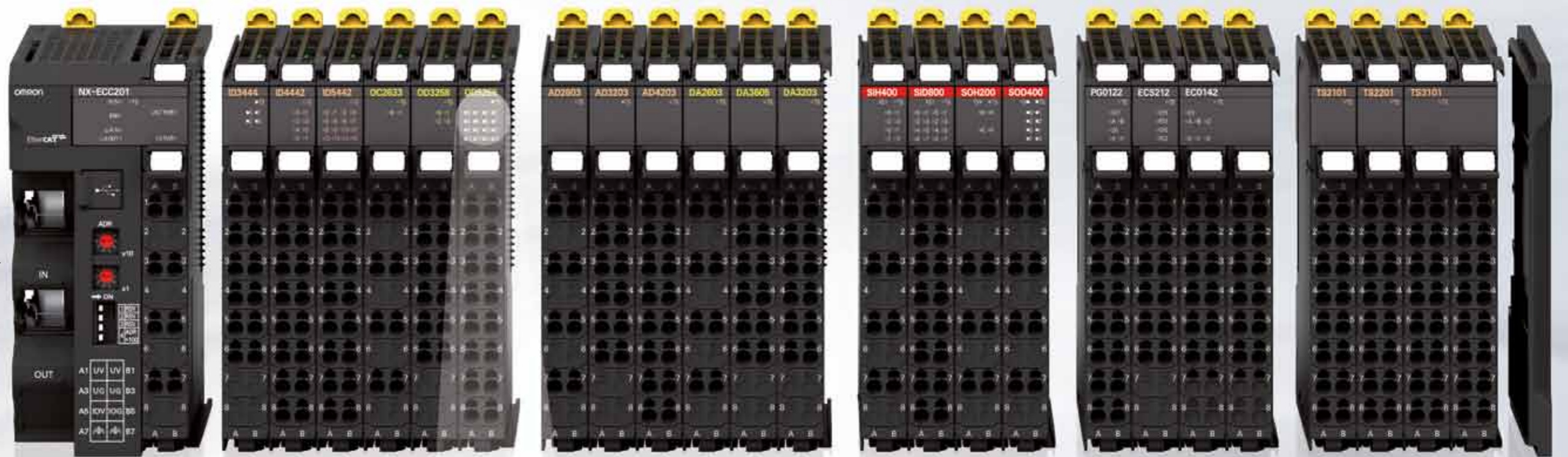
Time Stamp sequence example
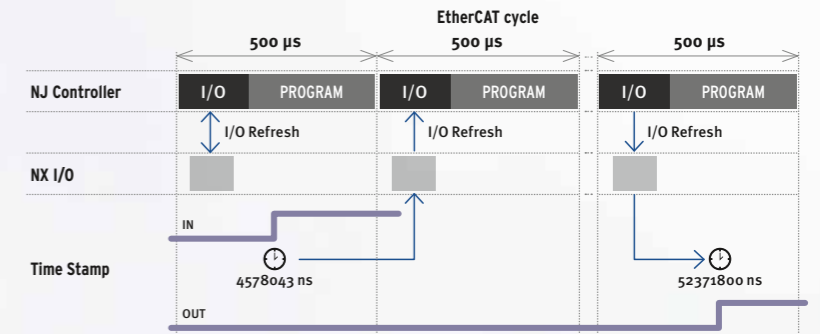
Accurate control of input events and perfect control of output with nanosecond resolution

EtherCAT coupler
- Up to 1024 byte input / 1024 byte output
- Automatic backup/restore of all I/O unit parameters. Except Safety Control unit and Safety I/O units

Digital I/O
- Units for 4, 8 or 16 points
- Standard, high-speed and time-stamp* models

Analogue I/O
- +/-10V voltage and 4-20 mA current signals
- 2, 4 or 8 channels per input unit
- 2 or 4 channels per output unit
- Standard and high-performance models

Safety I/O*
- Up to 8 safety input points per unit
- Freely allocation of the Safety I/O units

