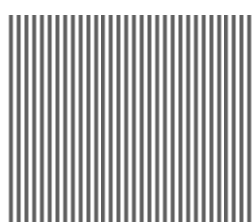


CHINO

Digital Program Controller

KP3000

**COMMUNICATIONS
INTERFACES**



INSTRUCTIONS

Retain this manual apart from the instrument
and in an easily accessible place.

Please make sure that this manual is handed to the final user of the instrument.

CHINO

Table of Contents

1. Introduction	- 1 -	9. PRIVATE protocol	- 59 -
2. For safe use of the product.....	- 2 -	9-1. Difference between RS—232C and	
2-1 Prerequisites for use	- 2 -	RS-422A/485	- 59 -
2-2. Symbol mark	- 2 -	9-2. Basic procedure of communication-	61 -
3. Overview	- 3 -	9-3. Communication format	- 63 -
3-1. RS-232C communication interface...	- 3 -	9-4. Positive response and negative	
3-2. RS-422A/485 communication interface -	3 -	response.....	- 70 -
4. Communication Protocol	- 4 -	9-5. Communication time chart	- 72 -
4-1. MODBUS Protocol	- 4 -	10. Communication (Digital) transmission -	74 -
4-2. PRIVATE Protocol	- 4 -	10-1. Overview	- 74 -
5. Communication Specifications	- 5 -	10-2. Specifications of communication	
5-1. MODBUS	- 5 -	division	- 75 -
5-2. PRIVATE.....	- 5 -	10-3. Communication transmission	
6. Setting the parameters for PC		setting	- 76 -
communication	- 6 -	10-4. Wiring	- 77 -
6-1. Communication speed (COM BIT RATE)		10-5. Example of combination.....	- 78 -
.....	- 7 -	11. Appendix	- 79 -
6-2. Set device number (COM NUMBER) -	7 -	11-1. Communication format list	- 79 -
6-3. Set the communication function (COM			
KIND)	- 7 -		
6-4. Setting communication protocol (COM			
PROTOCOL).....	- 8 -		
6-5. Setting communication character (COM			
CHARACTER)	- 8 -		
7. Wiring.....	- 10 -		
7-1. Precautions while wiring.....	- 10 -		
7-2. Cable for communication.....	- 11 -		
7-3. RS-232C connection	- 14 -		
7-4. Wiring of RS-422A/485	- 15 -		
8. MODBUS protocol.....	- 16 -		
8-1. Message transmission mode	- 17 -		
8-2. Data time interval.....	- 18 -		
8-3. Message configuration.....	- 18 -		
8-4. Method of creating a message	- 25 -		
8-5. Function code	- 26 -		
8-6. Process during abnormality	- 30 -		
8-7. Reference table	- 32 -		
8-8. MODBUS protocol support reference			
table.....	- 53 -		

1. Introduction

Thank you for purchasing Digital Program Setter 'KP3000 series'.

KP 3000 series is Digital Program Setter with output accuracy of $\pm 0.1\%$, output update cycle of approximately 0.1 seconds and front size of 96X96mm.

Up to 30 types of program patterns etc. are various functionalities that are provided as standard provisions. Besides a digital indicator with large easy to view LED display, various settings have an interactive system with high resolution dot matrix LCD display and handling is also easy with precise control.

Understand the setter properly and read this instruction manual beforehand in order to avoid any trouble.

This is a 'Communication' instruction manual. For general specifications, read 'General' instruction manual along with this manual.

Request

- For the persons doing instrumentation, installation and sales -

Be sure to handover this instruction manual to the persons using the controller.

- For the users of the controller -

Preserve this instruction manual until you scrap the controller.

Notice

1. You should not copy or forward fully or partially this document without prior notice.
2. The contents of this document may be changed without notice.
3. We have taken enough care regarding the contents of this document however if at all you notice a mistake or an omission contact our nearest office.
4. Please understand that regarding the result of the operation, whatever is the result the company will not be responsible.

2. For safe use of the product

In order to use the controller safely, read the following precautions and understand them.

2-1 Prerequisites for use

The controller is a general product of component type that is to be used by mounting it in a panel for instrumentation inside a room. Do not use it in any other condition.

When using, design a fail safe on the final product side and review regularly and use the controller after confirming the safety of the system. For the wiring, adjustment and operation of the controller, contact a professional having knowledge of instrumentation.

It is necessary that the people actually using this controller read this instruction manual, and have enough understanding of various precautions and the basic operations of the controller.

2-2. Symbol mark

The following symbol marks are used in the product itself and in this instruction manual hence understand the meaning of these symbol marks properly.

Symbol mark	Meaning
 Warning	If there is a possibility of death or severe injuries then explain the precautions to avoid that possibility.
 Precaution	If there is a possibility of small injuries or a possibility of the controller or its nearby devices getting damaged then explain the precautions to avoid those possibilities.
	It is a symbol for ground terminal. Always connect the ground terminal to protective grounding.

3. Overview

RS-232C, RS-422A, RS-485 are available in communication interface of KP and are used for communication with personal computer (hereinafter referred to as PC).

PC can receive measurement data from KP, various parameters can be set and operation commands can be issued. Number of KP connections is 1 for RS-232 and maximum 31 for RS-422A, RS-485.

3-1. RS-232C communication interface

RS-232C is the data communication standard set and executed by Electronic India Alliance (EIA) and Japanese equivalent for that is JIS C 6361.

This standard is basically an interface with modem and data terminal device connected to it and only electrical and mechanical specifications are given.

Presently RS-232C communication interface that is used in industrial instruments like PC and DB series, only some of them completely conform to the above standards, and signal wire count and connectors for connection etc. may sometimes differ from the standards.

As nothing is specified about the software part or what we call 'data transmission procedure' it does not mean that the devices that RS-232C communications interface can be connected unconditionally.

Hence, it is necessary that the designer investigates and confirms the specifications and transmission procedure of the mutual device. However if the connection partner is able to program those specifications optionally like the PC, the designer, by creating the appropriate program, can combine it with almost all the devices.

When investigating the RS-232C standards, the method of referring to JIS C 6361 is the simplest method.

3-2. RS-422A/485 communication interface

RS-422A/485 communication interface can communicate by connecting in parallel the KP series of a number of machines (maximum 31) through the signal that conforms to RS-422A/485.

PCs that have RS-422A/485 communication interface are less however as it is a serial communication, connection can be easily done by using RS232C $\longleftrightarrow$ RS-422A/485 signal converter.

Line converter (Our company model: SC8-10) for RS-232C $\longleftrightarrow$ RS-422A/485 signal conversion is available with our company. You may order it from us.

Difference between RS-422A and RS-485 is that RS-422A uses 4 signal wires whereas RS-485 uses 2 signal wires.

4. Communication Protocol

KP has the following two protocols and switching can be done by front key settings.

4-1. MODBUS Protocol

MODBUS is a registered trademark of SCHNEIDER company.

MODBUS protocol has two modes namely RTU mode and ASCII mode and switching can be done using front key settings. It has the transmission function of measurement data and settings, operation function.

4-2. PRIVATE Protocol

PRIVATE is usual CHINO protocol.

Switching is done by setting the front key. It has the transmission function of measurement data and settings, operation function.

Old instrument of CHINO products is compatible with new instrument, however the parameter, which can not be set by PRIVATE, can be set by MODBUS. We recommended using MODBUS protocol if communication is set newly.

5. Communication Specifications

5-1. MODBUS

• Communication system	: Half duplex asynchronous system (Polling selecting system)
• Protocol	: MODBUS protocol
• Communication speed	: 38400,19200,9600,4800,2400bps switching
• Start bit	: 1 bit
• Data length	: 7 bits (ASCII mode) 8 bits (RTU mode/ASCII mode)
• Parity bit	: None/even/odd
• Stop bit	: 1 bit/2 bits
• Transmission code	: ASCII (ASCII mode) Binary (RTU mode)
• Error check (Error detection)	: LRC (ASCII mode) CRC-16 (RTU mode)
• Data transmission procedure	: No procedure
• Usage signal name	: Sending and receiving data only(Without using the control signal)

5-2. PRIVATE

• Communication system	: Half duplex asynchronous system (Polling selecting system)
• Protocol	: PRIVATE protocol
• Communication speed	: 38400,19200,9600,4800,2400bps switching
• Start bit	: 1 bit
• Data length	: 7 bits
• Parity bit	: Even
• Stop bit	: 1 bit
• Transmission code	: ASCII code
• Error check (Error detection)	: BCC (Block check character) Check sum
• Data transmission procedure	: No procedure
• Usage signal name	: Sending and receiving data only (Without using the control signal)

6. Setting the parameters for PC communication

According to the flow chart, set these 5 parameters 'Communication speed', 'Device number', 'Communication function', 'Communication protocol' and 'Communication character'.

1. Click  key from the operation screen.
2. Select MODE 8 from 'Select MODE screen' using   key.
3. Set the following fields of Communication settings screen (MODE 8).

Communication (Option) MODE 8 COMMUNICATION	
↓   key	
Communication speed COM BIT RATE 9600 bps	Select the following communication speeds using   key Register using  key Setting range: 2400, 4800, 9600, 19200, 38400
↓   key	
Device number (For RS-422/485) COM NUMBER 01	Select instrument number using     key Register using  key Setting range: 01 to 99
↓   key	
Communication function COM KIND COM TRANS	Select the following communication function using   key Register using  key Setting range: COM, TRANS
↓   key	
Communication Protocol COM PROTOCOL MODBUS (RTU)	Select the communication protocol mentioned below using   key Register it using  key Setting range: MODBUS (RTU), MODBUS (ASCII), PRIVATE
↓   key	
Communication character COM CHARACTER 8BIT/NON /STOP1	Select communication characters mentioned below using the   key and register it using  key Setting range: 7BIT/EVEN/STOP1, 7BIT/EVEN/STOP2, 7BIT/ODD /STOP1, 7BIT/ODD /STOP2, 8BIT/NON /STOP1, 8BIT/NON /STOP2, 8BIT/EVEN/STOP1, 8BIT/EVEN/STOP2, 8BIT/ODD /STOP1, 8BIT/ODD /STOP2

In case of PRIVATE, the setting is 7BIT/EVEN/STOP1.

6-1. Communication speed (COM BIT RATE)

Use KP and PC in same communication speed. (Usually initial value can be 9600 bps.)

① Display 'COMBITRATE' using  key.

② Select communication speed using   key and register it using  key.

Communication speed: 2400bps, 4800bps, 9600bps, 19200bps, 38400bps, (Initial value is 9600bps)

6-2. Set device number (COM NUMBER)

Set the device number of KP at the time of RS-422A/485.

In single to multiple KPs that communicate with the PC, always do the settings such that one KP does not overlap with the other KPs.

① 'COM NUMBER' is displayed using the  key.

② Set device number (1 to 99) using     key, select it and register it using  key.



Precautions

- ① Device number should be in a range from 1 to 99 and it should not overlap with the other KPs. (Initial value 1)
- ② In case of RS-232C, KP is connected to 1 machine but set the device number. Usually initial value can be 1.

6-3. Set the communication function (COM KIND)

Set the communication function.

① Display 'COM KIND' using  key.

② Select communication function using   key and register it using  key.

③ If 'COM' is selected, it becomes a high order communication function.

④ If 'TRANS' is selected, it becomes communication transmission function.

Communication function: COM, TRANS

6-4. Setting communication protocol (COM PROTOCOL)

- ① 'COM PROTOCOL' is displayed using  key.
- ② Select communication protocol using   key and register it using  key.

Selection	Communication Protocol	Initial value
MODBUS (RTU)	MODBUS protocol RTU mode	MODBUS (RTU)
MODBUS (ASCII)	MODBUS protocol ASCII mode	
PRIVATE	PRIVATE protocol	

※ If communication protocol is changed, communication character changes to initial value.

6-5. Setting communication character (COM CHARACTER)

- ① 'COM CHARACTER' is displayed using  key.
- ② Select communication character using   key and register it using  key.

[MODBUS RTU]

Selection	Bit length	Parity	Stop bit	Initial value
8BIT/NON/STOP1	8bit	None	1	8BIT/NON/STOP1
8BIT/NON/STOP2			2	
8BIT/EVEN/STOP1		Even	1	
8BIT/EVEN/STOP2			2	
8BIT/ODD/STOP1		Odd	1	
8BIT/ODD/STOP2			2	

[MODBUS ASCII]

Selection	Bit length	Parity	Stop bit	Initial value
7BIT/EVEN/STOP1	7bit	Even	1	7BIT/EVEN/STOP1
7BIT/EVEN/STOP2			2	
7BIT/ODD/STOP1		Odd	1	
7BIT/ODD/STOP2			2	
8BIT/NON/STOP1	8bit	None	1	
8BIT/NON/STOP2			2	
8BIT/EVEN/STOP1		Even	1	
8BIT/EVEN/STOP2			2	
8BIT/ODD/STOP1		Odd	1	
8BIT/ODD/STOP2			2	

[PRIVATE] (*When communication protocol is PRIVATE, communication character screen is not displayed)

Selection	Bit length	Parity	Stop bit	Initial value
7BIT/EVEN/STOP1	7bit	Even	1	7BIT/EVEN/STOP1

7. Wiring

7-1. Precautions while wiring

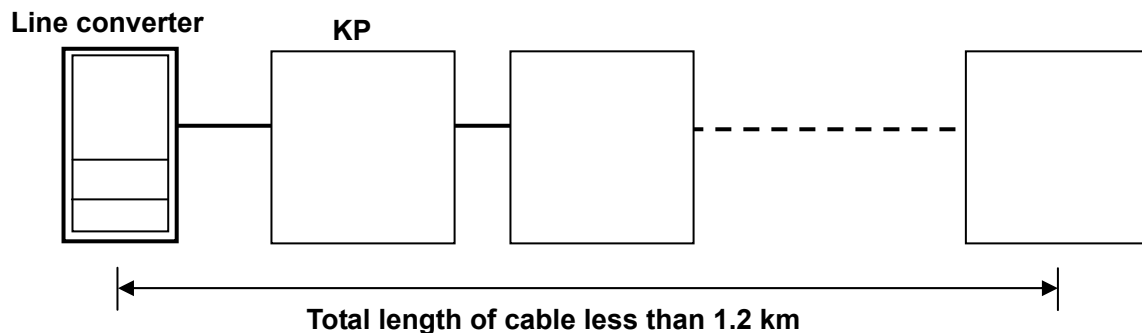
1. Communication terminal

Depending on the communication interfaces that are specified, terminal arrangement differs.
Refer to 4-3 Wiring in instruction manual [general] for terminal numbers.

2. Total length of RS-422A/485 communication cable is less than 1.2 km

Wiring space between each device can be anything but the total cable length distance is less than 1.2km.

(Line converter $\longleftrightarrow$ Last terminal KP)



3. Take action to avoid intermixing of noise.

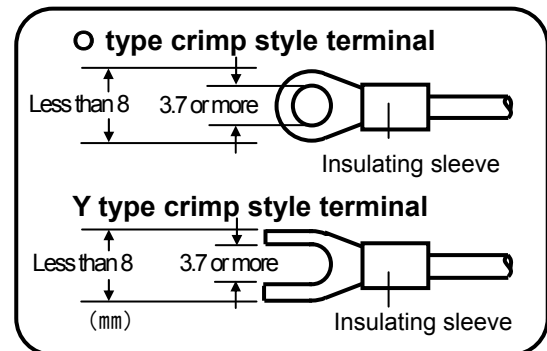
To avoid effect of noise place the power cable and other communication cables away from each other by at least 50 cm or more.

4. Always perform the crimp-style terminal process.

One of the causes of communication defect is loss of connection.

Always process the communication cable terminal using O type or Y type crimp style terminal with insulation sleeve.

(Terminal screw of KP, line converter is M3.5mm.)



5. Apply last terminal resistance.

When using RS-422A/485 communication, apply a resistance of 100Ω to the KP place in the last terminal. (For details, see clause 7.4)

(General metal coating resistance is okay. It is available with our company and you may order it.)

6. Number of machines of DB connections

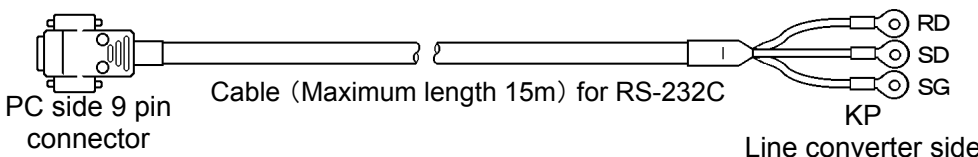
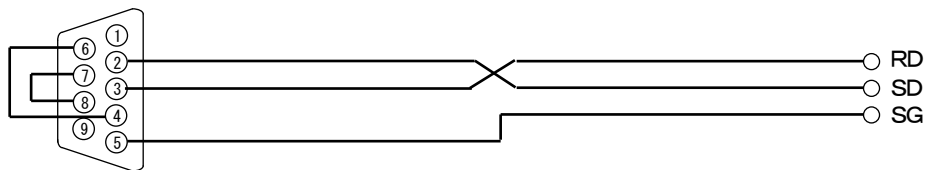
For RS-232C	:1
For RS-422A/485	: Maximum 31

7-2. Cable for communication

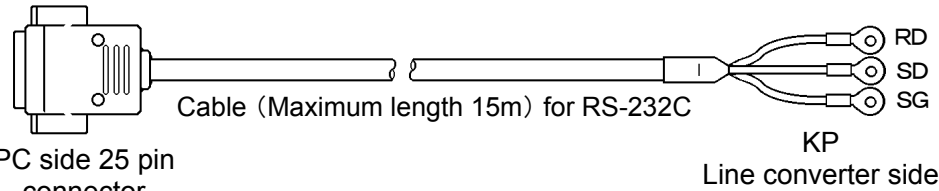
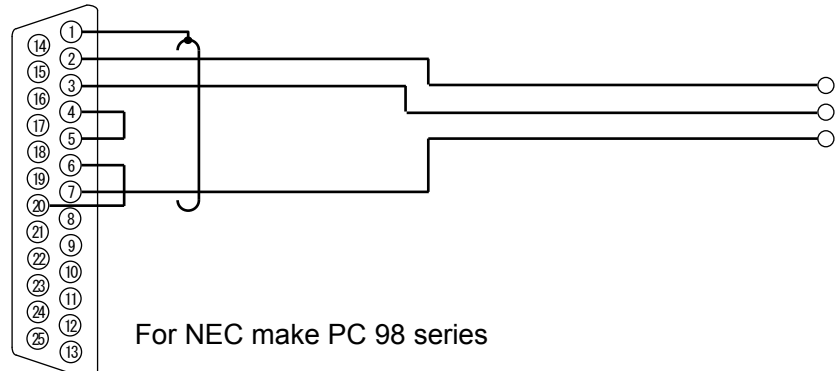
Before connecting, prepare the exclusive communication cables. They are available with our company also and you can order them.

