FP93
Program Controller
COMMUNICATION INTERFACE
(RS-232C/RS-485)

INSTRUCTION MANUAL

Thank you for purchasing the Shimaden FP93 controller.
Please check that the delivered product is the correct item you ordered. Please do not begin operating this product until you have read this instruction manual thoroughly and you understand its contents.

This instruction manual describes the communication interface which is an optional function of the FP93 digital controller. For details of FP93 performance and parameters, please refer to the separate instruction manual.

CONTENTS

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1. Outline

There are two types of communication systems, RS-232C and RS-485 employable as the FP93 communication interface . Each of them is capable of setting various data for the FP93 and reading through a personal computer or the like, using signals which comply with EIA standards.

RS-232C and RS-485 are data communication standards established by the Electronic Industries Association of the U.S. (EIA). The standards cover electrical and mechanical aspects, that is, matters related to applicable hardware but not the data transmission procedure of software. Therefore, it is not possible to communicate unconditionally with an apparatus which has the same interface. Hence, users need to have sufficient knowledge of specifications and transmission procedure.

When RS-485 is used, two or more of FP93 controllers can be connected to one another. There seems to be a limited number of personal computers, etc., which support this interface, but the use of a line converter for RS-232C <---> RS-485 creates stability.

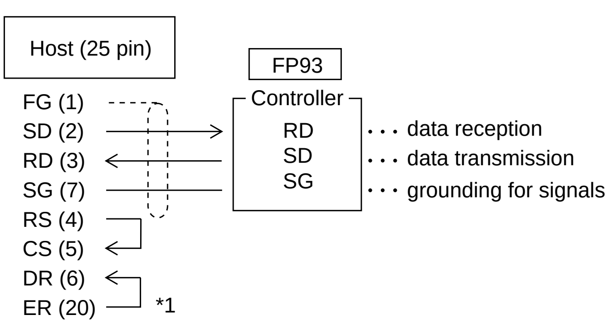
2. Specifications

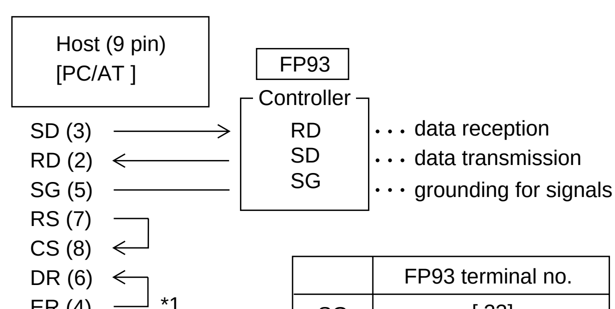
Signal level	:	Following EIA'S RS-232C and RS-485	
Communication system	:	RS-232C	3-line half duplex system
		RS-485	2-line half duplex multidrop (bus) system
Synchronization system	:	Half duplex	start-stop synchronization system
Communication distance	:	RS-232C	15 m maximum
		RS-485	maximum total of 500 m (differs depending on conditions.)
Communication rate	:	1200, 2400, 4800, 9600 and 19200bps	
Transmission procedure	:	No procedure	
Data format	:	Data 7 bits, even parity, stop 1 bit	
		Data 8 bits, no parity, stop 1 bit	
Communication code	:	ASCII codes	
Isolation	:	Insulated between communication signals and various inputs, system and various outputs	

3. Connecting controller with host computer

The FP93 controller is provided with only 3 lines for input and output, i.e., for data transmission, data reception and grounding for signals, not with any other signal lines. Since the controller has no control line, control signals should be taken care of on the host side.
In this instruction, an example of control signal processing methods is shown in drawings (portions surrounded by dotted lines). As the method depends on the system, however, you are advised to refer to the specifications of the host computer for details.

3-1. RS-232C





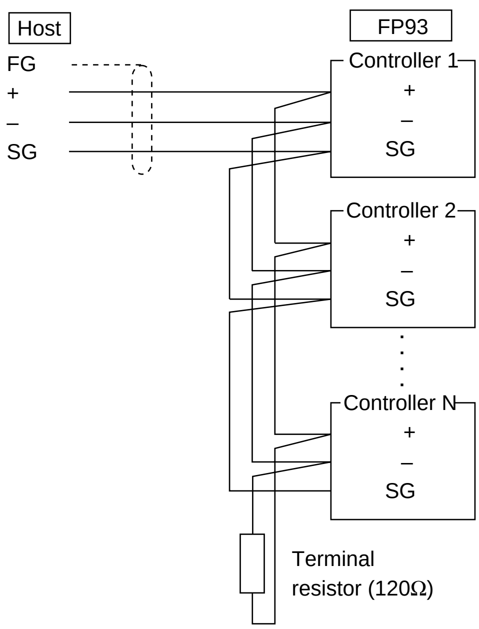
	FP93 terminal no.
SG	[23]
SD	[24]
RD	[25]

*1: Figures in ( ) represent pin numbers of connector.

3-2. RS-485

The input/output logical level of the FP93 controller is basically as follows:
In the mark state - terminal < + terminal
In the space state - terminal > + terminal

Until immediately before transmission, however, plus terminals and minus terminals of the controller have high impedance and outputs at the above levels are produced immediately before starting transmission. (See 3-3. 3-state output control.)

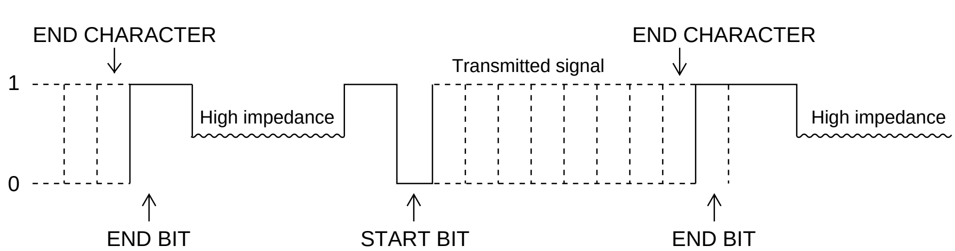


	FP93 terminal no.
SG	[23]
+	[24]
–	[25]

Note 1: In the case of RS-485, provide it with the attached terminal resistor of 1/2W, 120Ω across terminals + and if necessary. Nevertheless, it should be provided to only the last controller. If two or more controllers are provided with terminal resistors, correct operation cannot be guaranteed.

3-3. 3-state output control

Since RS-485 is of the multidrop system, transmission output has high impedance always while communication is not carried out or signals are being received in order to avoid collision between transmission signals. It changes from high impedance to the normal output condition immediately before transmission and returns to high impedance control simultaneously when transmission terminates. As the 3-state control is delayed by about 1 msec (maximum) from the completion of transmission of an end character end bit, however, a few microseconds' delay should be provided if the host side starts transmission immediately upon reception.

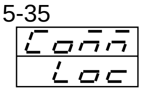


4. Setting of parameters related to communication

There are the following 8 communication-related parameters for the FP93 controller. These parameters are unable to be set or changed by communication; use front key for setting and changing. When parameters are set, see Item (17) of 5-10 of screen group 5 of the separate instruction manual for the controller and follow the described steps.

4-1. Setting communication mode

5-35



Initial value: Loc
Setting range: Com, Loc

Select communication mode. Front key operation allows only change from COM to LOC, though.

Mode	Effective command	COM lamp
Loc	Read	Unlighted
Com	Read, write	Lighted

4-2. Setting of communication address

5-36

Addr
1

Initial value: 1
Setting range: 1 ~ 255

While one FP93 controller is connected to one host computer in the case of 232C, RS-485 employs the multidrop system allowing it to be connected to a maximum of 32. Actually, however, communication has to be carried out bilaterally. Therefore, each instrument is assigned an address (machine No.) so that only the instrument with the designated address can answer.

Note 1: Although 1 to 255 addresses are available for setting, the number of connectable controllers is 31 maximum.

4-3. Setting Communication Speed

5-37

bPS
1200

Initial value: 1200
Setting range: 1200, 2400, 4800, 9600, 19200
A communication speed for transferring data to a host is selected.

4-4. Setting of communication data format

5-38

dAtA
7E1

Initial value: 7E1
Setting range: 2 types shown in the following table.

Select either one of the communication data formats shown below.

Mode	Data length	Parity	Stop bit
7E1	7 bit	EVEN	1 bit
8N1	8 bit	None	1 bit

4-5. Setting of start character

5-39

SchA
Stx

Initial value: STX
Setting range: STX, ATT

Setting a control code to be used.

Mode	Start character	Text end character	End character
STX	STX (02H)	ETX (03H)	CR (0DH)
ATT	"@" (40H)	" : " (3AH)	CR (0DH)

4-6. Communication BCC check setting screen

5-40

bcc
1

Initial value: 1
Setting range: 1 ~ 4

Select a BCC operation method to be used in BCC checking.