Position Control
- Encoder input units for connection of external axes to the Sysmac system
- Incremental and absolute encoder support
- Positioning control unit with pulse train output

Temperature Inputs
- Thermocouple or RTD inputs, 2 or 4 per unit

End Cover

NX I/O features

- NsynX technology provides deterministic I/O response with nanosecond resolution
- Digital I/O: high-speed and time-stamp models (NsynX)
- Analogue I/O: high performance models offer 10 μs conversion time per channel and 1:30000 resolution
- Detachable front connector with push-in type screwless terminals on all NX I/O units
- On/Offline configuration, simulation, and unified troubleshooting in the Sysmac Studio software

- High signal density; up to 16 I/O points in 12 mm width

- Fast and secure screwless push-in connections
- Removable I/O connectors for easy pre-wiring, testing and system maintenance

* Available soon

NX Safety Control*
Integrated safety into machine automation

The Sysmac platform integrates a safety solution within our one connection and one software concept. One connection is realised though the use of Safety over EtherCAT -FSoE- protocol. The One software is achieved by using the Sysmac Studio for configuration, programming and maintenance. The NX safety system consists of safety controller and safety I/O units. Both the safety controller and safety I/O can be freely distributed in an I/O rack throughout the network, mixing them in any combination with standard NX I/O.

Safety integration in One software
- Integrated Development Environment in Sysmac Studio provides one common software for hardware configuration, programming and maintenance of the Sysmac platform
- 46 safety FB/FN conforming with IEC 61131-3 standard programming
- PLCopen Function Blocks for safety

NJ Controller

Sysmac Studio

EtherCAT

Safety over EtherCAT frame

CDM	Safe data	CRC_0	Safe data	CRC_1	...	Conn ID

EtherCAT telegram

Safety over
EtherCAT

NX Safety controller
- The safety controller variables are part of the NJ controller project
- Flexibility and reusability of the programming code

NX Safety I/O
- Up to 8 safety input points per unit
- High connectivity I/O units for direct connection to a variety of devices
- I/O data monitoring in the NJ controller project

NX Safety features

- The safety controller meets PLe according to the ISO 13849-1 and SIL3 according to IEC 61508
- Flexible system lets you freely mix safety controller and safety I/O units with standard NX I/O
- Integration in One software, Sysmac Studio
- Modifications in the architecture do not require new safety certification

Functional Safety Type Approved
TÜVRheinland **FS**

ISO 13849-1, PLe

IEC 61508, SIL3

Note: Scheduled to be certified soon

* Available soon

Accurax G5 Servo system
At the heart of every great machine

Great machines are born from a perfect match between control and mechanics. G5 gives you that extra edge to build more accurate, faster, smaller and safer machines.

EtherCAT.

EtherCAT connectivity
• Compliant with CoE -CiA402 Drive profile-
• Cyclic Synchronous Position, Velocity and Torque modes
• Embedded Gear Ratio, Homing and Profile Position mode
• Distributed clock to ensure high precision synchronisation

Safety conformance
• PL-d according ISO13849-1
• STO: IEC61800-5-2
• SIL2 according to EN61508

Accurax G5 servo system features

• Compact size servo drives with EtherCAT connectivity built-in
• High-response frequency of 2 kHz
• Load vibration suppression
• Embedded Safety conforming ISO13849-1 Performance Level d
• Advanced tuning algorithms (Anti-vibration function, torque feedforward, disturbance observer)
• Wide range of linear and rotary servo motors

Improved rotary motors
• Low cogging torque servo motors
• High accuracy provided by 20 bit encoder
• IP67 for all motors and connectors
• Large range of motors from 0.16 Nm up to 96 Nm nominal torque (224 Nm peak)
• Standard and high inertia motors

Ironless linear motors
• Compact, efficient design
• Excellent force-to-weight ratio
• No latching force

Iron-core linear motors
• Compact, flat design
• Optimum ratio between force and volume
• Weight-optimized magnetic track

