Industrial IoT PAC Controller
HX Series

HITACHI
Inspire the Next

Modbus
EtherNet/IP
OPC

EtherCAT
CODESYS
PROFIBUS
PROFINET
DeviceNet

Automation Solutions by Hitachi

HX Series IoT Controller

The Hitachi HX series PAC Controller combines powerful features and efficiency to meet the demands of a global supply chain in manufacturing industries. In addition, HX series is already prepared for the next generation requirements in automation thanks to its IoT capabilities. Manufacturing & service innovations can be achieved with integrated functions and seamless connectivity from field machine level to cloud services.

Open standards

The Hitachi HX Series supports global manufacturing by standardized programming with 5 programming languages compatible with the IEC61131-3 international standard. The integrated EtherCAT and PROFINET master function (industrial open network) enables interconnection of a wide range of devices. Seamless data transfer from field level to cloud is achieved via OPC-Unified Architecture.

Improved processing speed

Through the effective combination of the recently developed high-performance CPU with CODESYS software, Hitachi provides sequential control (logic) and motion control on one CPU platform with very fast execution speed.

Simple & easy design environment

Next generation HX Series models are designed to provide the functionality as PAC Controller (Programmable Automation Controller) which is considered as evolution of both PLC & IPC. This enables users to achieve lower TCO (Total cost of ownership) through space reduction, lower installation, development and maintenance costs.

Communication Motion Control Sequental Control

Integrated network communication and core controls required for automated machines & production facilities

- Compatibility with IEC61131-3
- Local data logging by transmitting data to SD memory
- OPC-UA ERP coordination, MES connection, SCADA system
- Information system Ethernet (TCP / IP), IP communication, web supports
- EtherCAT motion control (Multi axes I/O control via EtherCAT)
- Supporting field networks*

*Some network requires combination use with master module.

General Overview

Flexible expansion

The functionality of the HX CPU can be expanded by adding various modules. The flexibility is given by the option to connect additional base racks using the connection port for cabinet expandability or using EtherCAT network to remote control base racks using a slave controller.

- Digital I/ O
- Analogue I/O
- Special Function Modules

Max. 5 expansion bases
Max. I/O No. 4,224 I/O points
Max. 66 I/O module
are possible to connect

Additional I/O expansion can be achieved by attaching EtherCAT slave I/O (max. 255 sets)

EtherCAT®

Model Line-up

	Hardware Specifications					Functional Features				
Standard Model HX-CP1S08	Program data memory **8 MB**	Ethernet port **2**	USB Host, device			EtherCAT master	PROFINET master			
Full Function Model HX-CP1H16	Program data memory **16 MB**	Ethernet port **3**	USB Host, device	SD Card	Serial comm. **RS-485**	EtherCAT master	PROFINET master	Web Visual-ization		
Motion Model HX-CP1S08M	Program data memory **8 MB**	Ethernet port **2**	USB Host, device			EtherCAT master	PROFINET master		Soft Motion	
CNC Motion Model HX-CP1H16M	Program data memory **16 MB**	Ethernet port **3**	USB Host, device	SD Card	Serial comm. **RS-485**	EtherCAT master	PROFINET master	Web Visual-ization	Soft Motion	CNC G-Code
Hybrid Model HXC-CP1H16	Program data memory **16 MB**	Ethernet port **3**	USB Host, device	SD Card	Serial comm. **RS-485**	EtherCAT master	PROFINET master	Web Visual-ization		C/C ++ program
Redundant Model HX-CP1H16R	Program data memory **16 MB**	Ethernet port **3**	USB Host, device	SD Card	Serial comm. **RS-485**	EtherCAT master	PROFINET master	Web Visual-ization		CPU Redund-ancy

Standard Features of all Models

Less maintenance costs

■ **Battery-less design**

Non-volatile memory is used for programming memory & data memory. The CPU can record manufacturing data without optional batteries to protect the data from sudden power failures.

■ **Fan-less design**

The CPU has no mechanical parts which need to be replaced.

Less costs for software development

■ CODESYS – globally accepted, standardized programming software
■ Easy to use for PLC beginners, computer system engineers etc.
■ Variable names can be commonly used between PLC, HMI and SCADA

Data Protection

■ **Block unauthorized access**

- Detect / Protect unauthorized external access
- Block unauthorized remote login connection
- Prevent malicious data hacking

■ **Control user access**

- Detect / Protect unauthorized external access
- Block unauthorized remote login connection
- Prevent malicious data hacking

| Online user registration | Access permission | User management |
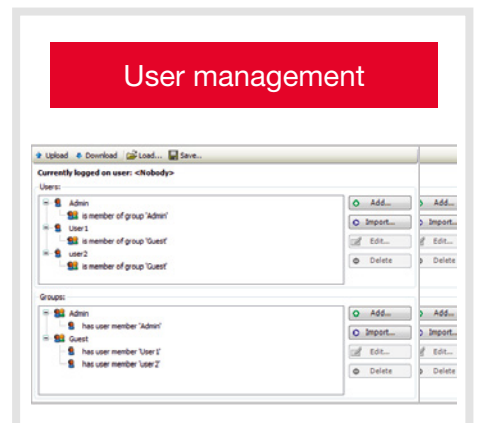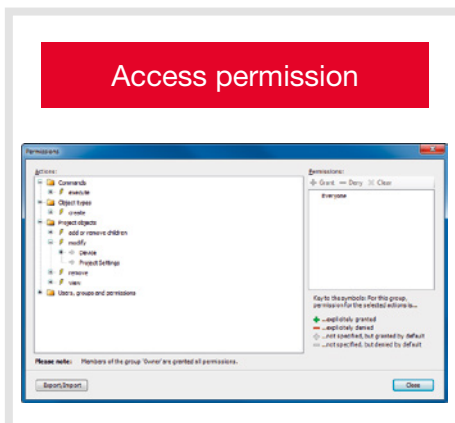
5 programming languages

