

## iCube Control<sup>TM</sup>

The new machine controller ecosystem





## Built for you

Whether you want the flexibility of open system design, the scalability of modular system integration or the certainty of security and safety—you get it all with the iCube Control platform. With one controller, built to perform impeccably over the life of your system.

iCube Control is the open automation machine control solution, based on the PLCnext technology running on a realtime Linux system that gives engineers, application developers, machine builders and designers total control over their systems, delivering:

## Flexibility

- Program in IEC61131-3, along with high-level languages
- · Collaborate securely across teams and geographies
- Choose from a wide variety of Yaskawa servo technology matched to your application

## Scalability

- One machine controller and one software engineering tool for Motion, Logic, Safety, HMI and Robotics
- Scale controller features to meet your specific application requirements
- Easily integrate additional components with open network communications

## Certainty

- Engineered to ensure the highest quality and longterm product life cycle
- Integrated FailSafe over EtherCAT for a complete machine safety solution
- Secure controller communications and web-based management

## Expert support

- Expert engineering resources, from design to development
- Quick, nimble and thorough response, from concept to implementation
- Delivered by Yaskawa, the world's largest manufacturer of robotics and automation systems

## i<sup>3</sup>-Mechatronics

Yaskawa is a pioneer in developing connected devices that enhance productivity and production flexibility. iCube Mechatronics stands for:

## Integrated

Smart products that enable the collection and analysis of real-time data

## Intelligent

Big Data analysis and AI learning deliver new ways of optimizing the production process at every level

### **Innovative**

Insights gained from the production process trigger improvements to production and quality



## iCube Control architecture overview



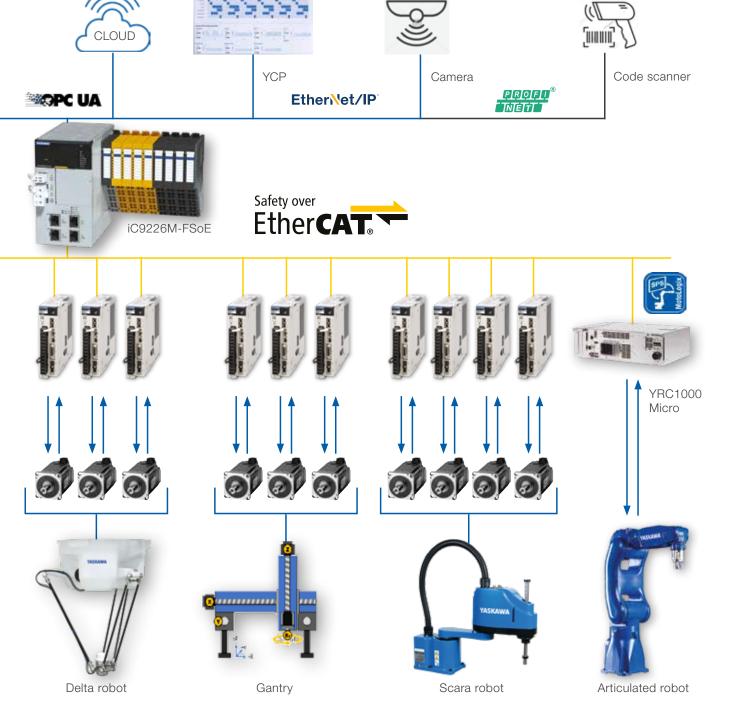




Safety over

## Your system for full control

- One machine controller and one software engineering tool for Motion, Logic, Safety, HMI and Robotics
- Integrated EtherCAT machine controller and EtherCAT (FSoE) Safety Master
- Compatible with a broad range of Yaskawa mechatronics technology

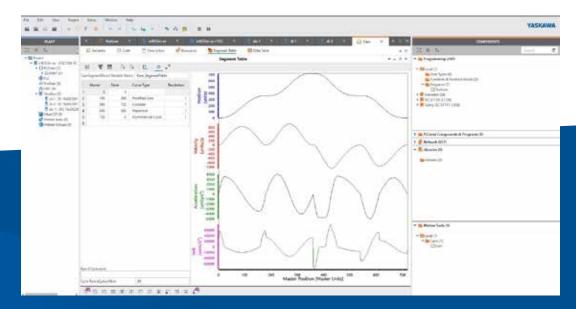


## iCube Engineer

## Engineered for your opportunities

Open up your possibilities and develop more efficient solutions. Designed for collaborative working, iCube Engineer gives developers the freedom to program function modules in the language of their choice.





