INST.No. INE-325A

CHINO

INSTRUCTION MANUAL FOR JU THYRISTOR REGULATOR COMMUNICATIONS INTERFACE

INSTRUCTIONS

Always keep this manual with the unit and in an easily accessible place.

Please make sure that this manual is delivered with the unit to the final user.

CHINO

Contents

INTRODUCTION

This instruction manual describes the specifications and operation of the communications interface (RS-422A/RS-485) of the setting communications unit for JU series thyristor regulators.

1.Other Instruction Manual to be consulted

To understand the contents of this instruction, it is necessary to fully understand the operations and specifications of the setting communications unit for JU series thyristor regulators.
This instruction manual is for the communications interface only. For the running and operation, please refer to the following instruction manuals:

1. JU series single-phase thyristor regulator (manual No. INE-316□)
2. Thyristor regulator setting communications unit (manual No.INE-317□)

* Also refer to the instruction manual of the computer being used.

2.Caution Display ⚠

This manual contains explanation of precautions. Observe these precautions when operating and handling the communications interfaces, otherwise the instrument may be damaged, resulting in a deterioration in its performance, or operation failures may also occur.

⚠ Caution

(1) The right is reserved to change the contents of this manual at any time without notice.
(2) The contents of this manual have been prepared professionally. However, if you have any questions, or notice of error or an omission of descriptions found on this manual, please contact your nearest CHINO sales agent.
(3) CHINO Corporation is not responsible for any results influenced by the operation of this communications interface, irrespective of item (2) above.

1. GENERAL

By adding the communications interface to the setting communications unit for JU series thyristor regulators, the settings of various parameters including manual output, gradient and elevation and entering of load voltage, current, power, resistance value, alarms, etc. can be performed from a master unit (personal computer, PLC, etc.)
Two types (RS-422A and RS-485) of the communications interface are available by switching them by the connections at terminals. The MODBUS protocol used offers easy system configuration with other units using this type of communications protocol.

1.1 RS-422A/RS-485 Communications Interface

The RS-422A or RS-485 communications interface can communicate with setting communications units and/or other units up to 31 sets. If a personal computer is used as the master unit, an RS-232C⇔RS-422A/485 signal converter may be required.
A line converter (Model SC8-10) for RS-232C⇔RS-422A/485 signal conversion is available from CHINO.
RS-422A uses 4 signal lines (2 lines for transmission and 2 lines for receiving) and RS-485 uses 2 signal lines by switching them for transmission and receiving.

1.2 Communications Protocol

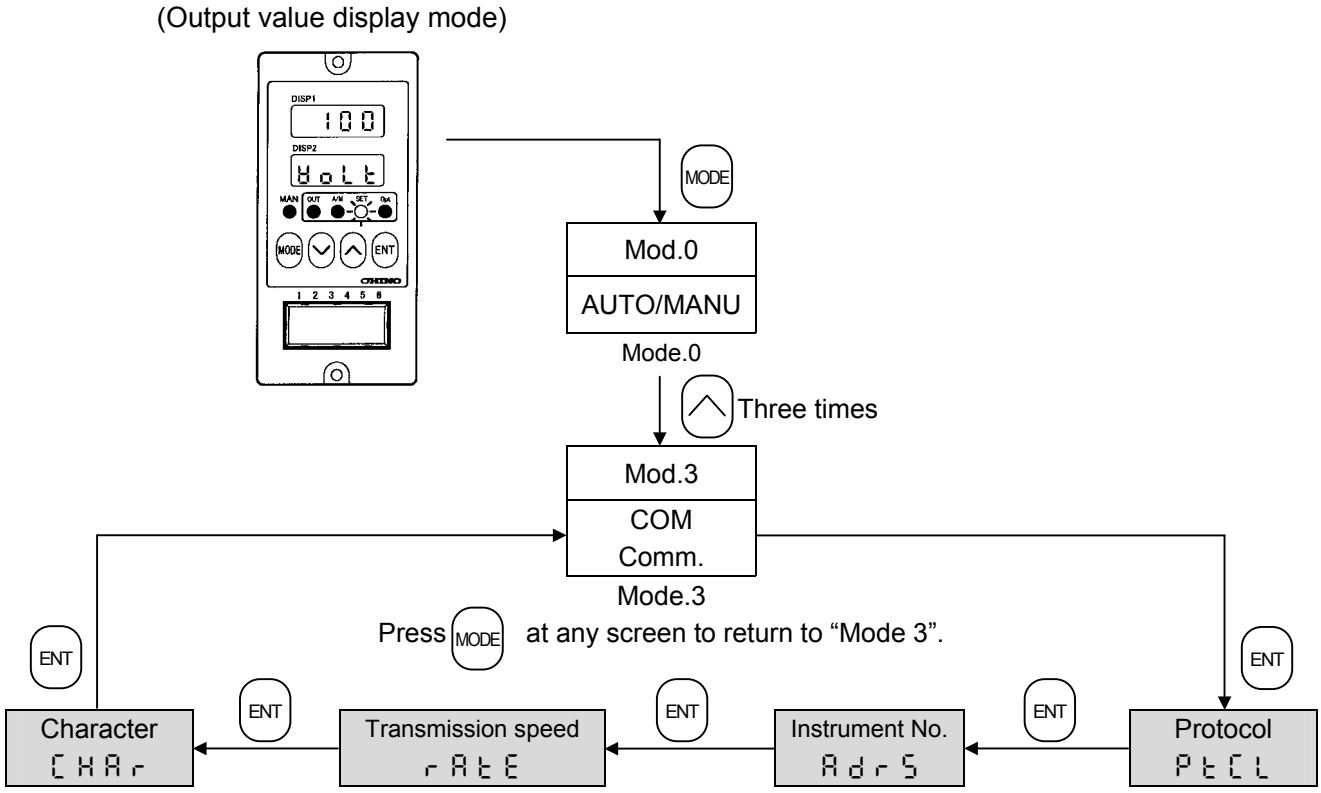
MODBUS Protocol (MODBUS is the registered trademark of Schneider Automation Inc.)
MODBUS Protocol has RTU mode and ASCII mode that can be selected by function keys.

1.3 Communications Specifications

* Half-duplex (polling selecting system)
* Protocol: MODBUS protocol
* Transmission speed: 19200, 9600,bps selectable
* Start bit: 1 bit
* Data length: 7 bits(ASCII)/8 bits(RUT/ASCII) selectable
* Parity bit: Even / Odd / No parity selectable
* Stop bit: 1 bit / 2 bits selectable
* Transmission code : Binary(RTU) / ASCII(ASCII)
* Error check: LRC(ASCII) / CRC-16(RTU)

2. SETTING OF COMMUNICATIONS PARAMETERS

Set up 4 parameters of ”Protocol”, “Instrument No.”, ” Transmission speed” and “Character”.



2.1 Setting of Protocol (PtCL)

(1) Press ENT to display PtCL in DISP2.

(2) Select the protocol by pressing ∧ or ∨, and then press ENT to store it.

Kind	Protocol	Default
rtU	Modbus rtu	rtU
ASC	Modbus ascii	

*When the protocol is changed, the setting of the character will be changed to the default value.

2.2 Setting of Instrument No. (AdrS)

Set instrument numbers to setting communications units (1 set to plural sets) for the communications with a master unit (personal computer, PLC, etc.). Make sure not to set the same number to different units.

