

TECHNICAL FEATURES OF FLEX-PC N SERIES

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1. FOREWORD

With expansion of its fields of application, programmable controller (PC) needs are becoming more diverse. PC manufacturers are meeting these needs by developing function modules, adding functions, and upgrading performance. Users in each field want an "optimum PC better matched to their needs".

A "PC that satisfies the need for higher speed, lower price, and smaller size and also allows simple construction of the bottom-up type network system of the future" is wanted especially in the machine control field, the main field of application of the PC.

Backed by the newest electronic device and control technology, Fuji Electric has developed the "FLEX-PC N Series (hereinafter abbreviated the N Series)" that just fits the individual specifications of the machine" to meet the needs of the previously mentioned machine control field. By means of this, the Fuji Electric general-purpose PC has become two series; the stand-alone custom-oriented N Series and the existing computer integrated manufacturing (CIM) distributed control-oriented MICREX-F Series (hereinafter abbreviated the F Series). This abundant product line has made it possible for us to meet the needs of a diversifying market over a wide range and in detail.

The technical features of the N Series are introduced below.

2. NEEDS OF THE MACHINE CONTROL FIELD AND DEVELOPMENT CONCEPT

2.1 Needs of the machine control field

According to Japan Electric Manufacturer's Association statistics and the results of an independent Fuji Electric survey, besides the conventional strong need for reduction of the size and minimization of the cost of the machine and control panel, the desire for a general-purpose PC from fields that use the PC with microcomputer-dedicated machines stands out as a main need of the machine control field. This is because it was clear that microcomputer-dedicated machines place a heavy load on the machine manufacturer and user from the standpoints of development efficiency and serviceability. The rapid application of a general-purpose PC that can lighten this

Fig. 1 N Series

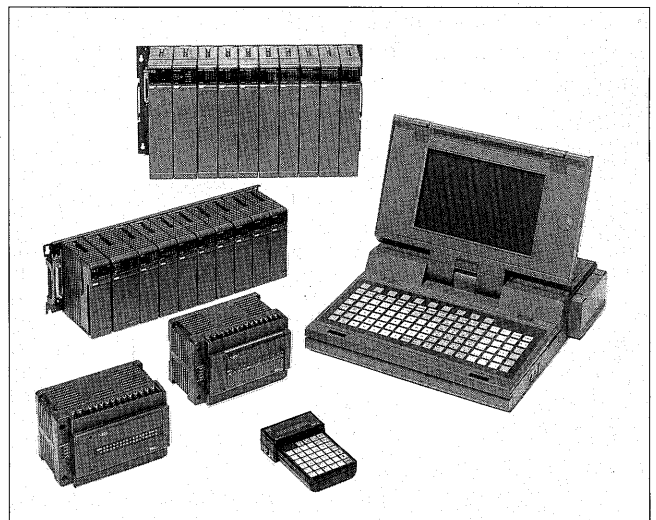
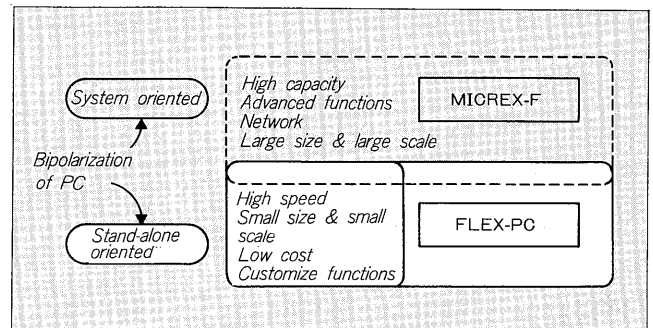


Fig. 2 Positioning of FLEX-PC in Fuji Electric PC



load is desired.

Basically, high-speed response and repetition error accompanying speeding up of the machine can be minimized, the individual specifications of each machine can be flexibly dealt with, and discrimination with equipment of the same field is possible. Moreover, provision of an economical network which can be used with total factory automation (FA) and computer integrated manufacturing (CIM) is also a factor in PC use.

Further improvement is also demanded from the standpoints of construction, function, performance, usage environment, and software development environment, which are also general needs of the PC.

