YOKOGAWA

Co-innovating tomorrow™

OpreX™ Control Devices

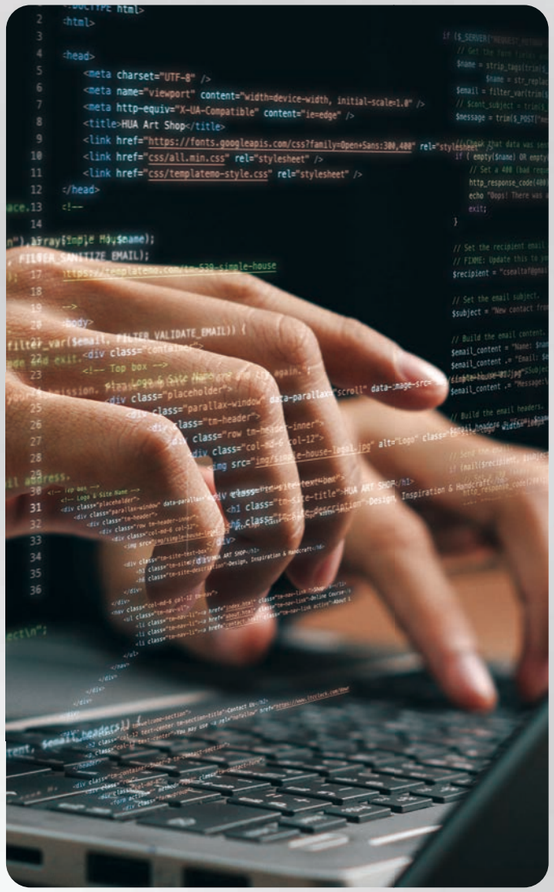
A8

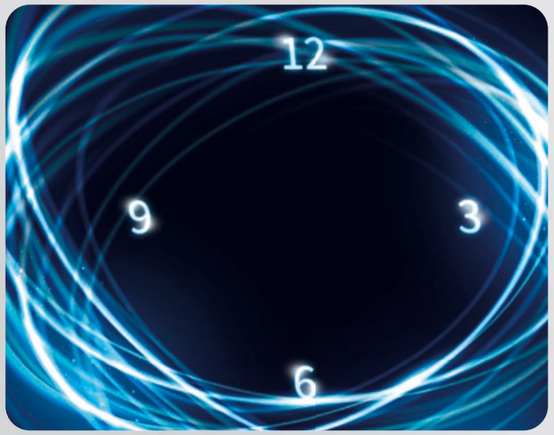
OpreX Intelligent Edge Controllers

Bulletin 34S01A11-01 EN

A8 Series

Master programming,
Master timing,
Innovate control





OpreX Intelligent Edge Controllers A8

Designed for all embedded device developers.
Innovate development with "Data stream".

{C/C++}

Write only valuable programs

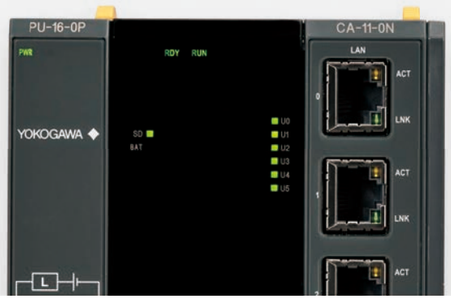
A new form of real-time control

Adopting the global standard network

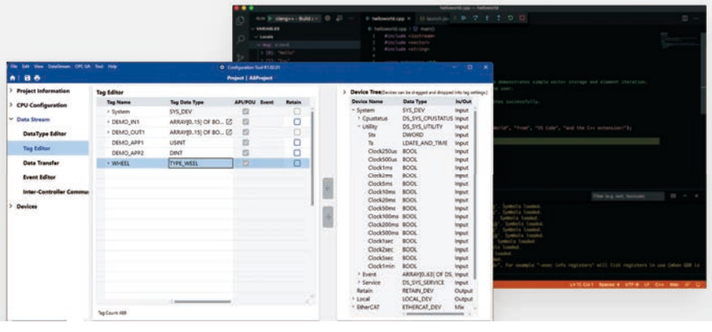
A8 Series

Write only valuable programs

A8 adopts the data stream architecture, which centrally manages all information required for control. Data stream completely separates hardware and software dependencies, enabling parallel development of design and implementation. This significantly enhances development speed and flexibility.



