Increasing Applications of Integrated Controller "MICREX-SX"

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1. Introduction

One and a half years have elapsed since the "MICREX-SX" series was introduced to the market. This series has been favorably received due to its concept of anticipating future needs, its application to new fields using high-speed processing, and open architecture approach that match the needs of the time. To expand the application range further, we have improved the functions not only of the hardware level, but also of the software and usability.

In this paper, we will introduce a summary of these improvements. Their details and application examples will be described in other papers in this special issue.

2. Expansion of Application Range by Integration with Peripheral Modules

2.1 Integration of control, operation and monitoring realized on an open platform

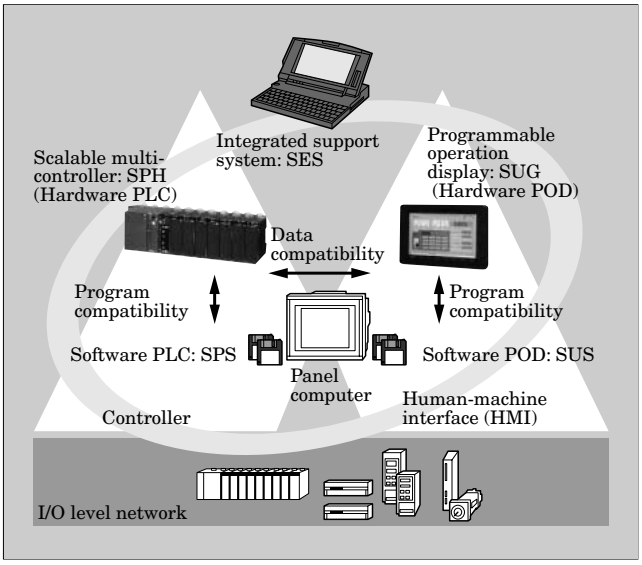
There are two types of programmable controllers (PLCs) and programmable operation displays (PODs), a hardware type which is realized with each specific hardware, and a software type, for which functions are realized with a personal computer on an open platform.

The programs of the hardware PLC (SPH) and software PLC (SPS), and the hardware POD (SUG) and software POD (SUS) are designed for compatibility with the integration of these devices. Therefore, when developing programs, effective development and device transition is possible without having to be conscious of the implementation system, and further extension of the application fields are intended.

Here, we have provided the following personal computer based ISA bus boards to utilize the expandability of personal computers and to construct integrated systems with control components such as PLC, POD, etc.

(1) OPCN-1 board which is an open network below PLC in rank
(2) SX bus board that connects the variety of devices supported by the SX bus

Fig.1 Concept of integration of control, operation and monitoring



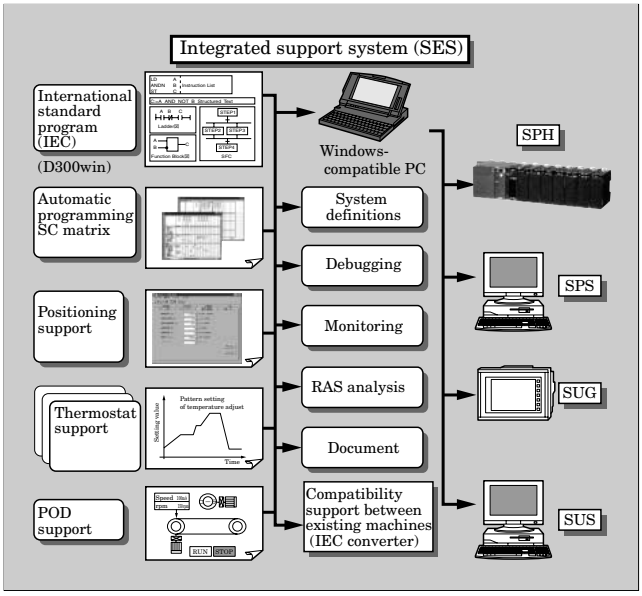
(3) PLC board which integrates the equivalent functions of the hardware PLC (SPH300) and realizes high-speed processing on a personal computer
(4) Other various boards to realize organic combinations with components of MICREX-SX

As mentioned above, owing to the support from both the software and hardware due to the superior environment for program development and the provision of a wide variety of ISA bus boards, an optimal system construction is possible. In Fig. 1, the concept of the integration of control, operation and monitoring is shown.