7-2-1. Communication cable for RS-232C (Between PC/Line converter)

① Connection between PC (9 pin) and KP, PC (9 pin) and line converter

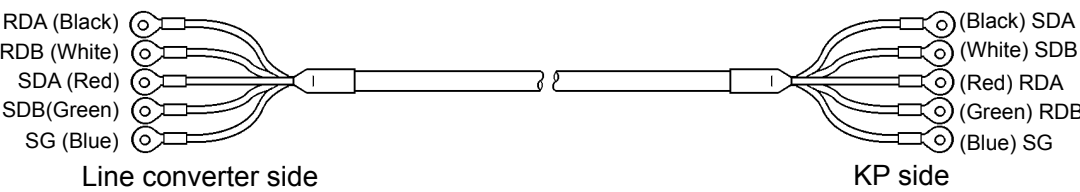
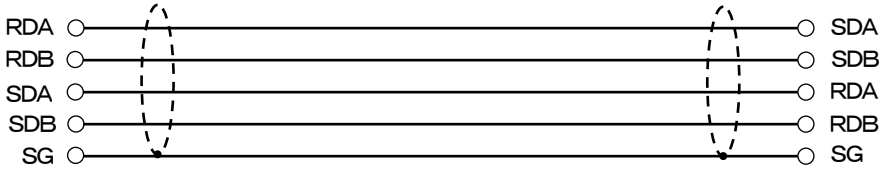
Cable	9 pin connector ↔ 0 type crimp-style terminal ↔ RS-232C cable
Format	 PC side 9 pin connector Cable (Maximum length 15m) for RS-232C Line converter side
Internal wiring	 RD SD SG
Model code	RZ-CRS6 □□ Cable length is 1 to 15m (Specified)

② Connection between PC (25 pin) and KP, PC (25 pin) and line converter

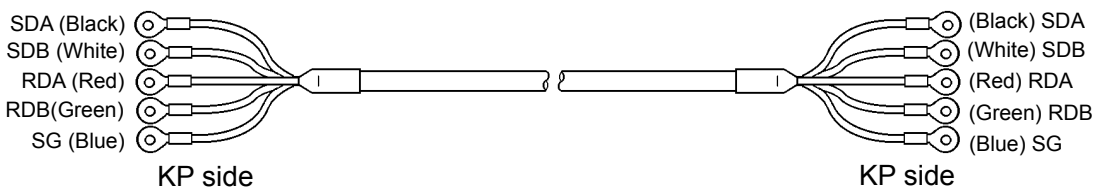
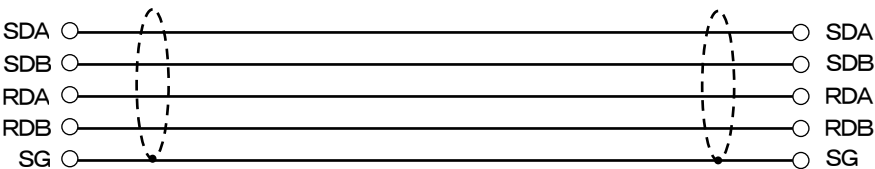
Cable	25 pin connector ↔ 0 type crimp-style terminal RS-232C cable
Format	 PC side 25 pin connector Cable (Maximum length 15m) for RS-232C Line converter side
Internal wiring	 For NEC make PC 98 series
Model code	RZ-CRS2 □□ Cable length is 1 to 15m (Specify)

7-2-2. Communication cable for RS-422A

① Connection between line converter and KP

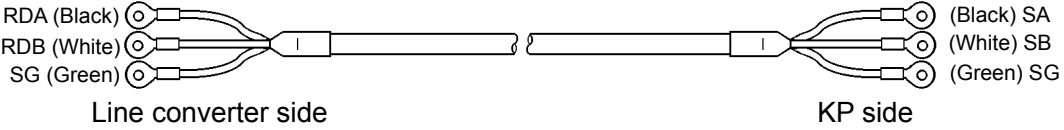
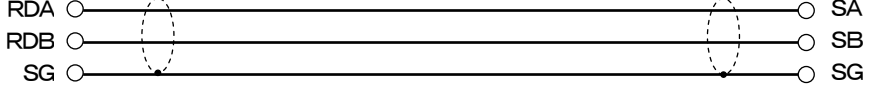
Cable	0 type crimp style terminal ↔ 0 type crimp style terminal RS-422A cable (For line converter)
Format	 SG (Signal grand) wiring is available on both sides using 2 wick VCTF wire that is further twisted to 4 wicks. It is disconnected and used as there is no SG terminal on the line converter side.
Internal wiring	
Model code	RZ-CRA2□□  Cable length is 01 to 99m (Specified)

② Connection between KPs

Cable	0 type crimp style wire ↔ 0 type crimp style RS-422A cable (For serial connection)
Format	 SG (Signal grand) wiring is available on both sides using 2 wick VCTF wire which is further twisted to 4 wicks.
Internal wiring	
Model code	RZ-CRA1□□  Cable length is 01 to 99m (Specified)

7-2-3. Communication cable for RS-485

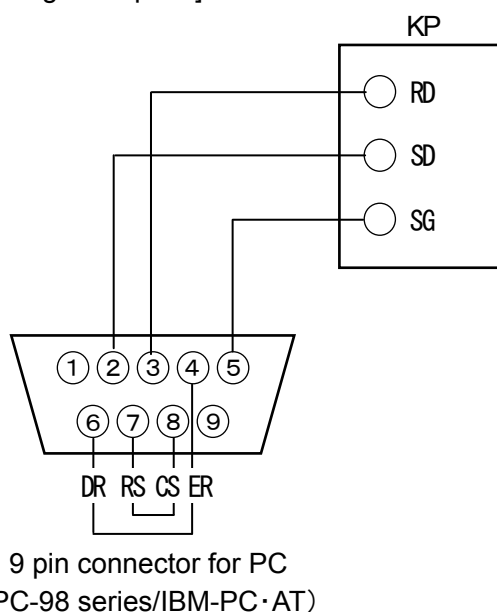
① Connection between line converter and KP; and between KPs

Cable	0 type crimp style terminal ↔ 0 type crimp style terminal RS-485 cable
Format	 Line converter side KP side SG (Signal Grand) wire is available in both the terminals using 2 wick cable made by twisting CVVS wire. It is disconnected and used as there is no SG terminal on the line converter side.
Internal wiring	 RDA ○ RDB ○ SG ○ SA ○ SB ○ SG ○
Model code	RZ-LEC□□□ └ Cable length is 001 to 200m (Specified)

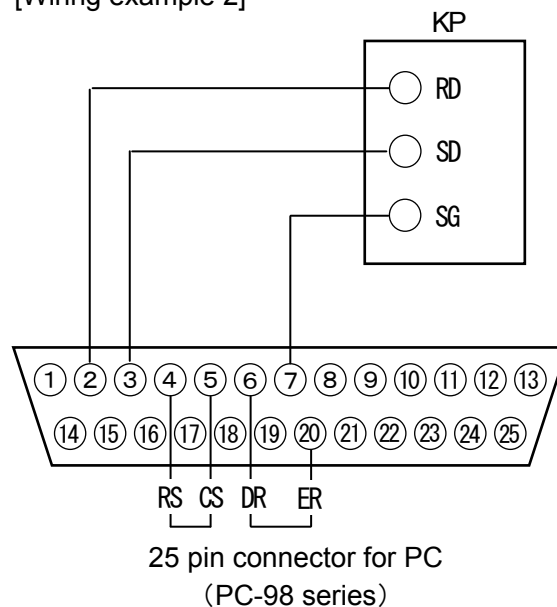
7-3. RS-232C connection

KP uses sending, receiving and Signal Grand (SG) only and does not use any other control signal. In general PC as controlling is done by control signal, it does not operate just by connecting 3 signal wires. As the wiring process in the connector, differs on how the PC controls the control signal, see the instruction manual of the PC that is being used.

[Wiring example 1]



[Wiring example 2]



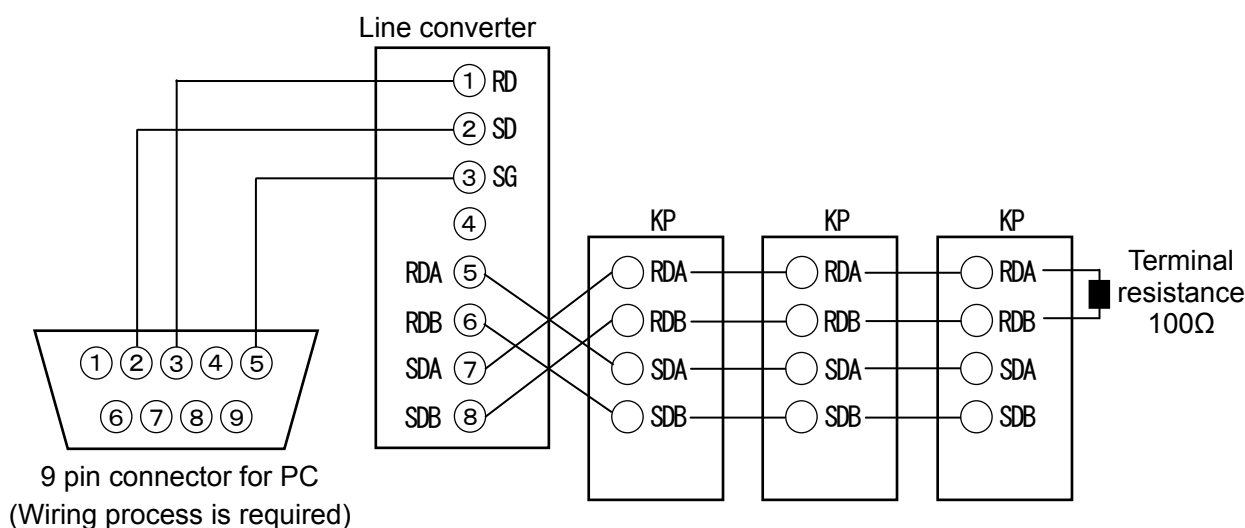
Precautions

RS-232C cable length is maximum 15m. NEC make PC98 series 9 pin connector is 'Wiring example 1' and 25 pin connector is connected as shown in 'Wiring example 2'.

7-4. Wiring of RS-422A/485

Connect RS-422A/485 communication interface to the PC using line converter (Our company model: SC8-10). Line converter and PC use only three signals namely send, receive and signal ground and do not use any other control signal. Hence, wiring process in the connector similar to that in RS-232C connection is necessary. (For details, see the instruction manual of the line converter.)

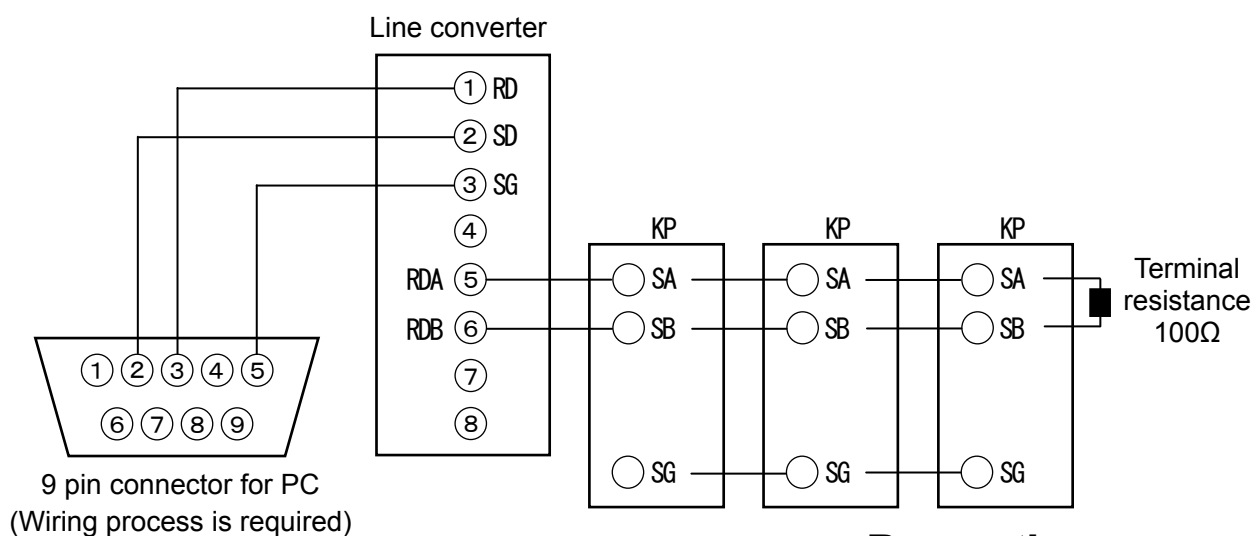
Wiring of RS-422A



⚠ Precautions

Do not connect the SG wire to FG terminal or grounding terminal of the device.

Wiring of RS-485



⚠ Precautions

Do not connect the SG wire to FG terminal or grounding terminal of the device.

8. MODBUS protocol

Basic procedure and precautions regarding communication



Precautions

In order to avoid accidents always read the contents and understand them.

1. When setting (Right) the parameters, setting is controlled using key operations.

Communication is possible any time in KP. Response is received against the data request from the PC at any time.

2. Device number is necessary in RS-232C also.

In RS-232C, PC and KP are connected on one to one basis. Device is set and communication for this device number is performed.

3. As control signal wire is not used, consider resending the command.

Serial interface of KP communicates without using the control wire. As a result, sometimes reception defect may occur due to KP status hence consider resending the command.

4. Do not remove the communication cable or a device and do not switch ON-OFF the power supply during communication.

If cable or device that makes up the serial interface is removed or power supply is switched ON-OFF, operation is stopped and error may occur. If this is the status, it is necessary to reset all the devices that make up the serial interface and redo everything from the beginning.

5. Send the next command only after confirming that the communication drive is OFF.

In RS-422A/485, multiple devices are connected to the same communication line and only one machine whose device number is specified by the PC drives the communication line. At that time in order that the PC receives all the characters for sure, let some time elapse after the last character is sent and then switch OFF the drive of communication line. If command for the next device is sent by the PC before it gets switched OFF, signals conflict and normal communication is not performed, hence take care when using high speed PCs. This interval is approximately 5ms.

8-1. Message transmission mode

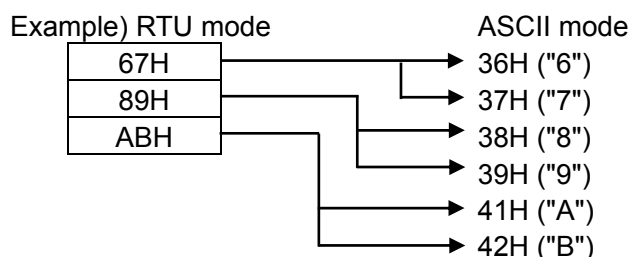
There are two types of modes namely RTU (Remote Terminal Unit) mode and ASCII mode and they are selected using the front key setting.

<Table 1 Comparison between RTU mode and ASCII mode>

Item		RTU mode	ASCII mode
Interface		RS-232C, RS-422A, RS-485	
Communication system		Half duplex asynchronous system	
Communication speed		2400,4800,9600,19200,38400bps	
Transmission code		Binary	ASCII
Error check (Error detection)	Vertical direction	Parity	
	Horizontal direction	CRC-16	LRC
Character configuration	Start bit	1 bit	
	Data length	7 bit/8 bits	
	Parity bit	None/even/odd	
	Stop bit	1 bit/2 bits	
Message start code		None	: (Colon)
Message end code		None	CR, LF
Data time interval		Less than 28 bit time	Less than 1 second

8-1-1. Transmission data

RTU mode is binary forwarding. ASCII mode splits the RTU 8 bit binary into high order and low order 4 bits and garbles each character (0 to 9, A to F).

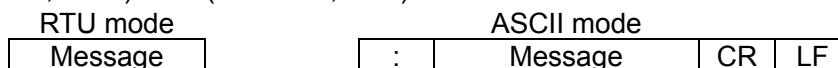


As the length of message in RTU mode is half that of ASCII mode and hence effective transmission is done.

8-1-2. Configuration of the message frame

RTU mode is made up of message part only.

ASCII mode is made up of start character ": (Colon, 3AH)", message and end character "CR (Carriage return, 0DH) + LF (Line feed, 0AH)".



ASCII mode has a strong point that, as the start character is ":" it facilitates troubleshooting.

8-2. Data time interval

During RTU mode: Less than 9600bps = 20msec, 9600bps or more = 5msec

During ASCII mode: Less than 1 second

When sending a message, do not let the time interval of data that makes up one message exceed the time span mentioned above. If it exceeds the time interval mentioned above, the receiving side (this device), in order to judge the end of transmission from the transmission side, processes it as an abnormal message reception.

In RTU mode message characters should be sent continuously whereas in ASCII mode as character gap is maximum 1 second, master (PC) processing speed is comparatively slow but it can be used.

8-3. Message configuration

MODBUS message is made up of the following, in case of both the RTU and ASCII mode.

Slave address
Function code
Data
Error check

8-3-1. Slave address

Set the slave address beforehand in a range of 1 to 99 using front key setting. Master usually does the transmission with one slave. All the connected devices receive in common the message sent from the master. However, the slave whose slave address matches with the slave address in the command message only responds to that message.

Slave address '0' is used in message (broad cast) for all the slaves from the master. In this case the slave does not return a response.

8-3-2. Function code

Function code is a code that is to be executed in the slave and each data is roughly categorized as follows. For details, see the reference table.

- ① Digital input data : DI input status etc.
- ② Analog setting value : Various setting information. Numeric value range is a numeric value within the range of 16 bits.
-32768 to 32767 (For details see reference table).
- ③ Analog input data : Measurement data, status etc. Numeric value range is a numeric value within a range of 16 bits.

<Table 2. Function code table>

Code	Function	Unit	MODBUS original function (Reference)
02	Reads digital input data	1 bit	Reads input relay status
03	Reads analog setting value	16 bits	Reads the contents of maintenance register
04	Reads analog input data	16 bits	Reads the contents of input register
06	Writes the analog setting value	16 bits	Writes to single maintenance register
08	Loop back test (Sends the received data)		Loop back test
16	Writes multiple analog setting values		Writes to multiple maintenance registers

8-3-3. Data division

Function of data differs depending on the function code. During the request from the master, it consists of code number (relative number calculated from reference number mentioned hereinafter) of the data that is to be read and written and the data unit count etc. Response from the slave is made up of data etc. that is requested.

Basic data of MODBUS is 16 bit integer on a whole and presence or absence of tag is specified for each data. Thus by putting the decimal point after another number make it as an integer value or by fixing the decimal point position make it standard by upper and lower limit of the scale and express it. In KP, a system of putting the decimal point in a different position is fetched.

Precautions

In the data division, specific numeric value can be assigned as error data, like input data. When using such data, first judge the error of the data and then combine it with decimal point data. If it is combined with decimal data earlier, then error data is mistook as normal data.

8-3-4. Reference number

In the KP, there is a number called 'Reference number' that is allotted and it is required when reading and writing the data. KP is categorized depending on its type, into 'Digital input data', 'analog input data' and 'analog settings value'. Number in the message is specified by "relative number" which is corresponding with each reference number.

<Table 3. Reference number and relative number>

Data kind	Reference number	Relative number	MODBUS original (Reference)
Digital input data	10001 to 20000	Reference number-10001	Input relay
Analog input data	30001 to 40000	Reference number-30001	Input register
Analog setting value	40001 to 50000	Reference number-40001	Maintenance register

Example) Relative number of execution SV of 'Reference number 30109' is '108'.

<Table 4. Reference number chart table>

Data kind	Parameter	Reference number	Relative number	Code	Reference table
Digital input Data	System abnormality status Alarm status	10002 to 10124	1 to 123	02	Section 8-7-3
Analog setting value	Setup parameter 1 Setup parameter 2 1 type parameter Execution parameter & specific parameter 8 type parameter No.1 8 type parameter No.2 8 type parameter No.3 8 type parameter No.4 8 type parameter No.5 8 type parameter No.6 8 type parameter No.7 8 type parameter No.8 System information Program pattern information Program pattern setting/editing Operation status information	40008 to 40020 40052 to 40092 40147 40151 40221 to 40224 40271 to 40274 40321 to 40324 40371 to 40374 40421 to 40424 40471 to 40474 40521 to 40524 40571 to 40574 48001 to 48033 49003 to 49049 49055 to 49096 49501 to 49534	7 to 19 51 to 91 146 150 220 to 223 270 to 273 320 to 323 370 to 373 420 to 423 470 to 473 520 to 523 570 to 573 8000 to 8032 9002 to 9048 9054 to 9095 9500 to 9533	03 06 16	Section 8-7-1
Analog input data	Real data, parameter information	30103 to 30144	102 to 143	04	Section 8-7-2

8-3-5. Error check

Error check of transmission frame differs depending on the mode.

RTU mode: CRC-16

ASCII mode: LRC

① Calculation of CRC-16

CRC system assigns the information that is to be sent, by generating polynomials, and sends the rest of the information by appending it at the end. Generating polynomial is as follows.

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

Target extends from slave address to the end of the data and calculation is done by the following procedure.

- 1) Initialization (=FFFFH) of CRC-16 data (Consider it as X)
- 2) Exclusive-OR (EX-OR) of data 1 and X → X
- 3) Shift X one bit to the right → X
- 4) If carry appears get A001H and EX-OR. If it does not appear, go to 5). → X
- 5) Repeat 3) and 4) until shifting is done for 8 times.
- 6) Net data and EX-OR of X. → X
- 7) Same as 3) to 5).
- 8) Repeat until the end of the data.
- 9) Create messages in low order and high order of 16 bit data (X) that is calculated.

Example) When data is [02H] [07H], CRC-16 becomes 1241H hence the error check data becomes [41H] [12H].

Reference: CRC-16 calculation program

```
/***** CRC-16 calculation program (C language) *****/
#include <stdio.h>
#include <conio.h>

void main(void)
{
    /** Internal change declaration **/
    unsigned int      iLoopCnt;                /* Loop counter */
    unsigned short    usData;                  /* Input data */
    unsigned short    usCrcData;               /* CRC-16 data */
    unsigned short    usErrChkData;           /* Error check data */
    int               iDummy;                 /* Dummy variable */

    /* Initialize the output result of CRC-16 data */
    usCrcData = 0xffff;

    printf("Enter hexadecimal data.(End using [q]) >\n");
    while( scanf("%x",&usData) != 0 )
    {
        /* Get the exclusion of CRC output result and the data that is input */
        usCrcData = usData ^ usCrcData;

        /** Do the CRC calculation **/
        /* Repeat till shifting up to 8 bits is done */
        for( iLoopCnt = 0 ; iLoopCnt < 8 ; iLoopCnt++ )
        {
            /* Check the existence of carry */
            if( usCrcData & 0x0001 )
            {
                /* When carry occurs */
                /* Shift CRC output result 1 bit to the right */
                usCrcData = usCrcData >> 1;

                /* Get the exclusion with A001H */
                usCrcData = usCrcData ^ 0xa001;
            }
            else
            {
                /* When carry does not occur */
                /* Shift CRC output result 1 bit to the right */
                usCrcData = usCrcData >> 1;
            }
        } /* for */
    } /* while */

    printf( "CRC-16 data is %xH.\n", usCrcData );

    /* Create error check data */
    usErrChkData = ( usCrcData >> 8 ) | ( usCrcData << 8 );
    printf( "Data for error check is %xH.", usErrChkData );

    iDummy = getch();
}
```

② LRC calculation method

Target extends from slave address to the end of the data and calculation is done by the following procedure.

