“SANMOTION C” Series Controller Module with EtherCAT Interface

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1. Introduction

“SANMOTION C” Series is a motion controller, targeted to control mainly the servo motors, realizing advanced position control and speed control for the FA industry. The production cost of the customer's device was reduced with less wiring by the motion network, and this is a product that can develop an efficient control system by unifying the function of the PLC (sequence controller), motion controller, and robot controller.

To respond the high-end requirements from the market, controller modules with EtherCAT interface, “CP240-A” and “CP242-A” (referred to below as the new model) were added to the lineup of the “SANMOTION C” Series. This document introduces an overview of the features of the product.

2. Background of the Development

While the performance of the control equipment in the FA industry is getting higher at the same time as the price dropping, the market interest continues to rise for the controller that are the core component of the system. With the our last lineup, there was a limit on the controllable number of axes by the limitation of the CPU processing speed and motion network communication speed, and there was a growing number of cases where the products could not meet the need for multiple axes control from the customer.

Also, motion network is becoming a popular method to realize wire-saving in the FA industry, and the introduction of the faster motion network is gathering attention of the industry.

With these backgrounds, the product was developed targeting multiple axes control by the faster CPU and high-speed motion network, and high cost performance.

3. Product Overview

Fig. 1 shows the external view of the new model.

Fig. 1: External view of the controller module “CP242-A”

3.1 Control CPU

The product has two models, “CP240-A” with 600 MHz CPU and “CP242-A” with 1.1 GHz CPU. For the CPU, the Atom from Intel, which is low cost and made a big hit in the netbook, a small and light laptop PC, is adopted. It is a CPU realizing high-speed processing and low power consumption, considering the usage on batteries for the netbook. From the lineup of the Atom, we have chosen the embedded type, which is guaranteed the long period supply.

3.2 Motion network

The EtherCAT is adopted as motion network, which is important as a motion controller. EtherCAT is an open high performance Ethernet-based fieldbus system, and many manufacturers are in the process of adopting it because of its open, fast-speed, flexible, and safety features.

In 2007, EtherCAT was integrated into the international fieldbus standard IEC 61158 Type 12 elements as well as into the drive profile standard IEC 61800-7. Table 1 shows EtherCAT interface specifications.

Table 1: EtherCAT interface specifications

Physical layer	IEC61158-2 IEEE802.3u (100BASE-TX)
Communication port	RJ45 connector
Communication rate	100 Mbit/s (full duplex)
Max. No. of nodes	65,535 slaves
Transmission distance	Max. 100 m (between nodes)
Cable	Twisted pair CAT5e

The number of the slave that can be connected to the network (maximum node number) is 65,535, and it is sufficient the number of axes for multiple axes control. Compared to the 10 Mbit/s communication speed of the conventional motion network field bus module "FM299" , it has a fast-speed of 100 Mbit/s.

With the high-speed processing of the CPU and the high-speed communication of the motion network, more axes can be controlled than before.

By combining with "SANMOTION R" Series ADVANCED MODEL AC servo amplifier with EtherCAT interface, it is possible to perform higher level control and realize various functions. For the details of the "SANMOTION R" Series ADVANCED MODEL AC servo amplifier with EtherCAT interface, please refer to our Technical Report No. 28.

3.3 Specifications

The new model has been equipped with CAN, Ethernet, and RS485 ports for the connection with the external devices. The bus link module can be connected to the CAN port, and extension modules can be added. A PC with a programming tool installed can be connected to the Ethernet port, and programming and debugging of the application software can be performed. Data communication with the HMI (touch panel) and external equipment such as image processing equipment can be performed by connecting them to the RS485 port.

The compact flash card installed with the runtime software (control software) and the application software can be used in the card slot on the front panel.

The width of the new model is 135 mm, compared with the 180 mm of the conventional controller module "CP232-Z" . It has achieved 33% reduction in size, including the width of the field bus module (22.5 mm), because the new model has built-in the EtherCAT interface.

Table 2 shows the specification of the new model.

