PROGRAMMING TOOL FOR MICREX-F SERIES

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① FOREWORD

In the sector of industry, the difference between the programmable controller (hereinafter abbreviated as PC) and general purpose computer is in the interface. That the users of PC's and general purpose computer makes out both system that exert predetermined performance combining the hardware with software is the same, but for handling the general purpose computers, a specialized knowledge on computer would be required, but it is PC that specialized experts in the control sector create such systems without needs of computer knowledge. That is, in other words, PC's must possess machine interface so as the non experts of computers but control experts should architecture PC's and administrate and maintain them.

In particular, together with the expansion of the field of application such as automatization of factory istallation by PC's, users having profound knowledge and experience in the administration of applied system will have to engage themselves, and for PC machine interface, a capability that utilize easily the performance of PC's more than before is required now.

The handheld program loader "D10" and portable program loader "D20" introduced in this article are developed with a view to improving the efficiency and simplifying the PC's programming operation, testing and maintenance in not only in the stand along system as well as distributed control system, as the man machine type interface for MICREX-F series (hereinafter abbreviated as F series).

② FEATURES

The main features of F series program loaders are as shown in the following.
(1) Possibility of common use to F100 series and F200 seires
(2) In spite of their compactness in size, a ladder diagram of 11 symbols × 8 lines can be displayed.
(3) Liquid crystal display is provided with a backlight so that it is easy to read the display.
(4) By means of relay symbol keys, symbolic program-

ming is possible.
(5) A program list with notes in 16 letters explaining the contents as well as page no., circuit no., and cross reference can be printed out. (D20)
(6) In addition to the status of contact and coils and set value of timer and counter and actual value, input value and output value of the application instructions can be displayed.
(7) Circuit parts that are not continuous can be monitored and programmed simultaneously and simultaneous monitoring of data memory can be made.

Fig. 1 Outer view of handheld program loader D10

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Fig. 2 Outer view of portable program loader D20
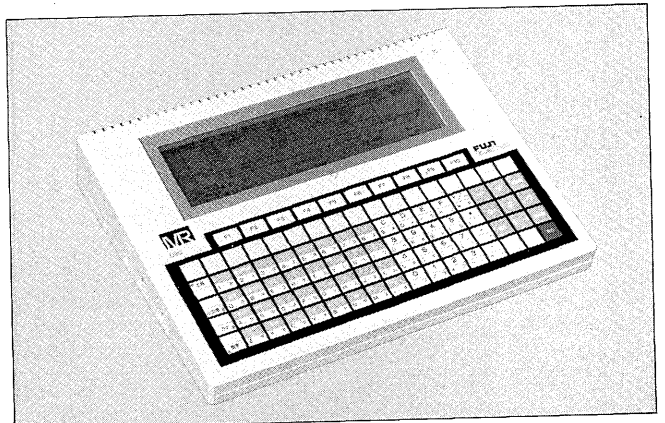
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(8) Forced output of PIO can be made.

(9) Loader interface is provided on the network (T link) and the loader can be used from anywhere.

The outer view of D10 is shown in *Fig. 1* and that of D20, in *Fig. 2*.

③ SYSTEM COMPOSITION

The program loaders of F series are so constructed that they can be connected to processors through T link, not directly connected to processors as in the case of conventional method. That is, with this system, manipulation from the processor unit as well as remote programming and remote monitoring at PIO unit can be effectuated. Further, since they permit simultaneous connection of two units on the same T-link, simultaneous monitoring of signals at the central position as well as at the local spot, or at two local spots can be effectuated.

Also, the protocol exchanged on T links are of the unified type not having to do if it is concerned with F100 series or F200, the operations are possible for either processor, without necessity of bringing forth any modifications or any change.

