Servo Systems Division

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The applications and requirements for servo systems are diversifying in line with changes in society and industrial structure, such as a declining birth rate, aging society, and globalization. Against this backdrop, SANYO DENKI develops products which solve our customers' issues and contribute to society.

This article will outline the features of our new products from 2017: one stepping motor and three servo amplifiers, telling how they can contribute to customer value.

First, as for stepping motor products, we released the *SANMOTION F series* 42 mm sq. 2-Phase 1.8˚ stepping motor featuring low noise and eco-efficiency. In the development of this product, we not only strived to achieve higher performance, but also put an effort to automate the production process, resulting in increased productivity.

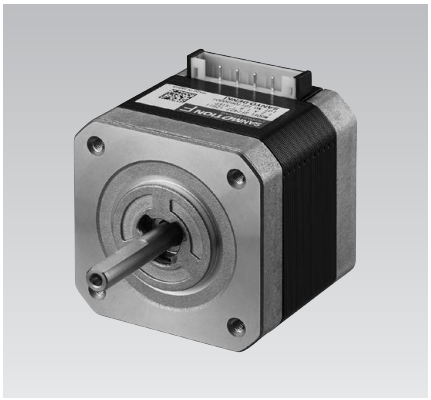
Next, regarding servo amplifier products, we added a 400 VAC input multi-axis servo amplifier to the *SANMOTION R ADVANCED MODEL* series. The addition of multi-axis 400 VAC input servo amplifiers to the current single-axis servo amplifier lineup significantly expands customer options, enabling the selection of the best servo system for customer equipment.

Moreover, we added an EtherCAT-enabled servo amplifier to the *SANMOTION R 3E Model* series. This product achieves an industry-leading minimum communication cycle of 62.5 μs (a half compared to conventional), and contributes to further improving the processing quality. In addition, the amount of data transfer in one communication cycle has increased to 1.6 times. A large amount of data can be collected in real-time, which contributes to the visualization of equipment operating status, as well as the IoT system with applications such as equipment failure prediction.

We also released *SANMOTION R 3E Model* Safety servo amplifiers with diverse safety functions and high safety performance. In recent years, in an increasing number of cases, machinery is required to have a safety system integrated conforming to international functional safety standards. This product enables users to build a safety system that offers high safety performance and flexibility, reducing the initial cost for startup.

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

■ *SANMOTION F Series* 42 mm sq. 2-Phase 1.8˚ Stepping Motor



SANMOTION F series 42 mm sq. 2-Phase 1.8˚ stepping motor achieves higher torque, lower noise, and higher efficiency than our current model. Besides, it was designed for automated production to improve productivity.

The features of this product are introduced below.

1. High torque

To increase torque, we optimized the shape of stator core magnetic circuit with magnetic circuit simulation, and widened the stator core winding space. Also, by adopting a magnet with high residual magnetic flux density, we have successfully achieved 10 to 15% higher torque with the motor length maintained.

2. Low noise

In addition to increasing torque, we also improved the noise level by increasing the rigidity of the stator core. Furthermore, by revising the fit tolerance and clearance for stator, flange, and end cap, the motor rigidity after assembly has been increased. As a result, compared with the current model, the noise level in the operating zones has decreased by 3 to 5 dB.

3. Eco-efficient

Iron loss has been reduced due to the abovementioned optimized design of the stator core. Moreover, copper loss has been reduced by expanding winding space. These loss reductions have resulted in up to 2% higher motor efficiency. Equivalent torque performance can be obtained with a smaller input current than the current model, which contributes to minimal heat generation and better eco-efficiency of equipment.

4. Increased productivity

For efficiently producing this product, we adopted an automated production line. In early stages of development, we designed a motor structure suited to automated production; that is, we designed the product and production process in parallel. Regarding the connection of the stator winding previously performed by hand, we designed a motor structure that performs both winding process and connection process simultaneously inside the winding machine.

As described above, compared to the current model, this product has achieved higher torque, lower noise, and better eco-efficiency. Particularly for applications where motors are operated in close proximity to patients or workers, such as medical devices, noise and heat generation can be reduced, which contributes to reduced noise and higher safety of equipment.

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

■ *SANMOTION R ADVANCED MODEL* 400 VAC Input Multi-axis Servo Amplifier

In line with the globalization of industry, there are greater needs for servo systems with 400 VAC input specifications from not only our customers in Europe, China, and Southeast Asia, but also Japan. As such, SANYO DENKI has added a 400 VAC input multi-axis servo amplifier to the *SANMOTION R ADVANCED MODEL*.

The features of this product are introduced below.

1. Downsizing of the system

Previously, it was necessary to use a step-down transformer to convert power voltage to use a 200 VAC input servo system in a 400 VAC environment. However, in the case of this product, 400 VAC can be directly supplied, eliminating the need for a step-down transformer, thus achieving downsizing of the system. Moreover, the arrangement (height) of the main circuit's terminals for DC bus power supplied from the power unit to the amplifier unit is standardized between units, therefore wiring at the copper bar is simple.

