The A to Z of the SANMOTION C

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1. Introduction

Did you know that the "C" of the "SANMOTION C" stands for "Controller"? One could perhaps visualize the product from the series name however, in fact, this product is not very well known. In light of this, this report aims to introduce the "SANMOTION C" in a straightforward way.

2. SANMOTION C Positioning

There are two types of controllers; the PC-based controller, which uses a PC (personal computer) as a platform, and the stand-alone controller, which uses the original architecture of each company as a platform. Sanyo Denki's "SANMOTION C" falls into the latter category as a stand-alone controller.

Table 1 categorizes the existing controllers.

PC-based controllers feature excellent expandability and flexibility. Typical applications include equipment which requires computer calculations and data processing (for example mounters and medical equipment which requires image processing) and semiconductor manufacturing equipment for which process control is principle.

Meanwhile, the merits of stand-alone controllers are reliability and sustainability, allowing the same product to supply power for a prolonged period of time. Stand-alone controllers are often used in applications which focus on performance, such as machine tools, processing machines and molding machines.

The "SANMOTION C" has incorporated the strengths of both PC-based and stand-alone controllers. Moreover, it has widened its application scope with the addition of kinematics for various robots.

Figure 1 shows the positioning of the "SANMOTION C".

Table 1: Controller categories

Category	Controller type	Development language	Application
PC-based	Software	C language, C++ language	Semiconductor manufacturing equipment, inspection equipment, mounters, food processing machines, medical equipment, packaging machines
	Bus connection board (PCI Express/PCI, ISA, VME, etc.)		
Stand-alone	CNC (Computer Numerical Control)	G language	Machine tools, injection molding machines, metal processing machines
	PLC (Programmable Logic Controller)	Ladder diagram	General industrial machinery, food processing machines, medical equipment, packaging machines
	Robot Controller	Original language	Articulated, scalar, parallel link, etc.
	Integrated controller (PLC + motion)	SFC language, C language PLC open language (IEC61131-3)	General industrial machinery, metal processing machines, food processing machines, medical equipment, packaging machines
	SANMOTION C (PLC + motion + robot)	PLC open language (IEC61131-3) original robot language	General industrial machinery, metal processing machines, coil winding machines, food processing machines, medical equipment, packaging machines, various robots

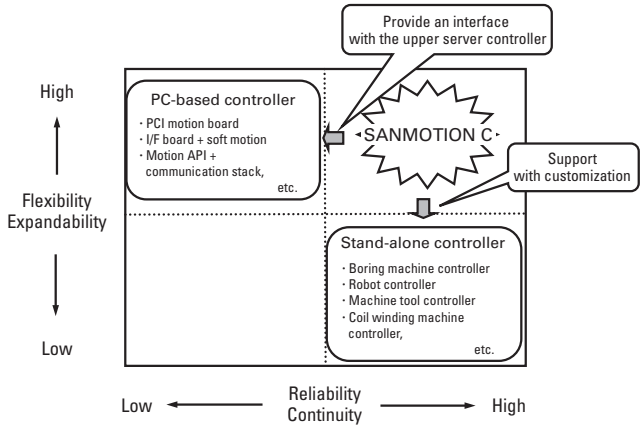

Fig. 1: "SANMOTION C" positioning

3. SANMOTION C Configuration

3.1 Software configuration

Figure 2 shows the software configuration of the "SANMOTION C".

Operating systems (OS) adopt the highly-reliable VxWorks as a real-time operating system (RTOS).

Using this RTOS, in addition to execution of system control software, robot control, PLC/motion control software can be executed at the upper server on the same level.

This software, including RTOS, is sold installed in a compact flash memory as basic software. Moreover, the "SANMOTION C" has a software configuration with flexibility and expandability so that robot control and PLC/motion control can be installed separately depending on the necessary functions of the equipment.

At the uppermost level, there is an application layer, which executes the application software created by the user using Studio-RC or Studio-MC, which are development support software for robot control and PLC/motion control.

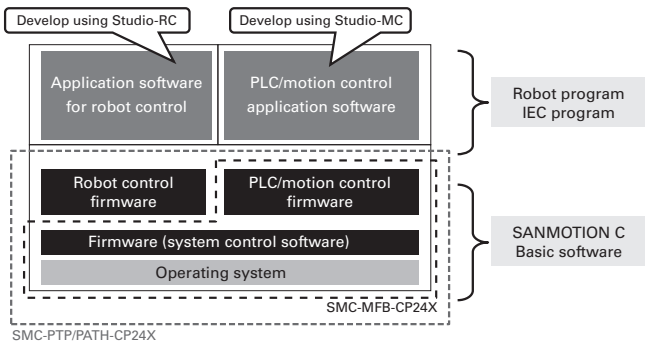

Fig. 2: Software configuration

3.2 Hardware configuration

Figure 3 shows the hardware configuration of the "SANMOTION C".

