

Development of the Small-sized Low-voltage AC Servo Amplifier “SANMOTION R” Series ADVANCED MODEL

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1. Introduction

The AC servo amplifier “SANMOTION R” Series is popular with its high performance and wide variety of functions, and we are expanding the series by adding the ADVANCED MODEL with higher performance and models with EtherCAT interface to the market.

We would like to introduce the small-sized and low voltage AC servo amplifier “SANMOTION R” Series ADVANCED MODEL (referred to as “SANMOTION R” hereafter), which was developed to expand the series.

2. Background of the Development

There has been a demand for low voltage input (DC 48 V/24 V) AC servo amplifiers, and we have been selling compatible products. However, conventional products were made by modifying the internal circuits of products with AC 200 V input as a base, so there was a limit to how small the product could be made.

In recent years, the requirements for small-sized and low voltage for servo motors and servo amplifiers are becoming greater from markets such as semiconductor manufacturing equipment, electronic parts installation equipment, or industrial robots. This has increased the demand for production of small and high performance servo amplifiers with a structure dedicated for low voltage.

In particular, the 14 mm square AC servo motor (driven by DC 48 V) that we started selling in 2009 caught the attention of the industry, but the market strongly desired a smaller servo amplifier that could drive this type of motor.

3. Product Features

3.1 Small size

Fig. 1 shows the photograph of the “SANMOTION R”.

In order to achieve the small-sized the “SANMOTION R” uses original designs for the internal circuits and many of the structures.



Fig. 1: Photograph of the small-sized and low voltage servo amplifier “SANMOTION R”

For the circuit part of power system, we adopted low-loss discrete MOS-FET instead of IPM (Intelligent Power Module) used in AC 100/200 V-input servo amplifier.

We also manufactured the drive power supply of MOS-FET with use of series regulator so as not to adopt SW power supply circuit impeding downsizing.

In addition, we pursued downsizing by reviewing circuit configuration and component parts for the circuit part of control system.

We optimized the space and creepage distance for designing pattern of printed circuit board as a low-voltage exclusive board, for the purpose of maximum downsizing by devising parts layout without increasing manufacturing hours.

Our devising for design achieved Fig.2 Outline dimensional drawing of servo amplifier, with the volume reduced by approximately 30% compared with AC 200 V-input servo amplifier as indicated in Fig.3.

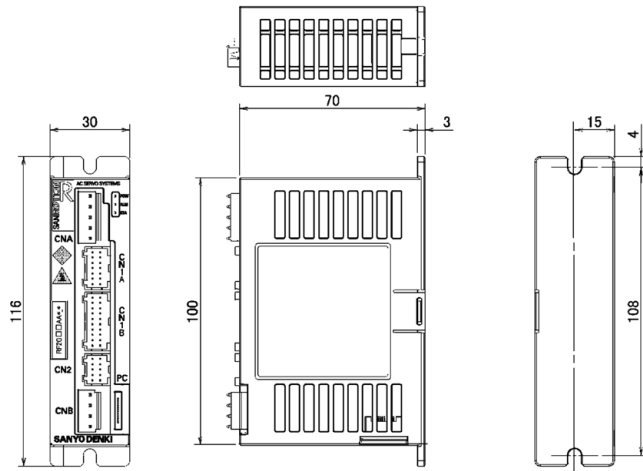


Fig. 2: Outline dimensional drawing of servo amplifier

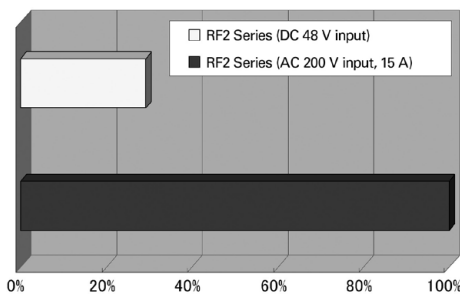


Fig. 3: Volume comparison with the AC 200 V type as 100%

3.2 Features and performance

The features and performance are basically equivalent to our AC 200 V-input AC servo amplifier “SANMOTION R” series ADVANCED MODEL, and a wide variety of functions such as automatic tuning and vibration suppression control can be available. Table 1 shows the specifications for this product.

DC 5 V is externally input as control power supply, DC 48 V as main power supply. Control functions adopt position control method; position command is input from host equipment input in pulse input method.

8 points of signal input/ output signal are provided. The functions assigned to the input/ output signals are selectable via setup software. Standard sensor is absolute encoder, however, wire-saving incremental encoder sensor is also applicable by switching hardware jumper inside of servo amplifier.

