

- ▶ Product Category
- ▶ Automation Systems
- ▶ Machine Automation Controllers
- ▶ Controller NJ Series
- ▶ CPU Units
  - ▶ NJ501-□□□□
  - ▶ NJ501-1□20 / NJ101-□□20
  - ▶ NJ501-1340
  - ▶ NJ501-4□□□
  - NJ301-□□□□**
  - ▶ NJ101-□□□□

- ▶ Product Category
- ▶ Cautions
- ▶ Item A to Z Index
- ▶ Applications
- ▶ Correction Notice

NJ-Series NJ301 CPU Units

## NJ301-□□□□



New controller that covers functions and high-speed processing required for machine control and safety, reliability and maintainability that are the features of industrial controllers. Ideal for small-scale control with up to 8 axes.

[▶ Item list of NJ301-□□□□](#)

about this Product Family

[Inquiry of this Product](#)

### Related Contents

- Common (4) ▼
- Automation Systems (1) ▼
- Machine Automation Controllers (2) ▼

- Features
- Lineup
- Specifications**
- Dimensions
- Catalog

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### General Specification

Item		NJ301-□□□□
Enclosure		Mounted in a panel
Grounding Method		Ground to less than 100 Ω
Dimensions (height×depth×width)		90 mm × 90 mm × 90 mm
Weight		550 g (including the End Cover)
Current Consumption		5 VDC, 1.90 A (including SD Memory Card and End Cover)
Power consumption		---
Operation Environment	Ambient Operating Temperature	0 to 55°C
	Ambient Operating Humidity	10% to 90% (with no condensation)
	Atmosphere	Must be free from corrosive gases.
	Ambient Storage Temperature	-20 to 75°C (excluding battery)
	Altitude	2,000 m or less
	Pollution Degree	2 or less: Conforms to JIS B3502 and IEC 61131-2.
	Noise Immunity	2 kV on power supply line (Conforms to IEC 61000-4-4.)
	Overvoltage Category	Category II: Conforms to JIS B3502 and IEC 61131-2.
	EMC Immunity Level	Zone B
	Vibration Resistance	Conforms to IEC 60068-2-6. 5 to 8.4 Hz with 3.5-mm amplitude, 8.4 to 150 Hz Acceleration of 9.8 m/s <sup>2</sup> for 100 min in X, Y, and Z directions (10 sweeps of 10 min each = 100 min total)
Shock Resistance	Conforms to IEC 60068-2-27. 147 m/s <sup>2</sup> , 3 times in X, Y, and Z directions (100 m/s <sup>2</sup> for Relay Output Units)	
Battery	Life	5 years at 25°C
	Model	CJ1W-BAT01
Applicable Standards		Conforms to cULus, NK, LR, EU Directives, RCM and KC Registration *.

\* Supported only by the CPU Units with unit version 1.01 or later.

### Performance Specifications

Item			NJ301		
			1200	1100	
Processing time	Instruction Execution Times	LD instruction	2.0ns (3.0ns or less)		
		Math Instructions (for Long Real Data)	42 ns or more		
Program-ming	Program capacity *2	Size	5 MB (100 KS)		
		Number	POU definition	750	
			POU instance	Using Sysmac Studio Ver. 1.04 or lower: 1,500 Using Sysmac Studio Ver. 1.05 or higher: 3,000	
	Variables capacity	No Retain Attribute *3	Size	2 MB	
			Number	22,500	
		Retain Attribute *4	Size	0.5 MB	
			Number	Using Sysmac Studio Ver. 1.04 or lower: 2,500 Using Sysmac Studio Ver. 1.05 or higher: 5,000	
	Data type	Number	1,000		
	Memory for CJ-Series Units (Can be Specified with AT Specifications for Variables.)	CIO Area	6,144 words (CIO 0 to CIO 6143)		
		Work Area	512 words (W0 to W511)		
		Holding Area	1,536 words (H0 to H1535)		
DM Area		32,768 words (D0 to D32767)			
EM Area		32,768 words × 4 banks (E0_00000 to E3_32767) *5			
Unit configuration	Maximum Number of Connectable Units	Maximum number of CJ/NX unit per CPU Rack or Expansion Rack	10 Units		
		Maximum number of CJ unit on the system	40 Units		
		Maximum number of NX unit on the system	4,096 (on NX series EtherCAT slave terminal)		
	Maximum number of Expansion Racks	3 max.			
	I/O Capacity	Maximum number of I/O Points on CJ-series Units	2,560 points max.		
	Power Supply Unit for CPU Rack and Expansion Racks	Model	NJ-P[[3001		
Power OFF Detection Time		AC Power Supply	30 to 45 ms		
		DC Power Supply	22 to 25 ms		
Motion control	Maximum Number of Controlled Axes	Maximum number of axes which can be defined. The number of controlled axes = The number of motion control axes + The number of singleaxis position control axes.			
		15 axes *6	15 axes *6		
	Motion control axes	Maximum number of motion control axes which can be defined. All motion control function is available.			
		15 axes	15 axes		
	Number of Controlled Axes	Maximum number of used real axes. The Number of used real axes includes following servo axes and encoder axes.			
		8 axes	4 axes		
		Used motion control servo axes	Maximum number of servo axes which all motion control function is available. The number of used motion control servo axes = The number of motion control axes whose axis type is set to servo axis and axis use is set to used axis.		
			8 axes	4 axes	
	Maximum number of axes for linear interpolation axis control	4 axes per axes group			
	Number of axes for circular interpolation axis control	2 axes per axes group			
	Maximum Number of Axes Groups	32 groups			
Motion Control Period	The same control period as that is used for the process data communications cycle for EtherCAT.				