- 1) Create message in RTU mode.
- 2) Add from the beginning (Slave address) to the end of data. → X
- 3) Get the complement (bit inversion) of X. → X
- 4) Add 1.(X=X+1)
- 5) Add X as LRC at the end of the message.
- 6) Convert everything to ASCII character.

Example) When data is [02H][07H], LRC becomes [F7H] hence

Binary message becomes [02H] [07H] [F7H]

ASCII message becomes [30H] [32H] [30H] [37H] [46H] [37H]

Reference: LRC calculation program

```
/* LRC calculation program (C language) */
```

```
#include <stdio.h>
```

```
#include <conio.h>
```

```
void main(void)
```

```
{
```

```
    /* Internal variable declaration */
```

```
    unsigned short    usData;                /* Input data */
```

```
    unsigned short    usLrcData;            /* LRC data */
```

```
    int               iDummy;              /* Dummy variable */
```

```
    /* Initialize the output result of LRC data */
```

```
    usLrcData = 0;
```

```
    printf(" Enter hexadecimal data.(End using [q]) >\n");
```

```
    while( scanf("%x",&usData) != 0 )
```

```
    {
```

```
        /* Add from the beginning to the end of the data */
```

```
        usLrcData += usData;
```

```
        /* Cancel high order, 1 byte */
```

```
        usLrcData = usLrcData & 0xff;
```

```
    } /* while */
```

```
    /* Get the exclusion with FFH */
```

```
    usLrcData = usLrcData ^ 0xff;
```

```
    /* Add 1 */
```

```
    usLrcData = usLrcData++;
```

```
    /* Cancel high order, 1 byte */
```

```
    usLrcData = usLrcData & 0xff;
```

```
    /* LRC error check */
```

```
    printf( "LRC-16 data is %xH..\n", usLrcData );
```

```
    iDummy = getch();
```

```
}
```

8-3-6. Precautions while processing the data

- ① Decimal point position of each data is clearly mentioned in the reference table. There are various points like fixing the decimal point position, points to be decided for every measurement range (See section 8.9) items as per linear decimal point setting. Take care about the decimal point position when data is regenerated.
- ② As every data can be accessed (changed), it is necessary to take care at the time of setting the related data. For example, there exists data initialization process etc. depending on the change in the measurement range. Process contents are mentioned in reference number table.
- ③ Read and write the data in the range of the numbers, specified by reference number. If data is read and written for the reference numbers that are not specified, device operation may get affected.
- ④ Many reference numbers that are not continuous can be read and written, however, if the reference number that is not specified is the starting number than it is an error (Error-02H).
- ⑤ When reading a number of reference numbers, the data of the number that is not specified by the reference number becomes '0'.
- ⑥ When writing multiple reference numbers, if an error is detected all the settings become disabled.

8-4. Method of creating a message

Message is made up of ① Slave address, ② Function code, ③ Data division, and ④ Error check code. (See section 8-3.)

Message that can be read and written once is within the following range.

Function code	Number of data units	
	ASCII mode	RTU mode
02	64	64
03	32	64
04	32	64
16	32	64

Note) Number of units of data is the request from high order

Method of creating a message is explained in the following example.

Example) Reading the 'PTN (selecting pattern No.)' and 'STP (executing step No.)' of 'Slave address 02' of KP.

8-4-1. Message in RTU mode

① Slave address: 02 [02H]

② Function code: 04 [04H]

Becomes 'Reading analog input data (Reading contents of input register)'. When function code is '04' specify 'Relative number of data 2 bytes' and 'number of units of data 2 bytes' that is to be read in data division. (See section 8-5. For 'Function code: 04', see section 8-5-4.)

※ It is necessary to confirm the number of bytes of data.

③ Data division: Starting relative number 125([00H] [7DH]), Number of units 2 ([00H] [02H])

PTN (selecting pattern No.) and STP (executing step No.) are stored in reference number '30103 to 30014' (See section 8-3-4. table 3). From the reference table, it is understood that PTN is stored in '30126' and STP is stored in '30127'. (See section 8-7. For details on reading the PTN see section 8-7-2.) Relative number of the beginning 'Reference number 30126' is $30126 - 30001 = 125$ and if displayed in 2 bytes it becomes '[00H] [7DH]' (See section 8-3-4 table 3).

Number of units of data to be read is '2 units' of PTN and STP, hence when displayed in 2 bytes, it becomes [00H] [02H].

④ Error check: Calculate using CRC-16 E0E1H ([E1H] [E0H])

Error check in RTU mode is calculated using CRC-16. (See section 8-3-5.①) Data of message basic division becomes [02H] [04H] [00H] [7DH] [00H] [02H] according to ① to ③ and CRC-16 becomes E0E1H. Thus error check data becomes [E1H] [E0H].

⑤ Message: [02H] [04H] [00H] [7DH] [00H] [02H] [E1H] [E0H]

Create message depending on the configuration of the message. (See section 8-3)

8-4-2. ASCII mode message

Calculate error check LRC from message basic division. LRC becomes 7BH (See section 8-3-5.②). Convert each data of basic division to ASCII code and also convert LRC to ASCII code and add it to basic division. Starting character of message is ":" and add "CR", "LF" at the end.

Diagram illustrating the bit fields for the **Header** and **Trailer** sections of the **IEEE 802.3** frame structure.

Header:

- [3 AH]:** Address type (0 for unicast, 1 for multicast/broadcast).
- [3 0 H]:** Source address (6 bytes).
- [3 2 H]:** Destination address (6 bytes).
- [3 0 H]:** Source address (6 bytes).
- [3 4 H]:** Source address (6 bytes).
- [3 0 H]:** Source address (6 bytes).
- [3 0 H]:** Source address (6 bytes).
- [3 7 H]:** Source address (6 bytes).
- [4 4 H]:** Source address (6 bytes).

Trailer:

- [3 0 H]:** Destination address (6 bytes).
- [3 0 H]:** Source address (6 bytes).
- [3 0 H]:** Source address (6 bytes).
- [3 2 H]:** Source address (6 bytes).
- [3 7 H]:** Source address (6 bytes).
- [4 2 H]:** Source address (6 bytes).
- [0 D H]:** Source address (6 bytes).
- [0 A H]:** Source address (6 bytes).

Control Fields:

- 02 H:** Control field (2 bytes).
- 04 H:** Control field (4 bytes).
- 00 H:** Control field (0 bytes).
- 7 D H:** Control field (7 bytes).
- 00 H:** Control field (0 bytes).
- 02 H:** Control field (2 bytes).
- 7 B H:** Control field (7 bytes).
- CR:** Control field (Control field).
- LF:** Control field (Line field).
- LRC:** Longitudinal Redundancy Check (LRC).

8-5. Function code

Function code wise response is shown below. (See section 8-3-2 <Table 2. Function code table>)
Note) See section 8-6 for response in case of abnormality

8-5-1. Reading digital input data [Function code: 02 (02H)]

From the specified numbers, only the number of units that are specified 'Digital (ON/OFF) input data with continuous numbers' are read. ON/OFF data is made up of response message data in which 8 units are arranged in numeric order for 1 data (1 byte). LSB (DO side) of each data becomes a digital data of the smallest number. If the units that are to be read are not in multiples of 8, then the bits that are not required become 0.

Example) Reading the digital settings value reference number 10005 of slave 1

Reference number	10005
Data	0

System normal

<RTU mode>

Master → Device	
Slave address	01H
Function code	02H
Starting number (H)	00H
Starting number (L)	04H
Number of units (H)	00H
Number of units (L)	01H
CRC(L)	F8H
CRC(H)	0BH

Slave address	01H
Function code	02H
Data count	01H
Initial 8 data	00H
CRC(L)	A1H
CRC(H)	88H

First 8 data

0	0	0	0	0	0	0	0
---	---	---	---	---	---	---	---

(00H)

↑ 108 101 ↑

Reference number

<ASCII mode error check> (*CRC(L)(H) of the above are LRC as follows.)

LRC	F8H	LRC	FCH
-----	-----	-----	-----

Note) Starting number (Relative number) is 'Reference number - 10001'.

(Decimal 10005 (=10005 - 10001) → Hexadecimal 04H)

Note) Data count is the number of bytes of data.

(It differs from request units. In the example request unit is 1 unit, data count is 1 unit).

8-5-2. Reading analog setting value [Function code: 03 (03H)]

From the specified number, only the number of specified units read the number series 'Analog setting value (2 bytes: 16 bytes) data'. Data consists of response message data that is arranged in numeric order and is split into high order 8 bit and low order 8 bit.

Example) Reading executing SV, executing time 'hour', and executing time 'minute' of slave 1.
(Reading 3 units of analog setting value reference number from 49003 to 49005 of slave 1.)

Reference number (Starting number)	49056 (232FH)	49057 (2360H)	49058 (2361H)
Data	1000 (03E8H)	10 (000AH)	20 (0014H)

← Example of SV = 100 and time = 10:20

<RTU mode>

Master → Device	
Slave address	01H
Function code	03H
Starting number (H)	23H
Starting number (L)	5FH
Number of units (H)	00H
Number of units (L)	03H
CRC (L)	3EH
CRC (H)	5DH

Device → Master (Normal)	
Slave address	01H
Function code	03H
Data count	06H
Executing SV (H)	03H
Executing SV (L)	E8H
Executing 'hour' (H)	00H
Executing 'hour' (L)	0AH
Executing 'minute' (H)	00H
Executing 'minute' (L)	14H
CRC (L)	61H
CRC (H)	5CH

<ASCII mode error check> (*CRC(L)(H) of the above are LRC as follows.)

LRC	ACH
-----	-----

LRC	EDH
-----	-----

Note) Starting number (Relative number) is 'Reference number - 40001'.

Note) Data count is the number of bytes of data.

(It differs from request units. In the example request unit count is 3 units, data count is 6 units).

Note) There is a limitation on the number of data units of the message (This device can be sent) that can be received at a time.

(See section 8-4.)

8-5-3. Reading analog input data [Function code: 04 (04H)]

From the specified numbers, only the number of units that are specified 'Analog input (2 bytes: 16 bytes) data of the number series' are read. Data is split into high order 8 bits and low order 8 bits and is arranged in numeric order and consists of the data of response message. Response example is similar to that of 'Function code 03'. However starting number (Relative number) is 'Reference number-30001'.

8-5-4. Writing analog setting value [Function code: 06 (06H)]

Consider the analog setting value of the specified number as the set value.

Example) Set SV decimal point position of slave 1 to 1.

<RTU mode>

Master → Device		Device → Master (Normal)	
Slave address	01H	Slave address	01H
Function code	06H	Function code	06H
Setting value number (H)	00H	Setting value number (H)	00H
Setting value number (L)	07H	Setting value number (L)	07H
Set data (H)	00H	Set data (H)	00H
Set data (L)	01H	Set data (L)	01H
CRC (L)	F9H	CRC (L)	F9H
CRC (H)	CBH	CRC (H)	CBH

<ASCII mode error check> (*CRC(L)(H) of the above are LRC as follows.)

LRC	F1H	LRC	F1H
-----	-----	-----	-----

Note) Starting number (Relative number) is 'Reference number - 40001'.

Note) During normal response the response is same as command message.

Note) If slave address is considered as 0, all the slave machines execute this command.

However, no slave machine responds.

8-5-5. Loop back test [Function code: 08 (08H)]

Perform transmission check between master slaves. Respond in accordance to the diagnosis code that is specified. In this device perform 'return check to send the received data as it is' and diagnosis code is fixed as '0000H'.

Example) Implement 'Loop back test' to slave 2.

<RTU mode>

Master → Device			Device → 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
Option data	*		Received data	*	
Option data	*		Received data	*	
CRC (L)	*		CRC (L)	*	
CRC (H)	*		CRC (H)	*	

8-5-6. Writing multiple analog setting values [Function code: 16(10H)]

From the specified number consider the analog setting value of the specified number of units as the specified status (ON/OFF). The data is split into high order 8 bits and low order 8 bits is arranged in numeric order and then sent.

Example) Set as, SV decimal point = 1, SV range, lower limit = -200.0, SV range higher limit = 1370.0 of slave 1.

(Set 3 units of analog setting value reference number of slave 1 from 40206 to 40208.)

Reference number (Starting number)	40008 (0007H)	40009 (0008H)	40010 (0009H)
Data	1 (0001H)	-2000 (F830H)	13700 (3584H)

<RTU mode>

Master → Device

Slave address	01H
Function code	10H
Starting number (H)	00H
Starting number (L)	07H
Number of units (H)	00H
Number of units (L)	03H
Data count	06H
Initial data(H)	00H
Initial data(L)	01H
Second data(H)	F8H
Second data(L)	30H
Third data(H)	35H
Third data(L)	84H
CRC(L)	4CH
CRC(H)	C6H

Device → Master (Normal)

Slave address	01H
Function code	10H
Starting number (H)	00H
Starting number (L)	07H
Number of units (H)	00H
Number of units (L)	03H
CRC(L)	31H
CRC(H)	C9H

<ASCII mode error check> (*CRC(L)(H) of the above are LRC as follows.)

LRC	FDH	LRC	E5H
-----	-----	-----	-----

Note) Starting number (Relative number) is 'Reference number - 40001'.

Note) If slave address is considered as 0, all the slave machines execute that command. However, no slave machine responds.

Note) There is a restriction on the number of data units of message that can be sent at a time. (That this device can receive). (See section 8-4.)

8-6. Process during abnormality

If there is an error in the contents of the message from the master, respond as follows.

8-6-1. In case of no response

In the following cases, the messages are ignored and no response is given.

- ① Transmission error (over run, framing, parity, CRC or LRC) is detected in the message.
- ② The slave address during the message is not the self address.
- ③ The data interval of the message is long.
 - RTU mode...When less than 9600bps: 20msec or more
 - When 9600bps or more: 5msec or more
 - ASCII mode...1 second or more
- ④ Transmission parameters do not match.
- ⑤ Received message exceeds the number of bytes that can be received (Sometimes no response is given when the number of messages that can be received are received.)

Note) When slave address is '0' by write function, it there is no error in the message, message is executed but there is no response. If the error mentioned above occurs in the message then also there is no response, hence when slave address is '0' the normality/abnormality cannot be judged.

8-6-2. Response of error message

In the contents of the message from the master if the errors mentioned in section 8-6-1 do not occur instead if the following error is detected, then display (respond) as 'error message' the code that shows error contents.

Format of error message is as follows.

Slave address	Function code	Function code + 80H
Function code + 80H	02	82H
Error code	03	83H
CRC(L)	04	84H
CRC(H)	06	86H
	08	88H
	16	90H

Error codes are as follows.

Error code	Contents
01H	Function code defect When function code that is not specified is received
02H	Relative number (reference number) defect When received starting number or setting value number is other than what is specified
03H	Defect of number of units of data - When the number of units of data to be sent in response to the received message exceeds the specified number of units - When requested number of data units is 0 - When received specified data count and actual data count do not match
11H	Other than setting value range When numeric value that is out of setting range is mentioned in the reference table
12H	Cannot be set - When operation screen and drive pattern No. are set at the time other than that of resetting - When operation screen and drive pattern No. is set, except when pattern selection system is COM or FREE - When ADV, STOP is set during RESET - When RUN, STOP, ADV is set during END - When operation screen and program drive is set except when program drive system is MASTER COM - When program operation sets time unit except during RESET - When pattern copy trigger is set when pattern of copy source is not set or pattern of copy destination is not deleted - When program operation sets pattern clear trigger except during RESET - When program operation sets step addition trigger except during RESET - When program operation sets step deletion trigger except during RESET

8-7. Reference table

8-7-1. Analog setting value

① Setup parameter 1

FNC code.....Application function code, R/W.....R: READ, W: WRITE

Reference number	FNC Code	R/W	Data name	Setting range (Communication range)	Initial value	Remarks
40008	03 06 16	R W W	SV decimal point	0 to 4 (0 to 4)	1 (Decimal 1-digit)	
40009 40010	03 06 16	R W W	SV range 'Lower limit' 'Higher limit'	-19999 to 30000 (-19999 to 30000)	0.0 2000.0	· Decimal point position = SV decimal point · Write when lower limit $\leq$ higher limit.
40020	03 06 16	R W W	SV decimal point for display	0 to 4 (0 to 4)	1 (Decimal 1-digit)	SV decimal point position of upper display

② Setup parameter 2

FNC code.....Application function code, R/W.....R: READ, W: WRITE

Reference number	FNC Code	R/W	Data name	Setting range (Communication range)	Initial value	Remarks
40052 40053	03 06 16	R W W	SV scale 'zero' 'span'	-19999 to 30000 (-19999 to 30000)	0.0 2000.0	Decimal point position = SV decimal point
40092	03 06 16	R W W	Operation when starting the power supply	0/1 (0/1)	0 (CONTINUE)	0= CONTINUE (Status before power cut off) 1= READY (Status of program operation reset)

③ 1 type parameter

FNC code.....Application function code, R/W.....R: READ, W: WRITE

Reference number	FNC Code	R/W	Data name	Setting range (Communication range)	Initial value	Remarks
40147	03 06 16	R W W	SV correction	-19999 to 20000 (-19999 to 20000)	0	Decimal point position : SV decimal point + 1-digit (Max. 4-digit)

④ Execution parameter & Specific parameter

FNC code.....Application function code, R/W.....R: READ, W: WRITE

Reference number	FNC Code	R/W	Data name	Setting range (Communication range)	Initial value	Remarks
40151	03	R	[Upper display] SV (setting value)	Within the range of SV limit (Within the range of SV limit)	0.0	SV value (SV during program operation) · Decimal point position = SV decimal point · No WRITE

⑤ 8 type parameter No. 1

FNC code.....Application function code, R/W.....R: READ, W: WRITE

Reference number	FNC Code	R/W	Data name	Setting range (Communication range)	Initial value	Remarks
40221	03 06 16	R W W	[8 type parameter] Time signal ON, No.1 'Hours' or 'Minutes'	0 to 999 (0 to 999)	000 (Hours or minutes)	· Can be written when there is external signal input. · Setting of HHH of HHH:LL · Unit = Every time unit 1) In case of H:M (hours:minutes), H (hours) 2) Incase of M:S (minutes:seconds), M (minutes)
40222	03 06 16	R W W	[8 type parameter] Time signal ON, No.1 'Minutes' or 'Seconds'	0 to 59 (0 to 59)	00 (Minutes or seconds)	· Can be written when there is external signal input. · Setting of LL of HHH:LL · Unit = Every time unit 1) In case of H:M (hours:minutes), H (hours) 2) Incase of M:S (minutes:seconds), M (minutes)
40223	03 06 16	R W W	[8 type parameter] Time signal OFF, No.1 'Hours' or 'Minutes'	0 to 999 (0 to 999)	000 (Hours or minutes)	· Can be written when there is external signal input. · Setting of HHH of HHH:LL · Unit = Every time unit 1) In case of H:M (hours:minutes), H (hours) 2) Incase of M:S (minutes:seconds), M (minutes)
40224	03 06 16	R W W	[8 type parameter] Time signal OFF, No.1 'Minutes' or 'Seconds'	0 to 59 (0 to 59)	00 (Minutes or seconds)	· Can be written when there is external signal input. · Setting of LL of HHH:LL · Unit = Every time unit 1) In case of H:M (hours:minutes), H (hours) 2) Incase of M:S (minutes:seconds), M (minutes)

⑥ 8 type parameter No. 2

FNC code.....Application function code, R/W.....R: READ, W: WRITE

Reference number	FNC Code	R/W	Data name	Setting range (Communication range)	Initial value	Remarks
40271	03 06 16	R W W	[8 type parameter] Time signal ON, No.2 'Hours' or 'Minutes'	0 to 999 (0 to 999)	000 (Hours or minutes)	· Can be written when there is external signal input. · Setting of HHH of HHH:LL · Unit = Every time unit 1) In case of H:M (hours:minutes), H (hours) 2) Incase of M:S (minutes:seconds), M (minutes)
40272	03 06 16	R W W	[8 type parameter] Time signal ON, No.2 'Minutes' or 'Seconds'	0 to 59 (0 to 59)	00 (Minutes or seconds)	· Can be written when there is external signal input. · Setting of LL of HHH:LL · Unit = Every time unit 1) In case of H:M (hours:minutes), H (hours) 2) Incase of M:S (minutes:seconds), M (minutes)
40273	03 06 16	R W W	[8 type parameter] Time signal OFF, No.2 'Hours' or 'Minutes'	0 to 999 (0 to 999)	000 (Hours or minutes)	· Can be written when there is external signal input. · Setting of HHH of HHH:LL · Unit = Every time unit 1) In case of H:M (hours:minutes), H (hours) 2) Incase of M:S (minutes:seconds), M (minutes)
40274	03 06 16	R W W	[8 type parameter] Time signal OFF, No.2 'Minutes' or 'Seconds'	0 to 59 (0 to 59)	00 (Minutes or seconds)	· Can be written when there is external signal input. · Setting of LL of HHH:LL · Unit = Every time unit 1) In case of H:M (hours:minutes), H (hours) 2) Incase of M:S (minutes:seconds), M (minutes)