## Integrated environment

- Motion, Robot, Logic, VFD and HMI
- Fully integrated SIL3 safety programming
- · Network configuration, diagnostics and security

## Open programming

- IEC61131-3 graphical, structured text or SFC programming
- Create libraries with C#, C++ and other high-level languages

## Control system security

Device certificates and multi-user password protection

## Collaborative

- Managed program access for multiple developers
- · Online editing and version detection

## The machine controller for all

A single machine controller for motion, logic, kinematics, safety, security and more. The iC9200 is ready for any challenge you face today and that you will face tomorrow.





- 3 core ARM Cortex-A17 1.26 GHz processor for fast processing of synchronous motion tasks
- High-speed DDR4 memory and eMMC flash
- Integrated real-time Ethernet network support

## Safety over EtherCAT

- Integrated EtherCAT machine controller and EtherCAT safety master
- FSoE network safety profile meeting SIL3 requirements

## Control system security

- Secure web-based management with multi-level password protection
- Secure OPC UA communications
- Designed for network security certification per ISA/IEC 62443

## Network communications



### Flexible I/O

• Expandable local I/O using standard SLIO Slice I/O



# Connectivity designed for You

Built to provide real-time data acquisition, processing, communication and feedback.

## Worldwide connectivity

- Easy web-based access from any internet-connected location
- Change settings from remote

## Reduced maintenance costs

- Monitor variables, status, diagnostics, and alarms from any web browser
- Download new programs to the controller without any Yaskawa software
- Upgrade controller and amplifier firmware
- · Monitor Servo axis position, velocity and torque
- Live display and setting of I/O values

## Flexible access

· Connect via computer or mobile device

## Secure access

YASKAWA

 HTTPS and password-based user logins with multiple levels of access



## The integration of motion and robotics



YASKAWA

Singular Control<sup>™</sup> delivers integrated control for Delta, SCARA, 6-axis, Gantry and customer-specific mechanisms.

## A complete mechatronic continuum

 Motion axes, standard mechanisms, robots, and custom mechanisms running interchangeably under the same controller and application code

## Familiar programming

- Program robots with ladder logic and function blocks
- No proprietary robot programming language

## Integrated control

 Control all types of mechanisms with one software engineering tool using the same function blocks

## Machine flexibility

• Swap mechanism type with minimal changes to application code

### Future enabled

- Easily upgrade to new mechanisms
- Migrate your machine IP as your technology progresses



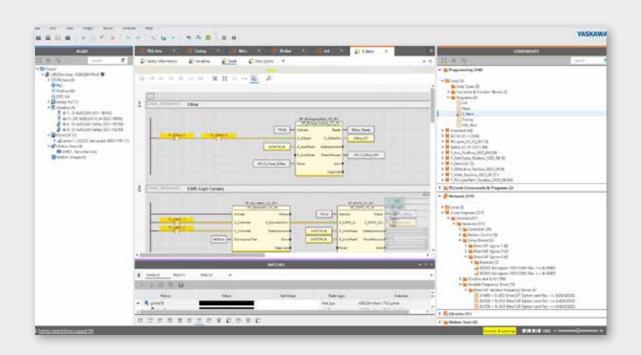
## Get the certainty of safety, security and supply

iCube Control combines automation technology with the certainty of machine safety you need to operate successfully, all in one fully integrated platform.

The iC9200 machine controllers are available with an integrated EtherCAT (FSoE) safety master, eliminating the need for an external safety PLC and allowing all safety and non-safety EtherCAT devices to be integrated onto a single network.

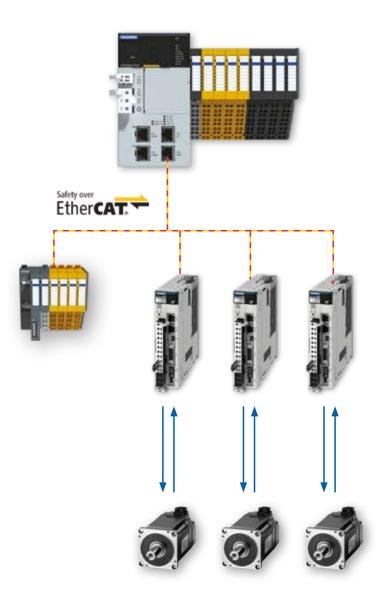
Safety applications are programmed using certified safety function blocks in iCube Engineer, allowing you to use a single software engineering tool for programming safety and non-safety logic and motion.