	<b>Cams</b>	<b>Number of Cam Data Points</b>	<b>Maximum Points per Cam Table</b>	65,535 points
			<b>Maximum Points for All Cam Tables</b>	262,140 points
		<b>Maximum Number of Cam Tables</b>	160 tables	
	<b>Position Units</b>			Pulses, millimeters, micrometers, nanometers, degrees or inches
	<b>Override Factors</b>			0.00% or 0.01% to 500.00%
<b>Peripheral USB port</b>	<b>Supported Services</b>			Sysmac Studio connection
	<b>Physical Layer</b>			USB 2.0-compliant B-type connector
	<b>Transmission Distance between Hub and Node</b>			5 m max.
<b>Built-in EtherNet/IP Port</b>	<b>Number of port</b>			1
	<b>Physical Layer</b>			10Base-T or 100Base-TX
	<b>Frame length</b>			1514 max.
	<b>Media Access Method</b>			CSMA/CD
	<b>Modulation</b>			Baseband
	<b>Topology</b>			Star
	<b>Baud Rate</b>			100 Mbps (100Base-TX)
	<b>Transmission Media</b>			STP (shielded, twisted-pair) cable of Ethernet category 5, 5e or higher
	<b>Maximum Transmission Distance between Ethernet Switch and Node</b>			100m
	<b>Maximum Number of Cascade Connections</b>			There are no restrictions if Ethernet switch is used.
	<b>CIP service: Tag Data Links (Cyclic Communications)</b>	<b>Maximum Number of Connections</b>		32
		<b>Packet interval *7</b>		1 to 10,000 ms in 1.0-ms increments *8 Can be set for each connection. (Data will be refreshed at the set interval, regardless of the number of nodes.)
		<b>Permissible Communications Band</b>		3,000 pps *9 *10 (including heartbeat)
		<b>Maximum Number of Tag Sets</b>		32
		<b>Tag types</b>		Network variables, CIO, Work, Holding, DM, and EM Areas
		<b>Number of tags per connection (i.e., per tag set)</b>		8 (7 tags if Controller status is included in the tag set.)
		<b>Maximum Link Data Size per Node (total size for all tags)</b>		256
		<b>Maximum number of tag</b>		19,200 bytes
		<b>Maximum Data Size per Connection</b>		600 bytes
<b>Maximum Number of Registrable Tag Sets</b>		32 (1 connection = 1 tag set)		
<b>Maximum Tag Set Size</b>		600 bytes (Two bytes are used if Controller status is included in the tag set.)		
<b>Multi-cast Packet Filter *11</b>		Supported.		
<b>Cip Message Service: Explicit Messages</b>	<b>Class 3 (number of connections)</b>		32 (clients plus server)	
	<b>UCMM (non-connection type)</b>	<b>Maximum Number of Clients that Can Communicate at One Time</b>	32	
		<b>Maximum Number of Servers that Can Communicate at One Time</b>	32	

	<b>Maximum number of TCP socket service</b>	30 *12
<b>Built-in EtherCAT Port</b>	<b>Communications Standard</b>	IEC 61158 Type12
	<b>EtherCAT Master Specifications</b>	Class B (Feature Pack Motion Control compliant)
	<b>Physical Layer</b>	100BASE-TX
	<b>Modulation</b>	Baseband
	<b>Baud Rate</b>	100 Mbps (100Base-TX)
	<b>Duplex mode</b>	Auto
	<b>Topology</b>	Line, daisy chain, and branching
	<b>Transmission Media</b>	Twisted-pair cable of category 5 or higher (double-shielded straight cable with aluminum tape and braiding)
	<b>Maximum Transmission Distance between Nodes</b>	100m
	<b>Maximum Number of Slaves</b>	192
	<b>Range of node address</b>	1-192
	<b>Maximum Process Data Size</b>	Inputs: 5,736 bytes Outputs: 5,736 bytes (However, the maximum number of process data frames is 4.)
	<b>Maximum Process Data Size per Slave</b>	Inputs: 1,434 bytes Outputs: 1,434 bytes
	<b>Communications Cycle</b>	500/1,000/2,000/4,000 $\mu$ s *13
<b>Sync Jitter</b>	1 $\mu$ s max.	
<b>Internal Clock</b>	At ambient temperature of 55°C: -3.5 to +0.5 min error per month At ambient temperature of 25°C: -1.5 to +1.5 min error per month At ambient temperature of 0°C: -3 to +1 min error per month	