- Advanced programming visualization (easy to read & understand)
- Flexible memory allocation (no need to allocate work memory address)
- Optimal language selection based on process requirements possible
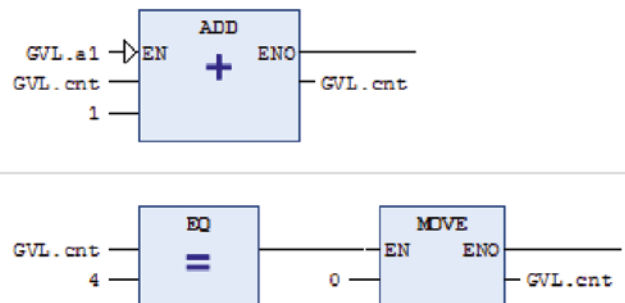- Library function which enables easy re-use of user programs

Ladder Logic Diagram (LD)

Recommended for interlock processing.
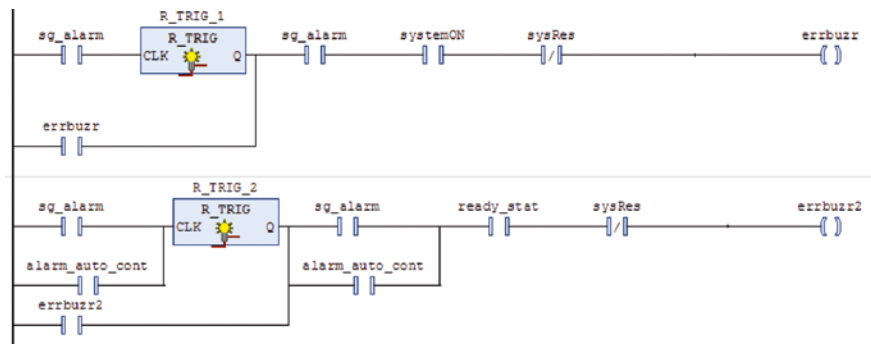
Function Block Diagram (FBD)

Graphical language easy to track command & data transfer between each function.

Structured Text (ST)

Ideal for programs having branch, repeat and calculation processes.

```
1   count_M3:=count_M3+1;
2   L2_wait_time (IN:=FALSE, PT:=T#3.6S);
3   L2_wait_time (IN:=TRUE);
4   FOR i:=0 TO count_T DO
5       K1_temp[i]:=B1_init; //Reset B1
6   END_FOR
7   IF count_Nmax <24 THEN
8       WHILE vxcount<10 DO
9           T1max:=125;  //Max.=125 digC
10      END_WHILE
11  END_IF
12  B100status:=FALSE;  //B100 complete
```

Instruction List (IL)

Memonic language. Best for the use of short programs and high speed calculation.

```
LD          sg_alarm
OR (        TON_1.Q
ANDN        doorclose
AND         alw_d_open
)
AND         ready_start
OR          lampcheck
ST          spare5
CAL         R_TRIG_1(
        CLK:= sg_alarm)
LD          R_TRIG_1.Q
OR          errbuzr
AND         sg_alarm
```
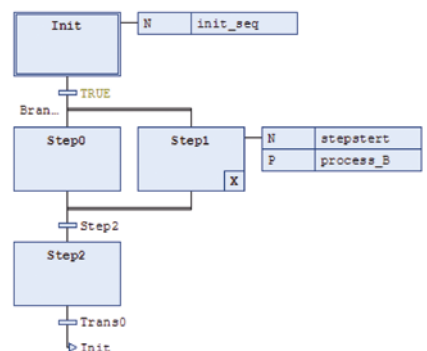
Sequential Function Chart (SFC)

Easy to show state transition.

Features of Full Function Model

Large size data logging (SD Card)

Non-volatile memory is used for programming memory & data memory. The CPU can record manufacturing data without optional batteries to protect the data from sudden power failures.

Web visualisation (Monitoring via Web Browser)

