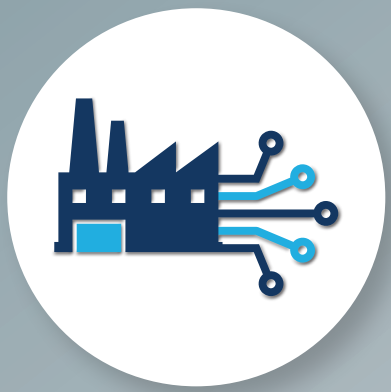
OMRON

NX-series Safety Controller

CIP Safety System

SAFETY, TECHNOLOGY & INNOVATION

Quick, easy and flexible integration of production line safety



Scalable from large automotive production lines to small parts production lines

- Flexible safety system for large-scale production
- Interlocking between various machines

Page 4

Quick and easy safety program design

- Reduce time required for design
- Reduce time required for verification

Page 8

Efficient safety management and maintenance

- Minimize system downtime
- Reduce maintenance work

Page 10

Manufacturers require flexible systems for global production and high-mix production.
System designs have become more and more complicated because these flexible systems need safety control according to control programs.
However, it is also required to reduce design and maintenance time to efficiently build various systems.
In order to meet these needs, we offer a new CIP Safety system using the NX Safety Network Controller.

Safety control for large systems

CIP Safety

Communication Control Unit
NX-CSG320

Safety CPU Unit
NX-SL5500/5700

High-speed safety control for mid-size systems

CIP Safety Safety over EtherCAT

Machine Automation Controller
NX-102

Safety CPU Unit
NX-SL5500/5700

Safety I/O Terminal
I/O model GI-SMD1624

Safety I/O Terminal
Input model GI-SID1224

Automation Software
Sysmac Studio
SYSMAC-SE/FE

EtherNet/IP

EtherNet/IP™ is a widely used and vendor-independent industrial Ethernet network that is managed by ODVA.

CIP Safety

The Common Industrial Protocol (CIP™) is an industry standard open network, enabling seamless communication among CIP networks. CIP Safety™ adds safety functionality to CIP networks.

EtherCAT

EtherCAT® is an industrial real-time communication network promoted by EtherCAT Technology Group (ETG).

Safety over EtherCAT

Safety over EtherCAT (FSoE) allows a single communication system to be used for both control and safety data.

Flexible safety system for large-scale production

EtherNet/IP for safety across the world

Production systems have to meet worldwide standards because of the globalization of production.
CIP Safety is a protocol for transmitting safety data via EtherNet/IP that is adopted by factory automation and robot manufacturers all over the world. Using CIP Safety, you can build globally standardized networks and simplify the global procurement of production systems.

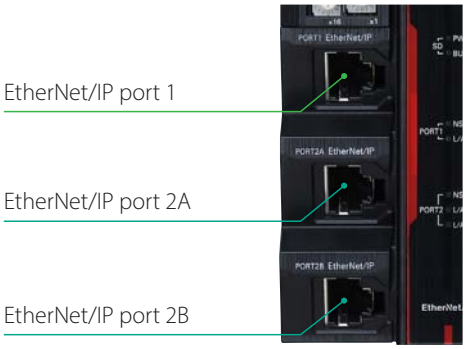
One connection using CIP Safety

Safety systems for industrial robots are becoming increasingly used; networks can be easily built with the NX-SL5 Safety CPU Units which support CIP Safety.

EtherNet/IP brings flexibility

The NX-CSG Communication Control Unit with multiple network ports enables a safety network to be divided into several segments, making it easy to connect many network devices required for a large production line. This allows flexibility to add or remove devices from existing safety systems.

