DC Power Input SANMOTION Model No. PB 2 Axes Driver with Built-in EtherCAT Interface

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1. Introduction

SANYO DENKI has already introduced the AC servo amplifier "SANMOTION R" series ADVANCED model with built-in EtherCAT interface, an ultrafast open network, into the market.

There are still demands for lower-priced positioning devices that can be used in the same network.

Furthermore, there are demands for the amplifiers applicable to absolute encoders requiring no homing operation, or the amplifiers enabling customer's applications to perform a wide variety of operations such as regenerative operation.

Having this background, SANYO DENKI newly developed a closed loop stepping system with built-in EtherCAT interface. This report introduces the product profile and features.

2. Advantages of Adopting EtherCAT Interface

2.1 Unified network within a device

Previously, customers needed multiple networks depending on control targets (such as motion systems or I/O systems). Currently customers are able to design equipments in a unified network with the great help of the high-speed performance of EtherCAT interface and various EtherCAT-compliant equipments which have been released. This can reduce man-hours for designing host controller and improve reliability.

2.2 Transfer data flexibility

With EtherCAT, we can achieve data transfer in the minimum required volume and optimization of communication data as the transfer data length and real-time parameters mapping can be flexibly created.

2.3 Reduced wiring costs

Commercially available Ethernet cables (Category 5e specification or higher) can be used for EtherCAT communication wiring. The new model is applicable to the customer's applications requiring high-speed motion which has been previously achieved by pulse train interface, by speeding up the communications, and this can also achieve a significant cost saving in wiring materials and man-hours.

2.4 Relief of master equipment development workload

EtherCAT does not require I/F card with a built-in dedicated LSI or similar device, so software control through PC is achieved. Furthermore, customers can choose from a variety of product lineups such as PLC.

3. Product Profile

3.1 Appearance and exterior

Figure 1 shows the appearance and Figure 2 shows the external dimensions, of the newly-developed model.
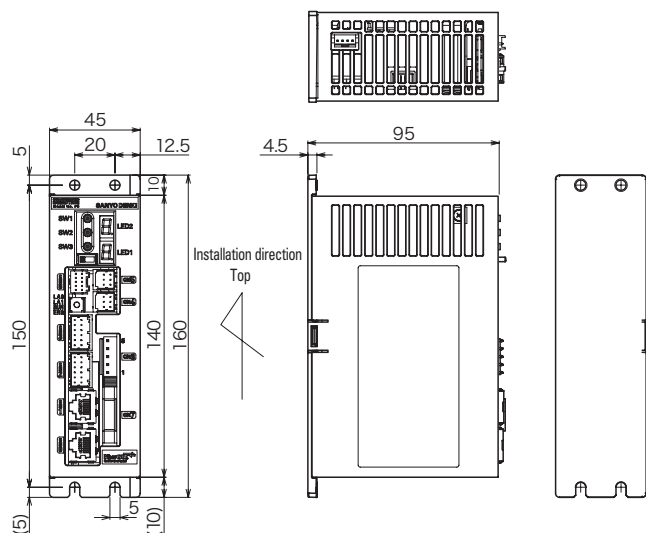

Figure 1: Appearance

Figure 2: External dimensions

3.2 Product specifications

Table 1 shows the outline of product specifications, and Table 2 shows the communication specifications.

4. Product Features

4.1 Performance

4.1.1 Application to regenerative operations

Regenerative energy is generated during downward driving in a vertical axis or decelerating operations.

Model No.PB has previously suppressed the regenerative power voltage by controlling phase by software, however this control method can induce motor magnetic sound and vibrations, while having an advantage that no hardware are required.

The new model suppresses regenerative energy generation by adopting built-in PWM control method which can suppress regenerative current. This greatly reduces motor noise and vibrations during operation.

Furthermore, we had a regenerative control circuit built in the driver, so that regeneration operations are available by installing only an external regenerative resistor (optional) as needed.

