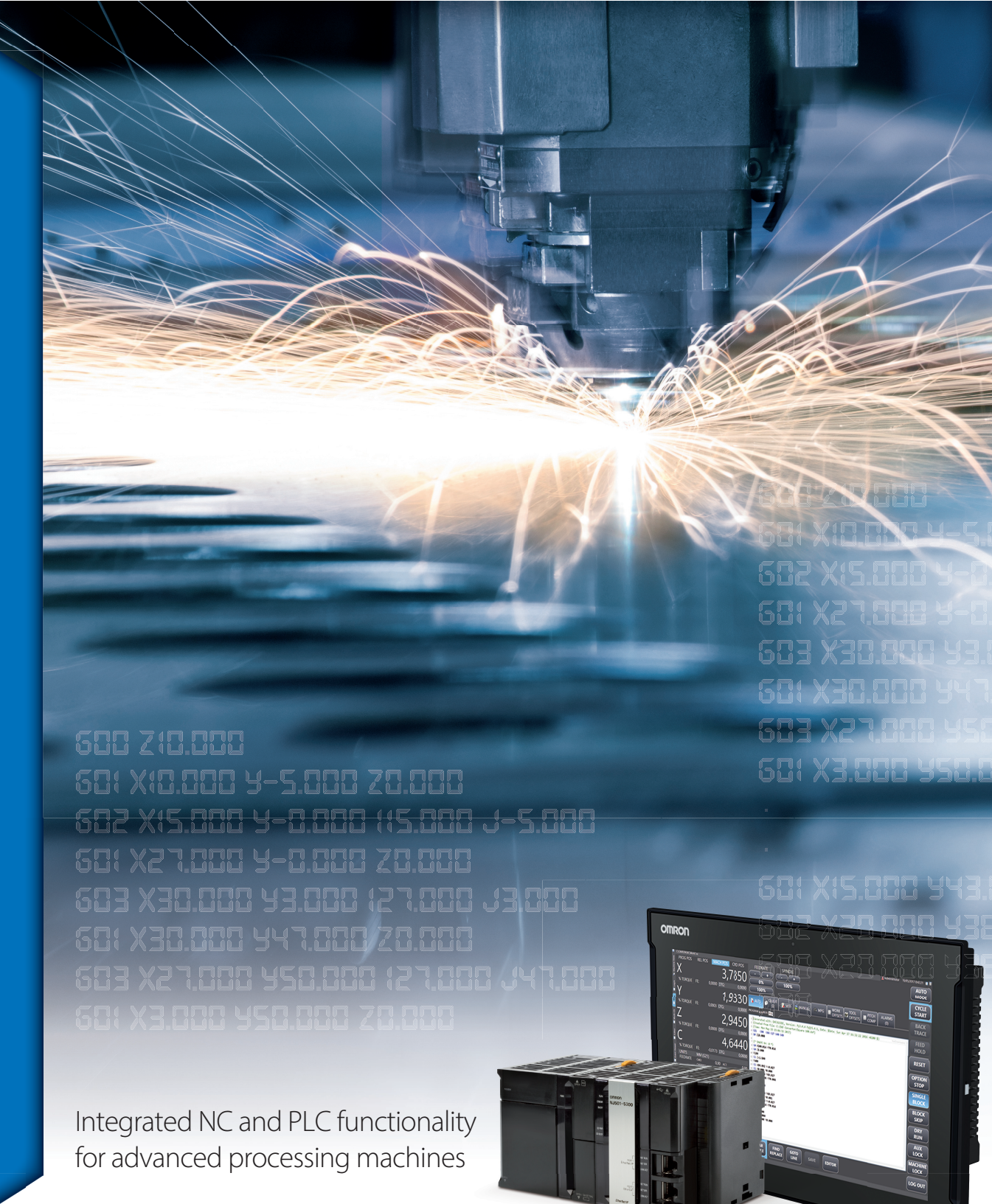


# NC Integrated Controller

Machine Automation Controller NJ Series



600 Z10.000  
601 X10.000 Y-5.000 Z0.000  
602 X15.000 Y-0.000 (15.000 J-5.000  
601 X27.000 Y-0.000 Z0.000  
603 X30.000 Y3.000 (27.000 J3.000  
601 X30.000 Y47.000 Z0.000  
603 X27.000 Y50.000 (27.000 J47.000  
601 X3.000 Y50.000 Z0.000

Integrated NC and PLC functionality  
for advanced processing machines

# 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

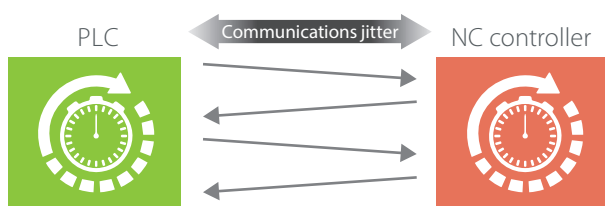
# NC and PLC functionality fully synchronized at high speed

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 synchronizes all devices at high speed, significantly reducing the machine cycle time.

