SD16 Series
Digital Indicator

COMMUNICATION INTERFACE
(RS-232C/RS-485)

INSTRUCTION MANUAL

Thank you for purchasing the Shimaden SD16 series indicator.
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 SD16 digital indicator. For details of SD16's performance and parameters, please refer to the separate instruction manual.

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SHIMADEN CO.,LTD.

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1. Outline

There are two types of communication systems, RS-232C and RS-485 employable as the SD16 series communication interface. Each of them is capable of setting various data for the SD16 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 SD16 indicators 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.

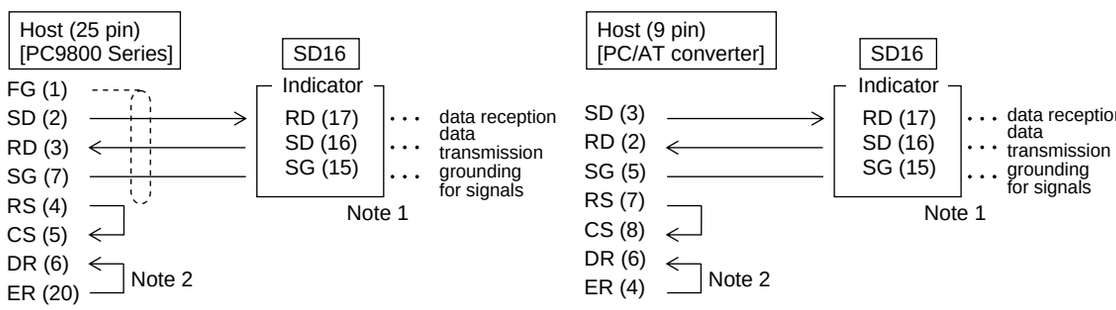
2. Specifications

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 SD16 series indicator 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 indicator 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. 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

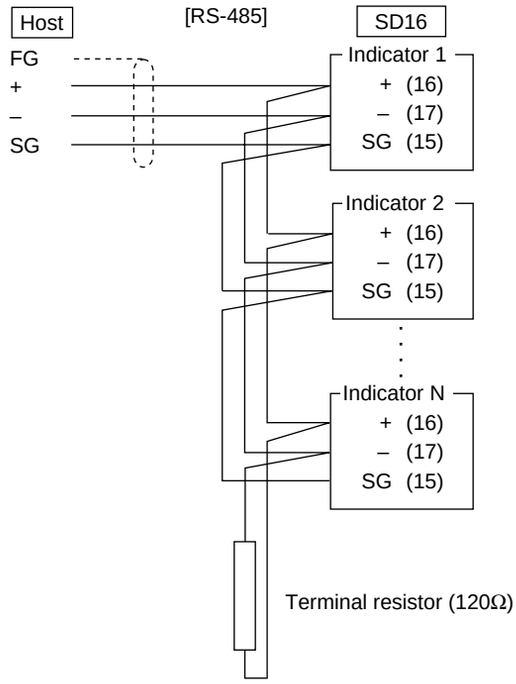


Note 1: Figures in ( ) represent terminal numbers of SD16.
Note 2: Figures in ( ) represent pin numbers of connector.

3-2 RS-485

The input/output logical level of the SD16 indicator is basically as follows:
[RS-485]
In the mark state - terminal < + terminal
In the space state - terminal > + terminal

Until immediately before transmission, however, plus terminals and minus terminals of the indicator have high impedance and outputs at the above levels are produced immediately before starting transmission. (See 3-4 Control of 3-state output.)