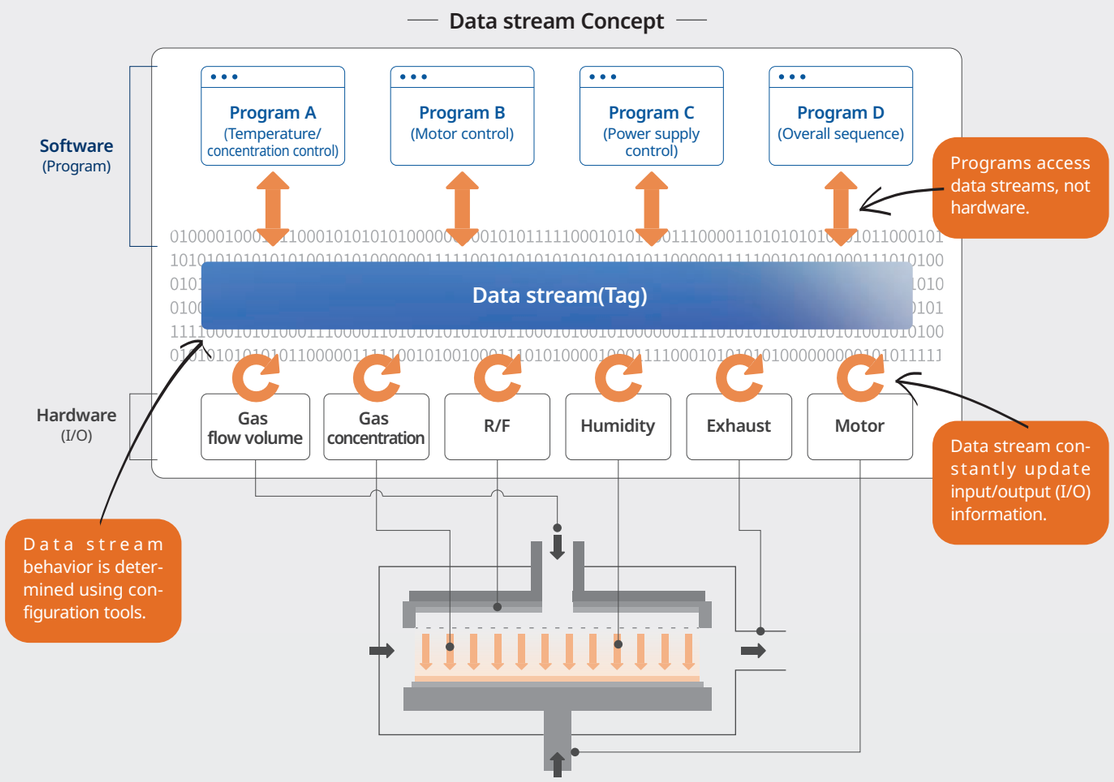
All hardware-related configurations are consolidated into a dedicated configuration tool. This allows engineers to focus on control logic without being burdened by configuration changes, reducing Time to Market.



Data stream

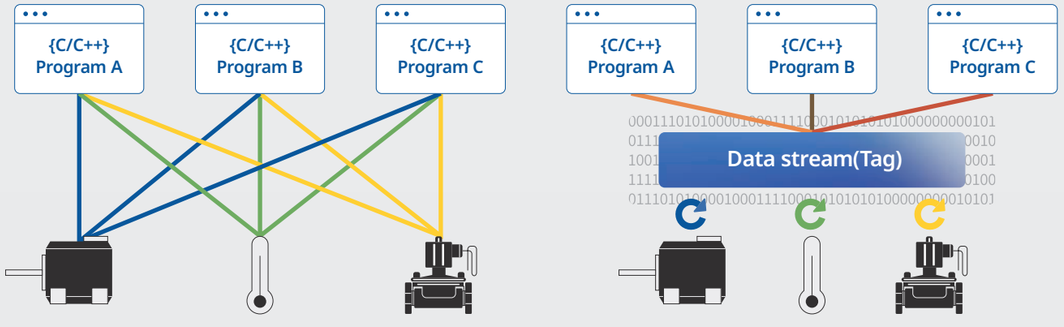
Data stream is a mechanism that automatically reflects input/output data such as I/O and communication data, enabling unified access from user programs. Programs access tag data associated with the device linked to the data stream, rather than the device itself, making data-centric programming possible.

Data stream Concept



Example Control Target (Chamber)

Relationship Between Programs and Hardware



Each program accessed via device-specific interfaces

Access via interfaces optimized for each program

Effect of Data stream

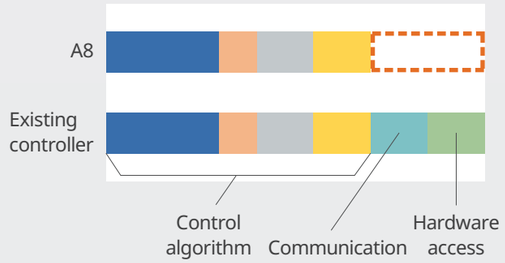
You can focus on building control algorithms.