SLIO safety input and output modules can be mounted directly to the iC9200 controller or remotely on an EtherCAT fieldbus module.

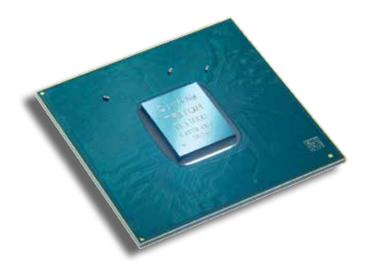
Yaskawa Servopacks featuring the Advanced Safety Module provide safe motion, meeting SIL3 requirements.

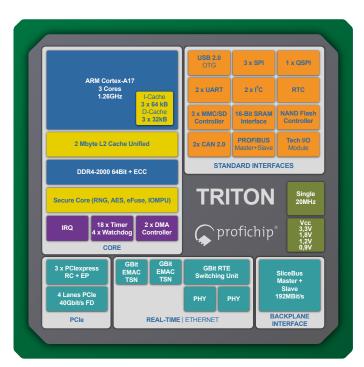




# TRITON - the IloT powerhouse

The iC9200 machine controllers are powered by the Triton processor. They are designed by Yaskawa specifically for demanding machine control applications, including multi-axis synchronized motion. The controller supports multiple modern field buses and provides a feature set that can be tailored to meet your specific requirements.





Technical Data	TRITON
Processor type	3 × ARM Cortex A17 cores up to 1.26 GHz
Floating point unit per core	64-bit
Cache	64/32 kB instruction/data cache 2 MB of L2 cache (with ECC)







## Hardware model options

Model	iC9226M-EC	iC9226M-FSoE
Network Master	EtherCAT (CoE, FoE, EoE)	EtherCAT (CoE, EoE, FoE) EtherCAT Safety (FSoE)
Fieldbus Support	OPC UA Client, Server, Pub/Sub EtherNet/IP Scanner and Adapter PROFINET IO RT PROFINET I-Device Modbus TCP Client/Server	
Connections	2 × 100 Meg 24 VDC Power SD Memory	it Ethernet jabit Network Supply (Input) y Card Slot or local SLIO Modules
Processor	Triton ARM Cortex-A17 1.	26 GHz, 3 Core Processor
Memory	Flash Memory: 4 GB eMMC SDRAM: 2 GB DDR4 Program Memory: 12 MB Data Storage Memory: 32 MB Retained Data Storage: 3 MB MRAM	
Synchronized Axis Count	Up to 64 Real and	d 64 Virtual Axes

## System requirements for iCube Engineer

License type	Professional license	Free trial version	
Duration	Unlimited	30-days	
Operating System	Windows 10 (64-	-bit) > build 1709	
Languages Supported	English,	German	
SW Platform	.NET Fram	nework 4.8	
Harddisk	Min. 2	. Gbyte	
RAM (DDR4)	Min. 8	Min. 8 Gbyte	
CPU	Min. Inte	el Core i5	
Graphic Card	Min. MS Dire	Min. MS DirectX 9 WDDM	

## Open programming

You can program the iCube controller using the language you know best: either standard IEC61131-3 languages, like graphical languages (SFC, FBD or NOLD) and textual language (ST), or high level languages (C++, Python, Java, Mathlab, ...). It's your choice.

## **NOLD** Editor

The safety CPU is programmed in the NOLD Editor.



## SFC Editor

Sequential Function Chart (SFC) is one of the standardized languages of IEC61131-3 and supported by iCube Engineer. SFC allows you to graphically create program organization in terms of steps, actions and transitions.



## ST Editor

The ST editor is a text editor and is used to implement code in Structured Text (ST) and Extended Structured Text (ExST).



## Safety in LD Editor



## Function Block Diagram (FBD) Editor



## High Level Languages

Our new iCube Engineer development environment opens up countless new possibilities for the development of solutions. Designed for collaboration, it gives developers the freedom to develop function modules in the language of their choice.







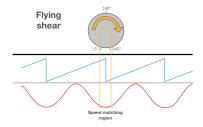




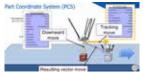
## Software solutions

## Flying Shear

A flying shear application cuts a moving web of material into predetermined lengths "on-the-fly," without stopping the material web. The cutting tool must be precisely synchronized with the material web, otherwise the cut may take place at the wrong position or be incomplete, leading to material scrap and downtime.