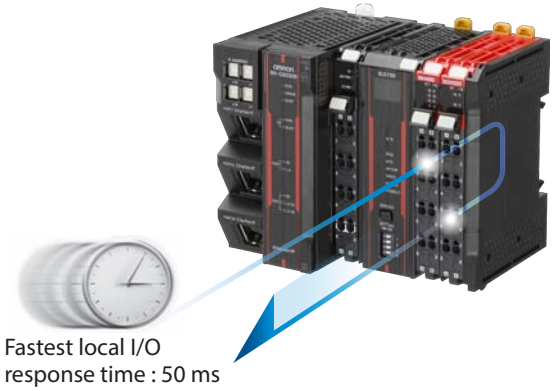
Safety control between lines : Port 1
Robot control within process : Port 2A, 2B



Fast and fixed response cycle facilitates reconfiguration

Using the NX-CSG Communication Control Unit in conjunction with the NX-SL5 Safety CPU Unit provides safety communications via CIP Safety and at the same time provides local high-speed safety I/O control. With the fastest local I/O response time of 50 ms, the NX-SL5 Safety CPU Unit can be used for applications where a high level of responsiveness is required.

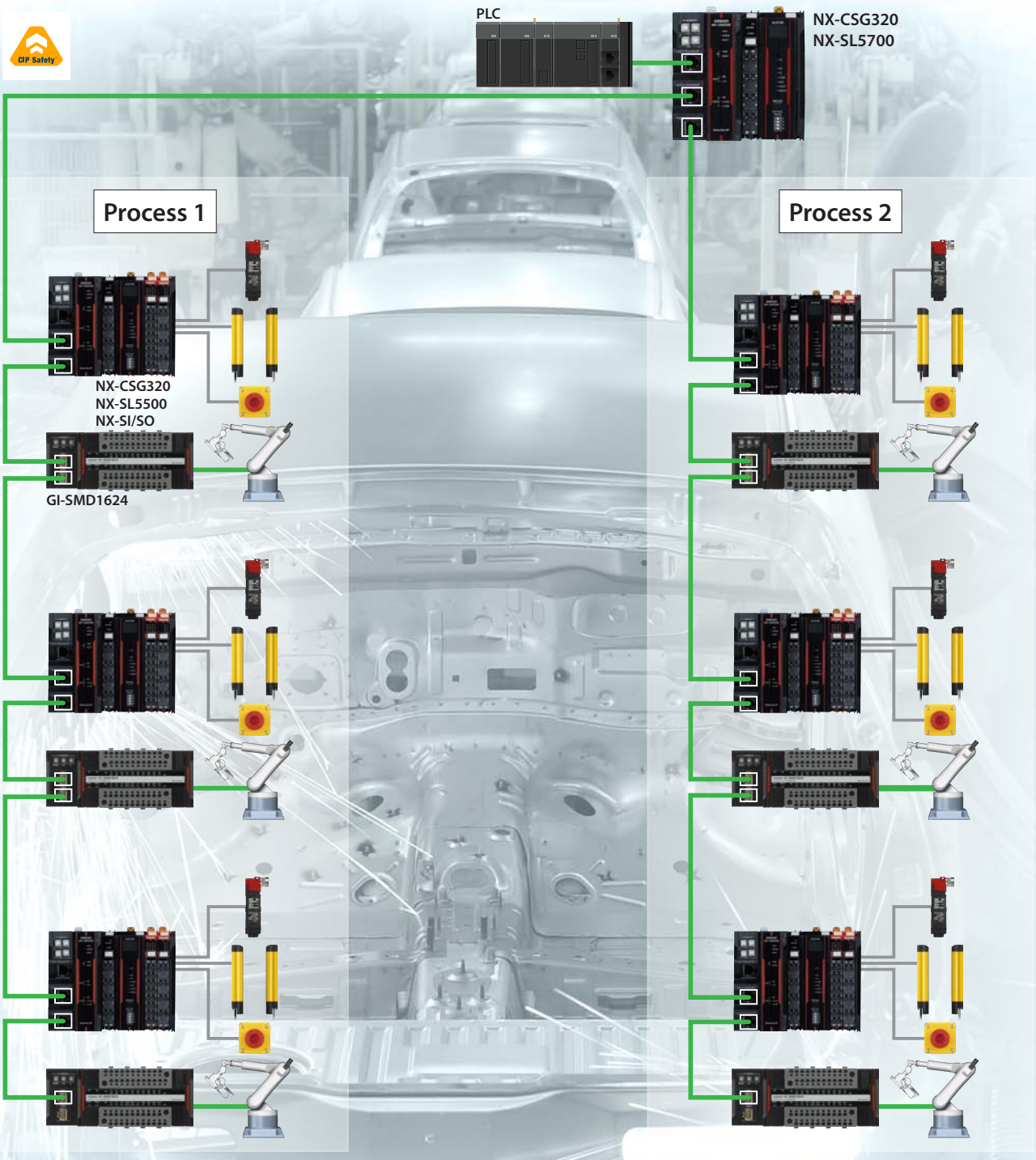
* Calculate the response speed of your system taking the performance of I/O devices into consideration. Refer to the manual for details.