Programs no longer require "code necessary to run control algorithms," such as I/O settings or data acquisition. Designers can concentrate on building high-value-added control algorithms.

Programs where reduction is expected

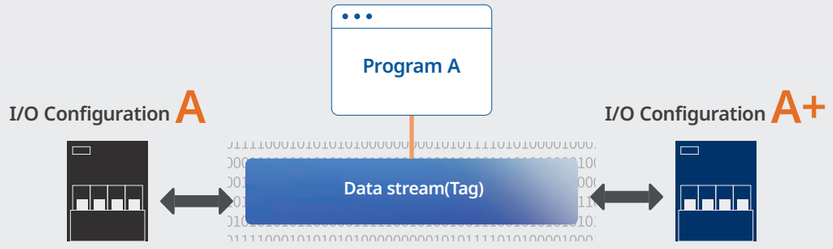
- Service initialization programs
  No need to call API or configure procedures for accessing A8-specific services like various hardware or communications.
- Event monitoring program
  Data registered as event monitoring targets automatically notifies the program of any changes in their values.
- Data Transfer Program within data stream
  Using data transfer settings, data is transferred between tags without going through the program.

Code Reduction Concept



This enhances program versatility and reusability.

The program accesses tags on the data stream. Even if changes occur in the I/O configuration, etc., they can be accommodated by adjusting the tag and I/O assignment settings in the configuration tool, thereby increasing program versatility.

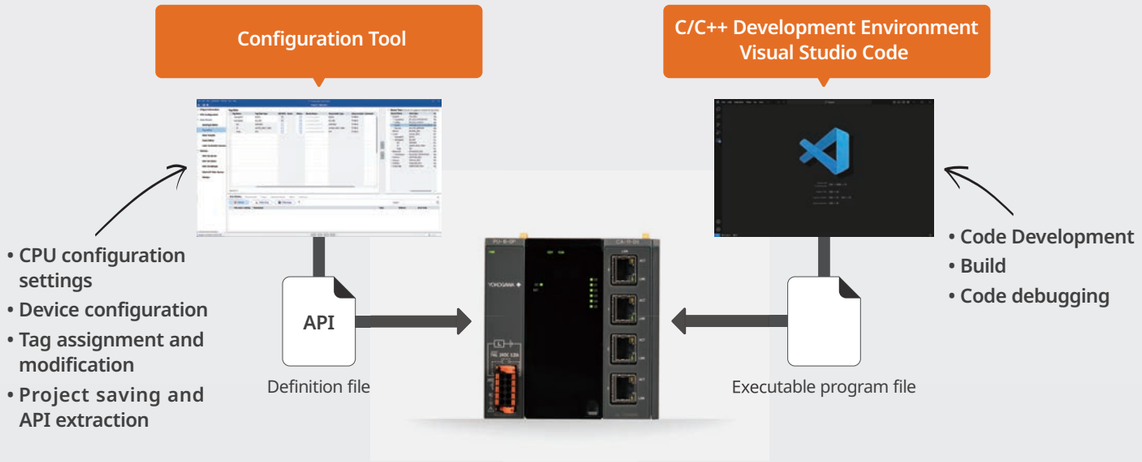


Facilitates parallel and distributed development.

The separation of hardware and software facilitates parallel development of programs and hardware, as well as distributed program development by multiple teams. This shortens device development time and enables earlier market introduction.

Development Environment

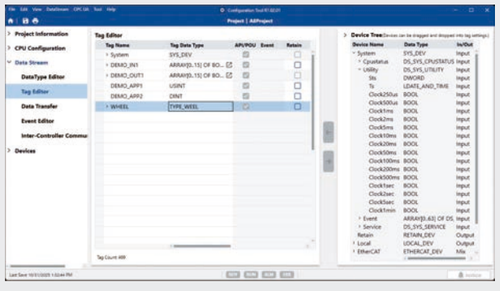
Two tools are used for application development. The configuration tool provided by Yokogawa is used to determine data stream and CPU operations. Visual Studio Code, widely used by programmers, is used for application program development. Combining these tools enables development with separation between the device and the application software.



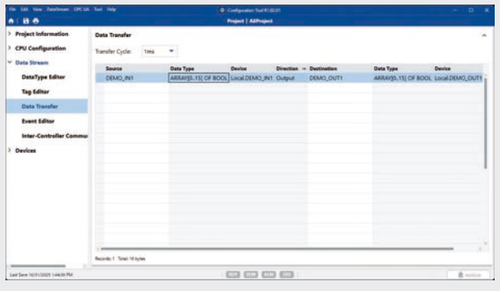
Configuration Tool

This tool determines the operation of the A8. It configures data stream behavior, communication settings for EtherCAT and OPC UA, and security settings.