## **Conveyor Tracking**



Conveyor tracking is needed for picking parts with a robot arm from a moving conveyor without stopping the convey-

## MotoLogix

Via the MotoLogix library, you can control articulated arms (= Motoman Robots) with standard PLCopen FBs written in the iCube in IEC61131-3 language. So, you don't need a proprietary



robotic programming language any longer. We can control several robots with only 1 TeachPendant or HMI.

## Case Packing Toolbox

Path Generator Function block generates robot path based on case size, product dimensions, and pack patterns. Data-driven structure allows ease-of-use without sacrificing flexibility. Path Processor executes and coordinates motion sequencing and error recovery.

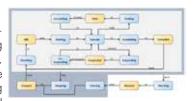
## MotoPick Software

For picking, sorting, transfer, collation, singulation, tray fill. A software solution that combines everything necessary for successful picking operation.



## **PackML**

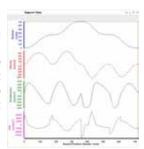
PackML is the contraction of Packaging Machine Language. The primary objective of PackML is to bring a common "look and



feel" and operational consistency to all machines that make up a Packing Line (Note: Can be used for other types of discrete process).

## Camming

Cam applications are used in a non-linear relationship between the master and slave servo where the cam input matches the position of the master, and the cam output matches the slave position.



### Compass

Yaskawa Compass™ is the direct route to a more effective operator interface, pointing CNC machine builders to a solution that is quick and easy to implement and even easier to customize.



### IO-Link

 $\ensuremath{\mathsf{IO}\text{-}\mathsf{Link}}$  is a fieldbus independent Point-to-Point interface for the connection of actuators and sensors. It is

easy to integrate in every existing fieldbus system. The SLIO IO-Link module enables communication



between the iCube Controller and IO-Link capable field devices such as sensors and actuators according to IEC 61131-9.

### Palletsolver

This software is a PC-based pattern generation tool to optimize pallet efficiency. It includes 2D and 3D vision guidance for inspecting products, identifying shapes to define the picking strategy. Line tracking enables product handling while it is still moving on the conveyor to optimize your productivity.

## Servo Drives

Precision. Dynamics. Quality.

## Servo motors - 200 V models

## **SGMXJ**



- Medium inertia High speed
- 50 W 750 W
- 7000 rpm

## SGMXG



- Medium inertia High speed
- 300 W 15 kW
- 4000 rpm

## SGMXA



- Low inertia High speed
- 50 W 7 kW
- 7000 rpm

## **Direct Drives**

Direct drive products save space, eliminate backlash and cut component costs, adding extra mechanical strength to stiffen dynamic applications.

## Direct drives - 200 V models

## SGM7F



- With core, inner rotor
- Rated: 2 Nm 200 Nm Peak: 6 Nm - 600 Nm

## SGM7E



- · Coreless. inner rotor
- Rated: 2 Nm 35 Nm Peak: 6 Nm - 105 Nm

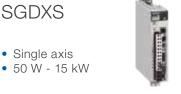
## SGM7D



- · Medium capacity, with core
- Rated: 1.3 Nm 240 Nm Peak: 4 Nm - 400 Nm

## Servopacks - 200 V models

## **SGDXS**



## **SGDXW**



## **SGDXT**

- Triple axis
- 50 W 400 W (per axis)



The leading manufacturer of servo motors brings more than 30 years of design innovation into each rotary servo. Choose from a wide range of sizes, speeds and torque ratings, then add an amplifier and an MPiec controller to create a complete motion automation system.

## Servo motors - 400 V models







## Direct Drive Linear

Maximum speed and acceleration for linear motion. Choose from four designs to reduce compliance, replace mechanical linkages and create a better fit for your application.