Table 1: Servo amplifier specifications

Item	Specifications	
Amplifier model No.	RF2G21A0A00	
Control functions	Position control, model tracking control	
Control method	MOSFET-PWM, sine wave drive	
Input power	Control power	DC 5 V ± 5%
	Main power	DC 48 V ± 10% (DC 24 V ± 10%)
Amplifier capacity (output current)	Rated	3.3 Arms or lower (during natural cooling)
		6.0 Arms or lower (during forced cooling)
	Instantaneous maximum	14.4 Arms or less
Environment	Operating ambient temperature	0 to 40°C
	Storage temperature	- 20 to 65°C
	Operating and storage humidity	90% RH or less (no condensation)
	Altitude	1000 m or less
	Vibration	4.9 m/s ² , frequency range 10 to 55 Hz Within 2 H in each of X, Y, or Z direction
	Impact	19.6 m/s ²
Structure	Tray type, rear mounting	
External shape	Height	116 mm (including mount)
	Width	30 mm
	Depth	70 mm
	Mass	0.23 kg ± 10%
Frequency characteristic	1200 Hz (high speed sampling mode)	
Speed control range	1:5000 (internal speed command)	
Protection functions	Over current, current detector malfunction, overload, main circuit over-voltage, main circuit under-voltage, control circuit under-voltage, encoder malfunction, over velocity, velocity control malfunction, velocity feedback malfunction, CPU malfunction, memory malfunction, parameter malfunction, excessive position deviation, position command pulse malfunction, amplifier overheat, external malfunction	
I/O signal	Command input	Pulse-chain input
	General input	Bidirectional photo coupler × 8 inputs
	General output	Open collector × 8 outputs
	Position signal output	Encoder output, pulse divider
Display (3 LED displays)	Alarm, status, control power	
Dynamic brake	Built-in	
Regeneration processing	Optional	
Analog monitor	Optional	
Standards and compliance	UL, CE, and RoHS directive	

In order to push the size as small as possible, the “SANMOTION R” does not contain the digital operator that is installed in the front of the AC 200 V input servo amplifier. Therefore, operators select the functions of the servo amplifier and set the parameters from a computer installed with setup software. Operators can use the setup software for the AC 200 V input “SANMOTION R” Series ADVANCED MODEL, which can be downloaded from our homepage free of charge.

3.3 Combination motors

The standard combination motor for the “SANMOTION R” is our AC servo motor “SANMOTION R” Series DC 48 V winding R2 motor. The motor lineup includes 40 mm square to 60 mm square flanges, with five types from 30 W to 200 W (Table 2).

The sensor specification for the standard motor is serial absolute encoder with 17-bit resolution, and high precision control with little vibration can be achieved.

In addition to the standard combination motors listed in Table 2, the 14 mm square AC servo motor described above can also be driven.

Table 2: Standard motor-amplifier combinations

Servo amplifier model No.				RF2G21A0A00				
Servo motor model No. / < > flange size R2GA				04003F	04005F	04008D	06010D	06020D
Item	Condition	Symbol	Units	<□40mm>	<□40mm>	<□40mm>	<□60mm>	<□60mm>
Rated output	★	P_R	W	30	50	80	100	200
Rated rotational velocity	★	N_R	min^{-1}	3000	3000	3000	3000	3000
Maximum rotational velocity	★	N_{max}	min^{-1}	6000	6000	5000	5000	4500
Rated torque	★	T_R	$\text{N} \cdot \text{m}$	0.098	0.159	0.255	0.318	0.637
Continuous stall torque	★	T_S	$\text{N} \cdot \text{m}$	0.108	0.167	0.255	0.353	0.637
Instantaneous maximum torque	★	T_P	$\text{N} \cdot \text{m}$	0.24	0.54	0.86	0.84	1.5
Rated current	★	I_R	Arms	1.9	3.8	4.1	5.1	6.0
Continuous stall current	★	I_S	Arms	2.0	3.9	4.1	5.5	6.0
Instantaneous maximum current	★	I_P	Arms	4.8	13.7	14.1	14.1	14.1
Torque factor		K_T	$\text{N} \cdot \text{m} / \text{Arms}$	0.0582	0.047	0.0693	0.0673	0.117
Each phase voltage factor		$K_{E\phi}$	$\text{mV} / \text{min}^{-1}$	2.03	1.64	2.42	2.35	4.07
Phase resistance		R_ϕ	Ω	1.00	0.33	0.32	0.19	0.19
Rated power rate	★	Q_R	kW/s	3.9	6.7	10	8.6	19
Moment of inertia		J_M	$\frac{\text{kg} \cdot \text{m}^2}{(\text{GD}^2/4)} \times 10^{-4}$	0.0247	0.0376	0.0627	0.117	0.219
Mass		WE	Kg	0.35	0.39	0.51	0.71	0.96
Brake mass		W	kg	0.27	0.27	0.27	0.34	0.39

Values for the items marked ★ and velocity-torque characteristics show the values after reaching temperature saturation. The other items show the value at 20°C.