MX2 and RX Inverter series
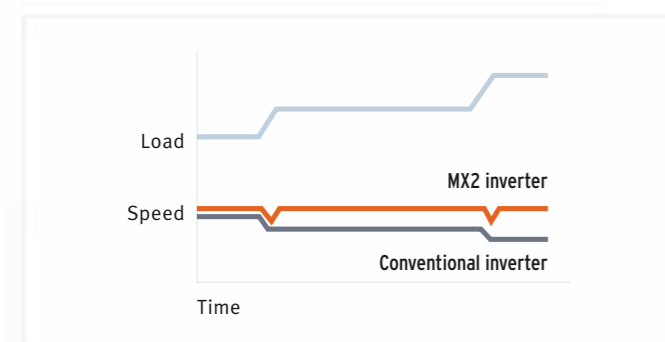## Drive solution for machine automation

Thanks to its advanced design and algorithms, the MX2 inverter provides smooth control down to zero speed, plus precise operation for cyclic operations and torque control capability in open loop. The RX series combines high performance, application functionality and customisation to match the precise requirements. Both, the MX2 and RX inverter series are fully integrated within the Omron Sysmac automation platform.

Motor efficiency control
• Double rating VT 120%/1 min and CT 150%/1 min
• Energy saving function

Torque control in open loop
• Ideal for low to medium torque applications
• Can replace a flux vector inverter or servo drive in suitable systems

Quick response to load fluctuation
• Stable control without decreasing machine speed improves quality and productivity

MX2

EtherCAT

200% starting torque
• Near stand-still operation
• High starting torque in open loop
• Control of fast cyclic loads

RX

EtherCAT

(Example of Speed vs. Torque Characteristics: RX series type)
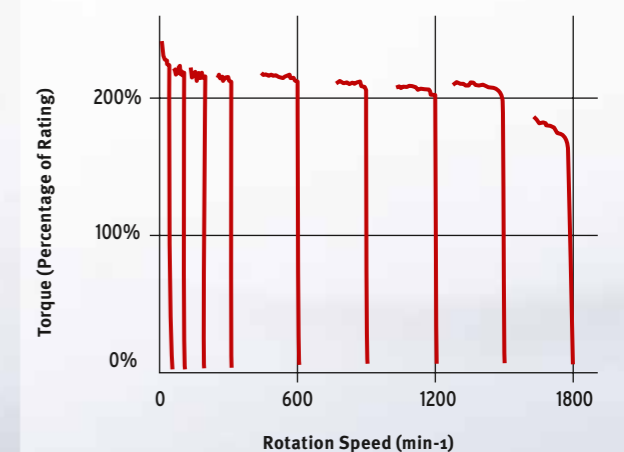
MX2 features

• Power range up to 15 kW
• Torque control in open loop, ideal for low to medium torque applications
• 200% starting torque near stand-still operation (0.5 Hz)
• Double rating VT 120%/1 min and CT 150%/1 min
• IM and PM motor control
• Drive Programming
• 24 VDC backup supply for control board and communications
• Built-in application functionality (i.e. Brake control)

RX features

• Power range up to 132 kW
• Sensor-less and closed-loop vector control
• High starting torque in open-loop (200% at 0.3 Hz)
• Full torque at 0 Hz in closed-loop
• Double rating VT 120%/1 min and CT 150%/1 min
• Drive Programming
• Built-in application functionality (i.e. ELS - Electronic Line Shaft-)

FQ-M Vision Sensor
Designed for object tracking

The new FQ-M series is a vision sensor designed specifically for pick and place applications. It comes with EtherCAT embedded and can be configured and monitored from Sysmac Studio software. The FQ-M series is compact, fast and includes an incremental encoder input for easy tracking and calibration.

EtherCAT.