## Direct drives linear - 200 V and 400 V models







## Servopacks - 400 V models





## AC Drives

Variable frequency drives for industrial applications

## General application drives

## GA700 Premium Drive



- 200 VAC 3ph: 0.55 110 kW
- 400 VAC 3ph: 0.75 630 kW

## GA500 Compact Drive



- 200 VAC 1ph: 0.1 4 kW
- 200 VAC 3ph: 0.1 22 kW
- 400 VAC 3ph: 0.4 30 kW

## Application specific drives

CR700 Premium Crane Drive



• 400 VAC 3ph: 0.55 – 315 kW

## LA700 Premium Lift Drive



- 200 VAC 3ph: 4.0 110 kW
- 400 VAC 3ph: 4.0 160 kW

## LA500 Compact Lift Drive



- 200 VAC 3ph: 4.0 18.5 kW
- 400 VAC 3ph: 4.0 22 kW

## HV600 HVAC Drive



## FP605 Pump & Fan Drive



- 400 VAC 3ph: 1.5 160 kW
- 400 VAC 3ph: 1.5 355 kW

With world-leading quality and technology, Yaskawa delivers AC drives that help preserve the environment, support comfortable lifestyles, and improve the efficiency and productivity of industrial machines all over the world.

## Regenerative drives

## U1000 Matrix Drive

• 200 VAC 3ph: 4.0 – 55 kW

• 400 VAC 3ph: 2.2 – 500 kW

## D1000 AFE Unit



• 200 VAC 3ph: 5.0 – 130 kW

• 400 VAC 3ph: 5.0 – 630 kW

## R1000 Intelligent Braking Resistor



• 400 VAC 3ph: 3.5 - 300 kW

## Multi-Protocol Ethernet option

The Multi-Protocol Ethernet option card (JOHB-SMP3) is a single circuit board option card for Yas-kawa AC drives that contains multiple Ethernet protocols. You can use a series of configuration switches on the circuit board to select the correct protocol for your application.

## JOHB-SMP3

- BACnet/IP
- EtherCAT
- EtherNet/IP
- ProfiNet
- Modbus TCP/IP
- MECHATROLINK-4



## SLIO I/O modules

Compact. Intelligent. Flexible.

The most effective decentralized I/O system available, SLIO is designed to help you modernize and standardize while retaining a sense of flexibility. SLIO can help reduce setup time and minimize user errors.





## Side mounting

Mount SLIO I/O directly to an iC9200 series controller using the controller's integrated Slice Bus.

## Reconfigure without wiring

Updating or amending a SLIO system is as easy as removing an existing module and snapping in a new one. System functions can be changed without removing the wiring from the contact block.





## High speed backplane bus

Achieve reaction times as fast as 20 microseconds with the SLIO high speed backplane bus. Connect as many as 64 modules at a time, while maintaining speeds up to 48 Mbit/s.

lotoufoa	
	ce modules
053-1PN01	PROFINET Coupler
053-1DP00	PROFIBUS Coupler
053-1EC01	EtherCAT Coupler
053-1IP01	EtherNet/IP Coupler
053-1MT01	Modbus TCP Coupler
053-1ML00	MECHATROLINK-III Coupler
053-1ML40	MECHATROLINK-IV Coupler
053-1CA00	CANopen Coupler
	modules
001-1BA00	Potential distributor module 8x DC 24V
001-1BA10	Potential distributor module 8x DC 0V
001-1BA20	Potential distributor module 4x DC 24 V, 4x DC 0 V
Functio	n modules
050-1BA00	1x 32 Bit(AB) DC 24 V, DO 1x DC 24 V 0.5 A
050-1BA10	1x 32 Bit(AB) DC 5 V 2 MHz
050-1BB00	2x 32 Bit(AB) DC 24 V
050-1BB30	2x 32 Bit(AB) DC 24 V ECO
050-1BB40	2x 24 Bit DC 24 V 600 kHz, Frequency measurement
050-1BS00	1x SSI, RS422, 8 32 Bit, 1x DI, 1x CO, 1x CI
054-1BA00	1x Stepper 24 V 1.5 A, 1CH (2 DO), Feedback (2 DI)
054-2BA10	1x Stepper 24-48 V 5 A, 1CH (1 D0 / 3 DI)
054-1CB00	1x DC Mot 24 V 1.5 A, 2 CH (2 D0), Feedback (2 DI)
054-1DA00	1x PulseTrain RS422, 0-1000 kHz, 24 V DC, Feed-
060 14400	back (2 DI)
060-1AA00	Line extension module, Master 2 m
060-1AA01 060-1BA00	Line extension module, Master 10 m  Line extension module, Slave 2 m
061-1BA00	Line extension module, Slave 2 m
-	
040-1BA00	unication processors RS232C, ASCII, STX/ETX, 3964R, Modbus, PtP
040-1DA00	RS422/485, ASCII, STX/ETX, 3964R, Modbus, PtP
040-10A00 042-11000	IO-Link Master, 4 channels, Standard-I/O (SIO) or
042 11000	IO-Link Modus
Digital	input modules
021-1BB00	DI 2x DC 24V
021-1BB10	DI 2x DC 24 V 2 μs 4 ms
021-1BD00	DI 4x DC 24 V
021-1BD10	DI 4x DC 24 V 2 µs 4 ms
021-1BD40	DI 4x DC 24 V 3-wire
021-1BD50	DI 4x DC 24 V NPN
021-1BD70	DI 4x DC 24 V Time stamp
021-1BD80	DI 4x DC 24V Time stamp NPN
021-1BF00	DI 8x DC 24 V
021-1BF01	DI 8x DC 24 V 0.5 ms
021-1BF50	DI 8x DC 24 V NPN
021-1BF51	DI 8x DC 24V 0.5 ms NPN
021-1BH00	DI 16x DC 24 V
021-1DF00	DI 8x DC 24 V Diagnostic
021-1DF50	DI 8x DC 24V Diagnostic NPN
Digital:	Safety input modules
021-1SD00	DI 4x DC 24 V Safety / PROFIsafe
021-1SD10	DI 4x DC 24 V Safety / FSoE
Power	supply
007-1AB00	DC 24 V 10 A
007-1AB10	DC 24 V 4 A   DC 24 V +5 V/2 A
007-1AB10 007-0AA00	DC 24 V 4A   DC 24 V +5 V/2A DC 24 V Only electronic module