2.2 Enriched integrated support system

The integrated support system (SES) of the MICR EX-SX series is implemented under an integrated environment that centers around PLC support with an international standard language, and integrates POD support and function module support. The SES improves efficiency of control program development for high functionality and improves the efficiency of peripheral device support. Figure 2 shows a functional configuration of the integrated support system.

Fig.2 Functional configuration of integrated support system



We will introduce specific means to make each support tool efficient, from software development to maintenance.

2.2.1 D300win in accordance with international standard languages

The MICREX-SX series provides a programming support tool (D300win) that is completely based on the international standard languages (IEC61131-3), that are utilized in the major advanced nations such as Europe and North America, and can prepare IEC compliant programs with a minimum knowledge. Since being brought to market, improvements to the D300win have been planned to further enhance usability, and version 2 is introduced here. [For details, refer to the other paper titled, "New Features of the Loader D300winVer.2" in this special issue.] Some of features of the D300win including a list of new features of this latest version are described below.

(1) Programming with each language

The D300win fully supports 5 languages (IL, ST, LD, FBD and SFC) and programs can be developed using the most suitable language depending on the application.

(2) Automatic allocation of memory address

Conventionally, the memory addresses of variables were consciously allocated by a programmer when a program was being created. With the D300win, this allocation is automatically performed only by designating the data type and property of the variables according to the specifications of IEC. Consequently, the control of memory address allocation is reduced and redundant allocations can be prevented.

(3) Backup of program and data

In software development, the MICREX-SX is based on general source management, but provides the following two methods of backup of programs and data in consideration of lost source files in case of an emergency.

(a) Programs in the controller can be uploaded to the D300win. In addition to uploading as an IL language program, conversion from IL language to LD language is possible.

(b) The entire source may be stored in and read out from memory cards in the controller. The user can edit documents with the same content as was created.

(4) Creation of documents

The objects to be made efficient are not only software development, but from the viewpoint of supplying a device to an user, also include complete documents attached to the product. D300win realizes a print level equivalent to that of commercial applications running on the Windows*1, and facilitates the task of and saves power in creating documents.

2.2.2 Linking of variables between PLC and POD support tools

In general, the POD editor directly specifies the PLC memory address when transferring data and signals between the PLC and the POD. With connection to the POD in the MICREX-SX, variables in both support tools are automatically linked, and can be shared. Therefore, the task of address allocation in both these support tools can be made remarkably more efficient.

The shared variables can be allocated with 30 characters, preventing careless mistakes such as redundant allocation.

2.2.3 Integrated function module support

The operating environment and connection form of support tools for function modules such as PLC position control, fault diagnosis and communication are made common with the D300win. Functions can be realized simply by implementing changes at the software level, enabling integration of the support tools and facilitating management of peripheral devices.

Further, in consideration of working offline, the parameters that were set in the various support tools are saved in the D300win project, and can be forwarded together with the program to PLC.

2.3 Position control function implemented in software

Conventionally, since a position control system was generally configured using a custom module (hardware) for each control function, it was necessary to prepare hardware for each position control function on the user side. In the MICREX-SX, the majority of the position control function is realized with software using high-speed CPU processing and a high-speed bus (SX bus). Therefore, the user can configure various position control systems with minimum types of hardware. In Fig. 3, a configuration of the position control module and software for position control is shown.

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*1 Windows: A registered trademark of Microsoft Corp., USA

This time, we have attempted to enrich the software of position control by preparing approximately 80 types of software. Table 1 lists the software for position control. Application programs can be simply configured by combining these types of software.

On other hand, as hardware, a servo-system directly coupled to the SX bus (FALDIC-α) is newly provided, enabling application to fields requiring high-speed response.