The "SANMOTION C" is configured from a CPU module and peripheral modules.

(1) CPU module: DIN rail mounting

<1> CPU operating clock: Available in two types, 600 MHz and 1.1 GHz.

<2> Ethernet, CAN, RS485, EtherCAT serial buses are standardly equipped.

<3> 2 ch of USB memory

(2) Peripheral modules: Used by connecting with the parallel bus from the CPU module side. Up to 12 modules can be connected.

The following six types of modules are available.

<1> Digital input/output module
16 ch input/16 ch output (sink/source)
32 ch input/32 ch output (sink/source)

<2> Analog input/output module
4 ch input/4 ch output, 12 bit resolution

<3> Encoder input module
2 ch input, 2 ch latch input, max 250 KHz

<4> Bus link module
CAN interface (125 KHz to 1 MHz)

<5> Interface module
2ch-RS232C, 2ch-RS485/422

<6> Field bus module
Sanyo Denki local motion bus (GA1060)

Peripheral modules consider flexibility and expandability so that the right one can be selected for the equipment's requirements.

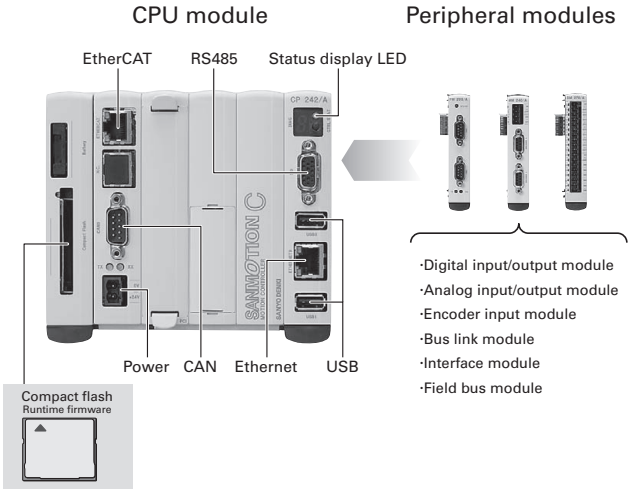

Fig. 3: Hardware configuration

4. Development Languages

4.1 PLC open languages

The “SANMOTION C” uses the open international standard languages (IEC61131-3). This international standard consists of six language types and program developers can select the language they are familiar with or the one suitable for the system when developing equipment application programs.

Figure 4 shows images of the six program languages.

<1> IL language : Instruction list
A text language resembling mnemonics

<2> LD language : Ladder diagrams
A graphic language enabling visualization of relay wiring. A programming language popular for conventional PLCs.

<3> ST language : Structured text
A structured text language resembling Pascal and BASIC.

<4> SFC language : Sequential function chart
A graphical programming language able to express the change in status of lines, etc. as it includes process advancement programs which control sequence processing.

<5> FBD language : Function block diagram
Possesses both input parameters and output parameters, dividing control (processing) combining multiple functions into components and simplifying as a single command. A graphic language for engineers familiar with DCS (Distributed Control System) in the instrumentation field.

<6> CFC language : Continuous function chart
A process flow chart used in DCS, etc. Controls by joining function block parameters with a line on editor. A graphic language which uses a re-locatable area as the address area and the user does not need to be conscious of anything other than the device name.

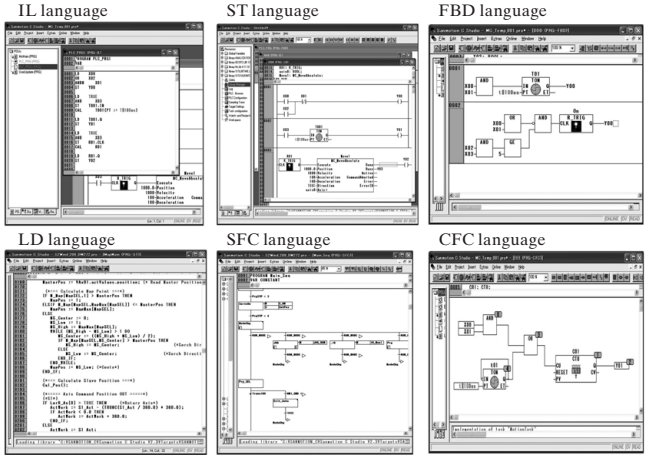

Fig. 4: International standard languages (IEC61131-3)

By using standardized development language, the developed program can be comprehended by anyone, thus improving the capitalization of software.

