INST.No. CP-COMMUNICATION-EN-1

CHINO

Digital Indicating Controller

CP350/CP370

[Communications]

INSTRUCTIONS

Table of Contents

1. Introduction

Thank you for purchasing Digital Indicating Controller “CP series”.
The generic name for a type with a front size of 48 x 96 is called "CP350" and that for a type with a front size of 96 x 96 is called "CP370".
This manual is a “Communications” instruction manual, and describes about communications interface. The type with a communications interface has a type code with “S” for 8th digit. Please read the “General” instruction manual to understand well the specifications, wiring, handling, and operation methods of the product, before reading this manual (“Communications”).
All information in this instruction manual is subject to change without prior notice.

The communications interface allows communications of high-order instruments (PC, PLC, etc.) with multiple (up to 31 sets of) CT350/CT370 series connected with the use of signals which conform to RS-485. For example, for communications with a PC, the CT350/CT370 series may be connected to a PC equipped with a RS-232C port with a RS-232C ↔ RS-485 converter placed between them.

Symbol mark

The following symbol marks are used for the product and in this instruction manual: Be sure to understand them properly.

⚠ Warning	Used to draw the user's attention to the danger that can result in death or serious injury of the involved person. It is also used for the precautions to avoid such an accident.
⚠ Precautions	Used to draw the user's attention to the danger that can result in small injuries of the involved person or damages of the peripheral instruments. It is also used for the precautions to avoid such an accident.

2. Communications Specifications

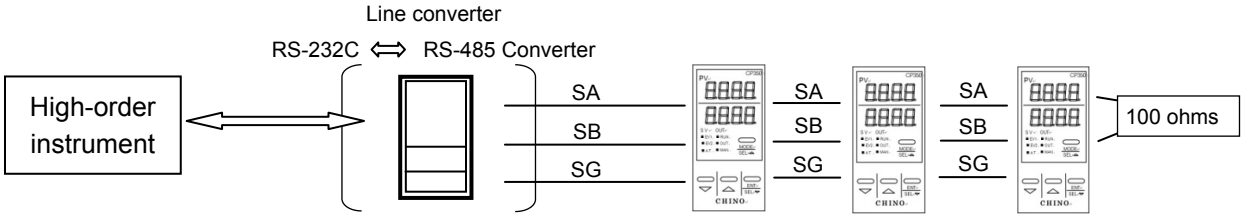
Protocol	Description
MODBUS	MODBUS includes RTU mode and ASCII mode, which can be selected. Functions are transmission of various data, setting of parameters, operations, digital transmission output, digital remote input, and others. • Communications method: Half duplex asynchronous method (Polling selecting system) • Transmission speed: 9600 bps, 19200 bps, 38400 bps • Start bit: 1bit • Data length: 7bit (ASCII mode), 8bit (RTU mode/ASCII mode) • Parity bit: None/Even/Odd • Stop bit: 1bit/2bit • Transmission code: ASCII (ASCII mode), Binary (RTU mode) • Error Check: LRC (ASCII mode), CRC-16 (RTU mode) • Transmission procedure: No procedure • Signals to be used: Transmission and reception data (Control signals not used) * MODBUS is a registered trademark of AEG Schneider Automation International S.A.S.
PRIVATE	CHINO's exclusive communications protocol. The function is limited to digital transmission output and digital remote input. Communications method: Half duplex asynchronous method (Polling selecting system) Transmission speed: 9600 bps, 19200 bps, 38400 bps Start bit: 1bit Data length: 7bit Parity bit: Even Stop bit: 1bit Transmission code: ASCII Code Error Check: BCC (Block Check Character) , Checksum Transmission procedure: No procedure Signals to be used: Transmission and reception data (Control signals not used) * PRIVATE is CHINO's exclusive protocol.

3. Wiring

Communications terminal numbers and notes on wiring are described in “General” instruction manual in detail; please be sure to read the manual. Here, only basic outlines regarding communications are described.

3-1. For High-order Communications

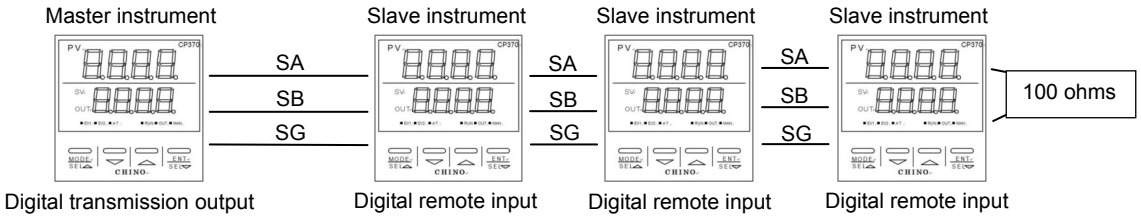
For communications established with high-order devices such as a PC, the basic wiring is as follows:
If the high-order instrument has no interface for RS-485, a line converter for converting intercommunication signals is required.



* Some line converters may not have SG terminals.
In that case, it does not need to be connected.

