

Development of the *SANMOTION C* Motion Controller SMC100

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1. Introduction

The manufacturing industry is pushing ahead with the development of production equipment embedded with information and communication technology (ICT) to respond faster to changing market conditions and demands. ICT makes it possible to monitor production status in real time, predict when equipment will require maintenance, and respond swiftly to potential issues—all which are vital to maintaining high production standards. As such, motion controllers require communication functions to gather and transmit data from production equipment to production management systems. Moreover, to effectively utilize space on the production line and achieve high-mix low-volume production, compact controllers, which can free up space in control panels, are in demand.

To meet such needs, we developed a compact motion controller which features sequence, motion, and robot control functions, as well as enhanced capabilities for communicating with ICT equipment.

This article introduces the main functions and features of the SMC100—the newest addition to the *SANMOTION C* motion controller lineup.

2. Product Overview

2.1 Appearance and dimensions

Figure 1 shows the appearance of the new *SANMOTION C* motion controller, SMC100, while Figure 2 shows its dimensions.

The product is mounted on a DIN rail for easy installation into a control panel.



Fig. 1 Appearance of the SMC100

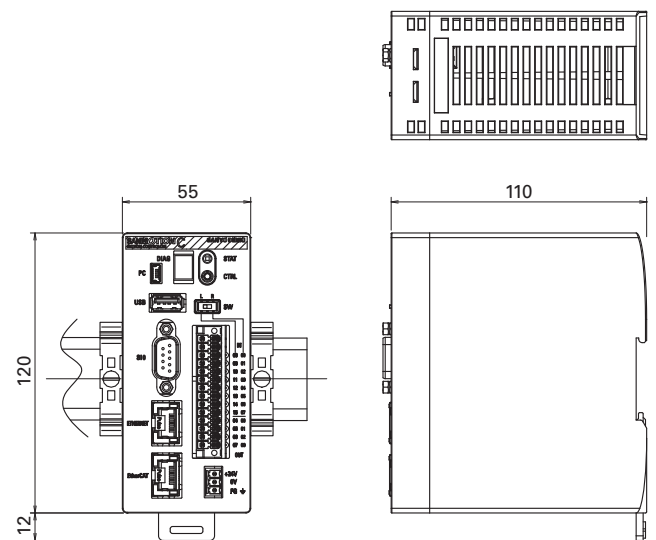


Fig. 2 Dimensions of the SMC100

2.2. Basic specifications

Table 1 shows the basic specifications of the SMC100. The new product is available in two configurations: the SMC100-A for controlling robots, and the SMC100-B, which specializes in PTP (Point-to-Point) positioning control.

Each model comes standard with EtherCAT interface—an industrial open network—to support motion networks. The high-speed EtherCAT enables real-time monitoring of equipment status. This product is equipped with Ethernet,

RS-485, and USB interfaces, and also supports the open protocol Modbus TCP, making it compatible with a variety of devices.

An onboard digital I/O allows the new product to control contacts such as sensors and switches without the need for an additional module.

The new product conforms to the international standards EMC Directive (Europe), UL/cUL (North America), and KC Mark (Korea).

Table 1 Basic specifications

Model no.	SMC100-A	SMC100-B
Interface	EtherCAT (100 Mbps) master function, FoE-compatible	
	Ethernet (10/100/1000 Mbps) protocols (Modbus TCP, OPC-UA)	
	RS-485 (9600 to 115200 bps)	
	USB 2.0 (for memory storage)	
Digital I/O	Digital input: 16 points, 24 VDC, positive/negative common input	
	Digital output: 8 points, 24 VDC, 0.5 A/point, sink output	
Input power supply	19.2 to 30 VDC, 0.8 A (main power supply) 19.2 to 30 VDC, 20 mA (I/O power supply)	
Power consumption	19.2 W	
Cooling method	Passive	
Dimensions (W, H, D)	55 × 120 × 110 mm	
Mass	300 g	
Control function	Sequence control Motion control (electronic cam, electronic gear, linear interpolation, circular interpolation) Robot control (cartesian coordinate robot, SCARA robot, and parallel link robot)	Sequence control Motion control (PTP control)
	Programming languages conforming to international standard (IEC 61131-3)	
Control language	G-code (complies with DIN 66025)	—
	Web visualization	
Standards	UL/cUL	UL 61010-1, UL 61010-2-201
	EMC Directive	EN 61131-2:2007
	KC Mark	KN 61000-6-2, KN 61000-6-4

3. Main Functions

The new product combines the three functions of sequence, motion, and robot control on a single controller. Furthermore, with its web server function, the status of production equipment can be checked from a PC or smartphone. The details of each function are provided below.

3.1 Motion control function

The new product not only features a sequence control function using digital I/O, but also a PTP positioning function, multi-axis synchronization, and an interpolation control function. These features give operators the ability to effortlessly create sophisticated control patterns. Table 2 provides details of the motion control function.

