Servo Systems Division

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The applications and requirements for servo systems are diversifying in line with changes in industrial structure and *monozukuri*, such as globalization and the spread of information and communication technology. Against such a backdrop, the Servo Systems Division is working alongside customers to develop new products that create new values.

This report will focus on new products developed in FY 2018 such as servo motors, servo amplifiers, and controllers, and introduce the various features of each product to explain how they create value for our customers.

First, we launched the *SANMOTION R1* series (flange size 40mm sq. to 80mm sq.), a small-capacity, low-inertia AC servo motor optimal for high hit rate applications. This servo motor meets the need for high acceleration/deceleration driving and high-responsiveness, and achieves higher torque and rotation speed than our current model. This helps to shorten equipment cycle time and improve productivity.

By adding this product to the R series lineup, we have further expanded our selection of motors that are suitable for the required performance and characteristics.

Next, regarding servo amplifier products, we have developed the *SANMOTION R 3E Model* 400 VAC input (150 A, 300 A) for rated outputs ranging from 5.5 to 30 kW that can be used in regions with 400 VAC power sources, such as Europe and Southeast Asia. The depth of this servo amplifier has been reduced while maintaining mounting compatibility with our current model. When changing from a 200 VAC input servo system, a transformer to convert input voltage is no longer required, which helps to make the system more compact. We also enhanced the monitoring functions in order to confirm the remaining component life of the holding brakes and relays, as well as the quality of encoder communication. These monitoring functions can contribute to systematic maintenance of the servo system, as well as breakdown/predictive maintenance.

For controller products, we launched the *SANMOTION C* Motion Controller SMC100. This motion controller is only one-quarter of the volume of our current model, contributing to the space-saving of production equipment such as control panels. EtherCAT communication is used for the motion network, enabling real-time motion control to be performed at high-speed. Moreover, this product also supports an OPC-UA server and Modbus TCP communication, so it can easily be connected to a production management system and peripheral devices. These abundant communication functions contribute to flexible and highly productive *monozukuri* using information and communication technologies.

This article will provide an overview of each new product and their respective features.

■ *SANMOTION R1* Small-Capacity 40, 60, 80mm sq. Low Inertia AC Servo Motor

In recent years, needs have diversified due to the globalization of markets, and there is an increasing demand for multiple motor lineups enabling customers to choose the optimal motor for their specific device and application. In particular, for applications where the main purpose is high-hit rate operation, a small servo motor with a low self moment of inertia is necessary to reduce cycle time.

Due to such circumstances, for applications requiring high-acceleration/deceleration and high responsiveness, we newly developed a small-capacity low inertia AC Servo Motor *SANMOTION R1* series (flange size 40mm sq. to 80mm sq.).

The features of this new model are as follows.

1. Expansion of the torque and rotational speed characteristics

Compared to our current model, the new model R1 has a peak torque approximately 20% higher and a maximum rotational speed approximately 20% faster, thereby achieving a wider operating range. We have designed motor characteristics which not only shorten short-stroke cycle time, but also improve equipment performance in long-stroke applications.

2. Improvement of acceleration performance

Self moment of inertia has been decreased while peak torque has been increased. Peak power rate, which is an indicator of acceleration performance, is up to 1.9 times greater than that of our current model. This makes quick response possible even with a load ten or more times greater than the self moment of inertia. With the new model R1, acceleration/deceleration time, including that of machinery with loads, has been dramatically reduced, enabling optimal performance for high hit rate operation.

3. Optimal proposals for applications

By adding the new R1 model to the R series lineup, customers are able to choose the optimal motor for each axis to suit the device's drive characteristics. By combining the R2 series, which has the versatility to cover a wide-range of applications, the R5 series, which has low torque and ripple for axes which require precision control, and this new model R1 series, which targets high acceleration/deceleration and high responsiveness, it is possible to significantly improve the overall operating characteristics of devices, and increase operating time.

Details of this new product are provided in the "New Product Introduction" section of this Technical Report.

■ *SANMOTION R 3E Model* 400 VAC Input Servo Amplifier (150 A, 300 A)

In line with the globalization of industry, there is an increasing need for 400 VAC input servo systems, primarily in European and Asian regions. As such, we newly developed the *SANMOTION R 3E Model* 400 VAC input servo amplifier (150 A, 300 A) to drive large-capacity servo motors with rated outputs ranging from 5.5 kW to 30 kW. With the addition of the 400 VAC input servo system, which can drive the same motor output as the 200 VAC input servo system, there are even more choices to realize optimal servo systems that suit our customers' particular power supply specifications.