⑦ 8 type parameter No.3

FNC code.....Application function code, R/W.....R: READ, W: WRITE

Reference number	FNC Code	R/W	Data name	Setting range (Communication range)	Initial value	Remarks
40321	03 06 16	R W W	[8 type parameter] Time signal ON, No.3 'Hours' or 'Minutes'	0 to 999 (0 to 999)	000 (Hours or minutes)	- Can be written when there is external signal input. - Setting of HHH of HHH:LL - Unit = Every time unit 1) In case of H:M (hours:minutes), H (hours) 2) Incase of M:S (minutes:seconds), M (minutes)
40322	03 06 16	R W W	[8 type parameter] Time signal ON, No.3 'Minutes' or 'Seconds'	0 to 59 (0 to 59)	00 (Minutes or seconds)	- Can be written when there is external signal input. - Setting of LL of HHH:LL - Unit = Every time unit 1) In case of H:M (hours:minutes), H (hours) 2) Incase of M:S (minutes:seconds), M (minutes)
40323	03 06 16	R W W	[8 type parameter] Time signal OFF, No.3 'Hours' or 'Minutes'	0 to 999 (0 to 999)	000 (Hours or minutes)	- Can be written when there is external signal input. - Setting of HHH of HHH:LL - Unit = Every time unit 1) In case of H:M (hours:minutes), H (hours) 2) Incase of M:S (minutes:seconds), M (minutes)
40324	03 06 16	R W W	[8 type parameter] Time signal OFF, No.3 'Minutes' or 'Seconds'	0 to 59 (0 to 59)	00 (Minutes or seconds)	- Can be written when there is external signal input. - Setting of LL of HHH:LL - Unit = Every time unit 1) In case of H:M (hours:minutes), H (hours) 2) Incase of M:S (minutes:seconds), M (minutes)

⑧ 8 type parameter No.4

FNC code.....Application function code, R/W.....R: READ, W: WRITE

Reference number	FNC Code	R/W	Data name	Setting range (Communication range)	Initial value	Remarks
40371	03 06 16	R W W	[8 type parameter] Time signal ON, No.4 'Hours' or 'Minutes'	0 to 999 (0 to 999)	000 (Hours or minutes)	- Can be written when there is external signal input. - Setting of HHH of HHH:LL - Unit = Every time unit 1) In case of H:M (hours:minutes), H (hours) 2) Incase of M:S (minutes:seconds), M (minutes)
40372	03 06 16	R W W	[8 type parameter] Time signal ON, No.4 'Minutes' or 'Seconds'	0 to 59 (0 to 59)	00 (Minutes or seconds)	- Can be written when there is external signal input. - Setting of LL of HHH:LL - Unit = Every time unit 1) In case of H:M (hours:minutes), H (hours) 2) Incase of M:S (minutes:seconds), M (minutes)
40373	03 06 16	R W W	[8 type parameter] Time signal OFF, No.4 'Hours' or 'Minutes'	0 to 999 (0 to 999)	000 (Hours or minutes)	- Can be written when there is external signal input. - Setting of HHH of HHH:LL - Unit = Every time unit 1) In case of H:M (hours:minutes), H (hours) 2) Incase of M:S (minutes:seconds), M (minutes)
40374	03 06 16	R W W	[8 type parameter] Time signal OFF, No.4 'Minutes' or 'Seconds'	0 to 59 (0 to 59)	00 (Minutes or seconds)	- Can be written when there is external signal input. - Setting of LL of HHH:LL - Unit = Every time unit 1) In case of H:M (hours:minutes), H (hours) 2) Incase of M:S (minutes:seconds), M (minutes)

⑨ 8 type parameter No.5

FNC code.....Application function code, R/W.....R: READ, W: WRITE

Reference number	FNC Code	R/W	Data name	Setting range (Communication range)	Initial value	Remarks
40421	03 06 16	R W W	[8 type parameter] Time signal ON, No.5 'Hours' or 'Minutes'	0 to 999 (0 to 999)	000 (Hours or minutes)	- Can be written when there is external signal input. - Setting of HHH of HHH:LL - Unit = Every time unit 1) In case of H:M (hours:minutes), H (hours) 2) Incase of M:S (minutes:seconds), M (minutes)
40422	03 06 16	R W W	[8 type parameter] Time signal ON, No.5 'Minutes' or 'Seconds'	0 to 59 (0 to 59)	00 (Minutes or seconds)	- Can be written when there is external signal input. - Setting of LL of HHH:LL - Unit = Every time unit 1) In case of H:M (hours:minutes), H (hours) 2) Incase of M:S (minutes:seconds), M (minutes)
40423	03 06 16	R W W	[8 type parameter] Time signal OFF, No.5 'Hours' or 'Minutes'	0 to 999 (0 to 999)	000 (Hours or minutes)	- Can be written when there is external signal input. - Setting of HHH of HHH:LL - Unit = Every time unit 1) In case of H:M (hours:minutes), H (hours) 2) Incase of M:S (minutes:seconds), M (minutes)
40424	03 06 16	R W W	[8 type parameter] Time signal OFF, No.5 'Minutes' or 'Seconds'	0 to 59 (0 to 59)	00 (Minutes or seconds)	- Can be written when there is external signal input. - Setting of LL of HHH:LL - Unit = Every time unit 1) In case of H:M (hours:minutes), H (hours) 2) Incase of M:S (minutes:seconds), M (minutes)

⑩ 8 type parameter No.6

FNC code.....Application function code, R/W.....R: READ, W: WRITE

Reference number	FNC Code	R/W	Data name	Setting range (Communication range)	Initial value	Remarks
40471	03 06 16	R W W	[8 type parameter] Time signal ON, No.6 'Hours' or 'Minutes'	0 to 999 (0 to 999)	000 (Hours or minutes)	- Can be written when there is external signal input. - Setting of HHH of HHH:LL - Unit = Every time unit 1) In case of H:M (hours:minutes), H (hours) 2) Incase of M:S (minutes:seconds), M (minutes)
40472	03 06 16	R W W	[8 type parameter] Time signal ON, No.6 'Minutes' or 'Seconds'	0 to 59 (0 to 59)	00 (Minutes or seconds)	- Can be written when there is external signal input. - Setting of LL of HHH:LL - Unit = Every time unit 1) In case of H:M (hours:minutes), H (hours) 2) Incase of M:S (minutes:seconds), M (minutes)
40473	03 06 16	R W W	[8 type parameter] Time signal OFF, No.6 'Hours' or 'Minutes'	0 to 999 (0 to 999)	000 (Hours or minutes)	- Can be written when there is external signal input. - Setting of HHH of HHH:LL - Unit = Every time unit 1) In case of H:M (hours:minutes), H (hours) 2) Incase of M:S (minutes:seconds), M (minutes)
40474	03 06 16	R W W	[8 type parameter] Time signal OFF, No.6 'Minutes' or 'Seconds'	0 to 59 (0 to 59)	00 (Minutes or seconds)	- Can be written when there is external signal input. - Setting of LL of HHH:LL - Unit = Every time unit 1) In case of H:M (hours:minutes), H (hours) 2) Incase of M:S (minutes:seconds), M (minutes)

⑪ 8 type parameter No.7

FNC code.....Application function code, R/W.....R: READ, W: WRITE

Reference number	FNC Code	R/W	Data name	Setting range (Communication range)	Initial value	Remarks
40521	03 06 16	R W W	[8 type parameter] Time signal ON, No.7 'Hours' or 'Minutes'	0 to 999 (0 to 999)	000 (Hours or minutes)	- Can be written when there is external signal input. - Setting of HHH of HHH:LL - Unit = Every time unit 1) In case of H:M (hours:minutes), H (hours) 2) Incase of M:S (minutes:seconds), M (minutes)
40522	03 06 16	R W W	[8 type parameter] Time signal ON, No.7 'Minutes' or 'Seconds'	0 to 59 (0 to 59)	00 (Minutes or seconds)	- Can be written when there is external signal input. - Setting of LL of HHH:LL - Unit = Every time unit 1) In case of H:M (hours:minutes), H (hours) 2) Incase of M:S (minutes:seconds), M (minutes)
40523	03 06 16	R W W	[8 type parameter] Time signal OFF, No.7 'Hours' or 'Minutes'	0 to 999 (0 to 999)	000 (Hours or minutes)	- Can be written when there is external signal input. - Setting of HHH of HHH:LL - Unit = Every time unit 1) In case of H:M (hours:minutes), H (hours) 2) Incase of M:S (minutes:seconds), M (minutes)
40524	03 06 16	R W W	[8 type parameter] Time signal OFF, No.7 'Minutes' or 'Seconds'	0 to 59 (0 to 59)	00 (Minutes or seconds)	- Can be written when there is external signal input. - Setting of LL of HHH:LL - Unit = Every time unit 1) In case of H:M (hours:minutes), H (hours) 2) Incase of M:S (minutes:seconds), M (minutes)

⑫ 8 type parameter No.8

FNC code.....Application function code, R/W.....R: READ, W: WRITE

Reference number	FNC Code	R/W	Data name	Setting range (Communication range)	Initial value	Remarks
40571	03 06 16	R W W	[8 type parameter] Time signal ON, No.8 'Hours' or 'Minutes'	0 to 999 (0 to 999)	000 (Hours or minutes)	- Can be written when there is external signal input. - Setting of HHH of HHH:LL - Unit = Every time unit 1) In case of H:M (hours:minutes), H (hours) 2) Incase of M:S (minutes:seconds), M (minutes)
40572	03 06 16	R W W	[8 type parameter] Time signal ON, No.8 'Minutes' or 'Seconds'	0 to 59 (0 to 59)	00 (Minutes or seconds)	- Can be written when there is external signal input. - Setting of LL of HHH:LL - Unit = Every time unit 1) In case of H:M (hours:minutes), H (hours) 2) Incase of M:S (minutes:seconds), M (minutes)
40573	03 06 16	R W W	[8 type parameter] Time signal OFF, No.8 'Hours' or 'Minutes'	0 to 999 (0 to 999)	000 (Hours or minutes)	- Can be written when there is external signal input. - Setting of HHH of HHH:LL - Unit = Every time unit 1) In case of H:M (hours:minutes), H (hours) 2) Incase of M:S (minutes:seconds), M (minutes)
40574	03 06 16	R W W	[8 type parameter] Time signal OFF, No.8 'Minutes' or 'Seconds'	0 to 59 (0 to 59)	00 (Minutes or seconds)	- Can be written when there is external signal input. - Setting of LL of HHH:LL - Unit = Every time unit 1) In case of H:M (hours:minutes), H (hours) 2) In case of M:S (minutes:seconds), M (minutes)

⑬ System setting

FNC code.....Application function code, R/W.....R: READ, W: WRITE

Reference number	FNC Code	R/W	Data name	Setting range (Communication range)	Initial value	Remarks
48001	03 06 16	R W W	Display back light	0/1/2 (0/1/2)	2 (AUTO)	0=Green 1=Orange 2=AUTO (Normal...Green, Alarm activation ...Orange)
48002	03 06 16	R W W	Display contrast	0 to 100 (0 to 100)	50%	
48003	03 06 16	R W W	Key backlight	0/1/2 (0/1/2)	0 (AUTO)	0=AUTO (In case of pressing the key, lighting [extinction after 30 seconds]) 1=OFF (Always extinction) 2=ON (Always lighting)

FNC code.....Application function code, R/W.....R: READ, W: WRITE

Reference number	FNC Code	R/W	Data name	Setting range (Communication range)	Initial value	Remarks
						· Function of terminal (Lower order 8 bits) [DI] (External signal input) 00h = -- (no setting) 01h = RUN/STOP (RUN/STOP operation) 02h = ADV (ADVANCE operation) 03h = RESET (RESET operation) 04h = WAIT (WAIT operation) 05h = FAST (FAST operation) 06h = PTN1 (Pattern No. selection BCD_1) 07h = PTN2 (Pattern No. selection BCD_2) 08h = PTN4 (Pattern No. selection BCD_4) 09h = PTN8 (Pattern No. selection BCD_8) 0Ah = PTN10 (Pattern No. selection BCD_10) 0Bh = PTN20 (Pattern No. selection BCD_20)
48012			External signal allocation			
48013			[First zone]			
48014			Terminal No.12			
48015			Terminal No.13			
48016			Terminal No.14			
48017			Terminal No.15			
			Terminal No.16			
			Terminal No.17			
48019			[Second zone]			
48020			Terminal No.19			
48021	03	R	Terminal No.20	0000h to 020Dh (0000h to 020Dh)	**00h (Each format)	[DO] (External signal output)
48022	06	W	Terminal No.21			00h = -- (no setting)
48023	16	W	Terminal No.22			01h = TS1 (Time signal 1)
48024			Terminal No.23			02h = TS2 (Time signal 2)
			Terminal No.24			03h = TS3 (Time signal 3)
			[Third zone]			04h = TS4 (Time signal 4)
48026			Terminal No.26			05h = TS5 (Time signal 5)
48027			Terminal No.27			06h = TS6 (Time signal 6)
48028			Terminal No.28			07h = TS7 (Time signal 7)
48029			Terminal No.29			08h = TS8 (Time signal 8)
48030			Terminal No.30			09h = RUN/STOP (RUN/STOP status signal)
48031			Terminal No.31			0Ah = ADV (ADVANCE status signal)
48032			Terminal No.32			0Bh = RESET (RESET status signal)
48033			Terminal No.33			0Ch = WAIT (WAIT status signal)
						0Dh = END (END status signal)
						· Type of terminal (Lower order 8 bits) 00h = -- (no terminal or other than external signal input/output terminal) 01h = DI (External signal input terminal) 02h = DO (External signal output terminal) *Type of terminal cannot be written. *When type of terminal is other than DI or DO, cannot be written.

FNC code.....Application function code, R/W.....R: READ, W: WRITE

Reference number	FNC Code	R/W	Data name	Setting range (Communication range)	Initial value	Remarks								
						[READ] (FNC_03) READ as type of terminal of external signal input/output for lower order 8 bits and function of terminal for higher order 8 bits. High order 8 bits Low order 8 bits <table><tr><td>Type of terminal</td><td>Function of terminal</td></tr><tr><td>15</td><td>8 7 0</td></tr></table> [WRITE] (FNC_06, FNC_16) WRITE as type of terminal of external signal input/output for lower order 8 bits. High order 8 bits are region of Reserve. High order 8 bits Low order 8 bits <table><tr><td>(Reseve)</td><td>Function of terminal</td></tr><tr><td>15</td><td>8 7 0</td></tr></table>	Type of terminal	Function of terminal	15	8 7 0	(Reseve)	Function of terminal	15	8 7 0
Type of terminal	Function of terminal													
15	8 7 0													
(Reseve)	Function of terminal													
15	8 7 0													

⑭ Program pattern information

FNC code.....Application function code, R/W.....R: READ, W: WRITE

Reference number	FNC Code	R/W	Data name	Setting range (Communication range)	Initial value	Remarks
49003	03 06 16	R W W	[Program pattern for R/W] Pattern No.	1 to 30 (1 to 30)	1 (Pattern 1)	Setting for Reading/Writing of program pattern (reference 49005 to 49045) 1 = PTN01 (pattern 1) to 30 = PTN30 (pattern 30) *Set before reading/writing of pattern information. *Written pattern number is stored until tuning off the power of instrument. *Reading/writing of pattern number of this reference is dedicated data for reading/writing program pattern information by communications. When read/write pattern number during program operation, use reference 49066/30126.
49004	03 06 16	R W W	[Program pattern for R/W] Step No.	0 to 19 (0 to 19)	0 (Step 0)	Setting for Reading/Writing of program pattern (reference 49005 to 49045) 1 = STP00 (pattern 0) to 19 = STP19 (pattern 19) *Set before reading/writing of pattern information. *Written step number is stored until tuning off the power of instrument. *Reading/writing of step number of this reference is dedicated data for reading/writing program pattern information by communications. When read/write step number during program operation, use reference 49066/30126.
49005	03 06 16	R W W	[Program pattern] Step repeat	0 to 99, FFh (0 to 99, FFh)	FFh (Blank display)	0 = Repeat starting step 1 to 99 = Repeat ending step FFh = Blank display (Excepting start/end step) *Read/write after writing reference 49003 and 49004. *Writing is not possible when reference 49004 is step 0 or after the final step.
49006	03 06 16	R W W	[Program pattern] SV	Within the range of SV limit (Within the range of SV limit)	0.0	· Decimal point position = SV decimal point *Read/write after writing reference 49003 and 49004. *Writing is not possible when reference 49004 is after the final step.

FNC code.....Application function code, R/W.....R: READ, W: WRITE

Reference number	FNC Code	R/W	Data name	Setting range (Communication range)	Initial value	Remarks
49007	03 06 16	R W W	[Program pattern] Time 'Hours' or 'Minutes'	000 to 999 (0 to 999)	0 (Hours or minutes)	- Setting of HHH of HHH:LL - Unit = Every time unit *Read/write after writing reference 49003 and 49004. *Writing is not possible when reference 49004 is step 0 or after the next step of the final step (= final step + 1). *When write to the next step of the final step, step is added to end of the pattern.
49008	03 06 16	R W W	[Program pattern] Time 'Minutes' or 'Seconds'	00 to 59 (0 to 59)	0 (Minutes or seconds)	- Setting of LL of HHH:LL - Unit = Every time unit *Read/write after writing reference 49003 and 49004. *Writing is not possible when reference 49004 is step 0 or after the next step of the final step (= final step + 1). *When write to the next step of the final step, step is added to end of the pattern.
49010	03 06 16	R W W	[Program pattern] SV No.	.0 to 8 (0 to 8)	[STEP1] 1 (No.1) [From STEP2] 0 (No.0)	0 = No.0 (continue of the prior step number) 1 to 8 = No.1 to 8 *Read/write after writing reference 49003 and 49004. *Writing is not possible when reference 49004 is step 0 or after the final step.
49020 49021 49022 49023 49024 49025 49026 49027	03 06 16	R W W	[Program pattern] Time signal No. "TS1" "TS2" "TS3" "TS4" "TS5" "TS6" "TS7" "TS8"	0 to 20 (0 to 20)	0 (OFF)	0 = OFF (All OFF) 1 to 8 = No.1 to No.8 11 to 18 = No.1R to No.8R (repeat) 20 = ON (All ON) *Read/write after writing reference 49003 and 49004. *Writing is not possible when reference 49004 is step 0 or after the final step.
49040	03	R	[Program pattern] Existing step count End step No.	0 to 19 (0 to 19)	0 (No setting step) (Step 0)	0 = No setting step to 19 = Setting step number 19 0 = STP00 (Step 0) to 19 = STP19 (Step 19) *No writing *Read/write after writing reference 49003. *Step No. setting of reference 49004 is not necessary.

FNC code.....Application function code, R/W.....R: READ, W: WRITE

Reference number	FNC Code	R/W	Data name	Setting range (Communication range)	Initial value	Remarks
49041	03 06 16	R W W	[Program pattern] Start SV	Range of measurement range Range of liner scale	0	· Decimal point position = SV decimal point *Read/write after writing reference 49003. *Setting of step No. of reference 49004 is not necessary.
49043	03 06 16	R W W	[Program pattern] Link destination pattern No.	0 to 19 (0 to 19)	0 (Non link)	0 = Non pattern link 1 = Link to pattern 1 19 = Link to pattern 19 *Read/write after writing reference 49003. *Setting of step No. of reference 49004 is not necessary.
49048	03 06 16	R W W	Time unit	0/1 (0/1)	0 (H:M)	0= H:M (Hours:Minutes) 1= M:S(Minutes:Seconds) * When program operation is other than during RESET, writing is not possible.
49049	03 06 16	R W W	SV during reset	Within the range of SV limit (Within the range of SV limit)	0	*When no transmission signal output and communication function is other than TRANS, writing is not possible.
49055	03 06 16	R W W	Pattern repeat	0 to 9999 (0 to 9999)	0 times	

[Supplemental remarks] Procedure of reading/writing to step information of program pattern

1) Example of procedure reading SV, time, and SV No. of step 1 of pattern No.1.

[Procedure 1] Register pattern No. and step No. of step is performed reading.

Setting

- Pattern No. = Pattern1

- Step No. = Step 1 (Example of command = 0110232A000204000100016CF9)

Master → Instrument	Command	Setting contents
Slave address	01H	Set the instrument number (MODE 8 of sending command to KP.)
Function cord	10H	Set the function cord 16 (= 10H) for writing multiple analog setting values.
Starting number(H)	23H	Specify starting number (beginning number) of reference is written continuous.
Ending number (L)	2AH	(Set the reference number 49003(=49003-40001=9002=232AH))
Quantity (H)	00H	Set two (=02H), which is the number from reference number 49003 (pattern No.) to 49004 (step No).
Quantity (L)	02H	
Data number	04H	4 byte (04H) = 2 × 2 byte data
Pattern No. (H)	00H	[Reference number 49003] Set the pattern No. of program pattern is written.
Pattern No. (L)	01H	When write to pattern 1, set 01 (0001H)
Step No. (H)	00H	[Reference number 49004] Set the step No. of program pattern is written.
Step No. (L)	01H	When write to pattern 1, set 01 (0001H)
CRC(L)	6CH	Set the cord for error check.
CRC(H)	F9H	(When it is MODBUS_RTU protocol, set the error check value of CRC-16.)