Fig. 3 N Series development concept

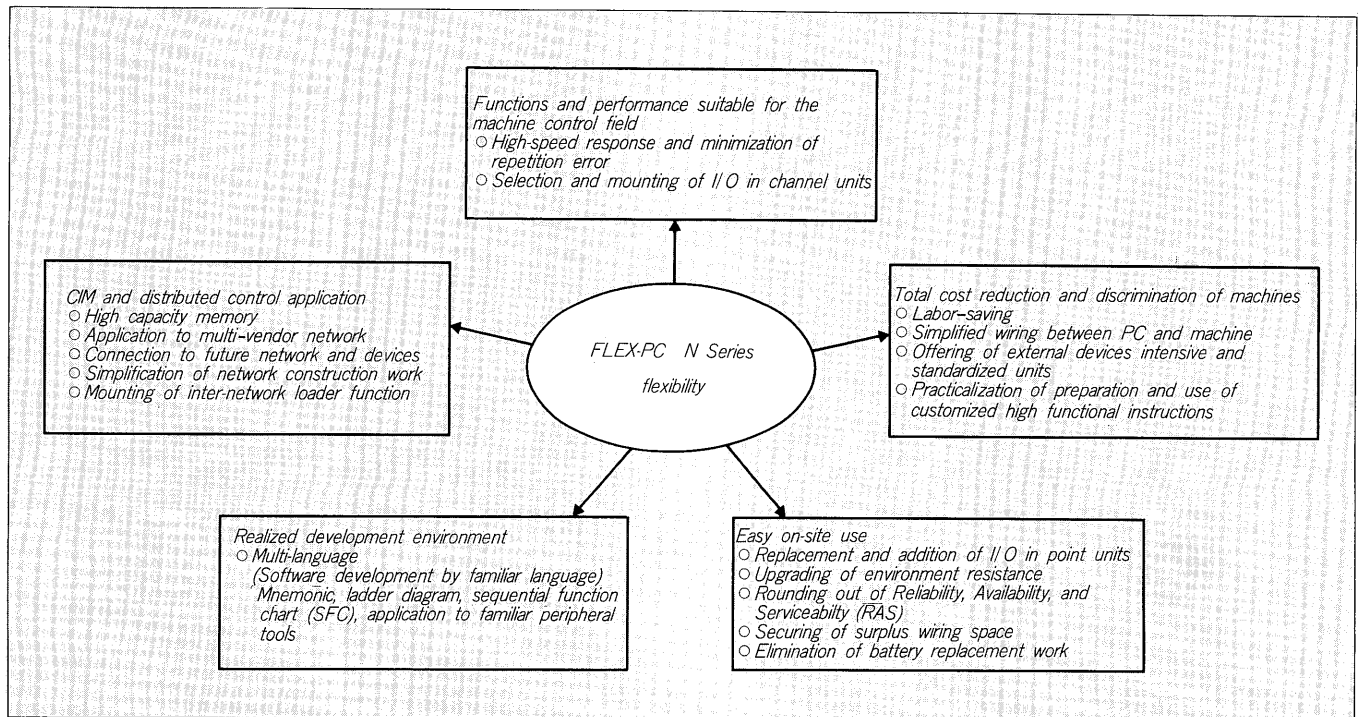


Fig. 4 NB Series

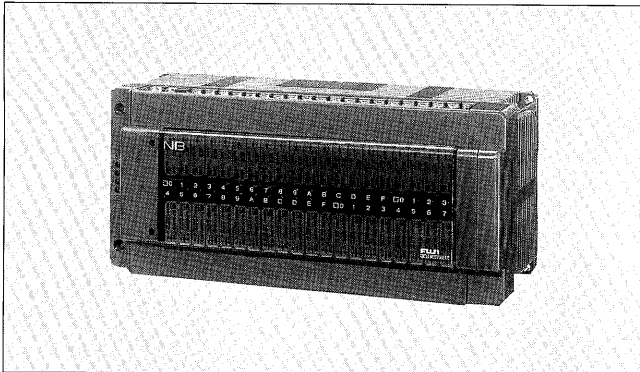
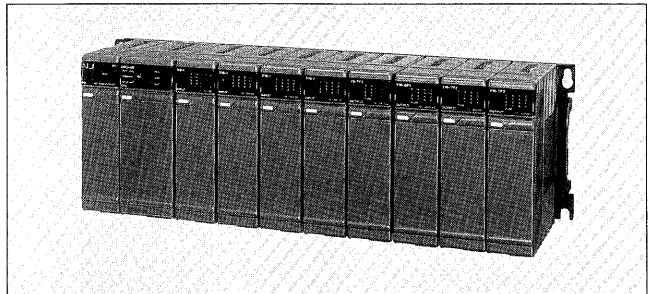