### Improved synchronization

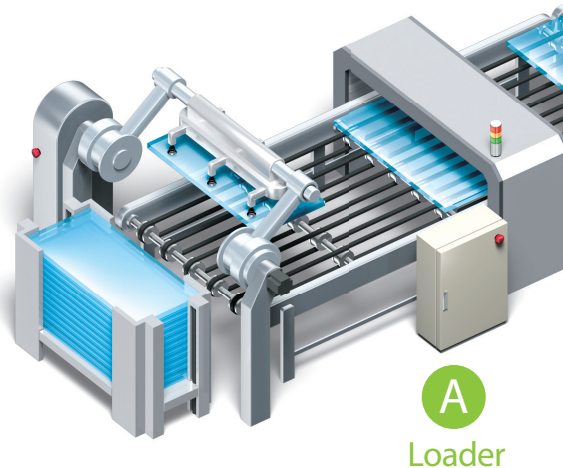
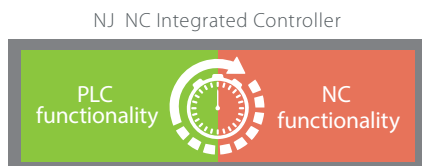
#### Conventional system PLC+NC

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

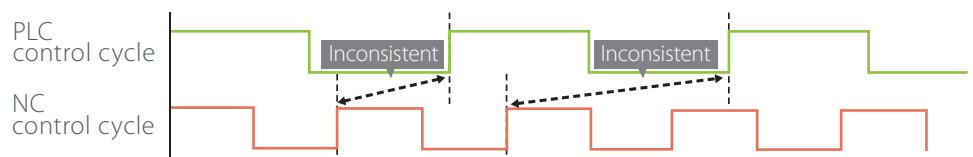


### Control cycle as you designed

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

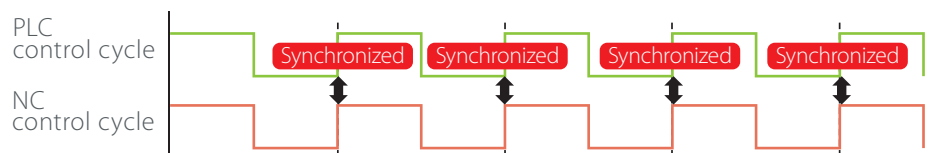
#### Conventional system

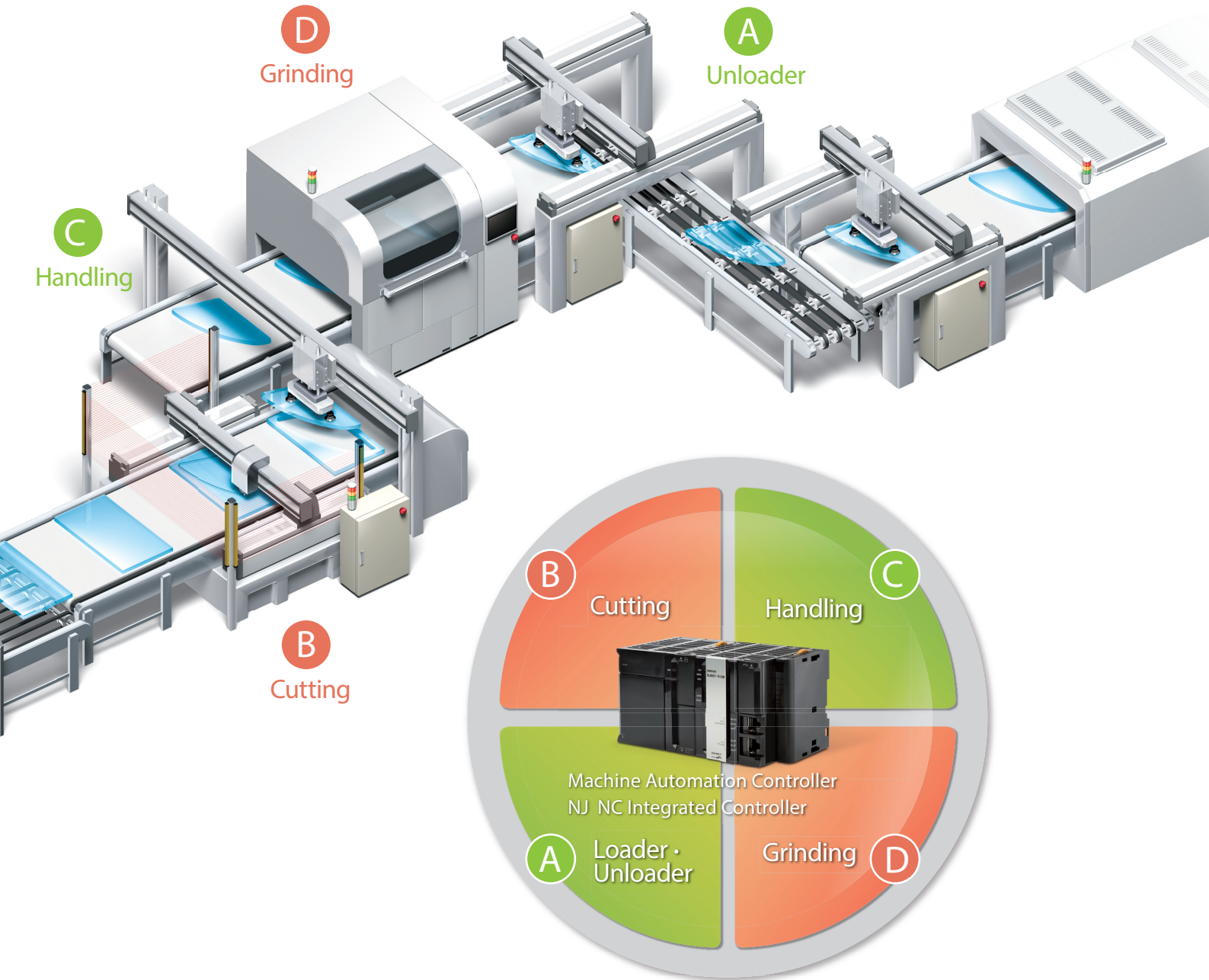
Two control cycles are inconsistent (Communications jitter must be taken into consideration)



#### NC Integrated Controller

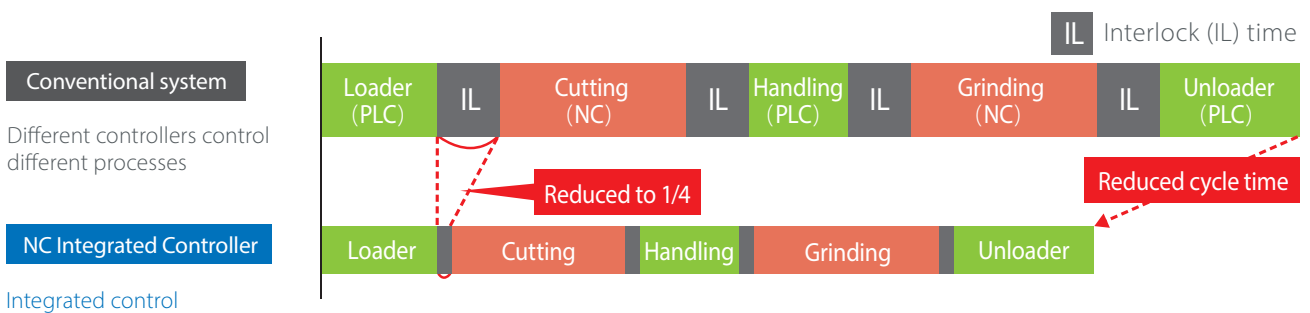
Two control cycles are fully synchronized





### 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.



Integrated control

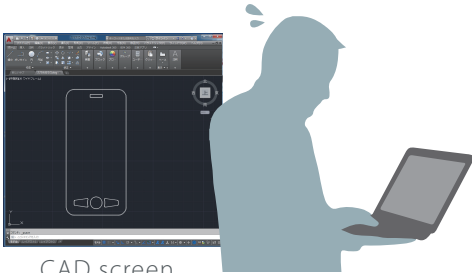
Simplify complex profiling

# 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

```
G00 Z10.000
G01 X10.000 Y-5.000 Z0.000
G02 X15.000 Y-0.000 I15.000 J-5.000
G01 X27.000 Y-0.000 Z0.000
G03 X30.000 Y3.000 I27.000 J3.000
G01 X30.000 Y47.000 Z0.000
G03 X27.000 Y50.000 I27.000 J47.000
G01 X3.000 Y50.000 Z0.000
.
.
G01 X15.000 Y43.000 Z0.000
G02 X20.000 Y38.000 I15.000 J38.000
G00 X20.000 Y38.000 Z10.000
M30
```