[Procedure 2] Notify parameter type of step information is performed reading (master → instrument).

Specify the reading of

- SV

- Time

- SV No. (Example of command = 0103232D00051E44)

Master → Instrument	Command	Setting contents
Slave address	01H	Set the instrument number (MODE 8 of sending command to KP.)
Function cord	03H	Set the function cord 03 (= 03H) for reading analog setting values.
Starting number(H)	23H	Specify starting number (beginning number) of reference is written continuous.
Ending number (L)	2DH	(Set the reference number 49006(=49006-40001=9005=232DH))
Quantity (H)	00H	Set five (=05H), which is the number from reference number 49006 (SV) to 49010 (SV No).
Quantity (L)	05H	
CRC(L)	1EH	Set the cord for error check.
CRC(H)	44H	(When it is MODBUS_RTU protocol, set the error check value of CRC-16.)

*When perform reading again to same pattern No. and step No., skip procedure 1.

[Procedure 3] Acquire the parameter is performed reading (instrument → master).

(The following is an example of command response from instrument to master after procedure 2 when SV, time, SV No. of pattern 1 and step 1 are following setting.)

Acquiring

• SV = 111.1

• Time = 22:33 (H:M)

• SV No. = No.4

(Example of command = 01030A045700160021000000047555)

Master → Instrument	Command	Setting contents
Slave address	01H	Set the instrument number (MODE 8 of sending command to KP.)
Function cord	03H	Set the function cord 03 (= 03H) for reading analog setting values.
Number of data	0AH	10 byte (0AH) = 5×2 byte data
SV(H)	04H	[Reference number 49006] Acquire SV value.
SV(L)	57H	0457H → (Decimal notation) → 1111 → (SV decimal point=1) → 111.1
Time, hours or minutes (H)	00H	[Reference number 49007] Acquire high order (HHH:) of time.
Time, hours or minutes (L)	16H	0016H → (Decimal notation) → 22
Time, minutes or seconds (H)	00H	[Reference number 49007] Acquire low order (: LL) of time.
Time, minutes or seconds (L)	21H	0021H → (Decimal notation) → 33
[Not Use]	00H	[Reference number 49009] is not in use reference number.
[Not Use]	00H	Erase the stored data for dummy data (indefinite).
SV No.(H)	00H	[Reference number 49010] Acquire SV No..
SV No.(L)	04H	04H → (Decimal notation) → 4
CRC(L)	75H	Set the cord for error check.
CRC(H)	55H	(When it is MODBUS_RTU protocol, set the error check value of CRC-16.)

Caution

When perform reading of program pattern (step) information, performed reading of each parameter after registration (writing) of corresponding pattern No. and step No. of reference 49003/49004.

2) Example of procedure of setting (writing) SV, time, and SV No. to step 1 of pattern No.1.

[Procedure 1] Register pattern No. and step No. of step which is written.

Setting • Pattern No. = Pattern

• Step No. = Step 1

(Example of command = 0110232A000204000100016CF9)

Master → Instrument	Command	Setting contents
Slave address	01H	Set the instrument number (MODE 8 of sending command to KP.)
Function cord	10H	Set the function cord 16 (= 10H) for writing multiple analog setting values.
Starting number(H)	23H	Specify starting number (beginning number) of reference is written continuous.
Ending number (L)	2AH	(Set the reference number 49003(=49003-40001=9002=232AH))
Quantity (H)	00H	Set two (=02H), which is the number from reference number 49003 (pattern No.) to 49004 (step No).
Quantity (L)	02H	
Data number	04H	4 byte (04H) = 2 × 2 byte data
Pattern No. (H)	00H	[Reference number 49003] Set the pattern No. of program pattern is written.
Pattern No. (L)	01H	When write to pattern 1, set 01 (0001H)
Step No. (H)	00H	[Reference number 49004] Set the step No. of program pattern is written.
Step No. (L)	01H	When write to pattern 1, set 01 (0001H)
CRC(L)	6CH	Set the cord for error check.
CRC(H)	F9H	(When it is MODBUS_RTU protocol, set the error check value of CRC-16.)

[Procedure 2] Notify step information is performed writing.

Setting • SV = 123.4

• Time = 76:54 (H:M)

• SV No. = No. 2 (Example of command = 0110232D00050A04D2004C0036000000024EBD)

Master → Instrument	Command	Setting contents
Slave address	01H	Set the instrument number (MODE 8 of sending command to KP.)
Function cord	10H	Set the function cord 16 (= 10H) for writing multiple analog setting values.
Starting number(H)	23H	Specify starting number (beginning number) of reference is written continuous.
Ending number (L)	2DH	(Set the reference number 49006(=49006-40001=9005=232DH))
Quantity (H)	00H	Set five (=05H), which is the number from reference number 49006 (SV) to 49010 (PID No).
Quantity (L)	05H	
Data number	0AH	10 byte (0AH) = 5 × 2 byte data
SV(H)	04H	[Reference number 49006] Acquire SV value.
SV(L)	D2H	Setting of SV=123.4 → (Eliminate decimal point) → 1234 → (Hexadecimal notation) → 04D2H
Time, hours or minutes (H)	00H	[Reference number 49007] Acquire high order (HHH:) of time.
Time, hours or minutes (L)	4CH	Setting of 76 hours of 76:54 → (Hexadecimal notation) → 004CH
Time, minutes or seconds (H)	00H	[Reference number 49007] Acquire low order (: LL) of time.
Time, minutes or seconds (L)	36H	Setting of 54 minutes of 76:54 → (Hexadecimal notation) → 0036H
[Not Use]	00H	[Reference number 49009] is not in use reference number.
[Not Use]	00H	Set 0000H
SV No.(H)	00H	[Reference number 49010] Acquire SV No..
SV No.(L)	02H	Setting of SV No.2 → (Hexadecimal notation) → 0002H
CRC(L)	4EH	Set the cord for error check.
CRC(H)	BDH	(When it is MODBUS_RTU protocol, set the error check value of CRC-16.)

*When perform Writing again to same pattern No. and step No., skip procedure 1.

Caution

When perform writing of program pattern (step) information, performed writing of each parameter after registration (writing) of corresponding pattern No. and step No. of reference 49003/49004.

⑰ Program pattern setting/editing

FNC code.....Application function code, R/W.....R: READ, W: WRITE

Reference number	FNC Code	R/W	Data name	Setting range (Communication range)	Initial value	Remarks
49056	03 06 16	R W W	[Execution] SV	Within the range of SV limit (Within the range of SV limit)	0.0	[MODE0] Reading/writing of execution SV · Decimal point position = SV decimal point
49057	03 06 16	R W W	[Execution] Time 'Hours' or 'Minutes'	000 to 999 (0 to 999)	000 (Hours or minutes)	[MODE0] Reading/writing of time · Setting of HHH of HHH:LL · Unit = Every time unit
49058	03 06 16	R W W	[Execution] Time 'Minutes' or 'Seconds'	00 to 59 (0 to 59)	00 (Minutes or seconds)	[MODE0] Reading/writing of time · Setting of LL of HHH:LL · Unit = Every time unit
49066	03 06 16	R W W	[Upper display] Pattern No.	1 to 30 (1 to 30)	1 (Pattern 1)	Reading /writing of pattern No. is performed program operation. 1 = PTN01 (Pattern 1) to 30 = PTN19 (pattern 30) *Writing is not possible in the following cases *When pattern selection system is other than COM in the case of 'with pattern selection input option'.
49067	03 06 16	R W W	[Operation screen] Program operation	[READ] 1/2/3/4/5/6 (1/2/3/4/5/6) [WRITE] 1/2/4/6 (1/2/4/6)	1 (RESET)	[READ] (FNC_03) 1= RESET (Reset of program operation) 2= RUN (Run of program operation) 3= FAST (Fast-forward of program operation) 4= STOP (Stop of program operation) 5= END (End of program operation) 6= ADV (Advance of step) [WRITE] (FNC_06, FNC_16) 1= RESET (Reset of program operation) 2= RUN (Run of program operation) 4= STOP (Stop of program operation) 6= ADV (Advance of step) *When program drive system (reference 49516) is other than MASTER COM/FREE, writing is not possible. *When program operation is in RESET, writing of ADV/STOP is not possible. *When program operation is in END, writing of RUN/STOP/ADV is not possible.

Reference number	FNC Code	R/W	Data name	Setting range (Communication range)	Initial value	Remarks						
49093	03 06 16	R W W	[Pattern/step editing] Pattern copy	[READ] 0/1/2/3/4/5 (0/1/2/3/4/5) [WRITE] 0102h to 1E1Dh (0102h to 1E1Dh)	-	Reading of [pattern/step] status [READ] (FNC_03) 0= No edition 1= Add step 2= Delete step 3= Pattern copy 4= Pattern clear (1 pattern) 5= Clear all patterns Pattern copy [WRITE] (FNC_06, FNC_16) 1= PTN1 (pattern 1) to 30= PTN30 (pattern 30) ·High order 8 bits = Copy source pattern No. ·Low order 8 bits = Copy source pattern No. <table><tr><td>High order 8 bit</td><td>Low order 8 bit</td></tr><tr><td>Copy source pattern No.</td><td>Copy destination pattern No.</td></tr><tr><td>15</td><td>8 7 0</td></tr></table> *When copy source pattern is not set (step number in existence (reference 49040) is 0 step), writing (pattern copy) is not possible. *When copy destination pattern is not erased (step number in existence (reference 49040) is other than 0 step). Writing (pattern copy) is not possible. → After clear in copy destination pattern (reference 49094), perform pattern copy. *When copy destination pattern No. and copy source pattern No. is same, writing (pattern copy) is not possible. *Continuous writing is not performed from reference 49093 to 49096 by FNC16 (function cord).	High order 8 bit	Low order 8 bit	Copy source pattern No.	Copy destination pattern No.	15	8 7 0
High order 8 bit	Low order 8 bit											
Copy source pattern No.	Copy destination pattern No.											
15	8 7 0											
49094	03 06 16	R W W	[Pattern/step editing] Pattern clear	[READ] 0/1/2/3/4/5 (0/1/2/3/4/5) [WRITE] 0 to 30 (0 to 30)	-	Reading of [pattern/step] status [READ] (FNC_03) 0= No edition 1= Add step 2= Delete step 3= Copy pattern 4= Clear pattern (1 pattern) 5= Clear all patterns Pattern clear [WRITE] (FNC_06, FNC_16) 0= Clear all pattern (All pattern information is initialized). 1= PTN1 (Pattern 1 is initialized) to 30= PTN30 (Pattern 30 is initialized) *Caution: When write [0], all pattern information is initialized. *When program operation (reference 49067) is other than RESET, writing is not possible.						

FNC code.....Application function code, R/W.....R: READ, W: WRITE

Reference number	FNC Code	R/W	Data name	Setting range (Communication range)	Initial value	Remarks						
49095	03 06 16	R W W	[Pattern/step editing] Add step	[READ] 0/1/2/3/4/5 (0/1/2/3/4/5) [WRITE] 0101h to 1312h (0101h to 1312h)	-	Reading of [pattern/step] status [READ] (FNC_03) 0= No edition 1= Add step 2= Delete step 3= Pattern copy 4= Pattern clear (1 pattern) 5= Clear all patterns Step adding [WRITE] (FNC_06, FNC_16) · High order 8 bits = Pattern No. 1= PTN1 (pattern 1) to 19= PTN19 (pattern 19) · Low order 8 bits = Step No. 1= STP1 (step1) to 18= STP18 (step18) <table><tr><td>High order 8 bit</td><td>Low order 8 bit</td></tr><tr><td>Pattern No.</td><td>Step No.</td></tr><tr><td>15</td><td>8 7 0</td></tr></table> *When program operation (reference 49067) is other than RESET, writing is not possible. *When step number in existence (reference 49040) is other than 19 step, writing (add step) is not possible. *When step number is exceed the step number in existence (reference 49040), writing (add step) is not possible.	High order 8 bit	Low order 8 bit	Pattern No.	Step No.	15	8 7 0
High order 8 bit	Low order 8 bit											
Pattern No.	Step No.											
15	8 7 0											

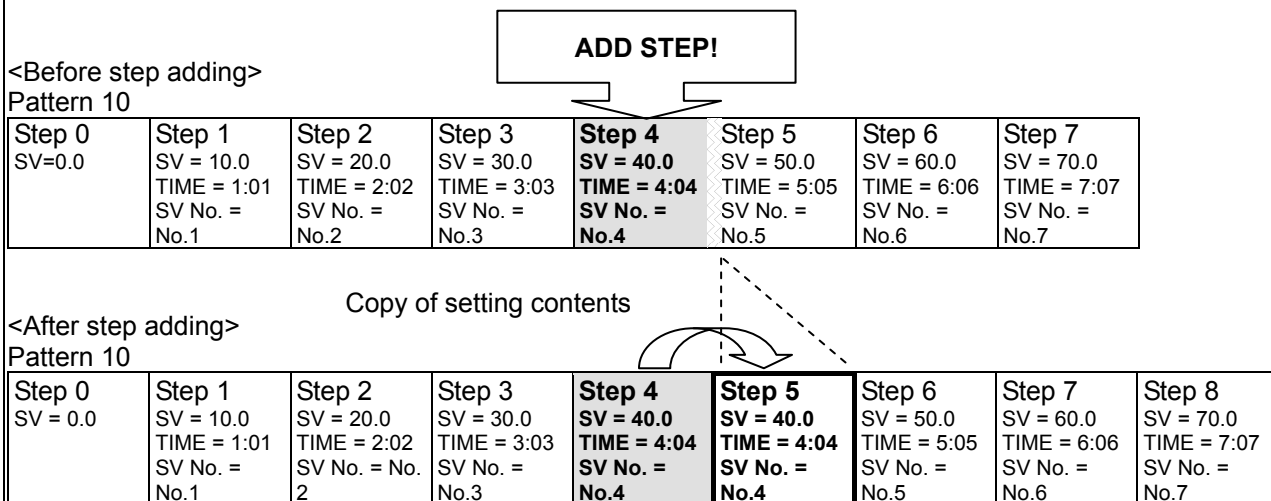
[Supplemental remarks]

The following is the example of adding new step between step 4 and step 5 of pattern 10.

<Command of step adding>

Issue of command of FNC code = 0.6, reference No. = 49095, setting data = 0A04h (0Ah → pattern No. = pattern 10, 04h → step No. = step 4).

* Example of command [MODBUS_RTU, slave address (instrument number) = 01]010623860A0464C4



Content of step adding operation:

- 1) Setting content of step 5 to step 7 is moved step 6 to step 8.
- 2) Add same content of step 4 to step 5.

FNC code.....Application function code, R/W.....R: READ, W: WRITE

Reference number	FNC Code	R/W	Data name	Setting range (Communication range)	Initial value	Remarks				
49096	03 06 16	R W W	[Pattern/step editing] Delete step	[READ] 0/1/2/3/4/5 (0/1/2/3/4/5) [WRITE] 0101h to 1313h (0101h to 1313h)	-	Reading of [pattern/step] status [READ] (FNC_03) 0= No edition 1= Add step 2= Delete step 3= Pattern copy 4= Pattern clear (1 pattern) 5= Clear all patterns Step deleting [WRITE] (FNC_06, FNC_16) · High order 8 bits = Pattern No. 1= PTN1 (pattern 1) to 19= PTN19 (pattern 19) · Low order 8 bits = Step No. 1= STP1 (step1) to 18= STP19 (step19) High order 8 bit Low order 8 bit <table><tr><td>Pattern No.</td><td>Step No.</td></tr><tr><td>15</td><td>8 7 0</td></tr></table> *When program operation (reference 49067) is other than RESET, writing is not possible. *When step number in existence (reference 49040) is 0, writing (delete step) is not possible. *When step number is exceed the step number in existence (reference 49040), writing (delete step) is not possible	Pattern No.	Step No.	15	8 7 0
Pattern No.	Step No.									
15	8 7 0									

[Supplemental remarks] The following is the example of deleting step 3 of pattern 10.

<Command of step deleting>

Issue of command of FNC code = 0.6, reference No. = 49096, setting data = 0A03h (0Ah → pattern No. = pattern 10, 03h → step No. = step 3).

* Example of command [MODBUS_RTU, slave address (instrument number) = 01]010623870A0374C6

DELETE STEP!

<Before step deleting>

Pattern 10

Step 0 SV = 0.0	Step 1 SV = 10.0 TIME = 1:01 SV No. = No.1	Step 2 SV = 20.0 TIME = 2:02 SV No. = No.2	Step 3 SV = 30.0 TIME = 3:03 SV No. = No.3	Step 4 SV = 40.0 TIME = 4:04 SV No. = No.4	Step 5 SV = 50.0 TIME = 5:05 SV No. = No.5	Step 6 SV = 60.0 TIME = 6:06 SV No. = No.6	Step 7 SV = 70.0 TIME = 7:07 SV No. = No.7
--------------------	--	--	--	--	--	--	--

<After step deleting>

Pattern 10

Step 0 SV = 0.0	Step 1 SV = 10.0 TIME = 1:01 SV No. = No.1	Step 2 SV = 20.0 TIME = 2:02 SV No. = No.2	Step 3 SV = 40.0 TIME = 4:04 SV No. = No.4	Step 4 SV = 50.0 TIME = 5:05 SV No. = No.5	Step 5 SV = 60.0 TIME = 6:06 SV No. = No.6	Step 6 SV = 70.0 TIME = 7:07 SV No. = No.7
--------------------	--	--	--	--	--	--

Content of step deleting operation:

- 1) Delete setting content of step 3.
- 2) Setting content of step 4 to step 7 is moved step 4 to step 6.