3-2. For Digital Transmission Output and Digital Remote Input

For remote operation with the use of digital transmission output and digital remote input, the basic wiring is as follows:
SVs of slave instruments follow according to SV of a master instrument.



Precautions for wiring

Precautions

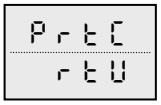
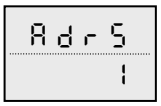
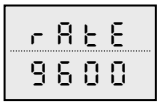
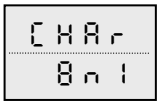
1. Communications cable and total extension
   Use communications cables such as CVVS lines, paying attention to impedance.
   Communications cables are optionally available.
   Type: RZ-LEC( )( )( ) * For ( )( )( ), the cable length (001 to 200: the unit is m) is placed.
   In addition, the total extension of the cable is a maximum of 1,200 m. However, note that it depends on wiring state.

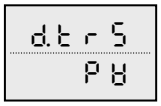
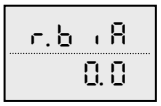
2. Number of connected instruments and termination resistor
   Up to 31 instruments can be connected on the same communications line.
   Also, a termination resistor (about 100 ohms) is connected to the terminal device on the same communications line for stability of communications signals.

3. Measures against noise and SG terminal
   Execute wiring paying attention to noise. Communications cable must be wired apart from power lines which have much noise.
   In addition, do not ground SG terminals.

4. Setting of Communications Parameter

The setting of communication parameter is executed with mode A.

[mode A] 	● The start screen of mode A. ● Mode A is used for setting the parameters of communications. ● This mode is displayed when the communications is added.
[Communications protocol] 	● Select a communications protocol. • 'rtU': MODBUS RTU • 'ASC ': MODBUS ASCII • 'Prbt': PRIVATE (CHINO's exclusive protocol) ● For 'Prbt', select digital transmission output or digital remote input as a communications function. ◎ When communications protocols are changed, communications characters are initialized.
[Communications function] 	● Select a communications function. • 'Com': High-order communications • 'trnC': Digital transmission output • 'rmt': Digital remote input ● For 'Com', select MODBUS RTU or MODBUS ASCII as a communications protocol. ◎ Select 'Com' for communications with a high-order instrument such as a PC and PLC, 'trnC' for digital transmission output for transmission of PV, SV, or MV of CP350/CP370, and 'rmt' for digital remote input for reception of SV of CP350/CP370.
[Communications instrument number] 	● Set a communications instrument number. ● Setting range is 1 to 99. ◎ If communications function is High-order communications, set instrument number which do not overlap with any instruments connected to the same communications line. The numbers do not have to be set in consecutive manner unless they are not overlapping. ◎ If the communications function is Digital transmission output or Digital remote input, the instrument numbers are arbitrary (can be overlapping).
[Communications transmission speed] 	● Select a communications transmission speed. • '9600': 9600 bps • '19.2k': 19200 bps • '38.4k': 38400 bps ◎ Select the same transmission speed for any instruments connected on the same communications line.
[Communications character] 	● Set a communications character. • '7E1': 7bitDATA/Even parity/1bitSTOP • '7E2': 7bitDATA/Even parity/2bitSTOP • '7o1': 7bitDATA/Odd parity/1bitSTOP • '7o2': 7bitDATA/Odd parity/2bitSTOP • '8n1': 8bitDATA/No parity/1bitSTOP • '8n2': 8bitDATA/No parity/2bitSTOP • '8E1': 8bitDATA/Even parity/1bitSTOP • '8E2': 8bitDATA/Even parity/2bitSTOP • '8o1': 8bitDATA/Odd parity/1bitSTOP • '8o2': 8bitDATA/Odd parity/2bitSTOP ● The initial value for MODBUS RTU of the communications protocol is '8n1', and set either one from '8n1' to '8o2'. The initial value for MODBUS ASCII is '7E1'. For PRIVATE, '7E1' is fixed.

[Communications transmission type] 	● Select a transmission type for digital transmission output. • 'PV': PV • 'SV': SV • 'MV1': MV1 (OUT1) : output value of the output 1 side • 'MV2': MV2 (OUT2) : output value of the output 2 side ● Some items are not displayed depending on specifications (model code). ● It is valid only when digital transmission output is selected as a communications function. ◎ Send the data of the selected transmission type.
[Remote/Local switching] 	● Select remote/local switching for digital remote input. • 'rmt': Remote SV • 'LoCL': Local SV ● It is valid only when digital remote input is selected as a communications function during constant value operation. ◎ To switch to Remote SV, select 'rmt' on this screen, or allocate Remote SV with outside input while the signal is ON.
[Remote SV shift] 	● Set Remote SV shift for digital remote input. ● Setting range is -199.9 to 999.9. ● It is valid only when digital remote input is selected as a communications function during constant value operation. ◎ Set Remote SV shift, if it is desired to execute correcting (bias value) calculation to remote SV.
[Remote SV decimal point] 	● Set it if it is required to match the decimal point of the master instrument to one of the slave instrument during operation with digital transmission output (on MODBUS) and digital remote input (on MODBUS). ● Setting range is 0 to 3. ● It is valid only when MODBUS RTU or MODBUS ASCII is selected as a communications protocol and digital transmission output or digital remote input is selected as a communications function. ◎ Since Remote SV does not have a decimal point on MODBUS, it is set to match the decimal points of Remote SVs of the master instrument and the slave instrument. ◎ For the combination between CP350/CP370s and with the same input range, setting is not required; however, for the combination with other series of controllers or with different input ranges, set either on the master instrument side or the slave instrument side to match the decimal points. ◎ Check that the decimal point of Remote SV matches on trial operation.

