OMRON

NC Integrated Controller

Machine Automation Controller NJ Series

Integrated NC and PLC functionality
for advanced processing machines

SYSMAC
always in control

NC Integrated Controller brings further of multi-purpose processing machines

With changes in consumer's needs and advancement of technologies, products with more diverse and complicated shapes and materials are increasing. Along with the changes in products, manufacturing sites are facing challenges of achieving more difficult processing at higher productivity rates.

To meet customer's challenges of the future manufacturing, Omron offers a solution to maximize the throughput of multi-purpose machines that handle multiple processes.

Three benefits from NC Integrated Controller

NC and PLC functionality fully synchronized at high speed	Minimize machine cycle time
Versatile NC functions	Simplify complex profiling
One software for NC setting and PLC programming	Optimize engineering time

Experience new manufacturing with the NJ NC Integrated Controller at the heart.

Sysmac Automation Platform

NJ Series NC Integrated Controller

development

Minimize machine cycle time

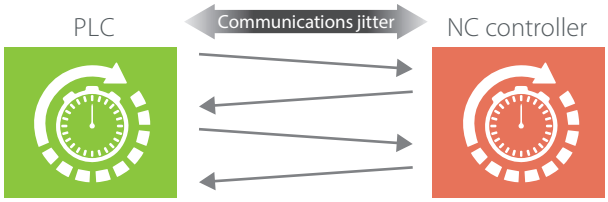
NC and PLC functionality fully synchronized at high speed

Efficient control of processing and other processes is crucial to performance and productivity of a multi-purpose machine which handles multiple processes.
The NC integrated controller provides both NC and PLC functionality and synchronize all devices at high speed, significantly reducing the machine cycle time.

Improved synchronization

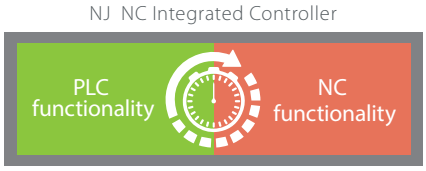
Conventional system PLC+NC

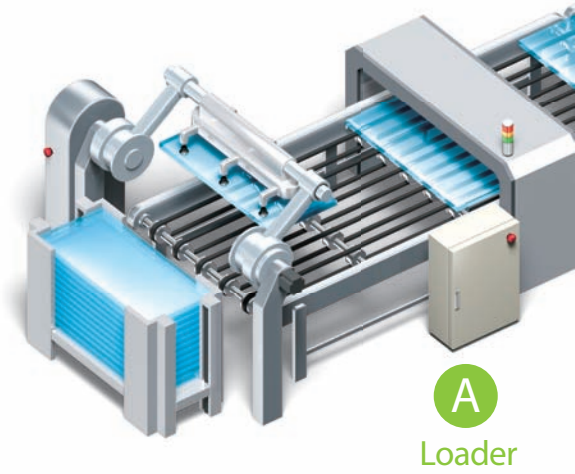
As CPU control cycles are not synchronized, communications jitter occurs



NC Integrated Controller

NC functionality and PLC functionality are fully synchronized in the same task period



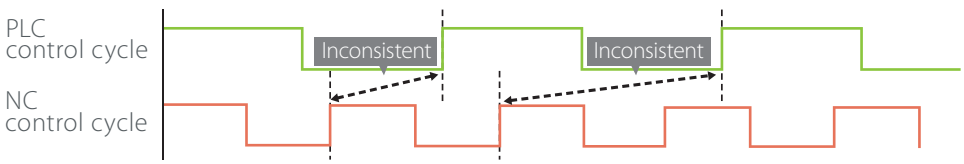


Control cycle as you designed

Programs for both PLC and NC are executed in the same task period, which enables processes to be synchronized with the cycle as you designed