Table 2 Motion control function

Number of controllable axes	8 axes max.
Communication cycle	2 to 16 ms
Control system	Position control, speed control, torque control
Acceleration/deceleration profile	Trapezoidal, sin ² , trapezoidal with jerk limit
Unit for positioning control	Arbitrary (pulse, mm, inch, degree)
Programming language	Complies with IEC 61131-3 IL, ST, LD, FBD, SFC, CFC
Motion function block	Homing, incremental mode, absolute mode, constant speed mode, electronic cam, electronic gear

3.2 Robot control function

The SMC100-A is equipped with three types of kinematics to control robot mechanisms. By combining special-purpose motion function blocks, it is possible to perform operations for each robot axis and interpolation control. These functions make it possible to program robot operations in a short period. Table 3 provides details of the robot control function.

Table 3 Robot control function

Number of controllable axes	Robot: 4 axes max.
Communication cycle	8 to 16 ms
Control system	PTP motion, 3D linear interpolation, 3D circular interpolation
Teaching method	Numeric input
Unit for positioning control	Arbitrary (pulse, mm, inch, degree)
Programming language	Motion function block
Robot mechanisms	Cartesian coordinate (3 axes), SCARA (4 axes), parallel link (4 axes)

3.3 Web visualization function

The SMC100 can be accessed via a web browser from a PC or smart device. Figure 3 shows a conceptual image of the web visualization function in use.

The web visualization function has a drawing tool for designing screens to display controller information on smart devices. There is an alarm display, user management, and various other drawing parts, making it possible to create complex programs and movements in a short time.

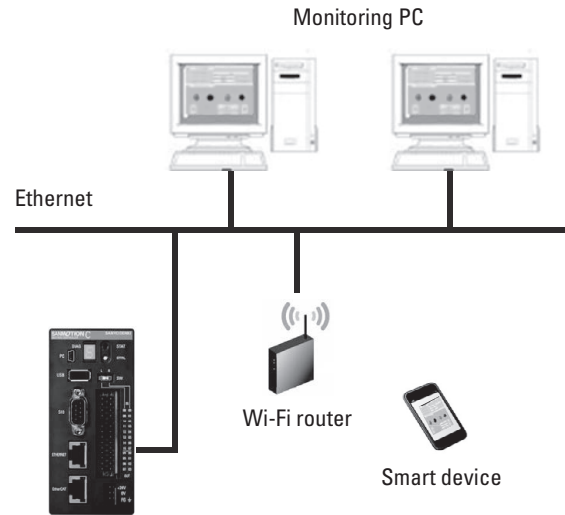


Fig. 3 Conceptual image of the web visualization function in use

3.4 Integrated development software (SANMOTION C Software Tool)

We have developed an integrated development tool for batch management of tasks like configuration, programming, screen creation for web visualization, and data tracking in a tree structure.

3.4.1 Configuration function

Figure 4 shows the configuration screen while configuring SMC100 and fieldbus devices. The layout of this screen enables simple configuration of the parameters for connected devices.

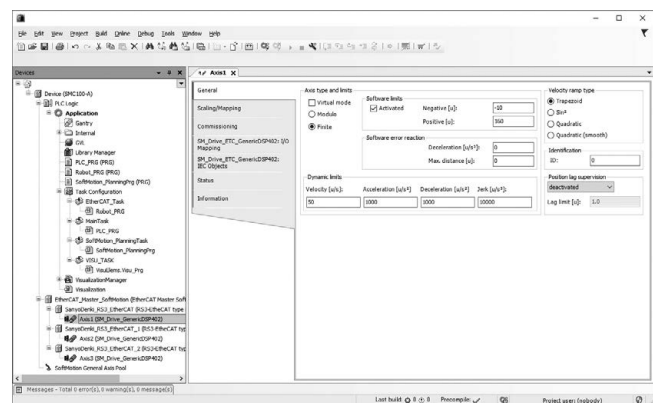


Fig. 4 Configuration screen

3.4.2 Programming function

Figure 5 shows an example of a screen for creating application programs. IEC 61131-3-compliant programming languages IL (instruction list), LD (ladder diagram), ST (structured text), SFC (sequential function chart), FBD (function block diagram), and CFC (continuous function chart) are available. Moreover, motion function blocks for motion and robot control streamline programming tasks.