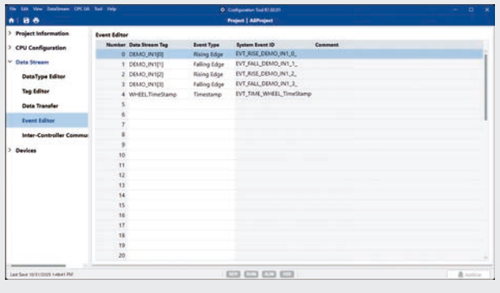
Data stream tag configuration



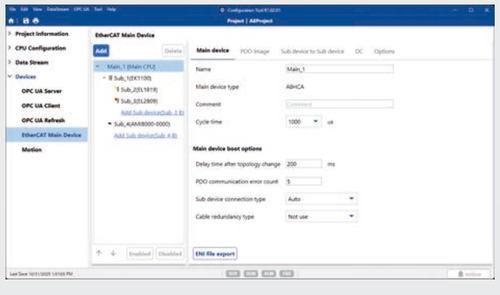
Data transfer settings



Event notification settings



EtherCAT configuration



A8 Series

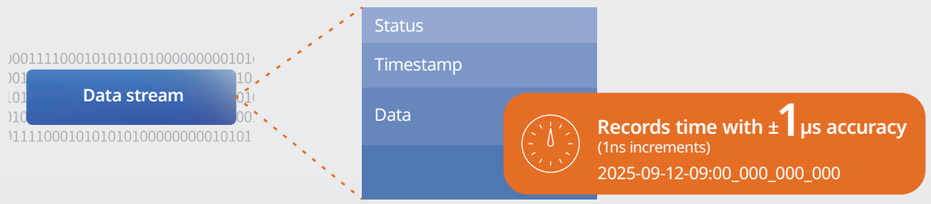
A New Form of Real-Time Control

By inter-controller synchronization across and DC synchronization across EtherCAT devices, it enables high-precision control with ±1µs accuracy. This innovative synchronization technology precisely coordinates complex operations while maintaining time consistency across the entire control system. Furthermore, the stable control foundation provided by real-time control and the utilization of metadata like timestamps achieve unprecedented "time-sensitive control".

Timestamp

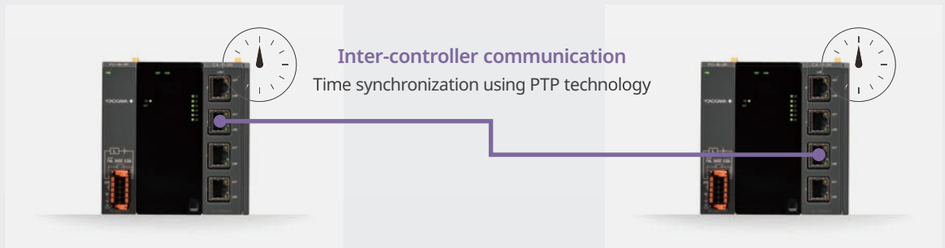
All data on the data stream is timestamped. Since timestamps can be used as event triggers, processing can be based on absolute "timestamp" rather than relative "time." This eliminates the need for timers or counters for event monitoring, simplifying programs and reducing CPU load.

Timestamp Structure



Inter-Controller Time Synchronization

Time synchronization is possible between up to 16 A8 units via inter-controller communication with time synchronization functionality. This synchronized A8 network allows each CPU to analyze device information updated by other CPUs in chronological order during its own processing. This enables distributed control that was unattainable with conventional control methods focused solely on detecting device changes.



Providing control libraries that support device control

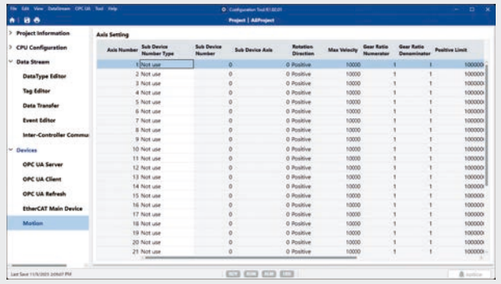
Motion Control Library

Controls up to 32 axes of motors connected via EtherCAT. The number of usable axes is limited by the selected option. (/STN: 8 axes, /ADV: 32 axes)
This library implements specifications based on function blocks defined in PLCopen Motion Control using C/C++.

Item	Specification
Interface	EtherCAT *1
Physical layer	100BASE-TX (port used for EtherCAT communication)
Number of control axes	Max. 32 axes
Control cycle	Same as the PDO communication cycle for EtherCAT communication
Sync mode	DC synchronization
Applicable CiA402 drive profiles	Cyclic synchronous position mode Homing mode

*1:Sub devices controlled by the motion control library do not support the hot connect function of EtherCAT communication.