5. MODBUS

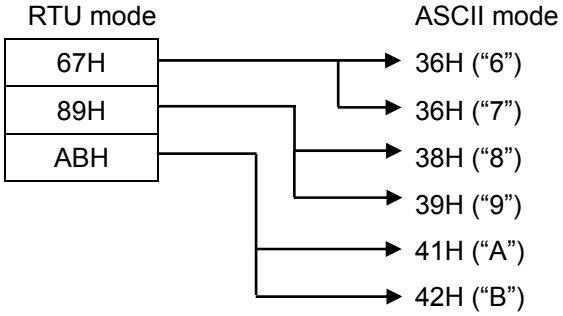
5-1. Message Transmission Mode

MODBUS includes RTU mode and ASCII mode as described below, and they can be selected with key settings.

Item		RTU mode	ASCII mode
Interface		RS-485	
Communications method		Half duplex asynchronous method	
Communications speed		9600, 19200, 38400 bps	
Transmission code		Binary	ASCII
Error check (Error detection)	Vertical direction	Parity	
	Horizontal direction	CRC-16	LRC
Character configuration	Start bit	1bit	
	Data length	7bit/8bit	
	Parity bit	None/Even/Odd	
	Stop bit	1bit/2bit	
Message start code		None	: (colon)
Message end code		None	CR, LF
Data interval		28bit hour or less	1s or less

5-1-1. Transmission Data

In RTU mode, binary transmission is executed. In ASCII mode, 8bit binary of RTU are disassembled to high-order and low-order 4bit, and each are characterized (0 to 9, A to F).



In RTU mode, the message length is half compared to one in ASCII mode; therefore, it provides efficient transmission.

5-1-2. Message Frame Configuration

In RTU mode, it consists of only message parts.
In ASCII mode, it consists of a start character “: (colon, 3AH)”, message, and end characters “CR (carriage return, 0DH) + LF (line feed, 0AH)”.

RTU mode

Message

ASCII mode

:	Message	CR	LF

In ASCII mode, there is a message start character “:”; therefore, it has an advantage of easy troubleshooting.

5-2. Data Interval

When messages are transmitted from high-order instruments, time period for data which form one message must be within the following time period. If it exceeds the following time period, the controller (receiving side) judges that transmission from the sending side has ended, and processes as abnormal message reception.

Mode	Data interval
RTU mode	Within 5 mS
ASCII mode	Within 1 S

With RTU mode, message characters must be transmitted continuously; however, with ASCII mode, the interval between characters is up to one second, therefore, relatively low processing speed of high-order instruments (such as a PC) is not a problem.

5-3. Message Configuration

MODBUS massages consist as follows, both in RTU mode and ASCII mode.

Instrument number
Function code
Data
Error check

5-3-1. Instrument Number

Set the instrument number (slave address) with key setting in the range of 1 to 99 in advance. Normally a high-order instrument communicates with one unit of controller. All connected controllers receive messages from a high-order instrument mutually; however, only the controller with an instrument number that matches with the number in a command message replies to the message.
Setting of “0” for the instrument number is used for messages (broadcast) to any controllers from high-order instruments. In this case, controllers do not reply.

5-3-2. Function Code

Function codes are for execution by controllers.

Function code	Function of controllers	Unit	MODBUS original function (Reference)
01	Reading of digital setting values	1bit	Reading of coil status
02	Reading of digital input data	1bit	Reading of input relay status
03	Reading of analog setting values	16bit	Reading of holding register contents
04	Reading of analog input data	16bit	Reading of input register contents
05	Writing of digital setting values	1bit	Change of single coil status
06	Writing of analog setting values	16bit	Writing of single holding register
08	Loop back test (transmission of received data)		Loop back test
15	Writing of multiple digital setting values		Change of multiple coil statuses
16	Writing of multiple analog setting values		Writing of multiple holding registers

5-3-3. Data Part

Data configuration depends on function codes. Data part consist of the code number (relative number calculated from the reference number) of target data to be read or written, number of data units, and others, on request from the master. The response from controllers consists of data for the request and others.
All of the basic data by MODBUS are 16bit integers, and signs are specified for each data item. Therefore, the data is expressed with integers with allocation of the decimal point position to another address or with normalization with upper/low limit values of the scale with fixed decimal point position. The controller employs the method where the decimal point position is allocated to another address.
Some of the data part assigns specific numeric values as error data, like input data. When such data is handled, first data error judgment and then combination with decimal point data must be executed. If the combination with decimal point data is executed first, error data may be handled wrongly as normal data.

