

Development of “SANMOTION F” Series Small-size 5-phase Driver

Nobutoshi Nakamura

Shigehiro Kamada

Daisaku Furihata

1. Introduction

For small-size devices in general industrial machinery that employ the stepping motor, customers often mount the driver circuit of the motor on the customer’s PCB due to the limited space and are forced to develop their own driver. However, developing a self-manufactured driver leads to a time-consuming design and verification processes for the circuit or heat liberation. Furthermore, it may also cause quality maintenance problems for the devices if the staff is unaccustomed to verification or adjustment work for the driver circuit of motor.

When the customer considers the use of the 5-phase stepping motor for the purpose of achieving low noise and high precision of the device, employing a small-size driver installed on a printed-circuit board can improve flexibility in the device design.

This document introduces the features performance capabilities of the small-size, 5-phase driver “SANMOTION F” series, which has been developed for this application.

2. Product Overview

2.1 Appearance and structure

The developed product is housed in the plastic case and has pins at the bottom for inserting a PCB. At the top of the product, switches for various settings are laid out. Fig. 1 shows a photograph of the driver.



Fig. 1: Photograph of the driver

2.2 Structure of the driver

The driver consists of two modules: the power block and control block. A special module has been developed for the power block in order to ensure the small size. This module has a FET chip bonded on the ceramic substrate. The control block includes alarm LED and switches for controlling the motor and for setting functions.

The outer case of the driver is made of plastic, and it is shaped to prevent any foreign matter from getting inside and to protect internal electronic parts. The switches and the alarm LED are laid out on the top side of the cover to allow the user to easily setup and verify the status for improved usability.

3. Product Specifications and Features

3.1 Specifications

Table 1 shows product specifications and figure 2 shows dimensions.

Products can be combined with the 28 mm sq. or 42 mm sq. 5-phase stepping motor “SANMOTION F” series. The interface to set the current and functions has been simplified so that the customer can include it in self-manufactured boards.

Since functions and parts to control the motor are built in the driver, external parts or radiating fins are not needed.

You can use the driver only by connecting the power supply, pulse input, and input signals for selecting functions.

Table 1: Specifications

		FS2D140C00		
Basic specifications	Input power	Main power	12 to 24 VDC \pm 10%	
		Control power	5 VDC \pm 5%	
	Environment	Operating ambient temperature	0 to 40°C	
		Operating ambient humidity	35 to 85% RH (no condensation)	
	Dimensions/mass	W34 × H30 × D15.8 (mm)/20 g		
Soldering specifications	260°C Max. 10 seconds or shorter (in the solder bath) up to two times 350°C Max. 3 seconds or shorter (soldering iron) up to two times			
Cooling	Natural air-cooling			
Function	Protection function	<ul style="list-style-type: none"> · Detection of over-heated driver · Detection of main power voltage drops 		
	LED indication	Alarm indication		
	Self-running function mode	Continuous rotation in the clockwise direction at 1 kpps		
	Pulse input method (Select with the DIP switch)	Dual input: CW and CCW pulse input method Single input: Pulse and direction signal input method		
	Current setting (Select with the DIP switch)	<ul style="list-style-type: none"> · Selection of motor rated current · Selection of operation current · Selection of low-loss operation current · Selection of stop current 		
	Input signal (CMOS)	<ul style="list-style-type: none"> · Pulse (negative logic), direction signal input · Excitation switch selection input (FULL/HALF) · Operation current selection input · Power-off input 		
	Output signal (CMOS)	<ul style="list-style-type: none"> · Phase origin monitor output 		

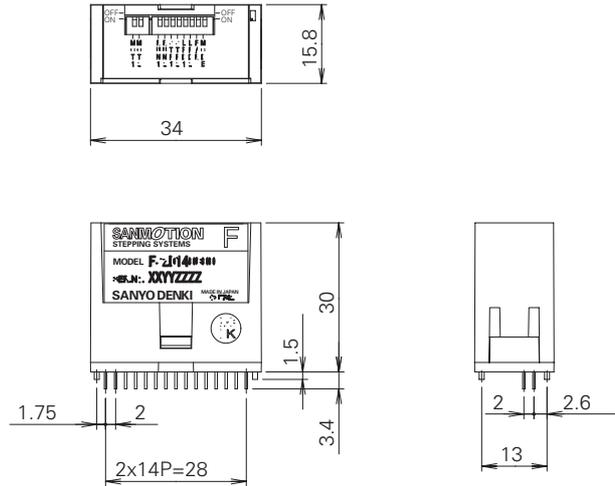


Fig. 2: Dimensions of FS2D140C00

3.2 Operation current setting function

With the existing driver IC that is mounted on the board, the reference voltage for setting current must be switched depending on the current that is used. On this product, the four types of current settings can be configured by using the DIP switch and the current during operation can be switched with the input signal. The four types of settings are as follows:

- Selection of motor rated current
- Selection of operation current
- Selection of low-loss operation current
- Selection of stop current

(1) Selection of motor rated current

Either a rated current of 0.35 A/phase or 0.75 A/phase can be selected.

(2) Selection of operation current

You can select from among four types of operation current that range from 100% to 70% of the rated current.

(3) Selection of low-loss operation current

You can select from among four types of current that range from 90% to 60% of the operation current. Operation current and low-loss current can be switched using the operation current selection input signal.

(4) Selection of stopping current

You can select from among four types of operation current (operation current, or 40%, 50%, or 60% of the operation current) when operations have been stopped.

3.3 Self-running function mode

The self-running mode is included in the product. With self-running mode, just connecting the motor and power supply causes the product to continuously rotate in the clockwise direction without any pulse inputs when it is mounted on the board. This mode allows the user to easily test the product after first mounting on the board or verify the motor operations for maintenance or regular checks.

3.4 Low-loss

The FET chip with low ON-resistance has been chosen for the power block to control the motor, which is bonded onto the ceramic substrate. This method contributed a 10% decrease in loss compared to our conventional products. The decrease in loss means that the product does not need a radiating fin or forced air-cooling, resulting in work improvement for thermal design.

4. Conclusion

The small-size, 5-phase driver “SANMOTION F” series is a product that can be easily mounted onto the customer's PCB.

Since it can be mounted onto the PCBs, power supply and control signals can be patterned, allowing wiring saving and compact design.

Compared to the conventional model, this product is smaller and realizes less loss, and it is widely recommended to customers looking for a compact 5-phase driver that can be mounted to a PCB.

We plan to further improve the product by reducing the size and adding micro-step functions in order to expand into applications such as high-precision testing units, compact X-Y stages, and industrial and consumer camera systems.



Nobutoshi Nakamura

Joined Sanyo Denki in 1985.
Servo Systems Division, 2nd Design Dept.
Previously worked on the design and development of stepping motors. Now works on the design and development of stepping motor drivers.



Shigehiro Kamata

Joined Sanyo Denki in 1986.
Servo Systems Division, 2nd Design Dept.
Previously worked on the design and development of controllers. Now works on the design and development of stepping motor drivers.



Daisaku Furihata

Joined Sanyo Denki in 1996.
Servo Systems Division, 2nd Design Dept.
Previously worked on the design and development of servo amplifiers. Now works on the design and development of stepping motor drivers.