2. High response control

Based on the control performance of AC servo amplifier *SANMOTION R ADVANCED MODEL*, we added a phase delay improvement function and torque feed-forward function. This has further improved response to commands, and contributed to better machining quality and productivity.

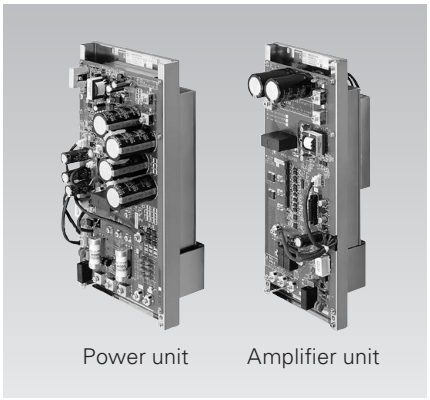
3. Eco-efficient

This is a servo system that can have multiple amplifier units sharing a single power unit. The eco-efficiency of the equipment is improved as the motor regenerative current that occurs in one motor can be used as power to drive a separate motor (powering). Furthermore, we added a power consumption monitoring function that estimates power consumption based on the speed and current of the motor. The visualization of power consumption makes it possible to assess the energy usage status and operating status of equipment and production facilities, thus we can expect that this model will better overall eco-efficiency of a factory and reduce energy costs.

4. Lightweight

For the housing (sheet metal) we have adopted stainless steel, which maintains equivalent strength as the conventional material (cold-rolled sheet metal) while being thinner, thus reducing weight. Moreover, stainless steel has high anti-corrosion properties, therefore this product can be used with peace-of-mind, even in environments with major temperature and humidity fluctuations.

Details of this product are provided in the "New Products Introduction" section of this report.



Power unit　　Amplifier unit

■ *SANMOTION R 3E Model* EtherCAT Servo Amplifier

Since SANYO DENKI released the EtherCAT servo amplifier of the *SANMOTION R ADVANCED MODEL* in 2009, we have enhanced our lineup with low-voltage input and multi-axis models, and these are used by many of our customers. In 2017, we developed the latest series *SANMOTION R 3E Model* EtherCAT servo amplifier. This product not only offers the strong control performance and support for abundant functions of the *SANMOTION R 3E Model*, it also features improved EtherCAT communication performance and function.

1. Shortest communication cycle in the industry

At 62.5 μs, this product achieves the shortest minimum communication cycle in the industry (in speed/torque control mode). This maximizes servo potential, making smooth operations possible and contributing to high quality processing by equipment.

2. Increased amount of data transfer

The maximum amount of data transfer in one communication cycle has increased from 20 objects on the current model to 31 objects on the new model, which is an increase of around 1.6 times. This makes it possible to obtain monitoring and diagnosis information from many servo amplifiers and motors in real-time, which in turn contributes to visualization of servo device and equipment operating statuses, as well as the IoT system with applications such as equipment failure prediction.

3. Improved convenience

The new models feature a scaling function enabling users to select the unit of measurement used for commands and feedback data to suit the structure of the particular piece of equipment. In the past, there was a need for the host controller to convert position command into encoder pulse units to perform control. By using this scaling function, it is possible to directly handle positional data using the original units of [mm] for linear-driven components, and [degree] for rotating components, thus alleviating the computing burden of the host controller and improving convenience.

■ *SANMOTION R 3E Model* Safety Servo Amplifier

Recent years has seen the rise of a demand for the servo systems used in equipment to have various safety functions conforming to international safety standards. Against this backdrop, we have released a safety servo amplifier with diverse safety functions and high safety performance in the *SANMOTION R 3E Model* series. This product is of a structure whereby an expansion board (safety function expansion board) to control safety functions is mounted to the servo amplifier side, and it can be applied to all products in the *SANMOTION R 3E Model* lineup.

The features of this product are introduced below.

1. Safety function

This product supports five types of safety functions demanded of many types of equipment to "stop the motor safely," and "rotate the motor safely." These are the "Safe Torque Off (STO)," "Safe Stop 1 (SS1)," "Safe Stop 2 (SS2)," "Safe Operating Stop (SOS)," and "Safely-Limited Speed (SLS)."

2. Safety performance

By newly developing a diagnosis function that detects encoder failure, even if this product is combined with a standard encoder that does not comply with the functional safety standard, it achieves the below safety performance, which is the highest in the industry (based on our own research as of April 2017).

[Standard compliance and safety performance level]

- EN 61508: SIL3, IEC 62061: SILCL3
- ISO 13849-1:2015 PL=e

This reduces the cost for introducing a safety system.

3. Safety input

Equipped with five safety inputs, this model enables users to select the safety function suitable for the control status of a certain application or piece of equipment. Moreover, up to 31 types of Safely-Limited Speed values are available to select from.

4. Safety output

With two types of safety output functions [Safe Brake Control (SBC) and Safe Speed Monitor (SSM)], and three types of status outputs (functional safety input status, safety function execution status, Safe Torque Off status), this product can monitor safety status, malfunction of safety functions.

As described above, by using this product, customers can minimize their start-up costs (product cost, costs for obtaining safety standard certifications) and build a safety system offering high safety performance and flexibility.

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