

Development of the *SANMOTION C S200* Motion Controller

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1. Introduction

In recent years, IoT technologies have been increasingly used in various industries to improve productivity and quality. To ensure efficient, stable production, motion controllers must be capable of detecting changes in the operating status and the ambient environment of equipment to allow users to monitor the conditions of production sites. Controllers are also required to collect and store real-time error data in the event of a failure to minimize recovery time.

Against this backdrop, we developed a motion controller that accurately monitors the operating status of equipment and enables users to remotely perform maintenance.

This article introduces the main functions and features of the *SANMOTION C S200* (hereinafter, “new product”)—the latest addition to the *SANMOTION C* motion controller lineup.

2. Product Overview

2.1 External view

Figure 1 shows the new product and Figure 2 shows its external dimensions.



Fig. 1 The *SANMOTION C S200* motion controller

It comes with a DIN rail⁽¹⁾ for easy installation on a control panel.

(1) DIN stands for Deutsche Industrie Norm (German Institute for Standardization). The DIN rail is a metal rail that conforms to this standard.

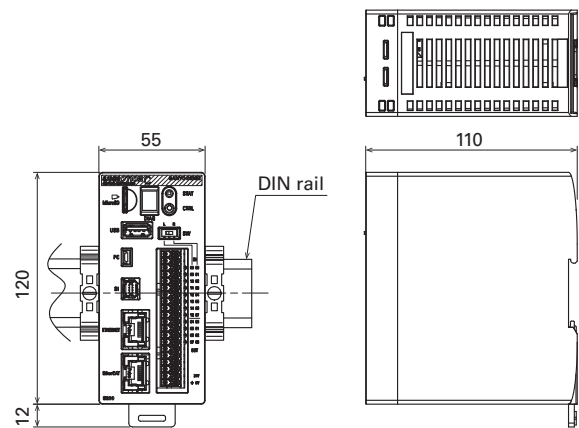


Fig. 2 Dimensions of the new product (Unit: mm)

2.2 Specifications

Table 1 shows the product lineup and general specifications, and Figure 3 shows a system configuration example.

The new product is available in two models: an advanced model for complex interpolation control and a basic model specialized in PTP (Point-to-Point) positioning control.

Both models support EtherCAT (as master), Ethernet, RS-485, and 1-Wire⁽²⁾ communications to connect to sensor devices from which environmental data can be collected. Furthermore, the USB (Type-A) port can connect to both memory storage media and a webcam for obtaining image data. It comes with a built-in microSD card slot as standard for recording and storing equipment status changes and error log data.

It is also equipped with MQTT⁽³⁾ communication and authentication functions to facilitate connection to cloud systems for storing the recorded data.

Table 1 General specifications

Items	Advanced model	Basic model	
Interface	EtherCAT (100 Mbps) master function, FoE-compatible		
	Ethernet (10/100/1000 Mbps) protocols (Modbus TDP, OPC UA, Ethernet/IP)		
	RS-485 (9600 to 115200 bps), 1-Wire (15400 bps, half-duplex bidirectional communication)		
	USB 2.0: Type A (for memory storage and webcam), Mini-B (for PC)		
	MicroSD card slot (up to 32 GB)		
Digital input/output	Digital input: 16 points, 24 VDC, positive/negative common input Digital output: 8 points, 24 VDC, 0.5 A/point, sinking output		
Analog output	Analog output: 2 points, output range 4 to 20 mA, resolution 4000		
Input power supply	19.2 to 30 VDC, 0.9 A (main power supply) 19.2 to 30 VDC, 140 mA or more (I/O power supply)		
Power consumption	22 W		
Cooling method	Passive air cooling		
Dimensions (W × H × D)	55 × 120 × 110 mm		
Mass	300 g		
Control functions	Sequence control Motion control (Electronic cam and gear, linear interpolation, circular interpolation) Robot control: CNC function (Cartesian coordinate, SCARA, parallel link)	Sequence control Motion control (PTP control)	
	Control language	Programming languages conforming to international standard (IEC 61131-3) G-code (complies with DIN 66025)	
Network functions	Web-based data visualization ⁽⁴⁾		
	Edge Gateway		
	MQTT protocol		
	Email notification (SMTP protocol)		
	Web-based application		
Compliance with standards	UL/cUL	UL 61010-1, 3rd Ed., UL 61010-2-201, 2nd Ed. CSA C22.2 No. 61010-2-201:18, 2nd Ed., CSA C22.2 No. 61010-1-12, 3rd Ed.	
	EMC Directive	EN 61131-2:2007	
	UKCA Mark	EN 61131-2:2007	
	KC Mark	KS C 9610-6-4:2017, KS C 9610-6-2:2019	