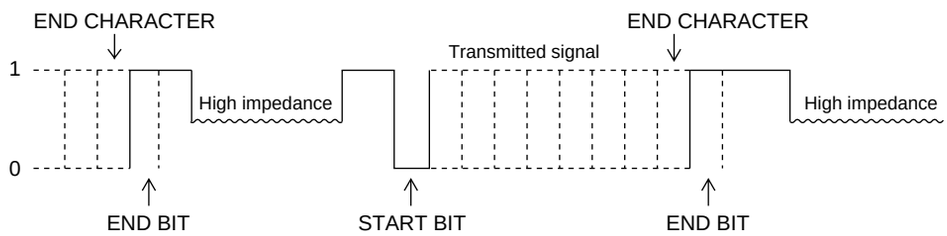
Note 1: For terminal resistance, please refer to "3-3 Terminal resistance."

3-3 Terminal resistance

(1) When the RS485 communication system is employed, the last indicator needs to be attached with a terminal resistor. The attached terminal resistor (1/2W 120Ω or so) should be inserted across the terminals (16) and (17).
Terminal resistance should be turned ON only in the last indicator. If terminal resistance is turned ON in two or more indicators, proper functioning cannot be guaranteed.

3-4 Control of 3-state output

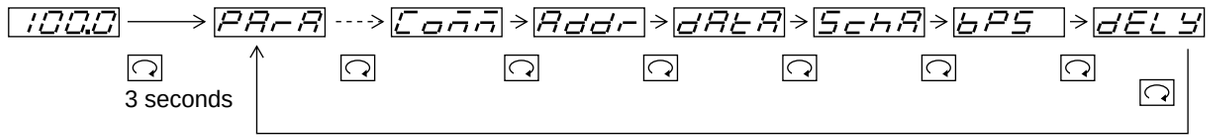
As the RS-485 employs the multidrop system, transmission output is held at high impedance while communication is not carried out and during reception. This is to avoid collision of transmission signals.
Output is switched from high impedance to its ordinary state immediately before the start of communication and is controlled to high impedance again when the communication ends. Nevertheless, the 3-state control delays by about 1 mSEC (max) from the transmission of the end bit of the end characters. Therefore, a delay time of a few milliseconds or longer should be provided in case the host starts transmission upon termination of reception.



4. Setting of parameters related to communication

As shown below, there are six communication-related parameters for SD16. It is not possible to set or change them through communications, that is, setting or changing them should be carried by front key operation. For setting, follow the procedure described in "4. Screen instruction" of the separate instruction manual of SD16.

On the basic screen, press the [↻] key continuously for 3 seconds to move to the [PAr-A] screen, and set the respective parameters related to communication by means of the [↻] key.



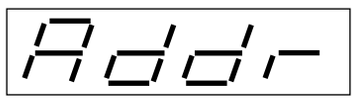
4-1 Setting of communication mode

Setting range: Loc, Com
Initial value: Loc

You can select and set either of the following two communication modes. However, only changing from Remote to Local is possible by front key operation . Remote can be set only through communication.

Selectable mode	Communication mode
Loc	Local
Com	Remote

4-2 Setting of machine address

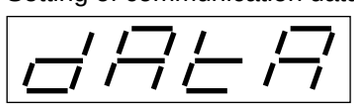


Setting range: 1 ~ 255
Initial value: 1

While only one SD16 is allowed to the host computer in the case of RS-232C, as many as 31 SD16 (maximum) can be connected for RS-485 which employs the multidrop system. Since actual communication is carried out between one SD16 and the host computer, however, addresses (machine numbers) are assigned to the respective apparatuses so that only one with a designated address can respond.

Note 1: Addresses, 1 to 255, can be set for 31 apparatuses maximum.

4-3 Setting of communication data format

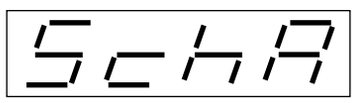


Setting range: Two types shown below.
Initial value: 7E1

One of the following two communication data formats can be selected for setting.

	Length of data	Parity	Stop bit
7E1	7bit	EVEN	1bit
8n1	8bit	None	1bit

4-4 Setting of start character

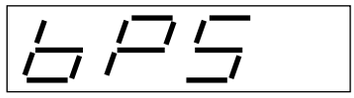


Setting range: Stx, Att
Initial value: Stx

A control code to be used should be selected from the following.