Mode	BCC operation
1	Addition
2	Addition +2's complement
3	XOR
4	None

4-7. Communication delay time

5-41

dELY
20

Initial value: 20
Setting range: 1 ~ 100

Set the length of delay time from receipt of a communication command to transmission.
Delay time (msec) = Set value (count) $\times$ 0.512 (msec)

Note 1: When RS-485 is used, some converters take longer time for 3-state control than others and it may lead to signal collision. This can be avoided by increasing delay time. Care should be taken particularly when the communication rate is slow (1200bps or 2400bps).

Note 2: Actual delay time from receipt of a communication command to transmission is a total of the above-mentioned delay time and command processing time by software. Particularly for writing commands, about 400 msec may be taken for processing.

4-8. Communication memory mode selecting screen

5-42

mEm
EEP

Initial value: EEP
Selectable range: EEP, Ram, r_E

Since the number of writing cycles of volatile memory EEPROM used in FP93 is limited, the life of EEPROM is shortened if SV data or the like are rewritten frequently by communication. To prevent this, in case data are to be rewritten frequently by communication, set the RAM mode in which only RAM data are rewritten without rewriting EEPROM, thereby maintaining the life of EEPROM as long as possible.

Mode	Description
EEP mode	In this mode EEPROM data are also rewritten every time data are changed by communication. Accordingly, data are maintained when power is turned off.
RAM mode	In this mode only RAM data are rewritten but EEPROM data are not when data are changed by communication. Therefore, RAM data are deleted when power is turned off. Upon applying power again, operation starts with data stored in EEPROM.
r_E mode	FIX SV, OUT, STEP SV and START SV data are written in RAM and others in EEPROM.

Note: On RAM as communication memory mode
When the RAM mode is selected, all of set data are written in RAM. It should be noted that nonconformity of set data arises from such a pattern as shown below:
On the assumption that 05 is set for the input range (K 0.0 ~ 800.0˚C):

1. Through communication, event code is changed from higher deviation value to higher absolute value. (This change is recorded in RAM.)
2. Communication mode is changed from COM to LOC.
3. The event action point setting is changed from 800.0 to 700.0 by key operation. (Since this is done in LOC mode, the changed data is written in EEPROM.)
4. Power supply is interrupted. Then power is applied again.
5. The event code recorded in RAM is cleared and higher deviation value is read from EEPROM.
6. Since 700.0 is written as event action point in EEPROM, 700.0 is read.
7. The setting range of higher deviation values are actually from -1999 to 2000 units but the above steps result in the setting of an impossible value of 7000 units.
   Such being the case, for proper control, you have to set correct data again.

5. Outline of standard serial communication protocols

In the FP93, the Shimaden standard serial communication protocol. This enables you to acquire and/or change data from instruments, which employ the standard serial protocol, by using the same format.

5-1. Communication procedure

(1) Master/slave relation
- The master side means personal computer or PLC (host).
- The slave side means the FP93 controller.
- A communication command from the master side starts communication and a response from the slave side terminates it. If abnormality such as a communication format error or a BCC error occurs, there will be no response. No response is sent, either, to broadcast instruction.

(2) Communication procedure
Communication goes on by transferring the transmission right to each other in the pattern that the slave side responds to the master side.

(3) Time-out
In case receipt of the end character does not complete within one second after receiving the start character, it is time-out and the controller is automatically put in the state of waiting for another command (a new start character). Accordingly, the host side should set one second minimum as the time-out duration.

5-2. Communication format

The FP93 allows for a variety of communication formats (start character, text end character, end character and BCC operating method) and communication data formats (data bit length, whether or not of parity, and stop bit length) for easy compliance with other protocols.
Nonetheless, the following serves as the basic format and you are encouraged to use them uniformly:
- Communication format
  Control code (start character, text end character, end charactor)→STX_ETX_CR
  Check sum (BCC operating method)→Add
- Communication data format (data bit length, whether or not of parity, stop bit length)→7E1

For setting a communication format and a communication data format, see "4. Setting of parameters related to communication."

(1) Outline of communication format
The communication format comprises the basic format portion I, the text portion and the basic format portion II.

1) Communication command format

Start character / Machine address / Sub-address — Command type / Starting address / The number of data / Data — Text end character / BCC data / End character (delimiter)

a	b		c	d	e				f	g	h	i		j
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫	⑬	⑭	⑮
STX	0	1	1	R	0	1	0	0	0	———	ETX	D	A	CR
STX	0	1	1	W	0	1	8	C	0	,****	ETX	E	7	CR

Basic format portion I (a–c) / Text portion (d–g) / Basic format portion II (h–j)

2) Response format

Start character / Machine address / Sub-address — Command type / Response code / Data — Text end character / BCC data / End character (delimiter)

a	b		c	d	e		g	h	i		j
①	②	③	④	⑤	⑥	⑦	⑪	⑫	⑬	⑭	⑮
STX	0	1	1	R	0	0	,****	ETX	3	C	CR
STX	0	1	1	W	0	0	———	ETX	4	E	CR

Basic format portion I (a–c) / Text portion (d–g) / Basic format portion II (h–j)

- The basic format portions I and II are common to read commands (R), write commands (W) and responses. Nonetheless, in BCC data of i(⑬ , ⑭) operation result data is inserted each time.
- The text portion differs depending on the types of commands, data addresses, responses, etc.

(2) Details of basic format portion I

a : Start character [① : 1 digit / STX(02H) or "@"(40H)]

- Indicates the start of communication bloc.
- Upon receipt of start character, it is judged as the first character of a new communication bloc.
- A start character and a text end character are selected in a pair.
  (See 4-4. Setting of start character.)
  Select with STX (02H) ---- ETX (03H), or select with "@"(40H) ---- " : "(3AH).

b : Machine address [②, ③ : 2 digits]

- Designates the instrument to communicate with.
- Address can be designated in a range from 1 to 255 (10 numerals).
- Binary 8 bit data (1 : 0000 0001 ~ 99 : 0110 0011) are split into high position 4 bits and low position 4 bits and converted to ASCII data.
  ② : ASCII data converted from the high position 4 bits.
  ③ : ASCII data converted from the low position 4 bits.
- Since the machine address=0 (30H, 30H) is used for broadcast instruction, it cannot be used as a machine address. As the FP93 controller does not support broadcast instruction, address=0 has no response.

c : Sub-address [④ : 1 digit]

- As the FP93 are single loop controllers, their sub-address is fixed to ④ = 1 (31H).
  Designation of any other address is taken as a sub-address error and there will be no response.

(3) Details of basic format portion II

h : Text end character [⑫ : 1 digit / ETX(03H) or " : " (3AH)]

- Indicates that the text portion terminates right before this character.

i : BCC data [⑬, ⑭ : 2 digits]

- BCC (Block Check Character) checks if there is any error in communication.
- There will be no response if BCC operation results in a BCC error.
- The following indicates the 4 types of BCC operation: (Type of BCC operation can be set on the front screen.)
  (1) Add
  Add operation is performed on every 1 character of ASCII data (1 byte) from the start character ① through the text end character ⑫ .
  (2) Add + 2' complement
  Add operation is performed on every 1 character of ASCII data (1 byte) from the start character ① through the text end character ⑫ , and two's complement of the low position 1 byte of the operation result is taken.
  (3) Exclusive OR
  XOR (exclusive OR) operation is performed on every 1 character of ASCII data (1 byte) from the machine address ② right after the start character through the text end character ⑫ .
  (4) None
  BCC operation is not performed. (⑬, ⑭ are omitted.)
- Regardless of the length of data bits (7 or 8), operation is carried out with 1 byte (8 bits) as a unit.
- The low position 1 byte data obtained as a result of the operations mentioned above is split into high position 4 bits and low position 4 bits and converted to ASCII codes.
  ⑬ : ASCII date converted from high position 4 bits.
  ⑭ : ASCII date converted from low position 4 bits.

Example 1: In the case of a read command (R) with Add set for BCC

①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑫	⑬	⑭	⑮	
STX	0	1	1	R	0	1	0	0	0	ETX	D	A	CR	
02H	+30H	+31H	+31H	+52H	+30H	+31H	+30H	+30H	+30H	+03H	= 1DAH			

Low position 1 byte of result of addition (1DAH)=DAH
⑬: "D"=44H, ⑭: "A" = 41H

Example 2: In the case of a read command (R) with Add + 2's complement set for BCC

①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑫	⑬	⑭	⑮	
STX	0	1	1	R	0	1	0	0	0	ETX	2	6	CR	
02H	+30H	+31H	+31H	+52H	+30H	+31H	+30H	+30H	+30H	+03H	= 1DAH			

Low position 1 byte of result of addition (1DAH)=DAH
Two's complement of low position 1 byte (DAH)=26H
⑬: "2"=32H, ⑭: "6"=36H

Example 3: In the case of a read command (R) with XOR set for BCC

①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑫	⑬	⑭	⑮	
STX	0	1	1	R	0	1	0	0	0	ETX	5	0	CR	
02H	30H	⊕31H	⊕31H	⊕52H	⊕30H	⊕31H	⊕30H	⊕30H	⊕30H	⊕03H	= 50H			

¥⊕ = XOR (exclusive OR).

Low position 1 byte of result of operation (50H)=50H
⑬: "5"=35H, ⑭: "0"=30H

j : End character (delimiter) [⑮: 1 digit/CR]
- Indicates that it is the end of communication message.