Fig. 5 NJ Series



2.2 Development concept

To embody the trends and needs of the previously mentioned machine control field, the N Series was developed on the following concepts:

- (1) Offering of functions and performance suitable for the machine control field

In machine control, speeding up of the I/O response time and minimization of the repetition error, which are the main factors that determine the performance of the machine, were realized.

A PC capable of meeting I/O specifications demands that differ minutely with the machine in channel units and has machine dimensions and cost advantages is also offered.

- (2) Total cost reduction and machine discrimination

Cost cutting efforts made by manufacturers in the past placed weight on the PC alone. However, the objective range of the N Series was expanded up to peripheral devices which make up the machinery and equipment and

was made a PC designed for total cost reduction as equipment and as a system. It also includes software discrimination implementation measures.

- (3) Improvement of ease-of-use at the site

A PC that meets, in detail, the various desires at the site, from installation work to maintenance after facility operation, is offered.

- (4) Improvement of design efficiency

The increase of the program capacity and complexity of the control contents of the general-purpose PC that accompany the increase in the control scale are becoming important problems in improving the efficiency of PC software development.

As a means of solving these problems, the N Series allows program development by the sequential function chart (SFC) language that is attracting attention as a PC standard language ideal for machine control, as well as by mnemonics and ladder diagram. A development environment that is used with the program system most familiar to the user is also offered.

Table 1 Series composition and outline specifications

Series		NB Series	NJ Series	NS Series
Applications		Small, compact PC Used as a stand-alone, machine-incorporated, system local PC	Medium and small scale, small building block PC Distributed type, stand-alone, machine-incorporated use only	Medium scale, standard building block PC Distributed type, stand-alone use.
Kinds of CPU		7 kinds	4 kinds	6 kinds
Basic outside dimensions [W×H×D (mm)]		165 × 110 × 105	435 × 135 × 120	480 × 250 × 130
System architecture		Single processor	Same as at left	Same as at left
Bus architecture		I/O; Custom 8-bit bus	Same as at left	Same as at left
Network		Connectable to T-link by N-bus (standard equipment) custom unit	Option modules: 8 Existing link: 6 New link: 3	Option modules: 10 Existing link: 8 New link: 3
Control operation	Program description		Mnemonic, ladder diagram, SFC	Same as at left
	Processor		Original processor (A) + 8-bit single chip	Original processor (A) + 8088 equivalent
	OS*1		Cyclic program + interval timer interrupt + event interrupt	Same as at left
	Memory capacity	Program	1k, 8k steps	4k, 8k, 16k steps
		Data	1.5k words	3.3k words (+ 16k words)
	Control operation functions		• Sequence operation • Fixed point arithmetic • Data operation • Special function operation (macro instruction)	Same as at left
Information processing	Instruction execution time	Sequence instruction	0.61 μs~	0.48 μs~
		Data instruction	1.63 μs~	1.62 μs~
	Input/output points	Standard usage range	24 to 368 points	48 to 512 points
		Maximum capacity	368 points	512 points
RAS*2	Kinds of I/O		• Digital I/O • Analog I/O • High-speed counter [10kHz, 8 chs] (built into body) • Intelligent I/O (display and setting, position control, ...)	• Digital I/O • Analog I/O • High-speed counter • Intelligent I/O (position control,.....)
	Error detection and display		Write to error information file and message (alphabetic, numeric, katakana 16 characters) display to handy loader by self-check function	Write (w/generation time) to error information file and message display to handy loader by self-check function
	Maintenance units		One point units I/O module or unit replacement	Module replacement

* 1 : OS : Operating System, * 2 : RAS : Reliability, Availability and Serviceability

(5) Distributed control system

A proven network with abundant connection devices which simplify expansion to CIM is available with the N Series. A network that is fast and easy to build and is more suitable for machine control systems is also offered to users.