NC program in G-Code (example)



### Parameter setting

① Parameters are set using CAD/CAM software

### Automatic generation

② NC program in G-Code is generated

### Transferred

③ Program is transferred to NC integrated controller



Cutting

## NC functions for complex profiling applications



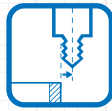
### G-Code

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



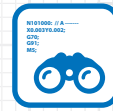
### High-speed control

Logic sequence, motion control and NC functionality with the fastest cycle time of 500  $\mu$ s



### 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



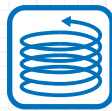
### Block Retrace

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



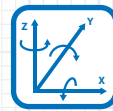
### Compensation

High-precision processing by compensating position of NC motors



### 3D interpolation

Helical, spiral and conical interpolation for 3D profiling



### Coordinate systems

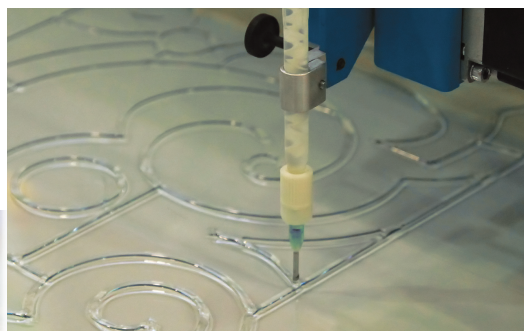
Various profiling using machine coordinate system, workpiece coordinate system, and local coordinate system



