INST.No.INE-812

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

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1. Introduction

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

KP 3000 series is Digital Program Setter with output accuracy of ±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.

A 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 ⟺ RS-422A/485 signal converter.

Line converter (Our company model: SC8-10) for RS-232C ⟺ 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 to use 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
・Step 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 RUN MODE key from the operation screen.
2. Select MODE 8 from 'Select MODE screen' using RESET PTN key.
3. Set the following fields of Communication settings screen (MODE 8).

Communication (Option)

```
MODE  8
  COMMUNICATION
```

↓ STOP SEL key

Communication speed

```
COM    BIT RATE
      9600 bps
```

Select the following communication speeds using RESET PTN key
Register using ENT key
Setting range:2400,4800,9600,19200,38400

↓ STOP SEL key

Device number (For RS-422/485)

```
COM    NUMBER
         01
```

Select instrument number using ADV FNC RESET PTN key
Register using ENT key
Setting range: 01 to 99

↓ STOP SEL key

Communication function

```
COM    KIND
    COM    TRANS
```

Select the following communication function using ADV FNC key
Register using ENT key
Setting range: COM, TRANS

↓ STOP SEL key

Communication Protocol

```
COM    PROTOCOL
 MODBUS( RTU )
```

Select the communication protocol mentioned below using RESET PTN key
Register it using ENT key
Setting range: MODBUS (RTU), MODBUS (ASCII), PRIVATE

↓ STOP SEL key

Communication character

```
COM    CHARCTER
8BIT/NON /STOP1
```

Select communication characters mentioned below using the RESET PTN key and register it using ENT 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 ' COM BIT RATE' using STOP/SEL key.

② Select communication speed using RESET/▽ PTN/△ key and register it using ENT 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 STOP/SEL key.

② Set device number (1 to 99) using ADV/> FNC/< RESET/▽ PTN/△ key, select it and register it using ENT 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 STOP/SEL key.

② Select communication function using ADV/> FNC/< key and register it using ENT 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 STOP/SEL key.

② Select communication protocol using RESET PTN key and register it using ENT key.

Selection	Communication Protocol	Initial value
RTU	MODBUS RTU	RTU
ASCII	MODBUS ASCII	
PRIVATE	PRIVATE	

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

6-5. Setting communication character (COM CHARACTER)

① 'COM CHARACTER' is displayed using STOP/SEL key.

② Select communication character using RESET PTN key and register it using ENT key.

【MODBUS RTU】

Selection	Bit length	Parity	Stop bit	Initial value
8N1	8bit	None	1	8N1
8N2			2	
8E1		Even	1	
8E2			2	
8O1		Odd	1	
8O2			2	

【MODBUS ASCII】

Selection	Bit length	Parity	Stop bit	Initial value
7E1	7bit	Even	1	7E1
7E2			2	
7O1		Odd	1	
7O2			2	
8N1	8bit	None	1	
8N2			2	
8E1		Even	1	
8E2			2	
8O1		Odd	1	
8O2			2	

【PRIVATE】

Selection	Bit length	Parity	Stop bit	Initial value
7E1	7bit	Even	1	7E1

7. Wiring

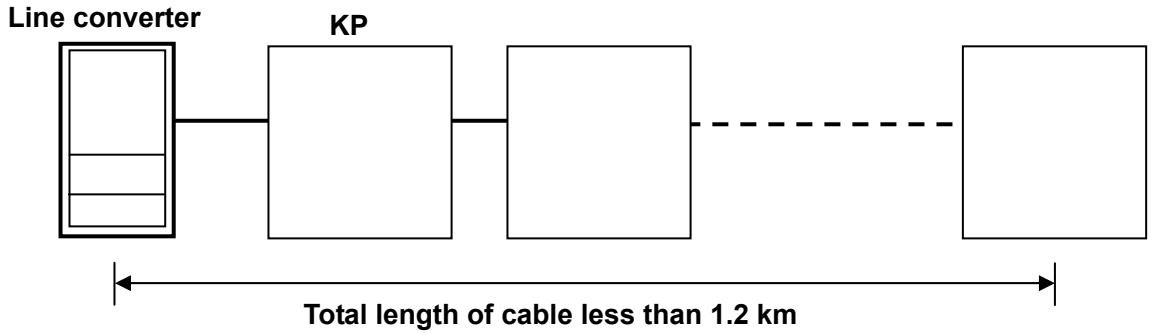
7-1. Precautions while wiring

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-422/485 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 ⟺ Last terminal KP)

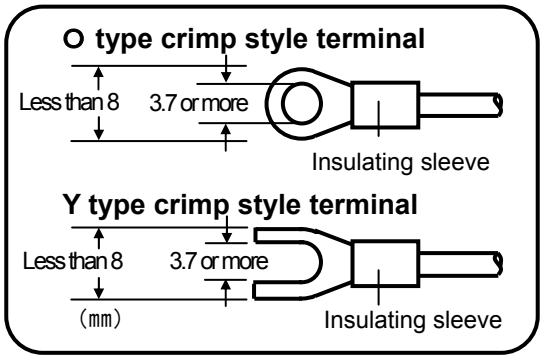


3. Take action to avoid intermixing of noise.

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 0 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)
(Generally metal coating resistance is okay. It is available with our company and you may order it.)

6. Number of machines of DB connections

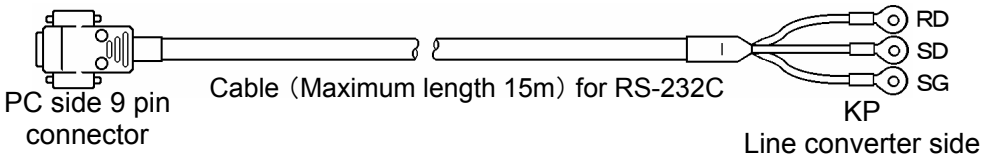
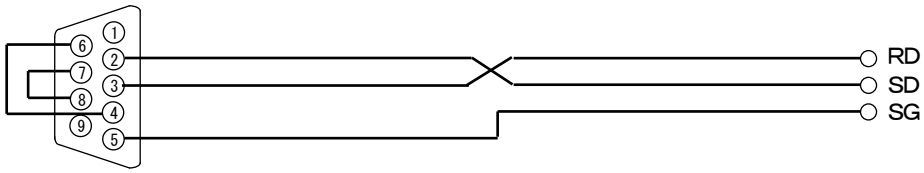
For RS-232C :1
For RS-422A/485 : Maximum 31

7-2. Cable for communication

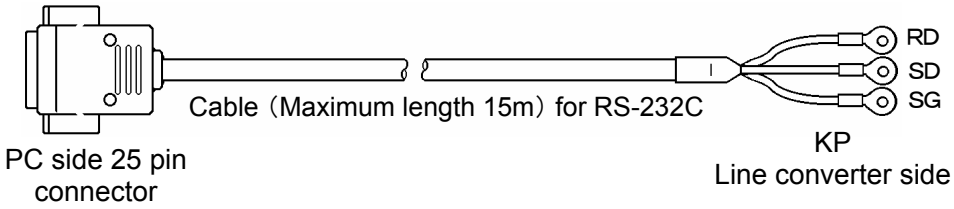
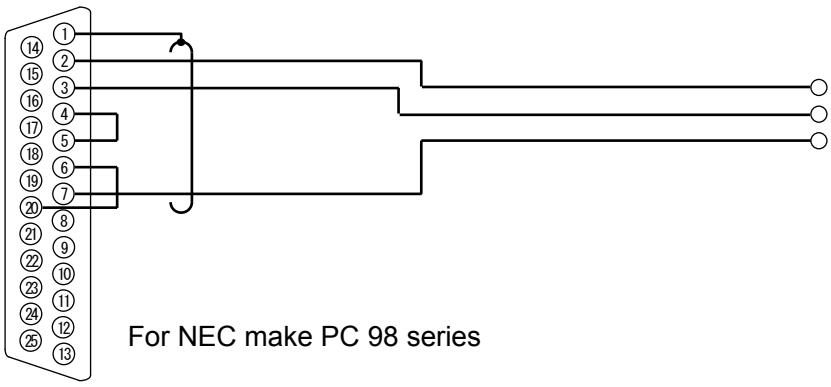
Before connecting get the exclusive communication cables ready. They are available with our company also and you can order them.

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

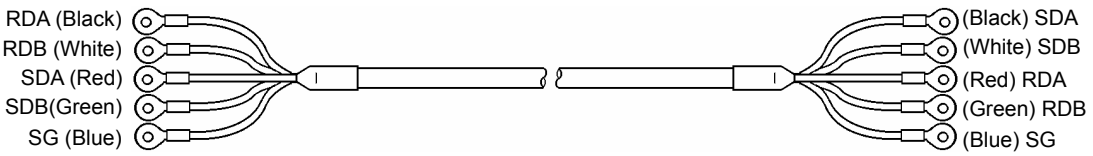
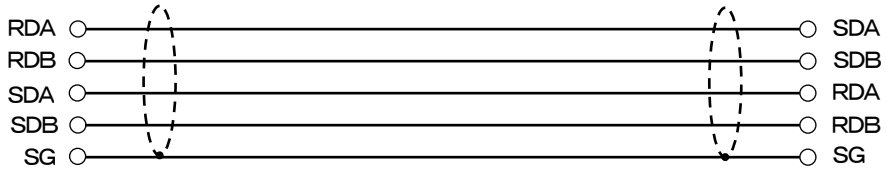
Cable	9 pin connector ↔ 0 type crimp-style terminal ↔RS-232 cable
Format	
Internal wiring	
Model code	**RZ-CRS6□□** Cable length is 1 to 15m (Specified)

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

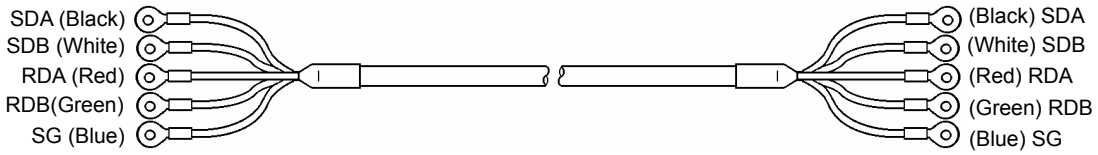
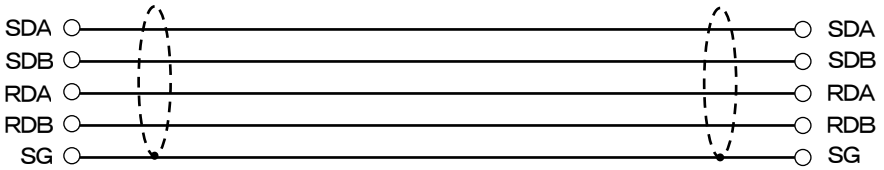
Cable	25 pin connector ↔ 0 type crimp-style terminal RS-232C cable
Format	
Internal wiring	
Model code	**RZ-CRS2□□** Cable length is 1 to 15m (Specify)

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

① Connection between line converter and KP

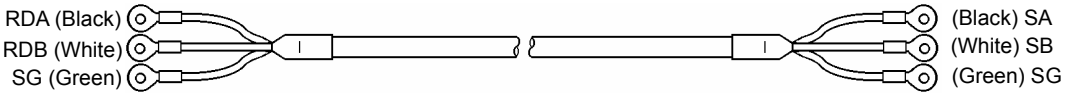
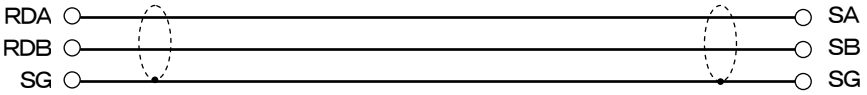
Cable	0 type crimp style terminal ↔ 0 type crimp style terminal RS-422A cable (For line converter)
Format	 Line converter side KP side SG (Signal grand) wiring is available on both sides using 2 wick VCTF wire which is further twisted to 4 wicks. It is disconnected and used as there is no SG terminal 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	 KP side KP side 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

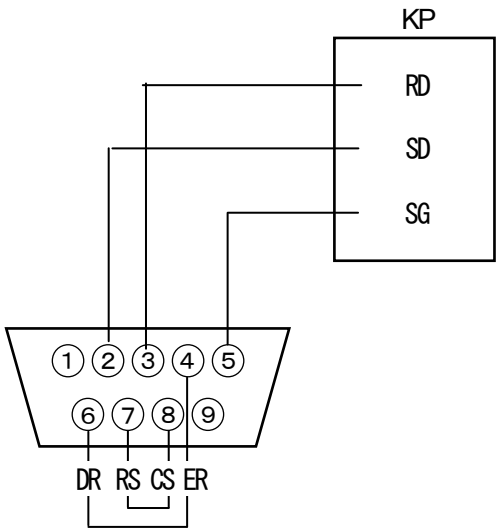
① Connection between line converter and KP; and between KPs

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	
Model code	**RZ-LEC□□□** └ Cable length is 001 to 200m (Specified)

