PROGRAMMING TOOLS FOR PROGRAMMABLE CONTROLLERS

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1. FOREWORD

With the development of programmable controller (PC) hardware with advanced functions and larger capacity, how the user can use the PC depends on a large extent on the user's application program development environment. Development and debugging of large application software require a considerable amount of manpower and improvement of development efficiency will become a big problem in the future.
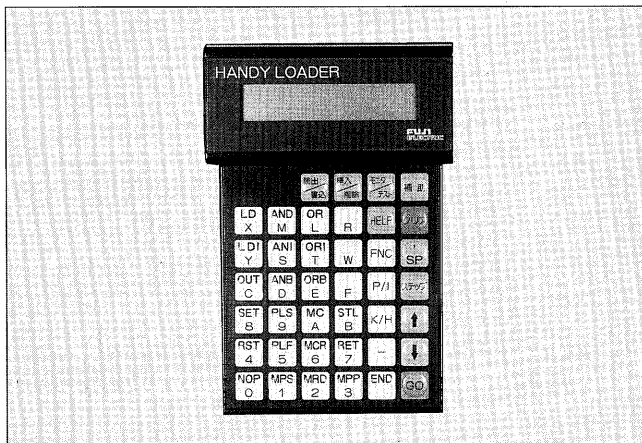
Moreover, expansion of the fields of application of the PC requires a man-machine interface that can be operated easily even by users who are not familiar with the PC. The high software development and debugging efficiency high performance LITE/N with large display, floppy disk drive, and ROM writer and the small custom handy loader designed for field maintenance have been developed as FLEX-PC N Series programming tools. A personal computer loader using a Toshiba J3100GT laptop personal computer and a custom handy loader have also been developed as N Series PC programming tools for major end users. These programming tools are outlined below.

2. KINDS OF TOOLS

2.1 Handy Loader

The Handy Loader (*Fig. 1*) is available in several models, depending on the programming language specifications. These models use the same hardware and are realized by simply changing the keyboard and system software.

To prevent erroneous writing of the user's program, a handy monitor with functions limited to program reading, monitoring and testing only are also available.

2.2 High performance loader LITE/N

The LITE/N (*Fig. 2*) was built by using LITE (software name D25) used with the MICREX-F loader as the basic
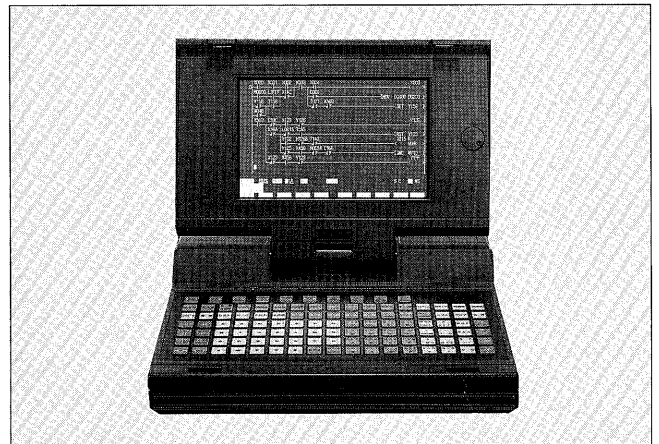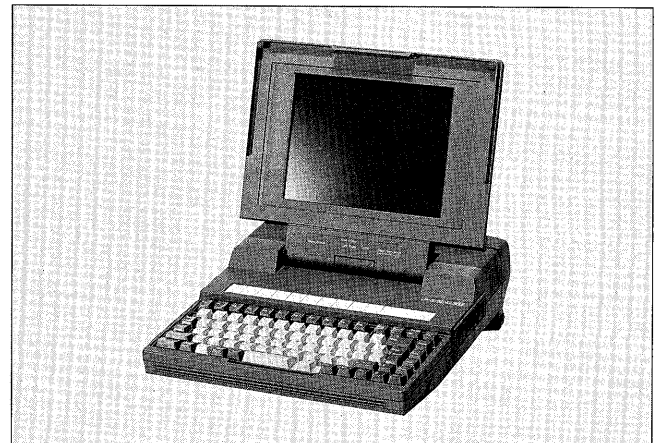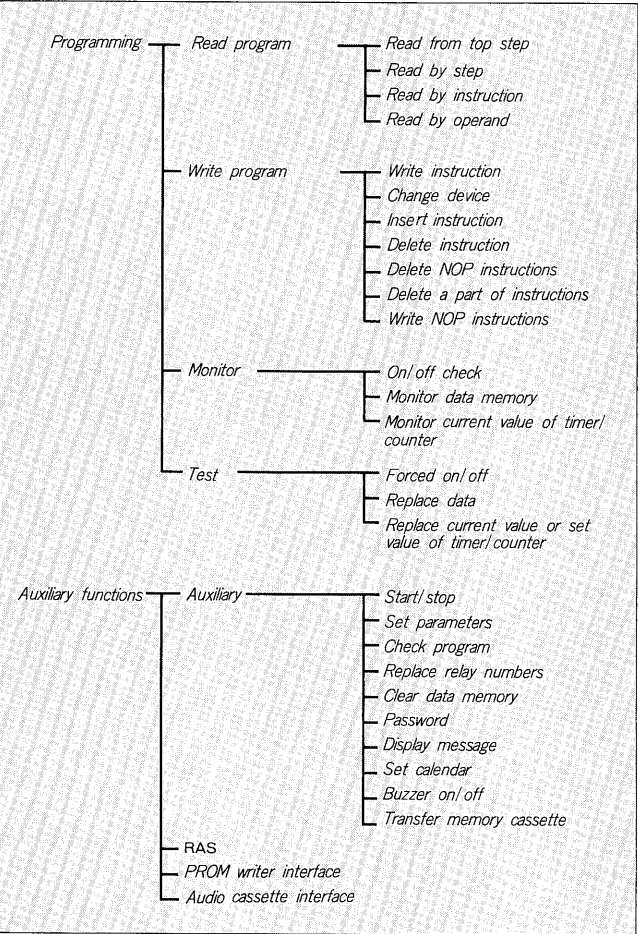
Fig. 2 High performance LITE/N

