

# MICREX-F SERIES INPUT/OUTPUT INTERFACE

Yoshihiro Chiba  
Tadakatsu Aida  
Koji Koizumi  
Akihide Hamada  
Tohru Ito  
Naoji Ohigashi

## 1 FOREWORD

Together with advancement of FA and FMS, diversification and independent dispersion of communication function, numerical processing function and analog processing function for being able to apply for control dispersion and concentration of supervision with economicity of programmable controller (hereinafter abbreviated as PC) are required. Also, it will be necessary for PIO (process input/output) of PC to be able to cope with the requirement of diversification of functions and independent dispersion of controls with economicity.

For making PIO unit independent, there has been a system called RIO (remote input/output) since fairly long time ago, and it has come to contribute largely to dispersed installation of PIO units. In RIO system, PIO modules are synthesized for making its composition, so that the number of connectable RIO's is limited and it was difficult to install PIO units in dispersed form with efficiency. PIO modules of RIO are often identical to PIO modules connected to processor units by means of mother boards, and though compatibility of PIO modules within a determined type of equipment may be secured, in case various types of equipment are used, often was the case that the PIO's differ one from another depending on the type of processors.

In MICREX-F series (hereinafter called F series), an economic system composition adapted to the scale and function of control system can be made, and its main aim being able to cope flexibly with the future expansion of the control system, that is, this is the system developed aiming at dispersed independent installation.

F series PIO decreases the dependency to the types of processors, and aiming at the facility of future expansion, it is provided with a construction that can be coupled with processor units through F series network (F-Net). Furthermore, in order that an economic dispersed installation may be attained, the fundamental PIO's (16, 32 points) are available in two types, that is, one, a capsule type having power supply incorporated within the unit itself so that it can be mounted directly as it is, and another, unit type, that is, a combination of mounting of several PIO modules, so that division of PIO's corresponding to the scale of

input/output signals can be easily attained.

## 2 COMPOSITION

F series PIO's are available in two types, namely: PIO's connectable to all processors (FPK 100, FPK 105, FPU 100, FPK 200 and FPK 205) through F-Net T link (terminal link in PIO level) and PIO's of exclusive use for processors (for FPU 100).

Seen from the point of view of construction, there are two types available, that is, capsule type and unit type, and as Fig. 1 and Table 1 show, PIO's suitable for the scale of

Fig. 1 Composition of F series PIO

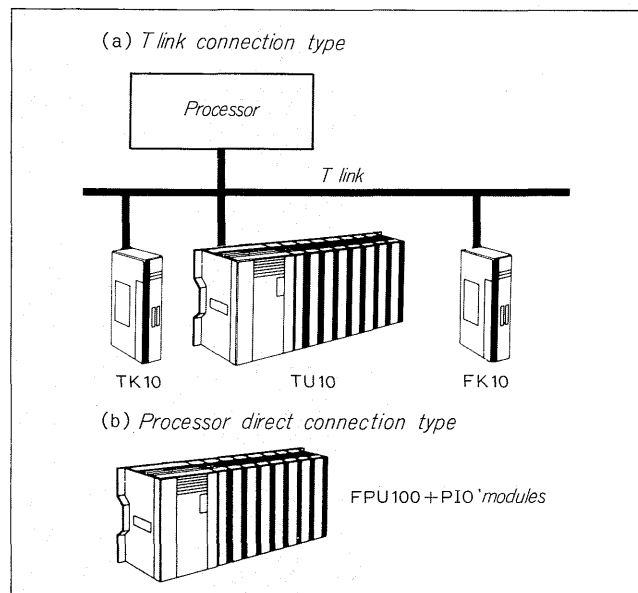


Table 1 Types of F series PIO's

Connecting type with processor	Construction		
	Capsule type	Unit type	Module type
T link connection	TK 10 FK 10	TU 10	—
Processor direct connection type	—	—	PIO module for FPU 100 unit

PIO dispersion, can be selected.