7-3. RS-232C connection

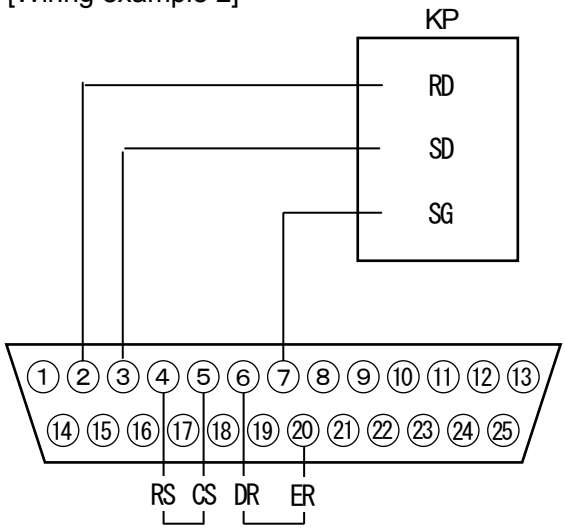
KP uses sending, receiving and Signal Grand (SG) only and does not use any other control signal. In general PC as controlling is done by control signal, it does not operate just by connecting 3 signal wires. As the wiring process in the connector, differs on how the PC controls the control signal, see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

[Wiring example 1]



9 pin connector for PC
（PC-98 series/IBM-PC･AT）

[Wiring example 2]



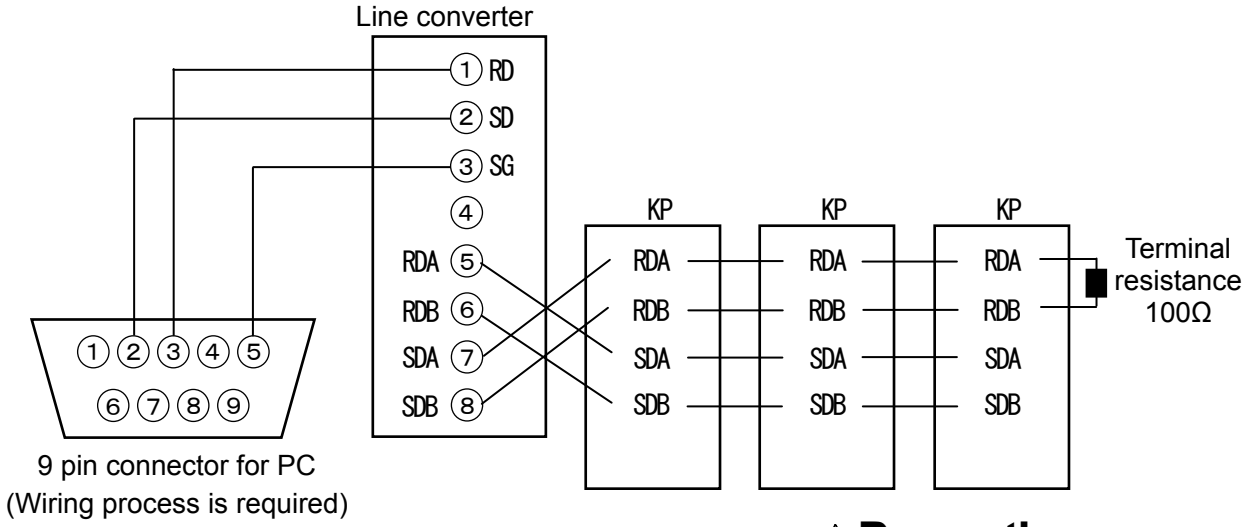
25 pin connector for PC
（PC-98 series）

⚠ Precautions	RS-232C cable length is maximum 15m. NEC make PC98 series 9 bit 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 grand 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.)

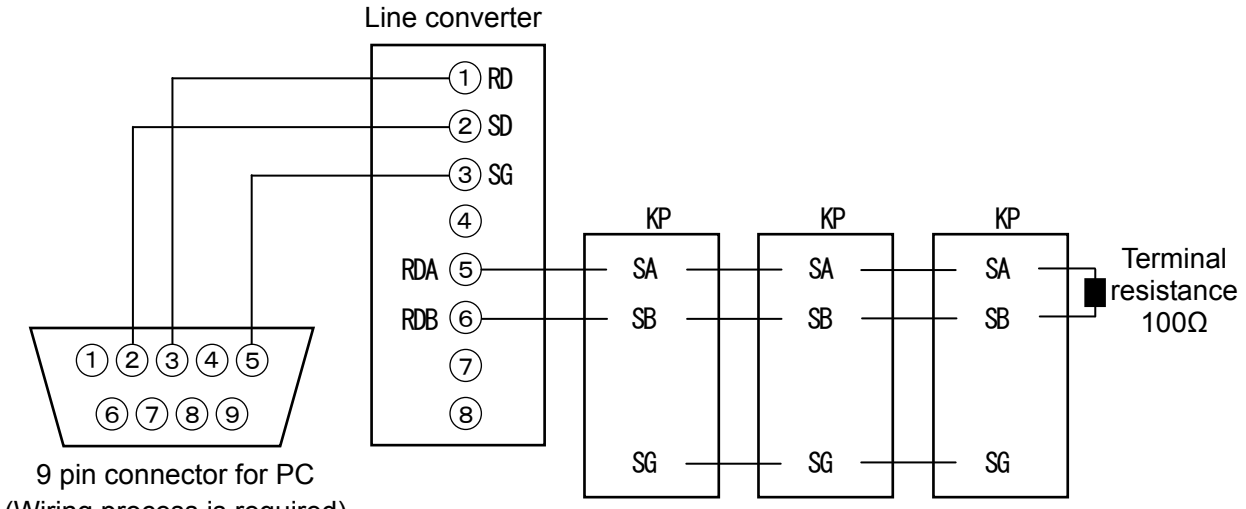
Wiring of RS-422A



⚠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

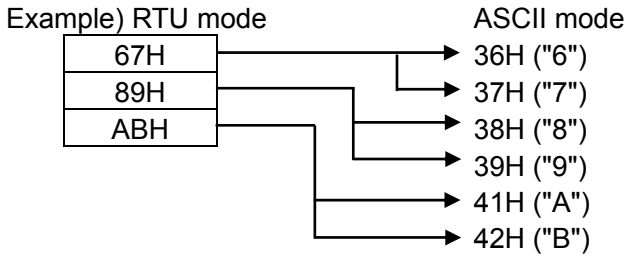
There are two types of modes namely RTU(Remote Terminal Unit) mode and ASCII mode and they are selected using the front key setting.

<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).

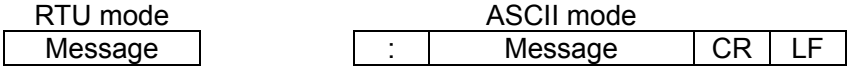


As the length of message in RTU mode is half that of ASCII mode and hence effective transmission is done.

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, ODH) + LF (Line feed, 0AH)".



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

8-2. Data time interval

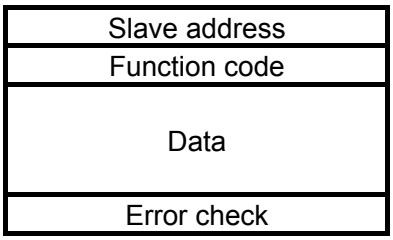
Dudring RTU mode: Less than 9600bps:20msec, 9600bps or more:5msec
During ASCII mode: Less than 1 second

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.



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'. (8-7. KP relative number table)

When reference number of MODBUS original is to be specified by relative number, see section 8.8 Reference table for MODBUS protocol.

<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 '100'.

<Table 4. KP reference number chart table>

Data kind	Parameter	Reference number	Relative number	Code	Reference table
Digital input Data	Error status Event status	10002 to 10124	1 to 123	02	Section 8-7-4
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	40008 to 40010 40052 to 40053 40147 40151 to 40195 40221 to 40224 40271 to 40274 40321 to 40324 40371 to 40374 40421 to 40424 40471 to 40474 40521 to 40524 40571 to 40574	7 to 9 51 to 52 146 150 to 194 220 to 223 270 to 273 320 to 323 330 to 373 420 to 423 470 to 473 520 to 523 570 to 573	03 06 16	Section 8-7-1
Pattern setting	Pattern information	49003 to 49534	9002 to 9533	03 06 16	Section 8-7-1
Analog input data	Real data parameter	30109 to 30144	108 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