Standardize the safety system network for a large robot system

System configuration

In this example, devices and machines communicate via EtherNet/IP and CIP Safety in this system.
Each process includes robots, safety light curtains, emergency stop switches, and other safety components. The NX-CSG Communication Control Unit and NX-SL5 Safety CPU Unit execute safety control programs in each process. CIP Safety is used for safety interlocking between processes and for building a safety control network across the system.



* Understand the connection specifications of devices which are used in the system before creating a network.

Interlocking between various machines

Simple configuration

CIP Safety allows safety devices and standard devices to be mixed on the same network, providing safety interlock control between machines. CIP Safety robots and remote I/O terminals can be easily connected.

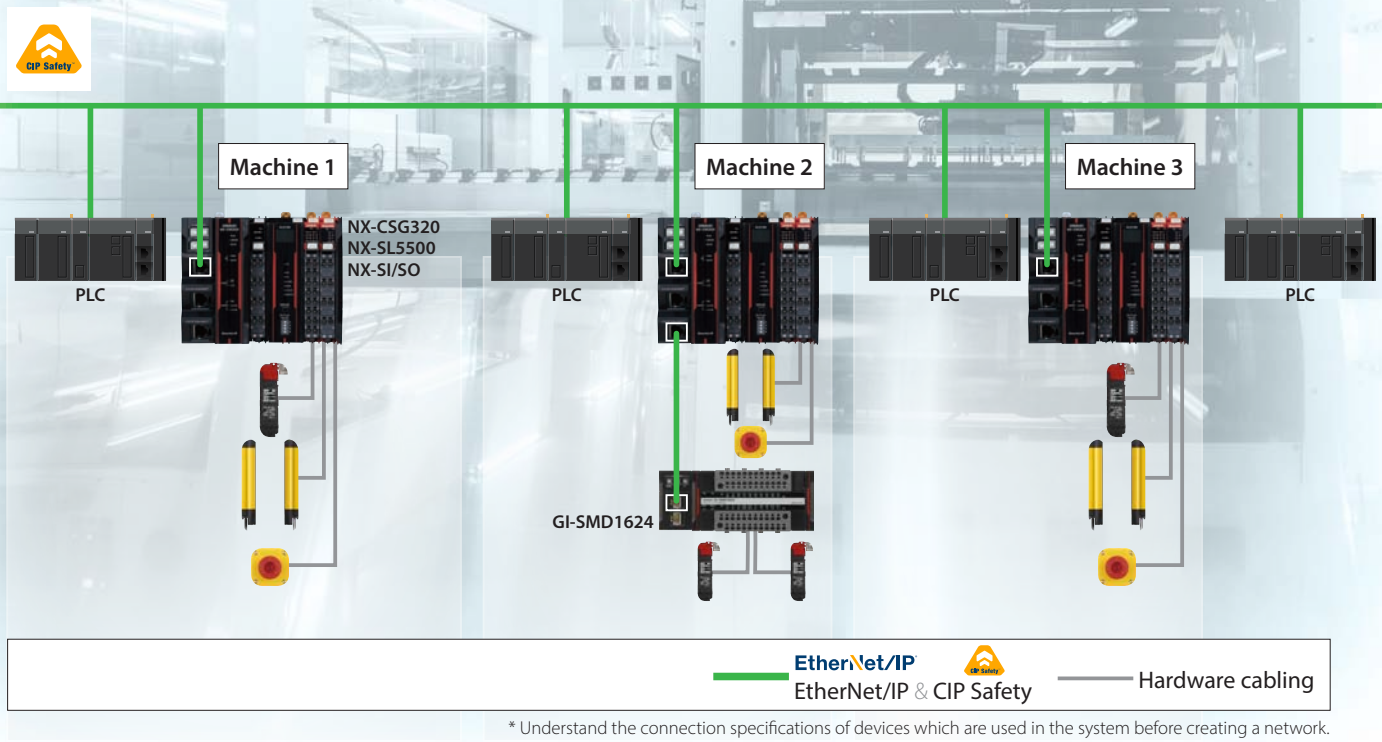
Modular processes bring flexibility to line layouts

