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FUJI PROGRAMMABLE CONTROLLER "FUJILOG-μT

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I. INTRODUCTION

General purpose programmable controller (hereinafter referred to as PC), FUJILOG-μT has been developed to apply to medium and small scale sequence controls. The features such as the simple programming using four basic instructions, flexible system configuration, small in dimensions and easiness of use have been highly evaluated. Since it was placed in the market initially, the functions have been increased and performance has been improved without changing the basic specifications. Especially, with the newly developed CPU module, non-volatile data memory and various intelligent couplings by adding CPU interface function are realized. Further, the PC can now be applied to wider systems as more input/output cards and power supply unit have been made available.

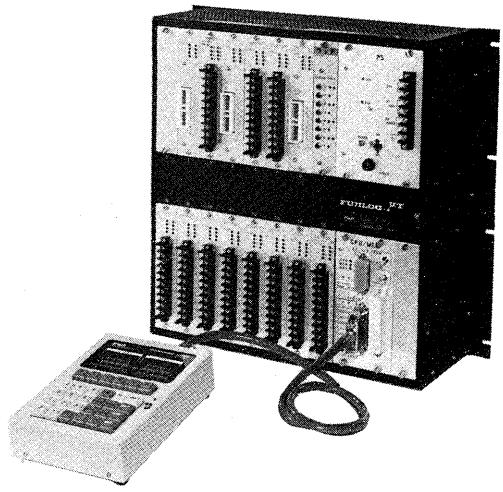

Fig. 1 Appearance of FUJILOG-μT

II. SYSTEM CONFIGURATION

For this PC, various functional modules are available so that the PC can be applied to a wide range of general purposes and that the most optimum system can be composed for each application. All the functional modules are of plug-in type, easing the maintenance and replacement. They are accommodated in a casing in response to each scale, and the system is composed by combining input/output cards further with the functional modules. *Figs. 1* and *2* show the appearance and system configuration respectively.

For the units, five types, namely UT 04A(P) through UT20A(P) are available for your choice in response to the number of input/output points of the applicable system. The unit is a common part of the PC, and the central control, program memory unit (CPU/MEM) and power supply unit (PS) composing modules are installed on a casing.

For the CPU/MEM unit, capacity and type of the program memory are selected, and for the PS unit, the voltage is selected. *Tables1* and *4* indicate the unit specifications and specifications of the PS unit.

UT15 and UT20 units consist of two casings. Out of these casings, the one on which the above described modules are installed is called basic unit, and the other on which the PS unit and interface (EXI/O module) which sends and receives signals to and from the CPU of the basic unit are mounted is called an expanded unit. The CPU and EXI/O module are joined with the special cable.

Each casing has a space to install required number of input/output cards in response to each unit size in addition to the above described modules. Various input/output cards are selected in response to the number of input/output points of the applicable system, and by installing the selected cards, one PC is composed.

The right slot of the CPU/MEM of the basic unit is CPU interface. Read and write of the PC program memory and data memory are executed by DMA processing without affecting executions of the PC, allowing various interfaces with external lines.

The monitor module (UT4701) is left inserted into this slot, and without using program loader, program can be checked, DS value (set value of the timer counter) can be changed, each data memory can be monitored, and forced ON-OFF controls can be made.

Fot the programming tools, various programming loaders are available. Connecting them directly to the