3. SYSTEM COMPOSITION AND SPECIFICATIONS

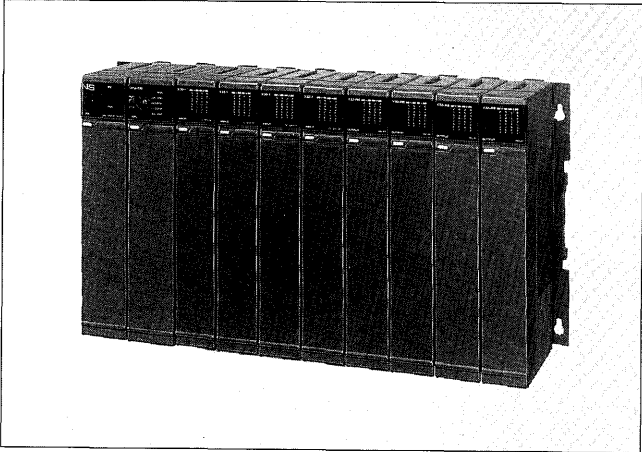
The N Series is serialized by control scale into the following three series. The series composition and outline specifications are shown in Table 1.

(1) NB Series

This series is for small scale general machine control use. The I/O specifications can be selected by block structure and custom I/O relay in channel units.

Program capacity: Maximum 8k steps
I/O points: Maximum 368

Fig. 6 NS Series



(2) NJ Series

This series has a compact size (height 135mm) build-

Fig. 7 Basic system composition

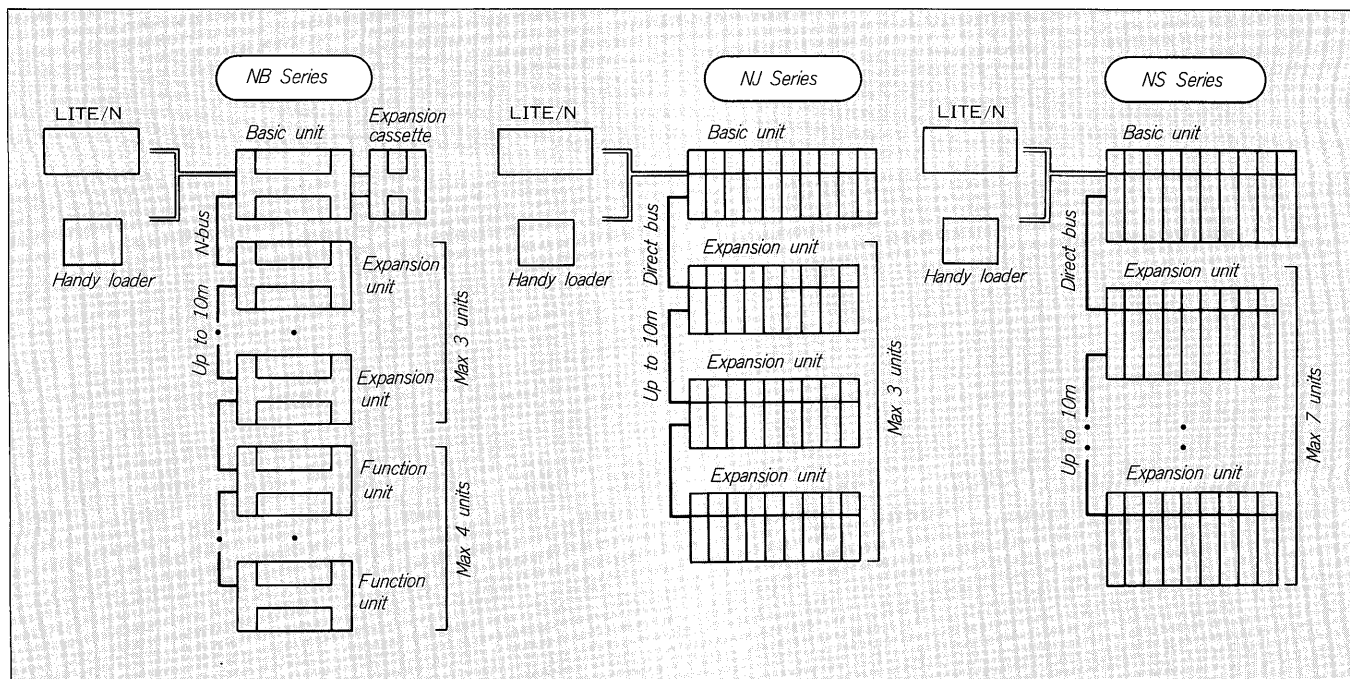
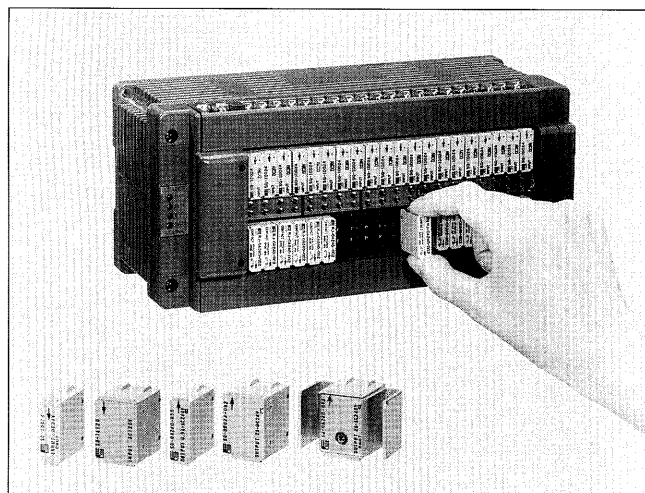