Digital	output modules
022-1BB00	DO 2x DC 24 V 0.5 A
022-1BB90	DO 2x DC 24 V 0.5 A PWM
022-1BD00	DO 4x DC 24 V 0.5 A
022-1BD20	DO 4x DC 24 V 2 A
022-1BD50	DO 4x DC 24 V 0.5 A NPN
022-1BD70	DO 4x DC 24V 0.5A Time stamp
022-1BD80	DO 4x DC 24V 0.5A Time stamp NPN
022-1BF00	D0 8x DC 24 V 0.5 A
022-1BF50	DO 8x DC 24 V 0.5 A NPN
022-1BH00	DO 16x DC 24V 0.5 A
022-1BH50	DO 16x DC 24V 0.5A NPN
022-1DF00	DO 8x DC 24V 0.5 A Diagnostic
022-1HB10	D0 2x Relay DC 30 V / AC 230 V/3 A
022-1HD10	DO 4x Relay DC 30 V / AC 230 V/1.8 A
	Safety output modules
022-1SD00	DO 4x DC 24V 0.5 A Safety / PROFIsafe
022-1SD00	D0 4x DC 24 V 0.5 A Safety / FNot isale
Analog	
031-1BB10	Al 2x12Bit 0(4)20mA ISO, 2-wire, potential separat-
031-1BB30	ed per channel Al 2x 12 Bit 010 V
031-1BB30 031-1BB40	Al 2x 12 Bit 0(4) 20 mA
031-1BB40 031-1BB60	Al 2x 12 Bit 0(4) 20 mA 2-wire
031-1BB00 031-1BB70	Al 2x 12 Bit -1010 V
031-1BB70 031-1BB90	Al 2x 16 Bit thermo coupler
031-1BD30	Al 4x 12 Bit 010 V
031-1BD30	AI 4x 12 Bit 0(4) 20 mA
031-1BD70	Al 4x 12 Bit -1010 V
031-1BD80	AI 4x 16 Bit R RTD, 2x 3/4-wire
031-1BF60	Al 8x 12 Bit 0(4) 20 mA
031-1BF74	Al 8x 12 Bit -1010 V
031-1CA20	Al 1x 16 Bit DMS, 1x 4/6-wire
031-1CB30	Al 2x 16 Bit 010 V
031-1CB40	Al 2x 16 Bit 0(4) 20 mA
031-1CB70	Al 2x 16 Bit -1010 V
031-1CD30	AI 4x 16 Bit 010 V
031-1CD35	Al 4x 16 Bit 010 V, Reduced parameter bytes
031-1CD40	AI 4x 16 Bit 0(4) 20 mA
031-1CD45	Al 4x 16 Bit 0(4) 20 mA, Reduced parameter bytes
031-1CD70	AI 4x 16 Bit -1010 V
031-1LB90	Al 2x 16 Bit thermo coupler
031-1LD90	AI 4x 16 Bit R RTD, 2x 3/4-wire
031-1PA00	AI 1x 3 Ph 230/400 V 1 A SLIO Energy measure-
	ment module
031-1PA10	AI 1x 3 Ph 230/400 V 1/5 A
Analog	output modules
032-1BB30	AO 2x 12 Bit 010 V
032-1BB40	AO 2x 12 Bit 0(4) 20mA
032-1BB70	AO 2x 12 Bit -1010 V
032-1BD30	AO 4x 12 Bit 010 V
032-1BD40	AO 4x 12 Bit 0(4) 20 mA
032-1BD70	AO 2x 12 Bit -1010 V
032-1CB30	AO 2x 16 Bit 010 V
032-1CB40	AO 2x 16 Bit 0(4) 20 mA
032-1CB70	AO 2x 16 Bit -1010 V
032-1CD30	AO 4x 16 Bit 010 V
032-1CD40	AO 4x 16 Bit 0(4) 20 mA
032-1CD70	AO 4x 16 Bit -1010 V