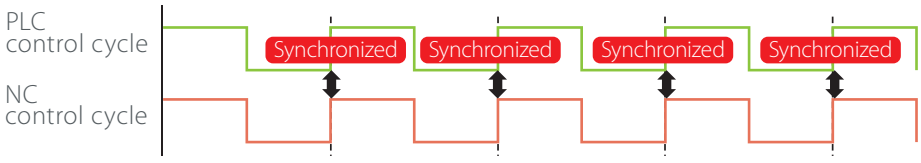
Conventional system

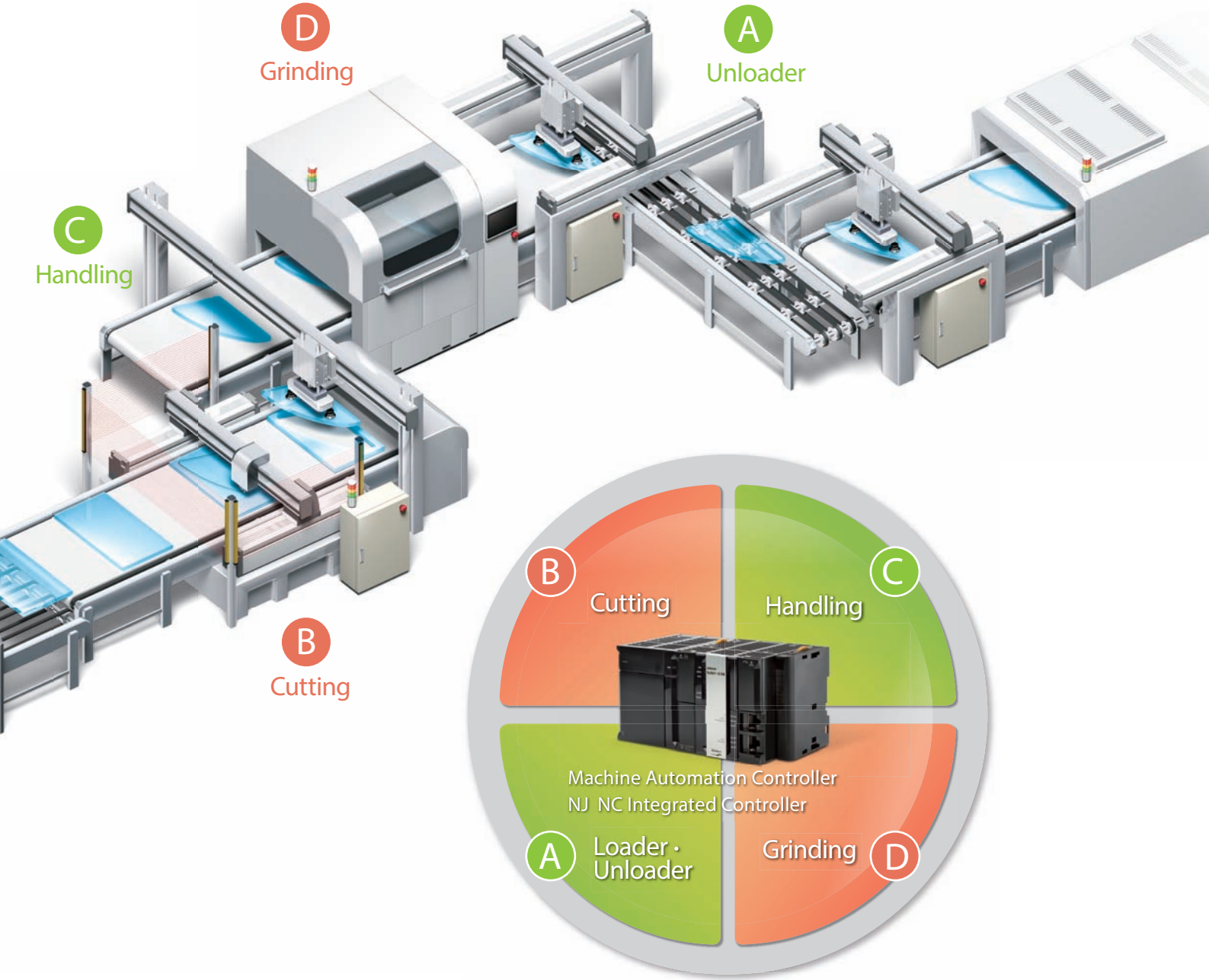
Two control cycles are inconsistent (Communications jitter must be taken into consideration)