The NX-CSG320 Communication Control Unit and NX-SL5 Safety CPU Unit exchange interlock signals with other machines while implementing safety control within the machine. Programs for machine control and safety control can be created for each machine. This modularized design helps standardize design and improve design efficiency.

Modular machines with individual CPU units

System configuration

Machine 1 and 3 are processing machines with the control program and safety control program for each machine. Machine 2 is a material handling machine that transports products processed by Machine 1 and 3 to the next process. The NX-CSG320 Communication Control Unit and NX-SL5 Safety CPU Unit are used for all machines, and CIP Safety is used for safety interlocking between machines.



* Understand the connection specifications of devices which are used in the system before creating a network.

Two different networks in a single system

The NX-SL5 Safety CPU Unit connected with the NX102 Machine Automation Controller enables the use of both EtherCAT + FSoE (Safety over EtherCAT) and EtherNet/IP + CIP Safety at the same time.
In addition to interlock control within a machine via FSoE, safety interlock between machines can be implemented using CIP Safety.

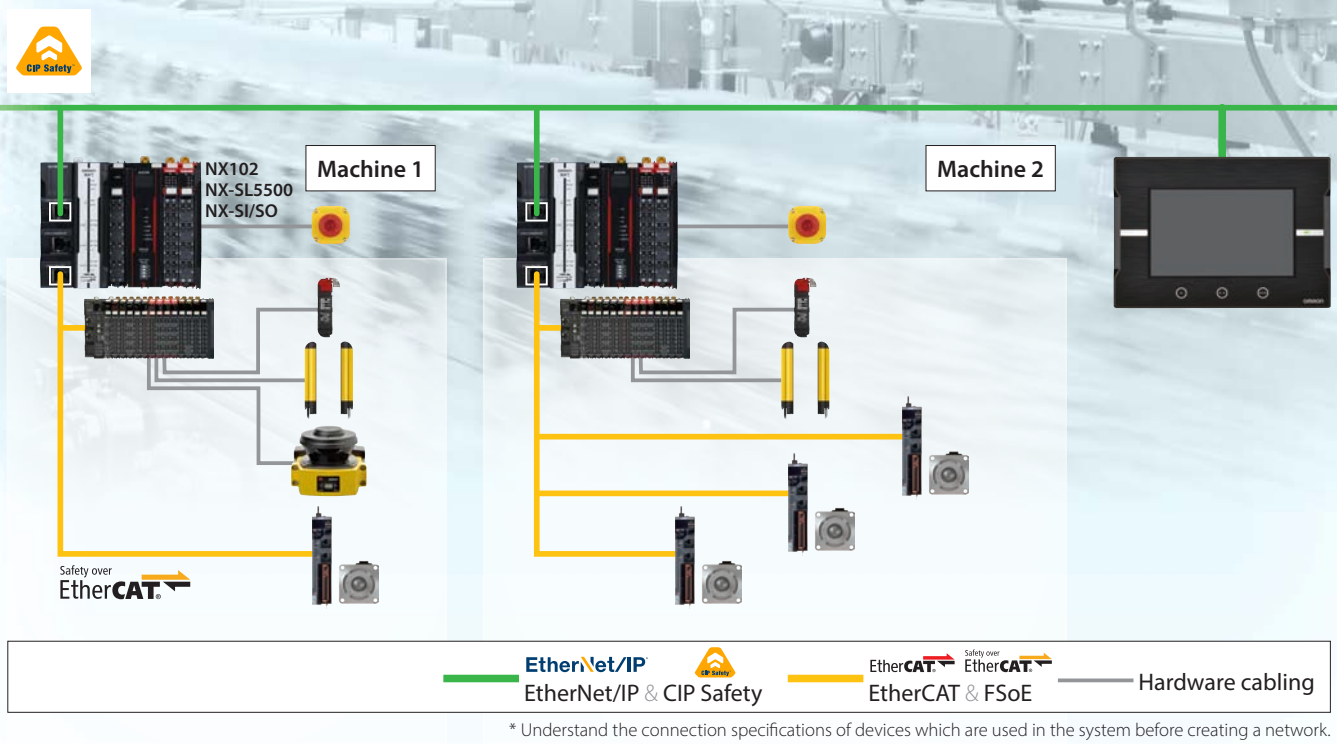
Integrated safety into high-speed machine control