Table 2: Specification of the new model

Model No.	**CP242-A**	**CP240-A**
CPU	Atom 1.1 GHz	Atom 600 MHz
Main memory	512 MB	
Motion network	EtherCAT (100BASE-TX)	
Ethernet	10/100 Mbit/S	
CAN	125 Kbit to 1 Mbit/S	
RS485	1200 to 115200 bps	
Power supply	DC 24 V (19.2 to 30 V)	
Operational temperature	0 to 55˚C	
Dimensions	120 mm(H)×135 mm(W)×100 mm(D)	
Weight	0.96 Kg	
Standards and compliance	UL, CE, and RoHS directive	

3.4 Extension module

The new model has the same height and depth as the conventional controller module, so it is possible to use the conventional extension module as is. Up to 12 extension modules can be connected via the connector on the right-side of the controller module. To use more than 12 modules, they can be connected via bus link module. Table 3 shows the extension modules that can be used.

Table 3: Usable extension modules

Analog I/O module	AM280-A (4AI,4AO)
Digital I/O module	DM272-A (8DI, 8DO)
	DM276-A (6DI, 8DO)
	DI266-A,B (16DI)
	DO276-A,B (16DO)
Field bus module	FM299-A (GA1060)
Interface module	SM210-A (RS232C×2)
	SM230-A (RS422/485×2)
Encoder module	MM240-A
Bus link module	BL210-B

3.5 Runtime software

The lineup of the runtime software (control software) was revised. It was separated to the types for each function, such as for the motion control or for the robot control, and the runtime software with only required functions can be selected. By doing so, runtime software for simple controls can be provided at a low cost. Table 4 shows the types and functions of the runtime software.

Table 4: List of functions of runtime software

Type	Functions
SMC-MFB	Motion control (electronic gears and electronic cams)
SMC-PTP	Basic (linear) robot control
SMC-PTPLS	Robot control (various robots)
SMC-PATH	Robot control (various robots, interpolation motion, path motion)
SMC-PATHPLS	Robot control (various robots, collision prevention, tracking, palletizing function)
SMC-PATHADV	High function robot control

3.6 Programming tool

New programming tool to write the application software is developed considering the operability and easiness to use. Programming tool runs on the Windows PC, and there are two types, the “SANMOTION Studio-MC” for motion programming and the “SANMOTION Studio-RC” for robot programming.

Following are some of the functions in the tool.

Fig. 2 shows the screen of the configuration tool for the setting of the controller and expansion module.

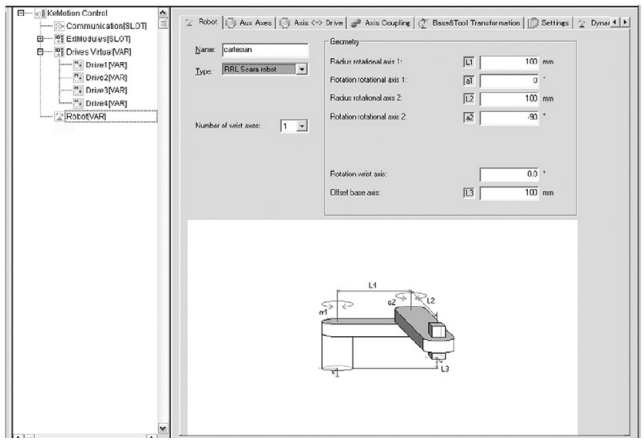

Fig. 2: Configuration tool

Fig. 3 shows the example of the screen writing an application program. Efficient programming can be done by utilizing MFB (Motion Function Block) in addition to the IL, LD, ST, SFC, and FBD standardized in the IEC61131-3.

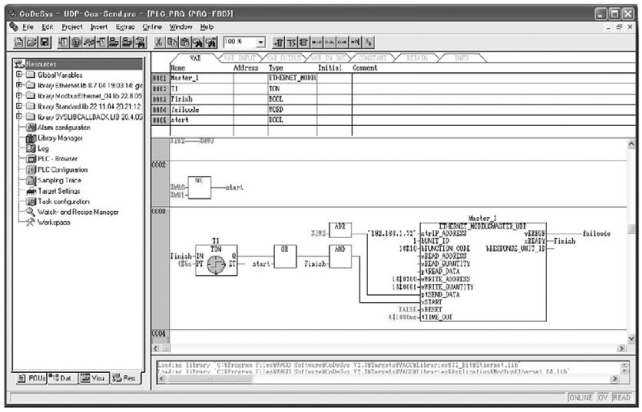

Fig. 3: Programming screen

Also, The cam tool can be used to programe the motion pattern of the electronic cam. Programming can be performed with a graphical interface using the motion pattern of arbitrary electronic cam on the screen. Fig. 4 shows the screen of the cam tool.