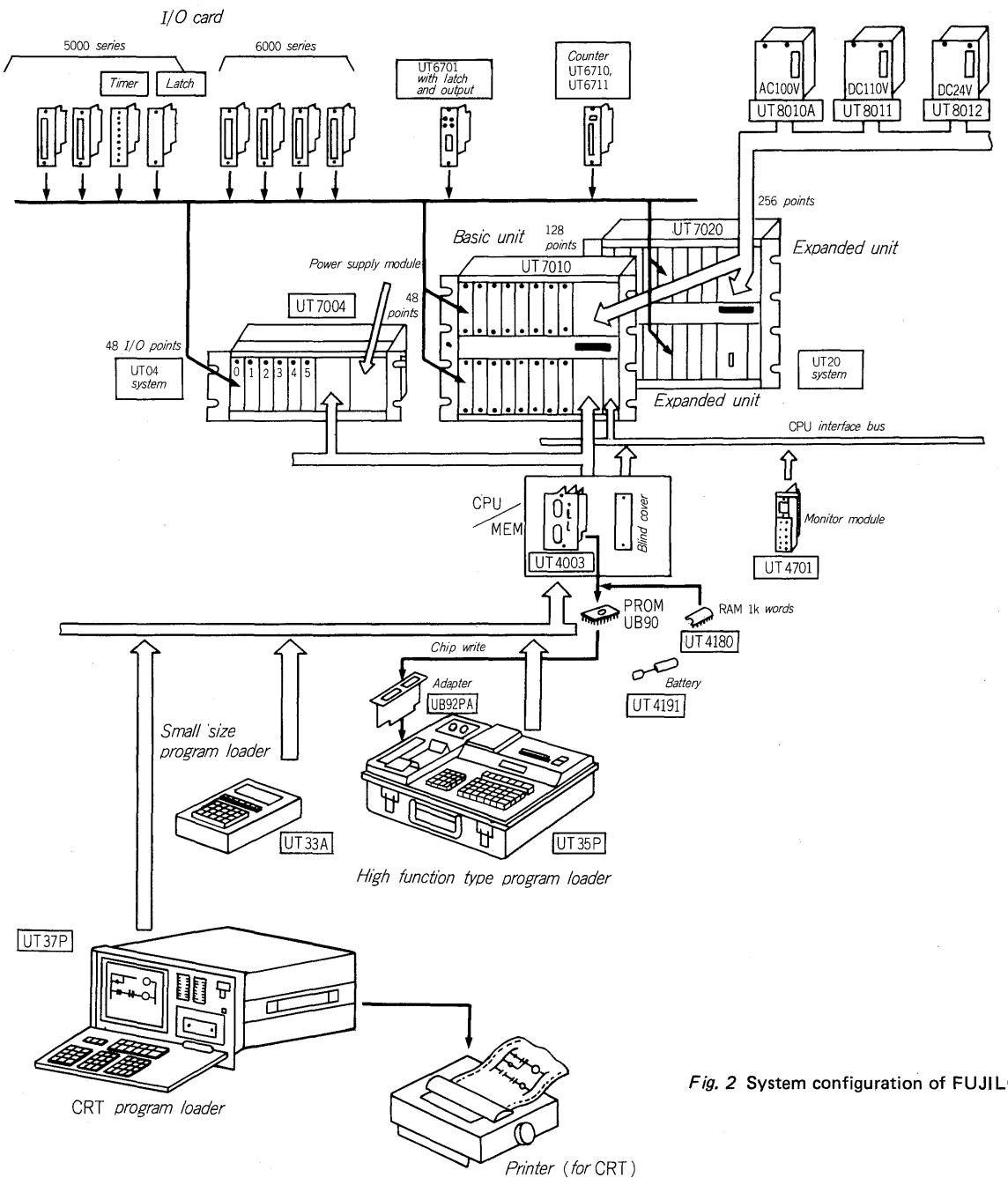

Fig. 2 System configuration of FUJILOG-μT

connectors of the CPU/MEM module, program can be written, contents of the program can be checked during program execution (RUN mode), and execution result of each program step, signal status of input/output itnernal data memory and the present value of the timer counter can be monitored. Further, with a high function type loader used, contents of the program can be stored by using a cassette magnetic tape (CMT), program list can be printed out, and program can be written into the EPROM.

Moreover, with a CRT program loader, programming can be made directly from a ladder graph, the program can be printed out and operating status of each contact can be monitored.

For the details of the programming tools, refer to page 26 for PROGRAMMING LOADER "UT33A" "UT34A" "UT35P" under a separate cover.

III. SPECIFICATIONS AND FUNCTIONS

1. Specifications

1) Specifications of unit

Tables 1 and *2* show the unit specifications of this PC and basic specifications respectively.