①Calculation 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 till 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();
}
```

②LRC 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, 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 measurement value of 'Slave address 02' 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])

Measurement value (Analog input data) is stored in reference number '30032 to 30144' (See section 8-3-4. table 3).From the table it is understood that execution pattern number is stored in '30126' and execution step number is stored in '30127'. (See section 8-7. For details on reading the measurement value 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 execution pattern number and execution step number, hence when displayed in 2 bytes, it becomes[00H] [02H].

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

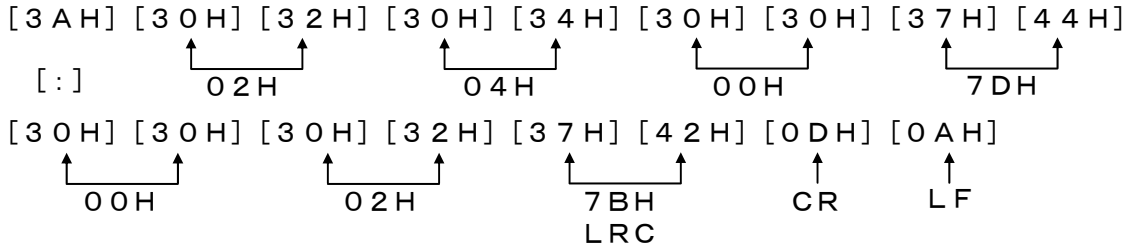
Error check in RTU mode is calculated using CRC-16. (See section 8-3-5.①) Data of message basic division becomes [02H] [04H] [00H] [7DH] [00H] [02H] according to ① to ③ and CRC-16 becomes E0E1H. Thus error check data becomes [E1H] [E0H].

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.□).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.



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 (Reading the status of input relay)

[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	OFF

Normal

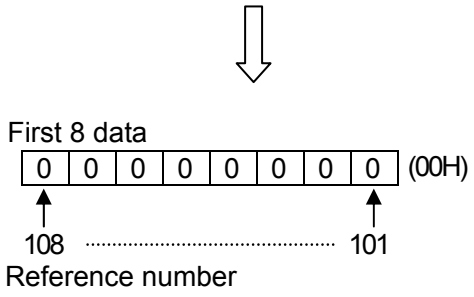
<RTU mode>

Master → Device

Slave address	01H
Function code	02H
Starting number (H)	00H
Starting number (L)	01H
Number of units (H)	00H
Number of units (L)	01H
CRC(L)	E8H
CRC(H)	0AH

Device → Master (Normal)

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



<ASCII mode error check>

Error check CRC（L）, CRC（H）part is as follows.

LRC	98H

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 (Reading the contents of maintenance register)

[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 which is split into high order 8 bit and low order 8 bit.

Example) Reading pattern No., step No., step repeat of slave 1.

(Reading 3 units of analog setting value reference number from 49003 to 49005 of slave 1.)

Reference number (Relative number)	49003 (232AH)	49004 (232BH)	49005 (232CH)
Data	1 (0001H)	2 (0002H)	10 (000AH)

← Example: Pattern No.= 1, Step No.= 2, Repeat step= 10

<RTU mode>

Master→ Device

Slave address	01H
Function code	03H
Starting number (H)	23H
Starting number (L)	2AH
Number of units (H)	00H
Number of units (L)	03H
CRC (L)	2FH
CRC (H)	87H

Device→Master(Normal)

Slave address	01H
Function code	03H
Data count	06H
Pattern No. (H)	00H
Pattern No. (L)	01H
Step No. (H)	00H
Step No. (L)	02H
Step repeat (H)	00H
Step repeat (L)	0AH
CRC (L)	3DH
CRC (H)	72H

<ASCII mode error check>

LRC	ACH

LRC	E9H

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 (Reading the contents of input register)

[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 (Writing to single maintenance register)

[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

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

Device→Master(Normal)

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

<ASCII mode error check>

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

Slave address		02H
Function code		08H
Diagnosis code (H)	Fixed	00H
Diagnosis code (L)		00H
Option data		*
Option data		*
CRC (L)		*
CRC (H)		*

Device→Master (Normal)

Slave address		02H
Function code		08H
Diagnosis code (H)	Fixed	00H
Diagnosis code (L)		00H
Received data		*
Received data		*
CRC (L)		*
CRC (H)		*

8-5-6.Writing multiple analog setting values (Writing to multiple maintenance register)

[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, Decimal point position -1 of slave 1, SV lower limit=-200.0, SV higher limit=1370.0

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

Reference number (Relative number)	7 (0007H)	8 (0008H)	9 (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〉

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 When transmission error (over run, framing, parity, CRC or LRC) is detected in the message.

② When the slave address during the message is not the self address.

③ When 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 When transmission parameters do not match.

⑤ When 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+80H
Error code
CRC(L)
CRC(H)

Function code	Function code+80H
02	82H
03	83H
04	84H
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 ・W0hen program operation sets step addition trigger except during RESET ・When program operation sets step deletion trigger except during RESET

8-7.KP relative number 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 digits (0 to 4)	1	Set decimal point position of linear scale.
40009 40010	03 06 16	R W W	SV limiter lower limit SV limiter higher limit	Within the scale setting value (-19999 to 30000) Within the scale setting value (-19999 to 30000)	Range lower limit Range higher limit	Decimal point position: SV decimal point Always set lower limit<= higher limit.
40020	03 06 16	R W W	SV decimal point for display	0 to 4 digits (0 to 4)	1	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 '0' SV scale 'span'	-19999 to 30000 (-19999 to 30000)	Measurement range	Decimal point position: SV decimal point position
40092	03 06 16	R W W	Operation when starting the power supply	0/1 (0/1)	0 (CONTINUE)	0=Continue operation (CONTINUE) 1= Reset 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: 0.1 times resolution of SV decimal point position

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	'SV (target) value' that is being used	Within the scope of range scale	-	

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	Time signal 8 types 'Parameter 1 of ON time hours or minutes'	0 to 999 hours or minutes (0 to 999)	000	Writing is possible only when DI exists
40222	03 06 16	R W W	Time signal 8 types 'Parameter 1 of ON time minutes or seconds'	0 to 59 minutes or seconds (0 to 59)	00	Writing is possible only when DI exists
40223	03 06 16	R W W	Time signal 8 types 'Parameter 1 of OFF time hours or minutes'	0 to 999 hours or minutes (0 to 999)	000	Writing is possible only when DI exists
40224	03 06 16	R W W	Time signal 8 types 'Parameter 1 of OFF time minutes or seconds'	0 to 59 minutes or seconds (0 to 59)	00	Writing is possible only when DI exists

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	Time signal 8 types 'Parameter 2 of ON time hours or minutes'	0 to 999 hours or minutes (0 to 999)	000	Writing is possible only when DI exists
40272	03 06 16	R W W	Time signal 8 types 'Parameter 2 of ON time minutes or seconds'	0 to 59 minutes or seconds (0 to 59)	00	Writing is possible only when DI exists
40273	03 06 16	R W W	Time signal 8 types 'Parameter 2 of OFF time hours or minutes'	0 to 999 hours or minutes (0 to 999)	000	Writing is possible only when DI exists
40274	03 06 16	R W W	Time signal 8 types 'Parameter 2 of OFF time minutes or seconds'	0 to 59 minutes or seconds (0 to 59)	00	Writing is possible only when DI exists

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	Time signal 8 types 'Parameter 3 of ON time hours or minutes'	0 to 999 hours or minutes (0 to 999)	000	Writing is possible only when DI exists
40322	03 06 16	R W W	Time signal 8 types 'Parameter 3 of ON time minutes or seconds'	0 to 59 minutes or seconds (0 to 59)	00	Writing is possible only when DI exists
40323	03 06 16	R W W	Time signal 8 types 'Parameter 3 of OFF time hours or minutes'」	0 to 999 hours or minutes (0 to 999)	000	Writing is possible only when DI exists
40324	03 06 16	R W W	Time signal 8 types 'Parameter 3 of OFF time minutes or seconds'	0 to 59 minutes or seconds (0 to 59)	00	Writing is possible only when DI exists

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	Time signal 8 types 'Parameter 4 of ON time hours or minutes'	0 to 999 hours or minutes (0 to 999)	000	Writing is possible only when DI exists
40372	03 06 16	R W W	Time signal 8 types 'Parameter 4 of ON time minutes or seconds'	0 to 59 minutes or seconds (0 to 59)	00	Writing is possible only when DI exists
40373	03 06 16	R W W	Time signal 8 types 'Parameter 4 of OFF time hours or minutes'	0 to 999 hours or minutes (0 to 999)	000	Writing is possible only when DI exists
40374	03 06 16	R W W	Time signal 8 types 'Parameter 4 of OFF time minutes or seconds'	0 to 59 minutes or seconds (0 to 59)	00	Writing is possible only when DI exists

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	Time signal 8 types 'Parameter 5 of ON time hours or minutes'	0 to 999 hours or minutes (0 to 999)	000	Writing is possible only when DI exists
40422	03 06 16	R W W	Time signal 8 types 'Parameter 5 of ON time minutes or seconds'	0 to 59 minutes or seconds (0 to 59)	00	Writing is possible only when DI exists
