

# “MICREX-SX SPH5000H” Highly Reliable Duplex Controller System

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A monitoring and control system indicates equipment operating status and abnormalities. On the basis of the information on the monitor, a supervisor gives instructions to operate equipment and devices through a monitoring and control system. Controllers collect various items of information including those to be shown on the monitor from equipment and devices on site and executes appropriate programs according to the instruction from a supervisor.

Infrastructures supporting society, such as water treatment facilities, are required to provide continuous 24-hour operation throughout a year. Even a brief operation downtime may disturb the service to be provided, which may lead to a significant loss to business operators. To avoid facility outage, high reliability is required for monitoring and control systems.

In order to meet such a market request, Fuji Electric has developed the “MICREX-SX SPH5000H” controller (see Fig. 1), which is a new CPU module of the integrated controller “MICREX-SX Series.” This module has high reliability with a duplex system.

Figure 2 shows the system configuration example of the monitoring and control system using the MICREX-SX SPH5000H. Table 1 shows the comparison of performance and specifications between the MICREX-SX SPH5000H and the “MICREX-SX SPH2000,” the conventional product.

The MICREX-SX SPH5000H has the features described in the following sections to enable the construction of highly-reliable and large-scale monitoring and



Fig. 1 “MICREX-SX SPH5000H”

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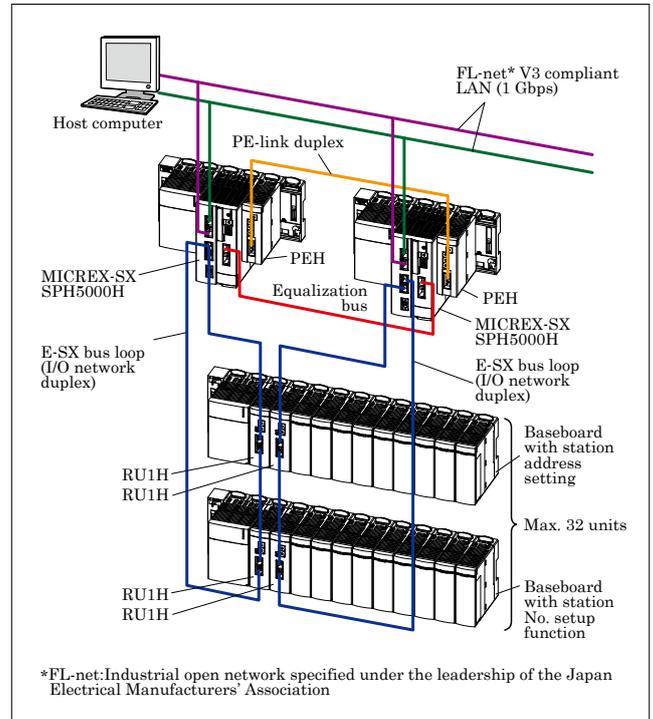


Fig. 2 System configuration example of the monitoring and control system using the “MICREX-SX SPH5000H”

Table 1 Comparison of the performance and specifications with the conventional product

Item	MICREX-SX SPH5000H	MICREX-SX SPH2000	Improvement
Program capacity	512 Ksteps	256 Ksteps	2 times larger
Data memory	2,048 Kwords	2,048 Kwords	—
I/O memory	4,096 words	512 words	4 times larger
Instruction execution time	Basic instruction: 6 ns	Basic instruction: 30 ns	5 times faster
	Applied instruction: 5 ns	Applied instruction: 40 ns	8 times faster
Equalization performance	60 ms/320 Kwords 300 ms/ 2,048 Kwords	250 ms/ 320 Kwords	4.4 times faster
Built-in Ethernet*1 performance and function	1 Gbps Dedicated to Ethernet	100 Mbps Selective use with equalization bus	10 times faster
Equalization bus performance	1 Gbps	100 Mbps	10 times faster
FL-net*2 compliant LAN performance and function	1 Gbps Built into MICREX-SX SPH5000H	100 Mbps External module	10 times faster
Data correction function	ECC function for program and data memory	None	—

\*1 Ethernet: Trademark or registered trademark of Fuji Xerox Co., Ltd.

\*2 FL-net: Industrial open network specified under the leadership of Japan Electrical Manufacturers' Association

control systems.

### 1. High Speed, High Capacity and High Reliability of Program Execution

To improve the program execution speed, we changed the processor with a clock speed of 300 MHz to one with a 1 GHz. We changed the memory with 130-MHz clock to the one with 1,600 MHz and increased the memory capacity. The increased heat generation due to the faster clock speed has been addressed with the cooling fin for the processor and the heat dissipation structure with enlarged opening in the dedicated housing. As is the conventional product, continuous operation is guaranteed in environments with an ambient temperature of 55 °C.