NC Integrated Controller

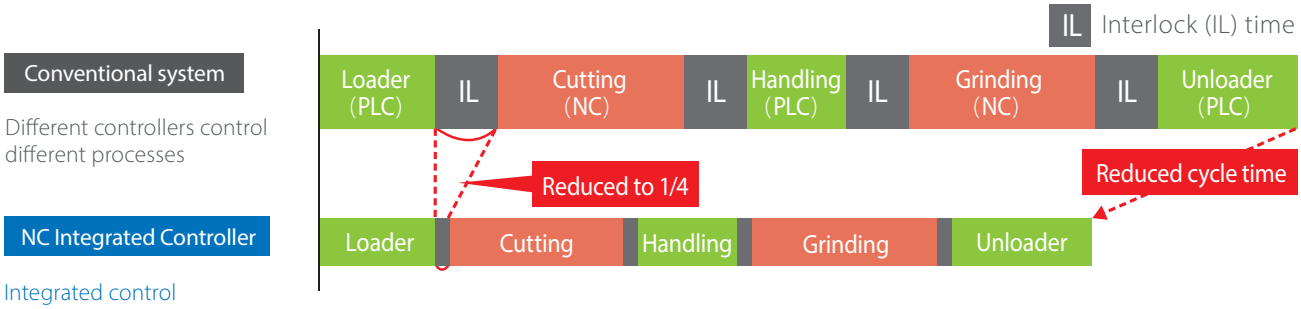
Two control cycles are fully synchronized





High-speed synchronization reduces interlock time

Interlock time between NC (processing) and PLC (other processes) will be reduced to 1/4 as compared to when separate controllers are used. Cycle time of a multi-purpose machine that generates many interlocks can be reduced.



Simplify complex profiling

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

CAD screen (example)

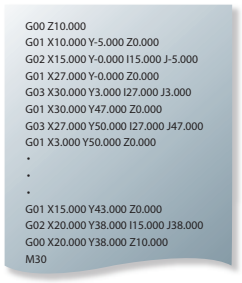
Program design

- 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

CAD/CAM



NC program in G-Code (example)

Parameter setting → **Automatic generation** → **Transferred**

① Parameters are set using CAD/CAM software

② NC program in G-Code is generated

③ Program is transferred to NC integrated controller

NC functions for complex profiling applications

G-Code
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 500 µs

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

Lookahead
Future instructions are analyzed in advance, movements are blended and optimized in speed and acceleration for a better performance

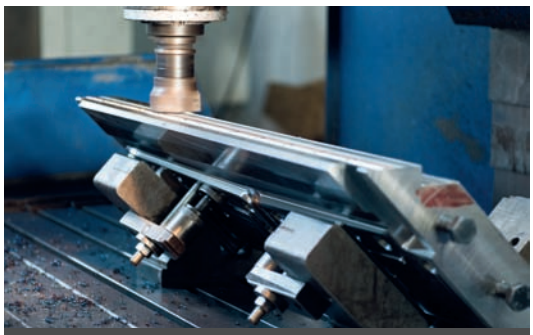
Block Retrace
Path can be reverted in order to remove the tool from cutting area

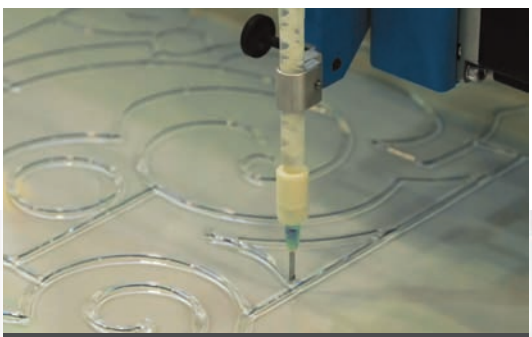
Compensation
High-precision processing by compensating position of NC motors