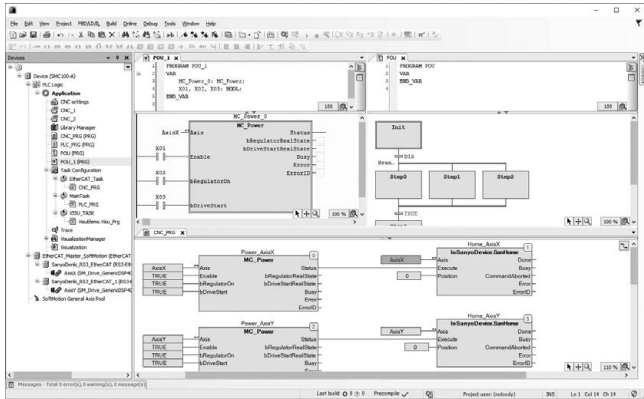


Fig. 5 Programming screen

3.4.3 CNC editor function

The new product also has a function to automatically convert CAD data (DXF file) into DIN 660250-compliant G-code. Figure 6 shows the CNC editor screen. This function automatically generates the G-code control program, reducing the time needed for application development.

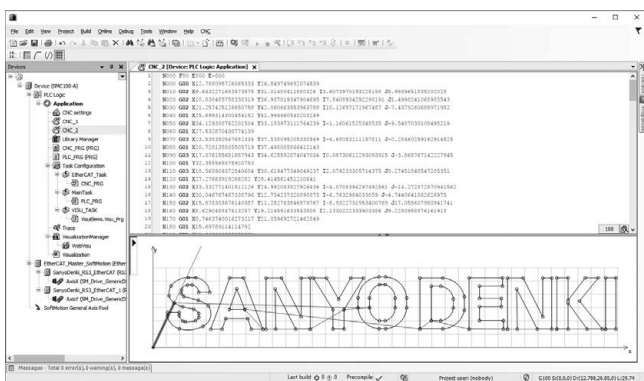


Fig. 6 CNC editor screen

4. Product Features

4.1 Downsizing

The volume of the new model has been reduced to one-quarter of the current model's by adopting multi-layer PCBs and high-density component mounting. Reducing the product size can help optimize control panel design. Table 4 shows a size comparison with the current model.

Table 4 Size comparison with the current model

Item	SMC100 series (new model)	SMC26x series (current model)
Dimensions (W, H, D) [mm]:	55 × 120 × 110	270 × 120 × 110
Volume [cm ³]	726	3240

4.2 Strengthened network functions

Figure 7 shows the connection configuration of the network.

The SMC100 features Ethernet-based OPC-UA and Modbus TCP communication protocols for sharing data with SCADA and other management systems. OPC-UA is a communication protocol that is not manufacturer or device-dependent. Additionally, the built-in Modbus TCP open protocol delivers improved compatibility with PCs, touch panel displays, and other peripherals. Also, using EtherCAT for the motion network provides the added benefit of being able to connect to all devices via an Ethernet cable. The ability to connect a network with the same kind of cable helps reduce system costs.

Furthermore, with a wireless environment and the web visualization function, operators can view the status of production equipment in real time via a smart device. If a fault occurs, operators will be immediately notified via their smartphone so that equipment downtime can be minimized.

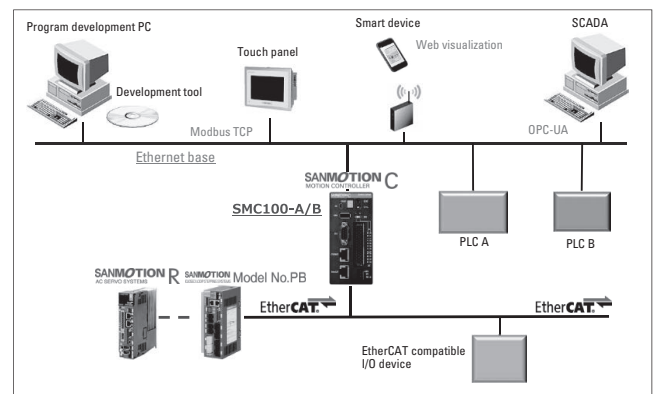


Fig. 7 Network connection configuration

4.3 Improved maintainability

The innovative design of the casing resulted in better heat dissipation, which eliminated the need for a cooling fan, further enhancing the reliability of the new model. Data storage uses non-volatile memory to eliminate backup battery life worries and data loss risks, reducing maintenance or data recovery costs.

5. Conclusion

This article introduced the main functions and features of the SMC100-A and SMC100-B, which are the newest additions to our *SANMOTION C* motion controller lineup. Compared to the current model, the new model

- (1) is smaller to help optimize control panel design and save space;
- (2) supports a variety of communication protocols such as Ethernet-based OPC-UA and Modbus TCP, for improved compatibility with production management systems such as SCADA, and peripheral equipment; and
- (3) features a web-based data visualization function for checking the operating status of equipment via smartphone or PC so that operators can quickly respond to any problems that may arise.

The new model helps save space on the production line, enables efficient data transmission between devices, and helps develop production equipment that effectively utilizes production data.

We will continue to develop products with features that meet market requirements to help create new value.



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