## HMI products

The smartest choice for usability, performance and connectivity.

## smartPanel

The slim design and rugged resistive touch screen are ideal for everyday industrial applications.

### **Features**

- ARM Cortex-A8 1GHz Processor
- Robust and durable-IP66 protection rating (front)
- Linux system environment

Model Number	Specifications
H41-A1A41-0	4.3", 480 × 272 px, Linux OS, HMI Designer
H71-A1A41-0	7", 800 × 480 px, Linux OS, HMI Designer
HA1-A1A41-0	10", 1024 × 600 px, Linux OS, HMI Designer



## Panel PC

Equipped with the latest performance features and a precise, responsive capacitive touchscreen for outstanding usability in a small space.

## **Features**

- Intel Celeron J1900 4 x 2.0 GHz processor
- Large integrated work memory
- Familiar Windows system environment
- Numerous interfaces for every application need
- Fanless construction and high-quality metal housing

Model Number	Specifications
67K-RTPO-KJ	10.1", 1280 × 800 px, Windows 10 IoT EP, HMI Designer
67P-RTP0-KJ	15.6", 1366 × 768 px, Windows 10 IoT EP, HMI Designer
67S-RTP0-KJ	21.5", 1920 × 1080 px, Windows 10 IoT EP, HMI Designer

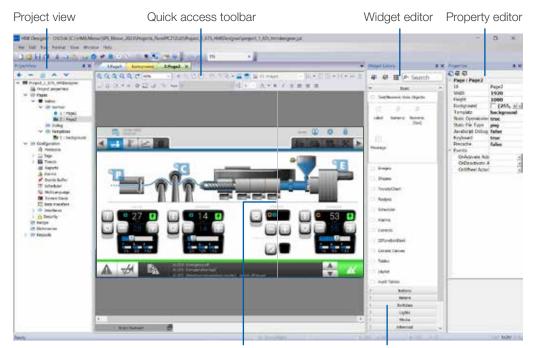


## HMI Designer

Integrated HMI development environment

HMI Designer is an HMI development environment that is included with iCube Engineer at no additional cost. It is available as a stand-alone version also for use with MPiec products using the Modbus/TCP driver.

Projects can run on smartPanels, PanelPCs, PCs, iC9200, or HTML5 web panels and iCube Engineer OPC UA tags will synchronize with the HMI project.



Snap to grid alignment tool

Widget gallery

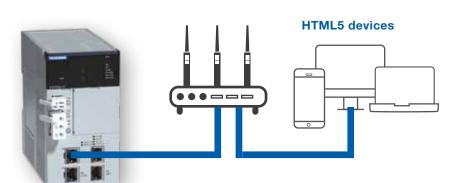
### **Features**

- 200+ drivers (HMI can act as a protocol converter)
- Recipe Manager
- Alarm Handling
- JavaScript
- Trending
- Datalogging
- Project simulation
- OPC UA online browsing
- OPC UA tags synchronize with iCube Engineer projects
- Projects on Yaskawa panels
- · Projects on PCs
- Project on iC9200
- Modbus/TCP tag import from Motionworks IEC project

## HMI project on iC9200

- iC9200 hosts the HMI project (WebVisu)
- Uses iCube resources (3-core processor, memory)
- Generic HTML5 device used for viewing
- iC9200 is selected as the target
- If "unified" project is selected (default), same project can be sent to controller or HMI panel









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