The NX-SL5 Safety CPU Unit combination with the NX102 Machine Automation Controller , provides both safety control and machine control with fast cycle times.
By mounting the NX-SL Safety CPU Unit and safety I/O units to the NX102 and by connecting the servo drives via FSoE on EtherCAT, you can configure a simple motion and safety control system using high-speed networks.

Line safety control and fast machine control at the same time

System configuration

The NX102 Machine Automation Controller and NX-SL5 Safety CPU Unit are used in Machine 1 and 2 to build a system with safety network and real-time control capabilities using EtherCAT. The machine status is reported to the host system and displayed on the HMI connected on the same network.



* Understand the connection specifications of devices which are used in the system before creating a network.

Improve design productivity

The Automation Software Sysmac Studio provides various functionalities to reduce time required for production system design and safety program verification.

Design Reduce time required for production system design

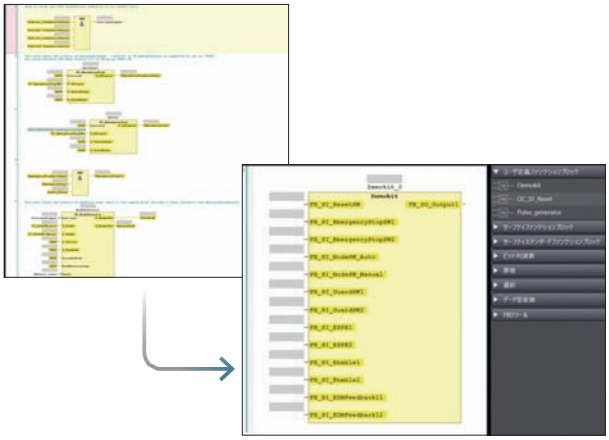
Automatic Programming

Create a truth table using input, output, and stop conditions of safety devices to automatically create a safety program for a simple machine.

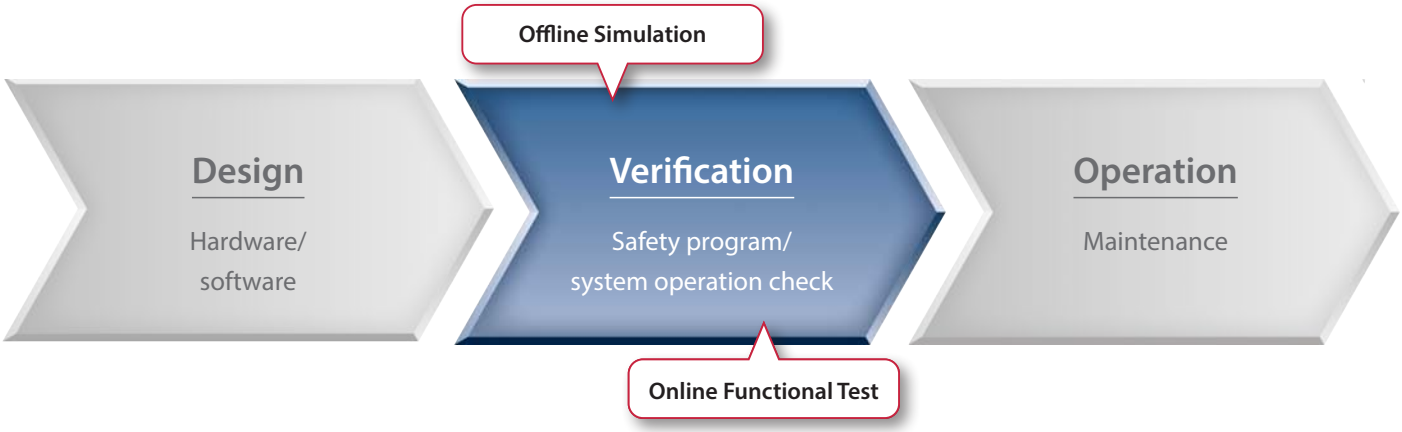
* Programs created by Automatic Programming will not guarantee functional safety. Refer to the User's Manual (Cat. No. Z395) for details.