3 FEATURES

F series PIO can be installed dispersely independently one from another both functionally and structurally under the control of processor unit. The following are their features.

(1) Reduction of dependability on types of processors  
As T link connecting type PIO's can be connected to any processors having T-link connecting function, when the control system is expanded, expansion can be made only through changing the processor type, so that it can cope with further expansion and with replacing of certain types of equipment, flexibly and with economicity.

(2) Large-scale reduction in wiring cost for input/output signals

By combining the capsule type and unit type devices only, a large-width unit for PIO division can be obtained and installed suitably in the vicinity of input/output signals.

(3) Expansion of PIO function is easy

Functions particular to each control system, are assigned to function capsule (FK10) for processing.

(4) Abundant PIO types

Besides DIO (digital input/output), AIO (analog input/output) and high-speed counter are available as standard PIO, and they can be applied with ease to any controls including analog and simple positioning controls.

(5) Possibility of connection to program loaders

As the program loaders D10 and D20 are provided with T-link connection function, T link connecting type PIO can be connected to program loaders. Consequently remote programming and remote monitoring using D10 and D20 can easily be realized.

(6) Super thin type construction and unified dimensions

The dimensions of the capsule type are 97 mm (depth) × 250 mm (height) while those of unit type, 100 mm (depth) × 250 mm (height), being all, those of unified type. As it is of super thin type construction, space for mounting can be reduced in large scale.

(7) Construction with high maintainability

Terminal boards for input/output signals, power supplies, and T link connection are all in high-operability screw-in type terminal blocks (M3 and 5), and as they are of connector type removable terminal block, the maintenance of the machine body can be effectuated without need to disconnect wiring of the terminal block. Furthermore, since they are provided with wiring ducts and covers that permits wiring to both directions of up- and downward, restriction for mounting due to the machine shape is little.

(8) Uniformity of display and display color that make reading out easy.

For display lamps, green color is used for indicating input/output signal and power supply, red for heavy fault and orange, for light fault, in total of three colors, so that if red or orange colored display lamps are not turned on, the normal running of the machine can be known at a glance.

known at a glance.

Outlines and specifications of each PIO device are introduced in the following chapter.

4 TK 10: CAPSULE TYPE T LINK CONNECTING PIO

The device is provided with its own power supply in order that it can construct a completely independent PIO dispersion system from processors, and it is a PIO with inputs/outputs capsulized as the minimum units. Besides T link interface unit, a part of internal circuit is made LSI and HIC (hybrid IC), then number of parts is thoroughly reduced through concentration of display elements, housing all these parts in a compact and robust resine mould case of 97 mm in depth, it is PIO of self cooled type. (See Fig. 2.)

As the standard practice for input/output, in order that it may be applied for a wide range of applications, digital inputs and outputs (DI, DO), analog inputs and outputs (AI, AO) and high-speed counters (PRC) are provided.

DI and DO specifications are shown in Table 2, and inner composition, in Fig. 3.

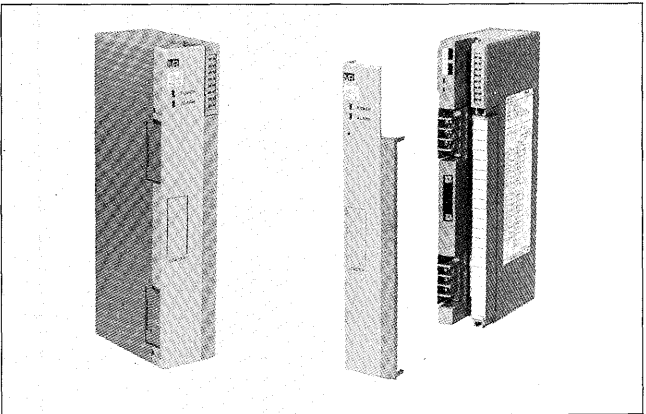
AI and AO capsules are intelligent PIO's having micro-processor incorporated. They have the following features:

(1) By microprocessors, A/D conversion control, data processing and filtering are made, and thus the degrees of precision and reliability are improved.