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


Milling


Grinding

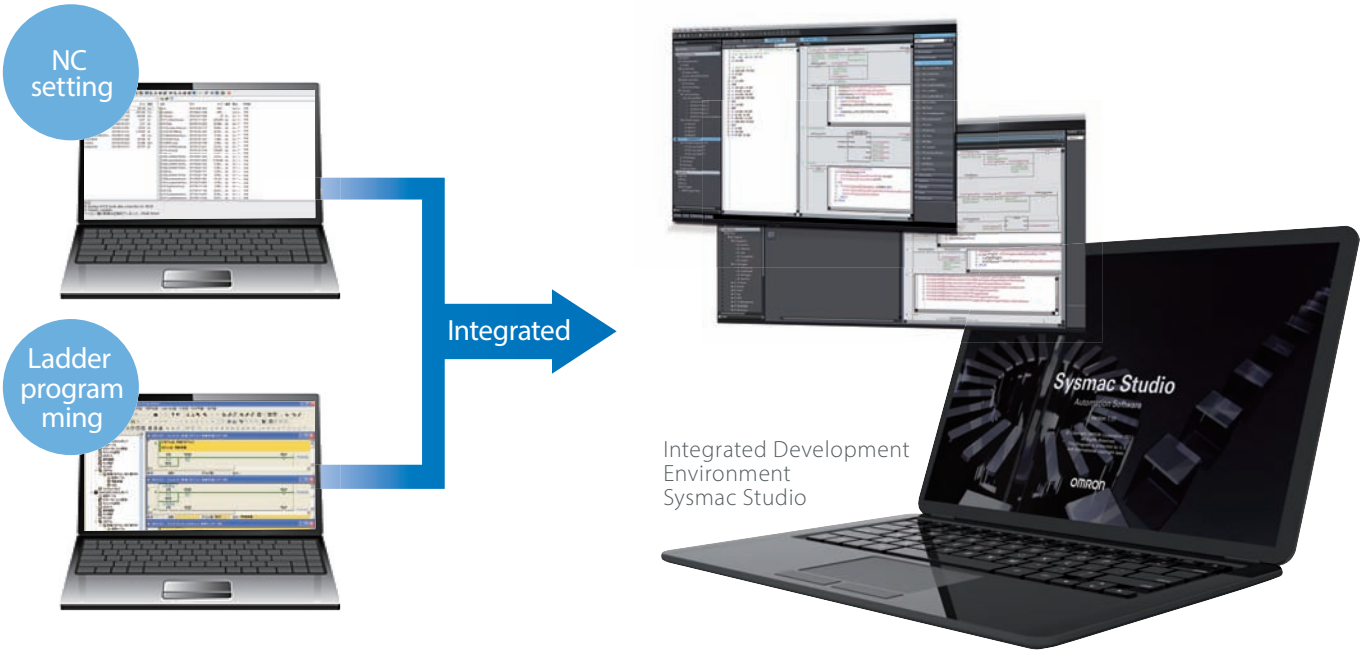

Dispensing


Sewing

Optimize engineering time

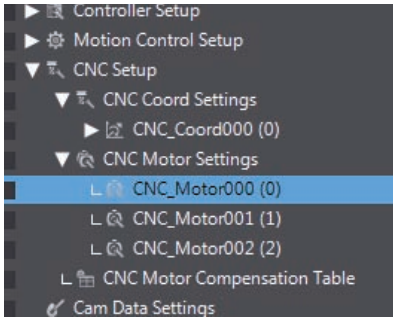
One software for NC setting and PLC programming

The Sysmac Studio provides a true Integrated Development Environment (IDE) for configuration, programming, monitoring, and 3D simulations. Programming based on IEC standard and PLCopen® Function Blocks (FBs) for motion control cuts programming time. FBs for NC control make program structure simple, even for synchronization between NC process and others.

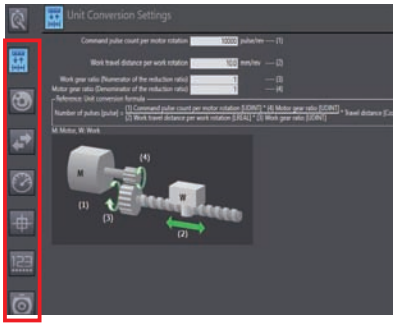


Intuitive user interface reduces configuration time

Easy to find NC settings

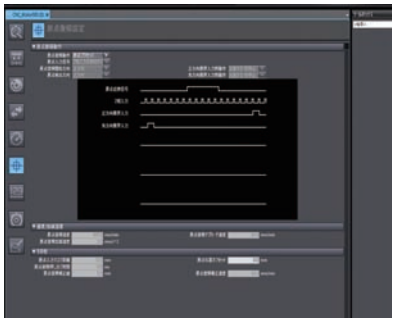


Parameter setting by device



Description of parameters

Description with graphics gives parameter details



A modular controller suitable for machines programmed for NC

- Combine with general-purpose HMI and your own PLC
- Traditional reliability and robustness
- Up to 16 synchronous axes, including NC processing and motion control