(1) Press ENT to display AdrS in DISP2.

(2) Select the instrument number (from 01 to 99) by pressing ∧ or ∨, and then press ENT to store it.

⚠ CAUTION

The instrument numbers are from 01 to 99. Make sure not to set the same number to different setting communication units or other instruments on the same communications line. (Default value 01)

2.3 Setting of Transmission Speed (rAtE)

Set the same transmission speed to setting communications units and a master unit (personal computer, PLC, etc.).

(1) Press ENT to display rAtE in DISP2.

(2) Select the transmission speed by pressing ∧ or ∨, and then press ENT to store it.

Transmission speed : 9600 (9.6k), 19200 (19.2k) bps（Default: 19200 bps）

2.4 Setting of Character (CHAr)

(1) Press ENT to display CHAr in DISP2.

(2) Select the character by pressing ∧ or ∨ , and then press ENT to store it.

Kind	Bit length	Parity	Stop bit	Default value
7E1	7 bits	Even	1	RTU 8N1 (ASCII) 7E1
7E2			2	
7O1		Odd	1	
7O2			2	
8N1	8 bits	No parity	1	
8N2			2	
8E1		Even	1	
8E2			2	
8O1		Odd	1	
8O2			2	

*The 8-bit length is only available in MODBUS RTU protocol.

3.CONNECTIONS

3.1 Connection Precautions

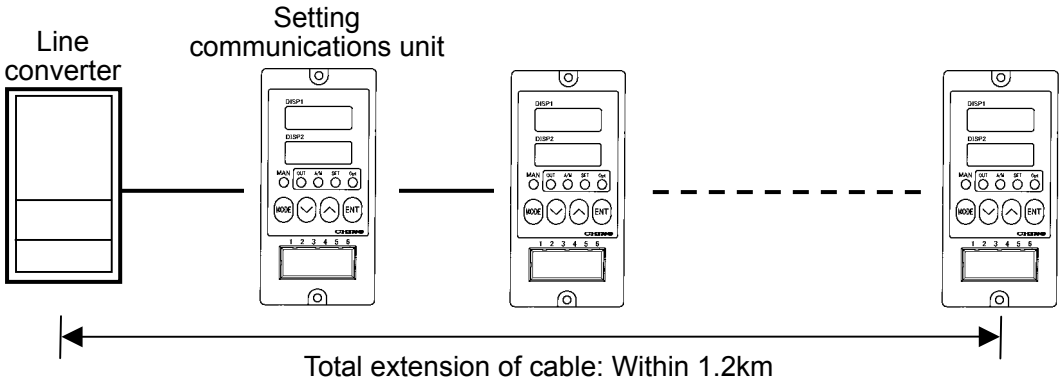
3.1.1 Communications Terminals

The terminal arrangement of RS-422A and RS-485 communications interface is different.

Terminal No.	RS-422A	RS-485
1	SDA	SA
2	SDB	SB
3	RDA	Short with 1.
4	RDB	Short with 2.
5	SG	SG

3.1.2 Total extension of RS-422A/485 communications cable is up to 1.2km.

The wiring interval between each instrument is option, but the total extension distance of cable is within 1.2km.
(Line converter ⇔ the final end of setting communications unit)



3.1.3 Noise preventive terminals

Separate the communications cable from drive power cables and other communications cable more than 50cm so as not to be affected by noises.

3.1.4 Mount a terminating resistor.

For using RS-422A or RS-485 communications interface, mount a 100 Ω resistor to the setting communications unit or other instrument connected at the final end. (For details, see Section 3.3.)
[A general metal film resistor can be used. The resistor (sold separately) is available from CHINO.]

3.1.5 Number of setting communications unit connectable

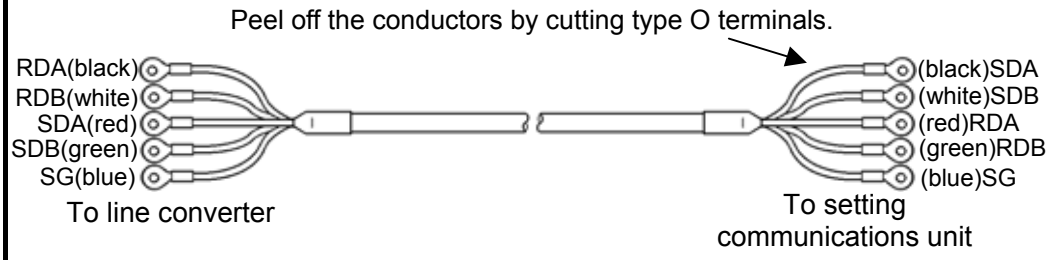
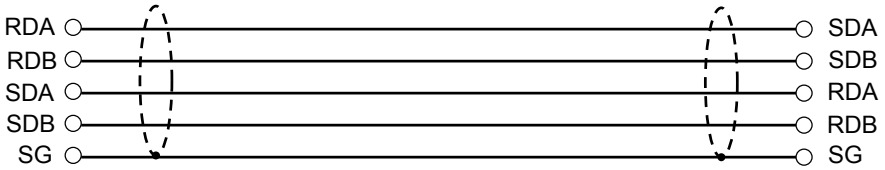
Up to 31 sets

3.2 Communications Cables

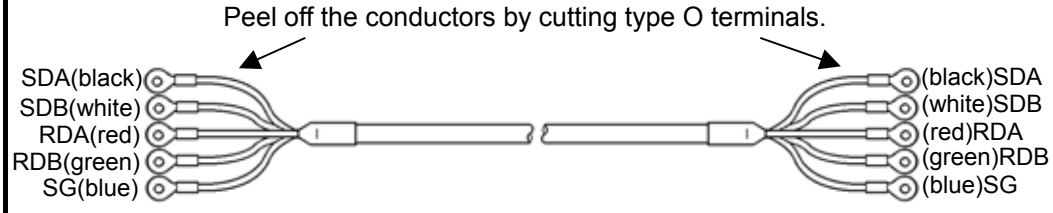
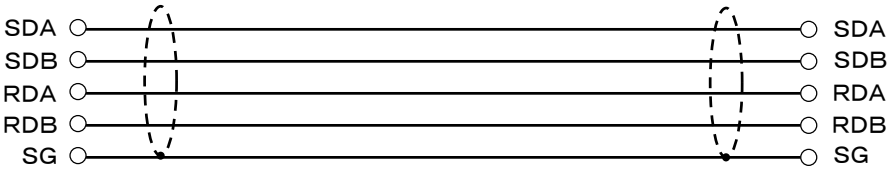
Make ready cables dedicated to communications before performing connection. Dedicated communications cables (sold separately) are available at CHINO.