(2) Data are expressed in BCD 4 digits in decimal expression that can be handled easily in the application program.

(3) Inputs/outputs are made multiple up to 4 points/

Fig. 2 TK 10



N 89-4418-12/ N 89-4418-13

Table 2 DIO specification of TK 10 and TU 10

DI	DC 24V, 48V, 100/110V (Non polarity) AC 100/110V, 200/220V	16, 32 points/capsule module
DO	Transistor output (sink, source) DC 24/48V (Load current: 0.2A) DC 110V (Load current: 0.2A) DC 24/48V (Load current: 2A)	16 points/capsule module
	Relay contact output AC 220V 2A, DC 24V 2A (Resistance load), DC 110V 0.5A (Resistance load)	16 points/capsule module (8 points/common) 12 points/capsule module (2 points/common)

Fig. 3 Internal composition of TK 10

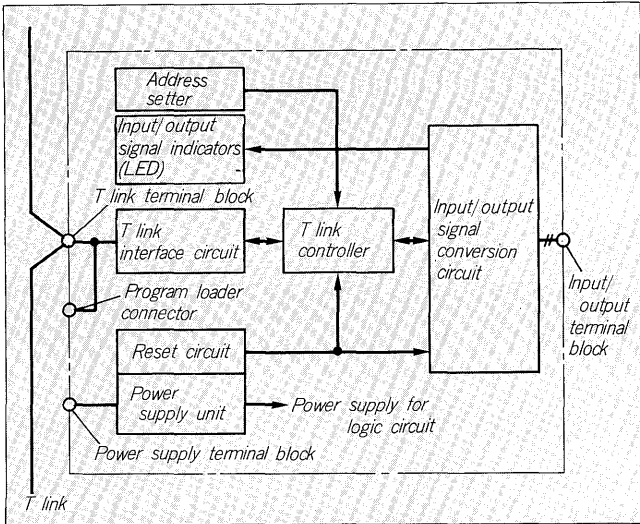


Table 3 Specifications of TK 10 AIO

Item	Signal level	No. of points	Insulation	Accuracy	Converting speed	Resolution
AI	0~20 mA, 4~20 mA	4	Photo-coupler (4 points common)	$\pm 0.25\%$ + LSD	30 ms/4 points	BCD 4 digits
	0~5 V, 1~5 V					
	0~10 V					
	-5~5 V					
	-10~10 V					
AO	0~20 mA, 4~20 mA	4	Photo-coupler (4 points common)	$\pm 0.25\%$ + LSD	4 ms/4 points	BCD 4 digits
	0~5 V, 1~5 V					
	0~10 V					
	-5~5 V					
	-10~10 V					

capsule.

Table 3 shows the specifications.

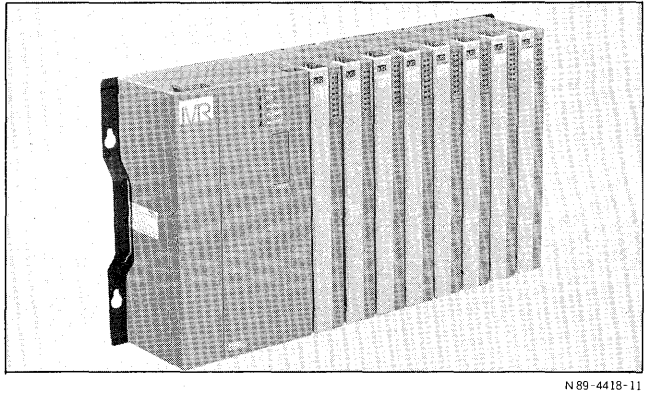
PRC is a high-speed counter that counts up output pulses of pulse encoder used for positioning control and flow rate measurement, and is of intelligent type having micro-processor incorporated and it has the following features:

- (1) High-speed signals of 50 kHz in three phases (A, B and Z) can be two-point inputted.
- (2) Controls as count start/stop can be effectuated "on line".
- (3) Data are expressed in decimal expression that is easy to handle for application program. (-32,768 ~ +32,767 or 0 ~ 65,535).