In addition to the above provided products, we are planning to provide motion control, which is a higher-grade position control, and to comply with JEM1473, "Function block for motion control of general-purpose programmable controller" of the Japan Electrical Manufacturer's Association.

Thus, the supported range of the MICREX-SX is further expanded, and depending on the position control function and accuracy, the user can change the module and software combination without having to select a device from different device groups. Scalable expansion can be achieved without wasting hardware and software resources.

Fig.3 Configuration of position control module and software for position control

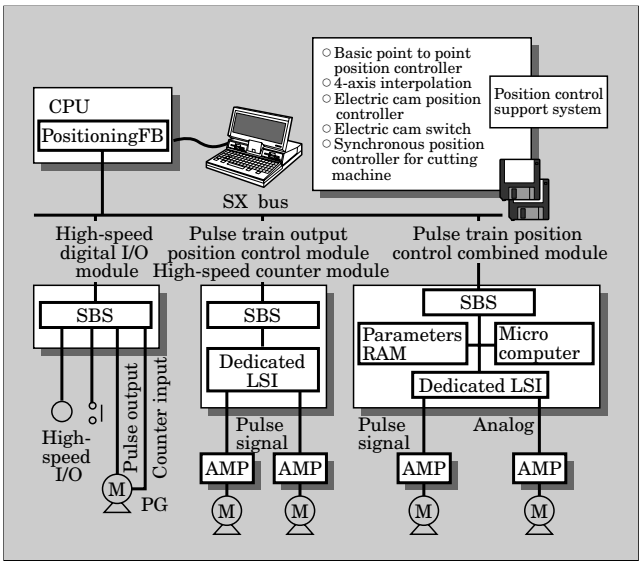


Table 1 Software for position control

Operation system	Software for position control	Kind
1-axis PTP operation	Software for simple position control	2
	Software for compact 1-axis PTP (include simple linear interpolation)	5
	Software for 1-axis PTP (include simple linear interpolation)	22
	Software for multi-function 1-axis PTP	28
Special synchronous operation	Software for special synchronous Software for multi-function 1-axis PTP	13
2- to 4-axis interpolation	Software for 2- to 4-axis interpolation Software for multi-function 1-axis PTP	9
Total		79

3. Expansion of Application Range by Block Engineering and IEC Language

3.1 Block engineering and hierarchical design of IEC

In the MICREX-SX, the whole control program can be hierarchically divided into individual functions, from large class to small class, and made as component parts. Fuji Electric has packaged these divided programs of each function unit as function blocks (FB), and configured a whole system by hierarchically combining these function blocks. We call this method "block engineering."

Figure 4 shows an overview of the hierarchical design and block engineering.

The packaged FBs are IEC compliant and can easily be made with D300win by the user himself.

3.2 Effect of block engineering

The following effects are expected with this block engineering.

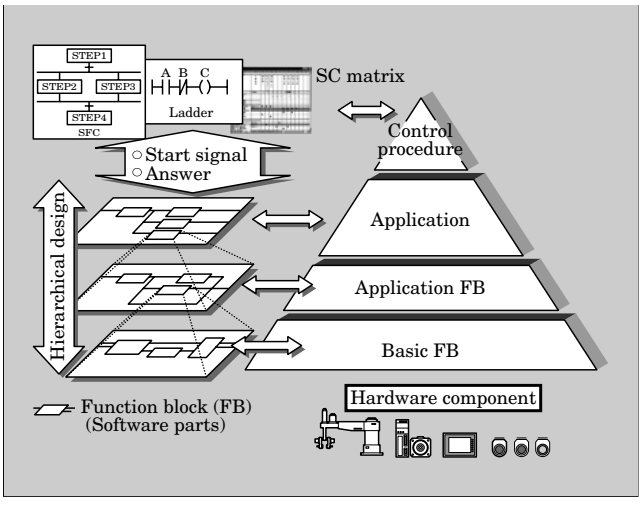
(1) The composition of an original library supporting various controls for each user, improvement of program productivity by implementing hierarchical design, and reduction of the system construction cost are possible.