Easy remote access to the controller´s web server to monitor the application status without preparing a customized HMI. Potential cost reduction for hardware and on site resources through off site monitoring.
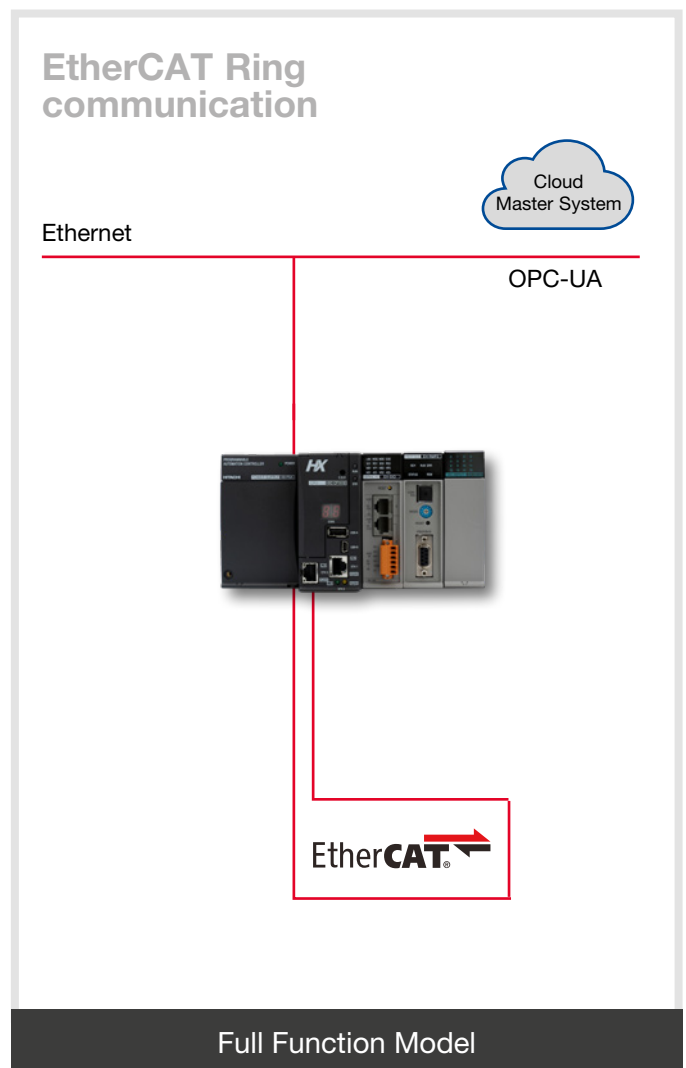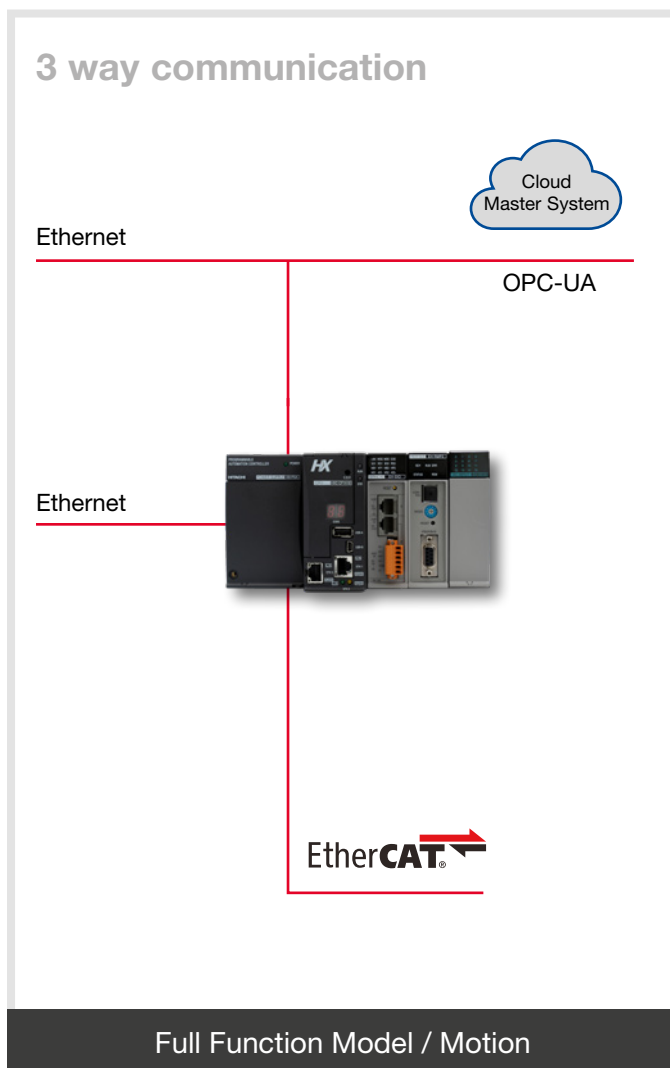