Parameters configurable via setup tool



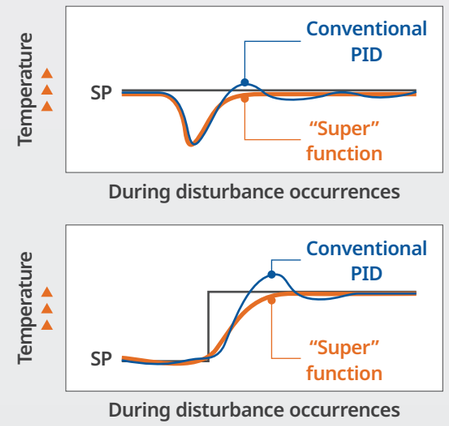
PID Control Library

This library performs PID calculations for up to 64 loops. PID control can be achieved by combining it with data measured within data stream and other user programs. This library provides PID calculations and auto-tuning functionality in API format.
The number of available loops is limited depending on the selected option. (/STN: 16 loops, /ADV: 64 loops)

Item	Specification
Control cycle	1, 2, 5, 10, 20, 50, 100, 200 ms
Operation mode	Automatic operation (AUTO) / Manual operation (MAN)
Number of control loops	Up to 64 loops
PID control mode	Standard PID control mode / Fixed-point control mode
Control output	Forward/reverse
Proportional band	0.1 to 999.9%
Integral time	OFF, 1 to 6000 sec *1
Derivative time	OFF, 1 to 6000 sec *1
Manual reset	-0.5 to 105.0%
Anti-reset windup	50.0 to 200.0%, automatic

*1:The number of decimal places can be changed when a control cycle of 10ms or less is selected.

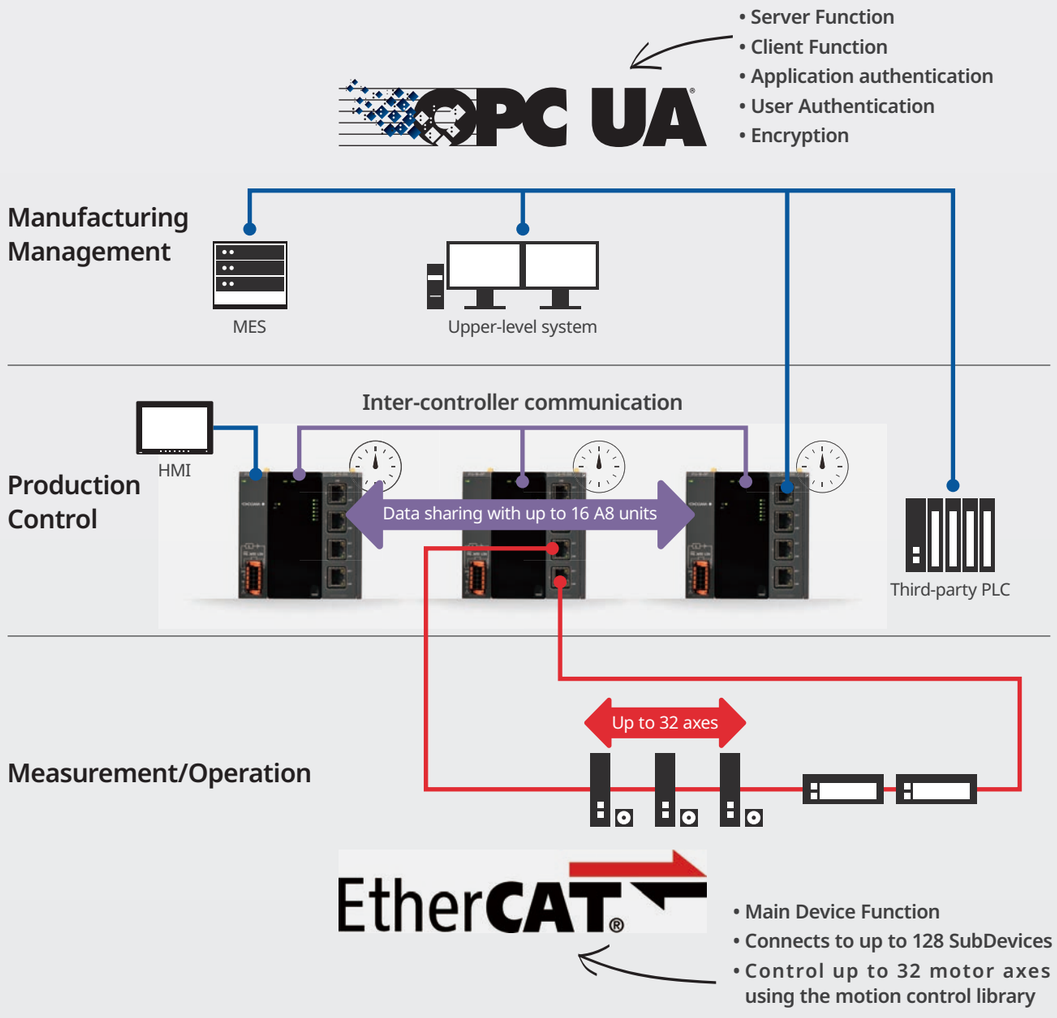
Features the "Super" overshoot suppression function inherited from Yokogawa temperature controllers