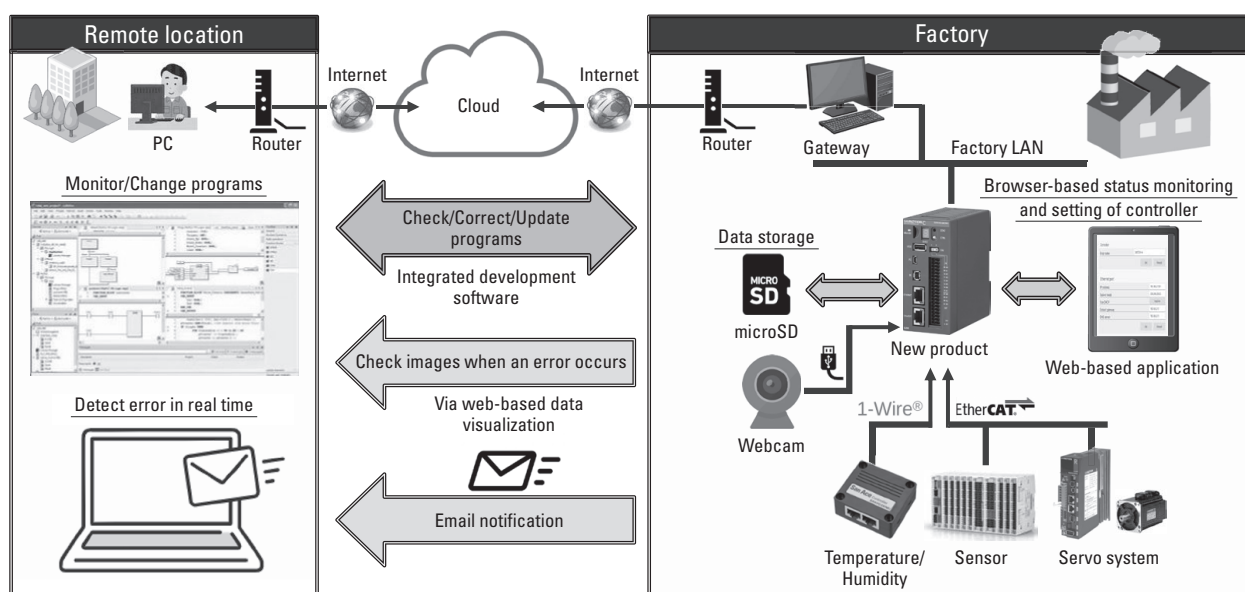


Fig. 3 System configuration

The new product features a remote maintenance and an email notification to inform users of detailed information in the event of equipment failure.

The new product complies with the following international standards: UL/cUL (North America), EMC Directive (Europe), UKCA Mark (United Kingdom), and KC Mark (South Korea).

- (2) 1-Wire is a communication bus protocol for transferring data using only a ground wire and a single signal/power line.
- (3) MQTT, or Message Queuing Telemetry Transport, is a lightweight communication protocol suitable for frequent sending and receiving of TCP/IP-based short messages.
- (4) A drawing tool feature for designing screens on a web browser.