5-3-4. Reference Number

All data items are assigned to “Reference number” and this number is required for writing/reading of data. Data items are categorized broadly into “Digital setting values”, “Digital input data”, “Analog input data”, and “Analog setting values”. Number designation in messages is executed with “relative number” which corresponds to each reference numbers.

Data type	Reference number	Relative number	MODBUS original (Reference)
Digital setting values	1 to 10000	Reference number - 1	Coil
Digital input data	10001 to 20000	Reference number - 10001	Input relay
Analog input data	30001 to 40000	Reference number - 30001	Input register
Analog setting values	40001 to 50000	Reference number - 40001	Holding register

The quick reference table of reference numbers is as follows.

Data type	Parameter	Reference number	Relative number	Function code
Digital setting values	Tuning	101	100	01 05 15
Digital input data	System status	10002	1	02
Analog setting values	Setup parameter 1	40001 - 40048	0 - 47	03 06 16
	Setup parameter 2	40051 - 40097	50 - 96	
	Class 1 parameter	40101 - 40148	100 - 147	
	Running parameter and unique parameter	40151 - 40187	150 - 186	
	Parameter group No. 1	40201 - 40246	200 - 245	
	Parameter group No. 2	40251 - 40287	250 - 286	
	Parameter group No. 3	40301 - 40337	300 - 336	
	Parameter group No. 4	40351 - 40387	350 - 386	
	Parameter group No. 5	40401 - 40437	400 - 436	
	Parameter group No. 6	40451 - 40487	450 - 486	
	Parameter group No. 7	40500 - 40537	500 - 536	
	Parameter group No. 8	40551 - 40587	550 - 586	
	Setting parameter	40701 - 40708	700 - 707	
	External input	48015 - 48020	8014 - 8019	
	Program patterns information	49003 - 49094	9002 - 9093	
	Program patterns information	49501 - 49589	9500 - 9588	
Analog input data	In-execution data	30101 - 30143	100 - 142	04

5-3-5. Error Check

With CRC-16 method adopted by RTU mode, information to be transmitted is divided by generating polynomial and transmitted with the remainder added to the end of the information.
The generating polynomial is as follows.

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

For the instrument number until the end of the data, calculate with the following procedure.

(1) Initialization of Data X in CRC-16 (=FFFFH)
(2) Exclusive OR (EX-OR) of data 1 and X. → X
(3) Shift X by 1bit to the right. → X
(4) If carry happens, remove A001H and EX-0R. If not, go to (5). → X
(5) Repeat (3) and (4) until it shifts for eight times.
(6) EX-OR of the next data and X. → X
(7) Same with (3) to (5).
(8) Repeat until the last data.
(9) Create messages in the order of low to high-order of 16bit data (X) calculated.

For example, when the data is [02H] [07H], CRC-16 is [1241H]; therefore, error check data is [41H] [12H].

With LRC method adopted by ASCII mode, for the slave address until the end of data, calculate with the following procedure.

(1) In RTU mode, create a message.
(2) Add from the top of data (slave address) to the end. → X
(3) Remove the complement of X (bit inversion). → X
(4) Add 1 (X = X + 1).
(5) Add X as LRC to the end of the message.
(6) Convert the entire data to ASCII characters.

For example, when the data is [02H] [07H], LRC is [F7H]; therefore, the binary message is [02H] [07H] [F7H], and the ASCII message is [30H] [32H] [30H] [37H] [46H] [37H].

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]) > ");
    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 presence 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..  ", usCrcData );

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

    iDummy = getch();
}
```

Reference: LRC Calculation Program

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

void main(void)
{
    /*** Internal change 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]) > ");
    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..", usLrcData );

    iDummy = getch();
}
```

5-3-6. Notes on Data Processing

(1) The decimal point of each data item is described in the reference table. Some of them are fixed, decided for each input type, or followed by linear scale decimal point, etc. Pay attention to the decimal point position upon data replay.
(2) Pay attention upon setting of related data, since each data item can be accessed (changed) one by one. An example would be initialization processing for related data with change of input type.
(3) Read/write data in the defined range of reference number. Writing to undefined reference number may cause adverse impacts.
(4) Discontinuous multiple reference numbers can be read/written; however, if undefined reference number is used as a starting number, error (Error 02H) occurs.
(5) When multiple reference numbers are read, the data of the number without defined reference number is “0”.
(6) When multiple reference numbers are written, all settings become invalid if an error is detected.

5-4. Message Creating Method

The message consists of (1) Slave address, (2) Function code, (3) Data part, and (4) Error check code.
Messages which can be read/written at once are as follows.

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

(Note) “Number of data items” is the number of data items requested by high-order instruments.

5-4-1. Message Creating Method in RTU Mode

As reference, the reading procedure for PV value and PV status of “Instrument number 02” is explained.