3.1 Handheld program loader "D10"

D10 is composed of microprocessor as the main element, display unit, keyboard unit, T link interface and cassette MT interface. In the display unit, custom liquid crystal display of (10 contacts + 1 coil) x 8 lines, and 16 letters x 2 lines is provided and for the keyboard unit, 7 x 7 keyboard is used. In particular, in order to miniaturize the device, custom LSI and hybrid IC have been specially developed. Also, for the rear side of the crystal liquid display, in due consideration of the device's use in a dark place, an EL (electroluminescence) backlight is provided.

3.2 Portable program loader "D20"

D20 is in a compact format of B4 size, and besides being provided with powerful programming function and display function, it is provided with cassette MT interface, printer interface, floppy disc interface. For the display, a large size liquid crystal display of 85 letters x 16 lines (with EL backlights) is adopted, so that the ladder diagram and message display are very easy to read. The keyboard is provided with function keys in order to meet the requirement of diversification of key operation. Also, in its internal mechanism, there is a program memory that permits to program even in case of Off-line.

The system composition of D10 and D20 is shown in *Fig. 3*.

④ SPECIFICATIONS AND FUNCTION

4.1 Specification

The specifications of D10 and D20 are as shown in *Table 1*.

4.2 Function

A list of functions of D10 and D20 is goven in *Table 2*.

⑤ PROGRAMMING

D10 and D20 have the following features:

(1) Symbolic programming system with which the ladder diagram and block diagram (D20 only) can be inputted directly to screen.

(2) Though compact in size, perfectioning of debug and test function through display of ladder 8 lines.

(3) Highly accomplished figure elaborating function by print out provided with page number, circuit number, cross reference and comments (D20).

With these features, a series of programming operation from programming, debugging up to figure elaboration are simplified. Also concept behind the manipulation of both devices is unified.
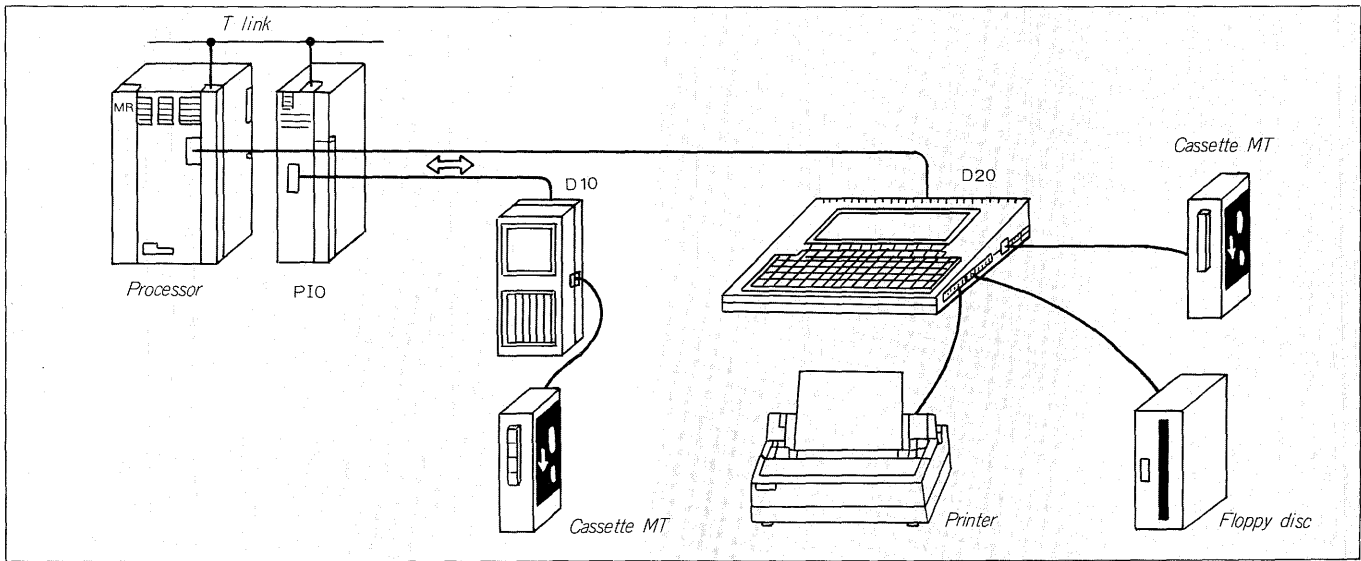
Fig. 3 System composition of D10 and D20