3. Features

This new product maintains the same dimensions and mass as the industry's smallest-in-class⁽⁵⁾ *SANMOTION C S100* with the addition of IoT capabilities. It can collect and store image data and environmental data of the equipment in real time while simultaneously performing motion control. It is also now possible to remotely monitor the equipment status and perform maintenance thanks to the connections to Automation Server⁽⁶⁾ or a cloud system. Moreover, it allows users to check the status of the new product and set parameters from a web browser. The details of each function are provided below.

3.1 Data collection and storage

Figure 4 shows the interface designed for data collection and storage. The new product can collect time-series data on connected servo systems, digital input/output, and environmental conditions. It can easily collect and store servo system position and status information by simply specifying the applicable motor axes in the program (see Figure 5). The new product stores the collected data on its built-in storage (32 GB) or a microSD card (max. 32 GB), enabling users to check the operation status of equipment over a long period. The new product also records the status as an image by connecting to a webcam. For example, when an error occurs, the new product records images before and after the error, enabling prompt identification of the root cause.

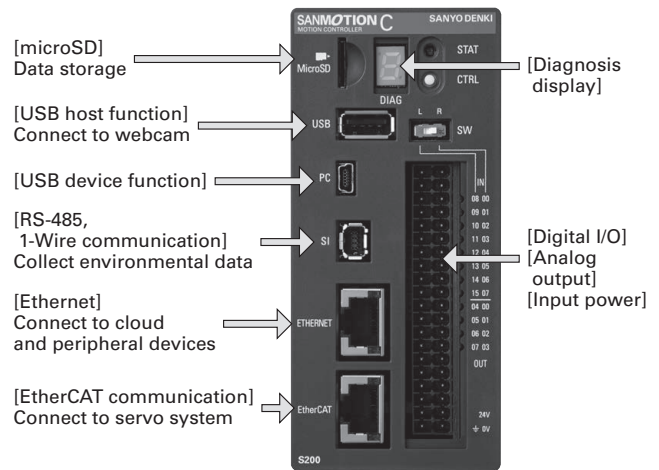


Fig. 4 Interface for data collection and storage

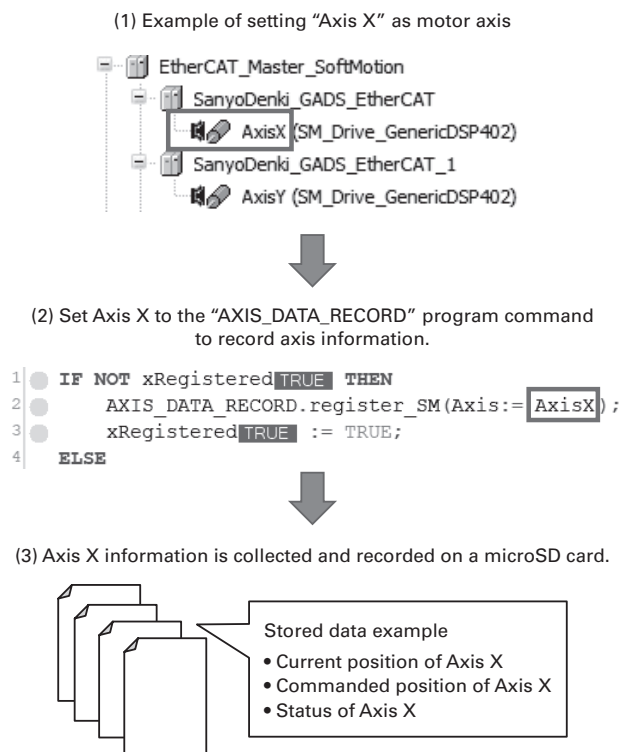


Fig. 5 Collecting and storing information on servo system axes

3.2 Remote status monitoring and maintenance functions

As shown in Figure 6, the new product can establish communication with a remote computer through Automation Server. The Edge Gateway is a function for connecting a computer to the new product via Automation Server. It has been incorporated into the new product and the integrated development tool (software for programming and configuring the servo system).