⑱ Operation status information

FNC code.....Application function code, R/W.....R: READ, W: WRITE

Reference number	FNC Code	R/W	Data name	Setting range (Communication range)	Initial value	Remarks																																
49501	03 06 16	R W W	Setting screen mode lock (bit support)	0000h to 0967h (0000h to 0967h)	0000h (Normal display)	[READ] (FNC_03) 0= Normal display 1= Lock (lock status) or NoDisp (screen non display) [WRITE] (FNC_06, FNC_16) 0= Normal display 1= Lock (lock status) * READ/WRITE after relating bit 0 to 11 of 16 bits data to mode 0 to 11. *Reading is indefinite and writing is no effect to unallocated bit (mode) or unshown mode. Low order 8 bit <table><tr><td></td><td>mode 6</td><td>mode 5</td><td></td><td></td><td>mode 2</td><td>mode 1</td><td>mode 0</td></tr><tr><td>bit 7</td><td>6</td><td>5</td><td></td><td></td><td>2</td><td>1</td><td>0</td></tr></table> High order 8 bit <table><tr><td></td><td></td><td></td><td></td><td>mode 11</td><td></td><td></td><td>mode 8</td></tr><tr><td>bit 15</td><td></td><td></td><td></td><td>11</td><td></td><td></td><td>8</td></tr></table>		mode 6	mode 5			mode 2	mode 1	mode 0	bit 7	6	5			2	1	0					mode 11			mode 8	bit 15				11			8
	mode 6	mode 5			mode 2	mode 1	mode 0																															
bit 7	6	5			2	1	0																															
				mode 11			mode 8																															
bit 15				11			8																															
49516	03 06 16	R W W	Program drive system	0/1/2/3/4 (0/1/2/3/4)	0 (MASTER KEY)	0=MASTER KEY (front key) 1=MASTER EXT (external input) 2=SLAVE EXT (synchronous method external input) 3=MASTER COM (communication) 4=FREE (front key/external input/communication) *Writing is possible in case of 'with external signal input'																																
49517	03 06 16	R W W	Select pattern system	0/1/2/3 (0/1/2/3)	0 (KEY)	0=KEY (font key) 1=EXT (external input) 2=COM (communication) 3=FREE (front key/external input/communication) *Writing is possible only in case of 'with external signal input'																																
49533	03 06 16	R W W	Key lock of driving operation	0/1 (0/1)	0 (UNLOCK)	0= UNLOCK (lock release) 1= LOCK (lock)																																
49534	03 06 16	R W W	Time display system	0/1/2/3 (0/1/2/3)	0 (PASS STEP)	0= PASS STEP (step elapsed time) 1= PASS PATTERN pattern elapsed time) 2= REMAIN STEP (step remaining time) 3= REMAIN PATTERN (pattern remaining time)																																

8-7-2. Analog input data (READ only)

Real data, parameter information

FNC code.....Application function code, R/W.....R: READ, W: WRITE

Reference number	FNC code	R/W	Data name	Detailed explanation
30103	04	R	[Upper display] SV (Setting value)	SV value (SV during program operation) · Decimal point position = PV decimal point
30109	04	R	[Execution] SV	[MODE0] SV in execution · Decimal point position = PV decimal point
30126	04	R	[Upper display] PTN (Pattern No. in selection)	Pattern No. during selection (1 to 30 = pattern 1 to 30)
30127	04	R	[Upper display] STP (Step No. in execution)	Step No. during execution (0 to 19 = step 1 to 19)
30128	04	R	[Time display screen] Patten progress time 'Hours' or 'Minutes'	'Hours' or 'Minutes' of program pattern elapsed/remaining time 000 to 999 = 0 to 999 'Days' or 'Hours' or 'Minutes' FFFFh = Time display digit over (over the 999:23 [D:H] display) · Unit = Every time unit (reference 30131) of time display screen
30129	04	R	[Time display screen] Patten progress time 'Minutes' or 'Seconds'	'Minutes' or 'Seconds' of program pattern elapsed/remaining time 00 to 23 = 0 to 23 'Hours' 00 to 59 = 0 to 59 'Minutes' or 'Seconds' FFFFh = Time display digit over (over the 999:23 [D:H] display) · Unit = Every time unit(reference 30131) of time display screen
30130	04	R	[Time display screen] Time display system	[MODE2] Time display system 0= PASS STEP (Step elapsed time) 1= PASS PATTERN (Pattern elapsed time) 2= REMAIN STEP (Step remaining time) 3= REMAIN PATTERN (Pattern remaining time)
30131	04	R	[Time display screen] Time unit of time display screen	Time unit of time display screen 0= D:H (Day : Hours) 1= H:M (Hours : Minutes) 2= M:S (Minutes : Seconds)
30141	04	R	[Setting screen] Mode screen, lock status	0= Normal display or NoDisp (screen non display) 1= Lock (lock status) * READ after relating bit 0 to 11 of 16bits data to mode 0 to 11. *Reading is indefinite value to unallocated bit (mode) or unshown mode. Low order 8 bit mode 5 mode 2 mode 1 mode 0 bit 7 5 2 1 0 High order 8 bit mode 11 mode 8 bit 15 11 8

FNC code.....Application function code, R/W.....R: READ, W: WRITE

Reference number	FNC code	R/W	Data name	Detailed explanation																
30143	04	R	Abnormality status	0= No error 1= Error activation (activating scale correction error)																
30144	04	R	Time signal status	0= Time signal OFF (extinction [TS1] or [TS2] or or [TS8]) 1= Time signal ON (lighting [TS1] or [TS2] or or [TS8]) * READ after relating bit 0 to 7 of 16 bits data to time signal 1 to 8. Low order 8 bits <table><tr><td>TS8</td><td>TS7</td><td>TS6</td><td>TS5</td><td>TS4</td><td>TS3</td><td>TS2</td><td>TS1</td></tr><tr><td>bit7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr></table>	TS8	TS7	TS6	TS5	TS4	TS3	TS2	TS1	bit7	6	5	4	3	2	1	0
TS8	TS7	TS6	TS5	TS4	TS3	TS2	TS1													
bit7	6	5	4	3	2	1	0													

8-7-3. Digital input data (READ only)

System abnormality status

FNC code.....Application function code, R/W.....R: READ, W: WRITE

Reference number	FNC code	R/W	Data name	Detailed explanation
10005	02	R	System abnormality	0= Normal 1= Correction data abnormality activation

8-8. MODBUS protocol support reference table

Analog setting value (40001 to 49999)							
Setup parameter 1		Setup parameter 2		1 type parameter		Execution parameters and specific parameters	
No.	Contents	No.	Contents	No.	Contents	No.	Contents
40001		40051		40101		40151	SV (Setting value) (R)
40002		40052	SV scale, ZERO	40102		40152	
40003		40053	SV scale, SPAN	40103		40153	
40004		40054		40104		40154	
40005		40055		40105		40155	
40006		40056		40106		40156	
40007		40057		40107		40157	
40008	SV decimal point position	40058		40108		40158	
40009	SV range, Lower limit	40059		40109		40159	
40010	SV range, Higher limit	40060		40110		40160	
40011		40061		40111		40161	
40012		40062		40112		40162	
40013		40063		40113		40163	
40014		40064		40114		40164	
40015		40065		40115		40165	
40016		40066		40116		40166	
40017		40067		40117		40167	
40018		40068		40118		40168	
40019		40069		40119		40169	
40020	SV decimal point for display	40070		40120		40170	
40021		40071		40121		40171	
40022		40072		40122		40172	
40023		40073		40123		40173	
40024		40074		40124		40174	
40025		40075		40125		40175	
40026		40076		40126		40176	
40027		40077		40127		40177	
40028		40078		40128		40178	
40029		40079		40129		40179	
40030		40080		40130		40180	
40031		40081		40131		40181	
40032		40082		40132		40182	
40033		40083		40133		40183	
40034		40084		40134		40184	
40035		40085		40135		40185	
40036		40086		40136		40186	
40037		40087		40137		40187	
40038		40088		40138		40188	
40039		40089		40139		40189	
40040		40090		40140		40190	
40041		40091		40141		40191	
40042		40092	Operation at the time of starting the power supply	40142		40192	
40043		40093		40143		40193	
40044		40094		40144		40194	
40045		40095		40145		40195	
40046		40096		40146		40196	
40047		40097		40147	SV correction	40197	
40048		40098		40148		40198	
40049		40099		40149		40199	
40050		40100		40150		40200	

Analog setting value (40001 to 49999)							
8 type parameter No.1		8 type parameter No.2		8 type parameter No.3		8 type parameter No.4	
No.	Contents	No.	Contents	No.	Contents	No.	Contents
40201		40251		40301		40351	
40202		40252		40302		40352	
40203		40253		40303		40353	
40204		40254		40304		40354	
40205		40255		40305		40355	
40206		40256		40306		40356	
40207		40257		40307		40357	
40208		40258		40308		40358	
40209		40259		40309		40359	
40210		40260		40310		40360	
40211		40261		40311		40361	
40212		40262		40312		40362	
40213		40263		40313		40363	
40214		40264		40314		40364	
40215		40265		40315		40365	
40216		40266		40316		40366	
40217		40267		40317		40367	
40218		40268		40318		40368	
40219		40269		40319		40369	
40220		40270		40320		40370	
40221	Time signal ON, Hours or minutes	40271	Time signal ON, Hours or minutes	40321	Time signal ON, Hours or minutes	40371	Time signal ON, Hours or minutes
40222	Time signal ON, Minutes or seconds	40272	Time signal ON, Minutes or seconds	40322	Time signal ON, Minutes or seconds	40372	Time signal ON, Minutes or seconds
40223	Time signal OFF, Hours or minutes	40273	Time signal OFF, Hours or minutes	40323	Time signal OFF, Hours or minutes	40373	Time signal OFF, Hours or minutes
40224	Time signal OFF, Minutes or seconds	40274	Time signal OFF, Minutes or seconds	40324	Time signal OFF, Minutes or seconds	40374	Time signal OFF, Minutes or seconds
40225		40275		40325		40375	
40226		40276		40326		40376	
40227		40277		40327		40377	
40228		40278		40328		40378	
40229		40279		40329		40379	
40230		40280		40330		40380	
40231		40281		40331		40381	
40232		40282		40332		40382	
40233		40283		40333		40383	
40234		40284		40334		40384	
40235		40285		40335		40385	
40236		40286		40336		40386	
40237		40287		40337		40387	
40238		40288		40338		40388	
40239		40289		40339		40389	
40240		40290		40340		40390	
40241		40291		40341		40391	
40242		40292		40342		40392	
40243		40293		40343		40393	
40244		40294		40344		40394	
40245		40295		40345		40395	
40246		40296		40346		40396	
40247		40297		40347		40397	
40248		40298		40348		40398	
40249		40299		40349		40399	
40250		40300		40350		40400	

Analog setting value (40001 to 49999)							
8 types parameter No. 5		8 types parameter No. 6		8 types parameter No. 7		8 types parameter No. 8	
No.	Contents	No.	Contents	No.	Contents	No.	Contents
40401		40451		40501		40551	
40402		40452		40502		40552	
40403		40453		40503		40553	
40404		40454		40504		40554	
40405		40455		40505		40555	
40406		40456		40506		40556	
40407		40457		40507		40557	
40408		40458		40508		40558	
40409		40459		40509		40559	
40410		40460		40510		40560	
40411		40461		40511		40561	
40412		40462		40512		40562	
40413		40463		40513		40563	
40414		40464		40514		40564	
40415		40465		40515		40565	
40416		40466		40516		40566	
40417		40467		40517		40567	
40418		40468		40518		40568	
40419		40469		40519		40569	
40420		40470		40520		40570	
40421	Time signal ON, Hours or minutes	40471	Time signal ON, Hours or minutes	40521	Time signal ON, Hours or minutes	40571	Time signal ON, Hours or minutes
40422	Time signal ON, Minutes or seconds	40472	Time signal ON, Minutes or seconds	40522	Time signal ON, Minutes or seconds	40572	Time signal ON, Minutes or seconds
40423	Time signal OFF, Hours or minutes	40473	Time signal OFF, Hours or minutes	40523	Time signal OFF, Hours or minutes	40573	Time signal OFF, Hours or minutes
40424	Time signal OFF, Minutes or seconds	40474	Time signal OFF, Minutes or seconds	40524	Time signal OFF, Minutes or seconds	40574	Time signal OFF, Minutes or seconds
40425		40475		40525		40575	
40426		40476		40526		40576	
40427		40477		40527		40577	
40428		40478		40528		40578	
40429		40479		40529		40579	
40430		40480		40530		40580	
40431		40481		40531		40581	
40432		40482		40532		40582	
40433		40483		40533		40583	
40434		40484		40534		40584	
40435		40485		40535		40585	
40436		40486		40536		40586	
40437		40487		40537		40587	
40438		40488		40538		40588	
40439		40489		40539		40589	
40440		40490		40540		40590	
40441		40491		40541		40591	
40442		40492		40542		40592	
40443		40493		40543		40593	
40444		40494		40544		40594	
40445		40495		40545		40595	
40446		40496		40546		40596	
40447		40497		40547		40597	
40448		40498		40548		40598	
40449		40499		40549		40599	
40450		40500		40550		40600	

Analog setting value (40001 to 49999)							
				System setting		Program pattern information	
No.	Contents	No.	Contents	No.	Contents	No.	Contents
40601		40701		48001	Display back light	49001	
40602		40702		48002	Display contrast	49002	
40603		40703		48003	Key backlight	49003	Pattern No. [for pattern R/W]
40604		40704		48004		49004	Step No. [for pattern R/W]
40605		40705		48005		49005	Step repeat
40606		40706		48006		49006	SV
40607		40707		48007		49007	Time, hours or minutes
40608		40708		48008		49008	Time, minutes or seconds
40609		40709		48009		49009	
40610		40710		48010		49010	SV No.
40611		40711		48011		49011	
40612		40712		48012	External signal allocation, Terminal No.12	49012	
40613		40713		48013	External signal allocation, Terminal No.13	49013	
40614		40714		48014	External signal allocation, Terminal No.14	49014	
40615		40715		48015	External signal allocation, Terminal No.15	49015	
40616		40716		48016	External signal allocation, Terminal No.16	49016	
40617		40717		48017	External signal allocation, Terminal No.17	49017	
40618		40718		48018		49018	
40619		40719		48019	External signal allocation, Terminal No.19	49019	
40620		40720		48020	External signal allocation, Terminal No.20	49020	Time signal 1 No.
40621		40721		48021	External signal allocation, Terminal No.21	49021	Time signal 2 No.
40622		40722		48022	External signal allocation, Terminal No.22	49022	Time signal 3 No.
40623		40723		48023	External signal allocation, Terminal No.23	49023	Time signal 4 No.
40624		40724		48024	External signal allocation, Terminal No.24	49024	Time signal 5 No.
40625		40725		48025		49025	Time signal 6 No.
40626		40726		48026	External signal allocation, Terminal No.26	49026	Time signal 7 No.
40627		40727		48027	External signal allocation, Terminal No.27	49027	Time signal 8 No.
40628		40728		48028	External signal allocation, Terminal No.28	49028	
40629		40729		48029	External signal allocation, Terminal No.29	49029	
40630		40730		48030	External signal allocation, Terminal No.30	49030	
40631		40731		48031	External signal allocation, Terminal No.31	49031	
40632		40732		48032	External signal allocation, Terminal No.32	49032	
40633		40733		48033	External signal allocation, Terminal No.33	49033	
40634		40734		48034		49034	
40635		40735		48035		49035	
40636		40736		48036		49036	
40637		40737		48037		49037	
40638		40738		48038		49038	
40639		40739		48039		49039	
40640		40740		48040		49040	Existing set step count (R)
40641		40741		48041		49041	Start SV
40642		40742		48042		49042	
40643		40743		48043		49043	Link destination pattern No.
40644		40744		48044		49044	
40645		40745		48045		49045	
40646		40746		48046		49046	
40647		40747		48047		49047	
40648		40748		48048		49048	Time unit
40649		40749		48049		49049	SV during reset
40650		40750		48050		49050	

Analog setting value (40001 to 49999)				Analog input data (30001 to 39999)			
Program pattern setting/editing		Operation status information		Real data & parameter			
No.	Contents	No.	Contents	No.	Contents	No.	Contents
49051		49501	Setting screen mode lock	30001		30101	
49052		49502		30002		30102	
49053		49503		30003		30103	SV (setting value)
49054		49504		30004		30104	
49055	Pattern repeat	49505		30005		30105	
49056	Executing SV	49506		30006		30106	
49057	Executing time, 'Hours' or 'Minutes'	49507		30007		30107	
49058	Executing time, 'Minutes' or 'Second'	49508		30008		30108	
49059		49509		30009		30109	Executing SV
49060		49510		30010		30110	
49061		49511		30011		30111	
49062		49512		30012		30112	
49063		49513		30013		30113	
49064		49514		30014		30114	
49065		49515		30015		30115	
49066	Pattern No.	49516	Program drive system	30016		30116	
49067	Program operation	49517	Select pattern system	30017		30117	
49068		49518		30018		30118	
49069		49519		30019		30119	
49070		49520		30020		30120	
49071		49521		30021		30121	
49072		49522		30022		30122	
49073		49523		30023		30123	
49074		49524		30024		30124	
49075		49525		30025		30125	
49076		49526		30026		30126	PTN (Pattern No. in selection)
49077		49527		30027		30127	STP (Step No. in execution)
49078		49528		30028		30128	Progress time, 'Hours' or 'Minutes'
49079		49529		30029		30129	Progress time, 'Minutes' or 'Seconds'
49080		49530		30030		30130	Time display system
49081		49531		30031		30131	Time display screen time unit
49082		49532		30032		30132	
49083		49533	Key lock of driving operation	30033		30133	
49084		49534	Time display system	30034		30134	
49085		49535		30035		30135	
49086		49536		30036		30136	
49087		49537		30037		30137	
49088		49538		30038		30138	
49089		49539		30039		30139	
49090		49540		30040		30140	
49091		49541		30041		30141	Mode screen, lock status
49092		49542		30042		30142	
49093	Pattern copy	49543		30043		30143	Abnormality status
49094	Pattern clear	49544		30044		30144	Time signal status
49095	Add step	49545		30045		30145	
49096	Delete step	49546		30046		30146	
49097		49547		30047		30147	
49098		49548		30048		30148	
49099		49549		30049		30149	
49100		49550		30050		30150	

Digital setting value (1 to 10000)				Digital input data (10001 to 20000)			
				System abnormality status			
No.	Contents	No.	Contents	No.	Contents	No.	Contents
101		151		10001		10101	
102		152		10002		10102	
103		153		10003		10103	
104		154		10004		10104	
105		155		10005	System abnormality	10105	
106		156		10006		10106	
107		157		10007		10107	
108		158		10008		10108	
109		159		10009		10109	
110		160		10010		10110	
111		161		10011		10111	
112		162		10012		10112	
113		163		10013		10113	
114		164		10014		10114	
115		165		10015		10115	
116		166		10016		10116	
117		167		10017		10117	
118		168		10018		10118	
119		169		10019		10119	
120		170		10020		10120	
121		171		10021		10121	
122		172		10022		10122	
123		173		10023		10123	
124		174		10024		10124	
125		175		10025		10125	
126		176		10026		10126	
127		177		10027		10127	
128		178		10028		10128	
129		179		10029		10129	
130		180		10030		10130	
131		181		10031		10131	
132		182		10032		10132	
133		183		10033		10133	
134		184		10034		10134	
135		185		10035		10135	
136		186		10036		10136	
137		187		10037		10137	
138		188		10038		10138	
139		189		10039		10139	
140		190		10040		10140	
141		191		10041		10141	
142		192		10042		10142	
143		193		10043		10143	
144		194		10044		10144	
145		195		10045		10145	
146		196		10046		10146	
147		197		10047		10147	
148		198		10048		10148	
149		199		10049		10149	
150		200		10050		10150	

9. PRIVATE protocol

9-1. Difference between RS—232C and RS-422A/485

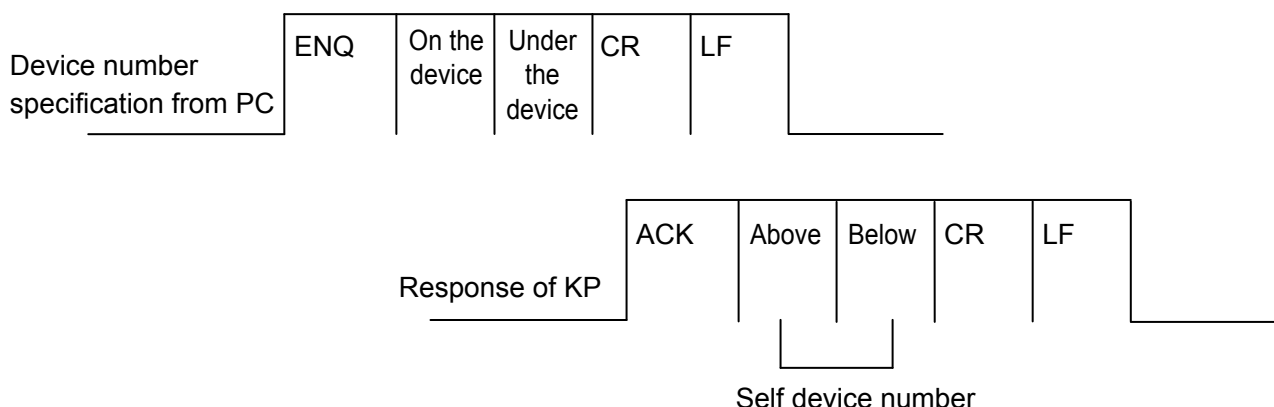
Only the level of RS-232C and RS-422A/RS-485 differs electrically, the communication procedure is the same.

However, RS-422A/RS-485 connects devices in series and communicates one of the devices by sending device number using specified procedure from computer.

This is called establishing the data link. For that each device sets its own device number beforehand such that it does not overlap with the other device number.(See 'setting parameters for communication') After the data link is established, communication procedure of RS-232C and RS-422A/RS-485 is exactly the same.

9-1-1. Establishing the data link

From the PC if you want to communicate by using the following procedure, send the device numbers before hand and establish data link with that device and communicate. After establishing the data link communicate with that device according to the procedure explained in 'Communication format'.



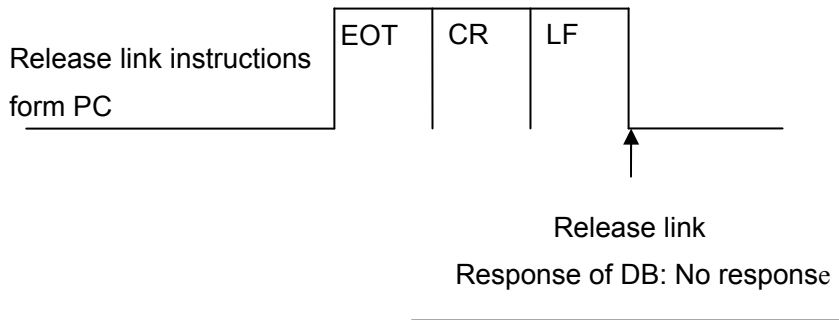
Precautions

To avoid accidents always read these contents and understand them.

1. Always send the device numbers in 2 digits from 01 to 99.
2. Do not use the device number 00.
3. Only the specified device responds within 1 second.
4. When the device of the specified device number does not exist, then there is no response.
5. If there is a device whose data link is already established the data link of that device is automatically released because data link with some other device is established.
6. If there is a power failure, a back up of the data link status of the data link before power failure is taken.
7. ENQ, ACK are control codes and they are expressed as hexadecimals as follows.
ENQ: 05H
ACK: 06H
8. When device number 1 is sent response of KP is as follows.
ACK 30 31 CR LF
When device number 99 is sent response of KP is as follows.
ACK 39 39 CR LF

9-1-2. Releasing the data link

When communicating with the device other than the device that is presently communicating, release the data link with the following procedure from the PC and then establish the data link with the next device by the procedure mentioned earlier.