- Web server function prepared as standard
- No requirement of customized HMI
- Availability of monitoring via standard web browser
- Remote maintenance, diagnosis and control can be also achieved
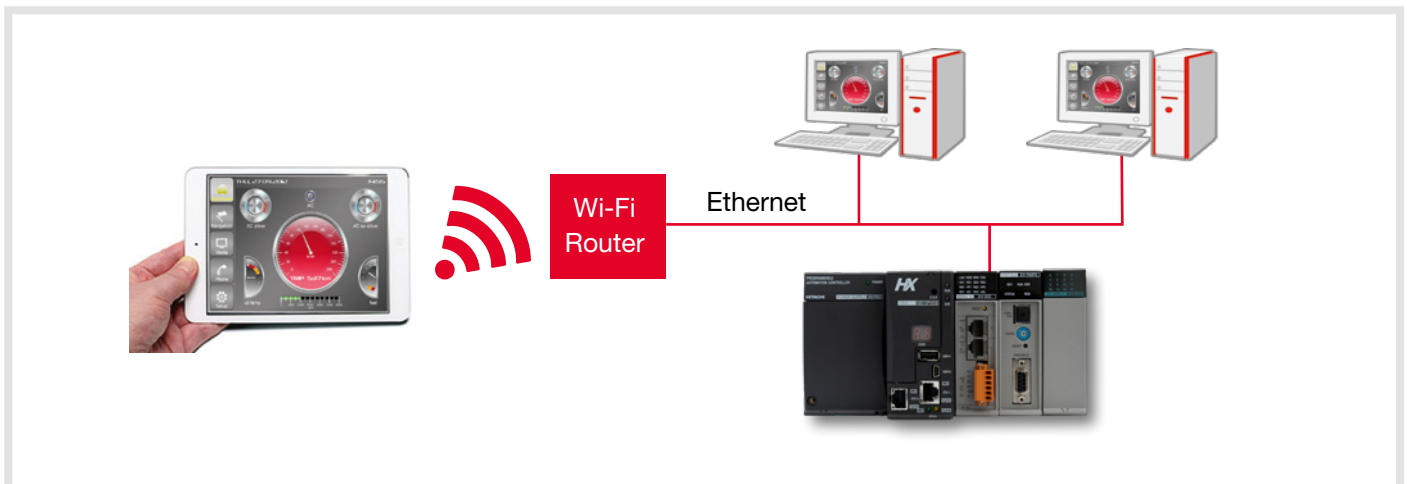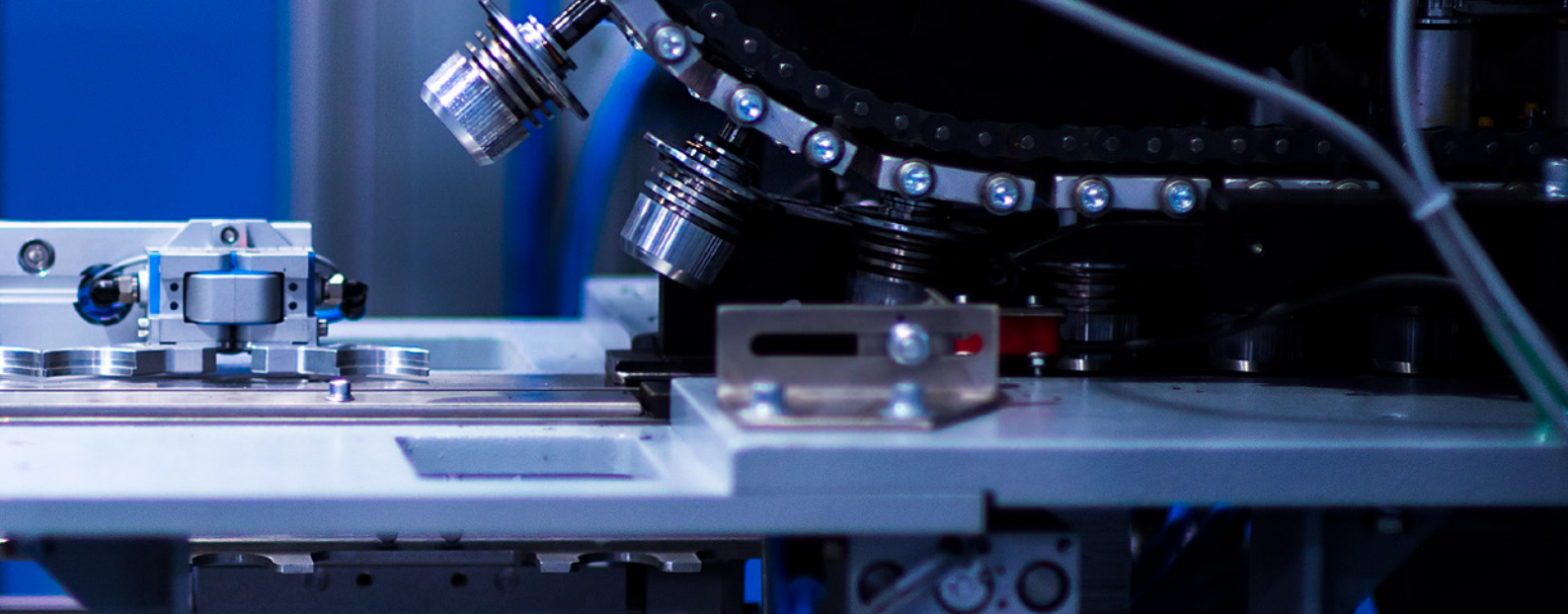
3 Ethernet ports as standard