(4) Basic format portions I and II common condition

1. If abnormalities as listed below are found in the basic format portions, there will be no response:
   - There is a hardware error.
   - Machine address or sub-address is different from that of the designated instrument.
   - Any of the characters specified in the above communication format is not in its specified position.
   - The result of BCC operation differs from BCC data.
2. Conversion of data: Every 4 bits of binary data are converted to ASCII data.
3. <A> through <F> in hexadecimal numbers are converted to ASCII data by using capital letters.

(5) Outline of text portion

The text portion changes according to the types of commands and responses. For details of the text portion, see 5-3 Details of read commands (R) and 5-4. Details of write commands (W).

d : Type of commands [⑤ : 1 digit]
- "R" (52H/capital letter): Indicates that it is a read command or a response to read command. Used to read (take) various data of FP93 from personal computer, PLC, etc.
- "W" (57H/capital letter): Indicates that it is a write command or a response to write command. Used to write (change) various data in FP93 from personal computer, PLC, etc.
- There is no response when any other abnormal character besides "R" and "W" is recognized.

e : Starting address [⑥, ⑦, ⑧, ⑨ : 4 digits]
- For a read command (R) or a write command (W), designates a starting address of where to read from or write in.
- A starting address is designated by binary number 16 bit (1 word/0 ~ 65535) data.
- 16 bit data are split into 4 bit groups and converted to ASCII data.
- For data addresses, refer to 6. Details of communication data addresses.

f : The number of data [⑩: 1 digit]

Binary numbers (16 bits)	D15, D14, D13, D12 0 0 0 0	D11, D10, D9, D8 0 0 0 1	D7, D6, D5, D4 1 0 0 0	D3, D2, D1, D0 1 1 0 0
Hexadecimal numbers (Hex)	0H	1H	8H	CH
ASCII data	" 0 " 30H	" 1 " 31H	" 8 " 38H	" C " 43H
	⑥	⑦	⑧	⑨

- For a read command (R) or a write command (W), designates the number of data to be read or written.
- The number of data is designated in the following range by converting binary number 4 bit data to ASCII data:
  "0" (30H) (one) ~ "9" (39H) (ten)
- For write commands, the number is fixed to "0" (30H) (one).
- The actual number of data is <the number of data = designated numerical value of data + 1>.

g : Data [⑪ : The number of digits depends on the number of data.]
- Designates data to be written (data to be changed) for write command (W) or data to be read for response to a read command (R).
- The data format is as follows:

g (⑪)

","	First data				Second data				......	nth data			
2CH	High position 1st digit	2nd digit	3rd digit	Low position 4th digit	High position 1st digit	2nd digit	3rd digit	Low position 4th digit		High position 1st digit	2nd digit	3rd digit	Low position 4th digit

- Data is always preceded by comma ("," 2CH) to show the subsequent portion is data.
- No punctuation code is used between data and data.
- The number of data is determined by the number of data (f: ⑩) of the communication command format.
- Each data is expressed by binary 16 bits (1 word), excluding a decimal point, as a unit. The position of decimal point is fixed in each data.
- 16 bit data are split into 4 bit groups and respectively converted to ASCII data.
- For details of data, refer to 5-3. Details of read commands (R) and 5-4. Details of write command (W).

e : Response code [⑥, ⑦: 2 digits]

- Designates a response code to a read command (R) or a write command (W).
- Binary 8 bit data (0 ~ 255) are split to high position 4 bits and low position 4 bits and respectively converted to ASCII data.
  - ⑥: ASCII data converted from high position 4 bits.
  - ⑦: ASCII data converted from low position 4 bits.
- In the case of normal response, "0" (30H), "0" (30H) is designated.
- In the case of abnormal response, abnormal code No. is converted to ASCII data and designated.
- For details of response codes, refer to 5-5. Details of Response codes.

5-3. Details of read commands (R)

Read commands (R) are used by a personal computer, PLC or the like to read (take) various data in FP93.

(1) Read Command (R) format

- The format of the text portion of a read command (R) is shown below:

Text portion

d	e				f
⑤	⑥	⑦	⑧	⑨	⑩
R 52H	0 30H	4 34H	0 30H	0 30H	4 34H

d: Indicates that it is a read command.
e: Designates the starting address of data to be read.
f: Designates how many data (words) are to be read from the starting address.

(The basic format portions I and II are common to all commands and responses.)

- The above command means the following:

Starting address of data to be read	=	0400H	(hexadecimal)
	=	0000 0100 0000 0000	(binary)
The number of data to be read	=	4H	(hexadecimal)
	=	0100	(binary)
	=	4	(decimal)
(The actual number of data)	=	5 (4 + 1)	

Thus, the command designates reading of 5 data from the data address 0400H.

(2) Normal response format to read command (R)

- The following is the normal response format (text portion) to read commands (R):

Text portion

d ⑤	e ⑥	⑦	g ⑪	first data				second data				......	5th data			
R 52H	0 30H	0 30H	, 2CH	0 30H	0 30H	1 31H	E 45H	0 30H	0 30H	7 37H	8 38H		0 30H	0 30H	0 30H	3 33H

(The basic format portions I and II are common to all commands and responses.)

- d(⑤): <R (52H)> indicates that it is a response to a read command (R) is inserted.
- e(⑥, ⑦): The response code <0 0 (30H, 30H)> indicates that it is a normal response to the read command (R) is inserted.
- g(⑪): Response data to the read command is inserted.
  The data format is as follows:
  1. To begin with, <, (2CH)> indicates the head of data is inserted.
  2. Then, data in the number according to <the number of data to be read> are inserted one by one, starting from the <data of starting address for reading>.
  3. Nothing is inserted between the respective data.

4. The respective data comprise binary 16 bits (1 word) data, excluding a decimal point, and are converted, 4 bits as a unit, to ASCII data and inserted.
5. The position of decimal point is fixed in the respective data.
6. The number of characters of response data is as follows:
   Number of characters=1 + 4× number of data to be read

- To the above read command (R), the following data are returned as a response:

Read starting address (0400H) →

The number of data to be read (4H: 5)

	Data address 16 bits (1 word)	Data 16 bits (1 word)	
	Hexadecimal	Hexadecimal	decimal
0	0400	001E	30
1	0401	0078	120
2	0402	001E	30
3	0403	0000	0
4	0404	0003	3

(3) Abnormal response format to read command (R)

- The following is the abnormal response format (text portion) to read commands (R):
  (The basic format portions I and II are common to all commands and responses.)

Text Portion

d	e	
⑤	⑥	⑦
R 52H	0 30H	7 37H

- d(⑤): <R (52H)> indicates that it is a response to a read command (R) is inserted.
- e(⑥, ⑦): A response code indicates that it is an abnormal response to the read command (R) is inserted.
- For details of abnormal response code, refer to 5-5. Details of response codes.
- No response data are inserted in an abnormal response.

5-4. Details of write commands (W)

A write command is used by a personal computer, PLC, etc. to write (change) various data in FP93.

To use a write command, the COM mode has to be selected on the 4-1 Communication mode selecting screen. As this parameter is unable to be changed from LOC to COM by front key operation, however, the change should be made by the following command transmission: (In the case of address=01, sub-address=1, start character=STX and BBC operation=addition)

Command format

STX	0	1	1	W	0	1	8	C	0	,	0	0	0	1	ETX	E	7	CR
02H	30H	31H	31H	57H	30H	31H	38H	43H	30H	2CH	30H	30H	30H	31H	03H	45H	37H	0DH

Once the above command is transmitted and a normal response is returned, the COM LED lamp on the front panel lights and mode is changed to communication.

(1) Write command (W) format

- The following is the text format of a write command.
  (The basic format portions I and II are common to all commands and responses.)

Text Portion

d	e				f	g				
⑤	⑥	⑦	⑧	⑨	⑩	⑪				
							Data to be written			
W 57H	0 30H	4 34H	0 30H	0 30H	0 30H	, 2CH	0 30H	0 30H	2 32H	8 38H

- d: Indicates that it is a write command. It is fixed to "W" (57H).
- e: Designates starting address of data to be written (changed).
- f: Designates the number of data to be written (changed).
- g: Designates data to be written (changed).
  1. To begin with, <, (2CH)> indicating the head of data is inserted.
  2. Then, data to be written (changed) are inserted.

3. The respective data comprise binary 16 bits (1 word) data, excluding a decimal point, and are converted, 4 bits as a unit, to ASCII data and inserted.
4. The position of decimal point is fixed in the respective data.

- The above command means the following:

Starting address of data to be written	= 0400H	(hexadecimal)
	= 0000 0100 0000 0000	(binary)
The number of data to be written	= 0H	(hexadecimal)
	= 0000	(binary)
	= 0	(decimal)
(The actual number of data)	= one (0+1)	
Data to be written	= 0028H	(hexadecimal)
	= 0000 0000 0010 1000	(binary)
	= 40	(decimal)

Thus, writing (changing) of data address 0400H and one piece of data (40: decimal) is designated.