4.1.2 Improvement of positioning accuracy

We improved current linearity by adopting newly developed PWM current control method so that the positioning can be achieved within 4 minutes in the state of complete stable stand-still motion, an advantage of stepping motor, holding torque.

Furthermore, the current waveform has few ripples, which reduces heat generation due to motor iron loss.

Figure 3 shows motor winding current waveform.

Table 1: Specifications

Item	Specifications
No. of connected motor axes	2 axes
Main circuit power voltage	DC 24 / 48 V
Control power voltage	DC 24 V (Common with the power for the holding brake)
Compatible motors	28 mm sq., 42 mm sq., 60 mm sq. motors: 5 types in total *Only 42 sq., 60 sq. motors (3 types) supported for absolute encoders
Compatible encoders	Optical incremental encoder: (500P/R) Absolute: (17 bit + multi-turn 16 bit) * The driver model number is different depending on the compatible encoder.
Control method	Mix Decay PWM control Sine wave drive method
Operation mode	Homing operation Profile position/speed mode Cycle sync position/speed mode
Dimensions	H 160 × W 45 × D95 mm
Mass	Approx. 0.5 kg
Structure	Tray type
Built-in functions	Holding brake control function Regeneration control circuit (External regeneration resistance optional)
Display	7 segment LED indicator
Interface	Communication · EtherCAT interface · Setup (RS-485 half duplex) Input signal · Home sensor · Limit sensor · Gate off signal Output signal General output signal (3 pts.)
Digital operator	Jog operations Holding brake control, etc.
Compatible regulations	UL, CE, and RoHS directive
Operating ambient temperature	0 to 55°C

Table 2: Communication specifications

| Item	Specifications
Device profile	IEC-61800-7 Profile type 1 (CiA 402) · CoE (CANopen over EtherCAT) · FoE (File access over EtherCAT)
Communication port	RJ45 connector (2 ports)
Communication speed	2 x 100 Mbaud (full duplex)
Max. No. of nodes	65,535 slaves
Transmission distance	Max. 100 m (between nodes)
Frame data	Max. 1484 byte
Cable	Shielded twisted pair CAT5e (Straight or crossed)
PDO Transmission mode	SYNC0 Event (DC Mode) SYNC1 Event (DC Mode) Synchronous with SM2 Event Asynchronous FreeRun Mode
Communication object	· SDO (Service Data Object) · PDO (Process Data Object)
PDO length	Max. 64 Byte(Input/Output)
LED indicator	Port 0/1 link display, RUN display, error display
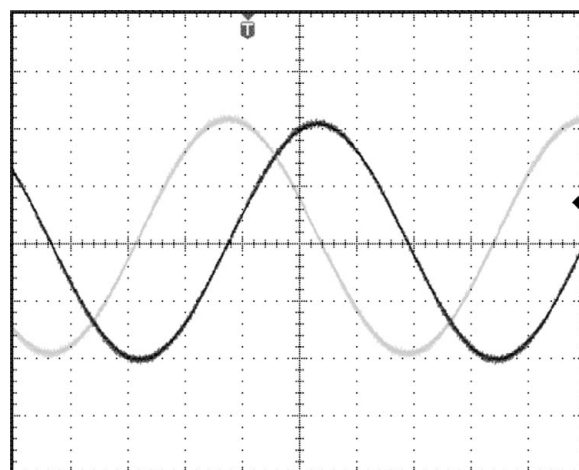
Figure 3: Motor winding current waveform

4.2 Functions
4.2.1 2-in-1 driver

We decentralized the costs required for EtherCAT interface physical layer, wiring, and number-of-axes-independent hardware such as power supply system.