3.2.1 Communications cables for RS-422A

(1) Connection between line converter and setting communications unit

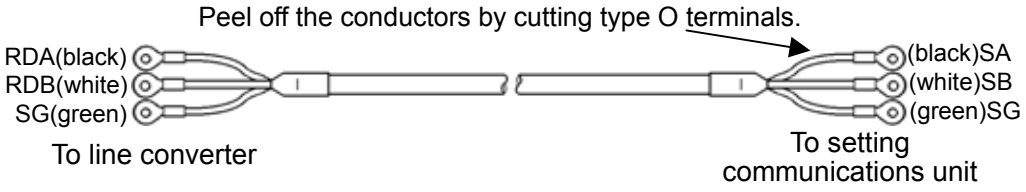
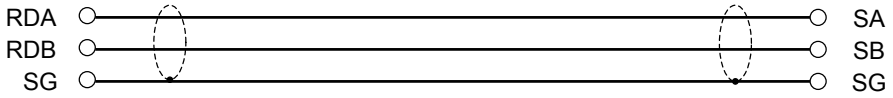
Cable	Type O crimp terminal ⟷ Twisted cable RS-422A cable (for line converter)
Style	 The cable consists of a pair of twisted dual-core VCTF wires with SG (signal grounding) wire at both ends. Cut off the SG wire on the line converter side because the converter has no SG terminal. Cut type O terminals and peel off conductors on the setting communications unit side.
Internal wiring	
Type code	RZ-CRA2□□ Cable length of 01 to 99 m (To be specified)

(2) Connection between setting communications unit and setting communications unit

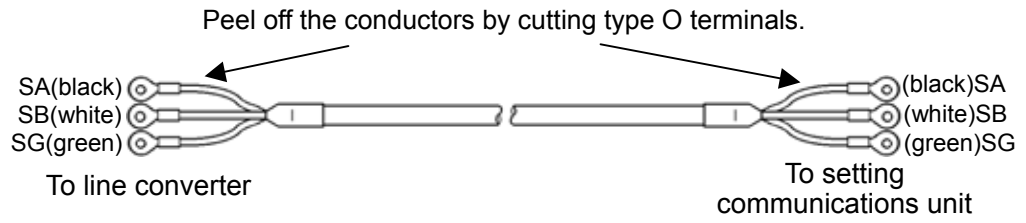
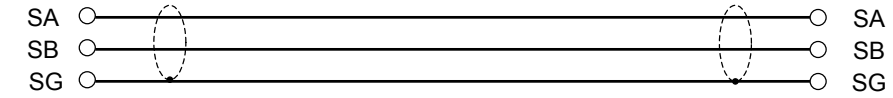
Cable	Twisted cable ⟷ Twisted cable RS-422A cable (for parallel connection)
Style	 The cable consists of a pair of twisted dual-core VCTF wires with SG (signal grounding) wire at both ends.
Internal wiring	
Type code	RZ-CRA1□□ Cable length of 1 to 99 m (To be specified)

3.2.2 Communications cables for RS-485

(1) Connection between line converter and setting communications unit

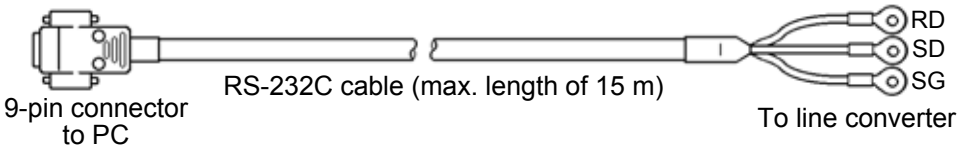
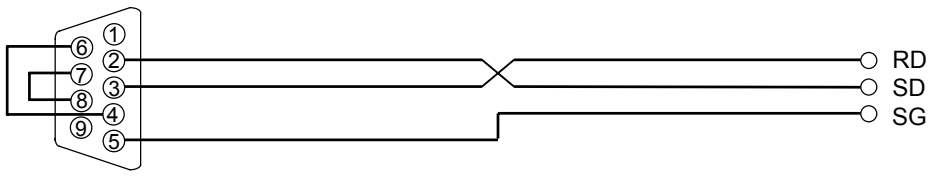
Cable	Type O crimp terminal ⟷ Twisted cable RS-485 cable (for line converter)
Style	 The cable consists of a twisted dual-core CVVS wires with SG (signal grounding) wire at both ends. Cut off the SG wire on the line converter side because this converter has no SG terminal.
Internal wiring	
Type code	RZ-LEC□□□ Cable length of 001 to 200 m (To be specified)

(2) Connection between setting communications unit and setting communications unit

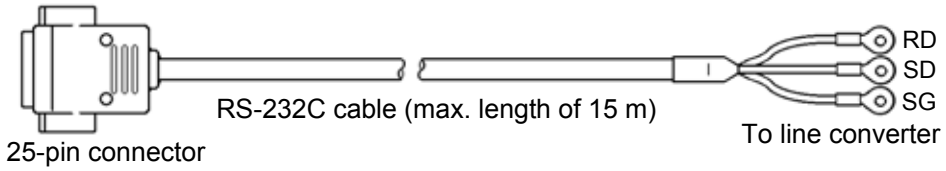
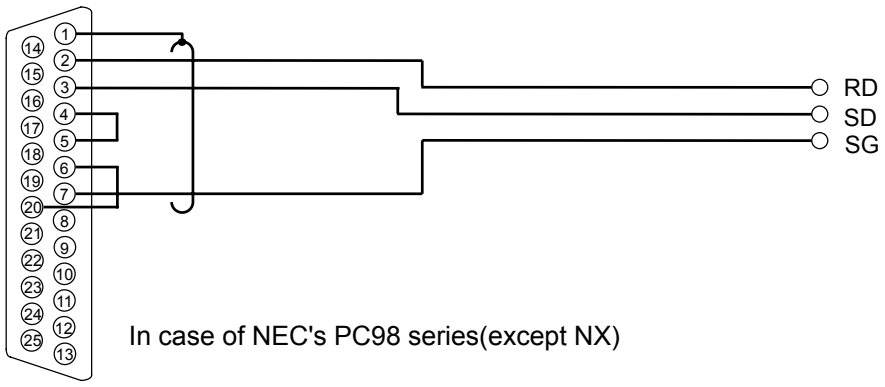
Cable	Twisted cable ⟷ Twisted cable RS-485 cable (for parallel connection)
Style	 The cable consists of a twisted dual-core CVVS wires with SG (signal grounding) wire at both ends.
Internal wiring	
Type code	RZ-CSS1Z2(0.2m) or RZ-LEC□□□ Cable length of 001 to 200 m (To be specified)

3.2.3 Communications cables for RS-232C (reference)

(1) Connection between PC (with 9-pin connector) and line converter.

Cable	9-pin connector ⟷ RS-232C cable with type O crimp terminal
Style	
Internal wiring	
Type code	**RZ-CRS6**□□ Cable length of 1 to 15 m (To be specified)