Fig. 8 I/O relay mounting type NB Series



ing block structure perfect for incorporation into the machine and control panel. While being small, it has the same functions as high-level models. Various function modules and communication modules are available to meet the need for an intelligent machine.

Program capacity: Maximum 16k steps

I/O points: Maximum 512

(3) NS Series

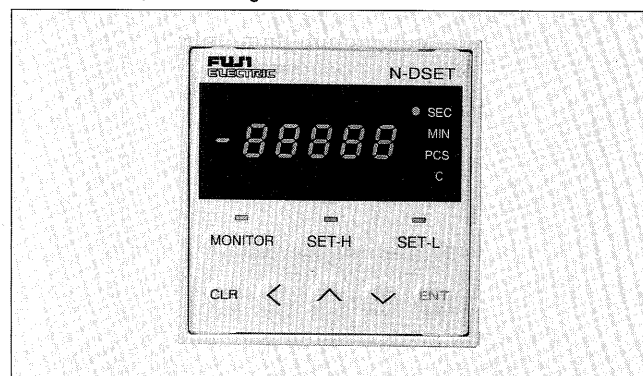
This series has a standard size (height 250mm) building block structure perfect for comparatively large system and large machine control. It also meets the need for CIM and simplified wiring, as well as high-speed operation.

Program capacity: Maximum 64k steps

I/O points: Maximum 2048

4. BASIC SYSTEM COMPOSITION

Fig. 9 Display and setting unit

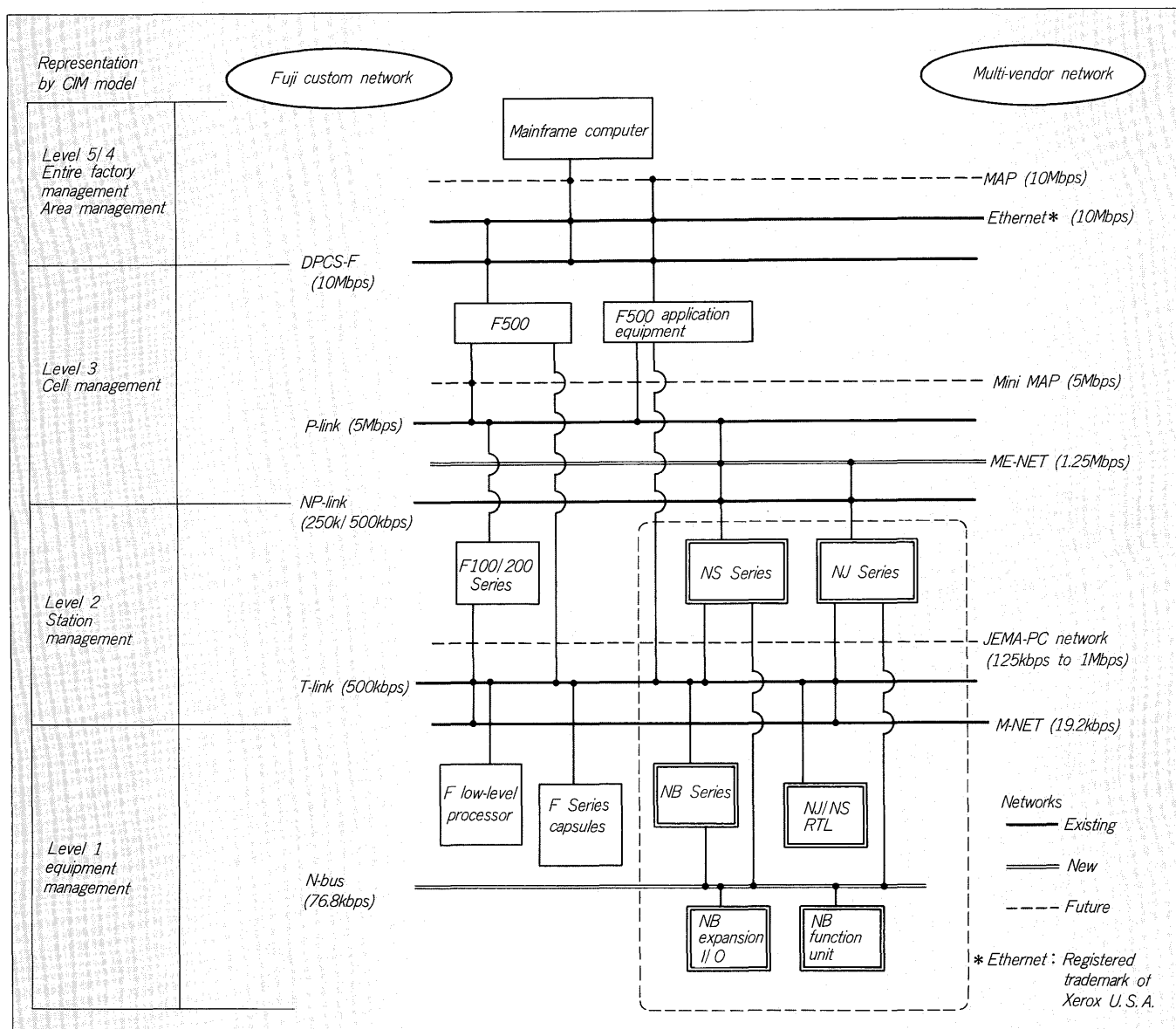


The N Series is made up of three series (NB, NJ and JS) and support tools. The basic system composition is shown in Fig. 4. An outline of the basic system composition is introduced below.

The NB Series consists of a basic unit and expansion units and function unit groups and an N-bus which connects these. The basic and expansion units can be selected, mounted and dismantled in I/O point units. Various frames corresponding to the number of I/O points are available for optimization according to the control scale. In the past, the series was configured so that expansion units and function units that used a parallel bus could be connected to the basic unit up to 10m away and the saving of wire inside the machine and control panel could be realized.