To retain parameter values and other data, the conventional product used low-speed static random access memories (SRAMs), which use a battery backup when the power is turned off. The battery life is short (five years), so that the system required periodical maintenance. We therefore replaced the SRAM with a non-volatile memory to eliminate the battery. Moreover, the system copies data stored on the non-volatile memory to a high-speed dynamic random access memory (DRAM) when the power is turned on. Since the system uses the DRAM during operation, it can execute programs faster. When the power is turned off, the system backs up its data automatically by copying it from the DRAM to the non-volatile memory. For this copying, the built-in high-capacity super-capacitor is used as a power supply.

Furthermore, the cache memory inside the processor and DRAM are provided with the error check and correction (ECC) function to improve reliability. When a one-bit error occurs in the memory due to external noise, the error is corrected and programs and data are read out without affecting the calculation performance, which ensures continuous operation.

### 2. Fast Duplex Control Network

To build a duplex control network, the conventional MICREX-SX SPH2000 has been combined with a LAN module compliant with FL-net\*1. The control data between the MICREX-SX SPH2000 and the FL-net compliant LAN module were sent and received via the processor bus on the baseboard. As a result, the program execution time increased proportionally to the data processing time.

On the other hand, the MICREX-SX SPH5000H has a built-in FL-net compliant LAN function to take advantage of the communication speed of the FL-net compliant LAN that has been improved from 100 Mbps

\*1: FL-net: Industrial open network specified under the leadership of Japan Electrical Manufacturers' Association

to 1 Gbps. Moreover, two processors are provided, one for executing programs and the other for executing the FL-net compliant LAN function, and they are connected via the high-speed internal bus.

This has improved the speed of data sending and receiving by 50 times and achieved faster control data communications without the increase in the program execution time.

### 3. Improved Speed and Capacity of Equalization Bus

The redundancy of the program execution section has been achieved by sending the data of the program execution result from the working system to the standby system through the equalization bus at every scan of program execution. Consequently, the equalization time required for sending and receiving equalization data greatly affects the control cycle.

In order to reduce the equalization time of the MICREX-SX SPH5000H, we improved the communication speed of the equalization bus from 100 Mbps to 1 Gbps, and modified the equalization process (see Fig. 3). The conventional MICREX-SX SPH2000 repeated a process of creating a frame of equalization data and then sending the frame. The MICREX-SX SPH5000H has two transmission buffers used for sending equalization data and has a mechanism of creating a transmission frame of equalization data and sending equalization data in parallel. As a result, its execution speed is 4.4 times as fast as the MICREX-SX SPH2000.

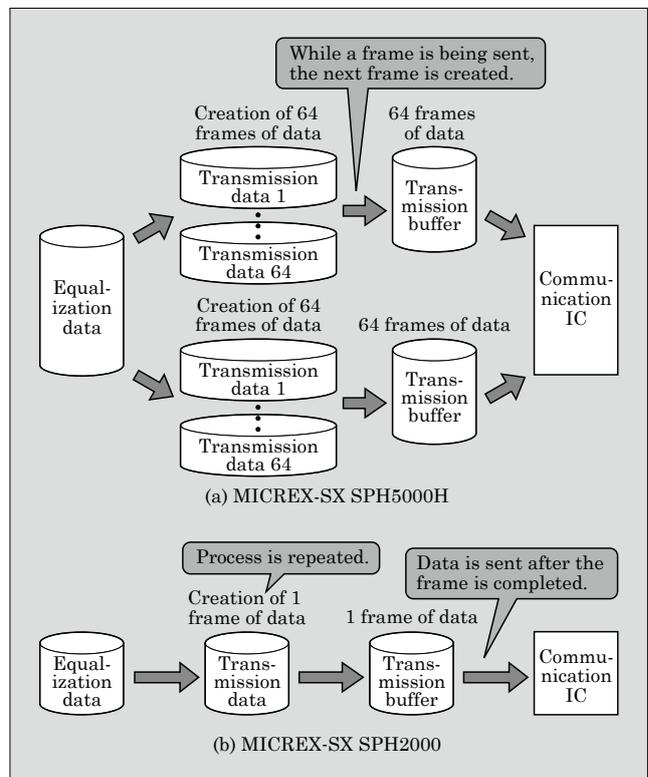


Fig. 3 Comparison of the equalization data sending processes

#### 4. Complete Duplex I/O Network

The MICREX-SX SPH5000H has incorporated a loop function and a duplex function of the E-SX bus to improve the reliability of the I/O network. In addition to the loop structure and duplex function of the E-SX bus, the interface module (RU1H) supports module duplex. Consequently, when an abnormality is detected in the I/O network, the working and standby systems are switched automatically to continue operation. To improve reliability, the I/O network has been designed to form a loop. This enables continuous operation without the need of switching the working and standby systems even when disconnection occurs at some point in the network cable.

#### 5. Compatibility with Conventional Products

As a successor to the conventional MICREX-SX SPH2000, the MICREX-SX SPH5000H provides the

higher performance and reliability as well as ensures compatibility with the following items to allow easy migration from the MICREX-SX SPH2000.

- Application programs
- Modules to be mounted onto the SX bus baseboard
- The maximum number of usable modules: 8 for Processor link modules, 8 for remote I/O master modules, and 16 for communication modules.

#### Launch time

April 2019

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#### Product Inquiries

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