"SANMOTION F" Series Stepping Motor with Integrated Driver and Built-in CANopen Interface

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1. Introduction

The "SANMOTION R" series AC servo amplifier with built-in CANopen interface was released in 2007 specifically to target the European servo systems market. In the European market, we sensed great expectations for CANopen interface, not just in the market for servo systems, but also in the market for stepping systems. In order to meet these expectations, we have developed a "SANMOTION F" series stepping motor with integrated driver and built-in CANopen interface.

This document introduces overview and features of this product.

2. Product Overview

2.1 Outer shape

The developed products are based on the 42 mm square and 60 mm square 5-phase stepping motor. They are each available with or without the built-in brake, meaning that a total of 4 models were developed.

Figs. 1 and 2 show product images without the built-in brake, which is known as the standard type. Figs. 3 through 6 show dimensional outline drawings of the 4 types.

2.2 Structure

The structure of this product has the driver unit arranged in the rear of the motor unit, with the CAN interface, power supply, and I/O connectors arranged on the top of the driver unit. The 60 mm square models are shaped like square cylinders, with the motor unit, brake unit, and driver unit arranged in a straight line. The 42 mm square models are shaped differently, with the driver unit and brake unit sticking out further than the motor unit.

This product has a built-in 500 P/R encoder, and it can manage its position with 4x speed for 2000 P/R. The device setting switch, the status display LED, the 7-segment LED, and the maintenance communication connector are on the rear of the driver unit. The cover on the rear face of the driver unit is removable to allow easy access to the switch and connector.

• Built-in brake type

The built-in brake type is arranged with a holding brake between the motor unit and driver unit.