Machine Automation Controller
NJ NC Integrated Controller

Graphic user interface for NC - CNC Operator

Operation software for PC to use NC functionality

Customizable software allows adding functionality by users (Requires Microsoft Visual Studio)

Total solution to maximize machine throughput

Integration and functionality

Sysmac is an integrated automation platform dedicated to providing complete control and management of your automation plant. At the core of this platform, the controller series offers synchronous control of all machine devices and advanced functionality. This multidisciplinary concept allows you to simplify solution architecture, reduce programming and optimize productivity.

✓Integrated machine controller

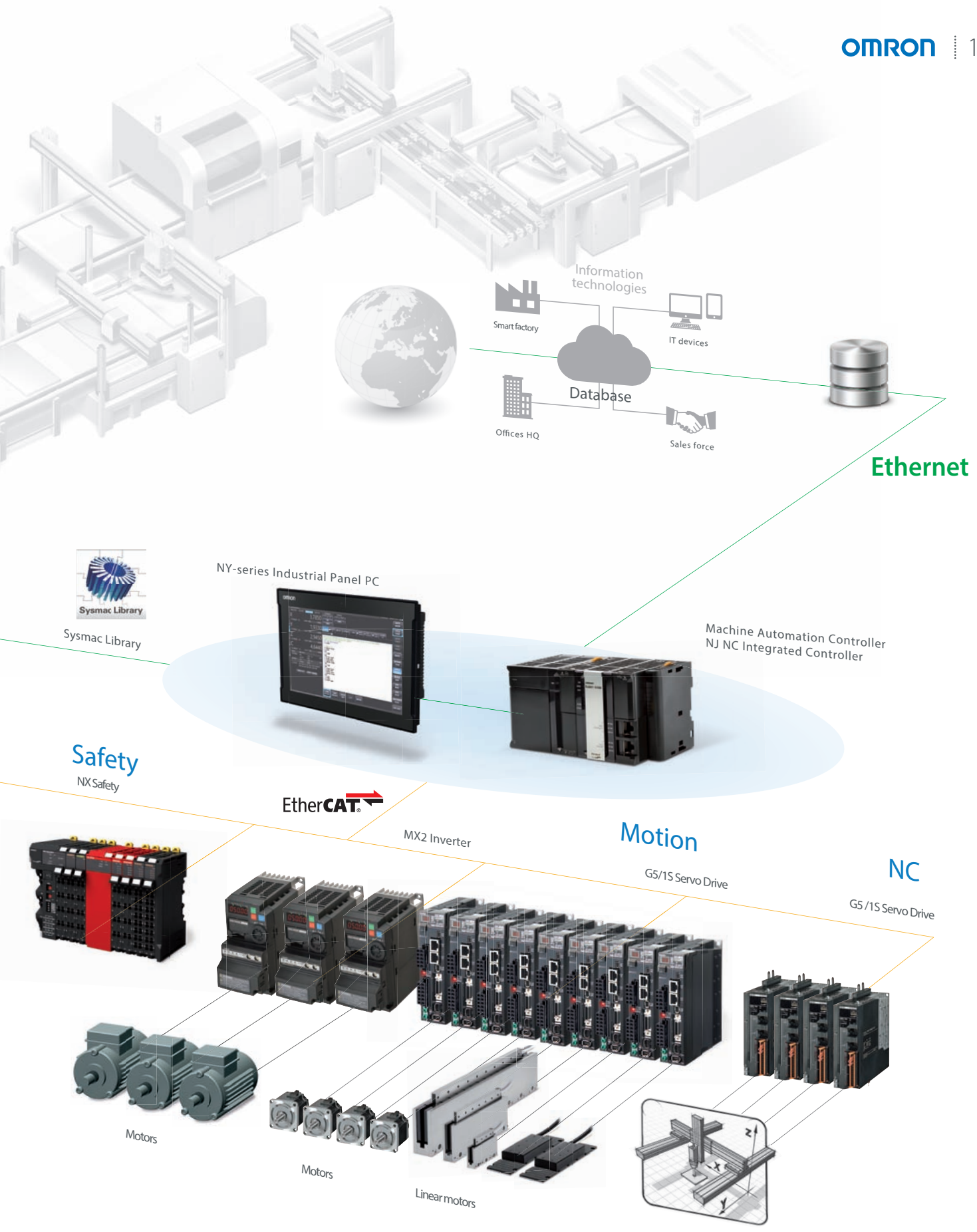
Logic sequence, motion, safety, I/O, vision, and NC in one. One integrated controller offers speed, flexibility and scalability of software centric architecture without compromising on the traditional reliability and robustness that you have come to expect from Omron PLCs.