Fig. 1 Handy Loader

Fig. 3 T-type high performance loader

Table 1 Handy Loader and LITE/N specifications

Item / Objective device	Handy Loader		LITE/N
	N-HLD011	N-HLD012	FLT-SSM-A10
Applicable processor	NB/NJ/NS (general specifications)	NB/NJ/NS (T type)	NB/NJ/NS (general specifications)
Connection to processor	By PC connection cable		By PC connection cable
Display	LCD display Character display 16 chars × 2 lines LCD backlighting		Plasma display Character display 80 chars × 25 lines Dot display 640 × 400
Keyboard	Membrane keypad 40 keys w/electronic buzzer		LITE/N custom keyboard 112 keys Detachable
User program memory	None (direct writing to processor)		64k steps (w/battery back-up)
Peripheral devices	PROM write adapter CMT interface adapter Used by expansion at loader		Printer interface RS-422 interface PROM write (connects to loader)
Power supply	Received from processor		AC100V
Dimensions	90 × 148 × 35 (mm)		360 × 410 × 90 (mm)
Weight	Approx. 200g		Approx. 8kg

Fig. 4 Handy Loader function table

Programming
— Read program
— Read from top step
— Read by step
— Read by instruction
— Read by operand

— Write program
— Write instruction
— Change device
— Insert instruction
— Delete instruction
— Delete NOP instructions
— Delete a part of instructions
— Write NOP instructions

— Monitor
— On/off check
— Monitor data memory
— Monitor current value of timer/counter

— Test
— Forced on/off
— Replace data
— Replace current value or set value of timer/counter

Auxiliary functions
— Auxiliary
— Start/stop
— Set parameters
— Check program
— Replace relay numbers
— Clear data memory
— Password
— Display message
— Set calendar
— Buzzer on/off
— Transfer memory cassette

— RAS
— PROM writer interface
— Audio cassette interface

hardware and combining it with a newly developed N Series keyboard and PROM writer. The LITE/N also supports floppy disk data storage, printer output, PROM writer, and other functions.

2.3 T- type high performance loader

This loader (*Fig. 3*) is an advanced functions loader

developed on function specifications common to all manufacturers of common peripheral devices for major end users. By installing the software for each PC manufacturer at this loader, the user can operate the PC of all manufacturers by a standard procedure.