Milling



Grinding



Dispensing

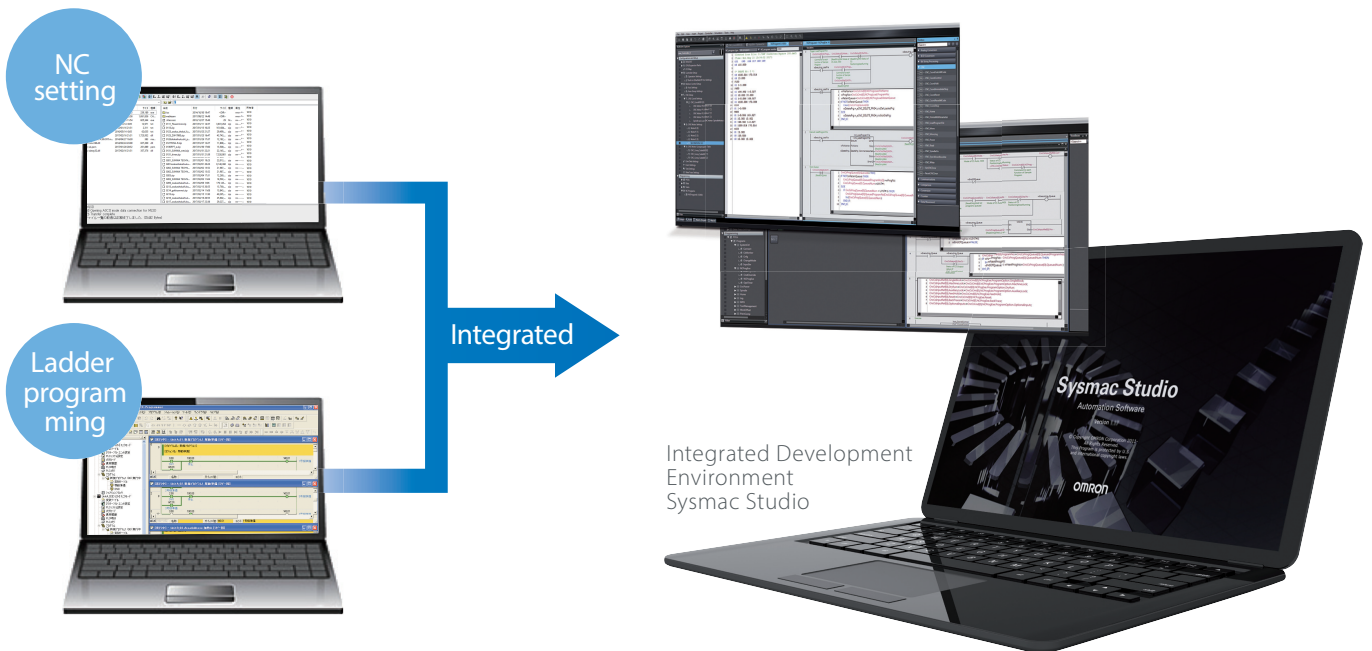


Sewing

Optimize engineering time

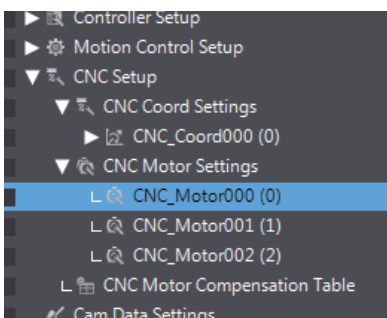
# One software for NC setting and PLC programming

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.

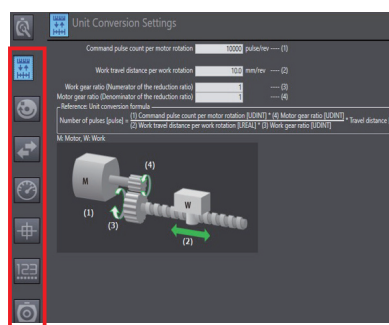


Intuitive user interface reduces configuration time

Easy to find NC settings

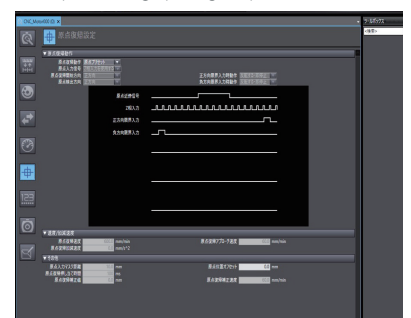


Parameter setting by device



Description of parameters

Description with graphics gives parameter details





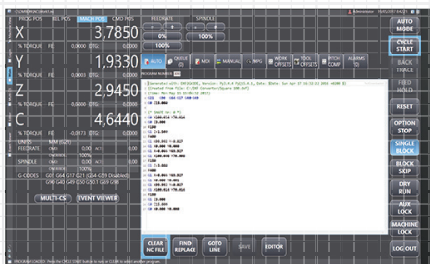
## A modular controller suitable for machines programmed for NC

- 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

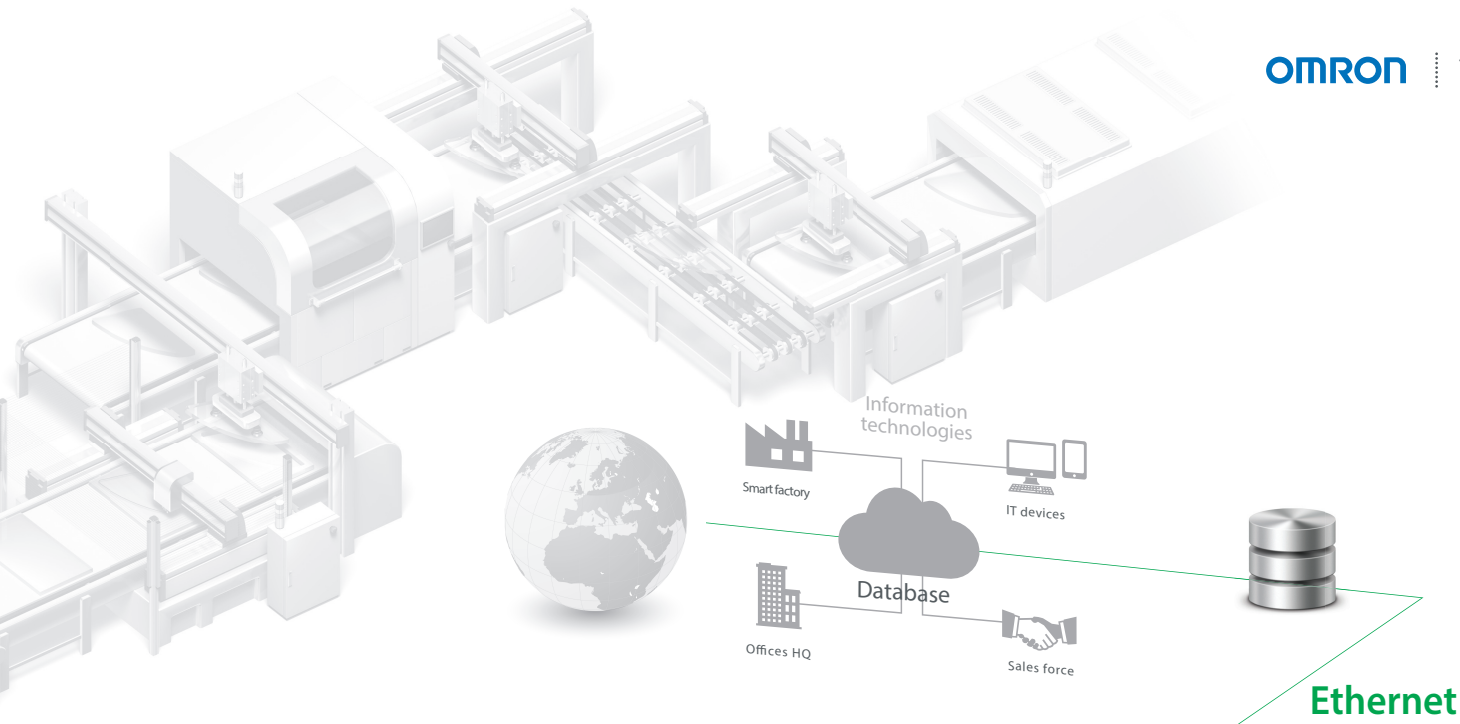
Logic sequence, motion, safety, I/O, vision, and NC in one. One integrated controller offers speed, flexibility and scalability of software centric architecture without compromising on the traditional reliability and robustness that you have come to expect from Omron PLCs.

