# Servo Systems Division

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In 2004, the Servo Systems Division of Sanyo Denki developed a number of new products in main fields, and refined the capabilities and performance of several others. This report is intended to serve as an introductory outline to the features of the following new products:

-The low-inertia, large-capacity "SANMOTION" Q4 AC servomotor, which was developed in response to the demand for high torque, high speed and high response for large injection molding machines and other machines;

-A new addition to the "SANMOTION" PB Series product lineup, namely a system compatible with a wide range of AC power inputs;

-The Type C AC servo amplifier with positioning capability, added to the "SANMOTION" Q series AC servo amplifier product line up;

-The new "SANMOTION" G drive system, utilizing a general-purpose inverter and stepping motor-type synchronous motor to provide flat torque properties over a wide speed range;

-A high-torque, 2-phase 86mm square 1.8° stepping motor, developed as an optimal driving motor for industrial sewing machines and stitching machines that is eco-friendly;

-Enhancements to the functionality of the "SANMOTION" Q Series AC servo amplifier, resulting in the development of the new "SANMOTION" R Series AC servo amplifier with improved tuning and vibration control functions.

## ■ Development of the low-inertia, large-capacity "SANMOTION" Q4 AC Servomotor

In recent years, a rapid shift has occurred regarding the method used for driving with resin injection molding machines, namely from hydraulic to electric drives using servomotors. High levels of torque, speed and response times are demanded for driving large injection molding machines, as well as high-speed injection mechanisms for thin-member injection. To meet such demands, the driving motor most offer large capacity, low inertia, high speed, and high torque.

To respond to these needs, we developed a low-inertia, large-capacity AC servomotor with a small moment of inertia for the rotor and high-speed, high-torque properties.

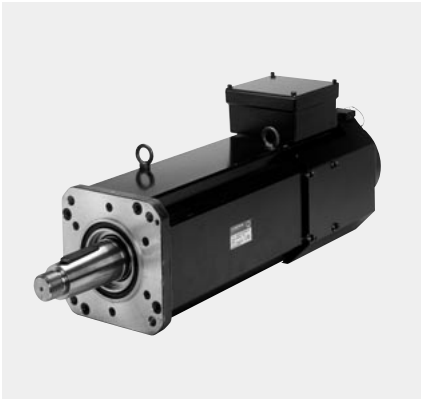
The details of this new servomotor are as follows:

- The product lineup consists of three models: two have a flange size of 180mm, and rated outputs of 11kW and 15kW respectively; the model with a flange size of 220mm has a rated output of 20kW.

- The rated rotation speed is 1500mim$^{-1}$, and the maximum rotating speed is 2000min$^{-1}$ (though speeds up to 3000min$^{-1}$ can be achieved depending on the combination of the servo amplifiers), which significantly high speeds for a large-capacity device.

- The moment of inertia has been reduced for the rotor, while simultaneously increasing the maximum acceleration almost by a factor of three. Under the same moment of load inertia, the time needed for acceleration is reduced by about 40% over previous models.

The AC servomotor can be combined with the existing battery-free high-resolution resolver, eliminating the need for backup batteries and contributing significantly towards the enhancement of servo system accuracy and environmental conservation.



## ■ Development of the "SANMOTION" R Series AC Servo Amplifier

Our Q Series servo amplifiers released in August 2002 have become popular amongst many users; now our R Series servo amplifiers with functions that are even more advanced than the Q Series are ready to be released into the market.

Some of the key features of the R Series amplifiers are:

- Enhanced accuracy in identification of load inertia by with the real-time auto-tuning function, making the R Series amplifier compatible with a wide variety of applications;
- An enhanced tuning function for simple and consistent positioning;
- Standard feed-forward vibration control and bypass notch filtering, for control over all types of mechanical vibrations;
- Identical form factor for amplifiers and user interfaces with Q Series amplifiers, allowing simple interchange and replacement of Q Series amplifiers with the R Series;
- An improved layout of servo amplifier parameters even greater user convenience.