3. SPECIFICATIONS AND FUNCTIONS

3.1 Specifications

The specifications of the Handy Loader and LITE/N are shown in *Table 1*.

3.2 Functions

The Handy Loader functions table is shown in *Fig. 4* and the LITE/N functions table is shown in *Fig. 5*. The T-type high performance loader functions table is shown in *Fig. 6*.

4. FEATURES

4.1 Handy Loader

(1) Usable with all N Series PC (NB, NJ, NS).
(2) Palm size loader consisting of a backlit 16 characters × 2 lines LCD and 40-key membrane keypad which simplifies monitoring, debugging, and other test operation and maintenance work, starting from program generation, by connecting it to the processor.
(3) Programming is performed by writing mnemonic instructions directly to the processor in instruction units. Although each data instruction depends on the function number (FNC number), data instructions can be input while referencing the name of each data instruction number by pressing the HELP key at FNC number input.
(4) Wall mounting construction for user maintenance, etc. The loader can also be attached directly to the NB Series.
(5) Expansion interface that connects the PROM writer
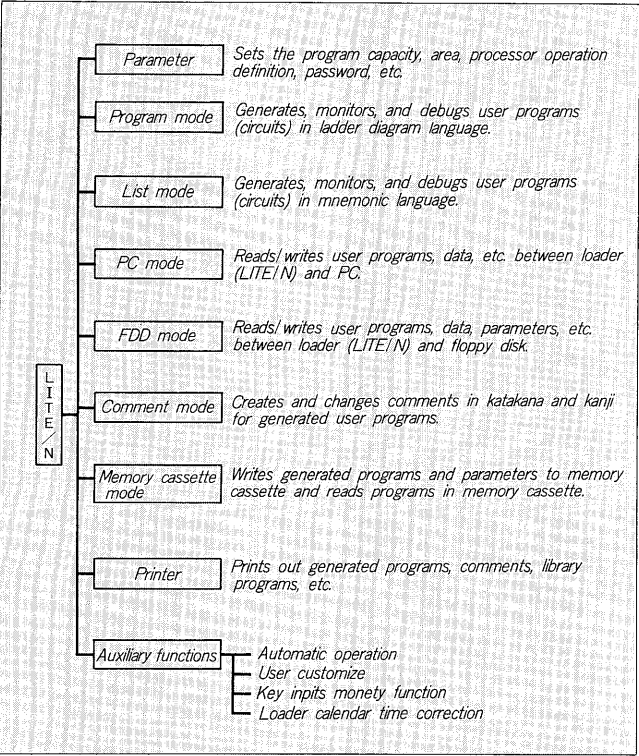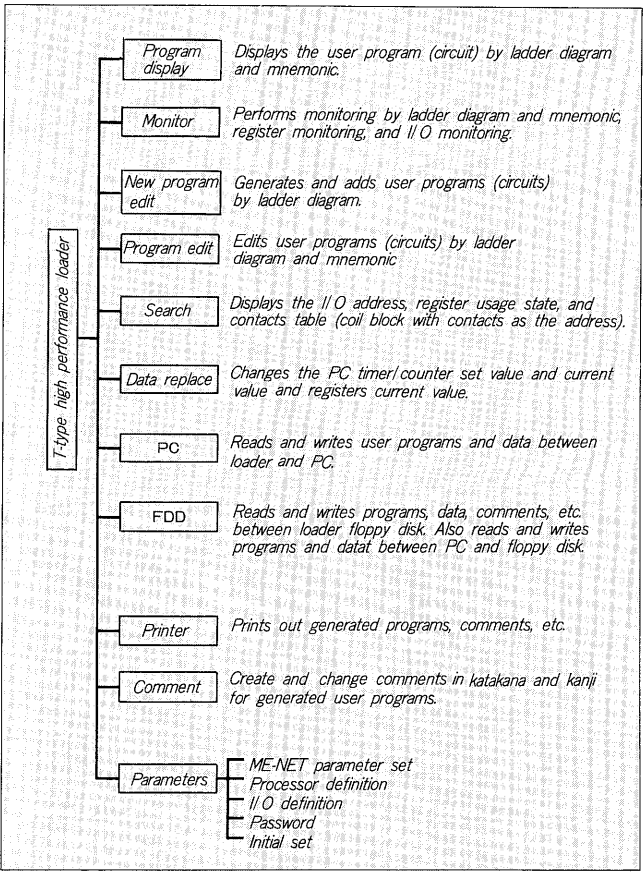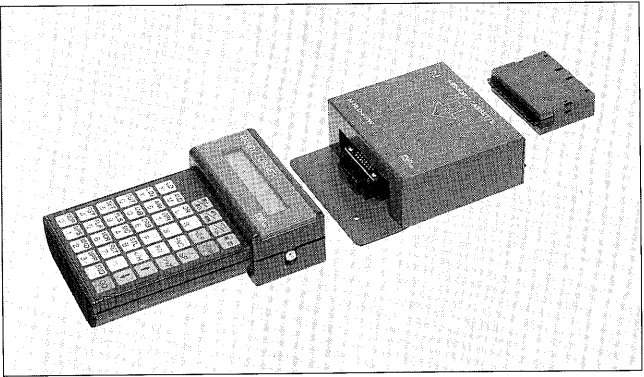
Fig. 5 LITE/N functions table

