

Servo Systems Division

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SANYO DENKI contributes to society by developing new products that help enhance the performance and quality of our customers' equipment and create new value. This article introduces the features and innovations of the Servo Systems products we developed in 2021 and describes how they contribute to our customers and society.

These include stepping motors, servo motors, and motion controllers.

First, we have developed the *SANMOTION F* 56 mm sq. 2-Phase 1.8° stepping motors, expanding the product lineup of the series. This product achieved a 40% higher torque compared to our conventional products by shortening the air-gap length between the stator and rotor and adopting a magnet with high residual magnetic flux density. In addition, the noise level has been reduced by 3 dB by optimizing component shapes and engagement method and increasing the motor rigidity. The motor efficiency has also been improved by 3% by increasing the winding fill factor. With these improvements in performance and characteristics, the new product contributes to the downsizing, energy savings, and noise reduction of equipment.

Next, we developed a highly

reliable, compact, energy-efficient holding brake for AC servo motors. To improve brake reliability, we and a supplier jointly developed a new friction plate and updated the assessment criteria of environmental durability. This helped improving brake torque stability even in environments with severe temperature and humidity changes. The brake wear rate due to idling wear has been reduced by half, further increasing reliability. Moreover, we achieved downsizing and lower power consumption with a new structure where the motor and brake are integrated into one unit and optimization of electromagnetic field. This new holding brake can improve the safety and reliability of equipment, as well as contribute to size reduction and energy savings.

In the field of linear motors, we developed a *SANMOTION* multi-axis integrated linear servo motor unit. This product achieves a high thrust thanks to its optimized magnetic circuit. The bobbin structure was devised with denser winding and reduced copper loss, resulting in reduced heat generation. In addition, we designed the linear motion guiding apparatus to suppress friction fluctuations during operation so that the settling performance would

be more uniform. This product can simplify the structure of customer equipment thanks to its multi-axis integrated design. With increased thrust and improved settling performance, it can also contribute to improving the performance and productivity of those equipment that requires fast repetitive motion, such as surface mounters.

In the field of robot motion control, we developed the *SANMOTION C S500* motion controller. This product can control robots of various configurations, including cutting-edge 7-axis articulated robots, and its robot communication cycle is eight times faster than that of our conventional product. With a variety of open networks supported, the controller can communicate with network devices in real time and can help make factories automated and IoT-ready. In addition, the new controller has been downsized to 30% of the conventional product. It features a much smaller size, improves the performance of customer equipment, and helps make customer systems IoT-ready by enabling features such as predictive maintenance using various data.

Below are the overview of these new products with their features.

■ SANMOTION F 56 mm sq. 2-Phase 1.8° Stepping Motor

The new *SANMOTION F* 56 mm sq. 2-Phase 1.8° stepping motor has about 40% higher motor torque as well as lower noise and higher efficiency than our conventional product. We also enhanced the lineup of its options.

The features of this product are introduced below.

1. High torque

The air-gap length has been reduced by 28% compared to the conventional product by improving the processing precision of components such as the stator and rotor, as well as by making improvements in motor assembly processes to increase the motor assembly precision. In addition, adopting a magnet with high residual flux helped increase the amount of magnetic flux in the air gap, resulting in 40% higher torque while maintaining the same overall motor length as the conventional product.

2. Low noise

The rigidity of the stator core has been increased by performing structural analysis and revising the shapes of the back yoke and pole. For the motor rigidity, on the other hand, the tightening allowance and engagement length between the bracket and stator have been optimized to improve the rigidity after assembling while keeping the ease of the motor

assembly. This reduced the noise level by 3 dB in the operating speed range.

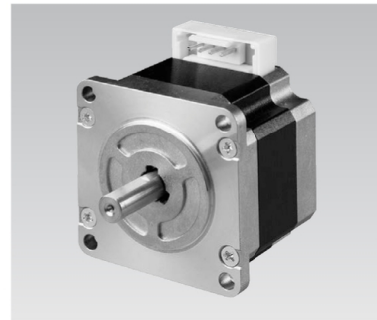
3. Energy saving

The copper loss has been reduced by increasing the winding fill factor within a slot. In addition, the total loss has been reduced by optimizing the core design to reduce iron loss and improved the motor efficiency by approximately 3%. These loss reductions and higher torque enabled to achieve equivalent torque to the conventional products with less input current, contributing to reducing heat generation in the equipment and energy savings.

4. Customizability and a wide lineup of options

Like the conventional product, the new product is designed for easy customization, including changing the shaft shape and adding tapped holes to the bracket. The lineup also includes models with low-backlash gears and harmonic gears, models with encoders, and models with electromagnetic brakes, providing a full range of options.

This wide lineup of options allows customers to configure custom products to best suit their equipment and provides customers with a greater degree of freedom in designing their equipment.