Precautions

To avoid accidents always read these contents and understand them.

1. By using this command, the data link of all the devices that are connected is released and following data link is established.
2. Data link of each device which is connected is released within 10msec from when this command given, hence for sending it further from the PC a time of 10msec or more is necessary.
3. EOT is control code and it is expressed as hexadecimal as follows.
EOT: 04H

9-2. Basic procedure of communication

9-2-1. Text format at the time of sending and receiving

STX	TEXT	ETX	BCC L	BCC H	CR	LF
-----	------	-----	-------	-------	----	----

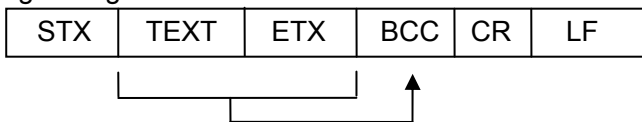
- ① Character received before STX is not received.
- ② Always add CR(0DH), LF(0AH) as end code. (For both sending and receiving).

9-2-2. Check sum

This device adds check sum data as BCC (Block Check Code).

Check sum means, seeing each text data as binary and sending low order 8 bits of that total sum as hexadecimal character.

- ① Target range of BCC



- ② BCC (Check sum)

The low order 8 bit data of the pure binary total sum of target range data is split into high and low order 4 bits and are converted to characters (30 to 39, 41 to 46H) 0 to F, and is kept in high order and low order sequence. (2 characters)

STX	TEXT	ETX	BCC L	BCC H	CR	LF
-----	------	-----	-------	-------	----	----

- ③ When adding parity to BCC, the parity of BCC itself is considered.
- ④ BCC is not added in positive and negative response.
- ⑤ Nor it is added to ENQ, ACK, EOT.
- ⑥ BCC is added and checked for both sending and receiving.

STX	1	2	,	0	ETX	BCC L	BCC H	CR	LF
	31	32	2C	30	03	32	43		
						(2)	(C)		

When the data to be sent and received is changed due to noise etc, by comparing with that value calculated on the receiving side, that occurrence might be detected.

9-2-3. Basic procedure of communication

- ① In case of KP with communication option, communication is possible at any point of time.
- ② In RS—422A/RS-485, first of all data link is established and then communication with KP is performed according to the communication format. In the end the data link is released and made available for next communication.
- ③ In RS-232C, communication with KP is done according to the communication format from the beginning.
- ④ If a command is sent for KP from high order PC or if parameter setting and pattern setting is done KP does not accept it and a negative response is sent if FNC key or the corresponding mode is not locked.

In this case, please lock the FNC key or the corresponding mode.

- ⑤ In case of data request command from high order PC, KP outputs the data regardless of lock/no lock status. (However, pattern setting data is output in case of RESET only)
- ⑥ When KP receives a data request from high order PC, if the request is correct, the data is sent. If the request is incorrect or if data sending is not possible, a negative response is sent.
- ⑦ When KP receives parameter setting, command from high order PC, if the command and the settings are correct a positive response is sent after internal processing.

If there is a mistake in the setting, command or if setting, command cannot be received, a negative response is sent.

9-2-4. Control code

Following code is used during communication.

STX(Text start signal)	: 02H
ETX(Text end signal)	: 03H
ACK(Positive response)	: 06H
NAK(Negative response)	: 15H
[RS-422A/485]	
ENQ(Enquiry signal)	: 05H
EOT(Transmission end signal)	: 04H

9-3. Communication format



Precautions

When transfer the parameter from old instrument to this instrument, check the setting range of each parameter because some parameters of setting range (for example, SV (setting value), alarm value etc.) is different from old instrument.

9-3-1. Data request command (PC → KP)

Command name	Command format	Status
① Real data request	STX Δ1, Δ1, ETX BCC CR LF (DF)	Current data request
② Execution parameter request	STX Δ1, Δ2, ETX BCC CR LF (EF)	Mode 0 execution parameter request
③ Setting program pattern data request [In case of resetting only]	STX Δ1, Δ3, □□, □□, ETX BCC CR LF Step No. Pattern No. Repeat pattern in case of 00 Request data	Program pattern data request Data request for each step
④ Individual setting parameter request	STX Δ1, Δ4, □□, □□, ETX BCC CR LF 1 to 8=Parameter No. When parameter is 8 types When 91 to 98=PID9 When 1=Parameter is 1 type Parameter type No.*1 *1 parameter type No. is a number given to setting parameter and is indicated in section 9-3-5.	Data request by specifying 1 setting parameter
⑤ Program pattern setting status request	STX Δ1, Δ5, □□, ETX BCC CR LF Pattern No.(1 to 30)	Pattern setting status request
⑥ Device status request	STX Δ1, Δ6, ETX BCC CR LF (20)	Request configuration status of the device
⑦ Mode lock status request	STX Δ1, Δ7, ETX BCC CR LF (30)	Request each mode lock status
⑧ Status 1 request	STX Δ1, Δ8, ETX BCC CR LF (40)	Request the status of alarm, error, time signal
⑨ Status 2 request	STX Δ1, Δ9, ETX BCC CR LF (50)	Request the status of program operation

(Note) Δ=Space

9-3-2. Response output of KP to the data request command (KP → PC)

Function	Output format
① Real data output In KP3000, PV, MV data becomes the dummy data.	STX Δ1, □□, □□, □, □□□□□□□□, □□□□□□□□, □□□□□□□□ Pattern No. Step No. PV(dummy) SV9(Set value) 0 in case of resetting PV status: 0=Normal, 4=Hardware error □, □, □□□, □□ □, □□□□□□□□, □, □□□□□□□□ Time unit Time 1=Minute 2= Hours 3= Days MV1 (dummy) MV2 (dummy) Time display system 1=Elapsed step 2=Elapsed pattern 3=Remaining step 4=Remaining pattern It becomes the dummy data ETX BCC CR LF All 9 digits in case of over range (Note) PV, SV data up to 4 positions after the decimal point can be sent and if it exceeds 6 digits including the decimal point, the digit in the lowest position is truncated.
② Mode 0 Execution parameter output In KP3000, all the data except SV data becomes a dummy data.	STX Δ2, □□□□□□□□, □□□□□□□□, □□□□□□□□, □□□□□□□□ Execution target SV Execution P (dummy) Execution I (dummy) □□□□□□□□, □□□□□□□□, □□□□□□□□, □□□□□□□□ Execution D (dummy) Execution AL1 (dummy) Execution AL2 (dummy) □□□□□□□□, □□□□□□□□, □□□□□□□□, □□□□□□□□ Execution AL3 (dummy) Execution AL4 (dummy) Execution OL (dummy) □□□□□□□□, □□□□□□□□, □□□□□□□□, □□□□□□□□ Execution OH (dummy) Execution variation limit (dummy) Execution sensor correction (dummy) □□□□□□□□, □□□□□□□□, □□□□□□□□, □□□□□□□□ Second P (dummy) Second I (dummy) Second D (dummy) ETX BCC CR LF
③ Setting program pattern data output [In case of reset only] In KP3000, all the parameter No. excluding TS become the dummy data.	(i) Step 0 output STX Δ3, Δ1, □□, Δ0, □□□□□□□□, □, ETX BCC CR LF Pattern No. Step No. Start SV 0= Start SV 1= Start PV (ii) Step n output STX Δ3, Δ2, □□, □□, □□□□□□□□, □□□, □□, □□, □□ Pattern No. Step No. SV Time. Repeat count Δ0= Repeat start step ΔΔ= Un-set step □, □, □, □, □, □, □, □□, □□, □□, □□, □□ PID ALM OPL OSL TS1 TS2 TS3 TS4 TS5 No. No. No. No. No. No. No. No. No. No. No. (dummy) (dummy) (dummy) (dummy) Waiting time No. (dummy) 0=ALL OFF 1=No.1 2= Repeat No.1 17=ALL ON Sensor correction No. (dummy) ETX BCC CR LF

Function	Output format
In case of KP3000, output at the time of END becomes the dummy data.	(iii) END step output STX Δ3, Δ3, □□, □□, □□, □□□□□□, ETX BCC CR LF Pattern No. Step No. Link destination Pattern No. 0=No link Output in case of END (dummy) (iv) Repeat pattern output STX Δ3, Δ6, □□□□□□□□, ETX BCC CR LF Repeat count
④ Individual setting parameter output	KP sends the requested setting parameter. Sending format is the same as individual parameter setting format in case of setting from PC in KP. (See 9-3-5) However as the number of digits of the data differ, see Appendix 1 Communication format list for the details.
⑤ Program pattern setting status output	STX Δ5, □□, □□, ETX BCC CR LF Setting step count 0= Not set Pattern No.
⑥ Device status output	STX Δ6, □, □, □, □, □, □, □, □, □, □, ETX BCC CR LF 1=Controller 2=Setter 0=Setter 1=Full multi-input 2=4-wire type Input Output 1 1=61, 65 [EMF] 2=62 3=63 [Linear] In the bracket ([]) in case of KP3000 Time signal Transmission 0=Does not exist 1=Exists Output 2 0=None 1=61, 65 3=63 Time unit 0=Hours/minutes 1=Minute/seconds Select pattern External drive

Function	Output format
⑦ Mode lock status output	STX Δ7, ☐, ☐, ☐, ☐, ☐, ☐, ☐, ☐, ☐, ☐, ☐, ☐, ETX BCC CR LF 1 2 3 4 5 6 7 8 Mode 0 FNC key { 0= Non lock 1=Lock 2=NoDisp
⑧ Status 1 Output	STX Δ8, ☐☐, ☐☐, ☐☐, ☐☐, ☐☐, ☐, ☐, ☐, ☐, ☐, ☐, ☐, ☐, ETX BCC CR LF AL1 AL2 AL3 AL4 TS1 TS2 TS3 TS4 TS5 Error Waiting time alarm Time signal { 0=OFF 1=ON ETX BCC CR LF In KP3000 everything except TS becomes the dummy data
⑨ Status 2 Output	STX Δ9, ☐, ☐, ☐, ☐, ☐, ☐, ☐, ☐, ☐, ☐, ☐, ☐, ☐, ETX BCC CR LF RUN { 0= RUN 1=STOP STOP { 0= STOP 1=RESET RESET { 0= RESET 1=END END { 0= ADV 1=CONST ADV { 0= MAN1 1=MAN2 CONST (dummy) MAN1 (dummy) MAN2 (dummy) WAIT (dummy) AT (dummy) FNC key LOCK M/S { 0=Master 1=Slave { 0=Non lock 1=Lock ETX BCC CR LF In KP3000 a part of the data becomes the dummy data.

9-3-3. Command that moves the KP status (PC → KP)

Command function	Command format
① Program drive [FNC lock]	STX Δ2, Δ1, □, □□, ETX BCC CR LF Pattern No. [Only in case of selecting RUN or pattern. In cases other than that, space is set] 1=RUN 2=STOP 3=ADV 4=RESET 5=Select pattern (Note) When external drive input, select pattern input options are attached, it is necessary to set the program drive system, select pattern system to COM. (communication), in mode 1.
② Mode Lock/release lock	STX Δ2, Δ7, □, □, □, □, □, □, □, □, □, □, ETX BCC CR LF 1 2 3 4 5 6 7 8 Mode 0 FNC key [0=Non lock 1=Lock]
③ Time display system [Mode 1 lock]	STX Δ2, Δ8, □, ETX BCC CR LF [1=Elapsed step 2=Elapsed pattern 3=Remaining steps 4=Remaining patterns]

9-3-4. Program pattern setting (PC → KP) [At the time of resetting only] [Mode 2 lock]

Set field	Set format
① Step 0	STX Δ3, Δ1, □□, 0 0, □□□□□□, □, ETX BCC CR LF Pattern No. Step No. Start SV 0= Start SV 1=Start PV In KP3000, set it to SV start.
② Step n	STX Δ3, Δ2, □□, □□, □□□□□□□□, □□□, □□, Pattern No. Step No. SV Time ETX BCC CR LF When setting the relevant step for the first time, if time is set as "0" (000 hours/00 minutes, or 000 minutes/00 seconds) error code 41 may occur. When setting the time as "0", set the time as □□□□.□□□□ and after the pattern setting is done, change the setting to □□□□.□□□□. (Note) Delimiter of time hours/minutes, minutes/seconds is period.
③ END step	STX Δ3, Δ3, □□, □□, □□, □□□□□□, ETX BCC CR LF Pattern No. Step No. □□ Output in case of END 0= Output 0 200= Fixed control Link destination pattern No. 00=No link In KP3000, mode 4 is locked using communication and 0 is set in END output.
[Mode 2 lock] [Mode 4 lock]	
④ Parameter No. setting	STX Δ3, Δ4, □□, □□, □, □, □, □, □, □, □, □, Pattern No. Step No. PID No. ALM No. OPL No. OSL No. □ Waiting time number Real temperature compensation No. (0=OFF) Sensor correction No. □□, □□, □□, □□, □□, ETX BCC CR LF TS1 TS2 TS3 TS4 TS5 00=ALL OFF *Set 00 in case of no TS. 01=No.1 02=Repeat No.1 16=Repeat No.8 99=ALL ON In KP3000, set 0, except for TS.
⑤ Repeat step	STX Δ3, Δ5, □□, □□, □□, □□, ETX BCC CR LF Pattern No. □□ End step Starting step Starting < End, always □□ Repeat count 1 to 99=Count 00=Cancel repeat
⑥ Repeat pattern	STX Δ3, Δ6, □□□□, ETX BCC CR LF Repeat count
⑦ Copy pattern	STX Δ3, Δ7, □□, □□, ETX BCC CR LF □□ Copy destination pattern No. □□ Copy source pattern No.
⑧ Clear pattern	STX Δ3, Δ8, □□, ETX BCC CR LF □□ 00=Clear ALL 1 to 19=Clear pattern unit

9-3-5. Individual parameter setting (PC → KP)

Parameter type	No.	Format
Time signal (1 to 8)	19	STX 19, □, □□□.□□, □□□.□□, ETX BCC CR LF ON Time OFF Time Do not change the setting in case of 6 digits space. 1 to 8=Parameter No. 0=Copy to No. 1 to 8
[Mode 6 lock]		(Note) Delimiter for time hours/minutes, minutes/seconds is a period.
SV decimal point	32	STX 32, □, ETX BCC CR LF
[Mode 5 lock]		(Note) Differs from display SV decimal point.
SV during Reset	49	STX 49, □□□□□□, ETX BCC CR LF
[Mode 2 lock]		
Reserve	51	STX 51, □□, □, ETX BCC CR LF Initial value:0 Initial value:5
[Mode 5 lock]		(Note) Only when read respond by initial value. Do not change the settings in case of write.
SV scale	52	STX 52, □□□□□□, □□□□□□, ETX BCC CR LF MIN MAX
[Mode 5 lock]		Do not change the settings when all the digits are spaces.

9-4. Positive response and negative response

9-4-1. Positive response

ACK	CR	LF
-----	----	----

ACK=06H

9-4-2. Negative response

NAK	Error	Code	CR	LF
-----	-------	------	----	----

NAK=15H

* Do not apply STX, ETX, BCC to ACK/NAK.

9-4-3. Error code

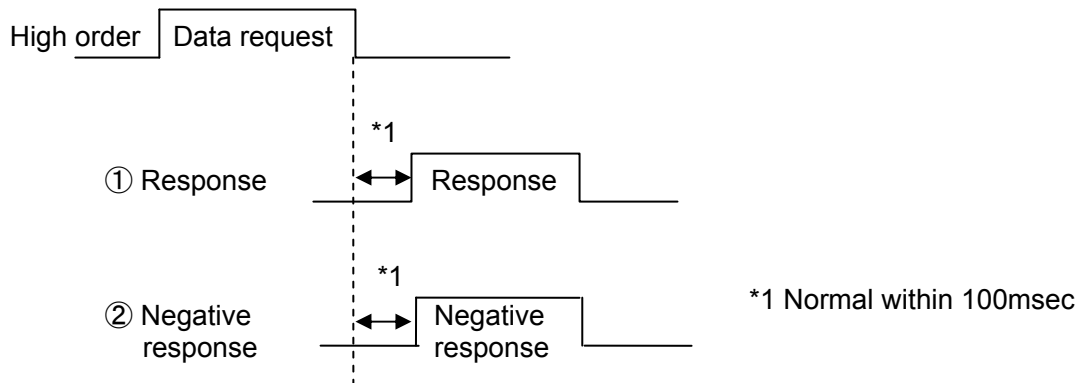
Code	Error type	Contents
△1	Framing	During non lock, high order was confirmed and command was sent.
△2	Over run	
△3	Parity	
△4	Check sum	
△5	Lock/non lock	
10	Format	Fast communication code error
11	"	
12	"	
14	"	
15	"	
16	Numeric value	- Excess reception buffer - Cannot recognize as numerals.
20	Data	
21	"	
22	"	
23	"	
24	"	- Undefined numeric value is received. (Numeric value is out of range) - L/H error (Greater and smaller relation is reversed) - SV RANG error (It is set out of SV RANG) - SV scope error - Z/S error (Greater and smaller relation is reversed) - Linear range error
25	"	
30	Program drive	
31	"	
32	"	
33	"	- ADV, STOP was done during reset. - Pattern was selected during STOP. - Pattern was selected during RUN. - RUN, STOP, ADV, Pattern were selected during END. - RUN, STOP, ADV, RESET was done during CONST. - Program drive was RUN, STOP, ADV, RESET during KEY or EXT
34	"	
35	External drive OP	

(Note) △=Space

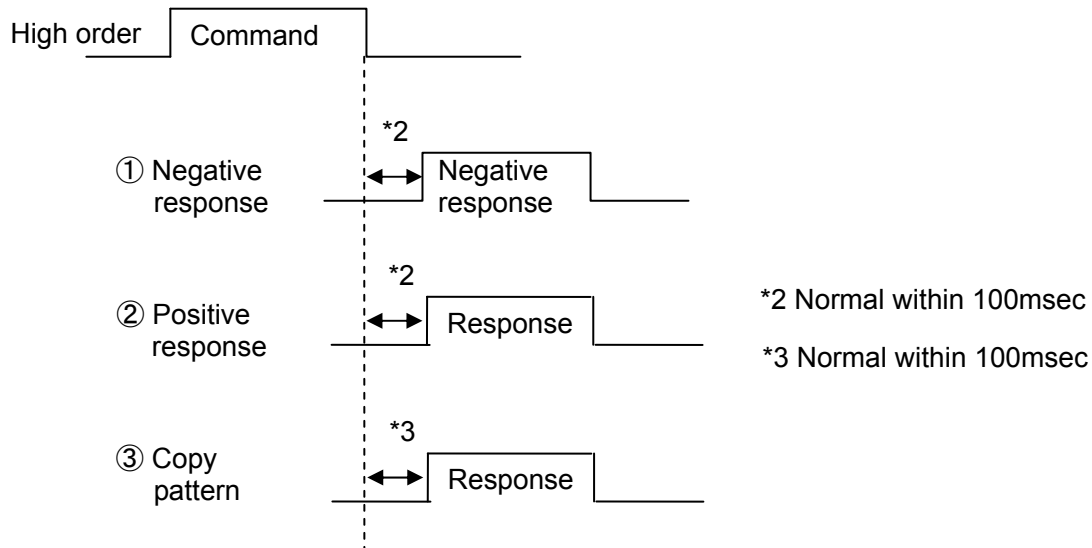
Code	Error type	Contents
36	Select pattern OP	· Select pattern selected the pattern in case of KEY or ETX
40	Set pattern	· Set the pattern except for RESET.
41	"	· Continued 2 steps and set Time=0.
43	"	· Set parameter No. in unset step (END step).
44	"	· Did repeat setting in unset step.
45	"	· Set after END step. (Add)
46	"	· Set END after unset step.
50	Copy pattern	· Copy pattern except in case of RESET.
51	"	· Copy destination is not cleared.
52	"	· Copy source pattern is not set.
53	Clear pattern	· Clear pattern except during RESET.
54	Read pattern	· Read requested the pattern data except during RESET.
55	"	· Read requested the unset step.
60	RUN; PTN No.	· Unset pattern is RUN. (Link destination includes the unset pattern)
61	RUN; Repeat step	· Repeat step setting of the pattern that was RUN is an error
65	AT start	· Started AT1 during RESET, PRG.
66	"	· Started AT2 except for RESET, PRG.
67	"	· Started AT3 except for RESET, PRG.
99	Others	· At the time of other error

9-5. Communication time chart

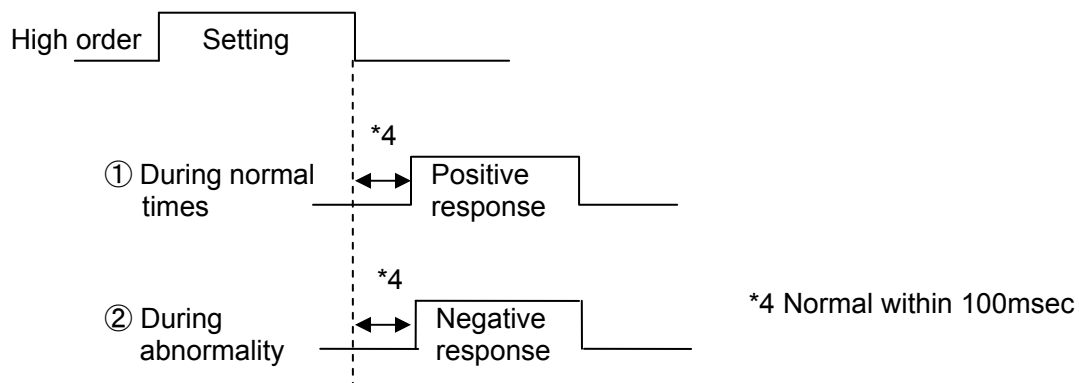
9-5-1. Response to data request



9-5-2. Response to command

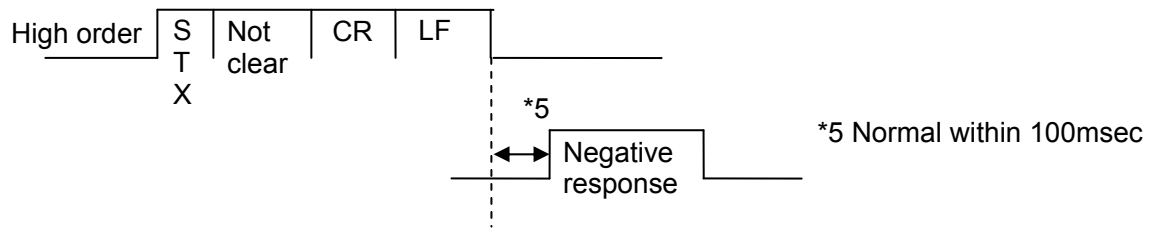


9-5-3. Response to pattern setting, parameter setting

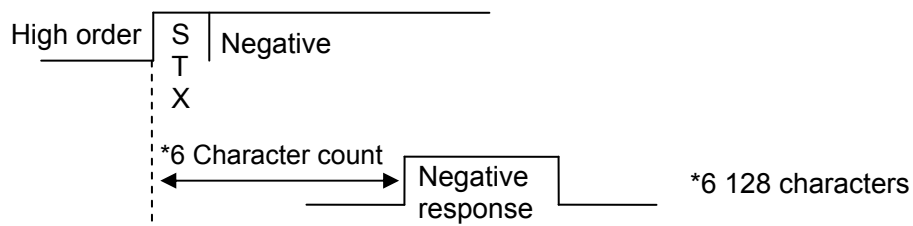


9-5-4. During other abnormalities

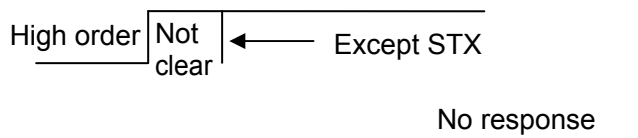
① Contents unclear



② Exceeding character count (Excess buffer)



③ When beginning with other than STX



Precautions

* When the front key operation 1 to 5 is to be repeated, it takes some seconds.