LITE/N		
	Parameter	Sets the program capacity, area, processor operation definition, password, etc.
	Program mode	Generates, monitors, and debugs user programs (circuits) in ladder diagram language.
	List mode	Generates, monitors, and debugs user programs (circuits) in mnemonic language.
	PC mode	Reads/writes user programs, data, etc. between loader (LITE/N) and PC.
	FDD mode	Reads/writes user programs, data, parameters, etc. between loader (LITE/N) and floppy disk.
	Comment mode	Creates and changes comments in katakana and kanji for generated user programs.
	Memory cassette mode	Writes generated programs and parameters to memory cassette and reads programs in memory cassette.
	Printer	Prints out generated programs, comments, library programs, etc.
	Auxiliary functions	Automatic operation / User customize / Key inpits monety function / Loader calendar time correction

Fig. 6 T-type high performance loader functions table

T-type high performance loader		
	Program display	Displays the user program (circuit) by ladder diagram and mnemonic.
	Monitor	Performs monitoring by ladder diagram and mnemonic, register monitoring, and I/O monitoring.
	New program edit	Generates and adds user programs (circuits) by ladder diagram.
	Program edit	Edits user programs (circuits) by ladder diagram and mnemonic
	Search	Displays the I/O address, register usage state, and contacts table (coil block with contacts as the address).
	Data replace	Changes the PC timer/counter set value and current value and registers current value.
	PC	Reads and writes user programs and data between loader and PC.
	FDD	Reads and writes programs, data, comments, etc. between loader floppy disk. Also reads and writes programs and datat between PC and floppy disk.
	Printer	Prints out generated programs, comments, etc.
	Comment	Create and change comments in katakana and kanji for generated user programs.
	Parameters	ME-NET parameter set / Processor definition / I/O definition / Password / Initial set

adapter and CMT interface adapter allows writing and program storage to memory cassette using a Handy Loader instead of a high performance loader. EPROM/ EEPROM cassette program writing, reading, and verification are possible by installing a PROM writer adapter. By installing a CMT interface adapter, programs can also be saved (recorded), restored, and verified by audio cassette.

(6) The user can display preregistered character strings (katakana, arabic figures 16 characters) on the Handy Loader display by application program. This function allows use of the loader as a simple display. When the Handy Loader is connected to a faulty PC, the self-test function of the PC automatically displays an error message on the display.

4.2 LITE/N

4.2.1 Features of functions

The high performance LITE/N provides a basic operating environment which can be used easily by users familiar with operation of the loader, which is the most popular device as a high performance loader.

The following functions, which serve to alleviate the dissatisfaction of users with their existing loader and improve user software development efficiency, are also provided.

(1) Basic functions

For the LITE/N, efforts were made to round out the basic functions for program generation by the user and to improve user development efficiency as a programming tool for editing large programs.

(a) FDD function that allows storage of large pro-

Fig. 7 Handy Loader and PROM Writer Adapter

grams and comments to floppy disk.

(b) Printout function that allows various printing.

(c) Sampling, trace, status latch, and other debugging functions that save exact control timing data and are used in analysis.