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

4-5 Setting of communication rate



Setting range: 1200, 2400, 4800, 9600, 19200
Initial value: 1200

A communication rate is selected and set from 1200, 2400, 4800, 9600 and 19200 bps.

4-6 Setting of delay time

Setting range: 0 ~ 500
Initial value: 80

A minimum delay time from the reception of communication command to the transmission can be set.

Delay time (msec) = set value (count) × 0.1 (msec)

Note1: In the case of RS-485, some types of line converters take a longer time for 3-state control and signal collision may occur. This can be avoided by increasing the delay time. Care should be taken particularly for lower communication rates (for example, 1200 bps or 2400 bps).

Note2: Actual time of delay from the reception of a communication command to transmission is a total of the above-described delay time and the time for software to process the command.
Processing write commands, in particular, may take about 400 msec in some cases.

* Setting of check sum

In SD16, the operating system to be used for BCC checking changes according to start characters.

SUM : Addition

XOR : XOR

For details, see the description about BCC data in "5-2. Communication format (3) Details of basic format Portion II."

5. Outline of standard serial communication protocols

5-1 Communication procedure

(1) Master/slave relation
- The master side means personal computer or PLC (host).
- The slave side means the SD16 series Indicator.
- 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 a one second minimum as the time-out duration.

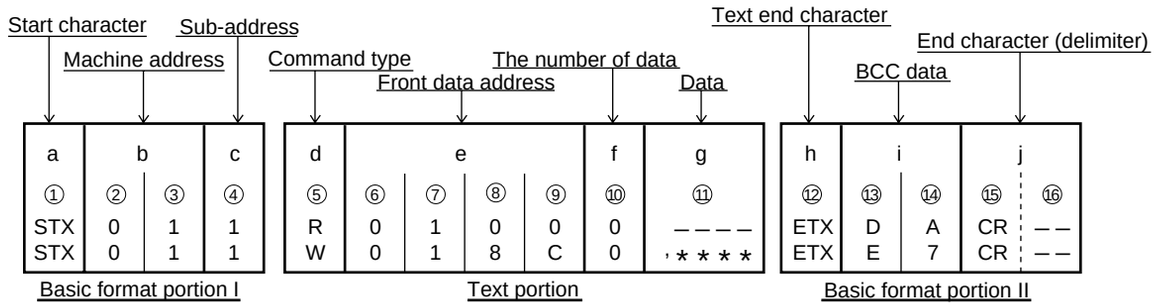
5-2 Communication format

The SD16 allows for some 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 their 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 or 8N1

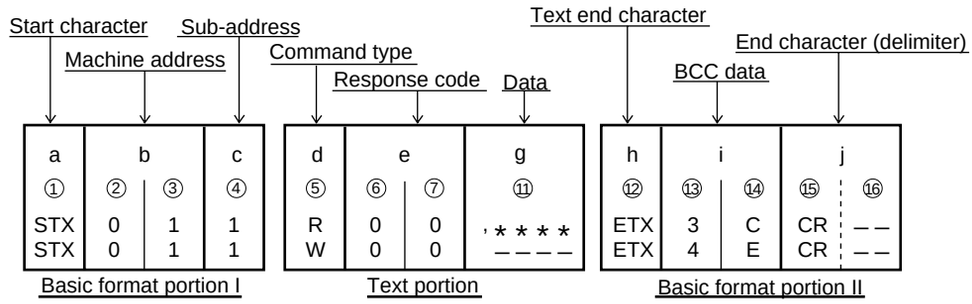
For setting a communication format and a communication data format, see "4. Setting of parameters related to communication."