The NJ Series consists of a basic unit mounting a power supply, CPU module and input/output (I/O) or function and communication module and expansion units mounting an I/O module, and an expansion bus which connects these up to a total length of 10m. Various I/O

Fig. 10 Network system



modules are available with 16 points/32 points/module as basic.

The NS Series has standard type outside dimensions. Besides basic I/O points per module of 32 points, it has the same composition as the NJ Series.

For each series, connection of support tools is performed by small modular type connector which is installed at the CPU module or basic unit.

5. FEATURES OF N SERIES

5.1 Functions and performance

Speeding up of the input to output response time and minimization of the repetition error are basic needs in a machine control system.

Each series in the N Series realizes the high-speed processing of the highest class by using a custom operation LSI executed by PC instruction and a high-speed archi-

ture. They also have an interrupt processing function, direct input/output instructions, and other partial speeding up functions which realize a PC which amply meets the previously mentioned needs.

The NB Series also has a high-speed counter (10 kHz, 8 channels) with coincidence interrupt function, external interrupt input, pulse catching input function, and so forth.

The parameter setting function which allows modification of some PC operations was rounded out to meet the machine individual specifications and improve ease of use. A function that controls PC operation continue/stop by user program at self-check error detection makes possible stop processing at trouble generation matched to the specifications demanded by the system.