The standard program memory capacity is as shown in *Table 1*, however, when requested, it is possible to install 1k words or 2k words for all units.

The input/output address range of each unit is fixed, and within that range, input/output cards can be installed freely in any desired positions.

Table 1 Unit specifications of JUJILOG-μT

Modules and others \ Unit type		UT04A(P)	UT05A(P)	UT10A(P)	UT15A(P)	UT20A(P)
Applicable CPU module and memory capacity		RAM system UT4003A-1 PROM system UT4003P-1 1 k words			RAM system UT4003A-2 PROM system UT4003P-2 2 k words	
Maximum number of I/O points and number of I/O cards		48 points	64 points	128 points	192 points	256 points
		6 sheets	8 sheets	16 sheets	24 sheets	32 sheets
Casing	Basic unit	UT7004	UT7005	UT7010		
	Expanded unit	–	–	–	UT7015	UT7020
	Expanded I/O unit and cable	–	–	–	UT4020 UT3101	
Power supply	Input voltage	Selected from input voltage AC100V, DC110V, and DC24V				
	Number of power supplies used	Each one			Each two	
Size	External dimensions (mm)	480 x 199 x 185	340 x 450 x 185	480 x 450 x 185	480 x 450 x 185 340 x 450 x 185	480 x 450 x 185 480 x 450 x 185
	System weight (kg)	10	13	18	33	36
Applicable program loaders		Small size program loader UT31A, UT33A High function type program loader UT32P, UT35P CRT type program loader UT37P Monitor module UT4701 (However, UT04 system is excluded)				

Table 2 General specifications of FUJILOG-μT

Item \ System		RAM	PROM	Remarks
Arithmetic processing unit	Control system	Cyclic operation		
	Program system	Stored program		
	Type of instruction	Logical operation, functional operation, input/output control		
	Arithmetic control function	Logical operation : AND, OR, NOT Functional operation : Timer (0.1 to 12.7 sec.) Counter (1 to 127) Shift register (8 steps) Step controller (8 steps) Input/output control : READ, WRITE Program control : Common interlock Others : CLR, NOP		
	Data memory	1024 points: for 128 cards; including input/output buffer		Non-volatile for 96~127 cards, with the attached battery
	Cycle time	20 ms fixed		
	Self-diagnosing	Control unit inhibit pattern detection, parity check		STX OFF stops when an error is detected
Program memory	Program capacity	1 and 2 k words depending on installing memory chip		
	Momory type	RAM, UT4180 Battery back-up	PROM, UB90	Up to two can be installed per 1 k word capacity of memory chip
	Memory backup system (battery)	NiCd battery, UT4191 recharging system 45°C Serviceable for 2 weeks, Initial charging 48 hours		Deta memory is also backed up with this battery
	Self-diagnosing	Monitoring battery voltage, Detecting battery disconnection		STX OFF stops when an error is detected
Test function		Deta momory ON-OFF can be controlled		By controlling from the program loader
Power supply		Rated input AC 100V, DC 110V, DC 24V		
Maximum number of input/output points		Total number of input/output points: 256 points (max)		
General specifications	Ambient conditions	0 ~ 45°C (RAM), 0 ~ 55°C (PROM) 10~85% RH (Without condensation)		
	Dielectric strength	AC 1500V 50/60Hz 1 minute		
	Cooling system	Self-cooling		
	Noise resistance	Noise simulator 1000V		

Programs are executed in the method of cyclic processing, namely, the program memories are executed repeatedly from step zero to step 2047, and the cycle time is fixed at 20 ms regardless of number of executed instructions or types of instruction.

For starting this PC, only automatic start mode applies. To be more specific, this PC is started automatically by applying the control power supply. The starting interlock is executed by combining starting contact (STX contact) with an external starting contact and by thus controlling input/output signal power supply.

For the operation modes, there are RUN mode under which programs are executed and PRG mode under which the execution stops, programs are written, added or corrected, and the modes are selected by operating the control switch attached on the front panel of the CPU/MEM module.