Fig. 1: 42 mm square standard type

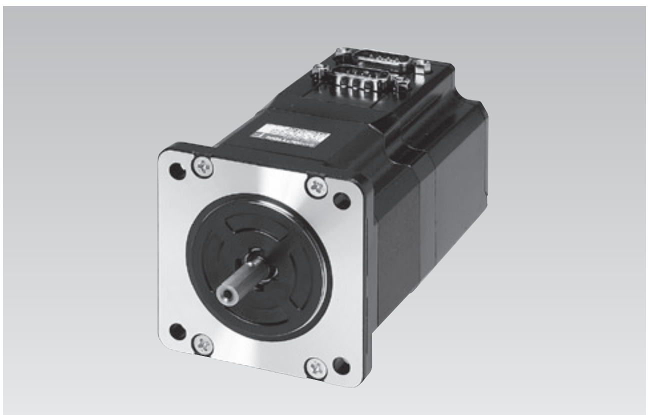

Fig. 2: 60 mm square standard type

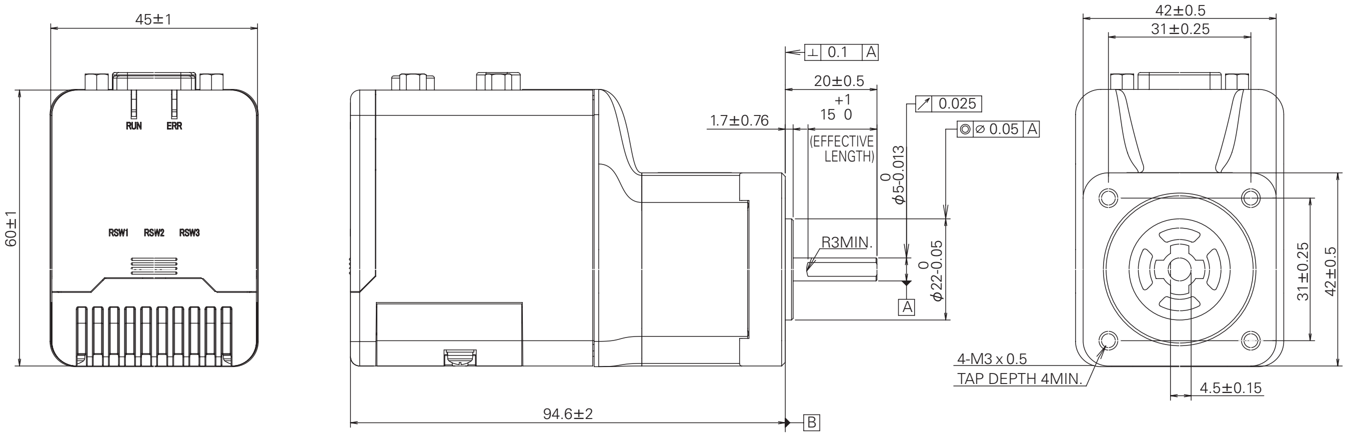

Fig. 3: 42 mm square standard type DPF1M542S-01

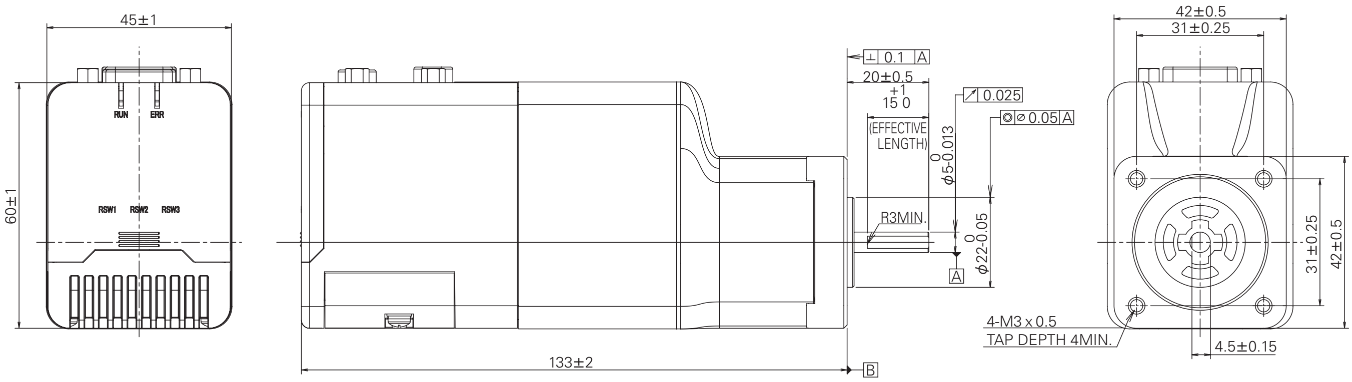

Fig. 4: 42 mm square built-in brake type DPF1M542SB01

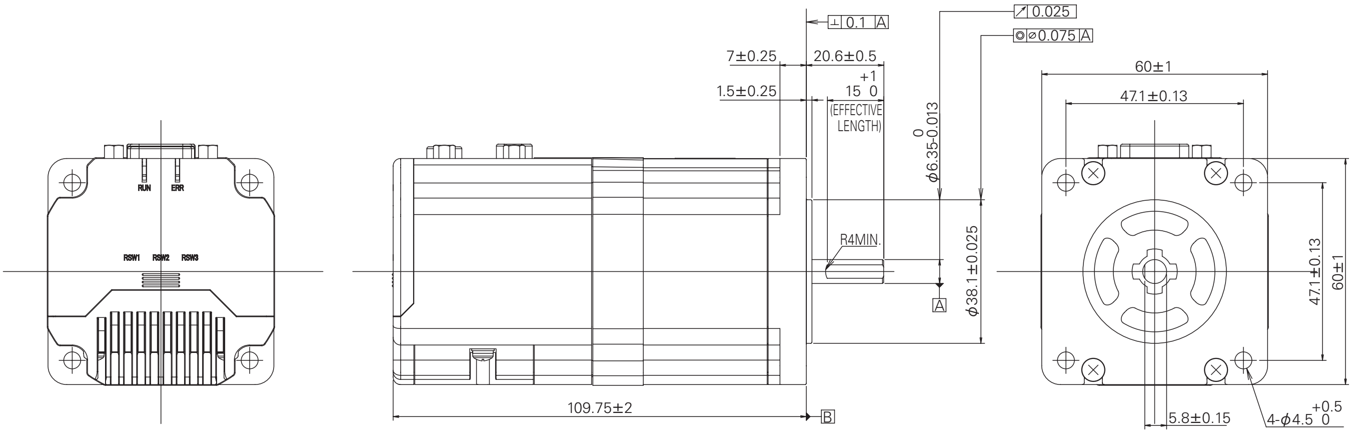

Fig. 5: 60 mm square standard type DPF2M562S-01

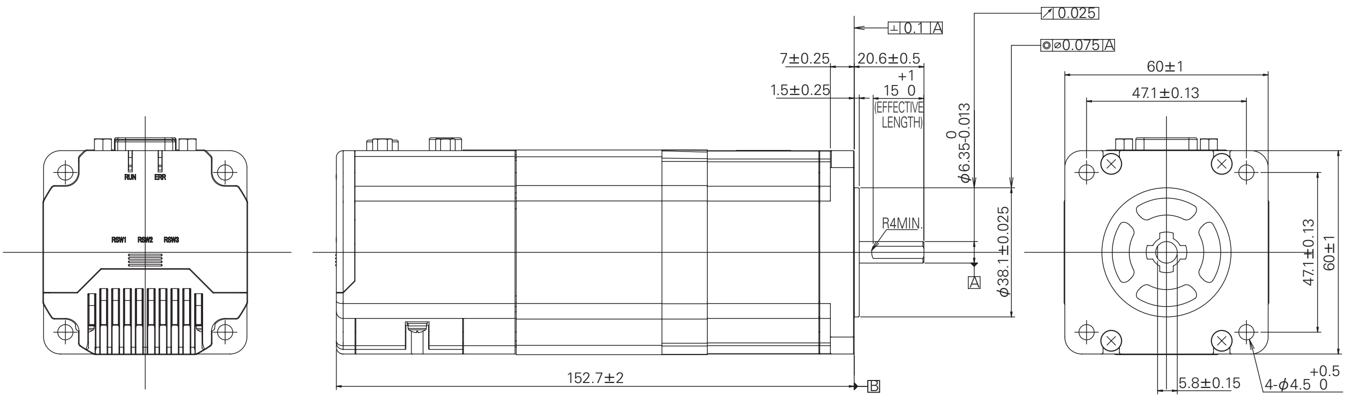

Fig. 6: 60 mm square built-in brake type DPF2M562SB01

Table 1: Specifications

			42 mm sq.		60 mm sq.	
			Standard	Built-in brake	Standard	Built-in brake
Model No.			DPF1M542S-01	DPF1M542SB01	DPF2M562S-01	DPF2M562SB01
Basic specifications	Input power		DC 24 to 36 V ± 10% For built-in brake: DC 24 V ± 10%			
	Environment	Temperature	0 to 50°C			
		Humidity	35 to 85% RH (no condensation)			
		Altitude	ASL up to 1,000 m			
	Holding torque (N · m)		0.28	0.28	0.98	0.98
	Holding torque for brake (N · m)		—	0.3	—	0.8
	Mass (kg)		0.45	0.65	0.9	1.2
Functions	Protection function		Driver overheat, overcurrent			
	LED indicator		Status display: 7 segment LED CAN: RUN/ERROR			
	CANopen interface	Bus connection, medium	Comply with CAN-Standard ISO 118988 (High-speed CAN)			
		Communication profile	Comply with CiA DS-301 V4.02.			
		Device profile	Comply with CiA DSP-402 V2.0			
		Communication port	D-sub9 (1 port)			
		CAN power source	Required			
		Baud rate	10 kbit/s, 20 kbit/s, 50 kbit/s, 125 kbit/s, 250 kbit/s, 500 kbit/s, 800 kbit/s, 1 Mbit/s, selectable by rotary switch			