4.2 Robot language

Sanyo Denki has prepared an original language to program robot operations. This has made it possible to easily change from the teaching pendant to an operation program onsite. Table 2 gives a list of robot commands.

Table 2: List of robot commands

Movement	
Point-to-point movement	PTP
Linear interpolation movement	Lin
Circular movement	Circ
Distance-specified PTP action	PTPRel
Distance-specified linear interpolation action	LinRel
Robot stop	StopRobot
Waits until main-run has reached a certain position	WaitIsFinished
Delays program execution as long as possible	WaitJustInTime
Homing of an axis	RefRobotAxis
Homing of an axis (asynchronous)	RefRobotAxisAsync
Wait until homing is completed	WaitRefFinished

Setting	
Action parameter setting	Dyn
Override setting	DynOvr
Overlap setting (Path)	Ovl
Acceleration/ deceleration curve setting	Ramp
Workpiece coordinate setting	RefSys
Tool coordinate setting	Tool
Posture control setting	OriMode

Flow Control	
Subroutine call	CALL ···
Pending command	WAIT ···
Branch command	IF ··· THEN ··· END_IF
Conditional judgment 1	ELSE
Conditional judgment 2	ELSIF ··· THEN
Repetition control	WHILE ··· DO ··· END_WHILE
Repetition control	LOOP ··· DO ··· END_LOOP
Program start	RUN ···
Program unload	KILL ···
Program return	RETURN
Label setting	LABEL ···
Unconditional jump	GOTO ···
Conditional jump	IF ··· GOTO ···

5. Interfaces and Uses

Figure 5 shows the interfaces and uses.

Controllers must control equipment. Not only is the motor controlled, but also various sensors, monitor display and other controllers. As such, the "SANMOTION C" is connected to several types of interfaces to control various control devices.

(1) Ethernet connection
- <1> Image processing unit: Confirms the position and shape of the target.
- <2> PLC: Simultaneously controls equipment.
- <3> Teaching pendant: Operates various robot.
- <4> PC: Monitors equipment parameters.

(2) RS485/422, RS232C connection
- <1> Touch panel display:Starts, monitors, etc. equipment as HMI (Human Machine Interface).

(3) CAN (Controller Area Network)
- <1> Remote I/O:Controls equipment proximity sensors, contacts, lights, etc.

(4) Analog connection
- <1> Hydraulic control unit: Controls pumps, etc.
- <2> Temperature adjustor: Controls equipment temperature.
- <3> Temperature measurement (thermocoupler): Measures temperature

(5) Encoder connection
- <1> Manual pulse generator: For JOG operations.
- <2> Incremental encoder:Commands the equipment's master position.

(6) EtherCAT connection
- <1> Servo amplifier: Operates the equipment freely.

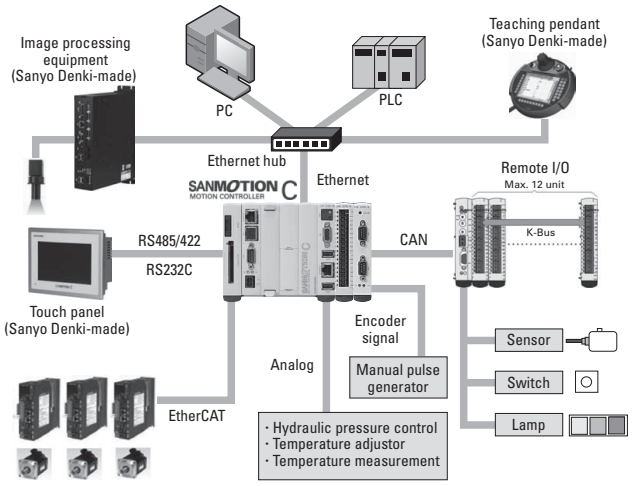

Fig. 5: Interfaces and uses

6. Example of Application

6.1 Chip mounter

Figures 6 and 7 show the system configuration of a chip mounter.

Specifications

<1> X axis: linear motor 2 axes
Head collision prevention operation.

<2> Y axis: Ball-screw drive 1 axis
Synchronized control with the X axis.