### ✓ 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.



Safety  
NX Safety

EtherCAT

Motion

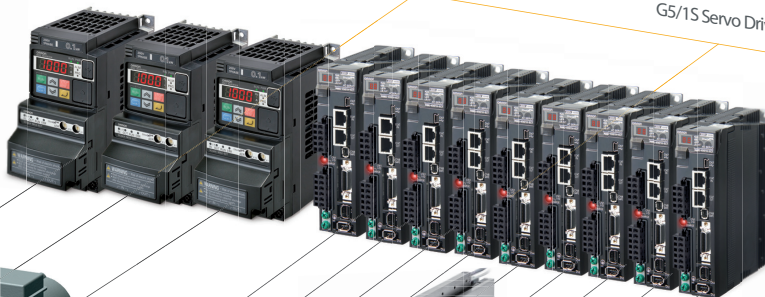
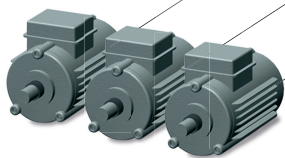
NC



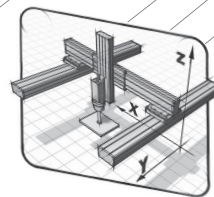
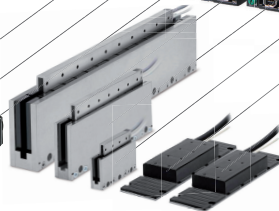
MX2 Inverter

G5/1S Servo Drive

G5/1S Servo Drive



Linear motors



# Product family

## MACHINE CONTROLLER



Product name		NJ-series NC Integrated Controller
Model		NJ501-5300
Hardware		Modular controller
Task		Multi-tasking program
Control functionality		<ul style="list-style-type: none"> <li>Logic sequence</li> <li>Motion</li> <li>NC</li> </ul>
Number of axes	Max. synchronous axis	16
	Synchronous axes per channel	4
	Number of channels	4
Fastest cycle time		500 $\mu$ s
Software tool	Integrated Development Environment	Sysmac Studio: <ul style="list-style-type: none"> <li>Ladder, Structured Text, In-Line ST</li> <li>IEC61131-3</li> <li>PLCopen for Motion Control and Safety</li> <li>G/M Code</li> </ul>
	Graphic user interface	CNC operator: <ul style="list-style-type: none"> <li>G/M Code</li> </ul>
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