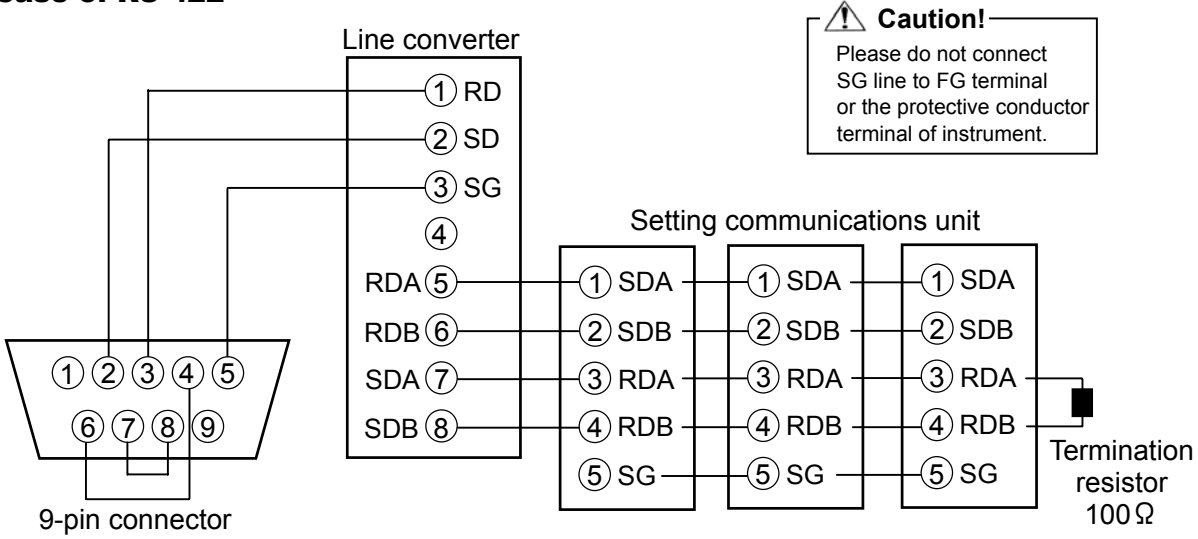
(2) Connection between PC (with 25-pin connector) and line converter.

Cable	25-pin connector ⟷ RS-232C cable with type O crimp terminal
Style	
Internal wiring	
Type code	**RZ-CRS2**□□ Cable length of 1 to 15 m (To be specified)

3.3 RS-422A/RS-485 Connections

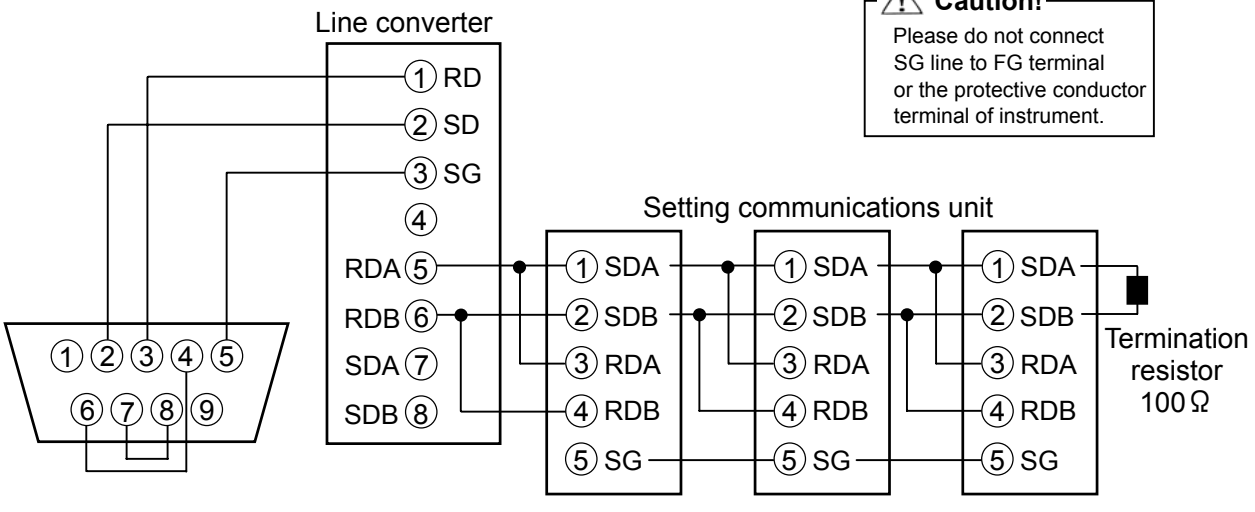
This paragraph shows the connection of RS-422A/485 communications interfaces to a personal computer by using the line converter (Model: SC8-10 from CHINO).
Since the line converter and the personal computer use three control signals (transmission, receiving, and signal grounding) only, the wiring arrangement in the connector is required like as RS-232C connections.
(For details, refer to the instruction manual for the line converter.)

In case of RS-422



* If the line converter is placed at the final end, mount a terminating resistor 100Ω between (5) and (6) of the line converter.
For CHINO SC8-10, the terminating resistor is connected by shorting between (4) and (5).

In case of RS-485



* If the line converter is placed at the final end, mount a terminating resistor 100Ω between (5) and (6) of the line converter.
For CHINO SC8-10, the terminating resistor is connected by shorting between (4) and (5).

4.MODBUS PROTOCOL

Basic Procedures of Communications and Precautions

⚠ Attention!

1. When you set the parameter (writing), set the key lock at first.

The setting communications unit is always ready for communications. It outputs a response at any time when data are requested from a master unit (personal computer, PLC, etc.).

However, for setting parameters of the setting communications unit from a master unit, it is necessary to set the setting communications unit to key lock condition in advance. Key lock is enabled by the function key of the setting communications unit or through communications from the master unit.

If parameters of the setting communications unit not being key lock condition are set from the master unit, the setting communications unit returns the error code of 12H.

2. Take care of command re-transmission as there is no control signal line in use.

Since the serial interfaces of the setting communications unit communicate freely without using any control line, a reception failure may occur under some conditions. Exercise care when resending a command.

3. Don't disconnect or short any cables or instruments constituting the serial interface, or turn the power on or off during communications.

Don't disconnect or short any cables or units constituting the serial interface, or turn the power on or off during communications, or the operation may stop or lead to a malfunction. When this happens, all the components of the serial interface must be reset to repeat the operation from the beginning.

4. Send the next command after making sure that the communications drive has been turned off.

For RS-485 communications interface, plural units are connected to the same communications line and only one instrument, of which instrument No. is specified by a master unit (personal computer, PLC, etc.), drives the communications line. The communications drive is turned off at a certain time (approx. 5 msec) after sending the last character so that the master unit receives all characters completely. If a personal computer transmits a command to the next unit before the communications drive is turned off, signals interfere with each other resulting in some communication failure. Exercise caution when you use a high-speed personal computer.

4.1 Message Transmission Modes

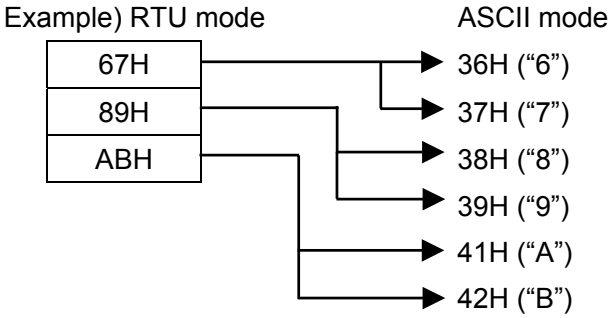
There are two modes of message transmission, RTU (Remote Terminal Unit) and ASCII, which can be selected by function keys.