The new model achieved approximately 30%-space saving that is calculated as the volume ratio of the new model to two single-axis drivers. Figure 4 shows the system configuration diagram.
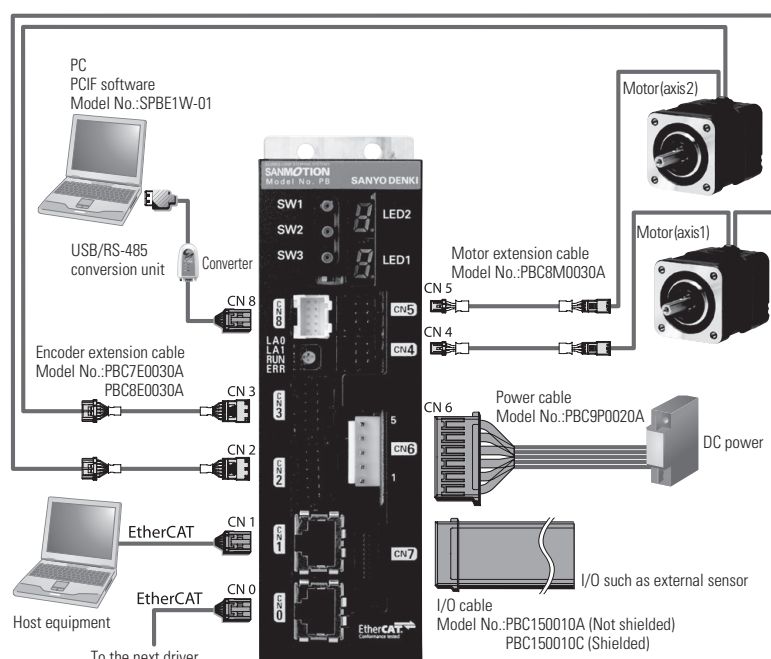

Figure 4: System configuration diagram

4.2.2 Compatible encoders

In addition to the conventional incremental encoder, the new model is newly applicable to absolute encoder.

This can eliminates the need for homing operation and excitation origin detection (initialization operation) after turning on the powering supply required by incremental encoder. So this can also enables the new model to apply to the applications needing these complicated operations that customers have wanted to avoid.

The followings are the lineup of driver model numbers.

- PB4D003E2D0: Incremental encoder-compatible driver
- PB4D003EAD0: Absolute encoder-compatible driver

4.2.3 2-axis synchronized operation function

A synchronized operation function in profile position mode has been newly built into the new model for the operation cases such as when driving single work (mechanism) in the two axes.

This can eliminate the need for monitoring synchronous deviation, so the master equipment loads and stresses on the works or mechanical systems due to synchronous deviation can also reduced.

4.2.4 Wide variety of operation modes

The following operation modes are built in the new model:

- Cycle synchronous mode (travel distance per unit of time continuously-updated)
- Profile position mode (driver-generated profile mode, velocity, acceleration/ deceleration, and travel distance are commanded)
- Homing operation mode (various homing operation modes such as home sensor, limit sensor, present position origin, or mechanical stop origin)

Also, probing function (Touch Probe Function), velocity mode, and mechanical stop operation (current limiting function) are bult in the new model as standard, this achieved selection of the optimum operation method depending on applications.

4.2.5 Setup software

We offer setup software having parameter-editing function and waveform tracing function for checking operation status.

Communication for setting up can be connected with being unaffected by the communication status of EtherCAT. So customers can check the operation status and perform tuning via PC during equipment operation.

We also commoditized this software to share with

SANYO DENKI servo amplifiers (SANMOTION R-series models) so as to improve the convenience for customers.

5. Conclusion

This report introduced the profile of the closed stepping system with built-in EtherCAT interface.

Compared to the conventional Model No. PB system, this new model can applicable to the applications which have been conventionally difficult to apply our models, by improving performance and building in the new functions. Also, having EtherCAT interface built in, which is expected to be globally promoted in the future, SANYO DENKI thinks this new model can be the system to improve customer's equipments tact time and offer technical advantages to customer,

We will continue to improve the series aiming at further increase in performance for the future.

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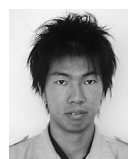Worked on the development and design of servo amplifiers.
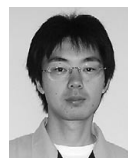
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