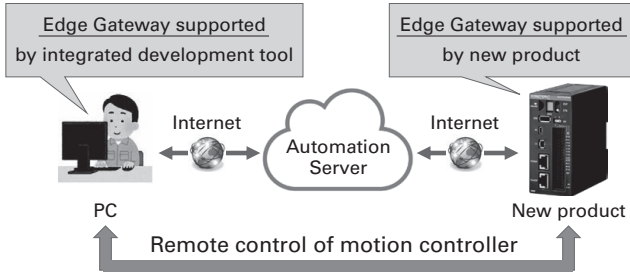


Fig. 6 Remote control of motion controller

Users can check the program variables of the new product by using the dashboard function of the Automation Server. Furthermore, since users can operate the new product remotely by connecting to a VPN,⁽⁷⁾ they can monitor and modify programs without actually visiting the work site.

- (5) Based on our research comparing IoT-ready motion controllers for 8-axis control (as of August 2023).
- (6) The name of the cloud service provided by CODESYS for remotely operating controllers.
- (7) VPN, or Virtual Private Network, is a technology for connecting locations with dedicated virtual lines and securely exchanging information.

3.2.1 Remote status monitoring

To monitor the equipment status from remote locations, users can use the dashboard to check the collected data, including the position of each axis, error information, and the digital signal status, as shown in Figure 7. Furthermore, users can grasp the equipment status by checking the running program variables in the new product.



Fig. 7 Dashboard

3.2.2 Remote maintenance

Users can monitor and modify programs, as shown in Figure 8, from remote locations by connecting the integrated development tool and the new product via the Automation Server's VPN. This enables users to perform maintenance on the new product from anywhere at any time, reducing the recovery time in case of equipment abnormality.

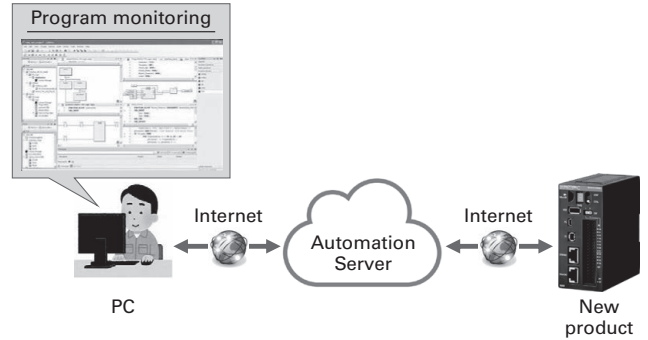


Fig. 8 Remote monitoring of programs

3.3 Email notification

Figure 9 shows the notification process flow in the event of equipment abnormalities.

Its email notification function uses the SMTP protocol, promptly informing the administrator when equipment errors are detected. Notifications can be set not only for errors but also for production conditions, such as when the planned production volume is reached. This enables the administrator to check the production status without being physically present on-site.

This feature allows the administrator to monitor the equipment and production status in real time, ensuring efficient, stable production.

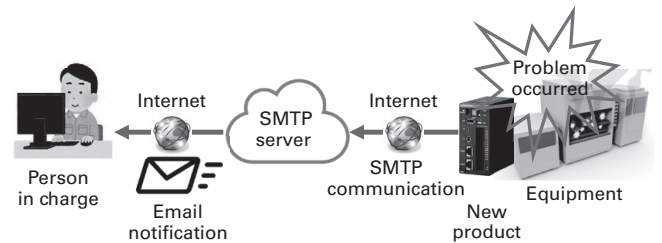


Fig. 9 Email notification

3.4 Connecting to cloud services

As shown in Figure 10, the new product performs communication using the MQTT protocol and implements authentication functions to connect to cloud systems. Security certificate and private key files can be configured from the screen shown in Figure 11 using a web browser.

This function enables quick connection to cloud systems.