(Table 1 Comparison between RTU and ASCII modes)

Item		RTU mode	ASCII mode
Interface		RS-422A、RS-485	
Communications system		Half-duplex start-stop synchronization	
Transmission speed		9600， 19200bps	
Character code		Binary	ASCII
Error check	Vertical	Parity	
	Horizontal	CRC-16	LRC
Character Configuration	Start bit	1 bit	
	Data bit	8 bits	7 bits, 8 bits
	Parity bit	No parity, even, odd	No parity, odd, even
	Stop bit	1 bit, 2 bits	
Message start code		None	: (Colon)
Message stop code		None	CR, LF
Data time interval		28 bit-time or shorter	1 second or shorter

4.1.1 Transmitted data

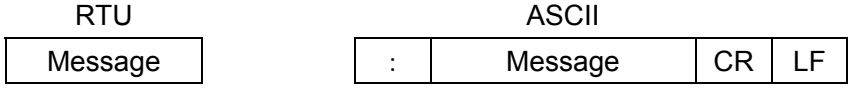
The RTU-mode data is transmitted in binary numbers. In ASCII mode, the 8-bit binary data of RTU is separated into higher-order 4 bits and lower-order 4 bits and both are characterized (0 - 9, A - F).



Length of the RTU-mode message is half that of an ASCII-mode message, ensuring a more efficient transmission.

4.1.2 Message frame configuration

The RTU-mode data consists only of a message section.
The ASCII mode data consists of a start character [: (colon, 3AH)], a message and a stop character [(CR (carriage return, 0DH) + LF (line feed, 0AH)].



The ASCII mode has the advantage of easier troubleshooting because its message has a start character [:].

4.2 Data Time Interval

In RTU mode: 28 bit-time or shorter (2.9 msec. at 9600 bps, 1.4 msec. at 19200 bps)
In ASCII mode: 1 second or shorter

When sending a message, keep the time interval of data constituting one message not longer than the time specified above. When the time interval of data is longer than the above, a receiving unit (i.e., this unit) recognizes that the data transmission from a sending unit is completed and this data is processed as an abnormally received message.
While message characters are continuously sent in RTU mode, the interval of data is maximum 1 second in ASCII mode, making it possible to use a master unit (personal computer, PLC, etc.) with a relatively slow processing speed.

4.3 Message Configuration

The MODBUS message has the following configuration in both RTU and ASCII modes.

Slave address
Function code
Data
Error check

4.3.1 Slave address

The slave address is the instrument number of this unit (See Section 2.2.) and the setting of this address (1 to 99) is necessary by function keys before communications. A master unit usually communicates with one slave unit. While all slave units being connected receive same message from the master unit, only the slave unit specified with the slave address included in the command message responds to the message transmitted.
The slave address "0" is used for a message (broadcast message) addressed to all slave units from a master unit. In this case, the slave units do not transmit any response to the master unit.

4.3.2 Function code

Function codes are for the functions to be executed by the slave units. The data is generally classified as follows. Refer to the reference table for details.

(Function code table)

Code	Functions	Unit	MODBUS original functions (ref.)
01	Read digital (ON/OFF) parameter	1 bit	Read coil status
02	Read digital input data	1 bit	Read input relay status
03	Read analog parameter	16 bits	Read hold register contents
04	Read analog input data	16 bits	Read input register contents
05	Write digital parameter	1 bit	Change single coil status
06	Write analog parameter	16 bits	Write into single hold register
08	Transmit received data (for diagnosis)		Loop-back test
15	Write two or more digital parameters		Change multiple coils status
16	Write two or more analog parameters		Write into multiple hold registers

4.3.3 Data section

Data configurations depend on the function codes. A request from a master unit is configured with the code number of the data to be read or written (Relative No. to be calculated from the Reference No. described below), the number of data pieces and others. A response from a slave unit configured with the data in responding to the request and others.
MODBUS basic data is a 16-bit integer and with/without codes depend on individual data. It is thus specified as integers with their decimal places assigned to separate addresses, or normalized with the high/low limits on a scale with fixed decimal places. The setting communications unit employs the system of assigning the decimal places to separate addresses.

4.3.4 Reference Nos.

Data in the setting communications unit have a "Reference No." assigned to each of them that is used as an identification of the data in reading and writing. The data in the setting communications unit are classified into "Digital parameter", "Digital input data", "Analog input data", and "Analog parameter" depending on their type. "Relative Nos." corresponding to the Reference Nos. specify data in a message.

(Table 3. Reference Nos. and Relative Nos.)

Data type	Reference No.	Relative No.
Digital parameter	1 to 10000	Reference No. – 1
Digital input data	10001 to 20000	Reference No. – 10001
Analog input data	30001 to 40000	Reference No. – 30001
Analog parameter	40001 to 50000	Reference No. – 40001

For details of reference numbers, see Page 22.

4.3.5 Error check

Error check for transmission frames is different between the transmission modes.
RTU mode: CRC-16
ASCII mode: LRC

4.3.5.1 Calculation of CRC-16

In the CRC system, the information to be transmitted is divided by a generating polynomial and the resulting remainder is added to the end of the data. The generation polynomial is as follows.

$$1 + X^2 + X^{15} + X^{16}$$

The calculation is executed from a slave address to the end of data with the following procedure.

1) Initialization of the CRC-16 data (assumed as X) (= FFFFH)
2) Exclusive logical sum (EX - OR) of data 1 and X $\longrightarrow$ X
3) 1 bit shifting of X to the right $\longrightarrow$ X
4) When a carry is generated, take A001H and EX-OR. If not, go to 5). $\longrightarrow$ X
5) Repeat 3) and 4) until shifting 8 times.
6) EX-OR of the next data and X $\longrightarrow$ X
7) Same as 3) to 5)
8) Repeating up to the last data
9) Creation of a message in the sequence from low to high orders of the calculated 16-bit data (X).

Example) When the data is 02H 07H, CRC-16 is 1241H and the error check data is 41H 12H.

Reference: CRC-16 Calculation Program

```
 10  D(1) = &H2 : D(2) = &H7 : N = 2
 20  GOSUB *CRCMAKE
 30  END
 40
100  *CRCMAKE
110  CRC = &HFFFF
120  FOR  I = 1 TO N
130   CRC = CRC XOR D(I)
140   FOR  J = 1 TO 8
150    CY = CRC AND &H1
160    IF CRC  <  0 THEN P = &H4000 ELSE
         P = 0 : GOTO 180
170    CRC = CRC AND &H7FFF
180    CRC = CRC \ 2
190    CRC = CRC OR P
200    IF CY = 1 THEN CRC = CRC XOR
         &HA001
210    NEXT  J
220  NEXT  I
230  IF CRC  <  0 THEN P = &H80 ELSE
       P = 0 : GOTO 250
240  CRC = CRC AND &H7FFF
250  C1 = CRC AND &HFF
260  C2 = ( CRC AND &H7F00 ) \ 256
270  C2 = C2 OR P
280  D (N+1) = C1 : D(N+2) = C2
290  RETURN
```

4.3.5.2 Calculation of LRC

The calculation is executed from a slave address to the end of data with the following procedure.

1) Creation of a message in RTU mode.
2) Addition of the start (slave address) to end of the data. → X
3) Complement (bit reverse) of X → X
4) Addition of 1 (X = X + 1)
5) Addition of X as LRC to the end of the message.
6) Conversion of the whole data to ASCII characters.

Example) When the data is | 02H | 07H | , LRC is F7H that is | 02H | 07H | F7H | as a binary message and the ASCII message is | 30H | 32H | 30H | 37H | 46H | 37H | .

