A fully integrated platform

One machine control through one connection and one software is how we define the Sysmac automation platform. The Machine Automation Controller integrates logic, motion, safety, robotics, vision, information, visualization and networking under one software: Sysmac Studio. This one software provides a true Integrated Development Environment (IDE). The machine 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 Controller**
- Complete integration of motion and logic
  - A large selection of CPU Units for up to 256 axes
- Safety integration
  - Flexible system lets you integrate safety into machine automation through the use of Safety over EtherCAT (FSoE).

**One Connection**
- Integration of machine control and Information
  - Built-in EtherCAT and EtherNet/IP™ ports: Global standard networks
  - NX102[^102] / NJ501-1[^501] CPU Unit with built-in international standard (IEC 62541) OPC UA communication functionality
  - Database connection: Logs real-time data from production lines directly into SQL Databases. This enables preventive maintenance and quality traceability.

**One Software**
- One integrated development environment software
  - Fully conforms with IEC 61131-3 standards
  - PLCopen function blocks for motion control
  - Packed with Omron’s rich technical know-how. Various software components help reduce programming time.
Motion Control

Complete integration of motion and logic

One controller integrates logic, motion, vision and information for complete control and management of machines. Position, displacement, and tension information collected from sensors can be quickly and easily fed back to the motion control.

Accurate feedback control with less than 1 μs jitter

The NJ/NX controller offers synchronous control of all machine devices, from input through to output. Distributed clock-based clock synchronization incorporated into EtherCAT slaves enables the I/O refresh cycle to be synchronized between units such as the FH Vision System, ZW Displacement Sensor, NX I/O, and GS/1S Servo Drive.

Preventive maintenance

Preventive maintenance of EtherCAT sensor

Monitoring the sensor status allows you to maintain before sensors malfunction due to dirt or aged deterioration.* The sensor settings can be saved and loaded, which minimizes downtime when troubles occur.

Preventive maintenance of actuator devices

The NJ/NX controller that integrates EtherCAT and motion control can constantly monitor actuator devices with a fast cycle time.

FROM

In harsh environments, sensors can become dirty, resulting in malfunctions.

Detection in dusty environment

Detection in oily environment

TO

Decreases in light intensity can be detected by monitoring sensors.

Initial display

Trend graph

Fully integrated and synchronized

* When combining the NJ/NX controller with the E3NW EtherCAT Sensor communications unit and creating the programmable terminal screens.

The sample program for Omron NS/NA Programmable Terminal is available. Contact your Omron sales representative for details.
machine data management for a variety of applications

**Information**

**NX102-□□□□/NJ101-□□□□/NJ501-□□□□/NX701-□□□□**

Fast machine data storage in database
The controller connects directly to a database without the need for a gateway. The special instructions allow easy access to the database. Real-time data collection enables productivity improvement, predictive maintenance, and quality traceability.

**NX102-□□□□/NJ501-□□□□**

International standard communication protocol
OPC UA directly connects automation and IT
OPC UA with strong security features (e.g., authentication and encryption) is widely used across the world and adopted for Industry 4.0 and PackML communications. The host system can access production data directly without connecting a gateway computer.

**NJ501-1340**

Semiconductor industry standard SECS/GEM communications functionality
The SECS/GEM CPU Unit integrates machine control and host communications, reducing time, cost, and complexity to establish SECS/GEM communications.

Previously
Separate computer or special communications unit is required.

Support for HSMs/SSL/SSM communications
Separate computer + SECS software

Machine control
Vision Sensor
Servo Drive
I/O
Inverter

Supported database
- Microsoft SQL server
- Oracle Database
- IBM DB2
- MySQL
- PostgreSQL
- Firebird

Database

Data collection
Quality
Inspection results
Production conditions

Previously lunar uninitiated communications

Host system
SCADA/HMI/MES/ERP

Manufacturing site
Machine control

**SEMI standards-full-GEM and user-defined messages support**

Non-GEM
E36 GEM
GEM300
E38 GEM
E32/HSMS/SS
TCP/IP
Ethernet

Application Model
Message Definition
Logical Protocol
Physical Protocol

Previously supported by Full-GEM

NX501-1340 attainability area

**Machine Automation Controller**
**Processing**

**NJ501-5300**

Versatile NC functions

G-Code reduces time required to design and program complex profiling.

**Conventional controller**

Processing programs are designed based on CAD data. Programming using PLC instructions and debugging are required for each figure.

Program design

- Exploding components into lines
- Types of lines: straight line, arc, free curve
- Target positions of lines
- Travel velocities
- Transition path between figures, etc.

**NC Integrated Controller**

**CAD/CAM software makes design easy**

**NC functions for complex profiling applications**

- **G-Code**
  - NC programming language allows manual programming on operation software and use in combination with any CAD/CAM software

- **High-speed control**
  - Logic sequence, motion control and NC functionality with the fastest cycle time of 50 μs

- **Cutter compensation 2D**
  - Tool diameter and shape compensation, matching the cutting point exactly as specified in G-Code

- **Lookahead**
  - NC instructions are analyzed in advance; movements are blended and optimized in speed and acceleration for a better performance

- **3D interpolation**
  - Helical, spiral and conical interpolation for 3D profiling

- **Coordinate systems**
  - Various profiling using machine coordinate system, workpiece coordinate system, and local coordinate system
Integrated machine and robot control brings flexibility to build machines

Integrating machine control and robot control, one controller allows you to build a conveyor tracking application where robots are precisely synchronized with conveyors.

One controller can control up to 64 axes including 8 parallel, Cartesian, or serial robots.

Standard IEC 61131-3 based instructions for motion and robot control reduce programming time.