40423	03 06 16	R W W	Time signal 8 types 'Parameter 5 of OFF time hours or minutes'	0 to 999 hours or minutes (0 to 999)	000	Writing is possible only when DI exists
40424	03 06 16	R W W	Time signal 8 types 'Parameter 5 of OFF time minutes or seconds'	0 to 59 minutes or seconds (0 to 59)	00	Writing is possible only when DI exists

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 (Range during communication)	Initial value	Remarks
40471	03 06 16	R W W	Time signal 8 types 'Parameter 6 of ON time hours or minutes'	0 to 999 hours or minutes (0 to 999)	000	Writing is possible only when DI exists
40472	03 06 16	R W W	Time signal 8 types 'Parameter 6 of ON time minutes or seconds'	0 to 59 minutes or seconds (0 to 59)	00	Writing is possible only when DI exists
40473	03 06 16	R W W	Time signal 8 types 'Parameter 6 of OFF time hours or minutes'	0 to 999 hours or minutes (0 to 999)	000	Writing is possible only when DI exists
40474	03 06 16	R W W	Time signal 8 types 'Parameter 6 of OFF time minutes or seconds'	0 to 59 minutes or seconds (0 to 59)	00	Writing is possible only when DI exists

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	Time signal 8 types 'Parameter 7 of ON time hours or minutes'	0 to 999 hours or minutes (0 to 999)	000	Writing is possible only when DI exists
40522	03 06 16	R W W	Time signal 8 types 'Parameter 7 of ON time minutes or seconds'	0 to 59 minutes or seconds (0 to 59)	00	Writing is possible only when DI exists
40523	03 06 16	R W W	Time signal 8 types 'Parameter 7 of OFF time hours or minutes'	0 to 999 hours or minutes (0 to 999)	000	Writing is possible only when DI exists
40524	03 06 16	R W W	Time signal 8 types 'Parameter 7 of OFF time minutes or seconds'	0 to 59 minutes or seconds (0 to 59)	00	Writing is possible only when DI exists

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	Time signal 8 types 'Parameter 8 of ON time hours or minutes'	0 to 999 hours or minutes (0 to 999)	000	Writing is possible only when DI exists
40572	03 06 16	R W W	Time signal 8 types 'Parameter 8 of ON time minutes or seconds'	0 to 59 minutes or seconds (0 to 59)	00	Writing is possible only when DI exists
40573	03 06 16	R W W	Time signal 8 types 'Parameter 8 of OFF time hours or minutes'	0 to 999 hours or minutes (0 to 999)	000	Writing is possible only when DI exists
40574	03 06 16	R W W	Time signal 8 types 'Parameter 8 of OFF time minutes or seconds'	0 to 59 minutes or seconds (0 to 59)	00	Writing is possible only when DI exists

⑬ DI/DO function allocation

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(Green/orange automatic switching)
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 (Automatic ON/OFF) 1=OFF (Does not glow normally) 2=ON (Glows normally)
48012	03 06 16	R W W	Terminal No.12 DI/DO function allocation	・Low order 8 bits [DI] 1/2/3/4/5/6/7/8/9/10/11 (1/2/3/4/5/6/7/8/9/10/11) [DO] 1/2/3/4/5/6/7/8/9/10/11/12/13 (1/2/3/4/5/6/7/8/9/10/11/12/13) ・High order 8 bits 0/1/2 (0/1/2)	-	・Low order 8 bits [DI] 0=Terminal information not confirmed 1=RUN/STOP 2=ADV 3=RESET 4=WAIT 5=FAST 6=PTN 1 7=PTN 2 8=PTN 4 9=PTN 8 10=PTN 10 11=PTN 20 [DO] 0=Terminal information not confirmed 1=Time signal 1 2=Time signal 2 3=Time signal 3 4=Time signal 4 5=Time signal 5 6=Time signal 6 7=Time signal 7 8=Time signal 8 9=RUN/STOP 10=ADV 11=RESET 12=WAIT 13=END *When reading, low order 8 bits become DI/DO function and high order 8 bits become DI/DO types. When writing, DI/DO type cannot be set. High order 8 bits Low order 8 bits DI/DO type | DI/DO function. Setting value

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
						·High order 8 bits 0= No terminal or other than input output terminal 1= DI terminal 2= DO terminal *In case of no terminal, DI/DO function cannot be written.
48013	03 06 16	R W W	Terminal No. 13 DI/DO function allocation	Same as reference number 48012	-	Same as reference number 48012
48014	03 06 16	R W W	Terminal No. 14 DI/DO function allocation	Same as reference number 48012	-	Same as reference number 48012
48015	03 06 16	R W W	Terminal No. 15 DI/DO function allocation	Same as reference number 48012	-	Same as reference number 48012
48016	03 06 16	R W W	Terminal No. 16 DI/DO function allocation	Same as reference number 48012	-	Same as reference number 48012
48017	03 06 16	R W W	Terminal No. 17 DI/DO function allocation	Same as reference number 48012	-	Same as reference number 48012
48019	03 06 16	R W W	Terminal No. 19 DI/DO function allocation	Same as reference number 48012	-	Same as reference number 48012
48020	03 06 16	R W W	Terminal No. 20 DI/DO function allocation	Same as reference number 48012	-	Same as reference number 48012
48021	03 06 16	R W W	Terminal No. 21 DI/DO function allocation	Same as reference number 48012	-	Same as reference number 48012
48022	03 06 16	R W W	Terminal No. 22 DI/DO function allocation	Same as reference number 48012	-	Same as reference number 48012
48023	03 06 16	R W W	Terminal No. 23 DI/DO function allocation	Same as reference number 48012	-	Same as reference number 48012
48024	03 06 16	R W W	Terminal No. 24 DI/DO function allocation	Same as reference number 48012	-	Same as reference number 48012
48026	03 06 16	R W W	Terminal No. 26 DI/DO function allocation	Same as reference number 48012	-	Same as reference number 48012
48027	03 06 16	R W W	Terminal No. 27 DI/DO function allocation	Same as reference number 48012	-	Same as reference number 48012

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
48028	03 06 16	R W W	Terminal No. 28 DI/DO function allocation	Same as reference number 48012	-	Same as reference number 48012
48029	03 06 16	R W W	Terminal No. 29 DI/DO function allocation	Same as reference number 48012	-	Same as reference number 48012
48030	03 06 16	R W W	Terminal No. 30 DI/DO function allocation	Same as reference number 48012	-	Same as reference number 48012
48031	03 06 16	R W W	Terminal No. 31 DI/DO function allocation	Same as reference number 48012	-	Same as reference number 48012
48032	03 06 16	R W W	Terminal No. 32 DI/DO function allocation	Same as reference number 48012	-	Same as reference number 48012
48033	03 06 16	R W W	Terminal No. 33 DI/DO function allocation	Same as reference number 48012	-	Same as reference number 48012

⑭ 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	'Pattern No.'	Pattern 1 to 30 (1 to 30)	1	Initial value:1(= Pattern No. 1) Set before reading or writing the pattern information.
49004	03 06 16	R W W	'Step No.'	Step 01 to 18 or Final step No. (0 to 19)	0	Initial value:0(= Step No. 0) Set before reading or writing the pattern information.
49005	03 06 16	R W W	Repeat step	0:Repeat start step 1 to 99: Repeat end step 255: Blank display (Other than repeat step section) (0 to 99/255)	255 (Blank display)	Writing is not possible when, reference 49004 'step No.' is 0 or later to END step.
49006	03 06 16	R W W	Program pattern 'SV'	[Step 0] Within the range of SV limit (Within the range of SV limit) [Step 01 to 19] Within the range of SV limit (Within the range of SV limit)	[Step 0] 0 SV value before [Step 01 to 19]	Writing is not possible when, reference 49004 'step No.' is later to END step. Decimal point position: SV decimal point position
49007	03 06 16	R W W	Program pattern 'Time hours or minutes'	000 to 999 (0 to 999)	0	Writing is not possible when, reference 49004 'step No.' is 0 or later to END step. Write, after setting a step No. other than step No.0.
49008	03 06 16	R W W	Program pattern 'Time minutes or seconds'	00 to 59 (0 to 59)	0	Writing is not possible when, reference 49004 'step No.' is 0 or later to END step. Write, after setting a step No. other than step No.0.
49010	03 06 16	R W W	SV No.	0: Previous step continua-tion 1 to 8: Parameter No. 1 to 8 (0 to 8)	1 (STEP1) 0 (form STEP2)	Writing is not possible when, reference 49004 'step No.' is 0 or later to END step. Write, after setting a step No. other than step No.0.
49020	03 06 16	R W W	Time signal No. No.1	0: Invalid 1 to 8: Parameter No. 1 to 8 11 to 18: Repeat of parameter No. 1 to Repeat of parameter No. 8 20:ON during section (0, 1 to 8, 11 to 18, 20)	0	Writing is not possible when, reference 49004 'step No.' is 0 or later to END step. Write, after setting a step No. other than step No.0.

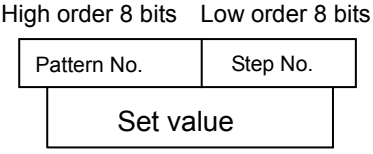
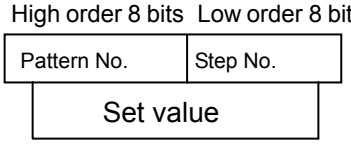
FNC code……Application function code, R/W……R: READ, W: WRITE

Reference number	FNC Code	R/W	Data name	Setting range (Communication range)	Initial value	Remarks
49021	03 06 16	R W W	Time signal No. No.2	Same as reference No. 49020	0	Same as reference No. 49020
49022	03 06 16	R W W	Time signal No.No.3	Same as reference No. 49020	0	Same as reference No. 49020
49023	03 06 16	R W W	Time signal No. No.4	Same as reference No. 49020	0	Same as reference No. 49020