## 5 TU 10: UNIT TYPE T LINK CONNECTING PIO

As shown in Fig. 4, it is a PIO unit with building block type PIO modules mounted and with T link interface

Fig. 4 TU 10



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module incorporated. The PIO modules are identical with those for processor direct connecting type FUP 100, to which a total of 8 modules can be mounted. This is a space saving type PIO having depth of 100 mm: a type suitable for applying to the machines having input/output signals concentrated in one point.

## 6 FK10: FUNCTION CAPSULE FOR T LINK CONNECTION

This is a PIO that can cope with multiple needs with economy by assigning the fundamental function of control and computation to processor unit and special function required by each case, to function capsule. It can realize with efficiency expansions of PC functions as personal computer interface, positioning control, etc.

### 6.1 Personal computer interface capsule

The personal computer interface capsule is a function capsule supporting protocol in BSC procedures, being provided with RS-232-C interface.

As shown in the example of connection of Fig. 6, the unit serves for interfacing between personal computer and processor or between PIO's. This capsule, as it is of T-link connecting type, can be installed in the vicinity of a personal computer. Consequently, though the direct connection without using modems is possible, in case of a distance larger than that established in the standard RS-232-C, it is connected through modems.

The data transmission to and from personal computer is, as shown in Transmission Specification shown in Table 4, done by BSC contention procedure and it supports BSC procedure and JEMIS 025-1984 (Japan Electric Measurement Industry Standards) based on BSC procedures. The data can be transmitted to any personal computers as long as they support these procedures. Parameter setting in each procedure as supervisory timer and interval timer, can be made through initial setting by application program of the processor unit and only with this, all transmission will be possible.