4.3.6 Precautions on data processing

(1) The decimal place of each data is shown in the reference table. The decimal place is fixed or is specified in each measuring range, or is followed by linear decimal place setting. When data is replayed, you are required to check it carefully.
(2) Read or write the data with Reference Nos. specified. If data is written on any non-specified Reference No., the proper operation of the unit may be affected.
(3) While it is possible to write data on two or more discreet Reference Nos., a start number with Reference No. not specified will result in an error (error No. 02H).
(4) When reading multiple Reference Nos., the data with non-specified Reference No. is shown by "0".
(5) When an error is detected during writing on multiple Reference Nos., all the programming becomes invalid.

4.4 Creating a Message

A message consists of (1) Slave address, (2) Function code, (3) Data section and (4) Error check code.

Messages being able to read or write at one time are within the following range.

Function code	Number of data pieces	
	ASCII	RTU
01	64	64
02	64	64
03	32	32
04	32	32
15	64	64
16	32	32

How to create a message will be described by an example given below.

Example) Readout of voltage value and decimal point position of voltage value from the setting communications unit with [slave address 02]

4.4.1 RTU mode message

(1) Slave address : 02 (02H)

(2) Function code : 04 (04H)

For reading out the voltage value and decimal point position of voltage value, the function code is 04H as shown in the reference table. Its function is [analog input data readout]. (Refer to para.4.7) For details of respective function codes, refer to 4.5 Function codes.

(3) Data section:

Starting Relative No. 1100 (04H | 4CH) and Number of data pieces 2 (00H | 02H)

Reference Nos. "30001 to 40000" are assigned to measured data (analog input data). The reference table shows that "30101" is assigned to the voltage value and "30102" is assigned to the decimal point position of the voltage value. (See Section 4.7)

The relative No. of the starting "Reference No. 30101" is 30101 - 30001 = 100 that can be expressed by 2 bytes " 04H | 4CH ".(See Section 4.3.4)

The number of data pieces to be read is "2" of the voltage value and the decimal point position of voltage value which can be expressed by " 00H | 02H " in 2 bytes

(4) Error check: 1FB1H calculated with CRC-16 (B1H | 1FH)

Error check in RTU mode is calculated with CRC-16. (See Section 4.3.5.1)

The data in the message core part is:

02H	04H	04H	4CH	00H	02H

according to (1) to (3) and CRC-16 is 1FB1H.

Error check data is therefore | B1H | 1FH | .

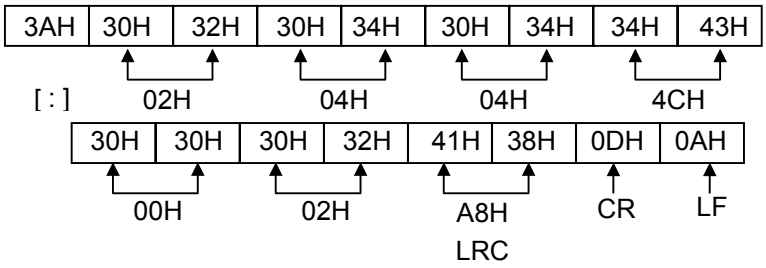
(5) Message:

02H	04H	04H	4CH	00H	02H	B1H	1FH

A message is created by the message configuration. (See Section 4.3)

4.4.2 Message in ASCII mode

The error check LRC is calculated with the message core part. (See Section 4.3.5.2). LRC is A8H. Each data in the core part is converted to ASCII code. LRC is also converted to ASCII code to be added to the core part. The character " : " is added to the start of the message, and "CR" and "LF" are added to the end of the message.



4.5 Function Code

Responses by function codes are shown below. (See Function code table in Section 4.3.2)
Note) See Section 4.6 for responses in abnormal status.

4.5.1 Read digital parameter (read coil status)

[Function code: 01 (01H)]
"Digital (ON/OFF) parameters with sequential numbers" starting from the specified Reference No. to the number of data pieces are read out. The response message data is configured by each eight ON/OFF data sequentially placed in one data (1 byte). The LSB of each data is the digital data with the smallest number. If the number of data pieces is not in multiplies of 8, an unnecessary bit is 0.

Example) Readout of digital setting values with Reference No. 1001 (AUTO/MANU) and 1002 (Run/Stop) of the slave unit 2

Reference No	1001	1002
Data	ON	ON
	MANU selection	Stop selection

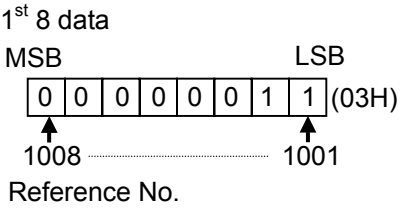
(RTU mode)

Master→Units

Slave address	02H
Function code	01H
Start No. (H)	03H
Start No. (L)	E8H
Number of data pieces (H)	00H
Number of data pieces (L)	02H
CRC (L)	3DH
CRC (H)	88H

Units→Master (normal)

Slave address	02H
Function code	01H
Number of data	01H
1st 8 data	03H
CRC (L)	11H
CRC (H)	CDH



(Error check in ASCII mode)

The error check: CRC (L) and CRC (H) are as follows.

LRC	10H	LRC	F9H

Note) Start No. (Relative No.) is given by "Reference No. - 1".
(Decimal number 1000 (=1001 - 1) → Hexadecimal 3E8H)

Note) Number of data is the number of data byte.
(This number is different from the number of requested data pieces. In the example given above, the number of requested data pieces is 2 and the number of data is 1).

4.5.2 Read digital input data (read input relay status)

[Function code. 02 (02H)]

"Digital (ON/OFF) input data with sequential numbers" starting from the specified Reference No. to the number of data pieces are read out. The response message data is configured by each eight ON/OFF data sequentially placed in one data (1 byte). The LSB of each data is the digital data with the smallest number. If the number of data pieces is not in multiplies of 8, an unnecessary bit is 0. The response example is the same as in "Function code 01", though its start number (Relative No.) is "Reference No. - 10001".

4.5.3 Read analog set value (read hold register contents)

[Function code. 03 (03H)]

"Analog parameters (2 bytes: 16 bits) with sequential numbers" starting from the specified Reference No. to the number of data pieces are read out. The response message data is configured by data split into high-order 8 bits and low-order 8 bits and arranged sequentially.

Example) Readout of slope setting and elevation of the slave unit 2
(Reading of analog parameters with Reference No. 41002 and 41003 of the slave unit 2)

Reference No.	41002	41003
Data	50 (0032H)	10 (000AH)

← Example of slope setting 50% and elevation 10%

(RTU mode)

Master→Units

Slave address	02H
Function code	03H
Start No. (H)	03H
Start No. (L)	E9H
Number of data pieces (H)	00H
Number of data pieces (L)	02H
CRC (L)	15H
CRC (H)	88H

Units→Master (normal)

Slave address	02H
Function code	03H
Number of data	04H
Slope data (H)	00H
Slope data (L)	32H
Elevation data (H)	00H
Elevation data (L)	0AH
CRC (L)	E8H
CRC (H)	FBH

(Error check in ASCII mode)

LRC	04H	LRC	22H

Note) Start No. (Relative No.) is given by "Reference No. - 40001".
(Decimal number 1001 (=41002-40001) → Hexadecimal 3E9H)

Note) Number of data is the number of data pieces bytes.

Note) The number of data pieces of a message receivable at one time (that can be transmitted from this unit) is limited. (See Section 4.4.).