User-defined Function Block (FB)

Programs can be easily converted into a user-defined function block (FB); help files can be attached to describe input and output conditions as well as the functionality of the program within the function block (FB). Different security levels can be set to protect the function block from viewing and unauthorized modifications.



* User-defined FBs can be used as modular software components according to the hardware configuration. They help standardize programs and maintain the consistency of design quality.



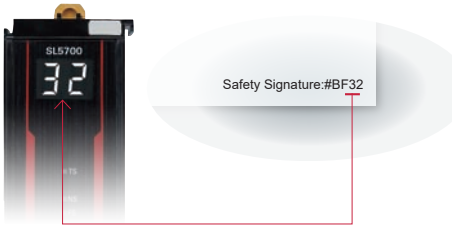
Verification Implement safety management without experts

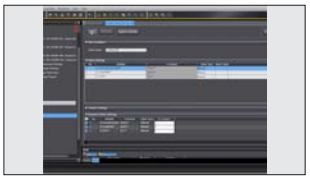
Offline Simulation

Programs can be simulated on your PC, Sysmac Studio allows verification of programs without connecting hardware.

Online Functional Test

Online Functional Test enables operation of safety functions to be checked when the NX-SL5 Safety CPU Unit is online with Sysmac Studio. The test results can be output as a report along with the safety signature; the safety signature is displayed on the seven-segment display of the NX-SL5 Safety CPU Unit, and can easily checked if the configuration matches the report after the program has been validated.





[Preparation]
Start the Sysmac Studio and go online with the NX-SL5. Register the safety devices to test and set the expected values of each signal.

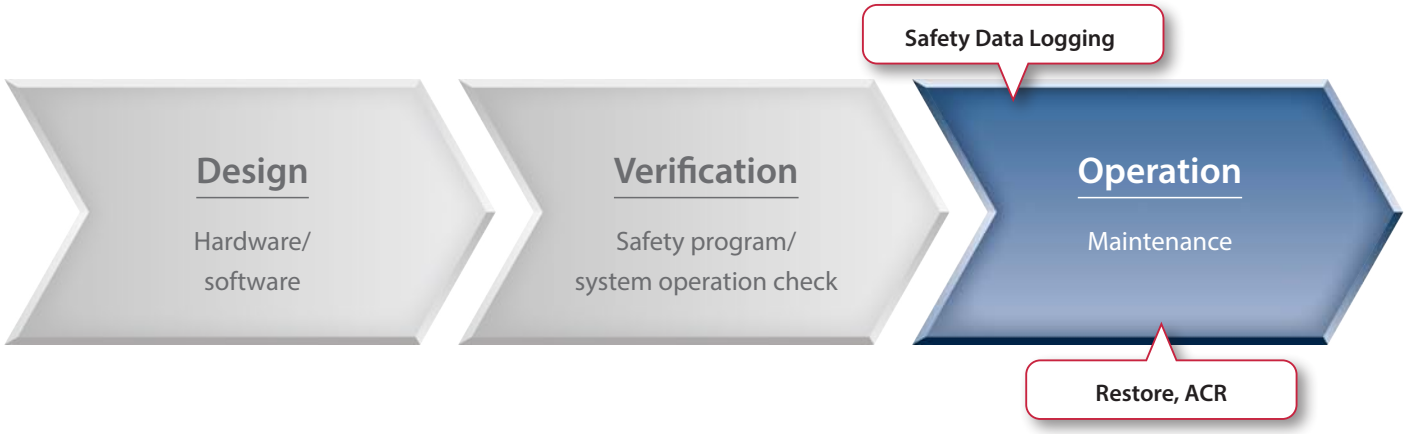
[Testing]
Operate safety devices by following the instructions on the screen. Check if each device operates correctly and input the check results.