9-5-5. Response of PC

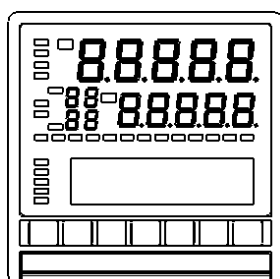
Response of KP for the request and setting from PC is carried out after a certain time. In other words if there is no response from KP after a fixed time, it is necessary send a request and settings from the PC again. For timer time when it is resend, see the time chart.

10. Communication (Digital) transmission

10-1. Overview

KP can, not only communicate with the PC but also can digitally communicate with KP → DB device (Between our company's controller-DB). It is called "Communication transmission" "Communication remote".

If this function is used, DBs on multiple machines operate with the same condition, consider KP as master device which is set in communication transmission and DB as slave device which is set in communication remote. Maximum 31 slave device SVs can be set using communication. It can be change to KP (master device) doing communication transmission or to communication remote DB (slave device) receiving it, by key settings of device itself.



If communication function of mode 8 is set as 'TRANS', it becomes a communication transmission (master unit) function.

(Communication function settings and transmission data contents)

Mode 8, Communication function settings (Master unit) → (Slave unit)	Transmission data contents
MODBUS protocol (Transmission) → (Remote) [Between DB/KP series]	• MODEBUS protocol • Master unit transmits "Run/Ready status", "SV No.", and "remote SV data (no decimal point information)", and then slave unit receives it
PRIVATE protocol (Transmission) → (Remote) [Between KP and controller of out company]	• PRIVATE protocol • Master unit transmits "remote SV data (with decimal point information)", and slave unit receives it. • To be compatible with controllers of our company except DB/KP series.

※Perform the following operation as master unit.

• MODBUS protocol

- ①Run/Ready ... Master unit: Transmit program operation
Run = Except program operation RESET
Ready = Program operation RESET
- ②SV No. ... Master unit: Transmit Executing SV No. of mode 2
- ③Remote SV data ... Transmit data selected in communication transmission type

• PRIVATE protocol

- Remote SV data ... Transmit data selected in communication transmission type

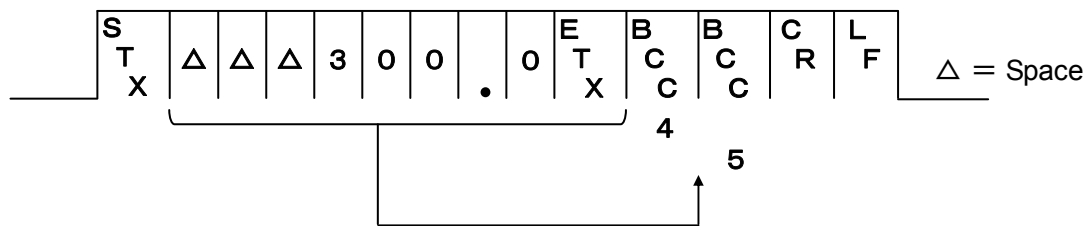
10-2. Specifications of communication division

- Communication system : Asynchronous method
- Communication speed : 38400,19200,9600,4800,2400bps switching communication speed
- Start bit : 1 bit
- Data length : 7 bit (ASCII mode/PRIVATE mode) or 8 bits (RTU mode/ASCII mode)
- Parity bit : None (RTU mode/ASCII mode), Even (RTU mode/ASCII mode/PRIVATE mode), Odd (RTU mode/ASCII mode)
- Stop bit : 1 bit (RTU mode/ASCII mode/PRIVATE mode), 2 bits (RTU mode/ASCII mode)
- Transmission code : ASCII (ASCII mode/PRIVATE mode) or Binary (RTU mode)
- Error check : Check sum ※1...For PRIVATE mode
: CRC-16 ...For RTU mode
: LRC ...For ASCII mode
- Usage signal name : Send or receive data only, without using control signal

※1 Check sum (BCC)

Check sum means, total sum of characters after STX up to ETX is calculated, lower order 8 bits are split into high and low order 4 bits and are converted to characters from 0 to F and are sent and received sequentially in high order and low order.

(Example)



Character	Δ	Δ	Δ	3	0	0	.	0	ETX	Total sum = BCC
ASCII code	20h	20h	20h	33h	30h	30h	2Eh	30h	03h	154h=45

10-3. Communication transmission setting

Set the following parameters in communication transmission KP.

- 1) Setting the communication speed (COM BIT RATE). (See 6-1)
- 2) Setting the communication function (COM KIND). (See 6-3)
- 3) Setting communication transmission type (COM TRANS KIND). (See 6-4)
- 4) Setting communication protocol (COM PROTOCOL). (See 6-5)
- 5) Setting communication character (COM CHARACTER). (See 6-6)

Reference In case of 'PRIVATE mode' communication transmission, KP outputs the data in the following format.



Data output: SV (Control setting value)

※ In case of 'RTU/ASCII mode' communication transmission, output the data by slave address '0' in MODBUS format mentioned earlier.



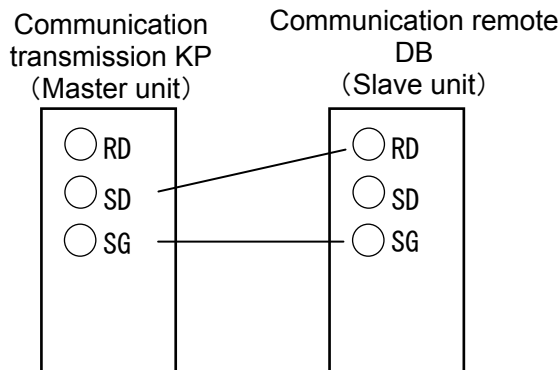
Precautions

- ① When connecting KP using communication transmission and DB using communication remote, the communication speed and transmission protocol must be the same.
- ② If analog remote and communication remote are used simultaneously analog remote takes precedence.
- ③ Analog transmission type and communication transmission type can be set separately.
- ④ If analog transmission option and communication transmission option are used simultaneously, transmission output is done from both.

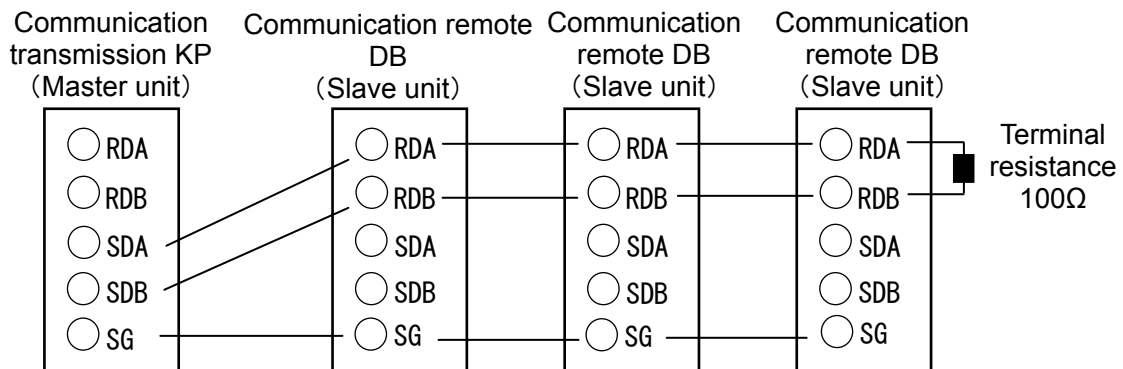
'Transmission scale lower limit' 'Transmission scale higher limit' 'remote scale lower limit' 'remote scale higher limit' of the parameter is set at the time of analog transmission/remote. Thus when using communication transmission one need not set them.

10-4. Wiring

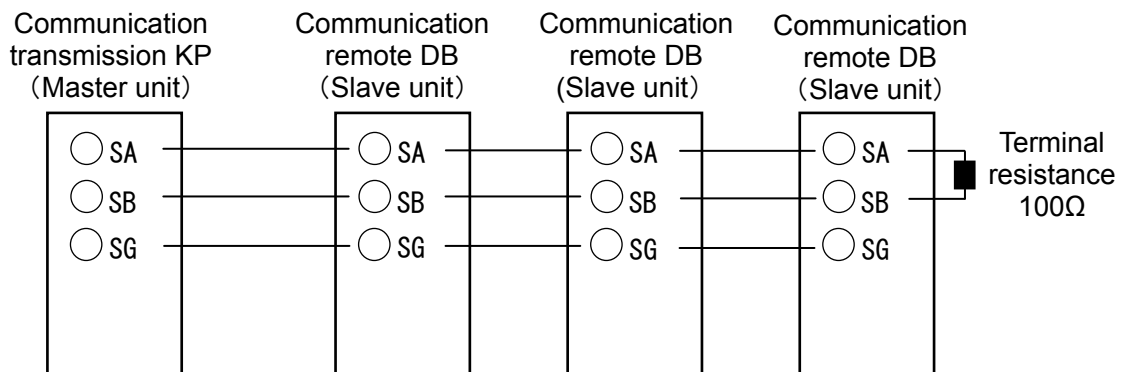
10-4-1. For RS-232C



10-4-2. For RS-422A



10-4-3. For RS-485



Precautions

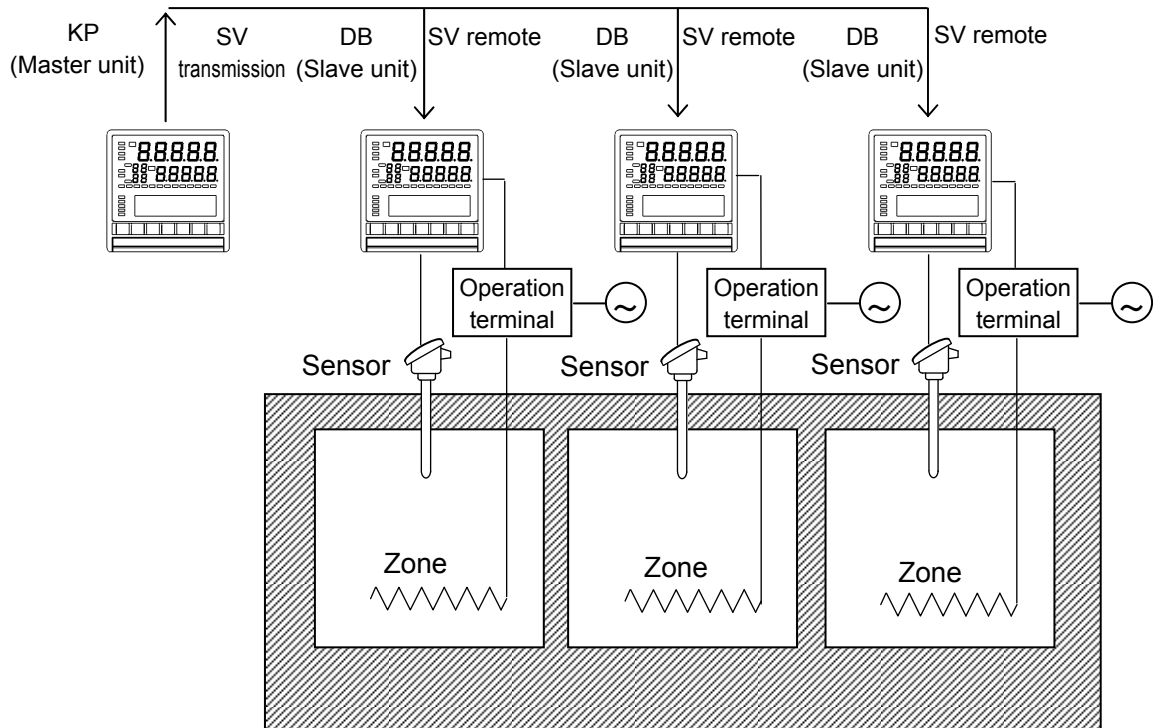
Refer to 4-3. Wiring in instruction manual [general] for terminal numbers.

10-5. Example of combination

10-5-1. Multizone temperature control

Perform communication transmission for SV using KP of master unit, and slave unit DB receives using communication remote.

As there is no error in analog division remote control with good precision is possible. If remote shift of DB is used, temperature slope can be held in multizone,



11. Appendix

11-1. Communication format list

As mentioned below Δ=Space(20H), X=Code data and numeric value data at the time of setting, O=Code data and numeric value data at the time of sending DB, SX=STX (02H), EX=ETX (03H), BCBC=BCC, CR=CR (0DH), LF=LF(0AH).

Communication Item	Format																															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		
Real data request	SX	Δ	1	,	Δ	1	,	EX	BC D	BC F	CR	LF																				
Response output	SX	Δ	1	,	○	○	,	○	○	,	○	,	○	○	○	○	○	○	○	○	,	○	○	○	○	○	○	○	○	○	,	
	PTN						STP						Dummy										SV									
	○ , ○ , ○				○ ○ ○ , ○ ○ ○ , ○ ○ ○				○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○ ○										○ , ○ , ○ ○ ○ ○ ○ ○ ○ ○ ○ ○													
	TIME						Dummy										Dummy															
	○	○	,	EX	BC	BC	CR	LF																								
	(MV2)																															
Execution parameter request	SX	Δ	1	,	Δ	2	,	EX	BC E	BC F	CR	LF																				
Response output	SX	Δ	2	,	○	○	○	○	○	○	○	○	,	○	○	○	○	○	○	○	○	,	○	○	○	○	○	○	○	○	○	
	SV						Dummy										Dummy															
	, ○ ○ ○				○ ○ ○ ○				○ ○ ○ , ○ ○ ○				○ ○ ○ ○				○ ○ ○ ○				, ○ ○ ○ ○				○ ○ ○ ○				, ○ ○ ○			
	Dummy										Dummy										Dummy											
	○ ○ ○ ○				○ ○ ○ , ○ ○ ○				○ ○ ○ ○				○ ○ ○ ○				, ○ ○ ○ ○				○ ○ ○ ○				, ○ ○ ○ ○				○ ○ ○ ○			
	Dummy										Dummy										Dummy											
	○ ○ ○ ○				○ ○ ○ ○				○ ○ ○ ○				○ ○ ○ ○				○ ○ ○ ○				, ○ ○ ○ ○				EX BC BC CR LF							
	Dummy										Dummy																					

Communication Item	Format																																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30										
Setting program Pattern data request	SX	Δ	1	,	Δ	3	,	x	x	,	x	x	,	EX	BC	BC	CR	LF																						
	PTN										STP																													
Step 0 output	SX	Δ	3	,	Δ	1	,	○	○	,	Δ	0	,	○	○	○	○	○	○	○	○	,	○	,	EX	BC	BC	CR	LF											
	PTN										Start SV																													
Step n output	SX	Δ	3	,	Δ	2	,	○	○	,	○	○	,	○	○	○	○	○	○	○	○	,	○	○	,	○	○	,	○	○	,	○								
	PTN										STP										SV																			
											Time																													
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Communication item	Format																														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
Program drive	SX	Δ	2	,	Δ	1	,	x	,	x	x	,	EX	BC	BC	CR	LF														
Mode lock/release	PTN																														
	SX	Δ	2	,	Δ	7	,	x	,	x	,	x	,	x	,	x	,	x	,	x	,	x	,	x	,	x	,	x	,	EX	BC
Time display System	FNC 0 1 2 3 4 5 6 7 8																														
	CR	LF																													
Step 0 setting	SX	Δ	2	,	Δ	8	,	x	,	EX	BC	BC	CR	LF																	
Step n setting	PTN Start SV																														
	SX	Δ	3	,	Δ	2	,	x	x	,	x	x	,	x	x	x	x	x	x	x	,	x	x	x	x	,	x	x	,	EX	BC
END step setting	PTN STP SV Time																														
	BC	CR	LF																												
Parameter No. setting	SX	Δ	3	,	Δ	3	,	x	x	,	x	x	,	x	x	,	Δ	Δ	0	,	EX	BC	BC	CR	LF						
	PTN STP Link TS1																														
Step repeat setting	TS2 TS3 TS4 TS5																														
	x	x	,	x	x	,	x	x	,	x	x	,	EX	BC	BC	CR	LF														
Pattern repeat setting	PTN Start End Count																														
	SX	Δ	3	,	Δ	6	,	x	x	x	x	,	EX	BC	BC	CR	LF														
Pattern copy	Count																														
	SX	Δ	3	,	Δ	7	,	x	x	,	x	x	,	EX	BC	BC	CR	LF													
Pattern clear	SX	Δ	3	,	Δ	8	,	x	x	,	EX	BC	BC	CR	LF																

Communication Item	Format																													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Time signal	SX	1	9	,	x	,	x	x	x	,	x	x	,	x	x	x	,	x	x	,	EX	BC	BC	CR	LF					
	SX	1	9	,	O	,	O	O	O	,	O	O	,	O	O	O	,	O	O	,	EX	BC	BC	CR	LF					
No.					ON_Time										OFF_Time															

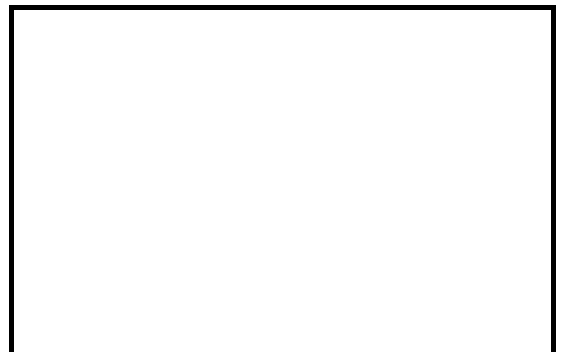
Communication item	Format																														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	
SV during Reset	SX SX	4 4	9 9	, ,	x O	x O	x O	x O	x O	x O	, O	EX O	BC ,	BC EX	CR BC	LF BC	CR	LF													
SV scale	SX SX	5 5	2 2	, ,	x O	x O	x O	x O	x O	x O	, O	x O	x ,	x O	x O	x O	x O	, O	EX O	BC O	BC O	CR ,	LF EX	BC	BC	CR	LF				
	Scale MIN															Scale MAX															

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Printed in Japan ()