		Node address	Up to 127, selectable by 2 rotary switches			
		Communication object	SDO, PDO, EMCY, NMT, SYNC			
		PDO Transmission mode	Synchronous transmission/Asynchronous transmission			
		Operation mode	Profile Position Mode, Profile Velocity Mode, Homing Mode			
	Input/output signal	Connector	D-sub15			
		Input signal	6 inputs, PNP (GND common) 5 to 24 V			
		Output signal	2 outputs, Open collector (none common, independent) 30 V 10 mA max			
	Maintenance serial I/F mode	RS485 standard	Half-duplex start-stop synchronous communication, Communication speed 115,200/38,400 bps			
	Resolution	Microstep	200 P/R, 400 P/R, 500 P/R, 800 P/R, 1000 P/R, 1250 P/R, 1600 P/R, 2000 P/R, 2500 P/R, 3200 P/R, 4000 P/R, 5000 P/R, 6400 P/R, 10000 P/R, 12500 P/R, 12800 P/R, 20000 P/R, 25000 P/R, 25600 P/R, 40000 P/R, 50000 P/R, 51200 P/R. 62500 P/R, 100000 P/R, 125000 P/R			
		Encoder	500 P/R			

3. Product Specifications and Features

3.1 Specifications

The general specifications are shown in Table 1 while the torque characteristics are shown in Figs. 7 and 8.

• Product lineup

42 mm sq.	Standard type	: DPF1M542S-01
	Built-in brake type	: DPF1M542SB01
60 mm sq.	Standard type	: DPF2M562S-01
	Built-in brake type	: DPF2M562SB01

There are standard and built-in brake types in both the 42 mm and 60 mm sizes, for a total of 4 types. For the built-in brake type, the brake unit operates during a power outage. This prevents the load from falling if the device is running on a vertical axis.