[Tests completed]
The test results are listed after all tests have been completed. The list can be output as a CSV file.

[Printing test results]
The test details, results, and executed date and time can be output as a PDF file. The names of the tester and approver can be added. The safety signature code, which identifies the validated program, is included at the bottom right of the report.

Maintenance without PC

No PC is required for maintenance, which reduces production system maintenance work and minimizes system downtime.



Operation Minimize system downtime

Safety Data Logging

An SD memory card containing logging settings is used for Safety Data Logging.
When start trigger conditions are met, the specified device variables and exposed variables can be logged in a chronological order and output to the SD memory card. This function helps to quickly identify the cause of a sudden stoppage of the system and determine preventive measures.

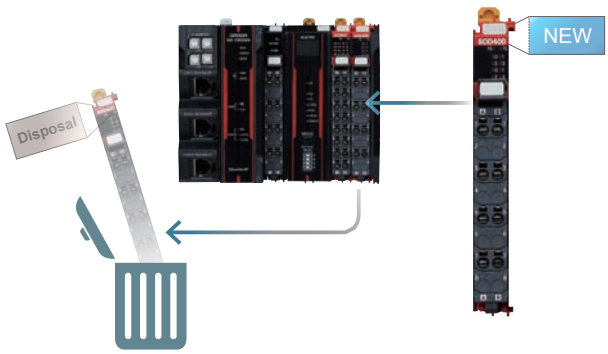
Operation Reduce maintenance work

Safety Unit Restore

Programs and settings can be stored on an SD memory card inserted into the communication control unit. When the safety CPU unit is replaced, the stored programs and settings can be easily copied to a new unit using the SD memory card.

ACR (Automatic Configuration Restart)

When replacing a safety I/O unit, just remove the old unit and mount a new one. The setting data is automatically downloaded. When replacing a safety I/O terminal, remove the memory cassette from the old terminal and install it into the new terminal to inherit the settings. No software is required. (See page 34)



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Ordering Information

Communication Control Unit

Unit type	Appearance	Supported communications protocol	Number of communications connectors	Network variables	Unit version	Model
Communication Control Unit		EtherNet/IP ✻1	3	2 ✻2	Ver. 1.01	**NX-CSG320**

Note: One NX-END02 End Cover is provided with the NX-CSG320 Communication Control Unit.
✻1. Routing of the CIP Safety protocol is supported.
✻2. PORT1 is an independent port. PORT2A and PORT2B are the ports with a built-in Ethernet switch.

Safety CPU Units

Unit type	Appearance	Specifications				Unit version	Model
		Maximum number of safety I/O points	Program capacity	Number of safety I/O connections	I/O refreshing method		
Safety CPU Unit (NX-SL5□□□)		1024 points	2048 KB	128	Free-Run refreshing	Ver. 1.4	**NX-SL5500**
		2032 points	4096 KB	254	Free-Run refreshing	Ver. 1.4	**NX-SL5700**

GI-S-series safety I/O terminals

Unit type	Appearance	Specifications							Unit version	Model
		Corresponding communication protocol	Number of connectors	Number of networks	Number of safety input points	Number of test output point	Number of safety output points	OMRON special safety input devices ✻2		
Safety I/O Terminals		EtherNet	2	1 ✻1	12 points	12 points	4 points	Cannot be connected.	Ver. 1.0	**GI-SMD1624**
					12 points	12 points	---	Cannot be connected.	Ver. 1.0	**GI-SID1224**

✻1. PORT1 and PORT2 are ports with switching hub.
✻2. See notes (✻1 to 3) in *Safety Input Units* for details.

Safety Input Units

Unit type	Appearance	Specifications							Unit version	Model
		Number of safety input points	Number of test output points	Internal I/O common	Rated input voltage	OMRON special safety input devices ✻1	Number of safety slave connections	I/O refreshing method		
Safety Input Units		4 points	2 points	Sinking inputs (PNP)	24 VDC	Can be connected.	1	Free-Run refreshing	Ver. 1.1	**NX-SIH400**
		8 points	2 points	Sinking inputs (PNP)	24 VDC	Cannot be connected.	1	Free-Run refreshing	Ver. 1.0	**NX-SID800**

✻1. The following OMRON special safety input devices can be connected directly without a special controller.
For detail of connectable OMRON special safety input devices, refer to *NX-series User's Manual Safety Control Unit/Communication Control Unit* (Cat. No. Z395).