<3> Z axis: 2 heads (8 axes linear motor/1 head)
Make the positioning time 5 ms or less.

<4> θ axis: 2 heads (2 axes belt pulley drive/1 head)

<5> 4 ch camera recognition
Recognizes parts ON the FLY.

<6> DI/DO: Each 32 ch
Also controls remote I/O board of RS422 communication.

Machine performance

Mounted at 40,000 CPH.

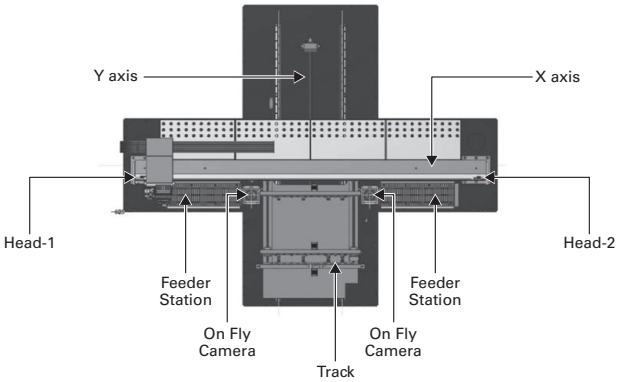

Fig. 6: Chip mounter

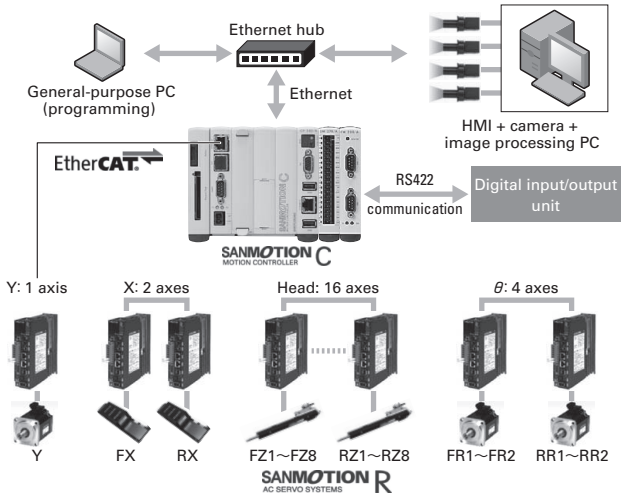

Fig. 7: Chip mounter system configuration

6.2 Parallel link robot

Figure 8 shows the configuration of a tracking system using a parallel link robot.

Specifications

<1> Controls 3 axes parallel link robot + rotation 1 axis
<2> Belt drive as the additional axis
<3> Operating range: ϕ300 mm
<4> Recognizes the products being transferred through the use of a camera and picks products at high speed using a parallel link robot.

Tracking characteristic

Achieved air picking at 100 times/minute.

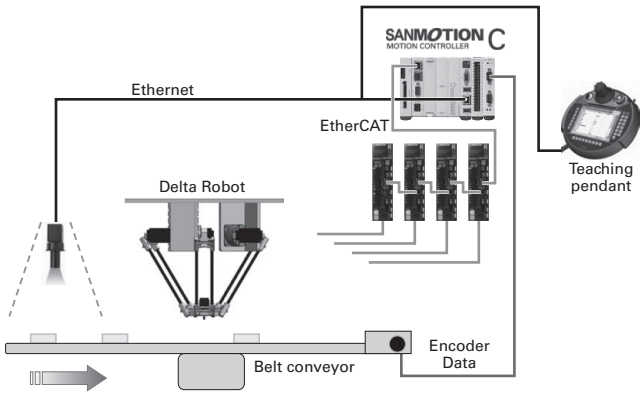

Fig. 8: Configuration of a parallel link robot tracking system

The two examples introduced above were achieved with Sanyo Denki's support. We wish to continue supporting customers and together aim for further value creation.

7. Conclusion

This report, as the A to Z of the "SANMOTION C", has described the positioning and configuration of the production from the series name origin and discussed application development languages, connection with peripheral devices and roles so that readers may better understand how the "SANMOTION C" is related to equipment development. Lastly, we introduced examples of application to explain how the "SANMOTION C" is applied.

Sanyo Denki hopes that this introduction helps our customers to better understand the "SANMOTION C" and provide various useful equipment development proposals.

We will continue to enhance our interfaces and strengthen our networking controllers in order to offer the optimal controllers for automation requirements.

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Joined Sanyo Denki in 1982.
Servo Systems Division, 2nd Design Dept.
Worked on the development and design of controllers.