- \*1. When the hardware revision for the Unit is A.
  - \*2. This is the capacity for the execution objects and variable tables (including variable names).
  - \*3. Words for CJ-series Units in the Holding, DM, and EM Areas are not included.
  - \*4. Words for CJ-series Units in the CIO and Work Areas are not included.
  - \*5. When the Spool function of the NJ501-1[ ]20 is enabled, the DB Connection Service uses E9\_0 to E18\_32767 (NJ501-1[ ]20).  
When the Spool function of the NJ101-[ ]20 is enabled, the DB Connection Service uses E1\_0 to E3\_32767 (NJ101-[ ]20).
  - \*6. This number of axes is achieved in a combination of a CPU Unit with unit version 1.06 or later and Sysmac Studio version 1.07 or higher.  
In other combinations, the maximum number of controlled axes is 8 axes (NJ301-1200) or 4 axes (NJ301-1100).
  - \*7. Data is updated on the line in the specified interval regardless of the number of nodes.
  - \*8. The Packet interval of the CPU Unit version 1.02 or earlier is 10 to 10,000 ms in 1.0-ms increments.
  - \*9. Means packets per second, i.e., the number of communications packets that can be sent or received in one second.
  - \*10. The Permissible Communications Band of the CPU Unit version 1.02 or earlier is 1,000 pps.
  - \*11. An IGMP client is mounted for the EtherNet/IP port. If an ethernet switch that supports IGMP snooping is used, filtering of unnecessary multicast packets is performed.
  - \*12. The Maximum number of TCP socket service of the CPU Unit version 1.02 or earlier is 16.
  - \*13. The Maximum Communications Cycle of the NJ301 CPU Unit version 1.02 or earlier is 1,000/2,000/4,000  $\mu$ s.  
The EtherCAT communications cycle of NJ501-4[ ]0 for robot control is 1 ms or more.
- Note: For robot control by NJ501-4[ ]0, use the G5 series/1S series AC Servo Drive with built-in EtherCAT communications, absolute encoder, and brake.

**Function Specifications**

Item			NJ301-[ ]000
<b>Tasks</b>	<b>Function</b>		I/O refreshing and the user program are executed in units that are called tasks. Tasks are used to specify execution conditions and execution priority.
	<b>Periodically Executed Tasks</b>	<b>Maximum Number of Primary Periodic Tasks</b>	1
		<b>Maximum Number of Periodic Tasks</b>	3
	<b>Conditionally executed tasks *1</b>	<b>Maximum number of event tasks</b>	32

			<b>Execution conditions</b>	When Activate Event Task instruction is executed or when condition expression for variable is met.	
	<b>Setup</b>	<b>System Service Monitoring Settings</b>		The execution interval and the percentage of the total user program execution time are monitored for the system services (processes that are executed by the CPU Unit separate from task execution).	
<b>Program- ming</b>	<b>POU (program organization units)</b>	<b>Programs</b>		POUs that are assigned to tasks.	
		<b>Function Blocks</b>		POUs that are used to create objects with specific conditions.	
		<b>Functions</b>		POUs that are used to create an object that determine unique outputs for the inputs, such as for data processing.	
	<b>Programming Languages</b>	<b>Types</b>		Ladder diagrams *2 and structured text (ST)	
	<b>Namespaces *3</b>			A concept that is used to group identifiers for POU definitions.	
	<b>Variables</b>	<b>External Access of Variables</b>	<b>Network Variables</b>	The function which allows access from the HMI, host computers, or other Controllers	
	<b>Data Types</b>	<b>Data Types</b>	<b>Data Types</b>	<b>Boolean</b>	BOOL
				<b>Bit Strings</b>	BYTE, WORD, DWORD, LWORD
				<b>Integers</b>	INT, SINT, DINT,LINT, UINT, USINT, UDINT, ULINT
				<b>Real Numbers</b>	REAL, LREAL
				<b>Durations</b>	TIME
				<b>Dates</b>	DATE
				<b>Times of Day</b>	TIME_OF_DAY
				<b>Date and Time</b>	DATE_AND_TIME
				<b>Text Strings</b>	STRING
		<b>Derivative Data Types</b>		Structures, unions, enumerations	
		<b>Structures</b>	<b>Function</b>	A derivative data type that groups together data with different variable types.	
			<b>Maximum Number of Members</b>	2048	
			<b>Nesting Maximum Levels</b>	8	
			<b>Member Data Types</b>	Basic data types, structures, unions, enumerations, array variables	
			<b>Specifying Member Offsets</b>	You can use member offsets to place structure members at any memory locations.*3	
		<b>Unions</b>	<b>Function</b>	A derivative data type that groups together data with different variable types.	
			<b>Maximum Number of Members</b>	4	
<b>Member Data Types</b>			BOOL, BYTE, WORD, DWORD, LWORD		
<b>Enumerations</b>		<b>Function</b>	A derivative data type that uses text strings called enumerators to express variable values.		
<b>Data Type Attributes</b>		<b>Array specifications</b>	<b>Function</b>	An array is a group of elements with the same data type. You specify the number (subscript) of the element from the first element to specify the element.	
	<b>Maximum Number of Dimensions</b>		3		
	<b>Maximum Number of Elements</b>		65535		
	<b>Array Specifications for FB Instances</b>		Supported.		
	<b>Range Specifications</b>		You can specify a range for a data type in advance. The data type can take only values that are in the specified range.		
	<b>Libraries</b>		User libraries		
<b>Motion Control</b>	<b>Control Modes</b>		position control, velocity control, torque control		
	<b>Axis Types</b>		Servo axes, virtual servo axes, encoder axes, and virtual encoder axes		