(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



2) Response format



- 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

(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 STX (02H) ---- ETX (03H), or select "@"(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 (decimal 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 SD16 series controller does not support broadcast instruction, address=0 has no response.

c : Sub-address [④ : 1 digit]
- Since the SD16 series are indicators, 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.
- For SD16, there are two types of BCC operations; "addition" when the start character is ＳＴＸ and "XOR" when it is ＡＳＣ (Only selecting the type of BCC operation is impossible.)
  (1) Add
  Add operation is carried out for each character (1 bite) of ASCII data as a unit, covering a range from the start character ① to the text end character ⑫ .
  (2) XOR
  XOR (exclusive OR) operation is carried out for each character (1 bite) of ASCII data as a unit, covering a range from the apparatus address ② (right after the start character) to the text end character ⑫ .
- 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 oftained 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 data converted from high position 4 bits.
⑭: ASCII data converted from low position 4 bits.

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

①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑫	⑬	⑭	⑮	⑯
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: BCC▶ In the case of a read command (R) with "XOR" set:

①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑫	⑬	⑭	⑮	⑯
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, ⑯ : 1 digit or 2 digits/CR or CR LF]
- Indicates that it is the end of communication message.
- For the SR16, end character is CR only.
  ⑮ : CR (0DH) (CR only, LF is not added.)

(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 SD16 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 SD16 from personal computer, PLC, etc.
- "B" (42H/capital letter): Indicates that it is broadcast instruction. Since SD16 does not support broadcast instruction, this is unable to be used.
- There is no response when any other abnormal character besides "R" and "W" is recognized.

e : Front data address [⑥, ⑦, ⑧, ⑨ : 4 digits]
- For a read command (R) or a write command (W), designates a front data address of where to read from or write in.
- A front data 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.

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

- For data addresses, refer to 5-6 Details of Communication data address list.

f : The number of data [⑩ : 1 digit]
- 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 after converting binary 4-bit data into ASCII data.
- Designation is possible in the following range for read commands (R):
  "0" (30H)(one) ~ "9" (39H)(ten)
  For SD16, however, the range is from "0" to "2" (32H)(three).
- It is fixed to "0" (30H)(one) for write commands (W).
- The number of actual data is <a designated value + one>.

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 SD16.

(1) Read Command (R) format
- The format of the text portion of a read command (R) is shown below:
  (The basic format portions I and II are common to all commands and responses.)

Text portion

d	e				f
⑤	⑥	⑦	⑧	⑨	⑩
R	0	5	0	0	2
52H	30H	35H	30H	30H	32H

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

- The above command means the following:

Front data address of data to be read	=	0500H	(hexadecimal)
	=	0000 0101 0000 0000 (binary)	
The number of data to be read	=	2H	(hexadecimal)
	=	0010	(binary)
	=	2	(decimal)
(The actual number of data)	=	Three (2 + 1)	

Thus, the command designates reading of three data from the data address 0500H.

(2) Normal response format to read command (R)
- The following is the normal 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		g ⑪												
⑤	⑥	⑦	first data				second data				third data				
R	0	0	,	0	0	0	3	0	0	6	E	0	0	1	4
52H	30H	30H	2CH	30H	30H	30H	33H	30H	30H	36H	45H	30H	30H	31H	34H

- d(⑤): <R (52H)> indicating that it is a response to a read command (R) is inserted.
- e(⑥, ⑦):The response code <0 0 (30H, 30H)> indicating 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)> indicating 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 the front data 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

(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	0	7
52H	30H	37H

- d(⑤): <R (52H)> indicating that it is a response to a read command (R) is inserted.
- e(⑥, ⑦): A response code indicating 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 (W) is used by a personal computer, PLC, etc. to write (change) various data in SD16.

To use a write command, the communication mode parameter has to be changed from Loc to Com but this is not possible by front key operation. The change should be made by the following command transmission. (In case the start character is "STX," BCC=Add)

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

When the above command has been sent and a normal response has been returned, the COM LED lamp on the front panel lights and the communication mode changes to COM.