The use of the motion control and PID control libraries requires the additional specification code /STN or /ADV.

Adopts globally standard networks

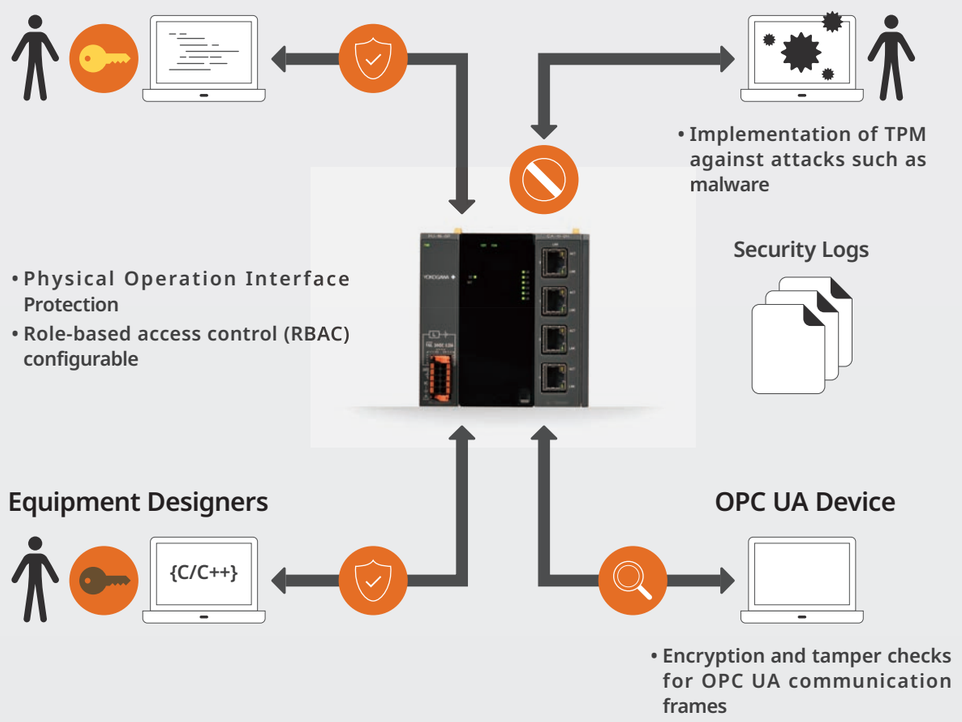
Adopts OPC UA and EtherCAT, widely used in factories worldwide. Provides secure communication with higher-level systems via OPC UA while delivering real-time control through EtherCAT.



A8 Series

Control Security

We provide reliable security features to protect your stable operation and software assets. In addition to role-based login permission settings, we implement TPM (Trusted Platform Module) as a countermeasure against malware and advanced cyberattacks.
This design offers robust defense against external threats while also flexibly accommodating the increasingly stringent security requirements expected for manufacturing equipment in the future.



Common Specifications

Item	Specification
Operating ambient temperature	0 to 55°C
Operating ambient humidity	5 to 95% RH (non-condensing)
Operating ambient atmosphere	No corrosive or flammable gases and no excessive dust
Storage ambient temperature	-25 to 75°C
Storage ambient humidity	5 to 95% RH (non-condensing)
Grounding	A8HPU-16-0P: Functional grounding
Noise immunity	EN IEC 61131-2 compliant
Withstand voltage	Specified for each module
Insulation resistance	Specified for each module
Vibration resistance	JIS B 3502:2021 and IEC 61131-2:2017 compliant Frequency: 5 to 8.4 Hz, Zero-to-peak amplitude: 3.5 mm Frequency: 8.4 to 150 Hz, Acceleration: 10 m/s^2 (1G) 10 sweep cycles in X, Y, and Z directions (1 octave/min)
Shock resistance	JIS B 3502:2021 and IEC 61131-2:2017 compliant 150 m/s^2 (15G), Operating time: 11 ms, Sinusoidal wave pulse: 3 times in each X, Y, and Z direction times in each X, Y, and Z direction
Installation	In the control panel *1
Installation altitude	2000 meters or less above sea level