## ■ Development of the AC Power Input "SANMOTION" PB System

In response to the need existing in the market for higher torque and compatibility with AC power input for our "SANMOTION" PB Series systems, we developed the AC power input-compatible PB Series system . Some of the key features of the AC power input "SANMOTION" PB Series servo amplifiers are:

- A choice of two different interfaces for the amplifier: Pulse train input and RS-485 with parallel I/F, both of which are interchangeable with conventional PB Series models;
- Five motor models are compatible with the AC power input "SANMOTION" PB Series: 42mm square, 60mm square (two models) and the newly developed 86mm square (two models), with standard output equivalents from 50W to 300W;
- Compatible with a wide range of inputs, from AC100V to 230V.
- Enhanced sensor resolution for improved control, from the conventional 200P/R to 500P/R;
- Improved position command resolution, equivalent to that of a five-phase motor (resolution: 500P/R×n,n=1,2,4,8,10 and 20), for greater compatibility with mechanical systems.

This newly developed system is suitable for a wide range of applications, including general industrial machines and semiconductor manufacturing facilities.

## ■ Development of "SANMOTION" Q Series Servo Amplifier with Positioning Function

In positioning systems, process management, position (coordinate) management, and speed profile generation are typically performed by motion controllers, and commands based on the speed profile are conveyed to servo amplifiers for controlling the position, speed and electric current.

The newly developed "SANMOTION" Q Series servo amplifier with positioning function offers added functionality beyond the process management, position (coordinate) management, and speed profile generation functions present in the previous generation Q Series servo amplifier. This new amplifier was developed in response to the market demand for reductions in master loads. Some of the key features of the Q Series servo amplifier with positioning function are:

- Registration of a maximum of 254 profiles (point data), with operation by activation signals based on the point data number, as designated by parallel 8-bit input;
- Simple editing of point data, test operations, monitoring, adjustment parameters for the servo section, and other functions by personal computer via the dedicated setup software.

## ■ Development of the New "SANMOTION" G Series Drive System with Stepping Motor-type Synchronous Motor

Typically, when a general-purpose inverter is used to vary the speed of stepping motor-type synchronous motors, only convex torque property curves with a peak in the vicinity of the rated frequency are obtained. However, many applications that require variable speed control also need flat torque properties in the regions below, near, or above the rated frequency. In response to this need, we developed a software algorithm that enables constant torque to be attained with high frequencies, and employed this algorithm in the development of our new drive system, "SANMOTION" G.

Some of the key features of the "SANMOTION" G Series drive system are:

- Rotation speed for the standard model: 0 to 72min$^{-1}$

  Rotation speed for the high-speed model: 0 to 120min$^{-1}$

- Rated torque for the standard model: 0.9/1.3/2/3.7 [N-m] (four models)

  Rated torque for the high-speed model: 1/1.8/2.2/2.9 [N-m] (four models), open loop and sensor-less control

- Flat high-torque properties up to the rated rotation speed

- Generation of position-retaining torque when th system is stopped

- Synchronous operation of multiple motor units by a single driver

## ■ High-torque Two-phase 86mm Square Stepping Motor

Another achievement for us in 2004 was the development of the 86mm sq. two-phase stepping motor, with a basic step angle of 1.8º, optimally suited for use as a driving motor for industrial sewing machines, stitching machines, and other general industrial machines.

In addition to increased torque in comparison to our conventional stepping motor models, this new stepping motor is also compatible with the RoHS Directive for reducing hazardous substances.

Thirty standard models are available with three different motor specifications (66L, 96.5L and 127L), as well as a wide range of axial specifications, coil specifications (unipolar and bipolar drive), and rated electricity current specifications. The product lineup also includes standard UL-certified models.

As a standard product, this stepping motor is compatible with our AC100V unipolar and bipolar drivers, and satisfies the industry's need for increased equipment speed and reduced environmental impact.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Joined Sanyo Denki in 1978
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Areas of Expertise: Development, design, production and quality control of servo systems