Fig. 5 Inner structure of TU 10

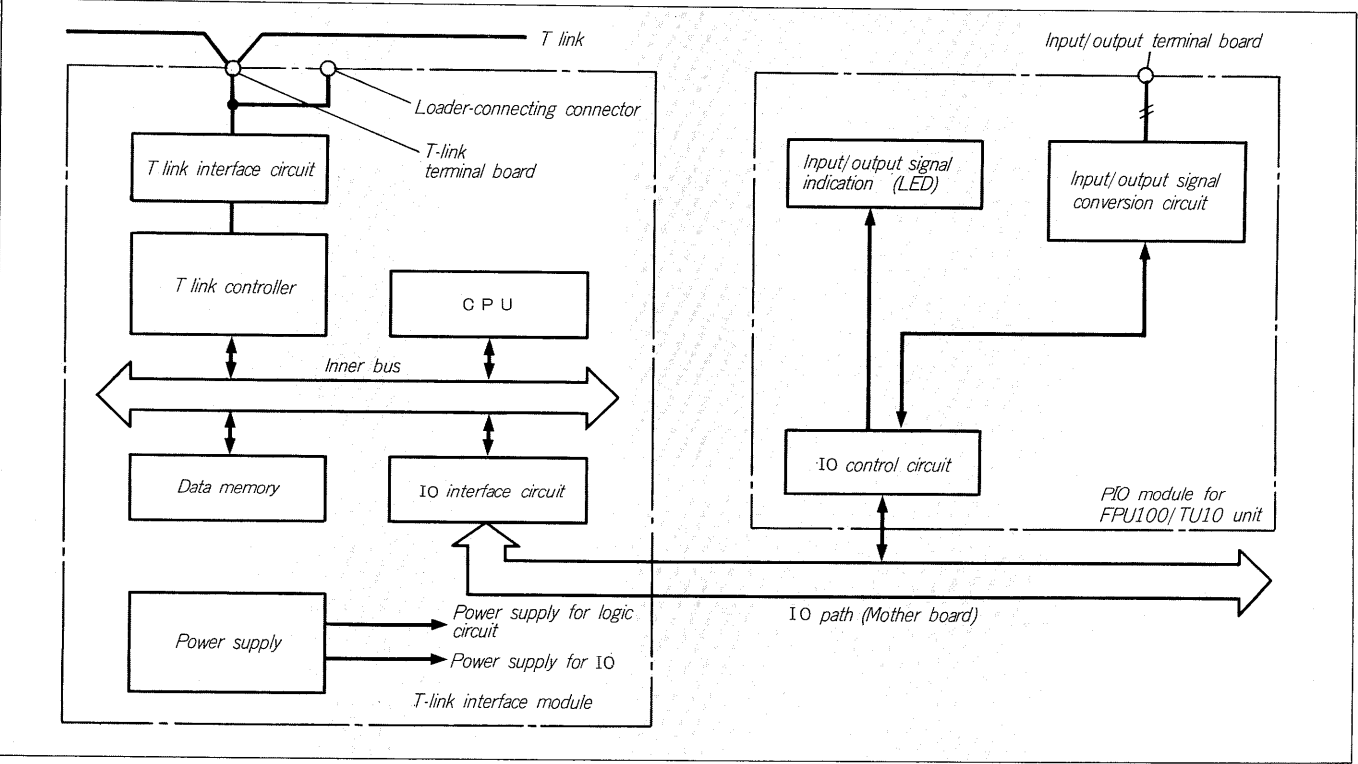
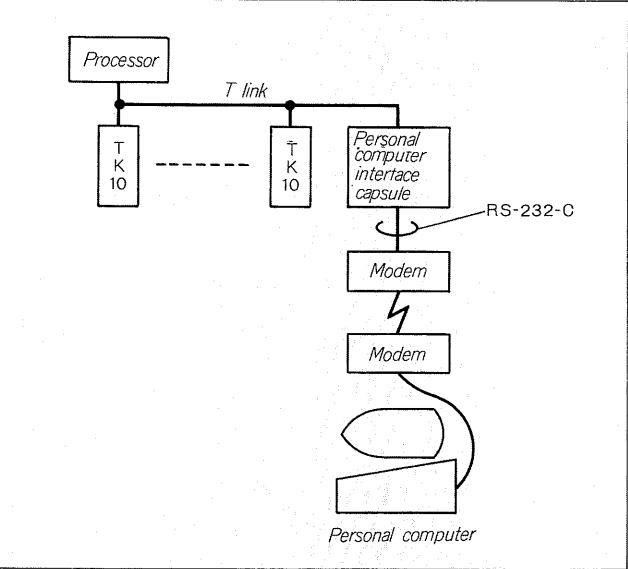


Fig. 6 Personal computer interface capsule – an example of connection



Controls on data exchange to and from personal computers can be made only with application program of the processor unit on transmitting relays and receiving relays mounted in the processor unit, without need to worry about the communication procedures.

6.2 Position control

The position control capsule is a function capsule that generates command pulses for positioning, and with this, as

Table 4 Transmission specification of personal computer interface capsule

Item	Specifications
Interface	RS-232-C
Applied circuit	Specific communication circuit (contention system)
Connecting system	Full duplex communication circuit (four wires) or Half duplex communication circuit (2 wires)
No. of channel	One channel
Communication system	Half duplex communication system
Synchronizing system	Independent synchronization system by SYNC (BSC)
Transmission speed	1,200, 2,400, 4,800, 9,600 (bits/sec.)
Hand shake system	Alternate response by ACK 0/ACK 1 and NAK
Transmission control code	EBCDIC 8 units
Transmission code system	EBCDIC or binary data
Error control	CRC 16 ... $G(X) = X^{16} + X^{15} + X^2 + 1$
Expansion transmitting function	Non transparent/transparent transmitting function provided.
Bit transmitting sequence	Transmitted from lower-order bits, except for CRC, in which case, bits are transmitted from higher-order coefficient bits.
Message length	Variable, single TEXT only

it has renear-line interpolation and arc interpolation functions, two-axis controls is possible.