49024	03 06 16	R W W	Time signal No. No.5	Same as reference No. 49020	0	Same as reference No. 49020
49025	03 06 16	R W W	Time signal No. No.6	Same as reference No. 49020	0	Same as reference No. 49020
49026	03 06 16	R W W	Time signal No. No.7	Same as reference No. 49020	0	Same as reference No. 49020
49027	03 06 16	R W W	Time signal No. No.8	Same as reference No. 49020	0	Same as reference No. 49020
49040	03	R	Existing step count	0 to 19 (0 to 19)	0	
49041	03 06 16	R W W	Program pattern Start SV 'Step 0'	Within the range of SV limit (Within the range of SV limit)	0	Decimal point position: SV decimal point position
49043	03 06 16	R W W	Program pattern Link to 'END step'	Pattern 1 to 30 (1 to 30)	0	
49048	03 06 16	R W W	Time unit hours minutes/minutes seconds (Mode 2)	0/1 (0/1)	0 (Hours/minutes)	0= Hours/minutes 1= Minutes/seconds *When program operation is other than 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	
49055	03 06 16	R W W	Repeat pattern	0 to 9999 (0 to 9999)	0	
49056	03 06 16	R W W	Executing SV (Mode 0)	Within the range of SV limit (Within the range of SV limit)	0	
49057	03 06 16	R W W	Executing time Hours or minutes (Mode 0)	0 to 999 hours or minutes (0 to 999)	000	

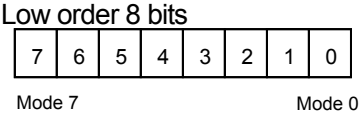
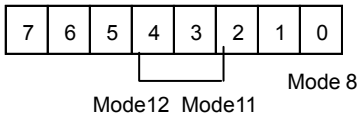
FNC code……Application function code, R/W……R: READ, W: WRITE

Reference number	FNC Code	R/W	Data name	Setting range (Communication range)	Initial value	Remarks
49058	03 06 16	R W W	Executing time Minutes or seconds (Mode 0)	0 to 59 minutes or seconds (0 to 59)	00	
49066	03 06 16	R W W	Operation screen Drive pattern No.	Pattern 1 to 30 (1 to 30)	1	Writing is not possible in the following cases ・When operation status is other than RESET ・When pattern selection system is other than COM or FREE in the case of 'with pattern selection input option'.
49067	03 06 16	R W W	Operation screen Program drive	[Read] 1/2/3/4/5/6 (1/2/3/4/5/6) [Write] 1/2/4/6 (1/2/4/6)	1	[Read] 1= RESET 2= RUN 3= FAST 4= STOP 5= END 6= ADV [Write] 1= RESET 2= RUN 4= STOP 6= ADV Writing is not possible in the following cases ・When ADV, STOP is set in RESET status When RUN, STOP, ADV is set in END status ・In case of 'with external drive input', program drive system is other than MASTER COM or FREE
49093	03 06 16	R W W	Copy pattern trigger	[Read] 0/1/2/3/4/5 (0/1/2/3/4/5) [Write] Source pattern No. 1 to 30 (1 to 30) Destination pattern No.1 to 30 (1 to 30)	-	[Read] Reads edit pattern status. 0=No edition 1=Add step 2=Delete step 3=Copy pattern 4=Clear pattern (1 pattern) 5= Clear all patterns [Write] High order 8 bits become the copy source pattern No. and low order 8 bits set the copy destination pattern No. High order 8 bits Low order 8 bits Source pattern No.. | Destination pattern No. Set value *When copy source pattern is not set or copy destination pattern is not eliminated, 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
49094	03 06 16	R W W	Pattern clear trigger	[Read] 0/1/2/3/4/5 (0/1/2/3/4/5) [Write] 0=Pattern all clear Pattern No.1 to 30 (0 to 30)	-	[Read] Read edit pattern status. 0=No edition 1=Add step 2= Delete step 3= Copy pattern 4= Clear pattern (1 pattern) 5= Clear all patterns [Write] When pattern of specified set value is cleared and set value 0 is set, execute pattern all clear. *When program operation is other than RESET, writing is not possible.
49095	03 06 16	R W W	Add step trigger	[Read] 0/1/2/3/4/5 (0/1/2/3/4/5) [Write] Pattern No.1 to 30 (1 to 30) Step No.1 to 18 or Final step No. (1 to 18 or Final step No.)	-	[Read] Read edit pattern status. 0=No edition 1=Add step 2= Delete step 3= Copy pattern 4= Clear pattern (1 pattern) 5= Clear all patterns [Write] High order 8 bits becomes the pattern No. and low order 8 bits sets the step No.  *When program operation is other than RESET, writing is not possible.
49096	03 06 16	R W W	Delete step trigger	[Read] 0/1/2/3/4/5 (0/1/2/3/4/5) [Write] Pattern No.1 to 30 (1 to 30) Step No.1 to 19 or Final step No. (1 to 19 or Final step No.)	-	[Read] Read edit pattern status. 0=No edition 1=Add step 2= Delete step 3= Copy pattern 4= Clear pattern (1 pattern) 5= Clear all patterns [Write] High order 8 bits becomes the pattern No. and low order 8 bits sets the step No.  *When program operation is other than RESET, writing is not possible.

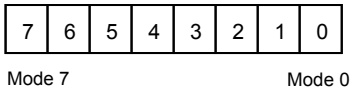
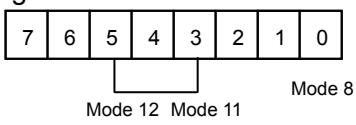
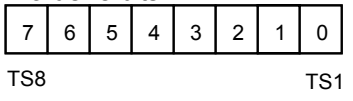
FNC code……Application function code, R/W……R: READ, W: WRITE

Reference number	FNC Code	R/W	Data name	Setting range (Communication range)	Initial value	Remarks
49501	03 06 16	R W W	Setting screen mode lock (bit support)	(0 to 65535)	-	0= Setting screen normal display 1= Setting screen lock status 1= Setting screen no display *Bit 0 to Bit 7 of low order 8 bits are set as mode 0 to mode 7 sequentially, high order bit 0 is set as mode 8 and bit 3 and 4 of high order 8 bit are set as mode 11, mode 12. Low order 8 bits  High order 8 bits 
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 1=MASTER EXT 2=SLAVE EXT 3=MASTER COM 4=FREE Writing is possible only in case of 'with external drive input'
49517	03 06 16	R W W	Select pattern system	0/1/2/3 (0/1/2/3)	0 (KEY)	0=KEY 1=EXT 2=COM 3=FREE Writing is possible only in case of 'With external input'
49533	03 06 16	R W W	Key lock of driving opera-tion	0/1 (0/1)	0 (PV hold OFF)	0= Unlock 1= Lock
49534	03 06 16	R W W	Time display system	0/1/2/3 (0/1/2/3)	0 (Elapsed step)	0=Elapsed step 1=Elapsed pattern 2=Remaining step 3=Remaining pattern

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
30109	04	R	Execution SV	Execution SV setting value (Decimal point position is same in 40008)
30126	04	R	Execution pattern number	Upper display pattern No.
30127	04	R	Execution step No.	Upper display step No.
30128	04	R	Execution time hours or minutes	Elapsed/remaining time hours or minutes value of operation screen 2
30129	04	R	Execution time minutes or seconds	Elapsed/remaining time minutes or seconds value of operation screen 2
30130	04	R	Display time system	0= Step elapsed time 1= Pattern elapsed time 2= Step remaining time 3= Pattern remaining time
30131	04	R	Display time unit	Time unit of operation screen 2 0=Day: Time 1=Hours: Minutes 2=Minutes: Seconds
30141	04	R	Lock status	0= Setting screen normal display 1= Setting screen lock status 0= Setting screen non display * Bit 0 to Bit 7 of low order 8 bits are set as mode 0 to mode 7 sequentially, bit 0 of high order 8 bits is set as mode 8 and bit 3 and 4 of high order 8 bits are set as mode 11, mode 12. Low order 8 bits  High order 8 bits 
30143	04	R	Status other than error	0= No error 1= Error occurrence
30144	04	R	Time signal status	0=ON 1=OFF *Time signal 1 to 8 is set for bit 0 to bit 7 of lower order 8 bits sequentially. Low order 8 bits 

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

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

Reference number	FNC code	R/W	Data name	Detailed explanation
10005	02	R	Correction data error	0= Normal 1= During correction data error occurrence

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 (R) is being used
40002		40052	SV scale MIN	40102		40152	
40003		40053	SV scale MAX	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 limiter L	40059		40109		40159	
40010	SV limiter H	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	TS ON hours or minutes	40271	TS ON hours or minutes	40321	TS ON hours or minutes	40371	TS ON hours or minutes
40222	TS ON minutes or seconds	40272	TS ON minutes or seconds	40322	TS ON minutes or seconds	40372	TS ON minutes or seconds
40223	TS OFF hours or minutes	40273	TS OFF hours or minutes	40323	TS OFF hours or minutes	40373	TS OFF hours or minutes
40224	TS OFF· minutes or seconds	40274	TS OFF· minutes or seconds	40324	TS OFF· minutes or seconds	40374	TS 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	TS ON hours or minutes	40471	TS ON hours or minutes	40521	TS ON hours or minutes	40571	TS ON hours or minutes
40422	TS ON minutes or seconds	40472	TS ON minutes or seconds	40522	TS ON minutes or seconds	40572	TS ON minutes or seconds
40423	TS OFF hours or minutes	40473	TS OFF hours or minutes	40523	TS OFF hours or minutes	40573	TS OFF hours or minutes
40424	TS OFF· minutes or seconds	40474	TS OFF· minutes or seconds	40524	TS OFF· minutes or seconds	40574	TS 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)							
No.9 Parameter				DI/DO function allotment		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.
40604		40704		48004		49004	Step No.
40605		40705		48005		49005	Repeat step
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	Terminal No. 12 DI/DO	49012	
40613		40713		48013	Terminal No. 13 DI/DO	49013	