SOFTWARE

INTEGRATED DEVELOPMENT ENVIRONMENT

OPERATION SOFTWARE



Product name	Sysmac Studio	CNC Operator License*	CNC Operator Software Development Kit
Model	SYSMAC-SE2□□□	SYSMAC-RTNC0001L	SYSMAC-RTNC0101D
Functions	<ul style="list-style-type: none"> <li>• Sysmac Studio is the Integrated Development Environment to configure, program and maintain all Sysmac Controllers and devices.</li> <li>• One single project file for the entire machine.</li> <li>• Intuitive IDE for logic, motion, safety, robotics, drives, vision, HMI and networks NC.</li> <li>• Reduce engineering and maintenance costs by using Omron libraries and IAGs. Develop your own libraries.</li> <li>• IEC-61131-3 compliant.</li> <li>• PLCopen FBs for motion and safety.</li> <li>• G/M Code available</li> <li>• Advanced functions for CAM editing, Drive tuning, 3D simulation, libraries and namespaces, vision algorithms, HMI design and complete machine maintenance.</li> <li>• Full Digital Machine development environment including: EtherNet/IP, EtherCAT, IO-Link, SQL and FTP.</li> <li>• Offline Simulation for logic, motion, robotics, safety and vision.</li> <li>• Advanced security function with 32 digit security password.</li> </ul>	<ul style="list-style-type: none"> <li>• G-Code File Editor</li> <li>• Execution monitor Active G/M code display</li> <li>• Command terminal</li> <li>• Jogging, homing</li> </ul>	<ul style="list-style-type: none"> <li>• The CNC Operator Software Development Kit provides a environment for customization of CNC Operator.</li> </ul>

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

G-CODE

Code	Function	Code	Function	Code	Function
G00	Rapid Positioning	G41	Tool Compensation, Left	G58	5th work coordinate system
G01	Liner Interpolation	G42	Tool Compensation, Right	G59	6th work coordinate system
G02	Circular Interpolation in CW direction	G43	Tool Offset, Positive	G61	Exact Stop Mode
G03	Circular Interpolation in CCW direction	G44	Tool Offset, Negative	G64	Continuous-path Mode
G04	Dwell	G49	Cancel Tool Offset	G68	Enables rotation
G09	Exact Stop	G50	Cancel Scaling	G69	Disables rotation
G17	X-Y Plane Selection	G51	Scaling	G74	Left-handed Tapping Cycle
G18	Z-X Plane Selection	G50.1	Cancel Mirroring	G80	Fixed Cycle Cancel
G19	Y-Z Plane Selection	G51.1	Mirroring	G84	Tapping Cycle
G20	Inch Input	G52	Local Coordinate System Set	G90	Absolute command
G21	Metric Input	G53	Dimension Shift Cancel	G91	Incremental command
G28	Return to Reference Point	G54	1st work coordinate system	G98	Fixed Cycle Return to Initial Level
G30	Return to 2nd, 3rd or 4th Reference Point	G55	2nd work coordinate system	G99	Fixed Cycle Return to R Point Level
G31	Skip Function	G56	3rd work coordinate system	G500	Enables Multi-block Acceleration/Deceleration Rate
G40	Cancel Tool Compensation	G57	4th work coordinate system	G501	Disables Multi-block Acceleration/Deceleration Rate

SERVOMOTORS/LINEAR MOTORS/DRIVES



Product name	G5 Servo Drives	1S Servo Drives
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	<ul style="list-style-type: none"> <li>• ISO13849-1 (PL-c,d)</li> <li>• EN61508 (SIL2)</li> <li>• EN62061 (SIL2)</li> <li>• IEC61800-5-2 (STO)</li> </ul>	<ul style="list-style-type: none"> <li>• ISO13849-1 (PL-e/PL-d)</li> <li>• EN61508 (SIL3/SIL2)</li> <li>• EN62061 (SIL3/SIL2)</li> <li>• IEC61800-5-2 (STO)</li> </ul>
Full closed loop	Built-in	No
Ordering information	G5 Series Catalog (Cat. No.I815)	1S Series Catalog (Cat. No.I821)





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	50W to 5 kW	400W 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)	






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)