✓Perfect match between fast machine control and data plant management.

Built-in ports: Machine control network EtherCAT® and factory automation network EtherNet/IP™. The two networks with one connection purpose is the perfect match between fast real time machine control and data plant management.

✓A wide range of products for complete production line

Our industry-leading lineup: Input (photoelectric/proximity/vision sensors, switches), Logic (PLCs, controllers), Output (servo systems, inverters, relays), and Safety.



sysmac
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Product family

MACHINE CONTROLLER

Product name		**NJ-series NC Integrated Controller**
Model		**NJ501-5300**
Hardware		Modular controller
Task		Multi-tasking program
Control functionality		• Logic sequence • Motion • NC
Number of axes	Number of motion axess	16 *1
	Number of CNC axes	16 *1
	Synchronous axes per channel	4
	Number of channels	4
Fastest cycle time		500 µs
Software tool	Integrated Development Environment	Sysmac Studio: • Ladder, Structured Text, In-Line ST • IEC61131-3 • PLCopen for Motion Control and Safety • G/M Code
	Graphic user interface	CNC operator: • G/M Code
Interpolation functions	Compensation	Tool Radius/Length, Cross, LeadScrew
	Interpolation	Linear, Circular, Helical, Conical, Spiral
	Coordinate system	MCS, WCS, LCS, Mirror, Scaling, Rotation, Plane Selection…
	Others	FeedRate Control, Accel/Decel Control,Lookahead, Machine Lock, Dry Run, Back Trace…
Program capacity		20 MB
NC program buffer		20 MB
Memory card		SD and SDHC
Built-in port		EtherNet/IP, EtherCAT, USB
EtherCAT slaves		192
Mounting		DIN rail
Global standards		EU Directives, cULus, RCM and KC Registration

*1. With a combination of a CPU Unit with CNC version 1.03 or higher and Sysmac Studio version 1.60 or higher, up to 32 axes can be controlled. For a CPU Unit with CNC version 1.02 or lower, the maximum number of motion axes and CNC axes total is 16 axes.

SOFTWARE

INTEGRATED DEVELOPMENT ENVIRONMENT

OPERATION SOFTWARE

Product name	Automation Software	CNC Operator License*	CNC Operator Software Development Kit
Model	Sysmac Studio	SYSMAC-RTNC0001L	SYSMAC-RTNC0101D
Functions	• Sysmac Studio is the Integrated Development Environment to configure, program and maintain all Sysmac Controllers and devices. • One single project file for the entire machine. • Intuitive IDE for logic, motion, safety, robotics, drives, vision, HMI and networks NC. • Reduce engineering and maintenance costs by using Omron libraries and IAGs. Develop your own libraries. • IEC-61131-3 compliant. • PLCopen FBs for motion and safety. • G/M Code available • Advanced functions for CAM editing, Drive tuning, 3D simulation, libraries and namespaces, vision algorithms, HMI design and complete machine maintenance. • Full Digital Machine development enviromnent including: EtherNet/IP, EtherCAT, IO-Link, SQL and FTP. • Offline Simulation for logic, motion, robotics, safety and vision. • Advanced security function with 32 digit security password.	• G-Code File Editor • Execution monitor Active G/M code display • Command terminal • Jogging, homing	• The CNC Operator Software Development Kit provides a • environment for customization of CNC Operator.