Positions that can be managed		Command positions and actual positions	
Single-axis	Single-axis Position Control	Absolute Positioning	Positioning is performed for a target position that is specified with an absolute value.
		Relative Positioning	Positioning is performed for a specified travel distance from the command current position.
		Interrupt Feeding	Positioning is performed for a specified travel distance from the position where an interrupt input was received from an external input.
		Cyclic synchronous absolute positioning *1	The function which outputs command positions in every control period in the position control mode.
	Single-axis Velocity Control	Velocity Control	Velocity control is performed in Position Control Mode.
		Cyclic Synchronous Velocity Control	A velocity command is output each control period in Velocity Control Mode.
	Single-axis Torque Control	Torque Control	The torque of the motor is controlled.
	Single-axis Synchronized Control	Starting Cam Operation	A cam motion is performed using the specified cam table.
		Ending Cam Operation	The cam motion for the axis that is specified with the input parameter is ended.
		Starting Gear Operation	A gear motion with the specified gear ratio is performed between a master axis and slave axis.
		Positioning Gear Operation	A gear motion with the specified gear ratio and sync position is performed between a master axis and slave axis.
		Ending Gear Operation	The specified gear motion or positioning gear motion is ended.
		Synchronous Positioning	Positioning is performed in sync with a specified master axis.
		Master Axis Phase Shift	The phase of a master axis in synchronized control is shifted.
		Combining Axes	The command positions of two axes are added or subtracted and the result is output as the command position.
	Single-axis Manual Operation	Powering the Servo	The Servo in the Servo Drive is turned ON to enable axis motion.
		Jogging	An axis is jogged at a specified target velocity.
	Auxiliary Functions for Single-axis Control	Resetting Axis Errors	Axes errors are cleared.
		Homing	A motor is operated and the limit signals, home proximity signal, and home signal are used to define home.
		Homing with parameter *1	Specifying the parameter, a motor is operated and the limit signals, home proximity signal, and home signal are used to define home.
		High-speed Homing	Positioning is performed for an absolute target position of 0 to return to home.
		Stopping	An axis is decelerated to a stop at the specified rate.
		Immediately Stopping	An axis is stopped immediately.
		Setting Override Factors	The target velocity of an axis can be changed.
		Changing the Current Position	The command current position or actual current position of an axis can be changed to any position.
		Enabling External Latches	The position of an axis is recorded when a trigger occurs.
		Disabling External Latches	The current latch is disabled.
Zone Monitoring		You can monitor the command position or actual position of an axis to see when it is within a specified range (zone).	
Enabling digital cam switches *4		You can turn a digital output ON and OFF according to the position of an axis.	
Monitoring Axis Following Error		You can monitor whether the difference between the command positions or actual positions of two specified	