Direct manipulation of the data register by bit processing instruction, etc. were also made possible to improve the ease of use from the software standpoint.

Table 2 General specifications

Item	Specification
Operating temperature	0 to +55°C
Operating humidity	20 to 95% RH (no condensation)
Storage temperature	-20 to +70°C
Storage humidity	20 to 95% RH (no condensation)
Atmosphere	Free from corrosive gases and dust
Vibration	Meets the requirements of JIS C 0911 (Crossover frequency 57Hz, 19.6m/s ²)
Shock	Meets the requirements of JIS C 0912 (test method 1-No. 3)
Noise immunity	Noise voltage: 1,500Vp-p, pulse width: 1 μs, rise time: 1 ns noise simulation (test condition)
Dielectric strength	Between AC external terminals and FG AC1,500V for 1 minute
Insulation resistance	Between external terminals and FG 10MΩ minimum (DC500V megger)
Grounding	Class 3 ground
Power supply	AC100 to 240V 1φ 50/60Hz DC24V Dropout tolerance Within 20ms (AC power supply) within 5ms (DC power supply)

5.2 Construction

The NB Series, which has small machine control with its strong demand for reduction of the size and lowering of the cost of the machine and control panel as its objective, is the first PC to realize a construction that allows specifications selection and mounting and dismounting in I/O point units with the same volume as an ordinary PC by development of a subminiature I/O relay group and custom interface LSI and the use of surface mounting technology. This makes it possible to build a small and economical system capable of meeting the I/O specifications and number of points needs of the individual machine in point units.

The NJ and NS Series have a building block structure. Modules can be selected as required. Three kinds of bases for 3/5/8 input/output module boards are also available for both basic base and expansion base. The size of the equipment has been reduced by using a custom LSI and an input/output module terminal block has been provided and wiring space with a margin to spare has been realized at the input/output unit. The power supply and module are separated to improve serviceability.

5.3 Function unit and function module

To cut the total cost and improve ease of use, the development of function units and function modules, including the devices installed at the periphery of the ordinary PC, is necessary. Moreover, specifications setting suitable not only for functions that perform complex, high-level control, but also for functions, at which simplification of start-up and maintenance by comparatively simple functions is sufficient, is of more importance and necessary.

From this viewpoint, for the N Series, a display and setting unit was developed to not only support analog

I/O, high-speed counter, position control module, and other basic function modules, but to also integrate a simple man-machine interface built by combining conventional command switches and digital switches and 7-segment LED, etc.

5.4 Software

The N Series uses programming languages already used by each user and a multi language system which can be handled with almost the same sense as tool operation. The languages which are supported are roughly divided into mnemonic, ladder diagram, and SFC.

Considering software development and simplification of on-site maintenance, the minimum number of instructions necessary as a PC (basic instructions: 43, data instructions: 59) are installed as standard. A User-Macro Function which allows the user to create and manage and use special function instructions (composed with standard installed instructions or microcomputer assembly language) with easy to understand comments has been newly established and consideration has been given to software standardization and machine and equipment discrimination.

5.5 Network

Abundant N Series network systems are available based on the positioning of each series so that the optimum system can be built according to the control objective and scale. The basic system is the F Series F-Net (P-link, T-link). The abundant device group of the F-net can be used. An easy to use, economical PC-PC link (NP-link) that refreshes comparatively small data using F-Net technology and a serial bus (N-bus) that allows the saving of wire inside the machine and control panel were newly established for the machine control field.

For multi-vendor networks, besides supporting (Mechatro-Network) ME-NET and M-NET user guidance type networks, application of the industry guidance type network (JEMA-PC network) which is current by in the preparatory stage of evaluation testing is also expected.

5.6 Environment resistance and serviceability

Environment resistance is not limited to the machine control field, but is also demanded in other fields with the increase of the range of applications of the PC. With the N Series, vibration resistance, noise immunity, power supply allowable dropout tolerance time, and other environment resistances were upgraded based on our abundant application record and experience with conventional products. The general specifications are shown in Table 2.

On the other hand, maintenance of the general-purpose PC with more advanced and diverse functions is becoming difficult for field maintenance personnel and simplification of the maintenance items, simplification of troubleshooting, and other serviceability improvements are being pursued.