■ Holding Brake (for AC Servo Motors)

In recent years, industrial robots have become increasingly popular in Japan to improve productivity at manufacturing sites in response to the shrinking workforce due to the declining birthrate and aging population. Against this backdrop, we developed a highly reliable holding brake (for AC servo motors) for use with industrial robots.

Its features are as follows.

1. Expanded lineup

To provide a greater selection of products suitable for customer equipment, we expanded our lineup of brakes for small-capacity, high-power motors with the addition of 11 holding brakes with 0.48 to 16 N m torque for use with 40 to 130 mm AC servo motors.

2. High reliability

We set new environmental durability assessment criteria and jointly developed a new friction plate with one of our supplier. This improved brake torque stability in high-temperature and high-humidity conditions. The brake wear rate due to idling wear has also been reduced by half, further enhancing reliability. These improvements allow it to be used safely even in equipment operated near people.

3. Size reduction

The new brake-integrated motor structure and optimized electromagnetic field have achieved downsizing. The overall length of the holding brake for 130 × 130 mm motors has been shortened by 13 mm compared to our conventional brake,

achieving a significant size reduction. This gives more space in customer equipment for downsizing, providing a greater degree of design freedom.

4. Low power consumption

The power consumption has been reduced by up to 44% compared to the conventional brake by optimizing the electromagnetic field, providing reduced power consumption and allowing power supplies to be downsized for customer equipment.



■ Multi-Axis Integrated Linear Servo Motor Unit

In equipment such as semiconductor manufacturing equipment and various automated assembly machines, multiple servo motors are often installed to the vertical moving Z-axis for pick-and-place applications. In addition, many types of equipment use small linear motors to shorten the cycle time and improve the productivity of the equipment.

To meet such needs, we developed the *SANMOTION* multi-axis integrated linear servo motor unit where multiple compact cylinder linear motors are integrated into one unit.

Its features are as follows.

1. High thrust and lower heat generation

The magnetic circuit structure with optimized magnet dimensions and

back yoke shape increased the effective magnetic flux and the motor thrust. Also, this product generates less heat by using a new bobbin structure with less winding problems for denser winding and reduced copper loss.

2. Uniform settling performance

The motor has ball splines and linear bushings installed in the linear motion guiding apparatus, improving the straightness of the moving shaft and reducing frictional thrust. This helps reduce disturbances caused by friction fluctuations during operation and provides uniform settling performance.

3. Multi-axis integrated unit

When customers would mount multiple conventional single-axis linear motors to their equipment, they had

to mount individual motors and make necessary adjustments, which was time consuming and cumbersome. The new product comes standard as a 4-axis integrated unit and the motor number and size can be customized tailored to customer equipment. This facilitates the motor mounting and simplifies the structure of their equipment as well.

The number of axes and the pitch between axes are also customizable to suit customer requirements.



■ SANMOTION C S500 Robot Motion Controller

In recent years, robots have been increasingly deployed in various industries in response to the labor shortage due to the declining birthrate and aging population in Japan. In the manufacturing industry, the robot introduction has automated assembly and conveyance processes, greatly contributing to improving equipment productivity. There is also a growing demand for autonomous robots in the logistics and service industries, requiring controllers capable of controlling various robots.

To meet these market demands, we developed three robot motion controllers: a compact standard model capable of controlling a wide range of robots with functions required for next-generation robots, a mid-range model, and a high-end model for equipment on large-scale production lines.

Its features are as follows.

1. Various robot control functions

This motion controller can control cartesian, horizontal articulated, delta, palletizing, and 6-axis articulated robots, as well as cutting-edge 7-axis articulated robots.

Functions such as trajectory control and interpolated operation can be done

with ease as the controller is equipped with various robot commands, contributing to in-house robot motion planning.

2. Improved control performance

The new product has a robot communication cycle that is eight times faster than the conventional products, improving the productivity and performance of customer equipment. In addition, a single motion controller can control up to four robots, reducing the cost of building robotic systems.

3. Enhanced network functions

The controller's interface supports various open networks such as EtherCAT, Modbus TCP, various PLC communication protocols, and OPC UA to help make factories automated and IoT-ready. This product can provide equipment diagnosis and preventive maintenance by sharing information with various devices in real time.

4. Shortened development time

This product features 3D robot motion simulation functionality that enables users to visually check the program behavior and robot status

on a computer. The interactive user interface functionality has been expanded to enable users to set controller and robot parameters simply by selecting the equipment to use. These functions aid customer program development and shorten the development time of customer equipment.

5. Reduced size and weight

The size and weight of the new product are only 30% and 37% of that of the conventional product, respectively, allowing it to mount in a limited space and downsize customer equipment.

Details on *SANMOTION C S500* are covered in a separate article in this Technical Report.



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Works on the design and development of servo amplifiers.