*1: This product is open-type equipment. It must be installed in a metallic enclosure with an impact rating of 6.8J or more, or IK09 or more

Power Specifications

Item	Specification
Model	A8HPU-16-0P
Power supply voltage	24 VDC
Power supply voltage Variation range *1	20.4 to 28.8 VDC (-15% to +20%)
Rated input power	45 W
Inrush current	10 A max.(28.8 VDC, Ta = 25°C)
Rated output power	40 W
Rated output voltage	5.2 VDC
Rated output current	7.7 A
Protection circuit *2	Built-in time-lag fuse (non-replaceable), Reverse polarity protection circuit
Insulation resistance	5 MΩ or more at 500 V DC (between all FG terminals and the other terminals and circuit *2)
	5 MΩ or more at 500 V DC, (between all FAIL signal contact output terminals and the other terminals and circuit *3)
Withstand voltage	500 V AC for 1 minute, (between all FG terminals and the other terminals and circuit *2)
	1000 V AC for 1 minute, (between all FAIL signal contact output terminals and the other terminals and circuit *3)
Hold-up time	5 ms (24 V), 2 ms (20.4 V)
FAIL signal contact output *4	Contact rating: 24 VDC (20.4 to 28.8 VDC), Rated current: 0.25 A (0.3 A max.) ON voltage: 0.5 V, Leakage current when off: 0.1 mA
External connection *5	10-pole push-in terminal block

*1: Avoid connecting a power supply that produces over 30 VDC. Avoid connecting an AC power supply. Connecting one of these power supplies may cause a malfunction.
*2: The FAIL signal contact output terminal, 24VDC terminal, and internal circuit
*3: The FG terminal, 24VDC terminal, and internal circuit
*4: If an inductive load, such as a relay, is connected, a surge suppressor is required on the load side. Install a surge suppressor or diode near the load to ensure that the voltage applied to the FAIL signal contact output terminal does not exceed the contact rating. The FAIL signal contact output has no polarity.
*5: When wiring to this module, be sure to use the terminal block provided. A 10-pole push-in terminal block (model: A2320JT) is available as spare parts.

CPU Specifications

Item		Specification
Model		A8HCA-11-0N
CPU		Cortex-A53 (Quad 1.2GHz)
OS		Linux (Kernel 6.6.70-rt51, Ubuntu 24.04)
Endian format		Little-endian
Memory	DDR4 SDRAM	4 GB (with ECC)
	MRAM	8MB
	eMMC	16GB
Interface	Ethernet	10BASE-T, 100BASE-TX, 1000BASE-T (4 ports)
	SD *1	Supports SDHC cards, SDXC cards, and UHS-I
	USB	USB2.0 device, Type-C connector
RAS functions	Instantaneous power interruption detection	Detects instantaneous power interruption and notifies user applications.
	Watchdog timer	Monitors the operating status of user applications.
	SD card fault detection	Detects overcurrent or short circuit and cuts off card power.
	FAIL signal output	Activates the power supply module's FAIL signal contact output to notify external devices upon fault detection.
Time	RTC *2	Year, month, day, hour, minute, second, day of week ±23 ppm (@25°C), equivalent to ±60 seconds per month (battery backup)
Security		Supports TPM 2.0 and secure boot.
Indicator LEDs		Two 7-segment displays, RDY, RUN, ERR, ALM, SD, USB, BAT, U0, U1, U2, U3, U4, U5
Switches	MODE0 switch	Selects functions for boot mode.
	MODE1 switch	Selects functions for smart access.
	SET switch	Executes maintenance functions.
	RESET switch	Executes forced hardware reset.
Maximum modules installable		1 module/1 node

*1: Use an SD memory card that complies with the operating temperature range of 0 to 85°C.
*2: The valid range is from January 1, 2001, 00:00:00 to December 31, 2099, 23:59:59. Since normal operation cannot be guaranteed, do not set values exceeding the above range.

Development Environment

Configuration Tool

This tool is used for configuring, maintaining, and monitoring this controller. It handles communication settings for data streams, EtherCAT, OPC UA, and other protocols.
Provided to customers who have purchased the product via the Yokogawa Member Site Customer Portal. Prior A8 user registration application is required.