*One CNC Operator License (SYSMAC-RTNC0001L) is bundled with a CPU Unit. Purchase additional licenses if required.

G-CODE

Code	Function
G00	Rapid Positioning
G01	Liner Interpolation
G02	Circular Interpolation in CW direction
G03	Circular Interpolation in CCW direction
G04	Dwell
G09	Exact Stop
G17	X-Y Plane Selection
G18	Z-X Plane Selection
G19	Y-Z Plane Selection
G20	Inch Input
G21	Metric Input
G28	Return to Reference Point
G30	Return to 2nd, 3rd or 4th Reference Point
G31	Skip Function
G40	Cancels Tool Compensation

Code	Function
G41	Tool Compensation, Left
G42	Tool Compensation, Right
G43	Tool Offset, Positive
G44	Tool Offset, Negative
G49	Cancels Tool Offset
G50	Cancel Scaling
G51	Scaling
G50.1	Cancel Mirroring
G51.1	Mirroring
G52	Local Coordinate System Set
G53	Dimension Shift Cancel
G54	1st work coordinate system
G55	2nd work coordinate system
G56	3rd work coordinate system
G57	4th work coordinate system

Code	Function
G58	5th work coordinate system
G59	6th work coordinate system
G61	Exact Stop Mode
G64	Continuous-path Mode
G68	Enables rotation
G69	Disables rotation
G74	Left-handed Tapping Cycle
G80	Fixed Cycle Cancel
G84	Tapping Cycle
G90	Absolute command
G91	Incremental command
G98	Fixed Cycle Return to Initial Level
G99	Fixed Cycle Return to R Point Level
G500	Enables Multi-block Acceleration/Deceleration Rate
G501	Disables Multi-block Acceleration/Deceleration Rate

SERVOMOTORS/LINEAR MOTORS/DRIVES

Product name	G5 Servo Drives	1S Servo Drives	1S-series with SS1/SLS Safety Sub-Function
Type	Built-in EtherCAT Communications	Built-in EtherCAT Communications	
100 VAC Applicable motor capacity/force	50 to 400 W	100 to 400W	
200 VAC Applicable motor capacity/force	50 W to 15 kW	100 to 3kW	
400 VAC Applicable motor capacity/force	400 W to 15 kW	600 to 3kW	
Applicable servomotor	G5 rotary servomotor, G5 linear motor	1S servomotor	
Control mode	Position, speed and torque control	Position, speed and torque control	
Safety approvals	• ISO13849-1 (PL-c,d) • EN61508 (SIL2) • EN62061 (SIL2) • IEC61800-5-2 (STO)	• ISO13849-1 (PL-e/PL-d) • EN61508 (SIL3/SIL2) • EN62061 (SIL3/SIL2) • IEC61800-5-2 (STO)	• ISO13849-1 (PL-e/PL-d) • EN61508 (SIL3/SIL2) • EN62061 (SIL3/SIL2) • IEC61800-5-2 (STO/SS1/SLS)
Full closed loop	Built-in	No	
Ordering information	G5 Series Catalog (Cat. No.I815)	1S Series Catalog (Cat. No.I821)	1S-series with SS1/SLS Safety Sub-Functions Pamphlet (I927) and Data Sheet (I928)

Product name	G5 Servomotors		1S Servomotors	
Rated rotation speed	3,000 r/min	2,000 r/min	3,000 r/min	2,000 r/min
Momentary maximum rotation speed	4,500 to 6,000 r/min	3,000 r/min	5000 to 6000 r/min	3000 r/min
Rated torque	0.16 to 15.9 Nm	1.91 to 23.9 Nm	0.318 to 9.55N·m	4.77 to 14.3 N·m
Capacity	50 W to 5 kW	400 W to 5 kW	100W to 3 kW	400W to 3kW
Applicable servo drive	G5 Servo Drive (for rotary servomotor)		1S Servo Drive	
Encoder resolution	20-bit incremental/17-bit absolute	20-bit incremental/17-bit absolute	23-bit absolute	23-bit absolute
Protective structure	IP67	IP67	IP67	IP67
Ordering information	G5 Series Catalog (Cat. No.I815)		1S Series Catalog (Cat. No.I821) or 1S-series with SS1/SLS Safety Sub-Functions Pamphlet (I927) and Data Sheet (I928)	