Connectivity
• EtherCAT port for object tracking
• Ethernet port for advanced configuration and monitoring
• Encoder input for accurate "on the fly tracking" and easy calibration
• Automatic strobe timing control

Detection
• Up to 5000 pieces per minute with 360 degree rotation
• Stable and robust detection under changeable environmental conditions

FQ-M features

• Made specifically for tracking applications
• Designed to work within Sysmac integrated automation with embedded EtherCAT and integrated software tool
• Smart camera with EtherCAT: camera, image processing and connectivity in one
• Vision sensor with encoder input for tracking function
• Calibration function of the complete system
• Can inspect a wide range of objects
• Sysmac Studio software for vision system operation and setting

EtherCAT.

Ethernet
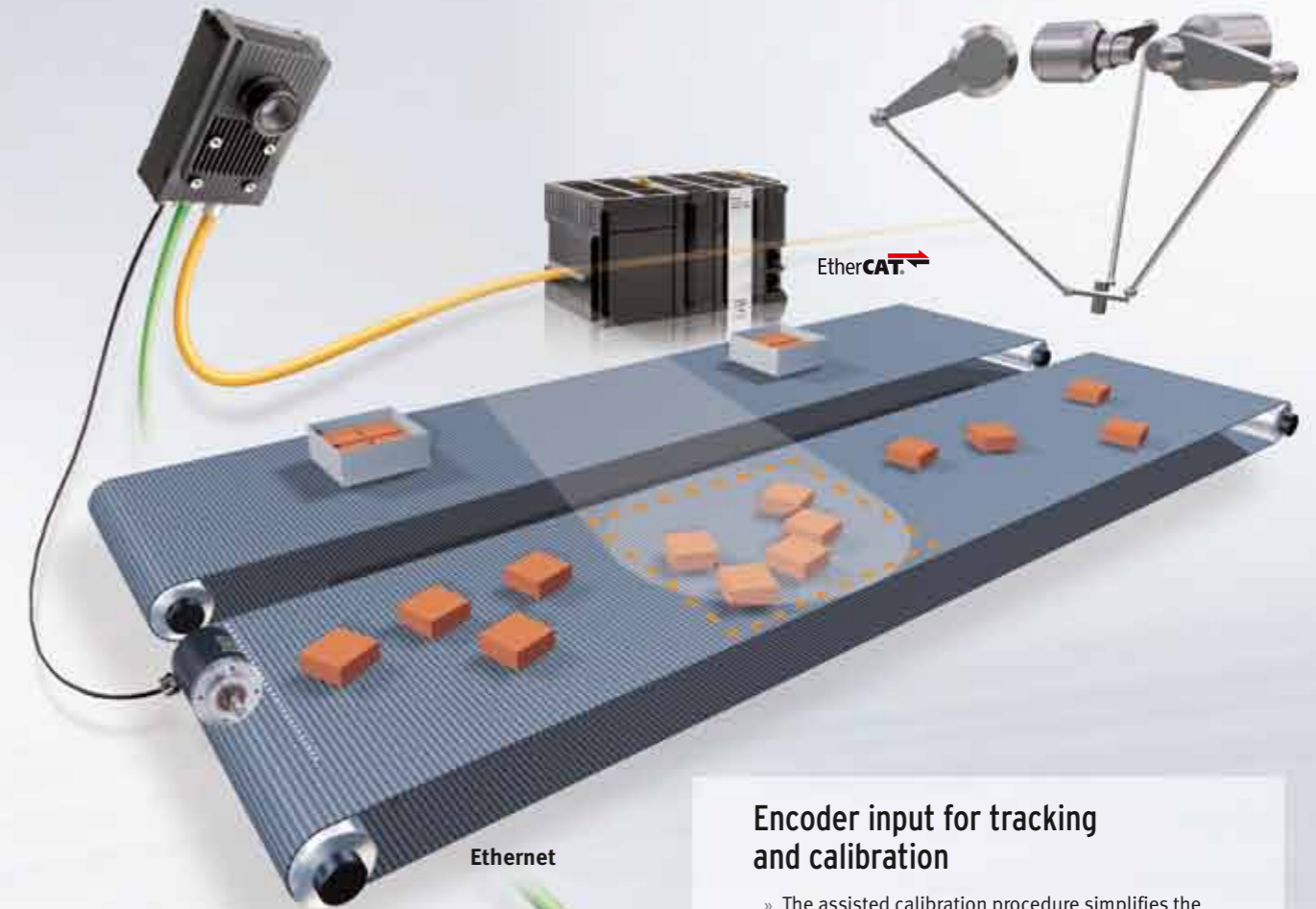
Design
• Camera and image processing in one
• Standard C-mount lenses; choose the field of view and focus distance you need
• Variety of industrial connector types (angled, straight) for correct mounting