This PC is self-diagnosed in the unit of a module. A fault of CPU/MEM module or power supply module is detected, relay STX which is operating when the PC is operating normally is caused to release, and at the same time, the indicator lamp on the front face of each module is caused to go out. Watching the indicator lamp, each module can be monitored because the lamp flickers, lights or goes out. *Table 3* shows status of the PC.

For the power supply modules, there are three types for both AC and DC. *Table 4* shows the specifications of the power supply unit.

2) Specifications of input/output card

UT5000 and UT6000 series input/output cards are used for this PC. The specifications for these cards are indicated in *Table 7* for FUJILOG-μH reported under a separate cover.

In addition to these cards, analogue timer card UT5610A can also be applied to this PC, and this card is used when a set change is required during operation.

The couter card is used as a normal input/output card. The external shape and dimensions are same. This is of a

Table 3 Table of monitoring status indicators of FUJILOG-μT

○ =Non Lighting ● = Lighting × =Don't care ⊙ =Flicker Lighting

Mode	CPU/MEM Module			Power supply module (PS)				Explanation
	CPU	MEM	BAT	POWER	RUN	STX	STX relay	
RUN	○	○	○	○	○	○	OFF	Power supply OFF or fault
	○	○	○	●	○	○	OFF	DC power supply within PS is faulty
	○	×	●	●	●	○	OFF	CPU failure
	●	○	●	●	●	○	OFF	Memory parity error
	●	●	○	●	●	○	OFF	Abnormal battery voltage or disconnected
	⊙	●	●	●	●	●	ON	Normal (arithemtic processing)
PRG	○	○	○	○	○	○	OFF	Power supply OFF or PS fault
	○	○	○	●	○			DC power supply within PS is faulty
	×	○	●	●	●			*Indicator circuit of CPU or MEM is faulty
	○	×	●	●	●			
	●	●	○	●	●			Abnormal battery voltage or disconnected battery
	●	●	●	●	●			Normal

* Under PRG mode, CPU, MEM indicators light unconditionally.

Table 4 Specifications of power supply unit of FUJILOG-μT

Item \ Type		UT8010A	TU8011	UT8012	Remarks
Input side	Rated input voltage	AC 100V	DC 110V	DC 24V	
	Permissible fluctuation range	−15 ~ +10%	−15 ~ +30%	−15 ~ +30%	
	Input current (peak value)	1.5A or less (20A 8ms)	1A or less (20A 8ms)	4A or less	
	Momentany power failure	10ms			
Output side	Internal output voltage	5V, Internal control circuit power supply, for excitation of 24V relay output card			Up to 64 point output, can be burned on simultaneously.
	STX contact output	1 a contact, current applied AC 220V/2A			
	EX POWER terminal	Input power is supplied to this terminal when this power supply switch is turned on			300VA max.
Actions taken for abnormality	Overvoltage/Overcurrent protection	Protections from overvoltage and overcurrent of internal power supplies (5V, 24V)			PC stops automatically when an abnormal condition is detected.
	Internal temperature monitoring	None	Applied		

high speed addition/subraction counter card, and a decimal 5-digit calculation circuit is built in the card. The card is equipped with an integration display and setter on the front. It is also possible to connect an external integration display and setter.

Count inputs are directly input from the front face this card, coincided output of a set value and integrated value and integrated value zero output are output, and these values can be read on the CPU through the PC input/output bus. Further, with output instructions, various controls can be made.

Fig. 3 shows the appearance of the counter card.

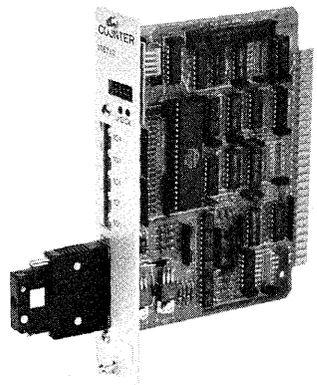

Fig. 3 Counter module of FUJILOG-μT

2. Function

Fig. 4 shows the functional block of the CPU/MEM module of this PC. A bus composition is employed in the unit, and DMA processings can be made from an external program loader and CPU interface by the bus controller. In response to a request from the outside, the bus controller releases the internal bus, and together with the interface circuit, the circuit configuration is well designed so that the access time from the outside is minimized.