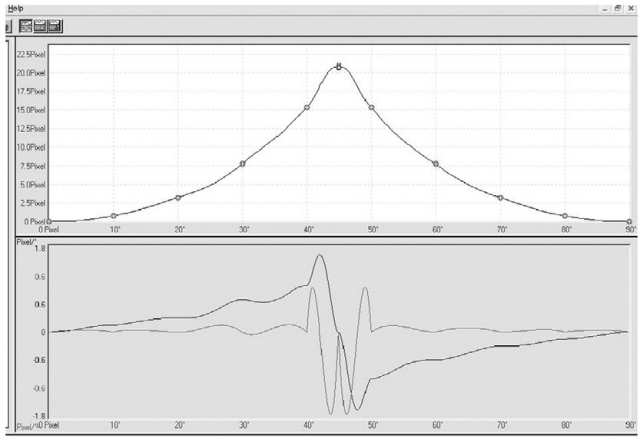

Fig. 4: Cam tool screen

The "Scope" is a tool to monitor the status of the whole system, each servo motor, and robot. Fig. 5 shows the screen of the "Scope" .

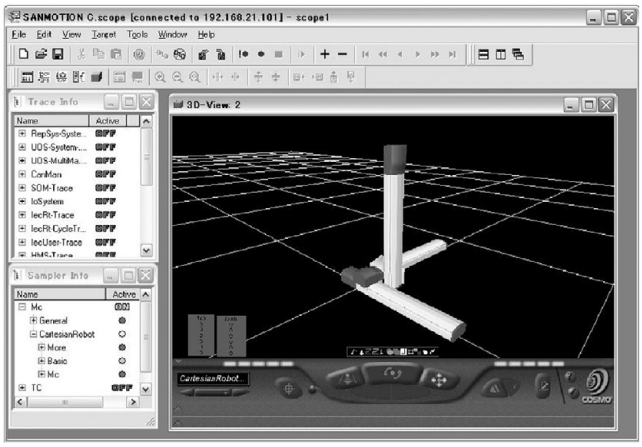

Fig. 5: Scope screen

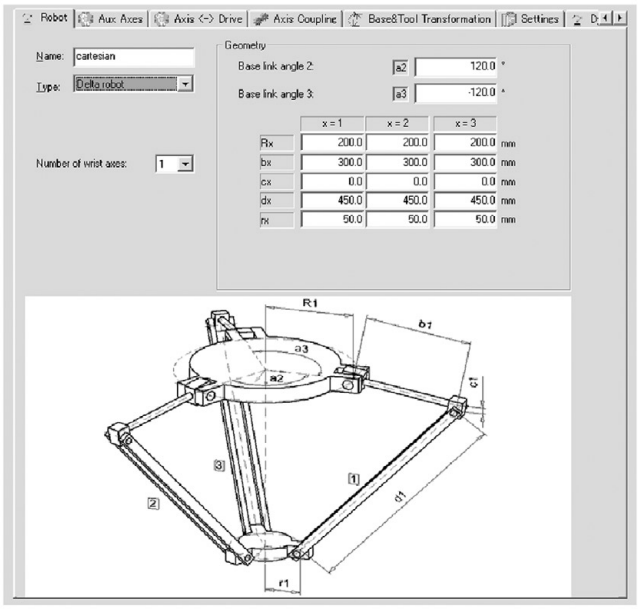

Fig. 6: Robot programming tool screen

4. Features

4.1 Functions

As a upper model of the conventional controller module, the new model has realized the high speed processing and multiple axes control, and has also made the following functions possible by combining with a servo amplifier with EtherCAT interface.

- Controlling of the position, speed, and torque mode/ switching of the modes
- Model following damping control
- Full close control

4.2 Programming tool for the robot mechanism

Programming tool for the robot mechanism, which was requested by many customers, can be used. The robot mechanism can be edited by selecting the robot shape and then entering the necessary dimensions by following the instructions on the screen. Fig. 6 shows the screen of the tool, and Fig. 7 shows the example of the robot mechanism that can be edited.