Software tool
• Fully integrated within the Sysmac Studio software tool
• Intuitive and icon driven set-up and configuration
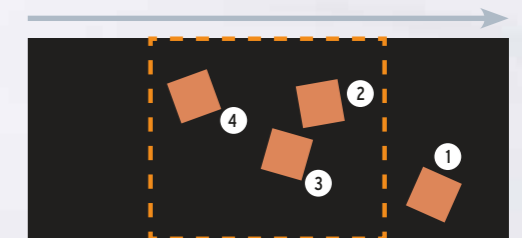• Trending and logging function

Encoder input for tracking and calibration

» The assisted calibration procedure simplifies the overall system set-up.

» Objects that overlap within more than one field of view are segregated and its data is ignored.
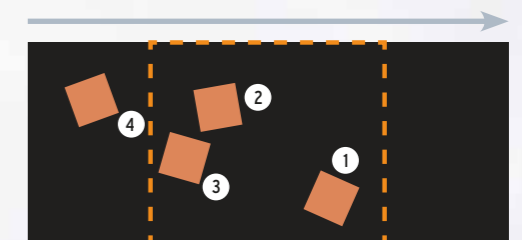
First shot: The position and orientation data of pieces 1, 2 and 3 are sent to the controller.

Next shot: Only the position and orientation data of piece 4 are sent to the controller.

Service and Support

Helsinki
Stockholm
Oslo
Gothenburg
Estonia
Malmö
Latvia
Århus
Copenhagen
Lithuania
Moscow
Amsterdam
Hamburg
Berlin
Warsaw
Den Bosch
Düsseldorf
Krakow
Milton Keynes
Frankfurt
Brussels
Prague
Stuttgart
Paris
Munich
Vienna
Piestany
Nantes
Rotkreuz
Budapest
Lyon
Lausanne
Velenje
Milan
Zagreb
Bucharest
Toulouse
Bologna
Belgrade
Pleven
Terni
Sofia
Vitoria
Barcelona
Skopje
Porto
Istanbul
Madrid
Valencia
Athens
Lisbon
Sevilla
Alger
Tunis
Casablanca

OMRON technical offices across the World

ATC Automation Center
Kusatsu (JPN), Shanghai (CHN),
Barcelona (Spain), Fremont CA (USA)

TS Tsunagi laboratory
Kusatsu (JPN), Shanghai
(CHN), Den Bosch (NL)

○ Premium partner

PRESENCE

COMPETENCE

CONFIDENCE

ASSURANCE

OMRON

Design

Our wide network of machine automation specialists will help you to select the right automation architecture and products to meet your requirements. Our flat structure based on expert-to-expert contact ensures that you will have ONE accountable and responsible expert to deal with on your complete project.

Proof of concept

As your project matures make use of our Automation centers to test and catch-up with technology trends in motion, robotics, networking, safety, quality control etc. Make use of our Tsunagi (connectivity) laboratory to interface, test and validate your complete system with our new machine network (EtherCAT) and factory network (EtherNet/IP).

We will assign a dedicated application engineer to assist with initial programming and proof testing of the critical aspects of your automation system. Our application engineers have in-depth expertise in and knowledge of networks, PLCs, motion, safety and HMIs when applied to machine automation.

Development

During your prototyping phase you will need flexibility in technical support, product supply and exchange. We will assign an inside sales contact to help you source the correct products fast during your prototyping phase.