Address (400H) ⟶ 0
The number of data to be written: one (0H)

Data address 16 bits (1 word)		Data 16 bits (1 word)	
Hexadecimal	Decimal	Hexadecimal	Decimal
0400	1024	0028	40
0401	1025	0078	120
0402	1026	001E	30

(2) Normal response format to write command (W)
- The following is the normal response format (text portion) to a write command (W).
(The basic format portions I and II are common to all commands and responses.)

text portion

d	e	
⑤	⑥	⑦
W 57H	0 30H	0 30H

- d(⑤): <W (57H)> indicates that it is a response to a write command (W) is inserted.
- e(⑥, ⑦): A response code < 00 (30H, 30H)> indicates that it is a normal response to the write command (W) is inserted.

(3) Abnormal response format to write command (W)
- The following is the abnormal response format (text portion) to a write command (W).
(The basic format portions I and II are common to all commands and responses.)

text portion

d	e	
⑤	⑥	⑦
W 57H	0 30H	9 39H

- d(⑤): <W (57H)> indicates that it is a response to a write command (W) is inserted.
- e(⑥, ⑦): A response code indicates that it is an abnormal response to the write command (W) is inserted.
- For details of abnormal codes, refer to 5-5 Details of response codes.

5-5. Details of response codes

(1) Types of response codes
- Communication responses to read commands (R) and write commands (W) always contain response codes.
- Response codes are divided broadly into two types:

$$\text{Response codes} \begin{cases} \text{Normal response codes} \\ \text{Abnormal response codes} \end{cases}$$

- A response code comprises 8 bits data of binary numbers (0 ~ 255).
- The types of response codes are listed below:

A List of Response Codes

Response code		Type of code	Description
Binary numbers	ASCII		
0000 0000	"0", "0" : 30H, 30H	Normal response	Normal response to read command (R) or write command (W)
0000 0001	"0", "1" : 30H, 31H	Hardware error in text portion	When a hardware error such as framing overrun or parity error has been detected in data in the text portion.
0000 0111	"0", "7" : 30H, 37H	Format error of text portion	Format of text portion is different from what was fixed.
0000 1000	"0", "8" : 30H, 38H	Error in data of text portion, data address or the number of data	Data of text portion is not in fixed format, or data address or the number of data is different from designated one.
0000 1001	"0", "9" : 30H, 39H	Data error	Data to be written get beyond range in which setting is possible.
0000 1010	"0", "A" : 30H, 41H	Execution command error	Execution command (such as AT command) was received in conditions where that execution command is not acceptable.
0000 1011	"0", "B" : 30H, 42H	Write mode error	Some types of data are unable to be changed at certain points in time. Write command containing such data was received at such a time.
0000 1100	"0", "C" : 30H, 43H	Specification or option error	Write command containing data of specification or option which was not added was received.

(2) Priority order of response codes
The smaller the value of response code, the higher the priority of the response code; When two or more response codes are generated, a response code of higher priority order is returned.

5-6. Details of communication data addresses

(1) Data address and read/write
- In a data address, binary numbers (16 bit data) are expressed by hexadecimal numbers, with 4 bits as a unit.
- R/W means that data are capable of being read and written.
- R means that data are only for reading.
- W means that data are only for writing.
- In case a data address only for writing is designated by a read command (R), or a data address only for reading is designated by a write command (W), it results in a data address error and the abnormal response code "0", "8" (30H, 38H) "error in data format, data address or the number of data in text portion" is returned.

(2) Data address and the number of data
- If a data address which is not included in the data addresses for FP93 is designated as the front data address, it results in a data address error, and the abnormal response code "0", "8" (30H, 38H) "error in data format, data address or the number of data in text portion" is returned.
- Even when a front data address is included in the data address list, the data address added with the number of data gets out of the data address list, it results in an error of the number of data, and abnormal response code "0", "8" (30H, 38H) " is returned.

(3) Data
- Since data comprise binary numbers (16 bit data) without a decimal point, the form of data, whether there is a decimal point or not, etc., have to be confirmed. (See the instruction manual of the instrument itself.)

  Example: How to express data with decimal point

				Hexadecimal data
20.0%	→	200	→	00C8
99.99	→	9999	→	270F
–40.00˚C	→	–4000	→	F060

- In data of which the unit is UNIT, the position of decimal point depends on the measuring range.
- In other data than the above, binary numbers with code (16 bit data: -32768 ~ 32767) are used.

Example) How to express 16 bit data

Data with code		Data without code	
Decimal	Hexadecimal	Decimal	Hexadecimal
0	0000	0	0000
1	0001	1	0001
≀	≀	≀	≀
32767	7FFF	32767	7FFF
-32768	8000	32768	8000
-32767	8001	32769	8001
≀	≀	≀	≀
-2	FFFE	65534	FFFE
-1	FFFF	65535	FFFF

(4) <Spare> of parameter portion
- When a <spare> portion is read by a read command (R), 0000H data is returned.
- When data is written in a <spare> portion by a write command (W), ordinary response code "0", "0" (30H, 30H) is returned but no change of data is carried out.

(5) Option-related parameters
- When the data address of a parameter which is not added as an option is designated, abnormal response code "0", "C" (30H, 43H)"Specification, option error" is returned to a read command (R) as well as a write command (W). If an address of data only for reading is read, however, the (0000H) data are returned.

(6) Parameters not shown in front panel displays owing to action specifications or setting specifications
- Even parameters which are not shown (used) on the front panel displays owing to action specifications or setting specifications are possible to be read and written in communication.

6. Communication data address list

Data address (hex)	Parameter	Setting range		R/W
0040		Series code 1	Unless four series codes from 0x0040 are read at a time, an error code (08) will be returned.	R
0041		Series code 2		R
0042		Series code 3		R
0043		Series code 4		R

- The address listed above is product ID data area and data are ASCII data, 8 bids as a unit.
  Therefore, one address represents two data.
- A series code is expressed by 8 data maximum and a surplus area is filled with 00H data.

Example 1) FP93

Address	H	L	H	L
0040	"F"	"P"	46H	50H
0041	"9"	"3"	39H	33H
0042			00H	00H
0043			00H	00H

0100	PV_W	Measured value	R
0101	SV_W	SV value in execution	R
0102	OUT1_W	Control output value	R
0103	Spare	Fixed to 0000H	R
0104	EXE_FLG	Action flag (bit without action = 0)	R
0105	EV_FLG	Event, DO output flag (without option = 0000H)	R
0106	Spare	Fixed to 0000H	R
0107	EXE_PID	PID No. in execution	R

- Details of EXE_FLG and EV_FLG are as follows:

	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
EXE_FLG :	0	0	0	0	0	0	0	COM	0	0	0	0	0	0	MAN	AT
EV_FLG :	0	0	0	0	0	0	0	0	0	0	0	0	0	0	EV2	EV1

- Higher limit side = 7FFFH
- Lower limit side = 8000H

Data address (hex)	Parameter	Setting range	R/W
010B	DI_FLG	DI input state flag	R

• DI_FLG Details are shown below.

		D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
DI_FLG	:	0	0	0	0	0	0	0	0	0	0	0	0	D14	D13	D12	D11

0110	UNIT	Unit of input 0:"˚C" 1:"˚F"	R
0111	RANGE	7-1 See the Table of Measuring Range Codes.	R
0112	Spare	Spare	R
0113	DP	0: None 1: 0.1 2: 0.01 3: 0.001	R
0114	SC_L	-1999 ~ 9989 units	R
0115	SC_H	-1989 ~ 9999 units	R

0120	E_PRG	Program action flag	R
0121	E_PTN	Pattern No. in execution	R
0122	Spare	Spare	R
0123	E_RPT	The number of patterns executed	R
0124	E_STP	Step number in execution	R
0125	E_TIM	Remaining time of step in execution	R
0126	E_PID	PID No. in execution	R

• E_PRG Details are shown below.

		D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
E_PRG	:	PRG	0	0	0	0	UP	LVL	DW	0	0	0	0	0	GUA	HLD	RUN

PRG	1: PRG,	0: FIX	GUA	1: GUA,	0: NOT GUA
UP	1: UP,	0: NOT UP	HLD	1: HLD,	0: NOT HLD
LVL	1: LVL,	0: NOT LVL	RUN	1: RUN,	0: NOT RUN
DW	1: DW,	0: NOT DW			

• When program is reset (RST), execution data turns to 7FFEH.