40614		40714		48014	Terminal No. 14 DI/DO	49014	
40615		40715		48015	Terminal No. 15 DI/DO	49015	
40616		40716		48016	Terminal No. 16 DI/DO	49016	
40617		40717		48017	Terminal No. 17 DI/DO	49017	
40618		40718		48018		49018	
40619		40719		48019	Terminal No. 19 DI/DO	49019	
40620		40720		48020	Terminal No. 20 DI/DO	49020	Time signal 1 No.
40621		40721		48021	Terminal No. 21 DI/DO	49021	Time signal 2 No.
40622		40722		48022	Terminal No. 22 DI/DO	49022	Time signal 3 No.
40623		40723		48023	Terminal No. 23 DI/DO	49023	Time signal 4 No.
40624		40724		48024	Terminal No. 24 DI/DO	49024	Time signal 5 No.
40625		40725		48025		49025	Time signal 6 No.
40626		40726		48026	Terminal No. 26 DI/DO	49026	Time signal 7 No.
40627		40727		48027	Terminal No. 27 DI/DO	49027	Time signal 8 No.
40628		40728		48028	Terminal No. 28 DI/DO	49028	
40629		40729		48029	Terminal No. 29 DI/DO	49029	
40630		40730		48030	Terminal No. 30 DI/DO	49030	
40631		40731		48031	Terminal No. 31 DI/DO	49031	
40632		40732		48032	Terminal No. 32 DI/DO	49032	
40633		40733		48033	Terminal No. 33 DI/DO	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	PV/SV start
40643		40743		48043		49043	Link to
40644		40744		48044		49044	
40645		40745		48045		49045	
40646		40746		48046		49046	
40647		40747		48047		49047	
40648		40748		48048		49048	Time unit (Mode 2)
40649		40749		48049		49049	Reset time SV
40650		40750		48050		49050	

Analog setting value (40001 to 49999)							
Pattern information		Pattern information					
No.	Contents	No.	Contents	No.	Contents	No.	Contents
49051		49501	Mode lock (bit support)	49551			
49052		49502		49552			
49053		49503		49553			
49054		49504		49554			
49055	Repeat pattern	49505		49555			
49056	SV (Mode 0)	49506		49556			
49057	Time H (Mode 0)	49507		49557			
49058	Time L (Mode 0)	49508		49558			
49059		49509		49559			
49060		49510		49560			
49061		49511		49561			
49062		49512		49562			
49063		49513		49563			
49064		49514		49564			
49065		49515		49565			
49066	Drive pattern No.	49516	Program drive system	49566			
49067	Program drive	49517	Select pattern system	49567			
49068		49518		49568			
49069		49519		49569			
49070		49520		49570			
49071		49521		49571			
49072		49522		49572			
49073		49523		49573			
49074		49524		49574			
49075		49525		49575			
49076		49526		49576			
49077		49527		49577			
49078		49528		49578			
49079		49529		49579			
49080		49530		49580			
49081		49531		49581			
49082		49532		49582			
49083		49533	FNC key lock	49583			
49084		49534	Display time	49584			
49085		49535		49585			
49086		49536		49586			
49087		49537		49587			
49088		49538		49588			
49089		49539		49589			
49090		49540		49590			
49091		49541		49591			
49092		49542		49592			
49093	Copy pattern trigger	49543		49593			
49094	Clear pattern trigger	49544		49594			
49095	Add step trigger	49545		49595			
49096	Delete step trigger	49546		49596			
49097		49547		49597			
49098		49548		49598			
49099		49549		49599			
49100		49550		49600			

Analog input data (30001 to 39999)							
Type information		Real data & parameter					
No.	Contents	No.	Contents	No.	Contents	No.	Contents
30001		30101					
30002		30102					
30003		30103					
30004		30104					
30005		30105					
30006		30106					
30007		30107					
30008		30108					
30009		30109	Execution SV (Mode 0)				
30010		30110					
30011		30111					
30012		30112					
30013		30113					
30014		30114					
30015		30115					
30016		30116					
30017		30117					
30018		30118					
30019		30119					
30020		30120					
30021		30121					
30022		30122					
30023		30123					
30024		30124					
30025		30125					
30026		30126	Execution pattern number				
30027		30127	Execution step number				
30028		30128	Execution time hours or minutes				
30029		30129	Execution time minutes or seconds				
30030		30130	Display time system				
30031		30131	Display time unit				
30032	Time unit (Mode 2)	30132					
30033		30133					
30034		30134					
30035		30135					
30036		30136					
30037		30137					
30038		30138					
30039		30139					
30040		30140					
30041		30141	Lock status				
30042		30142					
30043		30143	Status other than error				
30044		30144	Time signal status				
30045		30145					
30046		30146					
30047		30147					
30048		30148					
30049		30149					
30050		30150					

9.PRIVATE protocol

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

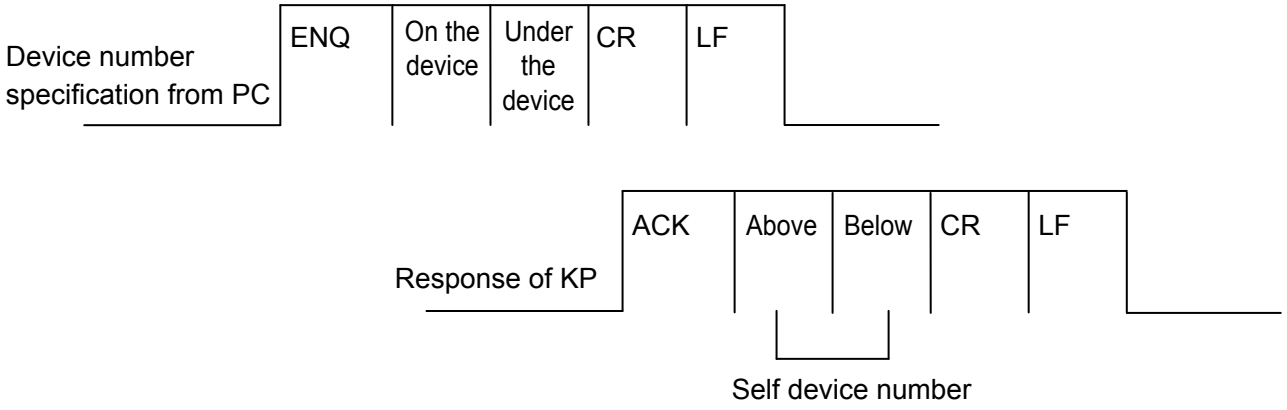
Only the level of RS-232C and RS-422A/RS-485 differs electrically, the communication procedure is the same.

However RS-422A/RS-485, by connecting a number of devices in series, from 1 amongst that .

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'.

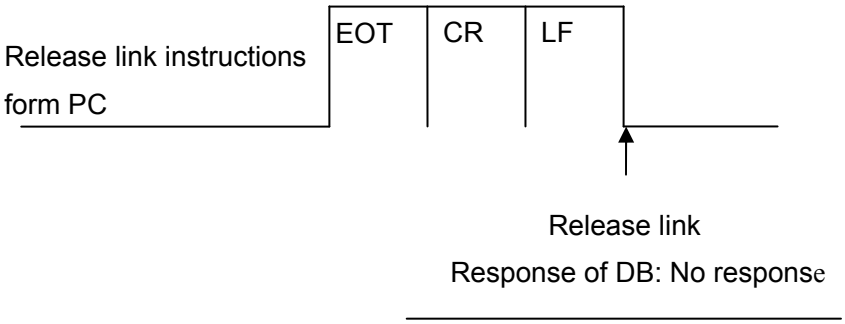


⚠Precautions	To avoid accidents always read these contents and understand them.

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.

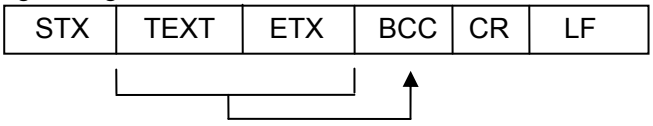
② Always add CR(0DH), LF(0AH) as end code. (For both sending and receiving).

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 may 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 If 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 △1, △1, ETX BCC CR LF (DF)	Current data request
② Execution parameter request	STX △1, △2, ETX BCC CR LF (EF)	Mode 0 execution parameter request
③ Setting program pattern data request [In case of resetting only]	STX △1, △3, □□, □□, 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 △1, △4, □□, □□, 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 9-5-3.	Data request by specifying 1 setting parameter
⑤ Program pattern setting status request	STX △1, △5, □□, ETX BCC CR LF └ Pattern No.(1 to 30)	Pattern setting status request
⑥ Device status request	STX △1, △6, ETX BCC CR LF (20)	Request configuration status of the device
⑦ Mode lock status request	STX △1, △7, ETX BCC CR LF (30)	Request each mode lock status
⑧ Status 1 request	STX △1, △8, ETX BCC CR LF (40)	Request the status of alarm, error, time signal
⑨ Status 2 request	STX △1, △9, ETX BCC CR LF (50)	Request the status of program operation

(Note) △=Space

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

<table>
<tr><th>Function</th><th>Output format</th></tr>
<tr><td>① Real data output

In KP3000, PV, MV data becomes the dummy data.</td><td>STX △1, □□, □□, □, □□□□□□□□, □□□□□□□□,
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)
It becomes the dummy data
It becomes the dummy data
Time display system (1=Elapsed step, 2=Elapsed pattern, 3=Remaining step, 4=Remaining pattern)
ETX BCC CR LF
All 9 digits in case of over range

(Note) PV, SV data up to 4 position 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.</td></tr>
<tr><td>② Mode 0 Execution parameter output

In KP3000, all the data except SV data becomes a dummy data.</td><td>STX △2, □□□□□□□□, □□□□□□□□, □□□□□□□□,
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</td></tr>
<tr><td>③ Setting program pattern data output
[In case of reset only]

In KP3000, all the parameter nos. excluding TS become the dummy data.</td><td>(i) Step 0 output
STX △3, △1, □□, △0, □□□□□□□□, □, ETX BCC CR LF
Pattern No. / Step No. / Start SV / 0= Start SV, 1= Start PV

(ii) Step n output
STX △3, △2, □□, □□, □□□□□□□□, □□□, □□, □□,
Pattern No. / Step No. / SV / Time.
Repeat count
△0= Repeat start step
△△= Un-set step

□, □, □, □, □, □, □, □□, □□, □□, □□, □□,
PID No. (dummy) / ALM No. (dummy) / OPL No. (dummy) / OSL No. (dummy)
TS1 / TS2 / TS3 / TS4 / TS5
Waiting time No. (dummy)
Real temperature compensation No. (dummy)
Sensor correction No. (dummy)
0=ALL OFF
1=No.1
2= Repeat No.1
17=ALL ON

ETX BCC CR LF</td></tr>
</table>

Function	Output format
In case of KP3000, output at the time of END becomes the dummy data.	(iii) END step output STX △3, △3, □□, □□, □□, □□□□□□, ETX BCC CR LF Pattern No. Step No. ┬ Output in case of END (dummy) Link destination Pattern No. 0=No link (iv) Repeat pattern output STX △3, △6, □□□□□□□□, 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 9-5-3) 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 △5, □□, □□, ETX BCC CR LF Setting step count 0= Not set Pattern No.
⑥ Device status output	STX △6, □, □, □, □, □, □, □, □, □, ETX BCC CR LF Time unit 0=Hours/minutes 1=Minute/seconds 1=Controller 2=Setter Select pattern External drive 0=Setter 1=Full multi-input 2=4-wire type Input Time signal Transmission 0=Does not exist 1=Exists Output 1 1=61, 65 [EMF] 2=62 3=63 [Linear] In the bracket ([ ]) in case of KP3000 Output 2 0=None 1=61, 65 3=63

Function	Output format
⑦ Mode lock status output	STX △7, □, □, □, □, □, □, □, □, □, □, 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 △8, □□, □□, □□, □□, □, □, □, □, □, □, □, AL1 AL2 AL3 AL4 TS1 TS2 TS3 TS4 TS5 Time signal: 0=OFF, 1=ON Error Waiting time alarm ETX BCC CR LF In KP3000 everything except TS becomes the dummy data