(1) Instrument number: 02 [02H]

(2) Function code: 04 [04H]
The function is “Reading of analog input data (reading of input register contents).
For the function code “04”, specify “Data relative number 2 bytes” to be read in the data part and “Number of data items 2 bytes” to be read. In addition, the number of bytes of data must be checked.

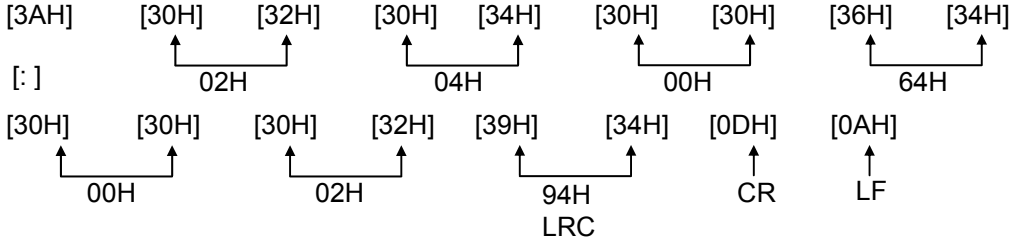
(3) Data part: Relative number at the top 100 [00H] [64H], the number of data items 2 [00H] [02H]
PV value and PV status are stored in the reference number “30032-30144”. The reference table shows PV value and PV status are stored in “30101” and “30102” respectively.
For reading of PV value, the relative number of the top “Reference number 30101” is 30101 – 30001 = 100, and [00H] [64H] when described in 2 bytes.
The number of read data items is “2 items”, PV value and PV status. Therefore, it is [00H] [02H].

(4) Error check: Calculation with CRC-16 2730H [30H] [27H]
For error check in RTU mode, calculate with CRC-16. The data of message basic part is [02H] [04H] [00H] [64H] [00H] [02H] with (1) to (3), and CRC-16 is 2730H. Therefore, the error check data is [30H] [27H].

(5) Message: [02H] [04H] [00H] [64H] [00H] [02H] [30H] [27H]
Create the message with the message configuration.

5-4-2. Message Creating Method in ASCII Mode

As reference, the reading procedure for PV value and PV status of “Instrument number 02” is explained.
When LRC is calculated from the message basic part, LRC is 94H. Convert each data item of the basic part into ASCII code as well as LRC, and add them to the basic part. Add the message start character “:” and “CR” and “LF” to the end.



5-5. Function Code

5-5-1. Reading of Digital Setting Value [Function Code: 01 (01H)]

Read “Digital setting value with consecutive numbers” as many items as specified by specified number. The data of the response message consists of eight digital setting values for one data (1 byte) which are placed in numerical order. The LSB (D0 side) of each data item has the digital setting value with the smallest number. If the number of read items is not multiples of eight, 0 is placed for an unnecessary bit.

(Example) Reading of digital setting value reference number 101 of instrument number 2

Reference number	101
Data	0

↔ AT end

<RTU mode>

High-order instrument → Controller

Instrument number	02H
Function code	01H
Starting number (H)	00H
Starting number (L)	64H
Number of items (H)	00H
Number of items (L)	01H
CRC (L)	BCH
CRC (H)	26H

Controller → High-order instrument

Instrument number	02H
Function code	01H
Number of data items	01H
First eight data items	00H
CRC (L)	51H
CRC (H)	CCH

<Error check in ASCII mode>

LRC	98H

* The part of CRC (L) (H) above corresponds to LRC below.

LRC	FCH

(Note) The start number (relative number) is “Reference number – 1”. Decimal 100 (= 101 – 1) → Hexadecimal 64H

(Note) The number of data items is the number of bytes of data. With this example, the number of items required is one, and the number of data items is one.

5-5-2. Reading of Digital Input Data [Function Code: 02 (02H)]

Read “Digital input data with consecutive numbers” as many items as specified by specified number. The data of the response message consists of eight digital iniput values for one data (1 byte) which are placed in numerical order. The LSB (D0 side) of each data item has the digital data with the smallest number. If the number of read items is not multiples of eight, 0 is placed for an unnecessary bit. Response example is the same as “Function code 01”, and the starting number (relative number) is “Reference number – 10001”.

5-5-3. Reading of Analog Setting Value [Function Code: 03 (03H)]

Read “Analog setting value (2 bytes: 16bit) data with consecutive numbers” as many items as specified by specified number.
The data of the response message consists of the data divided into high-order 8bit and low-order 8bit which are placed in numerical order.

(Example) Reading of P, I, D of PID No. 1 of the instrument number 1

Reference number (Starting number)	40206 (00CDH)	40207 (00CEH)	40208 (00CFH)
Data	50 (0032H)	60 (003CH)	30 (001EH)

↔ Example of P = 5.0, I = 60, D = 30

<RTU mode>

High-order instrument → Controller

Instrument number	01H
Function code	03H
Starting number (H)	00H
Starting number (L)	CDH
Number of items (H)	00H
Number of items (L)	03H
CRC(L)	94H
CRC(H)	34H

Controller → High-order instrument

Instrument number	01H
Function code	03H
Number of data items	06H
P(H)	00H
P(L)	32H
I(H)	00H
I(L)	3CH
D(H)	00H
D(L)	1EH
CRC(L)	58H
CRC(H)	B5H

<Error check in ASCII mode> * The part of CRC (L) (H) above corresponds to LRC below.