Redundancy minimizes downtime

Even if a part of the EtherCAT network is disconnected, Cable Redundancy provides continuous connectivity. This function allows you to fix disconnection without stopping the machines and production line where one controller provides both machine control and safety control.
Design

Reusable programs

Programming with variables

One Integrated Development Environment software Sysmac Studio is fully compliant with the open standard IEC 61131-3. Programming with variables eliminates the need to learn the internal memory map of the PLC and allows the programs to be reused.

Maintenance

Highly efficient maintenance

Troubleshooting

Troubleshooting in the Sysmac Studio and NA Programmable Terminal can manage errors across the entire system including the controller. You can check details of errors and solutions without reading manuals.

*1. This function can be used by applying the Team Development Option to Sysmac Studio version 1.20 or higher. Project version control function is supported by CPU Unit version 1.16 or later. Git and the Git logo are either registered trademarks or trademarks of Software Freedom Conservancy, Inc., corporate home of the Git Project, in the United States and/or other countries.

*2. Available with the Sysmac Studio 64-bit version. 3D CAD data supports STEP/IGES.
When you develop a project at the same time as your colleagues, the Sysmac Studio combined with the version control system (Git™) merges changes automatically and resolves conflicting changes. This makes merging easier and faster. You can even revert to the previous revision after graphically comparing the current project with a previous one.

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Development by multiple developers

- Project version control function*1

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For advanced machine control

- Motion programming

Advanced motion control applications can be created quickly just by combining PLCopen® Function Blocks for Motion Control.

- Model-Based design

Complex feedback control that is designed with MATLAB®/Simulink® can be imported into programs.

Verification

Fast system debugging

- Virtual mechanical debugging

Use only the Sysmac Studio with loaded 3D CAD data*2 for 3D simulations. Operation of a control program can be verified in a virtual environment, improving program accuracy during design and reducing rework during verification using physical devices.

For more information, see the video: www.fa.omron.co.jp/3d-simulation_e

- Enhanced by 3D simulation option*2

Movement of the machine connected online can be displayed on the CAD in real time, and movement can also be reproduced from the trace data. Maintenance and troubleshooting can be performed in remote locations.

Debugging in conjunction with a third-party simulator is possible.
## NJ/NX-series Lineup

<table>
<thead>
<tr>
<th>Series</th>
<th>NX701 CPU Units</th>
<th>NX102 CPU Units</th>
<th>NX1P2 CPU Units</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Product name</strong></td>
<td><strong>NX701 CPU Units</strong></td>
<td><strong>NX102 CPU Units</strong></td>
<td><strong>NX1P2 CPU Units</strong></td>
</tr>
<tr>
<td><strong>Model</strong></td>
<td>NX701</td>
<td>NX102</td>
<td>NX1P2</td>
</tr>
<tr>
<td><strong>Appearance</strong></td>
<td><img src="image1" alt="NX701 CPU Unit" /></td>
<td><img src="image2" alt="NX102 CPU Unit" /></td>
<td><img src="image3" alt="NX1P2 CPU Unit" /></td>
</tr>
<tr>
<td><strong>CPU Unit features</strong></td>
<td>Ideal for large-scale, fast, and highly-accurate control with up to 256 axes.</td>
<td>Compact controller with up to 8 axes motion control.</td>
<td>Compact controller with up to 4 axes motion control, up to 4 axes single-axis control, and built-in I/O.</td>
</tr>
<tr>
<td><strong>Instruction execution times</strong></td>
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<td>3.3 ns</td>
<td>3.3 ns</td>
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<td>Math instructions (for long real data)</td>
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<td><strong>Program capacity</strong></td>
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<td><strong>Variable capacity</strong></td>
<td>4 MB: Retained during power interruptions</td>
<td>1.5 MB: Retained during power interruptions</td>
<td>32 KB: Retained during power interruptions</td>
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<tr>
<td></td>
<td>256 MB: Not retained during power interruptions</td>
<td>32 MB: Not retained during power interruptions</td>
<td>2 MB: Not retained during power interruptions</td>
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<tr>
<td><strong>I/O capacity/maximum number of configuration Units (Expansion Racks)</strong></td>
<td></td>
<td>Up to 32 NX I/O Units connectable</td>
<td>Built-in I/O: 40 points max. Up to eight NX I/O Units connectable</td>
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<tr>
<td><strong>Number of motion axes</strong></td>
<td>128, 256</td>
<td>0, 2, 4, 8 *1</td>
<td>0, 2, 4 *1</td>
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<tr>
<td><strong>EtherCAT slaves</strong></td>
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<td>16</td>
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<tr>
<td><strong>Number of controlled robots</strong></td>
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<td><strong>External memory</strong></td>
<td>Memory Cards</td>
<td>Memory Cards</td>
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<tr>
<td><strong>Detailed specification (Datasheet)</strong></td>
<td>P141</td>
<td>P130</td>
<td>P116</td>
</tr>
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</table>

*1. Motion control axes and 4 single-axis position control axes.
2. The number of robots that can be controlled depends on the number of axes used in the system.
3. The number of controlled axes of the MC Control Function Module is included.

### Individual Pamphlets

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<th>Pamphlet</th>
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<td>OPC UA</td>
<td>P123</td>
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<td>P085</td>
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<td>NJ301-1300</td>
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Ideal for large-scale, fast, and highly-accurate control with up to 64 axes.

Ideal for small control with up to 8 axes.

Ideal for simple machines.

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<tr>
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4 MB: Not retained during power interruptions

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2 MB: Not retained during power interruptions

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<th>2,560 points/40 Units (3 Expansion Racks)</th>
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<tr>
<th></th>
<th>8 robots max.</th>
<th>4, 8</th>
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P140