Product name	G5 Servomotors		1S Servomotors
Rated rotation speed	1,500 r/min	1,000 r/min	1,000 r/min
Momentary maximum rotation speed	2,000 to 3,000 r/min	2,000 r/min	2000 r/min
Rated torque	47.8 to 95.5 Nm	8.59 to 57.3 Nm	8.59 to 28.7 N·m
Capacity	7.5 to 15 kW	900 W to 6 kW	900 W to 3kW
Applicable servo drive	G5 Servo Drive (for rotary servomotor)		1S Servo Drive
Encoder resolution	17-bit absolute	20-bit incremental/17-bit absolute	23-bit absolute
Protective structure	IP67	IP67	IP67
Ordering information	G5 Series Catalog (Cat. No.I815)		1S Series Catalog (Cat. No.I821) or 1S-series with SS1/SLS Safety Sub-Functions Pamphlet (I927) and Data Sheet (I928)

I/O

					
Series	**NX**			**GX**	
Type	Modular I/O			Block I/O	
Communications interface	EtherCAT			EtherCAT	
Number of connectable units	• 63 units max. • Input: 1,024 bytes max., output: 1,024 bytes max.			One expansion unit can be connected with one digital I/O terminal (16 inputs + 16 outputs)	
I/O types	• Digital I/O • Pulse output	• Analog I/O • Temperature input	• Encoder input • Safety	• Digital I/O • Encoder input	• Analog I/O • Expansion unit
Features	• Over 100 models of I/O units including position interface, temperature inputs and integrated safety • High-speed I/O units synchronized with the EtherCAT cycle • NsynX technology provides deterministic I/O response with nanosecond resolution • Detachable front connector with push-in type screw-less terminals in all NX I/O units • Up to 32 digital inputs or outputs			• Wide variety of lineup: digital I/O, analog I/O, and encoder input units • Easy maintenance: removable I/O terminal • Easy set-up: automatic and manual address setting	
Mounting	DIN track			DIN track	
Ordering information	NX-series I/O System Catalog (Cat. No.R183)			GX Series Data Sheet	

SAFETY

			
Product name	**NX Safety CPU Unit**	**NX Safety Input Unit**	**NX Safety Output Unit**
Network	FSoE – Safety over EtherCAT	FSoE – Safety over EtherCAT	FSoE – Safety over EtherCAT
Applicable Standards	EN ISO 13849-1, 2 (PLe/Safety Category 4), IEC 61508 (SIL3), EN 62061 (SIL CL3), EN 61131-2	EN ISO 13849-1, 2 (PLe/Safety Category 4), IEC 61508 (SIL3), EN 62061 (SIL CL3), EN 61131-2	EN ISO 13849-1, 2 (PLe/Safety Category 4), IEC 61508 (SIL3), EN 62061 (SIL CL3), EN 61131-2
Programming	• IEC 61131-3 standard • PLCopen Function Blocks for Safety	---	---
Number of safety master connections	32/128	---	---
Number of safety input/output points	---	• 4 points • 8 points	• 2 points • 4 points
Number of test output points	---	2 points	---
Terminal block	---	Screwless clamping terminal block	Screwless clamping terminal block
Features	• Freely mixing with standard NX I/O • Reusable certified programs • NX variables sharing in the NJ controller project	• Freely mixing with standard NX I/O • The 4-point unit can be directly connected with OMRON non-contact switches and singlebeam sensors • I/O data monitoring in the NJ controller project	• Freely mixing with standard NX I/O • The 2-point unit is characterized by large output breaking current of 2.0 A • I/O data monitoring in the NJ controller project
Mounting	DIN track	DIN track	DIN track
Ordering information	NX-SL/SI/SO Data Sheet		

Note: Do not use this document to operate the Unit.

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