⑨ Status 2 Output	STX △9, □, □, □, □, □, □, □, □, □, □, □, □, RUN: 0=, 1=RUN STOP: 0=, 1=STOP RESET: 0=, 1=RESET END: 0=, 1=END ADV: 0=, 1=ADV CONST (dummy) MAN1 (dummy) MAN2 (dummy) WAIT (dummy) AT (dummy) FNC key LOCK: 0=Non lock, 1=Lock M/S: 0=Master, 1=Slave 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 △2, △1, □, □□, 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 △2, △7, □, □, □, □, □, □, □, □, □, ETX BCC CR LF Mode 0 1 2 3 4 5 6 7 8 FNC key 0=Non lock 1=Lock
③ Time display system [Mode 1 lock]	STX △2, △8, □, 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 △3, △1, □□, 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 △3, △2, □□, □□, □□□□□□□, □□□, □□, 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 0 0 0 . 0 1 and after the pattern setting is done, change the setting to 0 0 0 . 0 0. (Note) Delimiter of time hours/minutes, minutes/seconds is period.
③ END step [Mode 2 lock] [Mode 4 lock]	STX △3, △3, □□, □□, □□, □□□□□□, 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.
④ Parameter No. setting	STX △3, △4, □□, □□, □, □, □, □, □, □, □, Pattern No. / Step No. / PID No. / ALM No / OPL No. / OSL No. / Sensor correction No. / Real temperature compensation No. (0=OFF) / Waiting time number □□, □□, □□, □□, □□, 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 △3, △5, □□, □□, □□, □□, ETX BCC CR LF Pattern No. / Starting step: Starting < End, always / End step / Repeat count: 1 to 99=Count, 00=Cancel repeat
⑥ Repeat pattern	STX △3, △6, □□□□, ETX BCC CR LF Repeat count
⑦ Copy pattern	STX △3, △7, □□, □□, ETX BCC CR LF Copy destination pattern No. Copy source pattern No.
⑧ Clear pattern	STX △3, △8, □□, 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) [Mode 6 lock]	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=PID No. 0=Copy to No. 1 to 8 (Note) Delimiter for time hours/minutes, minutes/seconds is a period.
SV decimal point [Mode 5 lock]	32	STX 32, □, ETX BCC CR LF (Note)Differs from display SV decimal point.
SV during Reset [Mode 2 lock]	49	STX 49, □□□□□□, ETX BCC CR LF
Reserve [Mode 5 lock]	51	STX 51, □□, □, ETX BCC CR LF Initial value:0 Initial value:5 (Note) Only when read respond by initial value. Do not change the settings in case of write.
SV scale [Mode 5 lock]	52	STX 52, □□□□□□, □□□□□□, ETX BCC CR LF MIN MAX 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

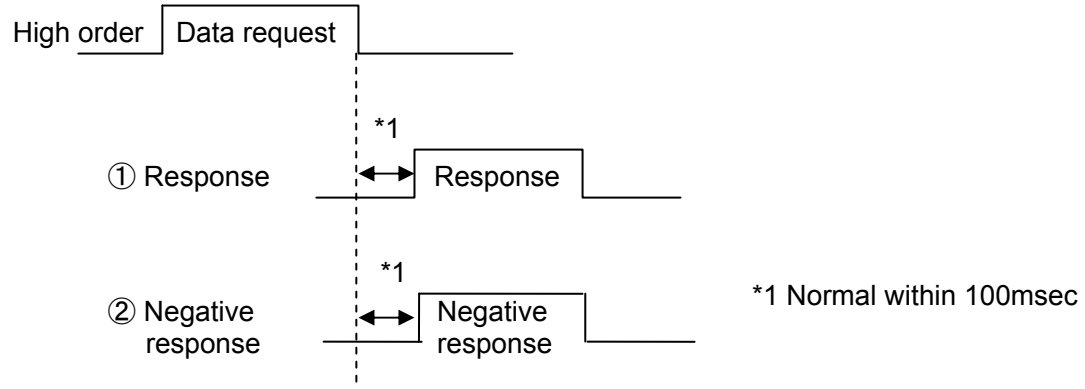
Code	Error type	Contents
△1	Framing	
△2	Over run	
△3	Parity	
△4	Check sum	
△5	Lock/non lock	・During non lock, high order was confirmed and command was sent.
10	Format	・Fast communication code error
11	〃	・Second communication code error
12	〃	・Third onwards communication code error
14	〃	・ETX error (No ETX)
15	〃	・Excess reception buffer
16	Numeric value	・Cannot recognize as numerals.
20	Data	・Undefined numeric value is received. (Numeric value is out of range)
21	〃	・L/H error (Greater and smaller relation is reversed)
22	〃	・SV RANG error (It is set out of SV RANG)
23	〃	・SV scope error
24	〃	・Z/S error (Greater and smaller relation is reversed)
25	〃	・Linear range error
30	Program drive	・ADV, STOP was done during reset.
31	〃	・Pattern was selected during STOP.
32	〃	・Pattern was selected during RUN.
33	〃	・RUN, STOP, ADV, Pattern were selected during END.
34	〃	・RUN, STOP, ADV, RESET was done during CONST.
35	External drive OP	・Program drive was RUN, STOP, ADV, RESET during KEY or EXT

(Note) △=Space

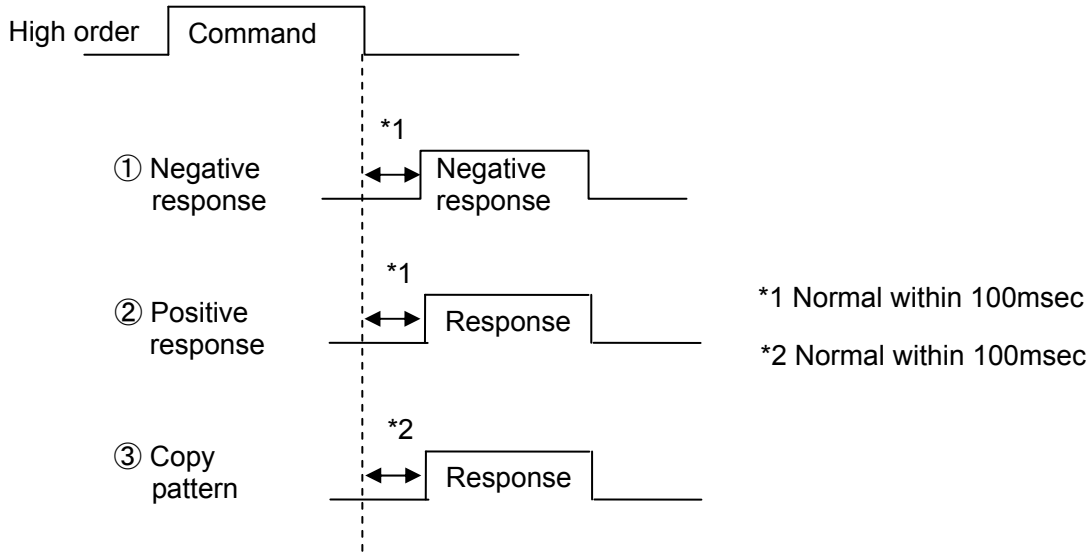
Code	Error type	Contents
36	Select pattern OP	・Select pattern selected the pattern in case of KEY or ETX
40	Set pattern	・Set the pattern except for RESET.
41	〃	・Continued 2 steps and set Time=0.
43	〃	・Set parameter No. in unset step (END step).
44	〃	・Did repeat setting in unset step.
45	〃	・Set after 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

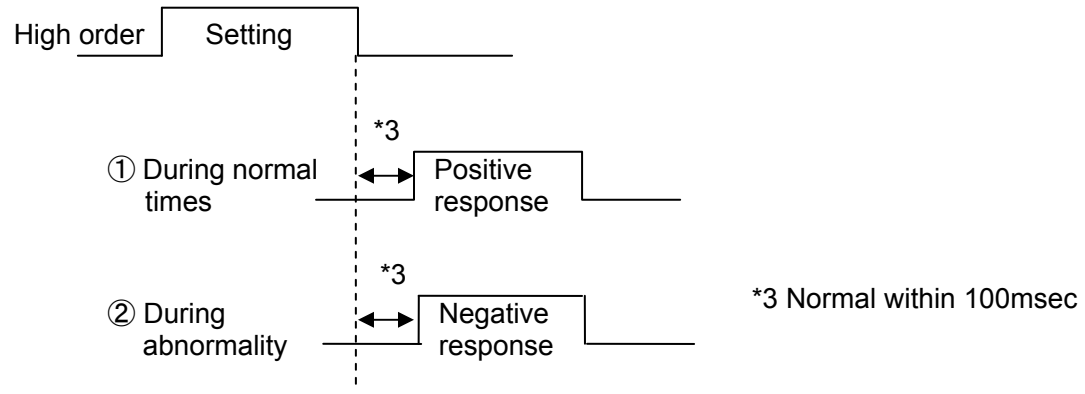
9-5-1.Response to data request



9-5-2.Response to command

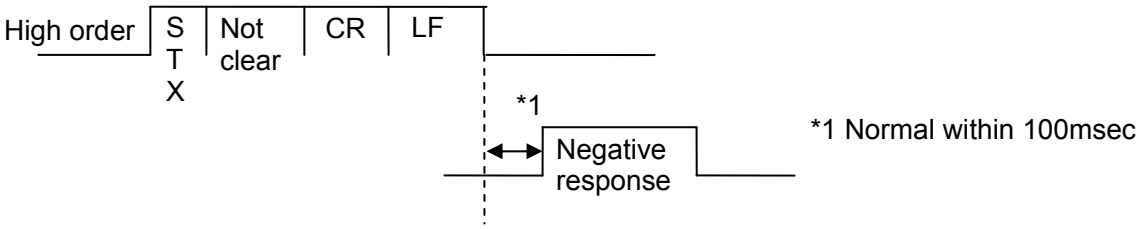


9-5-3.Response to pattern setting, parameter setting

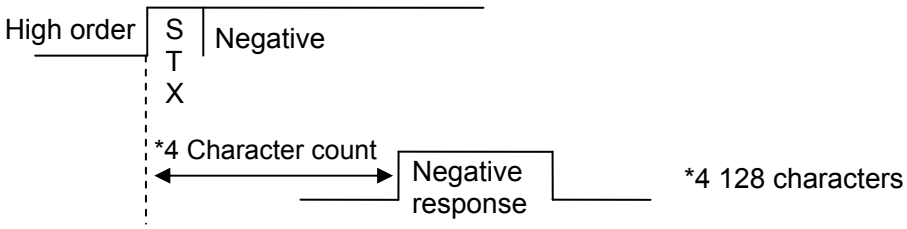


9-5-4.During other abnormalities

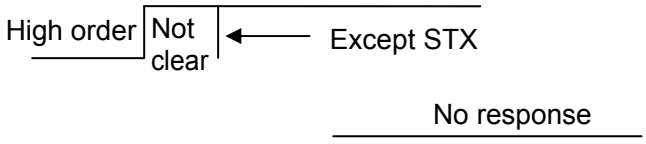
①Contents unclear



②Exceeding character count(Excess buffer)



③ When beginning with other than STX



9-5-5. Response of PC

Response of KP, to the request, 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.

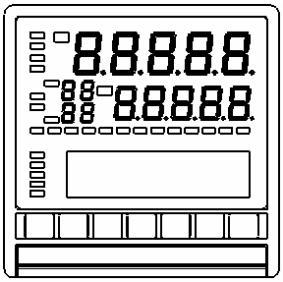
⚠Precautions	* When the front key operation 1 to 3 is to be repeated, it takes some seconds.

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 device) function.

(Communication function settings and transmission data contents)

Mode 8, communication function settings (Master device)→(Slave device)	Transmission data contents
Protocol=PRIVATE (Transmission)→(Remote) [KP,DB]	·Master device transmits the remote SV data and slave device receives it ·PRIVATE protocol ·Transmission when decimal point exists
Protocol=MODBUS (Transmission)→(Remote) [KP,DB]	·Master device transmits Run/Ready, execution No. selection, remote SV and slave device receives it. ·MODBUS protocol ·Transmission when decimal point does not exist

※In order that slave device does the reception it is necessary to switch it to remote mode.

※ Master device sends the following data.

·PRIVATE protocol

Remote SV data = Data selected in digital transmission type

·MODBUS protocol

① Run/Ready = Run status

② Select execution No. = SV No.

③ Remote SV = SV data

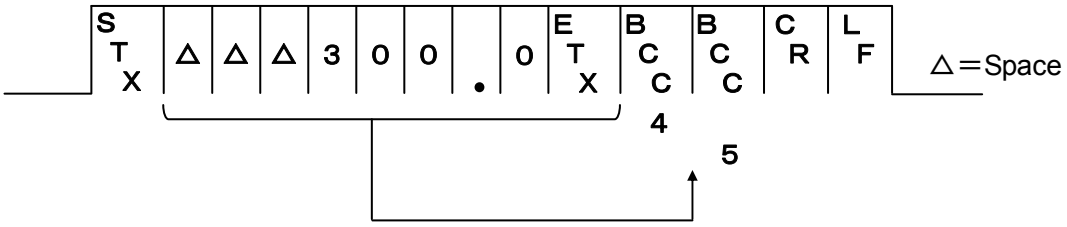
10-2. Specifications of communication division

- 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)



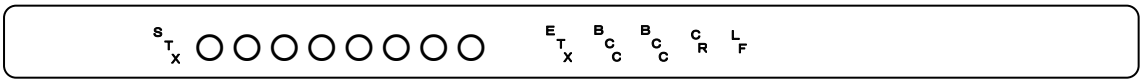
Character	△	△	△	3	0	0	•	0	ETX	Total sum=BCC
ASCII code	20h	20h	20h	33h	30h	30h	2Eh	30h	03h	154h=45

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 PROTCOL).(See 6-5)
5) Setting communication character (COM CHARCTER). (See 6-6)

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



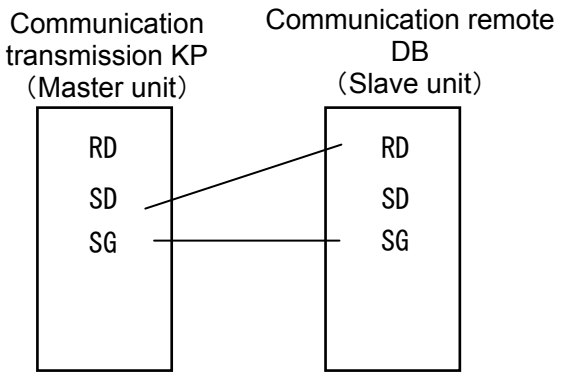
Data output: SV (Control setting value)

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

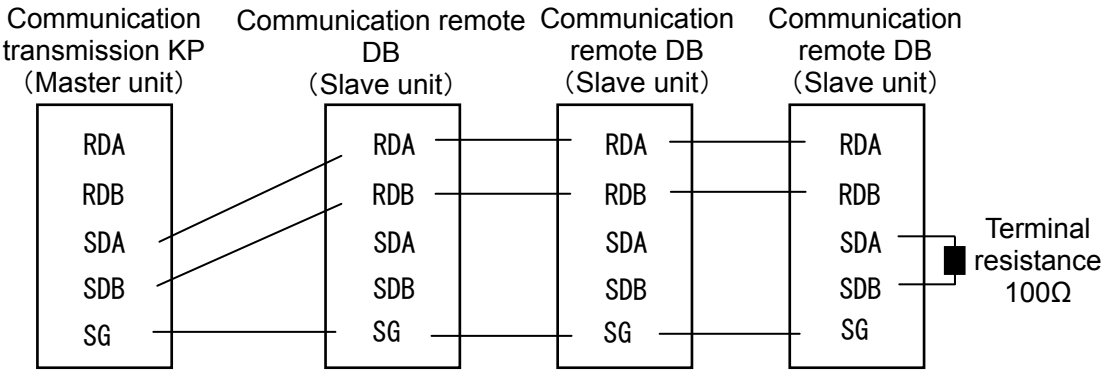
⚠ Precautions	① When connecting KP using communication transmission and DB using communication remote, make the communication protocol and communication speed of the device same. ② If analog remote and communication remote are used simultaneously analog remote takes precedence. ③ Analog transmission 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

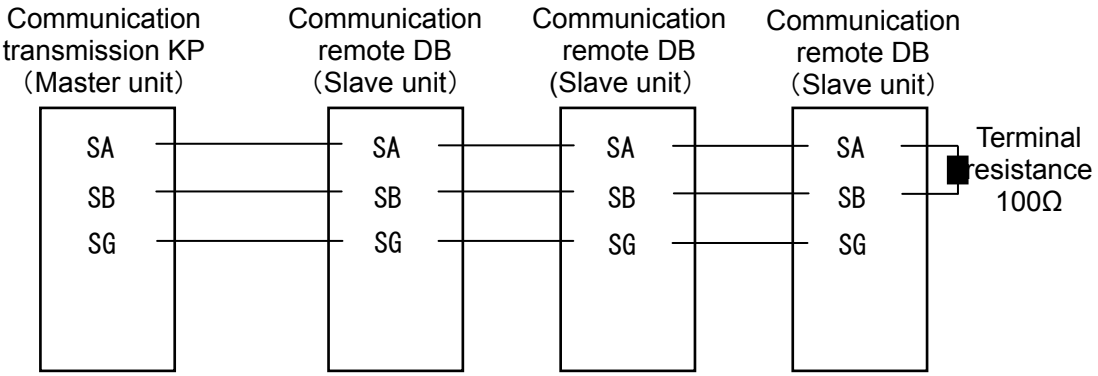
10-4-1. For RS-232C



10-4-2. For RS-422A



10-4-3.For RS-485



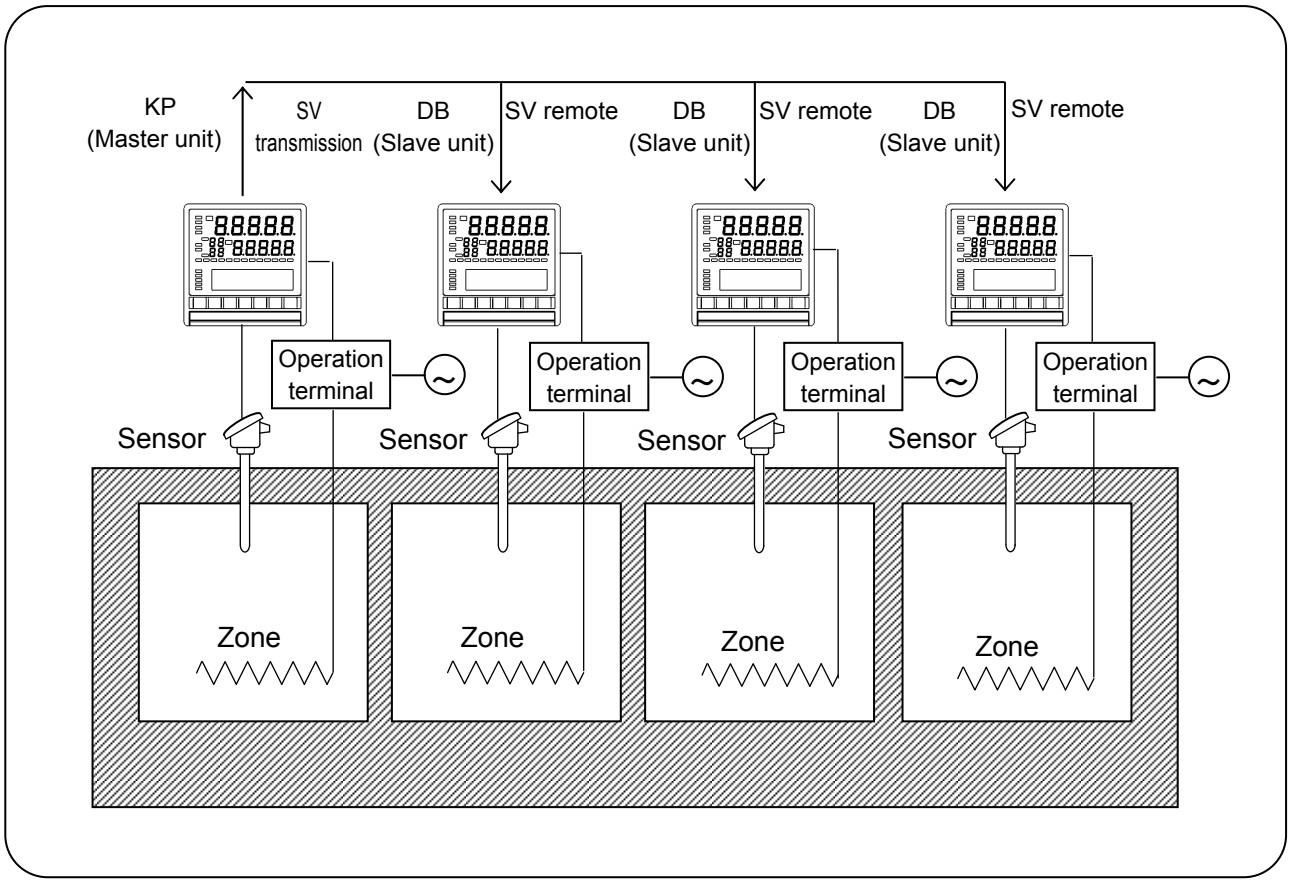
Precautions	Refer to 4-3. Wiring in instruction manual [general] for terminal numbers.

10-5. Example of combination

10-5-1. Multizone temperature control

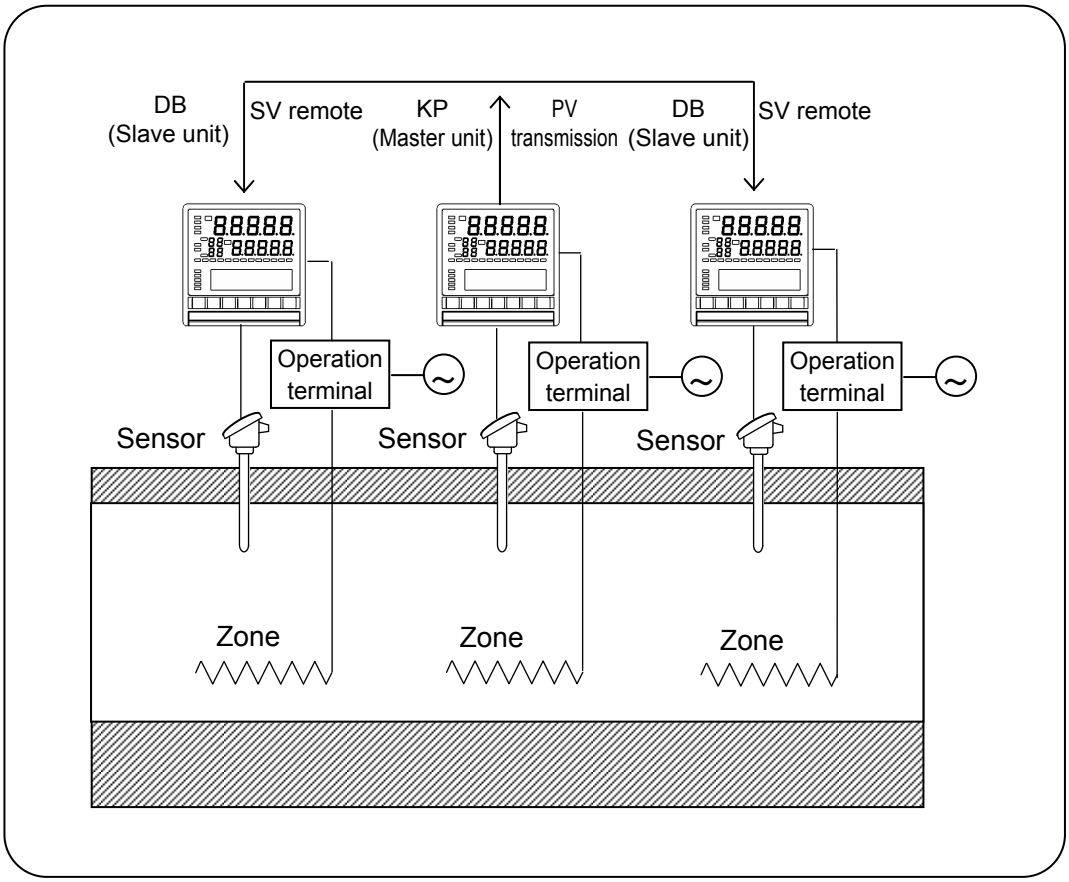
Perform communication transmission for SV using KP of base unit, and slave unit DB receives using communication remote.

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 mulitzone,



10-5-2. Controlling burning furnace zone

Communication transmission for PV is done using base unit in the center and both the cordless handsets receive SV as PV using communication remote and soakablity can be controlled properly.



11. Appendix

11-1. Communication format list

As mentioned below △=Space(20H)、X=Code data and numeric value data at the time of setting, ○=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	△	1	,	△	1	,	EX	BCD	BCF	CR	LF																		
Response output	SX	△	1	,	○	○	,	○	○	,	○	,	○	○	○	○	○	○	○	○	,	○	○	○	○	○	○	○	○	,
					PTN			STP								PV									SV				
	○	,	○	,	○	○	○	,	○	○	,	○	,	○	○	○	○	○	○	○	○	,	○	,	○	○	○	○	○	○
					TIME											MV1												MV2		
	○	○	,	EX	BC	BC	CR	LF																						
Execution parameter request	SX	△	1	,	△	2	,	EX	BCE	BCF	CR	LF																		
Response output	SX	△	2	,	○	○	○	○	○	○	○	○	,	○	○	○	○	○	○	○	○	,	○	○	○	○	○	○	○	○
								SV									P										I		
	,	○	○	○	○	○	○	○	○	,	○	○	○	○	○	○	○	○	,	○	○	○	○	○	○	○	○	,	○	○
					D									AL1									AL2							
	○	○	○	○	○	○	,	○	○	○	○	○	○	○	○	,	○	○	○	○	○	○	○	○	,	○	○	○	○	○
			AL3								AL4									OL								OH		
	○	○	○	,	○	○	○	○	○	○	○	○	,	○	○	○	○	○	○	○	○	,	○	○	○	○	○	○	○	○
							Variation quantity									Sensor correction										Second P				
	,	○	○	○	○	○	○	○	○	,	○	○	○	○	○	○	○	○	,	EX	BC	BC	CR	LF						
					Second I									Second D																

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	△	1	,	△	3	,	×	×	,	×	×	,	EX	BC	BC	CR	LF												
								PTN			STP																			
Step 0 Output Output	SX	△	3	,	△	1	,	○	○	,	△	0	,	○	○	○	○	○	○	○	○	,	○	,	EX	BC	BC	CR	LF	
								PTN								Start SV														
Step n output Output	SX	△	3	,	△	2	,	○	○	,	○	○	,	○	○	○	○	○	○	○	○	,	○	○	○	,	○	○	,	○
								PTN			STP						SV							Time						
	○	,	○	,	○	,	○	,	○	,	○	,	○	,	○	,	○	○	,	○	○	,	○	○	,	○	○	,	○	○