LRC	2CH

LRC	6AH

(Note) The starting number (relative number) is “Reference number – 40001”.
(Note) The number of data items is the number of bytes of data. With this example, the number of items requested is three, and the number of data items is six.

5-5-4. Reading of Analog Input Data [Function Code: 04 (04H)]

Read “Analog input (2 bytes: 16bit) data with consecutive numbers” as many items as specified by specified number.
The data of the response message consists of the data divided into high-order 8bit and low-order 8bit which are placed in numerical order. Response example is the same as “Function code 03”, and the starting number (relative number) is “Reference number – 30001”.

5-5-5. Writing of Digital Setting Value [Function Code: 05 (05H)]

The digital setting value of specified number is written to specified status.

(Example) Execution of AT of the instrument number 2 (1 is placed to digital setting value reference number 101 of slave 2.)

<RTU mode>

High-order instrument → Controller

Instrument number	02H
Function code	05H
Setting value number (H)	00H
Setting value number (L)	64H
Setting status (H)	FFH
Setting status (L)	00H
CRC(L)	CDH
CRC(H)	D6H

Controller → High-order instrument

Instrument number	02H
Function code	05H
Setting value number (H)	00H
Setting value number (L)	64H
Setting status (H)	FFH
Setting status (L)	00H
CRC(L)	CDH
CRC(H)	D6H

<Error check in ASCII mode>

LRC	96H

* The part of CRC (L) (H) above corresponds to LRC below.

LRC	96H

(Note) It is the same response with the command message upon normal response.
(Note) The setting value number (relative number) is “Reference number – 1”. Decimal 100 (= 101 – 1) → Hexadecimal 64H
(Note) On execution, set “FF00H”. Set “0000H” to terminate.
(Note) When 0 is placed to the instrument number (slave address), all controller execute this command. However, none of the controllers respond.

5-5-6. Writing of Analog Setting Value [Function Code: 06 (06H)]

The analog setting value of specified number is written to a specified value.

(Example) Setting of input type of the instrument number 1 to K1 (5).

<RTU mode>

High-order instrument → Controller

Instrument number	01H
Function code	06H
Setting value number (H)	00H
Setting value number (L)	00H
Setting data (H)	00H
Setting data (L)	05H
CRC(L)	49H
CRC(H)	C9H

Controller → High-order instrument

Instrument number	01H
Function code	06H
Setting value number (H)	00H
Setting value number (L)	00H
Setting data (H)	00H
Setting data (L)	05H
CRC(L)	49H
CRC(H)	C9H

<Error check in ASCII mode>

LRC	F4H

* The part of CRC (L) (H) above corresponds to LRC below.

LRC	F4H

(Note) The starting number (relative number) is “Reference number – 40001”.
(Note) It is the same response with the command message upon normal response.
(Note) When 0 is placed to the instrument number (slave address), all controller execute this command. However, none of the controllers respond.

5-5-7. Loop Back Test [Function Code: 08 (08H)]

Transmission check between a high-order instrument and a controller is executed. Responses are made according to specified diagnosis codes. The controller performs “Return check where received data is directly transmitted”, and the diagnosis code is “0000H”.

(Example) Execution of “Loop back test” for the instrument number 2

<RTU mode>

High-order instrument → Controller

Instrument number		02H
Function code		08H
Diagnosis code (H)	Fixed	00H
Diagnosis code (L)		00H
Optional data		*
Optional data		*
CRC(L)		*
CRC(H)		*

Controller → High-order instrument

Instrument number		02H
Function code		08H
Diagnosis code (H)	Fixed	00H
Diagnosis code (L)		00H
Received data		*
Received data		*
CRC(L)		*
CRC(H)		*

5-5-8. Writing of Multiple Digital Setting Values [Function Code: 15 (0FH)]

The digital setting values of specified number of items are written to specified status from a specified number. Digital setting values (0/1) are specified for each eight items as one data item in numerical order. The LSB (D0 side) of each data item has the digital data with the smallest number. If the number of written items is not multiples of eight, unnecessary bits are ignored.

(Example) Setting of AT1 of the instrument number 2 to execution (reference number 101 of the instrument number 2 is put into the following status.)

Reference number	101
Data	1

↔ AT execution

<RTU mode>

High-order instrument → Controller

Instrument number	02H
Function code	0FH
Starting number (H)	00H
Starting number (L)	64H
Number of items (H)	00H
Number of items (L)	01H
Number of data items	01H
First eight data items	01H
CRC(L)	DEH
CRC(H)	8AH

Controller → High-order instrument

Instrument number	02H
Function code	0FH
Starting number (H)	00H
Starting number (L)	64H
Number of items (H)	00H
Number of items (L)	01H
CRC(L)	D5H
CRC(H)	E7H

<Error check in ASCII mode>

LRC	88H

* The part of CRC (L) (H) above corresponds to LRC below.