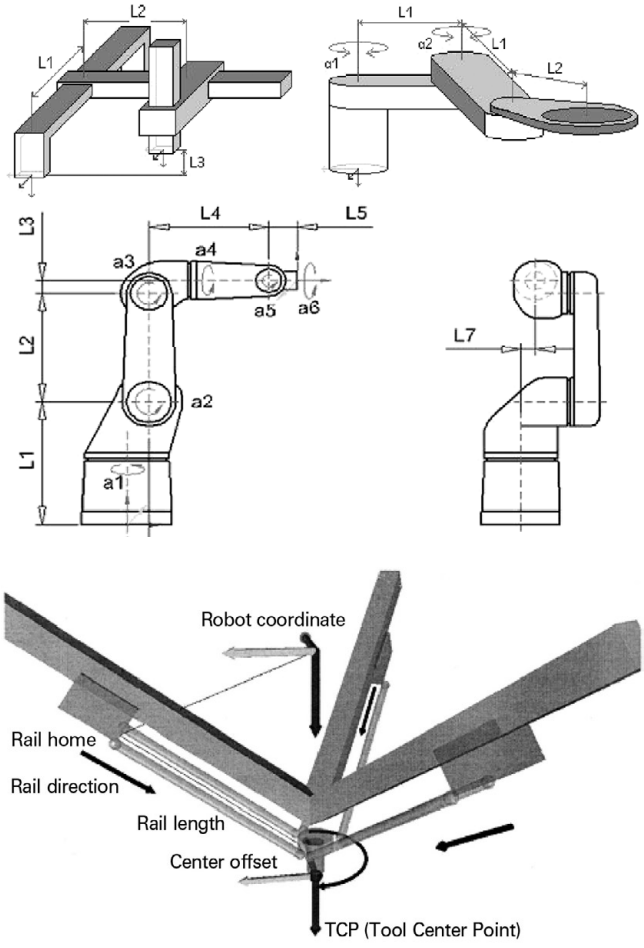

Fig. 7: Example of robot mechanism

4.3 Multiple axes control

The biggest features of the new model are EtherCAT interface with a big margin for the number of equipment that can be connected and the control of multiple axes by high speed CPU.

Performance of the equipment that handles the setup processing with an air cylinder or mechanism admit of improvement by making these peripherals controlled by servo motors, which will enhance the operating rate of the equipment. But to do this, multiple axes systems needed to lower the cost and realize a space-saving design. The new model has adequate ability.

When advancing the control system to a further multiple axes control system, there is a tendency for the number of I/O points to increase, for programs to become more complex, and for system performance to drop. The new model can control multiple axes without dropping the performance because of the high speed CPU.

Fig. 8 shows the system configurations of the multiple axes control.

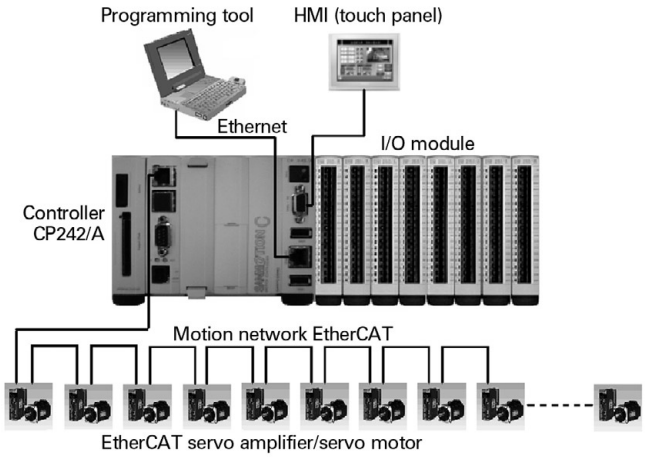

Fig. 8: Example of
the multiple axes control system structure

5.Conclusion

Motion network is becoming a requisite for the motion controller. It is also possible to develop a product with high cost performance by combining both features proficiently. Development of future business is promising with the combination of the high speed CPU and the EtherCAT interface, which is becoming popular in the market.

On the other hand, from the point of view of the customer, controllers and motion network is just a tool to achieve the performance of the equipment. We would like to continue the development of new products considering what the customers really need.

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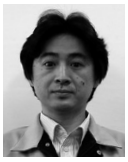

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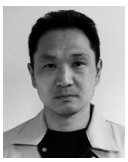

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