0182	OUT1_W	Control output set value in manual operation	W
0183	Spare	Spare	W
0184	AT	0=Not in execution, 1=In execution	W
0185	MAN	0=AUTO, 1=MAN	W

018C	COM	0=LOC, 1=COM	W

0190	RST	0=RST, 1=RUN	W
0191	HLD	0=Release of HLD, 1=HLD	W
0192	ADV	0=No execution, 1=ADV	W

0300	SV1	FIX SV value	W

Data address (hex)	Parameter	Setting range	R/W
030A	SV_L	Set value limiter on lower limit side	R/W
030B	SV_H	Set value limiter on higher limit side	R/W
0400	PB1	Control output Proportional band 1	R/W
0401	IT1	Control output Integral time 1	R/W
0402	DT1	Control output Derivative time 1	R/W
0403	MR1	Manual reset	R/W
0404	DF1	Hysteresis	R/W
0405	011_L	Control output Lower limit output limiter 1	R/W
0406	011_H	Control output Higher limit output limiter 1	R/W
0407	SF1	Control output Target value function 1	R/W
0408	PB2	Control output Proportional band 2	R/W
0409	IT2	Control output Integral time 2	R/W
040A	DT2	Control output Derivative time 2	R/W
040B	MR2	Manual reset 2	R/W
040C	DF2	Control output Hysteresis 2	R/W
040D	012_L	Control output Lower limit output limiter 2	R/W
040E	012_H	Control output Higher limit output limiter 2	R/W
040F	SF2	Control output Target value function 2	R/W
0410	PB3	Control output Proportional band 3	R/W
0411	IT3	Control output Integral time 3	R/W
0412	DT3	Control output Derivative time 3	R/W
0413	MR3	Manual reset 3	R/W
0414	DF3	Control output Hysteresis 3	R/W
0415	DI3_L	Control output Lower limit output limiter 3	R/W
0416	013_H	Control output Higher limit output limiter 3	R/W
0417	SF3	Control output Target value function 3	R/W
0418	PB4	Control output Proportional band 4	R/W
0419	IT4	Control output Integral time 4	R/W
041A	DT4	Control output Derivative time 4	R/W
041B	MR4	Manual reset 4	R/W
041C	DF4	Control output Hysteresis 4	R/W
041D	014_L	Control output Lower limit output limiter 4	R/W
041E	014_H	Control output Higher limit output limiter 4	R/W
041F	SF4	Control output Target value function 4	R/W
0420	PB5	Control output Proportional band 5	R/W
0421	IT5	Control output Integral time 5	R/W
0422	DT5	Control output Derivative time 5	R/W
0423	MR5	Manual reset 5	R/W
0424	DF5	Control output Hysteresis 5	R/W
0425	015_L	Control output Lower limit output limiter 5	R/W
0426	015_H	Control output Higher limit output limiter 5	R/W
0427	SF5	Control output Target value function 5	R/W
0428	PB6	Control output Proportional band 6	R/W
0429	IT6	Control output Integral time 6	R/W
042A	DT6	Control output Derivative time 6	R/W
042B	MR6	Manual reset 6	R/W
042C	DF6	Control output Hysteresis 6	R/W
042D	016_L	Control output Lower limit output limiter 6	R/W
042E	016_H	Control output Higher limit output limiter 6	R/W
042F	SF6	Control output Target value function 6	R/W

Data address (hex)	Parameter	Setting range	R/W
04C0	ZSP1	Zone 1 SP	R/W
04C1	ZSP2	Zone 2 SP	R/W
04C2	ZSP3	Zone 3 SP	R/W

04CA	ZHYS	Zone Hysteresis	R/W
04CB	ZPID	Zone PID (0:OFF, 1:ON)	R/W

0500	EV1_MD	Event 1 mode See 7-2 Table of Event/DO Types. (option)	R/W
0501	EV1_SP	Event 1 set value of FIX See 7-2 Table of Event/DO types. (option) Even when event mode is oFF, So or Hb, it is possible to change set data through communication but it is initialized when the event mode is changed. (A range allowing writing is –1999 ~ 9999.)	R/W
0502	EV1_DF	Event 1 Hysteresis (option)	R/W
0503	EV1_STB	Event 1 stand-by actions (option) 1: Alarm action without stand-by 2: Alarm action with stand-by (when power is plied) 3: Alarm action with stand-by (when power is applied and when SV is changed) 4: Control action without stand-by	R/W

0508	EV2_MD	Event 2 mode See 7-2 Table of Event/DO Types. (option)	R/W
0509	EV2_SP	Event 2 set value See 7-2 Table of Event/DO Types. (option) Even when event mode is oFF, So or Hb, it is possible to change set data through communication but it is initialized when the event mode is changed. (A range allowing writing is –1999 ~ 9999.)	R/W
050A	EV2_DF	Event 2 hysteresis (option)	R/W
050B	EV2_STB	Event 2 standby actions (option) 1: Alarm action without standby 2: Alarm action with standby (upon applying power) 3: Alarm action with standby (upon applying power and changing SV) 4: Control action without standby	R/W

0510	EV3_MD	Event 3 mode See 7-2 Table of Event/DO Types. (option)	R/W
0511	EV3_SP	Event 3 set value See 7-2 Table of Event/DO Types. (option) Even when event mode is oFF, So or Hb, it is possible to change set data through communication but it is initialized when the event mode is changed. (A range allowing writing is –1999 ~ 9999.)	R/W
0512	EV3_DF	Event 3 Hysteresis (option)	R/W
0513	EV3_STB	Event 3 standby actions (option) 1: Alarm action without standby 2: Alarm action with standby (upon applying power) 3: Alarm action with standby (upon applying power and changing SV) 4: Control action without standby	R/W

0518	DO1_MD	DO1 mode See 7-2 Table of Event/DO Types. (option)	R/W

0520	DO2_MD	DO2 mode See 7-2 Table of Event/DO Types. (option)	R/W

0528	DO3_MD	DO3 mode See 7-2 Table of Event/DO Types. (option)	R/W

0530	DO4_MD	DO4 mode See 7-2 Table of Event/DO Types. (option)	R/W

0581	DI2	DI2 See 7-3 Table of DI Types.	R/W
0582	DI3	DI3 See 7-3 Table of DI Types.	R/W
0583	DI4	DI4 See 7-3 Table of DI Types.	R/W

Data address (hex)	Parameter	Setting range	R/W
05A0	AO1_MD	Analog output mode 0=PV, 1=SV, 2=OUT (option)	R/W
05A1	AO1_L	Analog output scale lower limit value (option)	R/W
05A2	AO1_H	Analog output scale higher limit value (option)	R/W

05B0	COM_MEM	Communication memory mode 0=EEP, 1=RAM, 2=r_E (option)	R/W

0600	ACTMD	Output characteristic 0=RA , 1=DA	R/W
0601	01_CYC	Control output Proportional cycle	R/W

0611	KLOCK	Keylock 0=OFF, Release of keylock 1= Keylock of screen groups 3, 4 and 5 (except communication mode and special keys on communication speed screen) 2= Keylock of screen groups 1, 2, 3, 4 and 5 (except communication mode and special keys on communication speed screen) 3= Keylock of all screens except RUN/RST on basic screen, communication mode and special keys on communication speed screen.	R/W

0701	PV_B	PV bias	R/W
0702	PV_F	PV filter	R/W

0800	PRG_MD	Program mode (0: PRG, 1: FIX)	R/W
0801	Spare	Spare	R/W
0802	ST_PTN	Start pattern No.	R/W

0818	PTN_MOD	Pattern No.	R/W
0819	TIM_MOD	Time mode (0: hour/minute, 1: minute/second)	R/W
081A	SHT_MOD	Instantaneous stop mode	R/W
081B	SCO_MOD	Input abnormality mode (0: HLD, 1: RUN, 2: RST)	R/W

0820	FIX PIDNo.	FIX PID No.	R/W

0882	P01 STP	Pattern No. 01 The number of steps	R/W
0883	P01 RPT	Pattern No. 01 The number of pattern executions	R/W
0884	P01 ST_SV	Pattern No. 01 Start SV value	R/W
0885	P01 GUA_Z	Pattern No. 01 Guarantee zone	R/W
0886	Spare	Spare	R/W
0887	P01 PV_ST	Pattern No. 01 PV start	R/W
0888	Spare	Spare	R/W
0889	P01EV1	Pattern No. 01 EV 1 Level value	R/W
088A	P01EV2	Pattern No. 01 EV 2 Level value	R/W
088B	P01EV3	Pattern No. 01 EV 3 Level value	R/W

088E	P01 TS1STP	Pattern No. 01 Time signal 1 ON/OFF STP No.	R/W
088F	P01 TS1_ON	Pattern No. 01 Time signal 1 ON TIME	R/W
0890	P01 TS1_OFF	Pattern No. 01 Time signal 1 OFF TIME	R/W
0891	P01 TS2STP	Pattern No. 01 Time signal 2 ON/OFF STP No.	R/W
0892	P01 TS2_ON	Pattern No. 01 Time signal 2 ON TIME	R/W
0893	P01 TS2_OFF	Pattern No. 01 Time signal 2 OFF TIME	R/W

• TS1TSP and TS2STP Details are shown below.