(1) Write command (W) format

- The following is the text format of a write command (W).
  (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	0	5	0	0	0	,	0	0	0	2
57H	30H	35H	30H	30H	30H	2CH	30H	30H	30H	32H

- d: Indicates that it is a write command. It is fixed to "W" (57H).
- e: Designates the front data address of data to be written (changed).
- f: Designates the number of data to be written (changed).
  The number of written data is fixed to one, "0" (30H).
- 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:
  Front data address of data to be written = 0500H (hexadecimal)
  = 0000 0101 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 = 0002H (hexadecimal)
  = 0000 0000 0000 0010 (binary)
  = 2 (decimal)
  Thus, writing (changing) of data address 0500H and one piece of data (2: decimal) is designated.

Front data address of data to be written (500H) ⟶ 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
0500	1280	0002	2
0501	1281	006E	110
0502	1282	0014	20

(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	0	0
57H	30H	30H

- d(⑤): <W (57H)> indicating that it is a response to a write command (W) is inserted.
- e(⑥, ⑦):A response code < 00 (30H, 30H)> indicating 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	0	9
57H	30H	39H

- d(⑤): <W (57H)> indicating that it is a response to a write command (W) is inserted.
- e(⑥, ⑦):A response code indicating 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 contains response codes.
- Response codes are divided broadly into two types:

Response codes { Normal response codes / Abnormal response codes

- 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 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 format of text portion, data address or the number of data	Data format 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 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 Communication data address list

(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 SD16 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
100.00 ºC	→	10000	→	2710
-40.00 ºC	→	-4000	→	F060

- In data of which the unit is UNIT, the position of decimal point depends on the measuring range.
- In the case of a special measuring range (one exceeding 32768; 0 ~ 50,000 ºC, for example), binary numbers without code (16 bit data: 0 ~ 65535) are used for data which depend 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) <Reserved> in parameter portions
- When a <spare> part is read in response to a read command or written in response to a write command, abnormal response codes "0"and "8"(30H, 38H) are returned.

(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).

(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.

Note: The example shown as supplement to the parameter list is the case of communication with the following setting:
Start character → STX
Machine address → 01
Sub-address → 1
Check sum → Addition

Data address (Hex)	Parameter	Setting range	R/W
0100	PV value	Within measuring range	R
0104	EXE_FLG	Action flag (See detailed explanation on page 13.)	R
0105	AL_FLG	Alarm output flag (See detailed explanation on page 13.)	R

○Details of PV value

Example: When PV value is read (PV value = 14.50°C)

Read command format

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	44H	41H	0DH

is sent.

Normal response format

STX	0	1	1	R	0	0	,	0	5	A	A	ETX	5	C	CR
02H	30H	31H	31H	52H	30H	30H	2CH	30H	35H	41H	41H	03H	35H	43H	0DH

is sent back.

- HHHH (OVER HH) : 7FFFH
- LLLL (UNDER LL) : 8000H is returned.

○Details of action flag and alarm flag

About action flag and alarm output flag, EXE_FLG and AL_FLG data are shown below in detail:
(When not in action → bit = 0, When in action → bit = 1)

	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	0	0
AL_FLG :	0	0	0	0	0	0	0	0	0	0	0	0	0	0	AL2	AL1

Example: When AL_FLG is read while AL1 is in action.

	D15	D14	D13	D12	D11	D10	D9	D8	D7	D6	D5	D4	D3	D2	D1	D0
AL_FLG :	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	0H				0H				0H				1H			

STX	0	1	1	R	0	0	,	0	0	0	1	ETX	3	6	CR
02H	30H	31H	31H	52H	30H	30H	2CH	30H	30H	30H	31H	03H	33H	36H	0DH

is sent back.