It is interfaced with a positioning equipment using a pulse motor and/or servo motor, and with a processor or

Fig. 7 An example of connection and structure of a position control capsule

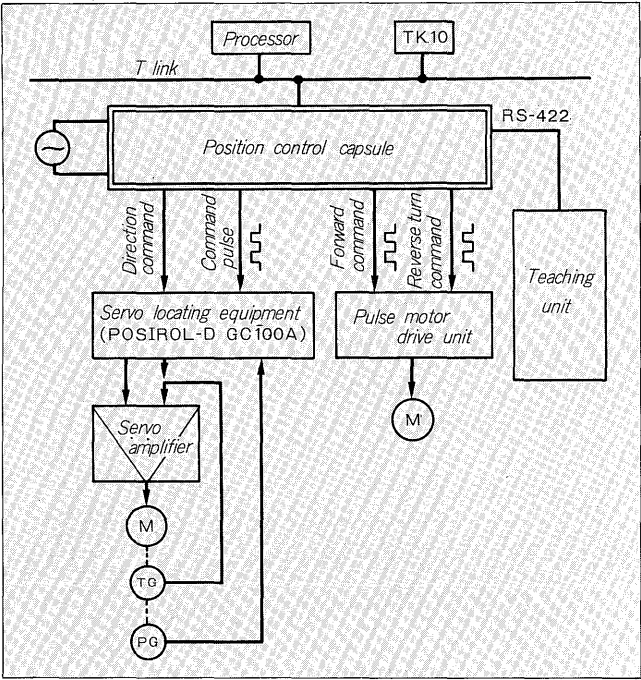


Table 5 Specifications for position control capsule

Item	Specifications
Controlled axis	2 axes
Maximum command	$\pm 8,388,607$ pulses
Command system	Incremental/absolute
Maximum speed	100 k pulse/sec.
Speed setting	Significant numeral 4 digits $F4 \times 100 \sim 0.00001\%$
Acceleration/deceleration characteristics	Index · linear (0.1 ~ 99.99 s 10 ms unit)
Interpolation function	Linear interpolation and arc interpolation
Data capacity	100 points (0~99)
Operating mode	Teaching unit Processor capsul
Setting data	Parameter: Linear accelerating/decelerating time Forward-turn stroke limiter (Soft OT) Reverse-turn stroke limiter (Soft OT) Maximum speed Backlash
	Original-point detection: Reset direction High-speed, low-speed Dwell timer, shift quantity
	Locating: Data No. Location data X, Y Speed, dwell timer, interpolation Incremental/absolute

between PIO's through T links. An example of connection and structure is shown in Fig. 7.

The positioning outputs are provided with two types of command outputs, that is: forward/reverse direction signals + command pulse, and another, forward-turn pulse + reverseturn pulse.

The operating modes of this capsule are two-fold: one that carries out the operation of positioning pattern in program from teaching unit. The start of positioning is carried out by command of the processor unit, and, as in case of DI and DO programs, set the positioning start bit of this capsule to ON with application program of the processor unit, then, carries out the positioning control by reading out positioning end signal ON. Another mode is that positioning pattern worked out by the application program of the processor unit is transferred to this capsule and the positioning start is carried out by the command of the processor unit as in the case of above-mentioned mode.

The input signals for positioning control as original point LS can be connected directly to this capsule, and,

also, they can be connected to the program loader.

7 SUMMARY

The field of application of PC's is believed to be expanding more and more as the central equipment for automatization and energy-saving of the control system. At the same time, the role that PIO plays will be more and more important, so that it is essential that their matching with various types of sensors, communication interface, freedom of installation place, power supply should be secured with high economicity.

We are intent on timely development of PIO's that can be applied for a wide range of application field, answering the demand of our users, also in the future.