Type	Model and corresponding PL and safety category
OMRON Single-beam Safety Sensors	E3ZS
OMRON Non-contact Door Switches ✻2	D40A-2 D40A D40Z ✻3
OMRON Safety Mats	UM ✻3, UMA ✻3
OMRON Safety Edges	SGE ✻3 (4-wire connection)

✻2. The D41D High-Coded Non-Contact Safety Door Switch, which requires no dedicated controller, can be connected directly to the GI-S Series, NX-SIH400, and NX-SID800.
✻3. Orders for The D40Z will be accepted until the end of April 2026. The UA, The UMA and The SGE were discontinued.

Safety Output Units

Unit type	Appearance	Specifications						Unit version	Model
		Number of safety output points	Internal I/O common	Maximum load current	Rated voltage	Number of safety slave connections	I/O refreshing method		
Safety Output Units		2 points	Sourcing outputs (PNP)	2.0 A/point, 4.0 A/Unit at 40°C, and 2.5 A/Unit at 55°C The maximum load current depends on the installation orientation and ambient temperature.	24 VDC	1	Free-Run refreshing	Ver. 1.0	**NX-SOH200**
		4 points	Sourcing outputs (PNP)	0.5 A/point and 2.0 A/Unit	24 VDC	1	Free-Run refreshing	Ver. 1.0	**NX-SOD400**

Automation Software Sysmac Studio

The Sysmac Studio is the software that provides an integrated environment for setting, programming, debugging and maintenance of machine automation controllers including the NJ/NX-series CPU Units, NY-series Industrial PC, EtherCAT Slave, and the HMI.

For details, refer to your local OMRON website and *Sysmac Studio Catalog* (Cat. No. P138).

Optional Products

SD Memory Card

Product name	Specification	Model
SD Memory Card	Flash Memory, 2 GB	**HMC-SD292**
	Flash Memory, 4 GB	**HMC-SD492**

Note: Refer to the HMC-SD292/492/1A2 datasheet for details on the memory card.

Unit/Terminal Block Coding Pins

Product Name	Specification	Model
Unit/Terminal Block Coding Pins	For 10 Units (Terminal Block: 30 pins, Unit: 30 pins)	**NX-AUX02**

Terminal Block

Product name	Specification				Model
	No. of terminals	Terminal number indications	Ground terminal mark	Terminal current capacity	
Terminal Block	8	A/B	Provided	10 A	**NX-TBC082**
	8	A/B	None	10 A	**NX-TBA082**
	16	A/B	None	10 A	**NX-TBA162**

NX-series NX102 CPU Units

For details on NX-series NX102 CPU Units, refer to the *NX1 Machine Automation Controller Datasheet* (Cat. No. P130).

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OMRON's Products Suppot IoT for Control Panels and Production Lines

Safety I/O Unit
NX-SI/SO Datasheet

Cat. No. F123

Safety CPU Unit
NX-SL5□□□ Datasheet

Cat. No. F124

Communication
Control Unit
NX-CSG Datasheet

Cat. No. F125

Safety I/O Terminal
GI-S Series Datasheet

Cat. No. F126

NX-series
I/O System Brochure

Cat. No. R183

Automation Software
Sysmac Studio
Brochure

Cat. No. P138

Automation Software
Sysmac StudioVer.1.□□
Datasheet

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

OMRON Corporation **Industrial Automation Company**

Kyoto, JAPAN **Contact : 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.
438B Alexandra Road, #08-01/02 Alexandra
Technopark, Singapore 119968
Tel: (65) 6835-3011 Fax: (65) 6835-3011

OMRON (CHINA) CO., LTD.
Room 2211, Bank of China Tower,
200 Yin Cheng Zhong Road,
PuDong New Area, Shanghai, 200120, China
Tel: (86) 21-6023-0333 Fax: (86) 21-5037-2388

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