The features of this new model are introduced below.

1. Downsized

While maintaining mounting compatibility with the current *SANMOTION R* 400 VAC input servo amplifier, we have reduced the depth of the product by as much as 10% by reducing heat generation.

Also, to use a 200 VAC input servo system in a 400 VAC environment it was necessary to use a step-down transformer to convert power voltage. However, 400 VAC can be directly supplied with this product, eliminating the need for a step-down transformer, thus contributing to downsizing of the system.

2. Enhancement of monitoring functions

This new model maintains the same performance and functions as *SANMOTION R 3E Model* 200 VAC input servo amplifiers while also featuring monitoring functions that monitor remaining life for components such as holding brakes and relays, as well as confirm quality of communication with the servo amplifier and encoder.

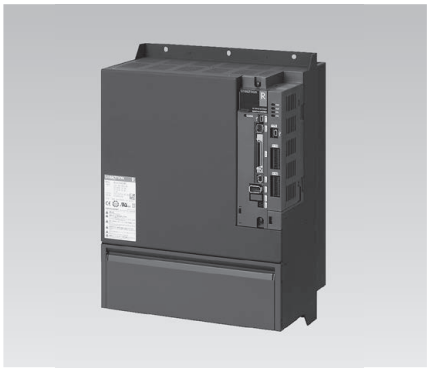
For example, the remaining life of the holding brakes is monitored by estimating brake wear from the accumulated braking rotation amount. By assessing remaining component life, the systematic maintenance of servo systems is possible. Monitoring the communication quality between the servo amplifier and encoder is a function enabling confirmation of the communication error frequency using a qualitative value. By using this monitor function, any drops in communication quality from degradation of the communication cable or environmental changes can be detected, and necessary actions can be taken before the equipment stops due to a fault.

3. Usability

A plastic cover that can be opened and closed covers the terminal block that connects the power cables and motor power cables. Wiring work is simplified, as there is no longer a need to take the cover on and off.

Moreover, both the 150 A and 300 A capacity models have a common front side depth of 150 mm. This means that individual cables can be connected easily within the control panel.

Also, a safety module can be added without changing the size of the servo amplifier exterior. This means that this product can also be used as a safety servo amplifier without having to change the mounting.



■ *SANMOTION C* Motion Controller

In recent years, various initiatives have been promoted on manufacturing lines using information and communication technology with the aim of achieving flexible and high productivity *monozukuri*. As such, the controllers used on manufacturing lines are required to have a communication function that enables the necessary information for production management systems to be collected from and transferred to production equipment to achieve effective usage of production information. Moreover, to effectively use space on manufacturing lines and flexibly respond to small-lot, high-mix production, it is preferable to have compact control equipment so the control panel can be downsized.

Against such a backdrop, we developed the *SANMOTION C SMC100*, a compact motion controller with a strengthened function for communication with information devices. The features of this new model are introduced below.

1. Downsized

The volume of this new model has been decreased by one-quarter over that of our current model through high multilayer formation of the PCBs and increasing the density of components. This reduces the space required by control panels and other production equipment, contributing to cost reduction of the system overall.

2. Strengthened network functions

This new model is equipped with an Ethernet-based OPC-UA server/ Modbus TCP communication function to connect to SCADA and other production management systems. These abundant communication functions improve connectivity with peripheral equipment, such as PCs and touch panel displays. Moreover, because EtherCAT is used for the motion network, there is the advantage of being able to connect all devices with Ethernet cables. Being able to wire the network with the same cable also contributes to reduced system costs. Moreover, with the web visualization function, workers can assess the status of production equipment in real-time on their smart phones or other devices. When a problem occurs, the worker is notified immediately of the situation on their smartphone, so they can know instantly when equipment has stopped or is malfunctioning, minimizing manufacturing line downtime.

3. Improved Maintainability

By designing the chassis with high heat dissipation properties, we have been able to eliminate the cooling fan, making the product highly reliable. Moreover, because the data retention function uses nonvolatile memory, there is no need for data recovery work at the end of the service life of a backup battery, which contributes to reduced maintenance costs.

Details of this new product are provided in the “New Product Introduction” section of this Technical Report.

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Works on the design and development of servo motors and stepping motors.