(2) System construction cost can be minimized by assembling the most suitable specific controller through integrating the original library into the MICREX-SX.

(3) Systems conventionally realized with a specific controller can be replaced with the MICREX-SX by means of customized combination of the library and the high-speed and high-performance of the MICREX-SX.

Further, the parameter setting and data transfer functions of various function modules, communication modules, etc. were made into FBs, and the product series of basic components is nearly complete.

Fig.4 Overview of hierarchical design and block engineering



In the future, it is planned to make standard control functions that are similar to applications, such as speed control, torque control, etc., into FBs.

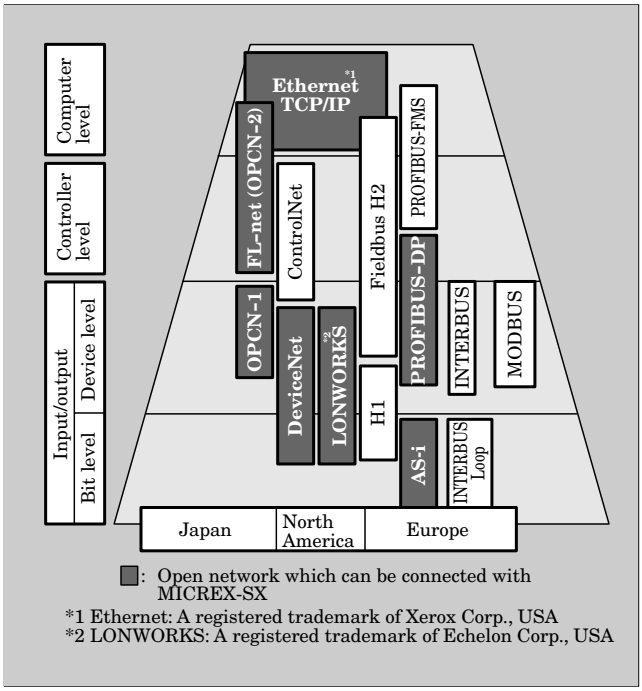
4. Expansion of Application Range by Open System

4.1 Support of standards and open network

4.1.1 Global standard product group according to main standards

The MICREX-SX is complies with main international standards and supports the vigorous overseas expansion of enterprises. The MICREX-SX has received approval for CE marking, and UL/cUL and NK/LR standards. Therefore, the user does not have to select a device according to the destination, and consequently the unification of manufacturing drawings and reduction of spare parts is possible.

Fig.5 Open networks corresponding to the MICREX-SX



4.1.2 System configuration having the optimum expandability

To properly configure the production systems of each enterprise, a wide variety of open network modules from computer level to bit level are prepared. Adoption of an open network enables the selection of an optimal device among manufacturers and the minimization of cost. In Fig. 5, open networks corresponding to the MICREX-SX are shown.

In addition to the open network modules, support of the open networks provides a wide variety of corresponding devices. Therefore, by supporting an open network, the troublesome selection of devices among vendors can be suppressed to a minimum. Table 2 lists equipment for open networks.

4.2 Excellent linking to general-purpose applications

4.2.1 Automatic programming using Excel*2

The MICREX-SX is provided with an automatic programming tool, the SC MATRIX, that automatically generates PLC language from a description of the control process schedule in Excel 97*3 spreadsheet format. The SC matrix realizes the process schedule mechanism with a pin board on Excel. The user can readily understand the straightforwardness of the matrix and the clear visualization of the working state

∗2 Excel: A registered trademark of Microsoft Corp., USA
∗3 Excel 97: A registered trademark of Microsoft Corp., USA