				axes exceeds a threshold value.
			<b>Resetting the Following Error</b>	The error between the command current position and actual current position is set to 0.
			<b>Torque Limit</b>	The torque control function of the Servo Drive can be enabled or disabled and the torque limits can be set to control the output torque.
			<b>Command position compensation *5</b>	The function which compensate the position for the axis in operation.
			<b>Start velocity *6</b>	You can set the initial velocity when axis motion starts.
<b>Axes Groups</b>	<b>Multi-axes Coordinated Control</b>		<b>Absolute Linear Interpolation</b>	Linear interpolation is performed to a specified absolute position.
			<b>Relative Linear Interpolation</b>	Linear interpolation is performed to a specified relative position.
			<b>Circular 2D Interpolation</b>	Circular interpolation is performed for two axes.
			<b>Axes Group Cyclic Synchronous Absolute Positioning</b>	A positioning command is output each control period in Position Control Mode.*3
	<b>Auxiliary Functions for Multi-axes Coordinated Control</b>		<b>Resetting Axes Group Errors</b>	Axes group errors and axis errors are cleared.
			<b>Enabling Axes Groups</b>	Motion of an axes group is enabled.
			<b>Disabling Axes Groups</b>	Motion of an axes group is disabled.
			<b>Stopping Axes Groups</b>	All axes in interpolated motion are decelerated to a stop.
			<b>Immediately Stopping Axes Groups</b>	All axes in interpolated motion are stopped immediately.
			<b>Setting Axes Group Override Factors</b>	The blended target velocity is changed during interpolated motion.
			<b>Reading Axes Group Positions</b>	The command current positions and actual current positions of an axes group can be read.*3
		<b>Changing the Axes in an Axes Group</b>	The Composition Axes parameter in the axes group parameters can be overwritten temporarily.*3	
	<b>Common Items</b>	<b>Cams</b>		<b>Setting Cam Table Properties</b>
			<b>Saving Cam Tables</b>	The cam table that is specified with the input parameter is saved in non-volatile memory in the CPU Unit.
			<b>Generating cam tables *7</b>	The cam table that is specified with the input parameter is generated from the cam property and cam node.
<b>Parameters</b>			<b>Writing MC Settings</b>	Some of the axis parameters or axes group parameters are overwritten temporarily.
			<b>Changing axis parameters *7</b>	You can access and change the axis parameters from the user program.
<b>Auxiliary Functions</b>	<b>Count Modes</b>			You can select either Linear Mode (finite length) or Rotary Mode (infinite length).
	<b>Unit Conversions</b>			You can set the display unit for each axis according to the machine.
	<b>Acceleration/Deceleration Control</b>		<b>Automatic Acceleration/Deceleration Control</b>	Jerk is set for the acceleration/deceleration curve for an axis motion or axes group motion.
			<b>Changing the Acceleration and Deceleration Rates</b>	You can change the acceleration or deceleration rate even during acceleration or deceleration.
	<b>In-position Check</b>			You can set an in-position range and in-position check time to confirm when positioning is completed.
	<b>Stop Method</b>			You can set the stop method to the immediate stop input signal or limit input signal.
	<b>Re-execution of Motion Control Instructions</b>			You can change the input variables for a motion control instruction during execution and execute the

				instruction again to change the target values during operation.
		<b>Multi-execution of Motion Control Instructions (Buffer Mode)</b>		You can specify when to start execution and how to connect the velocities between operations when another motion control instruction is executed during operation.
		<b>Continuous Axes Group Motions (Transition Mode)</b>		You can specify the Transition Mode for multi-execution of instructions for axes group operation.
		<b>Monitoring Functions</b>	<b>Software Limits</b>	Software limits are set for each axis.
			<b>Following Error</b>	The error between the command current value and the actual current value is monitored for an axis.
			<b>Velocity, Acceleration Rate, Deceleration Rate, Torque, Interpolation Velocity, Interpolation Acceleration Rate, And Interpolation Deceleration Rate</b>	You can set and monitor warning values for each axis and each axes group.
		<b>Absolute Encoder Support</b>		You can use an OMRON G5-Series or 1S-Series Servomotor with an Absolute Encoder to eliminate the need to perform homing at startup.
		<b>Input signal logic inversion *6</b>		You can inverse the logic of immediate stop input signal, positive limit input signal, negative limit input signal, or home proximity input signal.
	<b>External Interface Signals</b>			The Servo Drive input signals listed on the right are used. Home signal, home proximity signal, positive limit signal, negative limit signal, immediate stop signal, and interrupt input signal
<b>Unit (I/O) Management</b>	<b>EtherCAT Slaves</b>	<b>Maximum Number of Slaves</b>		192
	<b>CJ-Series Units</b>	<b>Maximum number of Units</b>		40
		<b>Basic I/O Units</b>	<b>Load Short-circuit Protection and I/O Disconnection Detection</b>	Alarm information for Basic I/O Units is read.
<b>Communications</b>	<b>Peripheral USB Port</b>			A port for communications with various kinds of Support Software running on a personal computer.
	<b>Built-in EtherNet/IP port Internal Port</b>	<b>Communications protocol</b>		TCP/IP, UDP/IP
		<b>CIP Communications Service</b>	<b>Tag Data Links</b>	Programless cyclic data exchange is performed with the devices on the EtherNet/IP network.
			<b>Message Communications</b>	CIP commands are sent to or received from the devices on the EtherNet/IP network.
		<b>TCP/IP functions</b>	<b>CIDR</b>	The function which performs IP address allocations without using a class (class A to C) of IP address.
			<b>IP Forwarding *5</b>	---
		<b>TCP/IP Applications</b>	<b>Socket Services</b>	Data is sent to and received from any node on Ethernet using the UDP or TCP protocol. Socket communications instructions are used.
			<b>FTP client *7</b>	File can be read from or written to computers at other Ethernet nodes from the CPU Unit. FTP client communications instructions are used.
			<b>FTP Server</b>	Files can be read from or written to the SD Memory Card in the CPU Unit from computers at other Ethernet nodes.
			<b>Automatic Clock Adjustment</b>	Clock information is read from the NTP server at the specified time or at a specified interval after the power supply to the CPU Unit is turned ON. The internal clock time in the CPU Unit is updated with the read time.
				<b>SNMP Agent</b>