D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
←------ ON STP NO ------→								←------ OFF STP NO ------→							

Data address (hex)	Parameter	Setting range	R/W
08A0	P01 S01_SV	Pattern No. 01 Step No. 01 SV value	R/W
08A1	P01 S01_TM	Pattern No. 01 Step No. 01 Step time	R/W
08A2	P01 S01_PE	Pattern No. 01 Step No. 01 PID No.	R/W
08A3	Spare	Spare	R/W
08A4	P01 S02_SV	Pattern No. 01 Step No. 02 SV value	R/W
08A5	P01 S02_TM	Pattern No. 01 Step No. 02 Step time	R/W
08A6	P01 S02_PE	Pattern No. 01 Step No. 02 PID No.	R/W
08A7	Spare	Spare	R/W
08A8	P01 S03_SV	Pattern No. 01 Step No. 03 SV value	R/W
08A9	P01 S03_TM	Pattern No. 01 Step No. 03 Step time	R/W
08AA	P01 S03_PE	Pattern No. 01 Step No. 03 PID No.	R/W
08AB	Spare	Spare	R/W
08AC	P01 S04_SV	Pattern No. 01 Step No. 04 SV value	R/W
08AD	P01 S04_TM	Pattern No. 01 Step No. 04 Step time	R/W
08AE	P01 S04_PE	Pattern No. 01 Step No. 04 PID No.	R/W
08AF	Spare	Spare	R/W
08B0	P01 S05_SV	Pattern No. 01 Step No. 05 SV value	R/W
08B1	P01 S05_TM	Pattern No. 01 Step No. 05 Step time	R/W
08B2	P01 S05_PE	Pattern No. 01 Step No. 05 PID No.	R/W
08B3	Spare	Spare	R/W
08B4	P01 S06_SV	Pattern No. 01 Step No. 06 SV value	R/W
08B5	P01 S06_TM	Pattern No. 01 Step No. 06 Step time	R/W
08B6	P01 S06_PE	Pattern No. 01 Step No. 06 PID No.	R/W
08B7	Spare	Spare	R/W
08B8	P01 S07_SV	Pattern No. 01 Step No. 07 SV value	R/W
08B9	P01 S07_TM	Pattern No. 01 Step No. 07 Step time	R/W
08BA	P01 S07_PE	Pattern No. 01 Step No. 07 PID No.	R/W
08BB	Spare	Spare	R/W
08BC	P01 S08_SV	Pattern No. 01 Step No. 08 SV value	R/W
08BD	P01 S08_TM	Pattern No. 01 Step No. 08 Step time	R/W
08BE	P01 S08_PE	Pattern No. 01 Step No. 08 PID No.	R/W
08BF	Spare	Spare	R/W
08C0	P01 S09_SV	Pattern No. 01 Step No. 09 SV value	R/W
08C1	P01 S09_TM	Pattern No. 01 Step No. 09 Step time	R/W
08C2	P01 S09_PE	Pattern No. 01 Step No. 09 PID No.	R/W
08C3	Spare	Spare	R/W
08C4	P01 S10_SV	Pattern No. 01 Step No. 10 SV value	R/W
08C5	P01 S10_TM	Pattern No. 01 Step No. 10 Step time	R/W
08C6	P01 S10_PE	Pattern No. 01 Step No. 10 PID No.	R/W

• S**_TM Details are shown below.

D15 D14 D13 D12 D11 D10 D9 D8 D7 D6 D5 D4 D3 D2 D1 D0

<---- 0 ~ 9 * 10h (m) ----> <---- 0 ~ 9 * 1h (m) ---- > <----0 ~ 5 * 10m (s)---- > < ---- 0 ~ 9 * 1m (s) ---- >

Data address (hex)	Parameter	Setting range	R/W
0902	P02 STP	Pattern No. 02 The number of steps	R/W
0903	P02 RPT	Pattern No. 02 The number of pattern executions	R/W
0904	P02 ST_SV	Pattern No. 02 Start SV value	R/W
0905	P02 GUA_Z	Pattern No. 02 Guarantee zone	R/W
0906	Spare	Spare	R/W
0907	P02 PV_ST	Pattern No. 02 PV start	R/W
0908	Spare	Spare	R/W
0909	P02 EV1	Pattern No. 02 EV1 Level value	R/W
090A	P02 EV2	Pattern No. 02 EV2 Level value	R/W
090B	P02 EV3	Pattern No. 02 EV3 Level value	R/W
090E	P02 TS1STP	Pattern No. 02 Time signal 1 ON/OFF STP No.	R/W
090F	P02 TS1_ON	Pattern No. 02 Time signal 1 ON TIME	R/W
0910	P02 TS1_OFF	Pattern No. 02 Time signal 1 OFF TIME	R/W
0911	P02 TS2STP	Pattern No. 02 Time signal 2 ON/OFF STP No.	R/W
0912	P02 TS2_ON	Pattern No. 02 Time signal 2 ON TIME	R/W
0913	P02 TS2_OFF	Pattern No. 02 Time signal 2 OFF TIME	R/W

• TS1STP and TS2STP Details are shown below.

D15 D14 D13 D12 D11 D10 D9 D8 D7 D6 D5 D4 D3 D2 D1 D0

<--------------- ON STP NO ---------------> <--------------- OFF STP NO --------------->

0920	P02 S01_SV	Pattern No. 02 Step No. 01 SV value	R/W
0921	P02 S01_TM	Pattern No. 02 Step No. 01 Step time	R/W
0922	P02 S01_PE	Pattern No. 02 Step No. 01 PID No.	R/W
0923	Spare	Spare	R/W
0924	P02 S02_SV	Pattern No. 02 Step No. 02 SV value	R/W
0925	P02 S02_TM	Pattern No. 02 Step No. 02 Step time	R/W
0926	P02 S02_PE	Pattern No. 02 Step No. 02 PID No.	R/W
0927	Spare	Spare	R/W
0928	P02 S03_SV	Pattern No. 02 Step No. 03 SV value	R/W
0929	P02 S03_TM	Pattern No. 02 Step No. 03 Step time	R/W
092A	P02 S03_PE	Pattern No. 02 Step No. 03 PID No.	R/W
092B	Spare	Spare	R/W
092C	P02 S04_SV	Pattern No. 02 Step No. 04 SV value	R/W
092D	P02 S04_TM	Pattern No. 02 Step No. 04 Step time	R/W
092E	P02 S04_PE	Pattern No. 02 Step No. 04 PID No.	R/W
092F	Spare	Spare	R/W
0930	P02 S05_SV	Pattern No. 02 Step No. 05 SV value	R/W
0931	P02 S05_TM	Pattern No. 02 Step No. 05 Step time	R/W
0932	P02 S05_PE	Pattern No. 02 Step No. 05 PID No.	R/W
0933	Spare	Spare	R/W
0934	P02 S06_SV	Pattern No. 02 Step No. 06 SV value	R/W
0935	P02 S06_TM	Pattern No. 02 Step No. 06 Step time	R/W
0936	P02 S06_PE	Pattern No. 02 Step No. 06 PID No.	R/W
0937	Spare	Spare	R/W
0938	P02 S07_SV	Pattern No. 02 Step No. 07 SV value	R/W
0939	P02 S07_TM	Pattern No. 02 Step No. 07 Step time	R/W
093A	P02 S07_PE	Pattern No. 02 Step No. 07 PID No.	R/W
093B	Spare	Spare	R/W

Data address (hex)	Parameter	Setting range	R/W
093C	P02 S08_SV	Pattern No. 02 Step No. 08 SV value	R/W
093D	P02 S08_TM	Pattern No. 02 Step No. 08 Step time	R/W
093E	P02 S08_PE	Pattern No. 02 Step No. 08 PID No.	R/W
093F	Spare	Spare	R/W
0940	P02 S09_SV	Pattern No. 02 Step No. 09 SV value	R/W
0941	P02 S09_TM	Pattern No. 02 Step No. 09 Step time	R/W
0942	P02 S09_PE	Pattern No. 02 Step No. 09 PID No.	R/W
0943	Spare	Spare	R/W
0944	P02 S10_SV	Pattern No. 02 Step No. 10 SV value	R/W
0945	P02 S10_TM	Pattern No. 02 Step No. 10 Step time	R/W
0946	P02 S10_PE	Pattern No. 02 Step No. 10 PID No.	R/W

• S**_TM Details are shown below.

D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
<---- 0 ~ 9 * 10h (m) ---->				<---- 0 ~ 9 * 1h (m) ---- >				<----0 ~ 5 * 10m (s)---- >				<---- 0 ~ 9 * 1m (s) ---->			

• Supplementary explanation of Pattern No.02 Step No.01 ~ Step No.10:
• Note that information has different meaning by the number of patterns.

The number of patterns	Maximum number of steps of each pattern	Meaning of Pattern No.02 Step No.01 ~ Step No.10 information
1	40	Information of Step No.11 ~ Step No.20 of Pattern 1
2	20	Information of Step No.11 ~ Step No.20 of Pattern 1
4	10	Information of Step No.01 ~ Step No.10 of Pattern 2

0982	P03 STP	Pattern No. 03 The number of steps	R/W
0983	P03 RPT	Pattern No. 03 The number of pattern executions	R/W
0984	P03 ST_SV	Pattern No. 03 Start SV value	R/W
0985	P03 GUA_Z	Pattern No. 03 Guarantee zone	R/W
0986	Spare	Spare	R/W
0987	P03 PV_ST	Pattern No. 03 PV start	R/W
0988	Spare	Spare	R/W
0989	P03 EV1	Pattern No. 03 EV1 Level value	R/W
098A	P03 EV2	Pattern No. 03 EV2 Level value	R/W
098B	P03 EV3	Pattern No. 03 EV3 Level value	R/W

098E	P03 TS1STP	Pattern No. 03 Time signal 1 ON/OFF STP No.	R/W
098F	P03 TS1_ON	Pattern No. 03 Time signal 1 ON TIME	R/W
0990	P03 TS1_OFF	Pattern No. 03 Time signal 1 OFF TIME	R/W
0991	P03 TS2STP	Pattern No. 03 Time signal 2 ON/OFF STP No.	R/W
0992	P03 TS1_ON	Pattern No. 03 Time signal 2 ON TIME	R/W
0993	P03 TS1_OFF	Pattern No. 03 Time signal 2 OFF TIME	R/W

• TS1STP and TS2STP Details are shown below.