Commissioning

With our world-wide network for service and support the export of your product is made simple, we will support you on-site with your customer, anywhere in the world. We can arrange a liaison sales engineer to facilitate training, spare parts supply or even machine commissioning. All this in a localised language with localised documentation – giving you complete peace of mind.

Serial production

As your production increases we will engage in supplying you within 24hrs and repairing within 3 days. All our products are global products meeting global standards - CE, cULus, NK, LR -

Product overview

Controller

NJ3 CPU units for 4 and 8 axes

NJ5 CPU units for 16, 32 and 64 axes

NJ-Series

- Integration of Logic and Motion in one Intel CPU
- Scalable control: CPUs for 4, 8, 16, 32 and 64 axes
- New PLC Logic and Motion cores, 100% Omron quality
- IEC 61131-3 programming languages
- EtherCAT and EtherNet/IP ports embedded
- Certified PLCopen Function Blocks for Motion Control
- Reuse with most of the CJ-series I/O units

I/O

NX I/O

NX I/O

- Over 70 models of I/O units including position control, temperature inputs and integrated safety
- High-speed I/O units synchronised with the EtherCAT cycle
- NsynX technology provides deterministic I/O response with nanosecond resolution
- Automatic backup/restore of all I/O unit parameters
- Detachable front connector with push-in type screw-less terminals in all NX I/O units
- Slim design: up to 16 I/O points in just 12 mm width

Safety

NX Safety*

NX Safety

- The safety controller meets Category 4, PLe according to the ISO 13849-1 and SIL3 according to IEC 61508
- Flexible system lets you freely mix safety controller and safety I/O units with standard NX I/O
- Up to 8 safety input points per unit
- Safety Function Blocks conforming with IEC 61131-3 standard programming
- PLCopen Function Blocks for safety

Servo

Accurax G5 servo drive

- High-response frequency of 2 kHz
- Built-in safety conforming ISO13849-1 Performance Level d
- High accuracy provided by 20 bit encoder
- Advanced vibration suppression functions

Accurax G5 servo motor

- Power range from 50 W to 15 kW
- IP67 protection
- Low cogging torque
- Standard and high inertia motors

Accurax G5 Linear motor solutions

- Linear motor force range from 26.5 to 760 N
- Ironless and iron-core motor types available
- Wide range of over 100 standard linear motor axes

Inverter

MX2 inverter

- Power range up to 15 kW
- Torque control in open loop
- 200% starting torque
- Double rating VT 120%/1 min and CT 150%/1 min

RX inverter

- Power range up to 132 kW
- Sensor-less and closed-loop vector control
- High starting torque in open-loop (200% at 0.3 Hz),
- Full torque at 0 Hz in closed-loop
- Double Rating VT 120%/1 min and CT 150%/1 min