Fig.6 Overview of SC MATRIX

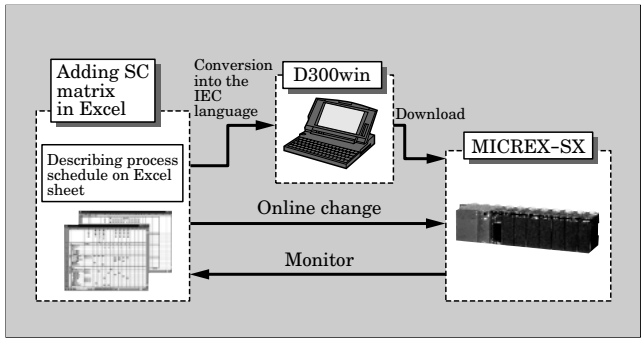
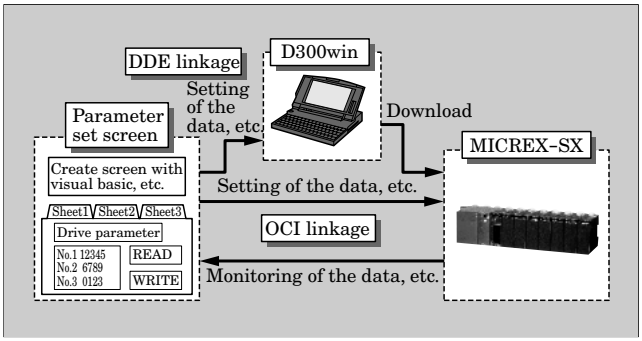


Table 2 Equipment for open networks

Item / Network category	Corresponding network	Master module	Equipment for open networks				
			Interface module to expansion	Terminal remote I/O	POD	Inverter	Servo system
Computer level	Ethernet	○	—	—	○	—	—
Controller level	FL-net (OPCN-2)	○	—	—	△	—	—
Device level	OPCN-1	○	○	○	○	—	△
	DeviceNet	○	△	△	—	○	△
	PROFIBUS-DP	△	△	△	△	○	△
	LONWORKS	△	—	△	—	—	—
Bit (sensor) level	AS-i	○	△	○	—	—	—

○: Compatible △: In development or planning

Fig.7 Linkage at DDE and OCI levels



using Excel's editing function without being conscious of the programming language. In Fig. 6, an overview of the SC matrix is shown. [For details, refer to the other paper titled, "Automatic Program Generation Software Package "SC MATRIX"" in this special issue.]

4.2.2 Linking of data to personal computers

The trend of open systems is expanding the application of personal computers into the control field and is increasing the need for users to link on-site controllers and general-purpose applications in the management system's personal computers. The internal information of the MICREX-SX is opened to the public to enable the linking of general-purpose applications to a PLC and the D300win at the DDE*4 (dynamic data exchange) level, etc. The user can create a parameter setting screen using a programming language such as Visual Basic*5 and closely link the data to a PLC and the D300win. Figure 7 shows linkage at the DDE and OCI*6 (open communication interface) levels.

*4 DDE: Function to exchange data and messages between applications

*5 Visual Basic: A registered trademark of Microsoft Corp., USA

*6 OCI: A registered trademark of Microsoft Corp., USA

4.3 Realization of tight coupling by opening the specification of the high-speed SX bus

It is possible with an open network to realize the optimum system configuration sought by the users, but in a position control system and in the human-machine interface connection that displays this data, there are the cases where higher-speed processing and higher response speed are required and even tighter coupling is sought. To meet these user needs, Fuji Electric has opened to the public the SX bus of the MICREX-SX, which realizes high-speed and facilitated distributed control (such as a T-branch). Therefore, high-grade custom systems can be configured on the user side, and open network systems also can be configured easily.

Furthermore, from the viewpoint of system expandability, an optical SX bus has been realized, enabling the construction of reliable systems with high noise resistance.

Presently, devices for the open SX bus are the servo-system, inverter, human-machine interface and temperature control unit. Hereafter, we intend to vigorously open the specifications of those devices (venders) requiring high-speed processing.

5. Conclusion

As described above, together with the enriched hardware and software, the application range of the MICREX-SX has expanded. The objective of system components is not only in the performance of the hardware, but the larger issue is in the usefulness of the surrounding utilities, and we think that the users also expect this usefulness.

Opening and standardizing systems is the trend of the times, and we intend to advance the development of the devices as a basic concept of the MICREX-SX.