			PID		ALM		OPL		OSL		Sensor		Real temperature compensation		MAI		TS1			TS2			TS3			TS4			TS5	
	,	EX	BC	BC	CR	LF																								
END Step Output	SX	△	3	,	△	3	,	○	○	,	○	○	,	○	○	,	○	○	○	○	○	○	,	EX	BC	BC	CR	LF		
								PTN			STP			Link			END output													
Pattern Repeat output	SX	△	3	,	△	6	,	○	○	○	○	○	○	○	○	,	EX	BC	BC	CR	LF									
										Repeat count																				
Individual settings Parameter request	SX	△	1	,	△	4	,	×	×	,	×	×	,	EX	BC	BC	CR	LF												
								Type			No.																			
Program pattern	SX	△	1	,	△	5	,	×	×	,	EX	BC	BC	CR	LF															
Setting status request								PTN																						
Response output	SX	△	5	,	○	○	,	○	○	,	EX	BC	BC	CR	LF															
					PTN			STP count																						
Device Status Request	SX	△	1	,	△	6	,	EX	BC 2	BC 0	CR	LF																		
Response output	SX	△	6	,	○	,	○	,	○	,	○	,	○	,	○	,	○	,	○	,	○	,	EX	BC	BC	CR	LF			
Mode lock Status Request	SX	△	1	,	△	7	,	EX	BC 3	BC 0	CR	LF																		
Response output	SX	△	7	,	○	,	○	,	○	,	○	,	○	,	○	,	○	,	○	,	○	,	○	,	EX	BC	BC	CR	LF	
					FNC		0		1		2		3		4		5		6		7		8							
Status 1 Request	SX	△	1	,	△	8	,	EX	BC 4	BC 0	CR_	LF																		
Response output	SX	△	8	,	○	○	,	○	○	,	○	○	,	○	○	,	○	,	○	,	○	,	○	,	○	,	○	,	○	,
					AL1			AL2			AL3			AL4							TS1		TS2		TS3		TS4		TS5	
	EX	BC	BC	CR	LF																									
Status 2 Request	SX	△	1	,	△	9	,	EX	BC 5	BC 0	CR	LF																		
Response output	SX	△	9	,	○	,	○	,	○	,	○	,	○	,	○	,	○	,	○	,	○	,	○	,	○	,	○	,	EX	BC
					RUN		STP		RES		END		ADV		CON		MAN		MAN		WAI		AI		FNC		M/S			
	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
Program drive	SX	△	2	,	△	1	,	×	,	× PTN	×	,	EX	BC	BC	CR	LF													
Execution parameter Setting	SX	△	2	,	△	2	,	× P	×	×	×	×	,	×	× I	×	×	,	×	× D	×	×	,	×	×	× AL1	×	×	,
	×	×	× AL2	×	×	×	,	×	×	×	× AL3	×	×	,	×	×	×	× AL4	×	×	×	,	×	×	× OL	×	×	,	×	× OH	×
	×	×	,	×	×	× OSL	×	×	,	×	×	× Sensor correction	×	×	×	,	EX	BC	BC	CR	LF									
AUTO/MAN Switching	SX	△	2	,	△	3	,	×	,	×	× MV1	×	,	×	,	×	× MV2	×	,	EX	BC	BC	CR	LF						
Fixed control (CONST)	SX	△	2	,	△	4	,	×	,	×	×	× SV	×	×	×	,	EX	BC	BC	CR	LF									
Cancel alarm output	SX	△	2	,	△	5	,	EX	BC 2	BC 0	CR	LF																		
Auto tuning	SX	△	2	,	△	6	,	×	,	EX	BC	BC	CR	LF																
Mode Lock/ Release lock	SX	△	2	,	△	7	,	× FNC	,	× 0	,	× 1	,	× 2	,	× 3	,	× 4	,	× 5	,	× 6	,	× 7	,	× 8	,	EX	BC	BC
	CR	LF																												
Time display System	SX	△	2	,	△	8	,	×	,	EX	BC	BC	CR	LF																
Step 0 Setting	SX	△	3	,	△	1	,	× PTN	×	,	0	0	,	×	×	× Start SV	×	×	×	,	×	,	EX	BC	BC	CR	LF			
Step n Setting	SX	△	3	,	△	2	,	× PTN	×	,	× STP	×	,	×	×	×	× SV	×	×	×	,	×	×	× Time	,	×	×	,	EX	BC
	BC	CR	LF																											
END Step Setting	SX	△	3	,	△	3	,	× PTN	×	,	× STP	×	,	× Link	×	,	× END output	×	×	,	EX	BC	BC	CR	LF					
Parameter No. Setting	SX	△	3	,	△	4	,	× PTN	×	,	× STP	×	,	× PID	,	× ALM	,	× OPL	,	× OSL	,	× Sensor	,	× Real temperature compensation	,	× WAI	,	× TS1	×	,
	× TS2	×	,	× TS3	×	,	× TS4	×	,	× TS5	×	,	EX	BC	BC	CR	LF													
Repeat Step Setting	SX	△	3	,	△	5	,	× PTN	×	,	× Start	×	,	× End	×	,	× Count	×	,	EX	BC	BC	CR	LF						
Repeat Pattern Setting	SX	△	3	,	△	6	,	×	× Count	×	×	,	EX	BC	BC	CR	LF													
Copy Pattern	SX	△	3	,	△	7	,	×	×	,	×	×	,	EX	BC	BC	CR	LF												
Clear pattern	SX	△	3	,	△	8	,	×	×	,	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	
Alarm	SX SX	1 1	2 2	, ,	× ○ No.	, ,	× ○	× ○	× ○	× ○	× ○	× ○	, ○	× ○	× ,	× ○	× ○	× ○	× ○	, ○	× ○	× ○	× ○	× ,	× ○	× ○	, ○	× ○	× ○	× ○	
										AL1										AL2									AL3		
	× ○	× ○	× ,	, ○	EX ○	BC ○	BC ○	CR ○	LF ○	○	○	,	EX	BC	BC	CR	LF														
								AL4																							
PID	SX SX	1 1	3 3	, ,	× ○ No.	× ○	, ,	× ○	× ○	× ○	× ○	× ○ P	, ○	× ○	× ○	× ,	× ○	, ○	× ○	× ○	× ○ I	× ○	, ○	EX ○	BC ,	BC ○	CR ○	LF ○	○ D	○	
	○	○	○	,	EX	BC	BC	CR	LF																						
Variation Limit	SX SX	1 1	4 4	, ,	× ○ No.	, ,	× ○	× ○	× ○	× ○	× ○	, ○	EX ○	BC ○	BC EX	CR BC	LF BC	CR	LF												
									Variation limit																						
Output Higher lower limit	SX SX	1 1	5 5	, ,	× ○ No.	, ,	× ○	× ○	× ○	× ○	× ○	, ○	× ○	× ○	× ,	× ○	× ○	, ○	EX ○	BC ○	BC ○	CR ○	LF ○	,	EX	BC	BC	CR	LF		
									OL-L									OL-H												
Sensor correction	SX SX	1 1	6 6	, ,	× ○ No.	, ,	× ○	× ○	× ○	× ○	× ○	× ○	, ○	EX ○	BC ,	BC EX	CR BC	LF BC	CR	LF											
									Sensor correction																						
Real temperature compensation	SX SX	1 1	7 7	, ,	× ○ No.	, ,	× ○	× ○	× ○	× ○	× ○	, ○	EX ○	BC ○	BC ,	CR EX	LF BC	BC	CR	LF											
									Real temperature compensation																						
Waiting time alarm	SX SX	1 1	8 8	, ,	× ○ No.	, ,	× ○	× ○	× ○	, ,	× ○	× ○	, ,	EX EX	BC BC	BC BC	CR CR	LF LF													
									Waiting 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
Time signal	SX SX	1 1	9 9	, ,	× ○ No.	, ,	× ○	× ○	× ○	, , ON-Time	× ○	× ○	, ,	× ○	× ○	× ○	, , OFF-Time	× ○	× ○	, ,	EX EX	BC BC	BC BC	CR CR	LF LF					
Digital filter	SX SX	2 2	0 0	, ,	× ○	× ○	× ○	× ○	, ○	EX ○	BC ○	BC ○	CR ,	LF EX	BC	BC	CR	LF												
Transmission type Transmission scale	SX SX	2 2	1 1	, ,	× ○ Type	, ,	× ○	× ○	× ○ Scale MIN	× ○	× ○	× ○	, ○	× ○	× ,	× ○	× ○	× ○ Scale MAX	× ○	, ○	EX ○	BC ○	BC ○	CR ,	LF EX	BC	BC	CR	LF	
Output 2 Gap	SX SX	2 2	2 2	, ,	× ○	× ○	× ○	× ○	× ○	× ○	, ○	EX ○	BC ,	BC EX	CR BC	LF BC	CR	LF												
Output 2 PID	SX SX	2 2	3 3	, ,	× ○	× ○	× ○	× ○ Second P	× ○	, ○	× ○	× ○	× ,	× ○	, ○	× ○	× ○ Second I	× ○	× ○	, ○	EX ○	BC ,	BC ○	CR ○	LF ○	○ Second D	○	○	○	○
	,	EX	BC	BC	CR	LF																								
Output 2 variation limit	SX SX	2 2	4 4	, ,	× ○	× ○	× ○	× ○	× ○	, ○	EX ○	BC ○	BC ,	CR EX	LF BC	BC	CR	LF												
Output 2 Higher and lower limit	SX SX	2 2	5 5	, ,	× ○	× ○	× ○	× ○	× ○	, ○	× ○	× ○	× ,	× ○	× ○	, ○	EX ○	BC ○	BC ○	CR ○	LF ○	, Second OH	EX	BC	BC	CR	LF_			
								Second OL																						
Second Position 2 dead band	SX SX	2 2	6 6	, ,	× ○	× ○	× ○	, ○	EX ○	BC ○	BC ○	CR ○	LF ,	EX	BC	BC	CR	LF												
Output at the time of second PV abnormality	SX SX	2 2	7 7	, ,	× ○	× ○	× ○	× ○	× ○	, ○	EX ○	BC ○	BC ,	CR EX	LF BC	BC	CR	LF												
Output 2 direct/reverse	SX SX	2 2	8 8	, ,	× ○	, ,	EX EX	BC BC	BC BC	CR CR	LF LF																			
Measurement input unit	SX SX	3 3	0 0	, ,	× ○ Input	× ○	, ,	× ○ Unit	, ,	EX EX	BC BC	BC BC	CR CR	LF LF																
SV Decimal point	SX SX	3 3	2 2	, ,	× ○	, ,	EX EX	BC BC	BC BC	CR CR	LF LF																			
PV Decimal point	SX SX	3 3	3 3	, ,	× ○	, ,	EX EX	BC BC	BC BC	CR CR	LF LF																			
Alarm filter	SX SX	3 3	4 4	, ,	× ○	× ○	× ○	× ○	× ○	× ○	, ○	EX ○	BC ,	BC EX	CR BC	LF 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
Alarm format Alarm Dead band	SX SX	3 3	5 5	, ,	× ○ No.	, ,	× ○ Mode	, ,	× ○	× ○	× ○	× ○ Dead band	× ○	, ○	EX ○	BC ○	BC ,	CR EX	LF BC	BC	CR	LF								
Position 2 dead band 2 dead band	SX SX	3 3	6 6	, ,	× ○	× ○	× ○	, ○	EX ○	BC ○	BC ○	CR ○	LF ,	EX	BC	BC	CR	LF												
Pulse cycle	SX SX	3 3	7 7	, ,	× ○	× ○	× ○	, ,	EX EX	BC BC	BC BC	CR CR	LF LF																	
FB zero Span Gain	SX SX	3 3	8 8	, ,	× ○	× ○	× ○	× ○	× ○ ZERO	, ○	× ○	× ○	× ,	× ○	× ○	, ○	× ○	× ○ SPAN	× ○	, ○	EX ○	BC ,	BC ○	CR ○	LF ○	○	○	○	○	○
	,	EX	BC	BC	CR	LF																								
Output preset	SX SX	3 3	9 9	, ,	× ○	× ○	× ○	× ○	× ○	× ○	, ○	EX ○	BC ,	BC EX	CR BC	LF BC	CR	LF												
Output during PV abnormality	SX SX	4 4	0 0	, ,	× ○	× ○	× ○	× ○	× ○	, ○	EX ○	BC ○	BC ,	CR EX	LF BC	BC	CR	LF												
Output Direct/ reverse	SX SX	4 4	1 1	, ,	× ○	, ,	EX EX	BC BC	BC BC	CR CR	LF LF																			
Linear range	SX SX	4 4	2 2	, ,	× ○	× ○	× ○	× ○	× ○ ZERO	× ○	, ○	× ○	× ,	× ○	× ○	× ○	× ○	, ○ SPAN	EX ○	BC ○	BC ○	CR ,	LF EX	BC	BC	LF				
Linear scale	SX SX	4 4	3 3	, ,	× ○	× ○	× ○	× ○	× ○ Scale MIN	× ○	, ○	× ○	× ,	× ○	× ○	× ○	× ○	, ○ Scale MAX	EX ○	BC ○	BC ○	CR ,	LF EX	BC	BC	CR	LF			
ARW	SX SX	4 4	4 4	, ,	× ○	× ○	× ○	× ○	× ○ Lower limit	, ○	× ○	× ○	× ,	× ○	× ○	, ○	EX ○	BC ○ Higher limit	BC ○	CR ○	LF ○	,	EX	BC	BC	CR	LF			
AT2 SV	SX SX	4 4	5 5	, ,	× ○ No.	, ,	× ○	, ,	× ○	× ○	× ○ AT2 SV	× ○	× ○	× ○	, ○	EX ○	BC ,	BC EX	CR BC	LF BC	CR	LF								
SV section	SX SX	4 4	6 6	, ,	× ○ No.	, ,	× ○	× ○	× ○	× ○ Delimiter SV	× ○	× ○	, ○	EX ○	BC ,	BC EX	CR BC	LF BC	CR	LF										
AT3 SV	SX SX	4 4	7 7	, ,	× ○ No.	, ,	× ○	, ,	× ○	× ○	× ○ AT3 SV	× ○	× ○	× ○	, ○	EX ○	BC ,	BC EX	CR BC	LF BC	CR	LF								
AT start direction	SX SX	4 4	8 8	, ,	× ○	, ,	EX EX	BC BC	BC BC	CR CR	LF 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
SV during Reset	SX SX	4 4	9 9	, ,	× ○	× ○	× ○	× ○	× ○	× ○	, ○	EX ○	BC ,	BC EX	CR BC	LF BC	CR	LF												
Thermocouple type Unit [Measurement device]	SX SX	5 5	1 1	, ,	× ○ Type	× ○	, ,	× ○ Unit	, ,	EX EX	BC BC	BC BC	CR CR	LF LF																
SV scale [Measurement device]	SX SX	5 5	2 2	, ,	× ○	× ○	× ○ Scale MIN	× ○	× ○	× ○	, ○	× ○	× ,	× ○	× ○	× ○	× ○ Scale MAX	, ○	EX ○	BC ○	BC ○	CR ,	LF EX	BC	BC	CR	LF			

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