Vision and sensing

FQ-M series Vision Sensor

- Camera, vision and connectivity in one
- Compact vision sensor
- Designed for high speed pick and place
- Encoder tracking and smart calibration function
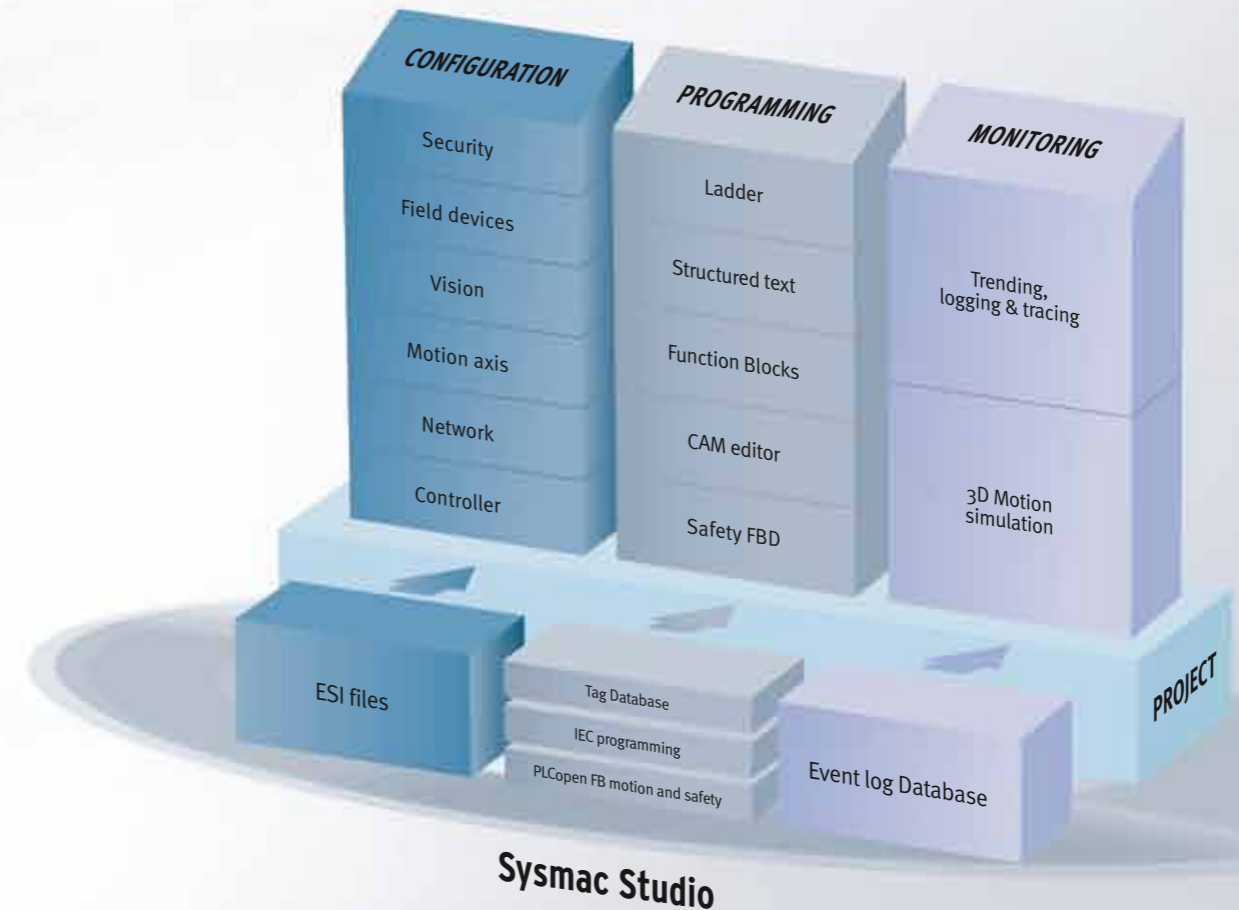- Fast and powerful object recognition

E3X-HD0 fiber optic sensor

- Easy set up and operation by Smart tuning and integration into Sysmac Studio
- Dynamic Power Control (DPC) for high operational stability for changing environmental conditions or challenging objects
- Connection of up to 30 sensors on one communication unit

ZW series displacement Sensor

- Compact and lighterweight fiber displacement sensor
- Stable measurements for any material with same mounting position
- Robust sensor head structure

Sysmac Studio

* Available soon

OMRON

Automation Systems
• Programmable logic controllers (PLC) • Human machine interfaces (HMI) • Remote I/O
• Industrial PC's • Software

Motion & Drives
• Motion controllers • Servo systems • Inverters • Robots

Control Components
• Temperature controllers • Power supplies • Timers • Counters • Programmable relays
• Digital panel indicators • Electromechanical relays • Monitoring products • Solid-state relays
• Limit switches • Pushbutton switches • Low voltage switch gear

Sensing & Safety
• Photoelectric sensors • Inductive sensors • Capacitive & pressure sensors
• Cable connectors • Displacement & width-measuring sensors • Vision systems
• Safety networks • Safety sensors • Safety units/relay units • Safety door/guard lock switches

CD_EN_04+Sysmac+Brochure