Table 1 Specifications of D10 and D20

Item / Equipment	D10	D20
Name of applicable processor	F100 series F200 series (With restriction)	F100 series F200 series
Connection system with processors	By T link	By T link
Display unit	Liquid crystal display (With EL backlight) Letter display 16 × 2 ladder display 11 symbols × 8 lines	Liquid crystal display (With EL backlight) Letter display 85 × 16
Keyboard unit	Flat key (49 keys) (With electronic buzzer)	Flat key (95 key) (With electronic buzzer) Symbol/alphabet/kana changeover
User program memory	None (direct write in to processor capsule)	16 k steps (With battery backup)
Peripheral equipment	Audio cassette MT	Audio cassette MT Printer Floppy disc (3.5 inches)
Ambient temperature	0~40°C	0~40°C
Ambient humidity	20~85% RH (No condensation)	20~85% RH (No condensation)
Power supply	receives from processor mainbody	AC 100 V + 10% (50/60 Hz) − 15%
Dimensions	110 × 200 × 32 (mm)	360 × 255 × 60 (mm)
Weight	about 0.5 kg	about 2.4 kg

Table 2 Functions of D10 and D20

Item		Equipment	D10	D20
Programming	Read out	Page No.	O	O
		Circuit No	O	O
		IO No	O	O
	Elaboration	ON LINE	O	O
		OFF LINE	−	O
		Change	O	O
		Insertion	O	O
		Deletion	O	O
		Page renumber	O	O
		Memory overflow alarm	O	O
	Edit	Transfer	−	O
		IO No. global change	−	O
Test	Monitor	Contact/coil ON OFF	O	O
		Timer/counter actual value	O	O
		Data memory	O	O
	Debug	Start/stop	O	O
		Step execute	−	O
		Condition stop	−	O
		Timer/counter set value change	O	O
	Instruction			
	Input/output forced ON/OFF		O	O
	Execute speed check		O	O
Print out	Program list		−	O
	Comment list		−	O
	List of IO/Memory using situation		−	O
Program conservation	Conservation to Audio cassette MT		O	O
	Conservation to floppy disc		−	O
	Output to printer		−	O
Maintenance and diagnosis	Processor failure display		O	O
	Failed relay status display		O	O

5.1 Composition of displayed figures

Fig. 4 shows an example of D10 program display, and

Fig. 5, that of D20. Each of the figures shows the identical program and the lower 3 lines are the example of application instruction display.

The display unit of D10 is composed of 10 contacts + 1 coil in transversal direction and 8 lines of ladder display unit and 16 letters × 2 line of message display unit in longitudinal direction. In the message display unit, present mode, cursor position contact no., coil number and circuit number are displayed.

D20 is provided with a figure of 512 × 128 dots and as in the case of D10, 10 contacts + 1 coil in the transversal direction and in addition of ladder display of 8 lines in longitudinal direction, and the numbers of each contact and coil can be displayed simultaneously. Also, by switching over the 8 line ladder display to 7 line display, the lowest line of the displayed figure will be the message display unit.

5.2 Program elaboration

Elaboration of programs is effectuated by keying in the relay symbol and contact/coil informations by observing the screen. The ladder diagram is made out by observing the screen. The ladder diagram is made out by cursor transfer, manipulation of symbol key shown in *Fig. 6*, and keying in of contact/coil informations. As the restriction on elaborating circuits is lessened by adopting line crossing without intersection and line connector, programs can be elaborated on the screen just as drawing out a ladder diagram on the writing table.

In D20, in addition to 1-line display of *Fig. 5*, the block diagram display as shown in *Fig. 7* can be attained also, and the data flow and processing can be expressed in an easy-to-understand form.