EtherCAT Port	Supported Services	Process Data Communications	Control information is exchanged in cyclic communications between the EtherCAT master and slaves.	
		SDO Communications	A communications method to exchange control information in noncyclic event communications between EtherCAT master and slaves. This communications method is defined by CoE.	
	Network Scanning		Information is read from connected slave devices and the slave configuration is automatically generated.	
	DC (Distributed Clock)		Time is synchronized by sharing the EtherCAT system time among all EtherCAT devices (including the master).	
	Packet Monitoring *8		The frames that are sent by the master and the frames that are received by the master can be saved. The data that is saved can be viewed with WireShark or other applications.	
	Enable/disable Settings for Slaves		The slaves can be enabled or disabled as communications targets.	
	Disconnecting/Connecting Slaves		Temporarily disconnects a slave from the EtherCAT network for maintenance, such as for replacement of the slave, and then connects the slave again.	
	Supported Application Protocol	CoE	SDO messages of the CAN application can be sent to slaves via EtherCAT.	
Communications Instructions			The following instructions are supported. CIP communications instructions, socket communications instructions, SDO message instructions, no-protocol communications instructions, protocol macro instructions, and FTP client instructions *7, and Modbus RTU protocol instructions *9	
Operation Management	RUN Output Contacts		The output on the Power Supply Unit turns ON in RUN mode.	
System Management	Event Logs	Function	Events are recorded in the logs.	
	Maximum number of events	System event log	512	
		Access event log	512	
	User-defined event log	512		
Debugging	Online Editing	Single	Programs, function blocks, functions, and global variables can be changed online. Different operators can change different POU's across a network.	
	Forced Refreshing		The user can force specific variables to TRUE or FALSE.	
	Maximum Number of Forced Variables	Device Variables for EtherCAT Slaves	64	
		Device Variables for CJ-series Units and Variables with AT Specifications	64	
	MC Test Run *10		Motor operation and wiring can be checked from the Sysmac Studio.	
	Synchronizing		The project file in the Sysmac Studio and the data in the CPU Unit can be made the same when online.	
	Differentiation monitoring *1		Rising/falling edge of contacts can be monitored.	
		Maximum number of contacts *1	8	
	Data Tracing	Types	Single Triggered Trace	When the trigger condition is met, the specified number of samples are taken and then tracing stops automatically.
			Continuous Trace	Data tracing is executed continuously and the trace data is collected by the Sysmac Studio.
Maximum Number of Simultaneous Data Trace		2		
Maximum Number of Records		10,000		
Sampling	Maximum Number of	48 variables		