LRC	8AH

(Note) The starting number (relative number) is “Reference number – 1”. Decimal 100 (= 101 – 1) → Hexadecimal 64H

(Note) When 0 is placed to the instrument number (slave address), all controller execute this command. However, none of the controllers respond.

(Note) The number of data items of messages which can be transmitted (can be received by the controller) at a time is limited.

5-5-9. Writing of Multiple Analog Setting Values [Function Code: 16 (10H)]

The analog setting values of specified number of items are written to the specified value from the specified number. The data is divided into high-order 8bit and low-order 8bit, placed in numerical order, then transmitted.

(Example) Setting of PID No. 1 of the instrument number 1 to P = 12.0 %, I = 90 sec, and D = 25 sec.

Reference number (Starting number)	40206 (00CDH)	40207 (00CEH)	40208 (00CFH)
Data	120 (0078H)	90 (005AH)	25 (0019H)

↔ Example of P = 12.0, I = 90, D = 25

<RTU mode>

High-order instrument → Controller

Instrument number	01H
Function code	10H
Starting number (H)	00H
Starting number (L)	CDH
Number of items (H)	00H
Number of items (L)	03H
Number of data items	06H
First data (H)	00H
First data (L)	78H
Second data (H)	00H
Second data (L)	5AH
Third data (H)	00H
Third data (L)	19H
CRC(L)	33H
CRC(H)	95H

Controller → High-order instrument

Instrument number	01H
Function code	10H
Starting number (H)	00H
Starting number (L)	CDH
Number of items (H)	00H
Number of items (L)	03H
CRC(L)	11H
CRC(H)	F7H

<Error check in ASCII mode>

LRC	2EH

* The part of CRC (L) (H) above corresponds to LRC below.

LRC	1FH

(Note) The starting number (relative number) is “Reference number – 40001”.

(Note) When 0 is placed to the instrument number (slave address), all controller execute this command. However, none of the controllers respond.

(Note) The number of data items of messages which can be transmitted (can be received by the controller) at a time is limited.

5-6. Process during Abnormality

5-6-1. For No Response

In the cases below, the controller ignores the message and does not respond.

(1) When a transmission error (overrun, framing, parity, CRC, or LRC) is detected in the message.
(2) When the slave address in the message is not one's own address.
(3) When the data interval of the message is long.
RTU mode: 5 mS or more
ASCII mode: 1 S or more
(4) When the transmission parameter does not conform.
(5) When the received message exceeds the receivable bytes.

(Note) When the instrument number (slave address) is "0" with the writing function, a message without an error allows the controller to execute the message, but not to respond. Also, the controller does not respond for a message with an error. Therefore, if the instrument number is "0", it is impossible to judge between normality and abnormality.

5-6-2. Response of Error Message

When the message from the high-order instrument does not have an error and the following failure is detected, the code to indicate the error contents is responded as "error message".
The format for error messages is as follows:

Instrument number
Function code + 80H
Error code
CRC (L)
CRC (H)

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

Error codes are as follows:

Error code	Description
01H	“Function code defect” • Reception of an undefined function code
02H	“Relative number (Reference number) defect” • The received starting number or setting value number is undefined.
03H	“The number of data items defect” • The number of data items transmitted in response to the received message exceeds the defined number. • The requested number of items is 0. • The received specified number of data items does not correspond to the actual number of data items.
11H	“Out of setting values range” • A numerical value which is out of the setting range defined in the reference table is set.
12H	“Setting impossible”. * The following are typical examples: • When the input type is a thermocouple or resistance thermometer and “Linear scale (decimal point, high limit, and low limit) is written. • During auto tuning, when “Auto tuning” is rewritten. • During program operations other than RESET phase, when “Pattern No. selection” is written. • During program operations other than RESET phase, when “Program time unit” is written. • During program operations other than RESET phase, when “Pattern clear” is written. • During program operations other than RESET phase, when “Program pattern” is written. • During RESET phase of program operation, when “Auto tuning” is written. • During RESET phase of program operation, when “ADV” or “STOP” is written. • During END phase of program operation, when “RUN”, “STOP”, or “ADV” is written. • During constant value operation, when “RUN”, “STOP”, “ADV”, or “RESET” is written. • During READY phase of constant value operation, when “Auto tuning” is written. • During automatic output operation, when “Manual output value” is written.

Communications Procedures and Cautions

⚠ Precautions

1. Cautions during Communications
   Avoid blocking electric power supply or disconnecting communications cables during communications. Otherwise, communications error will occur, and reactivation of systems on the same communications line will be required.