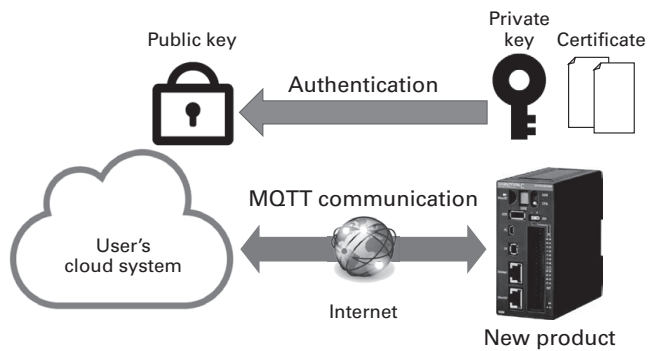


Fig. 10 Connecting to cloud system

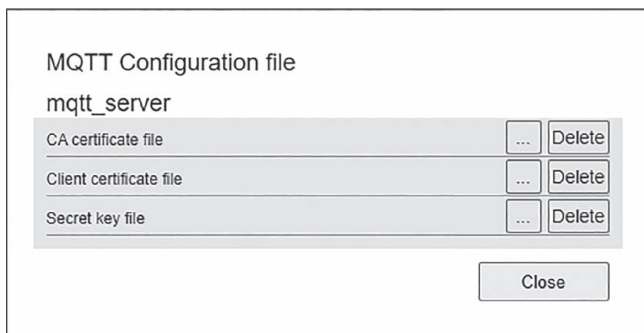


Fig. 11 Settings screen of certificate and private key files

3.5 Browser-based status display and settings

The new product provides improved usability with its web-based applications, which enable users to check the controller status and adjust settings on a web browser.

3.5.1 Product status display

Table 2 shows the status items to monitor, and Figure 12 shows the corresponding status display screen. Users can check the product's device name, serial number, version information, and the Ethernet port settings. Additionally, the new product has a feature to graphically display its status including CPU load and memory usage in real time. This feature can be used to check the performance of the new product and to help troubleshoot problems in the event of abnormal CPU load level fluctuations.

Users can check the storage space of the new product and the capacity and storage usage of a microSD card, preventing data storage errors caused by insufficient storage space.

Table 2 Status check items

Monitored items	Function
Controller information	Device name, serial no., etc.
Status	CPU usage, memory usage, etc.
Network settings	Ethernet and WLAN IP address, etc.
Digital/Analog signal	Status of input/output signals
1-wire device in connection	Information of connected device
Log data	Program running status
Webcam	Monitoring with live streaming and images
Service startup status	Status check of Edge Gateway and others

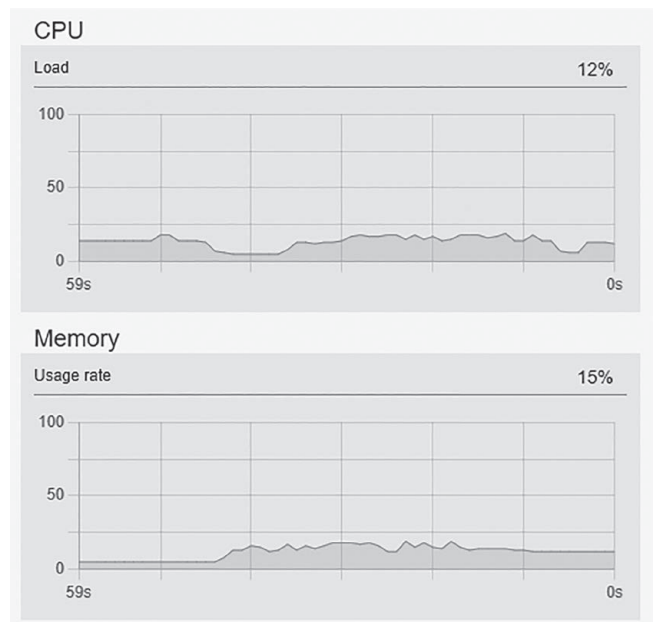


Fig. 12 Status display screen for the new product

3.5.2 Setting parameters

Table 3 shows the configurable parameters for the new product.

The new product allows users to configure network settings using a web browser instead of dedicated software, unlike previously. Users can also specify the sender and recipient email addresses on the email settings screen and check the email-sending status as shown in Figure 13. Additionally, the parameter setting screen for the webcam, shown in Figure 14, enables users to adjust the camera settings while viewing the images.