			Sampled Variables	
			Timing of Sampling	Sampling is performed for the specified task period, at the specified time, or when a sampling instruction is executed.
			Triggered Traces	Trigger conditions are set to record data before and after an event.
			Trigger Conditions	When BOOL variable changes to TRUE or FALSE Comparison of non-BOOL variable with a constant Comparison Method: Equals (=), Greater than (>), Greater than or equals (≥), Less Than (<), Less than or equals (≤), Not equal (≠)
			Delay	Trigger position setting: A slider is used to set the percentage of sampling before and after the trigger condition is met.
	Simulation			The operation of the CPU Unit is emulated in the Sysmac Studio.
Reliability Functions	Self-diagnosis	Controller Errors	Levels	Major fault, partial fault, minor fault, observation, and information
		User-defined errors		User-defined errors are registered in advance and then records are created by executing instructions.
			Levels	8 levels
Security	Protecting Software Assets and Preventing Operating Mistakes	CPU Unit Names and Serial IDs		When going online to a CPU Unit from the Sysmac Studio, the CPU Unit name in the project is compared to the name of the CPU Unit being connected to.
		Protection	User Program Transfer with No Restoration Information	You can prevent reading data in the CPU Unit from the Sysmac Studio.
			CPU Unit Write Protection	You can prevent writing data to the CPU Unit from the Sysmac Studio or SD Memory Card.
			Overall Project File Protection	You can use passwords to protect .smc files from unauthorized opening on the Sysmac Studio.
			Data Protection	You can use passwords to protect POUs on the Sysmac Studio.*3
		Verification of Operation Authority		Online operations can be restricted by operation rights to prevent damage to equipment or injuries that may be caused by operating mistakes.
			Number of Groups	5 *12
		Verification of User Program Execution ID		The user program cannot be executed without entering a user program execution ID from the Sysmac Studio for the specific hardware (CPU Unit).
SD Memory Card Functions	Storage Type			SD Memory Card, SDHC Memory Card
	Application	Automatic transfer from SD Memory Card *1		The data in the autoloading folder on an SD Memory Card is automatically loaded when the power supply to the Controller is turned ON.
		Transfer program from SD Memory Card *9		The user program on an SD Memory Card is loaded when the user changes systemdefined variable to TRUE.
		SD Memory Card Operation Instructions		You can access SD Memory Cards from instructions in the user program.
		File Operations from the Sysmac Studio		You can perform file operations for Controller files in the SD Memory Card and read/write standard document files on the computer.
		SD Memory Card Life Expiration Detection		Notification of the expiration of the life of the SD Memory Card is provided in a systemdefined variable and event log.
Backup functions *1	SD Memory Card backup functions	Operation	Using front switch	You can use front switch to backup, compare, or restore data.
			Using system-defined variables	You can use system-defined variables to backup, compare, or restore data. *13
			Memory Card Operations Dialog Box on Sysmac Studio	Backup and verification operations can be performed from the SD Memory Card Operations Dialog Box on the Sysmac Studio.
			Using instruction *7	Backup operation can be performed by using instruction.
		Protection	Prohibiting	Prohibit SD Memory Card backup functions.

			backing up data to the SD Memory Card	
Sysmac Studio Controller backup functions				Backup, restore, and verification operations for Units can be performed from the Sysmac Studio.

- \*1. Supported only by the CPU Units with unit version 1.03 or later.
- \*2. Inline ST is supported. (Inline ST is ST that is written as an element in a ladder diagram.)
- \*3. Supported only by the CPU Units with unit version 1.01 or later.
- \*4. Supported only by the CPU Units with unit version 1.06 or later.
- \*5. Supported only by the CPU Units with unit version 1.10 or later.
- \*6. Supported only by the CPU Units with unit version 1.05 or later.
- \*7. Supported only by the CPU Units with unit version 1.08 or later.
- \*8. For NJ301, Supported only by the CPU Units with unit version 1.10 or later.
- \*9. Supported only by the CPU Units with unit version 1.11 or later.
- \*10. Cannot be used with the NJ101-9000.
- \*11. Maximum Number of Simultaneous Data Trace of the NJ501-1[]20 CPU Unit with unit version 1.08 or later is 2.
- \*12. When the NJ501 CPU Units with unit version 1.00 is used, this value becomes two.
- \*13. Restore is supported with unit version 1.14 or later.

**Functions That Were Added or Changed for Each Unit Version and Sysmac Studio version**

**Additions and Changes to Functional Specifications**

The following table gives the unit version of the CPU Units and the Sysmac Studio version for each addition or change to the functional specifications.

Function				Addition/change	Unit version	Sysmac Studio version
Tasks	Function	Conditionally executed tasks		Addition	1.03	1.04
Programming	Namespaces			Addition	1.01	1.02
	Data types	Structure data types	Specifying member offsets	Addition Change	1.01	1.02 1.03
	Libraries			Addition	1.01	1.02
Motion control	Single axes	Single-axis position control	Cyclic synchronous absolute positioning	Addition	1.03	1.04
		Auxiliary function for single-axis control	Homing with specified parameters	Addition	1.03	1.04
			Enabling digital cam switches	Addition	1.06	1.07
			Command position compensation	Addition	1.10	1.12
			Start velocity	Addition	1.05	1.06
	Axes groups	Multi-axes coordinated control	Axes group cyclic synchronous absolute positioning	Addition	1.01	1.02
		Auxiliary functions for multi-axes coordinated control	Reading axes group positions	Addition	1.01	1.02
			Changing the axes in a group	Addition	1.01	1.02
	Common items	Cams	Generating cam tables	Addition	1.08	1.09
		Parameters	Changing axis parameters	Addition	1.08	1.09
Auxiliary functions	Input signal logic inversion		Addition	1.05	1.06	
Unit (I/O) management	NX Units			Addition	1.05	1.06
Communications	EtherNet/IP port	TCP/IP applications	FTP client	Addition	1.08	1.09
	EtherCAT port	Packet monitoring * (NJ301-□□□□□□□□)		Addition	1.10	1.12
	Communications instructions			Change	1.08 1.11	1.09 1.15
Debugging function	Differential monitoring			Addition	1.03	1.04
Reliability functions	Self diagnosis	Controller errors	Changing levels	Addition	1.03	1.04
Security	Asset protection	Protection	Data protection	Addition	1.01	1.02