The N Series meets these demands in detail. The main items are:

- (1) Elimination of battery replacement work by using a

Fig. 11 Handy loader

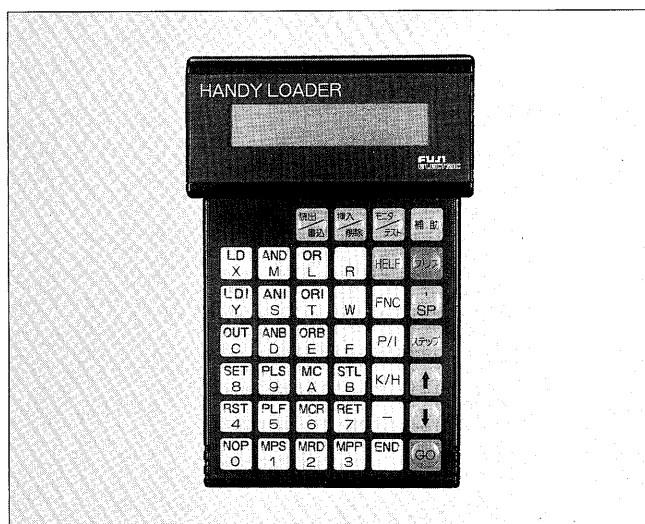
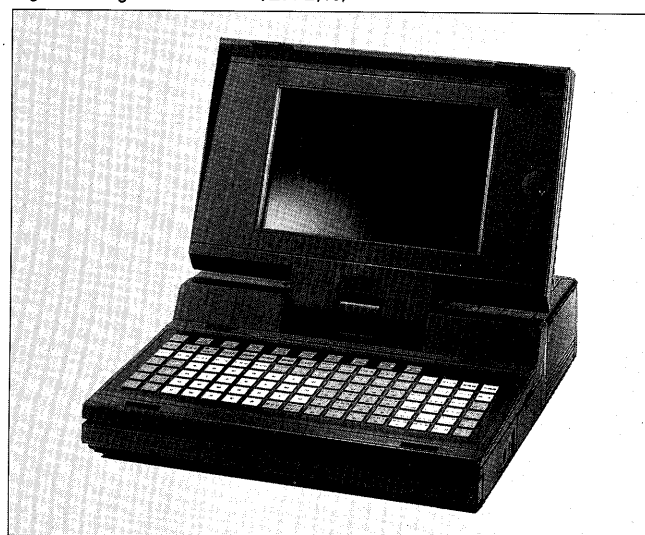


Fig. 12 High-level loader (LITE/N)



high capacity rechargeable lithium battery.

- (2) Reduction of the number of input module maintenance inventory items by making it possible to change the input module input filtering time by parameter setting.
- (3) Provision of a function which automatically displays self-check and external check result messages (alphabetic, numeric, katakana 16 characters) on the handy loader.

- (4) Installation of an error contents memory with generation time using an internal calendar.

5.7 Support tools

The N Series support tools are roughly divided into handy loader, high-level loader, and personal computer loader. The handy loader is shown in Fig. 11 and the high-level loader is shown in Fig. 12.

The handy loader is for development of small capacity programs and field maintenance and is often used as a set with the PC. The N Series handy loader realizes high key operability and monitoring characteristics by using an electronic circuit using a single-chip microprocessor and surface mounted parts and a keyboard with embossed keys and a back-lit liquid crystal display.

The high-level loader is designed to be common with F Series support tools. It can be used as an N Series loader by only changing the LITE keyboard. Operability is improved by adding an operation guidance display function, automatic operation function, input data instruction by guidance function, user customize function, etc.

The personal computer loader uses a commercial personal computer as a support tool. An external custom keyboard with keys frequently used with a PC is available to improve operability. Functionally, the personal computer loader is almost the same as the high-level loader, but there is a plan to upgrade its functions in the future by using a large capacity memory.

6. CONCLUSION

We are confident that development of the general-purpose PC N Series which just fits the individual specifications of the machine will further expand the field of applications of the general-purpose PC to the machine control field.

The N Series developed this time has various functions and constructions which can flexibly meet sophisticated individual specification needs. Development of function modules for fusion with the peripheral control devices surrounding the PC and further improvement of the ease of use of the support tools based on this are planned for the future.

In this propulsion, product planning emphasizing the technology as a means to product realization, is our intention.