Table 3 Setting parameters

Setting parameters	Function
Network settings	Settings of Ethernet and WLAN IP address, etc.
Notification email settings	Destination settings, send test email
Webcam settings	Setting of contrast and other parameters
Service startup settings	Automatic startup settings of Edge Gateway and other services

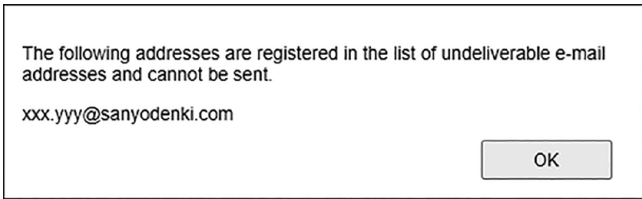


Fig. 13 Sent email status

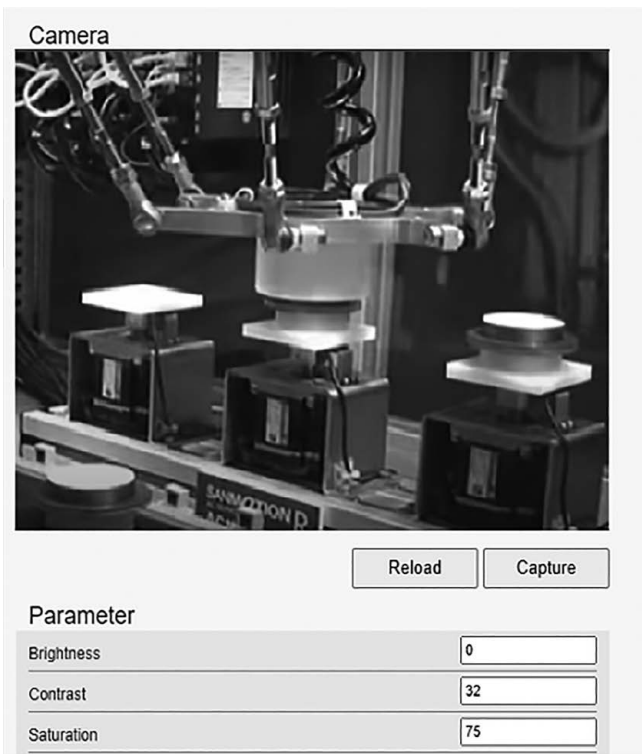


Fig. 14 Webcam settings screen

4. Conclusion

In this article, we introduced the *SANMOTION C S200* motion controller and described some of its features.

The following is a brief summary of the new features it offers.

- Can collect and store equipment data in real time. Users can quickly identify the cause of problems by using stored abnormality data for failure analysis.
- Employs Edge Gateway that connects the new product to remotely located computers via Automation Server. Automation Server’s dashboard enables remote monitoring of equipment status. Furthermore, users can remotely perform equipment maintenance via a VPN, reducing the recovery time in the event of failure.
- Can send notification emails based on error and production status, enabling users to quickly understand equipment status and production conditions, helping maintain stable, efficient production.
- Improved in usability by featuring browser-based status monitoring and settings application.

SANMOTION C S200 is a motion controller designed to detect changes in the operating status and ambient environment of equipment, promptly notifying users of the status. It collects and stores error log data in real time, minimizing recovery time in the event of a failure. Furthermore, it contributes to improving the productivity of equipment by enabling users to remotely monitor the operating status of equipment and perform maintenance when necessary.

Moving forward, we will continue to leverage IoT and digital technologies to develop products that help create new value for our customers.

Note: The company names, product names, and network protocol names mentioned in this article are the trademarks or registered trademarks of their respective owners.

Reference

- (1) Hideaki Kodama and 7 others: “Development of the *SANMOTION C SMC100* Motion Controller” SANYO DENKI Technical Report No. 47, pp. 30-34 (2019.5)

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