4.5.4 Read analog input data (read input register contents)

[Function code. 04 (04H)]
"Analog parameters (2 bytes: 16 bits) with sequential numbers" starting from the specified Reference No. to the number of data pieces are read out. The response message data is configured by data split into high-order 8 bits and low-order 8 bits and arranged sequentially. The response example is the same as in "Function code 03", though its start number (Relative No.) is "Reference No. - 30001".

4.5.5 Write digital parameter (Change single coil status)

[Function code: 05 (05H)]
A digital parameter with a specified number is brought into a specified status (ON or OFF).

Example) Setting of the slave unit 2 to MANU (for using the manual setting value of the setting communications unit)
(Turning ON the digital setting value with Reference No. 1001 of the slave unit 2)

(RTU mode)

Master→Units	
Slave address	02H
Function code	05H
Parameter No. (H)	03H
Parameter No. (L)	E8H
Programming status (H)	FFH
Programming status (L)	00H
CRC (L)	0CH
CRC (H)	79H

Units→ Master (normal)	
Slave address	02H
Function code	05H
Parameter No. (H)	03H
Parameter No. (L)	E8H
Programming status (H)	FFH
Programming status (L)	00H
CRC (L)	0CH
CRC (H)	79H

(Error check in ASCII mode)

LRC	0FH

LRC	0FH

Note) The response message is the same as the command message in normal response.
Note) Parameter No. (Relative No.) is given by "Reference No. - 1".
(Decimal number 1000 (=1001-1) → Hexadecimal 3E8H)
Note) For its execution, program "FF00H". For setting to AUTO (for using input from the thyristor unit), program "0000H".
Note) When the slave address is programmed to "0", all slave units execute this command but no response is transmitted from any of them.

4.5.6 Write analog parameter (Write into a single hold register)

[Function code: 06 (06H)]
An analog parameter with a specified number is brought into a specified value.

Example) Setting of the manual output value of the slave unit 2 to 90.0%
(Setting of the analog parameter with Reference No. 41001 of the slave unit2 to "900")

(RTU mode)

Master→Units		Units→Master (normal)	
Slave address	02H	Slave address	02H
Function code	06H	Function code	06H
Parameter No. (H)	03H	Parameter No. (H)	03H
Parameter No. (L)	E8H	Parameter No. (L)	E8H
Programming data (H)	03H	Programming data (H)	03H
Programming data (L)	84H	Programming data (L)	84H
CRC (L)	09H	CRC (L)	09H
CRC (H)	1AH	CRC (H)	1AH

(Error check in ASCII mode)

LRC	86H	LRC	86H

Note) The response message is the same as the command message in normal response.
Note) Parameter No. (Relative No.) is given by "Reference No. - 40001".
(Decimal number 1000 (=41211 - 40001) → Hexadecimal 3E8H)
Note) When the slave address is programmed to "0", all slave units execute this command but no response is transmitted from any of them.

4.5.7 Loop back test

[Function code: 08 (08H)]
Transmission between master and slave units is checked. Response is made according to a specified diagnosis code. This unit performs the checking by returning the received data without any modification and the diagnosis code is fixed at “0000H”,

Example) Execution of "Loop back test" on the slave unit 2

(RTU mode)

Master→Units			Units→Master (normal)		
Slave address		02H	Slave address		02H
Function code		08H	Function code		08H
Diagnosis code (H)	Fixed	00H	Diagnosis code (H)	Fixed	00H
Diagnosis code (L)		00H	Diagnosis code (L)		00H
Arbitrary data		*	Received data		*
Arbitrary data		*	Received data		*
CRC (L)		*	CRC (L)		*
CRC (H)		*	CRC (H)		*

4.5.8 Write multiple digital parameters (Change multiple coils status)

[Function code: 15 (0FH)]
Digital parameters starting from the specified Reference No. to the number of data pieces are brought into a specified status (ON or OFF). ON or OFF is specified by 1 data in each 8 sequential pieces. The LSB of each data is the digital data with the smallest number. If the number of data pieces is not in multiplies of 8, an unnecessary bit is ignored.

Example）Setting of the slave unit 2 to MANU (for using the manual setting value of the setting communications unit) and selecting of stop condition
(Setting of the digital setting values with Reference No. 1001 and 1002 in the slave unit 2 to the following conditions)

Reference No.	1001	1002
Data	ON	ON
	MANU selection	Stop selection

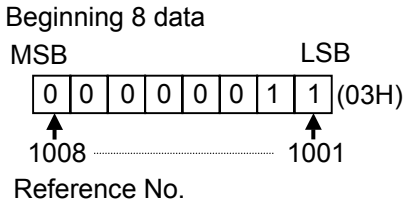
(RTU mode)

Master→Units

Slave address	02H
Function code	0FH
Start No. (H)	03H
Start No. (L)	E8H
Number of data pieces (H)	00H
Number of data pieces (L)	02H
Number of data	01H
1st 8 data	03H
CRC (L)	BEH
CRC (H)	A7H

Units→Master (normal)

Slave address	02H
Function code	0FH
Start No. (H)	03H
Start No. (L)	E8H
Number of data pieces (H)	00H
Number of data pieces (L)	02H
CRC (L)	54H
CRC (H)	49H



(Error check in ASCII mode)

LRC	FEH

LRC	02H

Note) Start No. (Relative value) is given by "Reference No. - 1".
(Decimal number 1000 (=1001 - 1) → Hexadecimal 3E8H)

Note) When the slave address is programmed to "0", all slave units execute this command but no response is transmitted from any of them.

Note) The number of data pieces of a message transmittable at one time (that can be received by this unit) is limited. (See Section 4.4.).

4.5.9 Write multiple analog parameters (Write into multiple hold registers)

[Function code: 16 (10H)]
Analog parameters starting from the specified Reference No. to the number of data pieces are brought into specified values. The data is transmitted by splitting into high-order 8 bits and low-order 8 bits and by arranging sequentially.

Example) Setting of the slave unit 2 to slope setting 50% and elevation 10%
(Setting of the analog parameters with Reference No. 41002 and 41003 of the slave unit 2)

Reference No.	41002	41003
Data	50 (0032H)	10 (000AH)

(RTU mode)

Master→Instruments

Slave address	02H
Function code	10H
Start No. (H)	03H
Start No. (L)	E9H
Number of data pieces (H)	00H
Number of data pieces (L)	02H
Number of data	04H
1st data (H)	00H
1st data (L)	32H
2nd data (H)	00H
2nd data (L)	0AH
CRC (L)	07H
CRC (H)	F1H

Instruments→Master (normal)

Slave address	02H
Function code	10H
Start No. (H)	03H
Start No. (L)	E9H
Number of data pieces (H)	00H
Number of data pieces (L)	02H
CRC (L)	90H
CRC (H)	4BH

(Error check in ASCII mode)

LRC	C0H

LRC	00H

Note) Start No. (Relative value) is given by "Reference No. - 40001".
(Decimal number 1001 (=41002 - 40001) → Hexadecimal 3E9H)

Note) When the slave address is programmed to "0", all slave units execute this command but no response is transmitted from any of them.

Note) The number of data pieces of a message transmittable at one time (that can be received by this unit) is limited. (See Section 4.4.).

4.6 Processing in Abnormal Status

The following response is given when any problem is found in the content of a message from a master unit.