3.2 CAN specifications

The CAN communication specification complies with DSP-402V2.0 and offers the following 3 operating modes.

- Profile Position Mode
- Profile Velocity Mode
- Homing Mode

3.3 Functions

3.3.1 Function settings

The CAN interface address and communication speed can be set with the switches on the back of the driver unit. Setting the switches before installing the device can help the network start up smoothly.

3.3.2 Status display

A 7-segment LED is used to indicate product status and alarms. This allows the status of the device to be determined without going through the CAN interface.

3.3.3 Maintenance port

A serial interface (RS-485) is provided for maintenance. This port supports the following functions.

* Setting and reading internal parameters
* Monitoring CAN communication
* Transmitting operation instructions to the motor

Even if a problem occurs on the CAN communication, this port can be used to grasp the situation and easily perform diagnosis. Furthermore, even if the CAN network is not established when starting up the device, function are set and operations are confirmed, so test operations can be performed.

3.4 Reduced loss in the drive circuit

Due to the integration of the driver and stepping motor, two problems developed: reducing the size of the 5-phase drive bridge circuit and lowering heat generation. This product uses a newly-developed hybrid IC for the 5-phase bridge circuit.

Characteristics of the newly-developed hybrid IC

- Latest FET with low on-state resistance is mounted as a power element
- Heat conductivity is improved with resin mold package
- The current control section has been shifted to software, reducing the number of parts

The new hybrid IC reduces power loss 18% over the previous model. Additionally, changing the current control section to software has reduced the number of parts by 20%. As a result of these improvements, the reduction of heat generation and size has been achieved, and 5-phase stepping motor and the driver are integrated.

3.5 Micro-step control

Micro-step control has been added to this product with 25 different types of micro-step divisions available for selection, including the 0.72° basic step angle. The number of divisions supports compatibility with the basic step angle of 1.8°. This means that the device can easily replace 2-phase stepping motors, which are the most commonly used type in Europe.

Furthermore, with the built-in auto-micro function, this produce reduced vibrations by about 50% from the previous stepping motor with built-in driver.

The auto-micro function is a function that automatically performs micro-step at low speeds.

4. Conclusion

This document has introduced a basic overview of the stepping motor with integrated driver and built-in CANopen interface.

This product incorporates the CANopen interface that has spread throughout many motion control networks in Europe, and realizes an integrated driver and motor. We hope that we have developed a product with excellent cost performance. With this product, we were able to eliminate the cost of wiring between the motor unit and the driver unit. Furthermore, by supporting three operation modes, the load is reduced on the controller and the system cost can be reduced.

The motion control network contains much more than just CANopen. We would like to use this product as a base to develop products that support networks other than CANopen in the future.

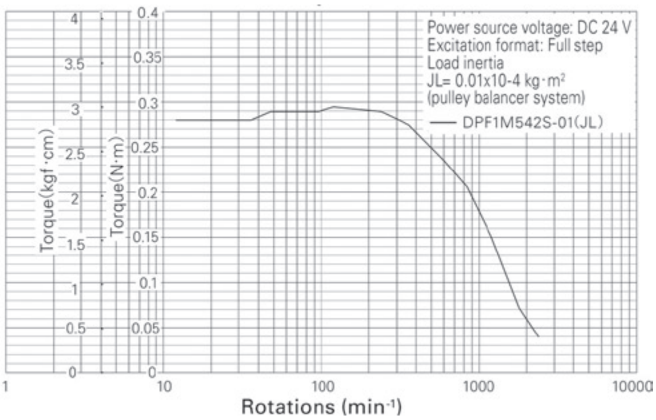

Fig. 7: DPF1M542S-01 torque characteristics

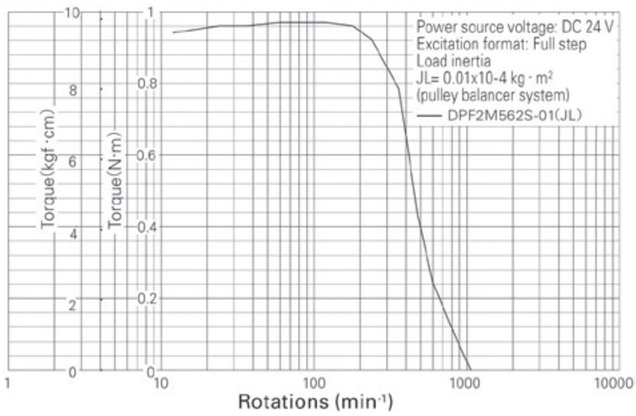

Fig. 8: DPF2M562S-01 torque characteristics

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