- Various communication modes between master, controller and slave units by one CPU
- Depending on its connection combination, various topologies are possible

3 way communication

Ethernet

Cloud Master System

OPC-UA

Ethernet

EtherCAT

Full Function Model / Motion

EtherCAT Ring communication

Ethernet

Cloud Master System

OPC-UA

EtherCAT

Full Function Model

Redundant Model

HX-CP1H16R

- CPU redundancy by direct Ethernet based connection between 2 redundant CPU's
- Applications which require high availability can be realized
- Local and remote I/O can be used and will be controlled by the active CPU
- Continuous checking of active and stand-by CPU
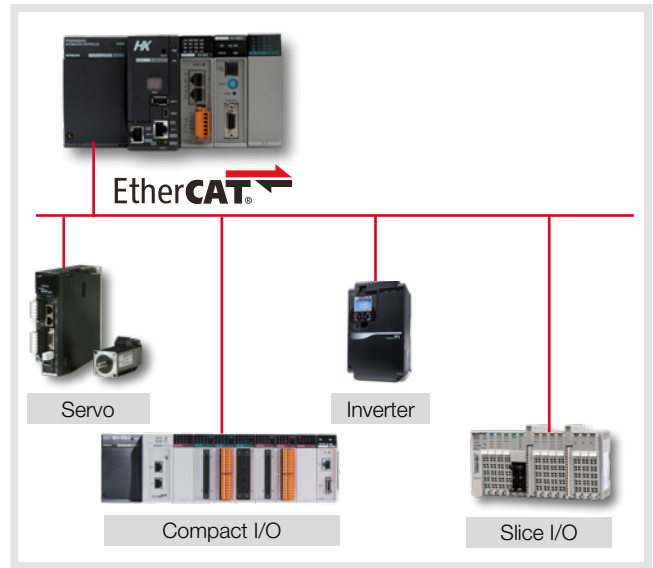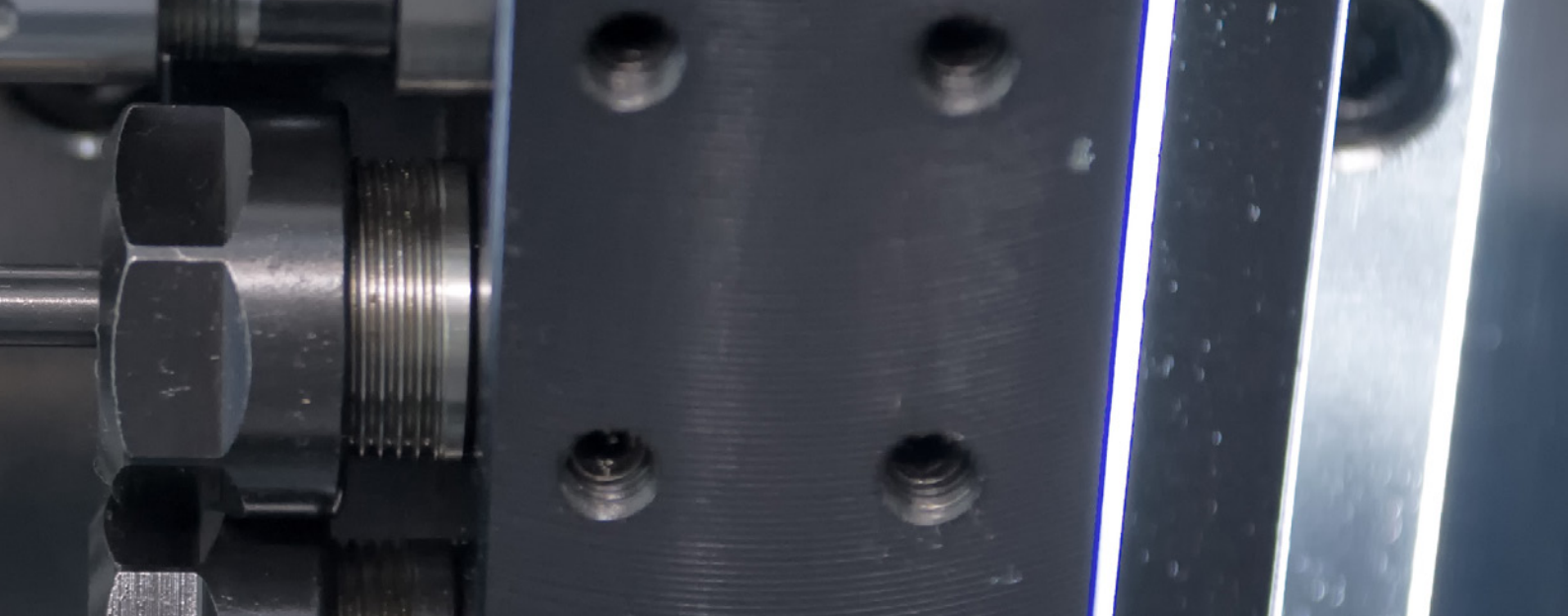- Additional 2 LAN ports are available for general purpose such as EtherCAT or communication to OPC clients
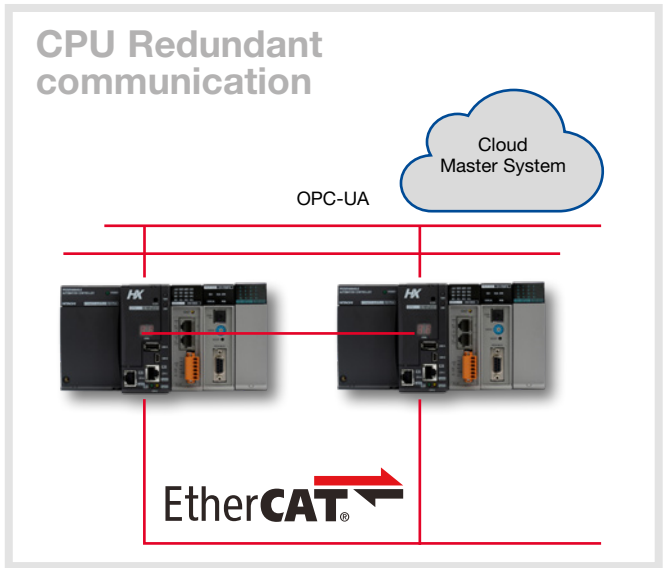
Motion Model & CNC Motion Model