Data address (Hex)	Parameter	Setting range	R/W
018C	Operation	0: Loc, 1: Com	W

Data address (Hex)	Parameter	Event/Do No.	Setting range	R/W
0500	Mode	AL1	1: Higher limit 2: Higher limit (standby) 3: Lower limit 4: Lower limit (standby)	R/W
0501	Set Point		Within measuring range	R/W
0502	Diffrntl		1 ~ 999 unit	R/W
0508	Mode	AL2	The same as above.	R/W
0509	Set Point			R/W
050A	Diffrntl			R/W

Data address (Hex)	Parameter	Setting range	R/W
05A1	Aol Sc_L	Within measuring range but Ao1 Sc_L ≠ Ao1 Sc_H	R/W
05A2	Aol Sc_H		R/W

0611	Key Lock	0: OFF 1: LOCK	R/W

0701	PV Bias	-200 ~ 200 unit	R/W
0702	PV Filt	0 ~ 100 sec.	R/W

- Example: When PV Bias = -10.0°C (10.0 → -100 → FF9CH) is written

Write command format

STX	0	1	1	W	0	7	0	1	0	,	F	F	9	C	ETX	1	A	CR
02H	30H	31H	31H	57H	30H	37H	30H	31H	30H	2CH	46H	46H	39H	43H	03H	31H	41H	0DH

Normal response format

STX	0	1	1	W	0	0	ETX	4	E	CR
02H	30H	31H	31H	57H	30H	30H	03H	34H	45H	0DH

Data address (Hex)	Parameter	Setting range	R/W
0704	UNIT	0: " °C " 1: " °F "	R/W
0705	RANGE	Thermocouple 1: B 2: R 3: S 4: K1 5: K2 6: E 7: J 8: T 9: N 10: U 11: L 12: WRe5-26 R.T.D. 31: Pt1 32: Pt2 Voltage 71: 0 ~ 10mV 81: 0 ~ 5V 82: 1 ~ 5V 83: 0 ~ 10V Current 95: 4 ~ 20mA	R/W

0707	DP	0: None 1: 0.1 2: 0.01 3: 0.001	Unable to be changed except linear input.	R/W
0708	in_L	-1999 ~ 9999 UNIT		R/W
0709	in_H			R/W

6. Supplementary description

6-1 Measuring range list

■ Thermocouple input

Range	Input type	Measuring range °C	Measuring range °F
1	B	0 ～ 1800	0 ～ 3300
2	R	0 ～ 1700	0 ～ 3100
3	S	0 ～ 1700	0 ～ 3100
4	K1	-199.9 ～ 800.0	-300 ～ 1500
5	K2	0 ～ 1200	0 ～ 2200
6	E	0 ～ 700	0 ～ 1300
7	J	0 ～ 600	0 ～ 1100
8	T	-199.9 ～ 300.0	-300 ～ 600
9	N	0 ～ 1300	0 ～ 2300
10	U	-199.9 ～ 300.0	-300 ～ 600
11	L	0 ～ 600	0 ～ 1100
12	WRe5-26	0 ～ 2300	0 ～ 4200

■ R.T. D (Pt100)

Range	Input type	Measuring range °C	Measuring range °F
31	Pt100	-200 ～ 600	-300 ～ 1100
32	Pt100	-100.0 ～ 100.0	-150.0 ～ 200.0

■ Linear input (current, voltage)

Range	Voltage (mV)	Current (mA)	Voltage (V)
71	0 ～ 10	——	——
81	——	——	0 ～ 5
82	——	——	1 ～ 5
83	——	——	0 ～10
95	——	4 ～ 20	——

Initial value: 0.0 ~ 100.0
Scaling range: -1999 ~ 9999 counts
Span: 10 ~ 5000 counts

Thermocouple
B. R. S. K. E. J. T. N: JIS/IEC
U. L: DIN43710
WRe5-26: a product of Hoskin [phonetic] Corp.

R.T.D.
Pt100: New JIS/IEC

7. 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

The contents of this manual are subject to change without notice.

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