	and preventing incorrect operation	Operation authority verification	Number of groups	Change	1.01	1.02
SD Memory Cards	Application	Automatic transfer from SD Memory Card		Addition	1.03	1.04
		Transfer program from SD Memory Card		Addition	1.11	1.15
Backing up data	SD Memory Card backups	Operating methods	CPU Unit front-panel DIP switch	Addition	1.03	1.04
			Specification with system-defined variables	Addition	1.03	1.04
			SD Memory Card Window in Sysmac Studio	Addition	1.03	1.04
			Special instruction	Addition	1.08	1.09
		Protection	Disabling backups to SD Memory Cards	Addition	1.03	1.04
	Sysmac Studio Controller backups			Addition	1.03	1.04

\* This addition applies only to an NJ301-□□□□ CPU Unit. The NJ501-□□□□ and NJ101-□□□□ CPU Units support packet monitoring with all versions.

### Performance Improvements for Unit Version Upgrades

This section introduces the functions for which performance was improved for each unit version of NJ-series CPU Unit and for each Sysmac Studio version.

Function				Performance value	Unit version	Sysmac Studio version
Programming	Program capacity	Quantities	Number of POU instances (NJ501-□□□□)	9,000	--	1.06 or higher
				6,000	--	1.05 or lower
		Number of POU instances (NJ301-□□□□)	3,000	1.04 or later	1.05 or higher	
			1,500		1.04 or lower	
			2,400	1.03 or earlier	1.05 or higher	
	1,500	1.04 or lower				
	Memory capacity for variables	Variables with a Retain attribute	Number of variables*1 (NJ301-□□□□)	5,000	1.04 or later	1.05 or higher
2,500				1.04 or lower		
2,500				1.03 or earlier	---	
Motion Control	Number of controlled axes	Maximum number of controlled axes*2*3*4 (NJ301-□□□□)	15 axes	1.06 or later	1.07 or higher	
			8 axes (NJ301-1200) 4 axes (NJ301-1100)			Other than the above combination
		Maximum number of axes for single-axis control*4*5 (NJ301-□□□□)	15 axes	1.06 or later	1.07 or higher	
			8 axes (NJ301-1200) 4 axes (NJ301-1100)			Other than the above combination
Built-in EtherNet/IP port	CIP service: Tag data links (cyclic communications)	Packet interval	Can be set for each connection. 1 to 10,000 ms in 1-ms increments	1.03 or later	--	
			Can be set for each connection. 10 to 10,000 ms in 1-ms increments	1.02 or earlier		
		Permissible communications band	3,000 pps*6 (including heartbeat)	1.03 or later	--	
			1,000 pps (including heartbeat)	1.02 or earlier		
	Number of TCP sockets	30	1.03 or later	--		
		16	1.02 or earlier			
Built-in	Communications cycle*7		500, 1,000, 2,000, or	1.03 or later	--	

EtherCAT port	(NJ301-□□□□)	4,000 μs	1.02 or earlier
		1,000, 2,000, or 4,000μs	

- \*1. The performance improvement applies only to an NJ301-□□□□ CPU Unit.  
The maximum number of variables with a Retain attributes for the NJ501-□□□□ is 10,000.
- \*2. This is the total for all axis types.
- \*3. The performance improvement applies only to an NJ301-□□□□ CPU Unit.  
The maximum numbers of controlled axes for the NJ501-□□□□ are as follows:  
NJ501-1500: 64 axes, NJ501-1400: 32 axes, and NJ501-1300: 16 axes
- \*4. There is no change in the maximum number of used real axes.
- \*5. The performance improvement applies only to an NJ301-□□□□ CPU Unit.  
The maximum numbers of axes for single-axis control for the NJ501-□□□□ are as follows:  
NJ501-1500: 64 axes, NJ501-1400: 32 axes, and NJ501-1300: 16 axes
- \*6. Here, pps means "packets per second" and indicates the number of packets that can be processed in one second.
- \*7. The performance improvement applies only to an NJ301-□□□□ CPU Unit.  
You can use 500, 1,000, 2,000 or 4,000 μs communications cycle with an NJ501-□□□□ CPU Unit, and 1,000, 2,000 or 4,000 μs communications cycle with an NJ101-□□□□ CPU Unit.

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[▲ Top of Page](#)

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