3.4 Optional add-on

We offer a kit of regenerative unit, analog monitor box, and connecting cable as an optional add-on.

Regenerative unit is a unit absorbing regenerative energy generated when motor stopped. Outline dimensional drawing of regenerative unit is shown in Fig.4. Considering installation of equipment, the outside dimensions are the same as servo amplifier. Control circuit inside of

regenerative unit is designed to operate by DC 48 V servo amplifier main power supply, so that exclusive power input is not required. Specifications for regenerative unit are shown in Table 3. We also offer analog monitor box (see Fig.5), enabling user to monitor detailed behaviors when tuning and performing maintenance the system. Signals you want to monitor are selectable via setup software.

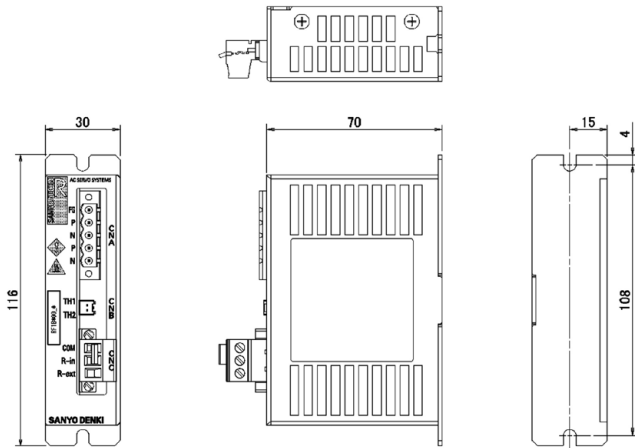


Fig. 4: Outline dimensional drawing of regenerative unit

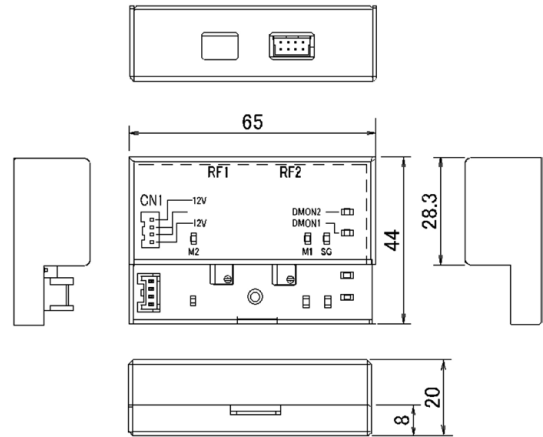


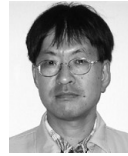
Fig. 5: Outline dimensional drawing of analog monitor box

Table 3: Regeneration unit specifications

Item	Specifications	
Regeneration unit model No.	RF1BB00	
Power supply	Operates through DC 48 V of main circuit	
Operation specifications	Regeneration start voltage	55 V \pm 1.5 V
	Hysteresis width	2 V \pm 0.5 V
	Built-in regeneration resistance value	15 Ω \pm 5%
	Allowable absorbed power	7 W
Environment	Operating ambient temperature	0 to 40°C
	Storage temperature	-20 to 65°C
	Operating and storage humidity	90% RH or less (no condensation)
	Altitude	1000 m or less
	Vibration	4.9 m/s ² , frequency range from 10 to 55 Hz Within 2 H in each of X, Y, or Z direction
	Impact	19.6 m/s ²
Structure	Tray type, rear mounting	
External shape	Height	116 mm (including mount)
	Width	30 mm
	Depth	70 mm
	Mass	0.18 kg \pm 10%
Protection function	Overheating detection by built-in thermostat	

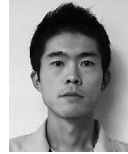
4. Conclusion

This document introduced a part of features of the small-sized low-voltage AC servo amplifier “SANMOTION R” series ADVANCE MODEL. This product achieved overwhelming downsizing to the extent of palm-sized product in ways that are hard to imagine from current AC servo amplifier. We believe this product sufficiently responds to downsizing and space saving increasingly demanded in FA-related facilities. We also believes this product can easily respond to technical advantages of applications driven by current stepping motor. We are aiming to expand variants of this product to meet the requirements of the market.



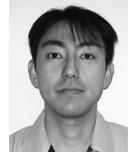
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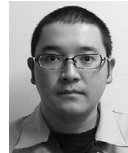
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