When the application instruction is written in, the operation is made for D10, through keying in of the instruction number. In D20, as shown in *Fig. 8*, first, the instruction group is selected and the instruction symbol of the selected group is displayed in the lowest line on the
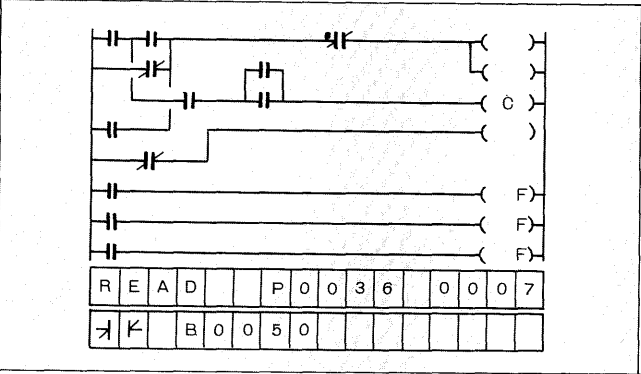
Fig. 4 An example of D10 program display

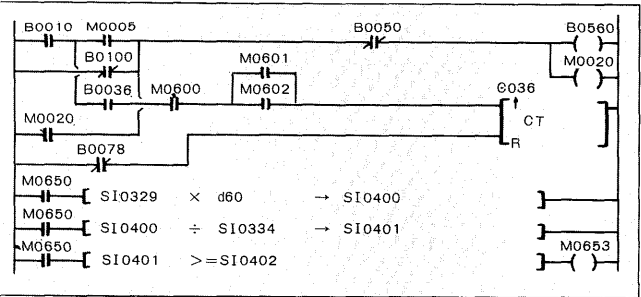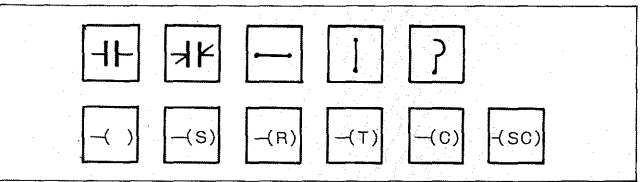*Fig. 4* An example of D10 program display

Fig. 5 An example of D20 program display

Fig. 6 Ladder diagram symbol keys

Fig. 7 Block diagram

Fig. 8 Inputting of D20 application instruction

(a) *Selecting of instruction group*

(b) *Inputting of function keys*

(c) *Inputting of operand*

screen. Then, when the function key corresponding to the instruction symbol is operated, the selected application instruction will be displayed in the cursor position. Then, slide the cursor and input the operated.

Besides the operations mentioned above, by functions of deletion and insertion, the change in programs can easily be effectuated.

5.3 Monitor

For confirming the functioning of the elaborated programs and maintenance and inspection during the operation, the users will have to know the operating condition of PC's. D10 and D20 are provided with monitor function and display the operating condition on the screen.

Fig. 9 shows the monitor screen of D10 and *Fig. 10,* that of D20. The OFF status of the contact and coil is shown by their symbols as they are, while their ON status, shown by "paint out" of the part thus being able to confirm the current continuity condition. As for the timer and counters, the contents of set value and actual value are indicated by numerical values. As for application instruction, the contents of memory in use are displayed by numerical values.