D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
<--------------- ON STP NO --------------->								<--------------- OFF STP NO --------------->							

09A0	P03 S01_SV	Pattern No. 03 Step No. 01 SV value	R/W
09A1	P03 S01_TM	Pattern No. 03 Step No. 01 Step time	R/W
09A2	P03 S01_PE	Pattern No. 03 Step No. 01 PID No.	R/W
09A3	Spare	Spare	R/W
09A4	P03 S02_SV	Pattern No. 03 Step No. 02 SV value	R/W
09A5	P03 S02_TM	Pattern No. 03 Step No. 02 Step time	R/W
09A6	P03 S02_PE	Pattern No. 03 Step No. 02 PID No.	R/W
09A7	Spare	Spare	R/W

Data address (hex)	Parameter	Setting range	R/W
09A8	P03 S03_SV	Pattern No. 03 Step No. 03 SV value	R/W
09A9	P03 S03_TM	Pattern No. 03 Step No. 03 Step time	R/W
09AA	P03 S03_PE	Pattern No. 03 Step No. 03 PID No.	R/W
09AB	Spare	Spare	R/W
09AC	P03 S04_SV	Pattern No. 03 Step No. 04 SV value	R/W
09AD	P03 S04_TM	Pattern No. 03 Step No. 04 Step time	R/W
09AE	P03 S04_PE	Pattern No. 03 Step No. 04 PID No.	R/W
09AF	Spare	Spare	R/W
09B0	P03 S05_SV	Pattern No. 03 Step No. 05 SV value	R/W
09B1	P03 S05_TM	Pattern No. 03 Step No. 05 Step time	R/W
09B2	P03 S05_PE	Pattern No. 03 Step No. 05 PID No.	R/W
09B3	Spare	Spare	R/W
09B4	P03 S06_SV	Pattern No. 03 Step No. 06 SV value	R/W
09B5	P03 S06_TM	Pattern No. 03 Step No. 06 Step time	R/W
09B6	P03 S06_PE	Pattern No. 03 Step No. 06 PID No.	R/W
09B7	Spare	Spare	R/W
09B8	P03 S07_SV	Pattern No. 03 Step No. 07 SV value	R/W
09B9	P03 S07_TM	Pattern No. 03 Step No. 07 Step time	R/W
09BA	P03 S07_PE	Pattern No. 03 Step No. 07 PID No.	R/W
09BB	Spare	Spare	R/W
09BC	P03 S08_SV	Pattern No. 03 Step No. 08 SV value	R/W
09BD	P03 S08_TM	Pattern No. 03 Step No. 08 Step time	R/W
09BE	P03 S08_PE	Pattern No. 03 Step No. 08 PID No.	R/W
09BF	Spare	Spare	R/W
09C0	P03 S09_SV	Pattern No. 03 Step No. 09 SV value	R/W
09C1	P03 S09_TM	Pattern No. 03 Step No. 09 Step time	R/W
09C2	P03 S09_PE	Pattern No. 03 Step No. 09 PID No.	R/W
09C3	Spare	Spare	R/W
09C4	P03 S10_SV	Pattern No. 03 Step No. 10 SV value	R/W
09C5	P03 S10_TM	Pattern No. 03 Step No. 10 Step time	R/W
09C6	P03 S10_PE	Pattern No. 03 Step No. 10 PID No.	R/W

- S**_TM Details are shown below.

D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
<---- 0 ~ 9 * 10h (m) ---->				<---- 0 ~ 9 * 1h (m) ---->				<----0 ~ 5 * 10m (s)---->				<---- 0 ~ 9 * 1m (s) ---->			

- Supplementary explanation of Pattern No.03 Step No.01 ~ Step No.10:
- Note that information has different meaning by the number of patterns.

The number of patterns	Maximum number of steps of each pattern	Meaning of Pattern No.03 Step No.01 ~ Step No.10 information
1	40	Information of Step No.21 ~ Step No.30 of Pattern 1
2	20	Information of Step No.01 ~ Step No.10 of Pattern 2
4	10	Information of Step No.01 ~ Step No.10 of Pattern 3

0A02	P04 STP	Pattern No. 04 The number of steps	R/W
0A03	P04 RPT	Pattern No. 04 The number of pattern executions	R/W
0A04	P04 ST_SV	Pattern No. 04 Start SV value	R/W
0A05	P04 GUA_Z	Pattern No. 04 Guarantee zone	R/W
0A06	Spare	Spare	R/W
0A07	P04 PV_ST	Pattern No. 04 PV start	R/W
0A08	Spare	Spare	R/W
0A09	P04 EV1	Pattern No. 04 EV1 Level value	R/W
0A0A	P04 EV2	Pattern No. 04 EV2 Level value	R/W
0A0B	P04 EV3	Pattern No. 04 EV3 Level value	R/W

Data address (hex)	Parameter	Setting range	R/W
0A0E	P04 TS1STP	Pattern No. 04 Time signal 1 ON/OFF STP No.	R/W
0A0F	P04 TS1_ON	Pattern No. 04 Time signal 1 ON TIME	R/W
0A10	P04 TS1_OFF	Pattern No. 04 Time signal 1 OFF TIME	R/W
0A11	P04 TS2STP	Pattern No. 04 Time signal 2 ON/OFF STP No.	R/W
0A12	P04 TS2_ON	Pattern No. 04 Time signal 2 ON TIME	R/W
0A13	P04 TS2_OFF	Pattern No. 04 Time signal 2 OFF TIME	R/W

• TS1STP and TS2STP Details are shown below.

D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
< - - - ON STP NO - - - >								< - - - OFF STP NO - - - >							

0A20	P04 S01_SV	Pattern No. 04 Step No. 01 SV value	R/W
0A21	P04 S01_TM	Pattern No. 04 Step No. 01 Step time	R/W
0A22	P04 S01_PE	Pattern No. 04 Step No. 01 PID No.	R/W
0A23	Spare	Spare	R/W
0A24	P04 S02_SV	Pattern No. 04 Step No. 02 SV value	R/W
0A25	P04 S02_TM	Pattern No. 04 Step No. 02 Step time	R/W
0A26	P04 S02_PE	Pattern No. 04 Step No. 02 PID No.	R/W
0A27	Spare	Spare	R/W
0A28	P04 S03_SV	Pattern No. 04 Step No. 03 SV value	R/W
0A29	P04 S03_TM	Pattern No. 04 Step No. 03 Step time	R/W
0A2A	P04 S03_PE	Pattern No. 04 Step No. 03 PID No.	R/W
0A2B	Spare	Spare	R/W
0A2C	P04 S04_SV	Pattern No. 04 Step No. 04 SV value	R/W
0A2D	P04 S04_TM	Pattern No. 04 Step No. 04 Step time	R/W
0A2E	P04 S04_PE	Pattern No. 04 Step No. 04 PID No.	R/W
0A2F	Spare	Spare	R/W
0A30	P04 S05_SV	Pattern No. 04 Step No. 05 SV value	R/W
0A31	P04 S05_TM	Pattern No. 04 Step No. 05 Step time	R/W
0A32	P04 S05_PE	Pattern No. 04 Step No. 05 PID No.	R/W
0A33	Spare	Spare	R/W
0A34	P04 S06_SV	Pattern No. 04 Step No. 06 SV value	R/W
0A35	P04 S06_TM	Pattern No. 04 Step No. 06 Step time	R/W
0A36	P04 S06_PE	Pattern No. 04 Step No. 06 PID No.	R/W
0A37	Spare	Spare	R/W
0A38	P04 S07_SV	Pattern No. 04 Step No. 07 SV value	R/W
0A39	P04 S07_TM	Pattern No. 04 Step No. 07 Step time	R/W
0A3A	P04 S07_PE	Pattern No. 04 Step No. 07 PID No.	R/W
0A3B	Spare	Spare	R/W
0A3C	P04 S08_SV	Pattern No. 04 Step No. 08 SV value	R/W
0A3D	P04 S08_TM	Pattern No. 04 Step No. 08 Step time	R/W
0A3E	P04 S08_PE	Pattern No. 04 Step No. 08 PID No.	R/W
0A3F	Spare	Spare	R/W
0A40	P04 S09_SV	Pattern No. 04 Step No. 09 SV value	R/W
0A41	P04 S09_TM	Pattern No. 04 Step No. 09 Step time	R/W
0A42	P04 S09_PE	Pattern No. 04 Step No. 09 PID No.	R/W
0A43	Spare	Spare	R/W
0A44	P04 S10_SV	Pattern No. 04 Step No. 10 SV value	R/W
0A45	P04 S10_TM	Pattern No. 04 Step No. 10 Step time	R/W
0A46	P04 S10_PE	Pattern No. 04 Step No. 10 PID No.	R/W

• S**_TM Details are shown below.