HX-CP1S08M / HX-CP1H16M

PLCopen based Motion control function block
- Position, velocity & acceleration control for simple single axis or for synchronized control of multiple axes, using graphical editor prepared for electronic cam function
- Motion simulation with a virtual axis function
- Motion and logic on one CPU
- LAN port supports motion functionality
- A variety of slaves such as inverters or remote I/O may be controlled via EtherCAT
- On CNC Motion Model, a SoftMotion CNC package is available with multi axes coordinated functions for CNC & robots

CPU Redundant communication

OPC-UA

Cloud Master System

EtherCAT®

EtherCAT®

Servo

Inverter

Compact I/O

Slice I/O

## Function blocks for PLCopen based motion control

In addition to PTP position control in single axis use, interpolation and synchronized control of multiple axes, the HX Series enables speed and torque control in combination with feedback data.

Motion control applicable for PLCopen standard Single Axis Part I and II Master/Slave Axis (e.g. MC_CamIn, MC_GearIn, MC_Phasing etc.)
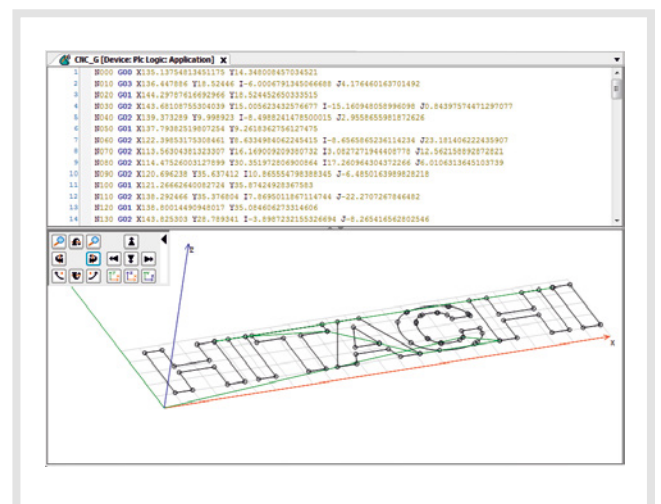
CAM editor

- Create cam table using the CAM editor
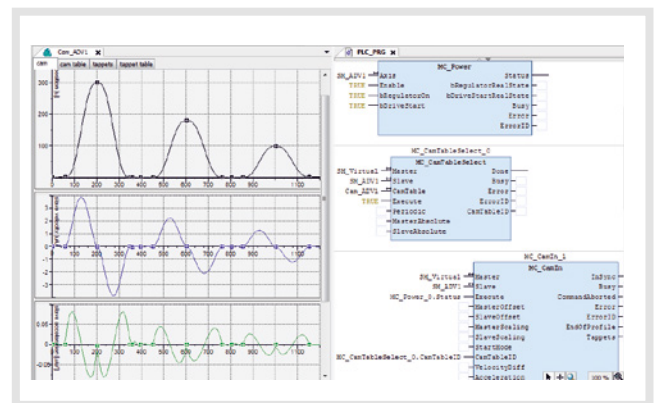
CNC (G code), available on CNC Motion Model only

- Trajectory control by G code.
  Possible to read out coordinates from DXF files.
  Examples: X-Y table, Multiple joint robots, Tripod robots

HX Standalone CPU Series

The HX Standalone CPU versions is a dedicated development according to the industrial market demands. Focussing on technology and CPU performance led to a reduced system design to achieve savings in cost and cabinet space.

- Enables the opportunity to use the HX CPU Units without the needs of a separate base rack and power supply
- Up to 3 Ethernet Interfaces for maximum on field connectivity
- Best choice for IoT applications and solutions with no demands on directly connected I/O modularity such as...
    - IoT gateway capability
    - High power and reliable edge computing solution using C/C++
    - Communication master on the field level network
    - Web server and Web Visualization application
    - Powerful Motion Controller using EtherCAT or PROFINET Master Functionality
- Easy integration with less demand on cabinet space
- Use of 24VDC or 12VDC power supply

Standalone Model

Standard Model	HX-CP1S08-0	
Full Function Model	HX-CP1H16-0	
Motion Model	HX-CP1S08M-0	
CNC Motion Model	HX-CP1H16M-0	
HX Hybrid Model	HXC-CP1H16-0	