To the internal bus, the control citcuit, program memory, data memory, ARG memory and input/output interface are connected, and signals are sent and received through the data bus in response to the address signal and control signal from the control circuit.

The control circuit sends address signals to the program memory by the program counter built in the citcuit, let the arithmetic operator read the data, and thus, generates control signlas to each unit required in executing the programs. The program counter is fixed at 2048 steps, and processing time is about 10 μs per step.

This PC has disgnostic functions such as parity check of signal at the execution processing and signal pattern detection. One program step execution basically consists of four steps as described below.

STEP 1: Reads instruction control codes (such as READ and AND) from the program memory, and stored

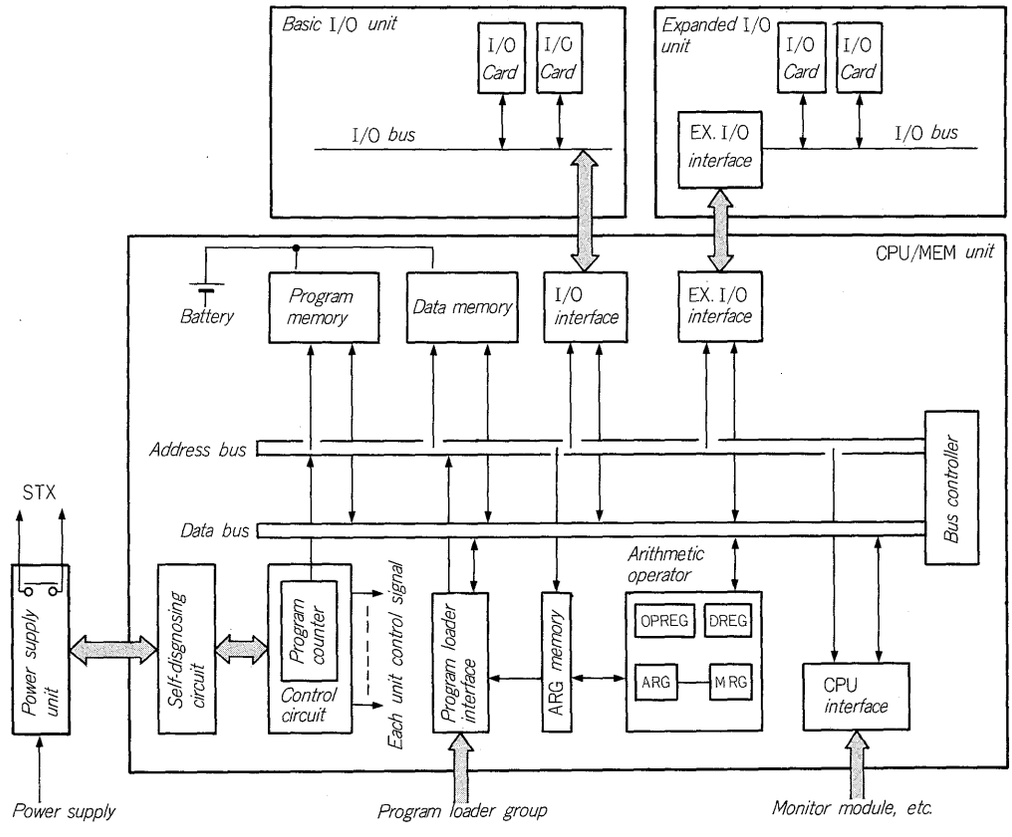

Fig. 4 Block diagram of FUJILOG-μT

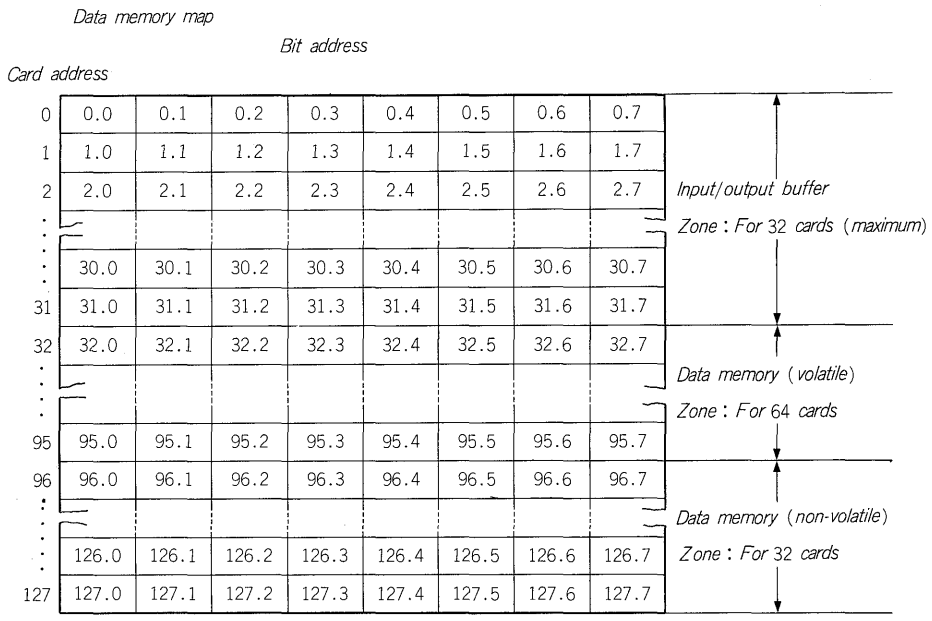

Fig. 5 Data memory map of FUJILOG-μT

them into the arithmetic operator.

STEP 2: Stores data of the data memory and input/output card designated by the insturction address unit into the arithmetic operator in the same manner as STEP 1.

STEP 3: Arithmetic operation is made within the arithmetic operator.

STEP 4: Stores the result of the arithmetic operations into the input/output card, data memory, ARG and ARG memory.

Next, the arithmetic operator receives and translates an instruction control code, and using bit logical arithmetic processings such as AND and OR, performs word processor functions such as timer, counter, shift register and step controller.

For the program memory, there are two types, namely, RAM and PROM. The RAM is backed up by CMOS IC and floating charge type NiCd battery. In addition, with this battery, the data memory is also non-volatilized.