D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
<---- 0 ~ 9 * 10h (m) ---->				<---- 0 ~ 9 * 1h (m) ---- >				<----0 ~ 5 * 10m (s)---- >				<---- 0 ~ 9 * 1m (s) ---->			

- Supplementary explanation of Pattern No.04 Step No.01 ~ Step No.10:
- Note that information has different meaning by the number of patterns.

The number of patterns	Maximum number of steps of each pattern	Meaning of Pattern No.04 Step No.01 ~ Step No.10 information
1	40	Information of Step No.31 ~ Step No.40 of Pattern 1
2	20	Information of Step No.11 ~ Step No.20 of Pattern 2
4	10	Information of Step No.01 ~ Step No.10 of Pattern 4

7. Supplementary explanation

7-1. Table of measuring range codes

<table>
<tr><th colspan="2" rowspan="2">Input</th><th rowspan="2">Code</th><th rowspan="2">Type of Input</th><th colspan="2">Measuring range</th></tr>
<tr><th>°C</th><th>°F</th></tr>
<tr><td rowspan="28">Multi-input</td><td rowspan="14">Thermocouple</td><td>01</td><td>B *1</td><td>0 ～ 1800</td><td>0 ～ 3300</td></tr>
<tr><td>02</td><td>R</td><td>0 ～ 1700</td><td>0 ～ 3100</td></tr>
<tr><td>03</td><td>S</td><td>0 ～ 1700</td><td>0 ～ 3100</td></tr>
<tr><td>04</td><td>K</td><td>-199.9 ～ 400.0</td><td>-300 ～ 750</td></tr>
<tr><td>05</td><td>K</td><td>0.0 ～ 800.0</td><td>0 ～ 1500</td></tr>
<tr><td>06</td><td>K</td><td>0 ～ 1200</td><td>0 ～ 2200</td></tr>
<tr><td>07</td><td>E</td><td>0 ～ 700</td><td>0 ～ 1300</td></tr>
<tr><td>08</td><td>J</td><td>0 ～ 600</td><td>0 ～ 1100</td></tr>
<tr><td>09</td><td>T</td><td>-199.9 ～ 200.0</td><td>-300 ～ 400</td></tr>
<tr><td>10</td><td>N</td><td>0 ～ 1300</td><td>0 ～ 2300</td></tr>
<tr><td>11</td><td>PLII</td><td>0 ～ 1300</td><td>0 ～ 2300</td></tr>
<tr><td>12</td><td>WRe5-26</td><td>0 ～ 2300</td><td>0 ～ 4200</td></tr>
<tr><td>13</td><td>U</td><td>-199.9 ～ 200.0</td><td>-300 ～ 400</td></tr>
<tr><td>14</td><td>L</td><td>0 ～ 600</td><td>0 ～ 1100</td></tr>
<tr><td rowspan="8">R.T.D.</td><td>31</td><td>Pt100</td><td>-200 ～ 600</td><td>-300 ～ 1100</td></tr>
<tr><td>32</td><td>Pt100</td><td>-100.0 ～ 100.0</td><td>-150.0 ～ 200.0</td></tr>
<tr><td>33</td><td>Pt100</td><td>-50.0 ～ 50.0</td><td>-50.0 ～ 120.0</td></tr>
<tr><td>34</td><td>Pt100</td><td>0.0 ～ 200.0</td><td>0.0 ～ 400.0</td></tr>
<tr><td>35</td><td>Jpt100</td><td>-200 ～ 500</td><td>-300 ～ 1000</td></tr>
<tr><td>36</td><td>Jpt100</td><td>-100.0 ～ 100.0</td><td>-150.0 ～ 200.0</td></tr>
<tr><td>37</td><td>Jpt100</td><td>-50.0 ～ 50.0</td><td>-50.0 ～ 120.0</td></tr>
<tr><td>38</td><td>Jpt100</td><td>0.0 ～ 200.0</td><td>0.0 ～ 400.0</td></tr>
<tr><td rowspan="6">mV</td><td>71</td><td>-10 ～ 10 mV</td><td colspan="2" rowspan="14">Owing to scaling function, any measuring range can be set within the following range.

Scaling range: -1999 to 9999 counts
Span : 10 to 5000 counts on condition of lower side < higher side, though.</td></tr>
<tr><td>72</td><td>0 ～ 10 mV</td></tr>
<tr><td>73</td><td>0 ～ 20 mV</td></tr>
<tr><td>74</td><td>0 ～ 50 mV</td></tr>
<tr><td>75</td><td>10 ～ 50 mV</td></tr>
<tr><td>76</td><td>0 ～ 100 mV</td></tr>
<tr><td rowspan="6">Voltage</td><td rowspan="6">V</td><td>81</td><td>-1 ～ 1 V</td></tr>
<tr><td>82</td><td>0 ～ 1 V</td></tr>
<tr><td>83</td><td>0 ～ 2 V</td></tr>
<tr><td>84</td><td>0 ～ 5 V</td></tr>
<tr><td>85</td><td>1 ～ 5 V</td></tr>
<tr><td>86</td><td>0 ～ 10 V</td></tr>
<tr><td rowspan="2">Current</td><td rowspan="2">mA</td><td>91</td><td>0 ～ 20 mA</td></tr>
<tr><td>92</td><td>4 ～ 20 mA</td></tr>
</table>

*1 Thermocouple B: Accuracy cannot be guaranteed on temperatures below 400 °C and 752 °F.

7-2. Table of Event/DO Types

Alarm/DO code	Event type	Value	Initial value	Setting range
non	None	0	— — — — — — — — —	— — — — — — —
Hd	Higher limit deviation	1	2000 Unit	-1999 ~ 2000 Unit
Ld	Lower limit deviation	2	-1999 Unit	-1999 ~ 2000 Unit
od	Outside higher/lower limit deviations	3	2000 Unit	0 ~ 2000 Unit
id	Within higher/lower limit deviations	4	2000 Unit	0 ~ 2000 Unit
HA	Higher limit absolute value	5	Higher limit of measuring range	Within measuring range
LA	Higher limit absolute value	6	Lower limit of measuring range	Within measuring range
So	Scaleover	7	EV/DO is continuously output during scaleover.	
HoLd	Hold	8	EV/DO is continuously output during HOLD	
GUA=	Guarantee soak	9	EV/DO is continuously output during guarantee soak.	
tmS1	Time signal 1	10	EV/DO is continuously output while time signal 1 is output.	
tmS2	Time signal 2	11	EV/DO is continuously output while time signal 2 is output.	
run	RUN status	12	EV/DO is continuously output while RUN is in execution.	
StPS	Step signal	13	EV/DO is output when step signal is output.	
EndS	End signal	14	EV/DO is output when end signal is output.	
FIy	FIX	15	EV/DO is continuously output during FIX.	

7-3. Table of DI Types

DI code	Event type	Value	Sense	Setting range
non	None	0	— — -	— — — — — — — — —
HoLd	Hold	1	Level	Hold when DI turns ON.
Adv	Advance	2	Edge	Advance when DI turns ON.
FIy	FIX level	3	Level	FIX action when DI turns ON.
StP2	Start pattern No. 2 bits	4	Level	Level Start pattern No. is specified by 2 bits by using 2 DIs. Setting possible only by DI3.
StP3	Start pattern No. 3 bits	5	Level	Start pattern No. is specified by 3 bits by using 3 DIs. Setting possible only by DI3.

8. ASCII code list

	b7b6b5	000	001	010	011	100	101	110	111
b4 ~ b1		0	1	2	3	4	5	6	7
0000	0	NUL	TC7 (DLE)	SP	0	@	P	`	p
0001	1	TC1 (SOH)	DC1	!	1	A	Q	a	q
0010	2	TC2 (STX)	DC2	”	2	B	R	b	r
0011	3	TC3 (ETX)	DC3	#	3	C	S	c	s
0100	4	TC4 (EOT)	DC4	$	4	D	T	d	t
0101	5	TC5 (ENQ)	TC8 (NAK)	%	5	E	U	e	u
0110	6	TC6 (ACK)	TC9 (SYN)	&	6	F	V	f	v
0111	7	BEL	TC10 (ETB)	’	7	G	W	g	w
1000	8	FE0 (BS)	CAN	(	8	H	X	h	x
1001	9	FE1 (HT)	EM	)	9	I	Y	i	y
1010	A	FE2 (LF)	SUB	*	:	J	Z	j	z
1011	B	FE3 (VT)	ESC	+	;	K	[	k	{
1100	C	FE4 (FF)	IS4 (FS)	,	<	L	\	l	|
1101	D	FE5 (CR)	IS3 (GS)	–	=	M	]	m	}
1110	E	SO	IS2 (RS)	.	>	N	^	n	~
1111	F	SI	IS1 (US)	/	?	O	_	o	DEL

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