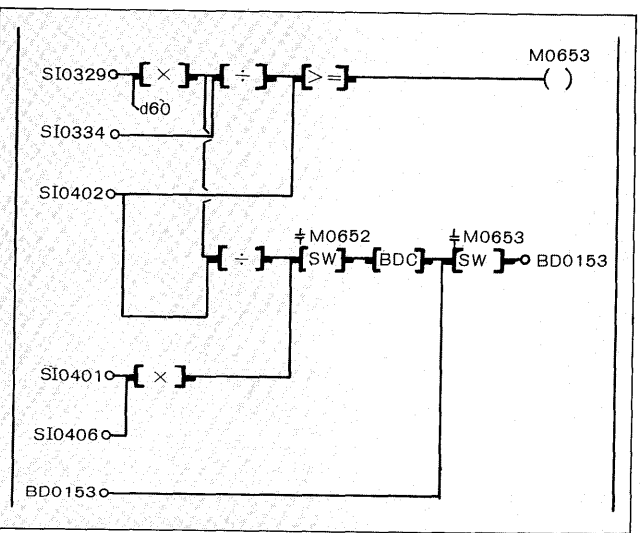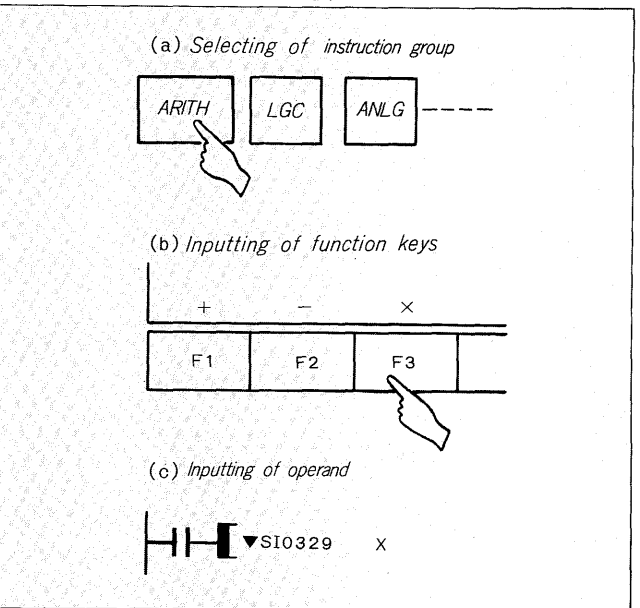Also, the monitor functions are available in types, that is, one monitoring the programs and another on data memory. With these, besides the conventional program ordered monitoring and address ordered monitoring on data memory on the picture of the screen, "superposed data region on the picture of the screen, "superposed reading" can be made. This not only monitors the two points of the partical circuit on the circuit diagram simultaneously, but also monitors the program and data at the same time, it is particularly effective for analysis on the cause of failure. *Fig. 11* shows an example of superposed reading of program upon data region.

Furthermore, as D10 and D20 can effectuate forced IO outputting, modification of set value, modification of memory contents and execution from the designated point
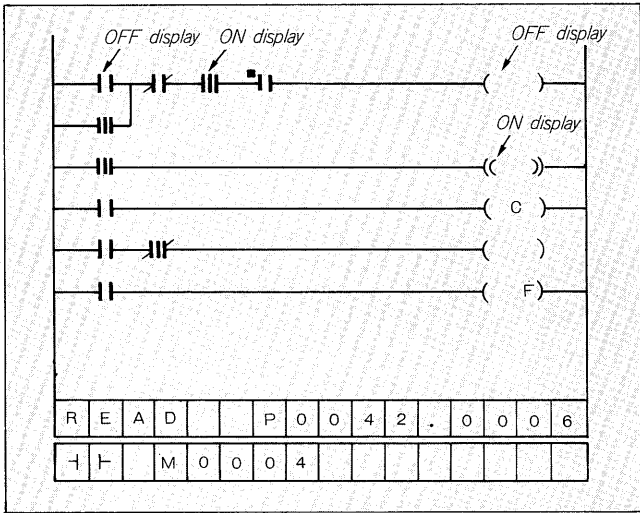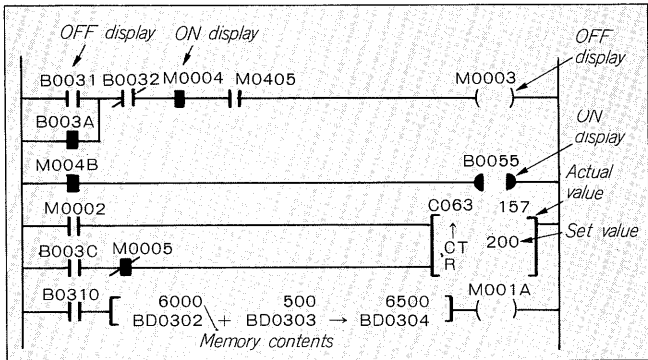
Fig. 9 Monitor screen (D10)

Fig. 10 Monitor screen (D20)

Fig. 11 Superposed picture

Fig. 12 Example of program list

of the program as well as stop at the designated point, they exert a big power for debugging of the program.