IV. PROGRAMMING

The main instruction system of this PC is for a bit processed arithmetic operation maily around the sequence control, and it is of a subset of the instruction system of the higher class FUJILOG-μH. For the types, refer to *Table 9* for FUJILOG-μH reported under a separate cover. (Those sequence control instructions excluding*).

Fig. 5 shows the data memory configuration of this PC.

In the input/output buffer zone, those portions where input/output cards are not installed can be used as data memories.

Functions of the data memory can be defined freely with programs, and in the non-volatile zone, the data can be held with the battery even when the PC stops.

V. PROGRAMMING EXAMPLE

The programming of this PC is the same as that of FUJILOG-μH which uses sequence control instructions. For the examples, refer to *Fig. 10* for FUJILOG-μH under a separate cover.

VI. POSTSCRIPT

It is considered that the series of PC system having a high controllability have been completed to precisely cope with each control size and function. To be more specific, input/output scales from 48 to 256 points and DC power supply have been made available as a series of system. Further, high speed counting process realized by using counter dards, data memory hold at the time of power failure, various searching functions realized by coupling with program loaders, test function which forcedly turns on and off data memory signal status, etc. are added, enhancing the functions and improving controllability.

As the next step, it is expected that this PC will be utilized further for expanded applications by adding PC monitoring function realized by coupling it with an external device and by newly installing CPU interface and for communications with higher grade machines and equipment.