(2) Automatic operation function

When using a loader, there are many cases where frequently used operating procedures are repeated. An automatic operation function was developed for the LITE/N to increase operating efficiency. If the contents of consecutive operations that are used frequently are registered in one function key, multiple key operations can be performed by one key operation.

Fig. 8 LITE/N key arrangement

Fig. 9 An example of LITE/N automatic operation function screen

Fig. 10 An example of LITE/N data instruction automatic guidance screen

(3) Data instruction automatic guidance

The recent increase in the functions of the PC has been accompanied by a steady increase in the number of data instructions and it has become difficult for the user to learn all these instructions and how they are used. With the LITE/N, for data instruction programs, window

(1) makes it possible to sort and display data instructions by function and to select the objective data instructions in a Japanese language menu interactive mode,

(2) reduces erroneous input by displaying the number and type of operands necessary even during input of the objective data instructions.

This has made it possible to input data instructions without referring to a manual.

(4) Guidance function

The problems involved with loader use are that the operation method is not understood and the manual must be referred to each time the loader is used. The guidance function immediately displays the optimum operation guidance according to the place on the screen

Fig. 11 An example of LITE/N user guidance function screen

by guidance key. This function has made manual-less operation possible.

(5) User customize

A user customize function that permits setting of

the previously described data instruction automatic guidance function, automatic operation function, and other functions to match user wants was added.

(6) Comment support

VJE-β[note1], the most popular Japanese language input environment for personal computers, etc., was used and transplanted onto the LITE/N. This enables Japanese language input equal to that of a word processor.

(7) Other loader system software development support

MS-DOS[note2] Ver 3.30, a popular OS even for general-purpose personal computers, was transplanted. This made it easy to transplant system softwares for programmable operating display (POD) loader, position control module loader, and others developed on MS-DOS systems to the LITE/N.

4.3 T-type high performance loader

This is a high performance loader based on common specifications set cooperatively with other PC manufacturers and centered about major end users. All manufacturers use the Toshiba J3100GT as common hardware. To realize operability common to all PC manufacturers, the user can program the PC of each manufacturer by a standard procedure and editing, debugging, etc. of PC programs used by the PC produced by multiple manufacturers can be performed by the same operations. A large capacity hard disk is provided at the hardware. Because different loaders can be installed to one personal computers, serviceability is also improved. Although not given in the common specifications, the following Fuji Electric original functions were realized as option functions:

(1) Comment input function

With the Fuji Electric loader, two comments can be input for contacts and coil. One comment is called "device comment" and is used for device name and other comments. The other comment is an ordinary comment and is within 14 em characters (kanji, katakana, etc.) and can be used to define the meaning and functions of the device. Comments can be input easily by using the Japenese language front end processor (ATOK5) installed in the J3100 as standard. Comment move, copy, and other

editing functions equal to those of a word processor are also provided. The comments edited here can be displayed in the program display mode or monitor display mode and can also be printed out.

(2) Parameter mode

The N Series PC parameters can be set in an easy to understand interactive mode so that PC operation can be set without referring to a manual, etc. This makes parameter setting easy.

(3) Others

Five-register monitor capable of monitoring arbitrary registers and I/O in the program monitor, CAD interface mode that allows data exchange with a CAD system, set value modification mode that changes the current value and set value of the timer/counter in the PC, and other convenient functions based on user desires are incorporated.

In developing this loader, basic parts (floppy disk, communication, display, and other I/O control) used in common by all manufacturers were consolidated into common module software that is used in by all manufacturers. This allows transplanting of the loader software of each manufacturer to other hardware by simply changing common modules even when the loader hardware environment (personal computer used, etc.) was changed.

5. CONCLUSION

The new N Series loaders offer a familiar operating environment for loaders already in use by users. Improvement of the PC program development environment will become an increasingly important problem in the future. As discussed in this article, a user environment was provided by simple operation by automatic key input, manual-less operation by guidance function, etc. We plan to listen to the voices of users and meet their needs in more detail.

Besides, Fuji Electric can offer the software of the English specifications by which the IBM personal computer can achieve various functions of LITE/N.

<Note 1> VJE-β: Registered trademark of VACS Corp.
<Note 2> MS-DOS: Registered trademark of Microsoft Corp.