Modbus
OPC
PROFINET®
EtherCAT®
EtherNet/IP
PLCopen motion control

Specifications of Standard Features

Item	Standard Model HX-CP1S08 / -0	Full Function Model HX-CP1H16 / -0	Motion Model HX-CP1S08M / -0	CNC Motion Model HX-CP1H16M / -0	Redundant Model HX-CP1H16R	Hybrid Model HXC-CP1H16 / -0
User program memory	8 MB	16 MB	8 MB	16 MB		
Data memory (non-retain)	8 MB	16 MB	8 MB	16 MB		
Data memory (retain)	0.5 MB					2 MB
Max. number of expansion bases**	5					
Available expansion cables**	0.5 m, 1 m, 2 m					
Max. expansion distance**	Max. 2 m between bases, total max. 8 m					
Max. number of I/O modules per base**	Max. 11 (excl. power supply module and CPU module)					
Maximum I/O (using 64 point I/O module)**	4,224 I/Os					
Processing time — Bit operation (min.)	1.0 ns					
Processing time — Double-precision floating point (min.)	6.6 ns					
Programming languages	IEC61131-3 compliant 5 languages (LD / FBD / SFC / IL / ST) + CFC (Continuous Function Chart)					
C program — Adaptation of C / C++ program	–					✓
C program — Data sharing	–					✓
C program — Web server for application management	–					✓
I/O updating cycle	Refresh processing					
Available features — OPC-UA	✓	✓	✓	✓	✓	✓
Available features — Web visualization	–	✓	–	✓	✓	✓
Available features — NTP (network time protocol)	✓	✓	✓	✓	✓	✓
Available features — FTP Server	✓	✓	✓	✓	✓	✓
Available features — EtherCAT Master	✓	✓	✓	✓	✓	✓
Available features — (communication cycle)	min. 1 ms					
Available features — Modbus-TCP Client/Server	✓	✓	✓	✓	✓	✓
Available features — Modbus-RTU Master/Slave	✓ ***	✓	✓ ***	✓	✓	✓
Available features — PROFINET Master	✓	✓	✓	✓	✓	✓
Available features — EtherNet/IP Scanner	✓	✓	✓	✓	✓	✓
Available features — SoftMotion (PLCopen compliant + CAM editor)	–	–	✓	✓	–	–
Available features — CNC (G Codes)	–	–	–	✓	–	–
Available features — CPU redundancy	–	–	–	–	✓	–
Standard input output interface — Ethernet port	2 ports	3 ports	2 ports	3 ports		
Standard input output interface — SD memory card slot	–	✓	–	✓	✓	✓
Standard input output interface — RS-485 Serial comm. port	–	✓	–	✓	✓	✓
Standard input output interface — USB host (USB Memory)	✓	✓	✓	✓	✓	✓
Standard input output interface — USB device (CODESYS protocol)	✓	✓	✓	✓	✓	✓
Realtime clock	Built-in RTC (deviation ±60 s / month at 25 °C)					
Battery (option for RTC)	HX-BAT (for RTC)					
Maintenance functions	Self-diagnosis (CPU error, Watch-dog timer error, Memory / Battery error, etc.)					

* EH-SIO serial module required
** Not included in Standalone Model

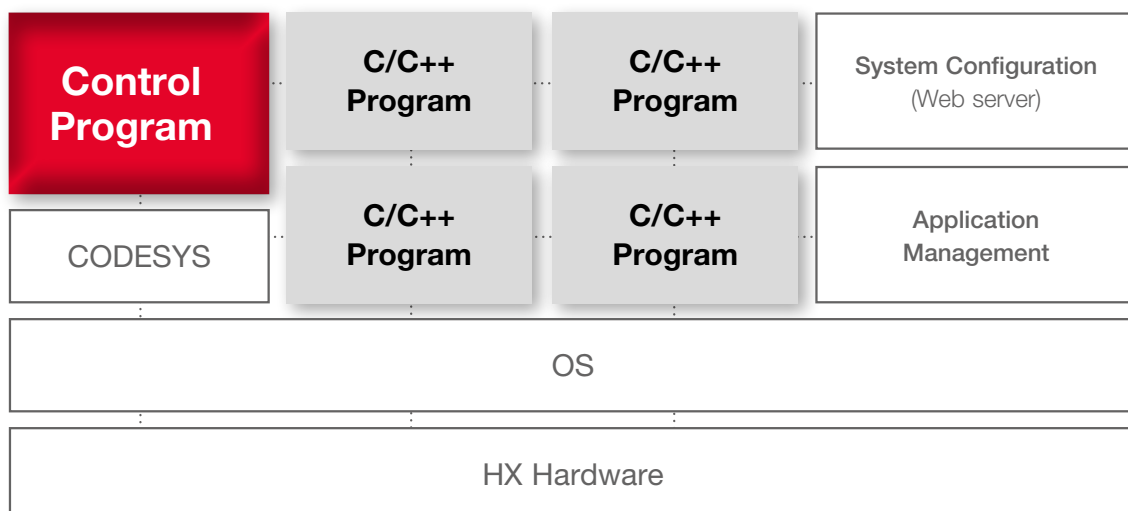# HX Hybrid Series

Hitachi's HX Hybrid CPU has been develop for special applications with a high focus of advanced solutions within the framework of the Industrial Internet of Things. Controlling IT and OT application within one solution enables the best possible use of resources.

HX Controller Hybrid Model adapts to Industrial IoT

- Hybrid Model CPU offers a large range of advanced features and functions to achieve a IoT solution
- Controlling of OT applications with the use CODSYS V3 runtime while controlling IT applications with the use of 4 independent operating C/C++ programs simultaneously on one hardware
- Shared variable container allows the bi-directional exchange of variables between OT and IT application in real time without interruption of the process

- It allows the adjustment and processing of C/C++ programs in parallel with control program without impact and keep controller operation stable in the control system
- Available as HX Hybrid CPU for base rack usage if an IO system is needed or available as standalone version, if the focus is on the CPU performance for features and functionality

Hardware Architecture

Control Program	C/C++ Program	C/C++ Program	System Configuration (Web server)
CODESYS	C/C++ Program	C/C++ Program	Application Management
OS			
HX Hardware			