Item		Specification
Model		A8SUT-00-MW
Operating environment	PC	PC/AT-compatible
	OS	Microsoft Windows 11 (64bit) Japanese or English version
	Required software	.NET 8.0
	CPU	1 GHz or faster 64-bit processor
	Memory	8 GB or more
	HDD free space	3 GB or more
	Display	1366 x 768 pixels or higher
	Communication I/F	USB, Ethernet
	Supported printer	A4-size printer compatible with the above OS
	Supported Japanese input	Microsoft IME, etc.

SDK(Software Development Kit)

This is a software development kit for developing user programs to run within this controller.
It is provided to customers who have purchased the product via the Yokogawa Member Site Customer Portal. Prior A8 user registration is required.

Item		Specification
Model		A8SCK-00-MW
Toolchain		GCC 13 series
Operating environment	CPU module	A8HCA-11-0N
	OS	Ubuntu 24.04 or later

Programming Tools

Microsoft's Visual Studio Code is required as the coding environment for C/C++ language programs. Please obtain Visual Studio Code from the Microsoft website.

Item	Specification	Notes
Development tool	Visual Studio Code	General-purpose development tool from Microsoft
OS *1	Microsoft Windows 11 (64bit)	-
Toolchain	GCC 13 series	Installed on the SDK

*1: An operating system that runs Visual Studio Code. It depends on the version used.

Hardware List

Name	Model	Specifications	
Power supply	A8HPU-16-0P	Output capacity: 40 W, Input voltage: 24 VDC 10-pole push-in terminal block	
CPU	A8HCA-11-0N		Linux (Kemel 6.6.70-rt51, Ubuntu 24.04) Main memory: 4 GB, System memory: 8 MB, Storage: 16 GB
	Option	/NBT	No backup battery equipped
		/STN	Standard license EtherCAT, Motion control: 8 axes, PID control: 16 loops
		/ADV	Advanced license EtherCAT, Motion control: 32 axes, PID control: 64 loops

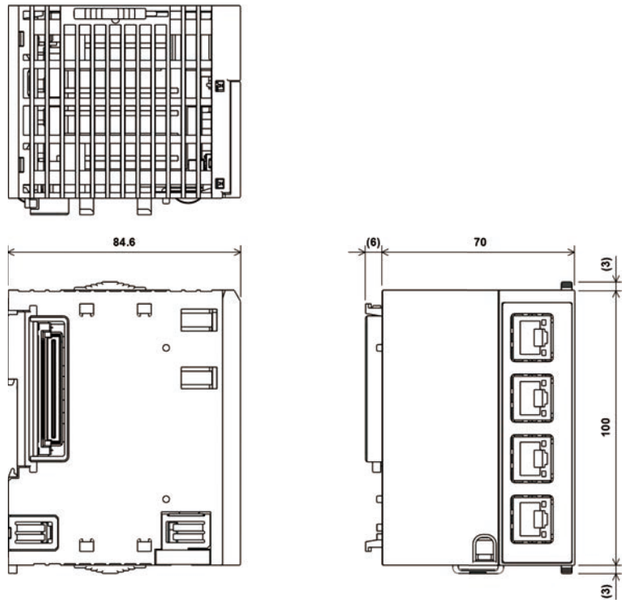
Accessory Parts List

Name	Part number	Available module
RTC backup battery	A1156EB	A8HCA-11-0N
Front cover	T9132BK	A8HCA-11-0N
End plate *1	T9132AA	A8HCA-11-0N
10-pole push-in terminal block	A2320JT	A8HPU-16-0P

*1: The end plate is included as standard with the power supply module.

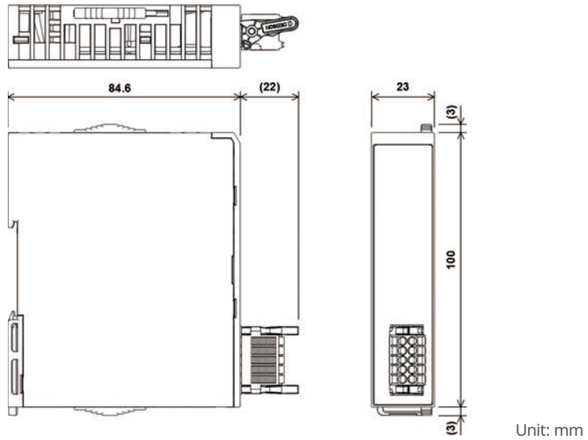
External Dimensions Drawing

CPU Module



Unit: mm

Power Supply Module



Unit: mm

A8 Website

Caution

- For proper and safe use of this product, read the instruction manual thoroughly.
- If faults of this product are expected to result in accidents or losses, install additional external protection and/or safety circuits.
- If the product is to be used in applications which may directly affect or threaten human lives and safety, such as railway facilities, aviation and space navigation, medical equipment or transport equipment, please contact Yokogawa's sales office.

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