5.4 Print out

In D20, by connecting a printer, various sorts of informations regarding the program can be printed out. Further, by combining with floppy disc device, comments can be added so that it is very effective for confirming the contents of the program and for maintenance.

(1) Program list

The contents of the program are printed out in the same type as that of picture display. By designation, cross reference, comments on the coil (maximum of 16 letters) and the name for the contacts (first 6 letters of the comment defined for the coil) can be written out at the same time. *Fig. 12* shows an example of print out.

(2) List of using situation

Situation of using and/or non using of the IO region, data memory, program, function module, timer and counter can be printed out.

(3) List of comments

Comments defined for each number of IO, data memory, program, function module, timer and counter can be printed out.
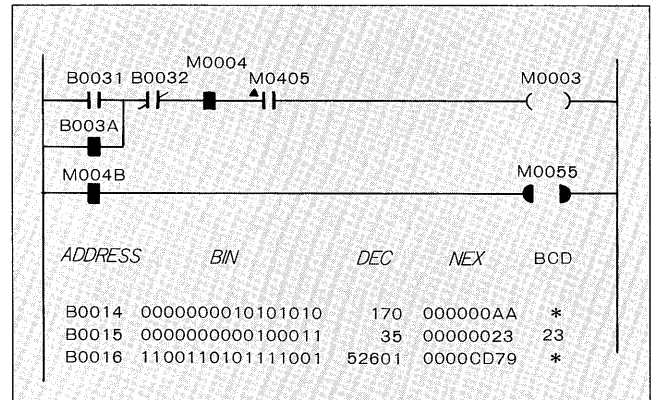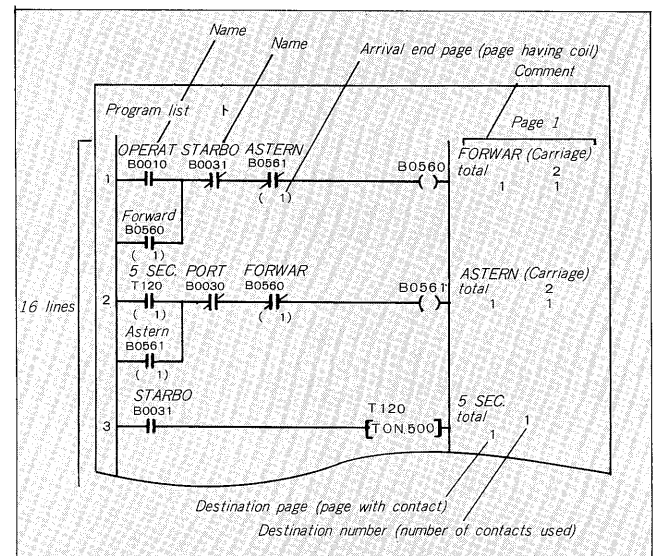
6 SUMMARY

D10 and D20 are the devices that give effective means of simplification in programming by efficient symbolic programming function. Also, they can provide means for confirming the operating states on the diagram, and together with various test functions, they help to increase the efficiency in testing and maintenance. Further by providing them with means for connecting with T links, PIO units installed in dispersed form can be used and, by connecting two units together, several persons can use them simultaneously in good coordination among them, so that they can execute adjustment and testing in wide range of application and systematically.

This article introduced only the outline of these devices, and by utilizing the functions that the loaders have, if PC's will come to an easy access of every user and if we can help our user in expanding the field of application, we feel our effort highly recompensed.