## I/O

		
Series	NX	GX
Type	Modular I/O	Block I/O
Communications interface	EtherCAT	EtherCAT
Number of connectable units	<ul style="list-style-type: none"> <li>• 63 units max.</li> <li>• Input: 1,024 bytes max., output: 1,024 bytes max.</li> </ul>	One expansion unit can be connected with one digital I/O terminal (16 inputs + 16 outputs)
I/O types	<ul style="list-style-type: none"> <li style="width: 33%;">• Digital I/O</li> <li style="width: 33%;">• Analog I/O</li> <li style="width: 33%;">• Encoder input</li> <li style="width: 33%;">• Pulse output</li> <li style="width: 33%;">• Temperature input</li> <li style="width: 33%;">• Safety</li> </ul>	<ul style="list-style-type: none"> <li style="width: 50%;">• Digital I/O</li> <li style="width: 50%;">• Analog I/O</li> <li style="width: 50%;">• Encoder input</li> <li style="width: 50%;">• Expansion unit</li> </ul>
Features	<ul style="list-style-type: none"> <li>• Over 100 models of I/O units including position interface, temperature inputs and integrated safety</li> <li>• High-speed I/O units synchronized with the EtherCAT cycle</li> <li>• NsynX technology provides deterministic I/O response with nanosecond resolution</li> <li>• Detachable front connector with push-in type screw-less terminals in all NX I/O units</li> <li>• Up to 32 digital inputs or outputs</li> </ul>	<ul style="list-style-type: none"> <li>• Wide variety of lineup: digital I/O, analog I/O, and encoder input units</li> <li>• Easy maintenance: removable I/O terminal</li> <li>• Easy set-up: automatic and manual address setting</li> </ul>
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	<ul style="list-style-type: none"> <li>• IEC 61131-3 standard</li> <li>• PLCopen Function Blocks for Safety</li> </ul>	---	---
Number of safety master connections	32/128	---	---
Number of safety input/output points	---	<ul style="list-style-type: none"> <li>• 4 points</li> <li>• 8 points</li> </ul>	<ul style="list-style-type: none"> <li>• 2 points</li> <li>• 4 points</li> </ul>
Number of test output points	---	2 points	---
Terminal block	---	Screwless damping terminal block	Screwless damping terminal block
Features	<ul style="list-style-type: none"> <li>• Freely mixing with standard NX I/O</li> <li>• Reusable certified programs</li> <li>• NX variables sharing in the NJ controller project</li> </ul>	<ul style="list-style-type: none"> <li>• Freely mixing with standard NX I/O</li> <li>• The 4-point unit can be directly connected with OMRON non-contact switches and singlebeam sensors</li> <li>• I/O data monitoring in the NJ controller project</li> </ul>	<ul style="list-style-type: none"> <li>• Freely mixing with standard NX I/O</li> <li>• The 2-point unit is characterized by large output breaking current of 2.0 A</li> <li>• I/O data monitoring in the NJ controller project</li> </ul>
Mounting	DIN track	DIN track	DIN track
Ordering information	NX-SL/SI/SO Data Sheet		

Sysmac is a trademark or registered trademark of OMRON Corporation in Japan and other countries for OMRON factory automation products. Microsoft, Visual Basic, and Windows are either registered trademark of Microsoft Corporation in the United States and other countries. Microsoft product screen shot(s) reprinted with permission from Microsoft Corporation. EtherCAT® is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany. Intel, and Intel Core are trademarks of Intel Corporation in the U.S. and other countries. EtherNet/IP™, DeviceNet™ are trademarks of the ODVA. Intel and Intel Core are trademarks or registered trademarks of Intel Corporation or its subsidiaries in the United States and other countries. Other company names and product names in this document are the trademarks or registered trademarks of their respective companies. The product photographs and figures that are used in this document may vary somewhat from the actual products.

**OMRON Corporation Industrial Automation Company**  
Kyoto, JAPAN

Contact: [www.ia.omron.com](http://www.ia.omron.com)

**Regional Headquarters**

**OMRON EUROPE B.V.**

Wegalaan 67-69, 2132 JD Hoofddorp  
The Netherlands  
Tel: (31)2356-81-300/Fax: (31)2356-81-388

**OMRON ELECTRONICS LLC**

2895 Greenspoint Parkway, Suite 200  
Hoffman Estates, IL 60169 U.S.A.  
Tel: (1) 847-843-7900/Fax: (1) 847-843-7787

**OMRON ASIA PACIFIC PTE. LTD.**

No. 438A Alexandra Road # 05-05/08 (Lobby 2),  
Alexandra Technopark,  
Singapore 119967  
Tel: (65) 6835-3011/Fax: (65) 6835-2711

**OMRON (CHINA) CO., LTD.**

Room 2211, Bank of China Tower,  
200 Yin Cheng Zhong Road,  
PuDong New Area, Shanghai, 200120, China  
Tel: (86) 21-5037-2222/Fax: (86) 21-5037-2200

**Authorized Distributor:**

© OMRON Corporation 2017-2022 All Rights Reserved.  
In the interest of product improvement,  
specifications are subject to change without notice.

**CSM\_1\_2**

**Cat. No. R190-E1-02**

0222(0917)