Virtual Controller Information

HX Series Module List

Item	Model	Specification
Power supply modules	HX-PSA	AC power supply 100 – 240 V, output DC 5 V, 3.8 A, external DC 24 V, 0.4 A
	HX-PSD	DC power supply 24 V, output DC 5 V, 4 A, 24 V – 0.2 A
Base racks	EH-BS3A	Base / Expansion rack with 3 I/O slots
	EH-BS5A	Base / Expansion rack with 5 I/O slots
	EH-BS6A	Base / Expansion rack with 6 I/O slots
	EH-BS8A	Base / Expansion rack with 8 I/O slots
	EH-BS11A	Base / Expansion rack with 11 I/O slots
Input modules	EH-XD8	8 points, DC 24 V input, removable terminal block
	EH-XD16	16 points, DC 24 V input, removable terminal block
	EH-XD32	32 points, DC 24 V input, connector type
	EH-XD32E	32 points, DC 24 V input, removable spring type terminal block
	EH-XD64	64 points, DC 24 V input, connector type
	EH-XA16	16 points, AC 100 – 120 V input, removable terminal block
	EH-XAH16	16 points, AC 200 – 240 V input, removable terminal block
Output modules	EH-YT8	8 points, transistor output, DC 12 / 24 V, sink type, removable terminal block
	EH-YT16	16 points, transistor output, DC 12 / 24 V, sink type, removable terminal block
	EH-YT32	32 points, transistor output, DC 12 / 24 V, sink type, connector type
	EH-YT32E	32 points, transistor output, DC 12 / 24 V, sink type, removable spring type terminal block
	EH-YT64	64 points, transistor output, DC 12 / 24 V, sink type, connector type
	EH-YTP8	8 points, transistor output, DC 12 / 24 V, source type, removable terminal block
	EH-YTP16	16 points, transistor output, DC 12 / 24 V, source type, removable terminal block
	EH-YTP16S	16 points, transistor output, DC 12 / 24 V, source type, short circuit protection, removable terminal block
	EH-YTP32	32 points, transistor output, DC 12 / 24 V, source type, connector type
	EH-YTP32E	32 points, transistor output, DC 12 / 24 V, source type, removable spring type terminal block
	EH-YTP64	64 points, transistor output, DC 12 / 24 V, source type, connector type
	EH-YR8B	8 points, individual relay output, AC 100 / 240 V, DC 24 V, removable terminal block
	EH-YR12	12 points, relay output, AC 100 / 240 V, DC 24 V, removable terminal block
	EH-YR16	16 points, relay output, AC 100 / 240 V, DC 24 V, 16 points / 1 common, removable terminal block
	EH-YS16	16 points, triac output, AC 100 / 240 V, removable terminal block

Item	Model	Specification
Analogue input modules	EH-AX44	12 bit analogue input, 4 – 20 mA, voltage 0 – 10 V, each 4 channel
	EH-AX8V	12 bit analogue input 8 ch., voltage 0 to +10 V
	EH-AX8H	12 bit analogue input 8 ch., voltage −10 to +10 V
	EH-AX8I	12 bit analogue input 8 ch., current 4 – 20 mA
	EH-AX8IO	12 bit analogue input 8 ch., current 0 – 22 mA
	EH-AXH8M	14 bit analogue input 8 channel, 0 – 22 mA, 4 – 22 mA, −10 to +10 V, 0 to 10 V
	EH-AXG5M	Insulation, 16 bit analogue input 5 channel, 0 – 22 mA, 4 – 22 mA, −10 to +10 V, 0 to 10 V
	EH-PT4	4 channel RTD (Pt 100 / Pt 1000) input, signed 15 bit
	EH-RTD8	8 / 6 channel RTD (Pt 100 / Pt 1000) input, signed 15 bit
	EH-TC8	8 channel thermocouple input module (K, E, J, T, B, R, S, N), signed 15 bit
Analogue output modules	EH-AY22	12 bit analogue output, 4 – 20 mA, 0 to 10 V, each 2 channel
	EH-AY2H	12 bit analogue output 2 channel, voltage −10 to +10 V
	EH-AY4V	12 bit analogue output 4 channel, voltage 0 to +10 V
	EH-AY4H	12 bit analogue output 4 channel, voltage −10 to +10 V
	EH-AY4I	12 bit analogue output 4 channel, current 4 – 20 mA
	EH-AYH8M	14 bit analogue output 8 channel, 0 – 22 mA, 4 – 22 mA, 0 to 10 V
	EH-AYG4M	Insulation, 16 bit analogue output 4 channel, 0 – 22 mA, 4 – 22 mA, −10 to +10 V, 0 to 10 V
Counter modules	EH-CU	2 channel high speed counter input, max frequency 100 kHz
		1 / 2 phase switchable, 4-point open collector output
	EH-CUE	1 channel high speed counter input, max. frequency 100 kHz
		1 / 2 phase switchable, 2-point open collector output
Positioning module	EH-POS	1 axis pulse positioning module, 400k pulse / second
Communication modules	EH-SIO	Serial communication module (RS-232C / RS-422 / 485, Modbus protocol)
	EH-RMP2	Profibus-DP master module
	EH-RMD2	DeviceNet scanner module
	EH-LNK	CPU link module, coaxial cable
Dummy module	EH-DUM	Module for open slots