4.6.1 No response

The message is ignored with no response given when

(1) A transmission error (overrun, framing, parity, CRC or LRC) is detected in the message;

(2) The slave address in the message is not the receiver's own address;

(3) Data interval in the messages is too long;

28 bits or longer in RTU mode

1 second or longer in ASCII mode

(4) Transmission parameters are not consistent with those of the receiver;

(5) The bytes of the received message exceed 96.

Note) When the slave address is "0" in the write function, the message is executed unless any error is detected in it, but with no response transmitted to it. Since no response is given also when the above error is detected in the message, whether it is normal or abnormal cannot be judged by the response from this unit when the slave address is "0".

4.6.2 Response error message

If the following failure is detected in a message from a master unit without any errors specified in Section 4.6.1, the code indicating the error is responded as an "error message".
The error message format is as follows.

Slave address
Function code + 80H
Error code
CRC(L)
CRC(H)

Function code	Function code + 80H
01	81H
02	82H
03	83H
04	84H
05	85H
06	86H
08	88H
15	8FH
16	90H

Error codes are as follows.

Error code	Description
01H	Function code failure When receiving an unspecified function code
02H	Relative No. (Reference No.) failure When the start No. or parameter No. received is not the specified number.
03H	Data pieces failure The number of data pieces to be transmitted in response to the message received exceeds a specified number. (See Section 4.4)
09H	Communications error between setting unit and JU thyristor unit ● If this error occurs when data are written continuously, data must be rewritten after resetting.
11H	Not in the programming range ● When a number not in the range of the reference table is set.
12H	Programming disabled ● Function keys are not locked. ● An attempt was made to set an item where no option is selected.

4.7 Setting unit reference table

Digital setting values

Reference No.	Function codes	Write/ Read	Data names	Setting ranges	Initial values	Remarks
1001	01 05 15	Read Write Write	AUTO / MANU	0 / 1 0000h/ff00h in case of function code 05	0	0:AUTO (for using input value from the thyristor unit) 1:MANU (for using manual setting values of the setting communications unit)
1002	01 05 15	Read Write Write	Run/Stop	0 / 1 0000h/ff00h in case of function code 05	0	0:Run (Contact input at the thyristor unit is effective.) 1:Stop
1003	01 05 15	Read Write Write	Parameters Not used / Used	0 / 1 0000h/ff00h in case of function code 05	0	Parameters (slope setting, high-limit/low-limit setting, soft start time) of the setting communications unit side 0: Not used / 1: Used
1010	01 05 15	Read Write Write	Disconnection alarm function Not used / Used	0 / 1 0000h/ff00h in case of function code 05	0	Effective only when optional disconnection alarm function is selected 0: Not used / 1: Used
1011	01 05 15	Read Write Write	Disconnection alarm Initial resistance value setting	0 / 1 0000h/ff00h in case of function code 05	0	Effective only when optional disconnection alarm function is selected 1: Set 0 when setting end
1012	01 05 15	Read Write Write	Current limit function Not used / Used	0 / 1 0000h/ff00h in case of function code 05	0	Effective only when optional current limit function is selected 0: Not used / 1: Used
1013	01 05 15	Read Write Write	Phase-angle firing/ Zero-cross firing	0 / 1 0000h/ff00h in case of function code 05	0	0: Phase angle firing 1: Zero-cross firing

Digital input data

Reference No.	Function codes	Write/ Read	Data names	Detailed description
11001	02	Read	JU communications error 1	0: Normal 1: Error (no response from JU tyristor unit)
11002	02	Read	JU communications error 2	0: Normal 1:Communications error between JU tyristor unit and setting communications unit
11003	02	Read	JU communications error 3	0: Normal 1: Error of parameter between JU thyrisotr unit and setting communications unit.
11010	02	Read	JU thyristor unit error	0: Normal 1: Error including JU thyristor unit memory error
11011	02	Read	Heater disconnection detection	0: Normal 1: Heater disconnection
11012	02	Read	Thyristor element error	0: Normal 1: Thyristor element abnormal
11013	02	Read	Over-current detection	0: Normal 1: Over-current detected
11014	02	Read	Rapid fuse breakage	0: Normal 1: Rapid fuse melted
11015	02	Read	Abnormal radiation fin temperature	0: Normal 1: Radiating fin temperature abnormal

Analog setting value

Reference No.	Function codes	Write/ Read	Data names	Setting ranges	Initial values	Remarks
41001	03 06 16	Read Write Write	Manual output	0.0 to 100.0 （0 to 1000）	0.0 （0）	Digital parameter Effective only when AUTO/MANU is set to MANU
41002	03 06 16	Read Write Write	Slope	0 to 100	100	Digital parameter Effective only when “used” is set in parameter selection
41003	03 06 16	Read Write Write	Elevation	0 to 100	0	Digital parameter Effective only when “used” is set in parameter selection
41004	03 06 16	Read Write Write	High-limit setting	0 to 100	100	Digital parameter Effective only when “used” is set in parameter selection
41005	03 06 16	Read Write Write	Low-limit setting	0 to 100	0	Digital parameter Effective only when “used” is set in parameter

Reference No.	Function codes	Write/ Read	Data names	Setting ranges	Initial values	Remarks
						selection

Reference No.	Function codes	Write/ Read	Data names	Setting ranges	Initial values	Remarks
41006	03 06 16	Read Write Write	Soft start time	1.0 to 20.0 （10 to 200）	1.0 （10）	Digital parameter Effective only when “used” is set in parameter selection
41010	03 06 16	Read Write Write	Heater disconnection ratio setting	10 to 100 （10 to 100）	100	Effective only when optional heater disconnection is selected
41011	03 06 16	Read Write Write	Heater disconnection delay time	0 to 255	0	Effective only when optional heater disconnection is selected
41012	03 06 16	Read Write Write	Current limit value	0 to 100	100	Effective only when optional current limit is selected
41013	03 06 16	Read Write Write	Feedback switching	0 to 4	Every model	Effective for phase-angle firing only Setting is possible in zero-cross firing. 0: None / 1: Voltage / 2: Current / 3: Power / 4: External
49501	03 06 16	Read Write Write	Function keys unlock/lock	0 to 1	0	0: Unlock / 1: Lock

Analog input data

Reference No.	Function codes	Write/ Read	Data names	Detailed description
31101	04	Read	Voltage value	Effective value voltage A decimal point is added by the following decimal point position.
31102	04	Read	Voltage value decimal point position	Decided by rated voltage
31103	04	Read	Voltage value status	0: Normal / 1: + over-range / 2: - over-range
31104	04	Read	Current value	Effective value current Decimal point is added by the following decimal point position.
31105	04	Read	Current value decimal point position	Decided by rated current
31106	04	Read	Current value	0: Normal / 1: + over-range / 2: - over-range

Reference No.	Function codes	Write/ Read	Data names	Detailed description
			status	
31107	04	Read	Power value	Effective value voltage Decimal point is added by the following decimal point position.
31108	04	Read	Power value decimal point position	Decided by rated voltage and rated current
31109	04	Read	Power value status	0: Normal / 1: + over-range / 2: - over-range
31110	04	Read	Load resistance value	Load resistance value Decimal point is added by the following decimal point position.
31111	04	Read	Load resistance value decimal point position	Decided by rated voltage and rated current
31112	04	Read	Load resistance value status	0: Normal / 1: + over-range / 2: - over-range

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