2. Instrument Number Switching Timing
   With RS-485, multiple controllers are connected on the same communications line, and only one controller with the instrument number specified by the high-order instrument (such as a PC) drives on the communication line. At this time the controller waits for a while after the last data item is transmitted to ensure all data items are delivered to the high-order instrument and turns OFF the drive of the communications line.
   If the high-order instrument transmits commands for the next controllers before the drive is turned OFF, communications signals collide and communications abnormality occurs; therefore, the high-order instrument must transmit commands for the next controllers at intervals of 5 mS or more after it receives the last data item.

3. Retransmission of Commands
   Communications control signal lines are not used for communications of controllers. Therefore, reception failures may occur depending on behavior status of a CPU within the controller. Retransmit commands if necessary.

4. Limitation of Key Operation
   If parameter writing operation is executed with the high-order instrument (such as a PC) while the controller is displayed on the setting screen, “enter-key” key becomes invalid temporarily. Screen transition allows “enter-key” key to be valid again.

5. Availability of Program Functions
   For controllers of “Non” program functions type (the tenth digit of the type code is “N”), reading/writing of the reference numbers and setting values for program functions must not be executed.

5-7. Reference Table

5-7-1. Analog Setting Values

(1) Setup parameter 1

FNC code: Applied function code, R/W: R is READ, W is WRITE.

Reference number	FNC code	R/W	Data name	Setting range (Range on communications)	Initial value	Description
40001	03 06 16	R W W	Input type	1 to 20 (1 to 20)	5 (K1)	1 = ”B” 0 to 1820 °C 2 = ”R” 0 to 1760 °C 3 = ”S” 0 to 1760 °C 4 = ”N” 0 to 1300 °C 5 = ”K” -200 to 1370 °C 6 = ”K” -199.9 to 500.0 °C 7 = ”E” -199.9 to 700.0 °C 8 = ”J” -199.9 to 900.0 °C 9 = ”T” -199.9 to 400.0 °C 10 = ”U” -199.9 to 400.0 °C 11 = ”L” -199.9 to 900.0 °C 12 = “WRe5-WRe26” 0 to 2310 °C 13 = “W -WRe26” 0 to 2310 °C 14 = “PtRh40 - PtRh20” 0 to 1880 °C 15 = “Platinel II” 0 to 1390 °C 16 = ”5V” 0.000 to 5.000 V 17 = ”Pt100” -199.9 to 850.0 °C 18 = ”Pt100” -199.9 to 200.0 °C 19 = ”JPt100” -199.9 to 649.0 °C 20 = ”JPt100” -199.9 to 200.0 °C
40004 40005	03 06 16	R W W	Measurement range “Low limit” “High limit”	Within input range (-1999 to 9999)	Every input range	• WRITE enabled within input range • WRITE enabled when low limit is smaller than high limit
40006 40007	03 06 16	R W W	Linear scale “Low limit” “High limit”	-1999 to 9999 (-1999 to 9999)	0.0 100.0	• Decimal point position is linear scale decimal point. • WRITE enabled with input type of DC voltage
40008	03 06 16	R W W	SV decimal point Linear scale “Decimal point”	0 to 3 (0 to 3)	0 (0 decimal digit)	• READ enabled with input types of thermocouples or resistance thermometer • READ/WRITE enabled with input type of DC voltage
40009 40010	03 06 16	R W W	SV limiter “Low limit” “High limit”	-1999 to 9999 (-1999 to 9999)	Every measurement range	• Decimal point position is SV decimal point. • WRITE enabled if low limit is equal to or smaller than high limit
40012	03 06 16	R W W	PV filter	0.0 to 99.9 (0 to 999)	0.1 sec.	• 0.0 = OFF
40014	03 06 16	R W W	SV filter	0.0 to 99.9 (0 to 999)	0.0 sec.	• 0.0 = OFF
40020	03 06 16	R W W	Remote SV Decimal point	0 to 3 (0 to 3)	0 (0 decimal digit)	• MODBUS remote SV decimal point.
40021	03 06 16	R W W	Control action	0/1 (0/1)	1 (Reverse operation)	0 = Direct operation (DIRECT) 1 = Reverse operation (REVERSE)
40022	03 06 16	R W W	Pulse cycle	1 to 180 (1 to 180)	30 sec.	

FNC code: Applied function code, R/W: R is READ, W is WRITE.

Reference number	FNC code	R/W	Data name	Setting range (Range on communications)	Initial value	Description
40026	03 06 16	R W W	[Second output] Control action	0/1 (0/1)	0 (Direct operation)	• WRITE enabled on addition of Control output 2 0 = Direct operation (DIRECT) 1 = Reverse operation (REVERSE)
40027	03 06 16	R W W	[Second output] Pulse cycle	1 to 180 (1 to 180)	30 sec.	• WRITE enabled on addition of Control output 2
40028	03 06 16	R W W	[Second output] Two output control method	0/1 (0/1)	0 (PID)	• WRITE enabled on addition of Control output 2 0 = PID formula 1 = SPLIT formula
40030	03 06 16	R W W	Alarm event RESET	0/1 (0/1)	0 (NON)	0 = NON 1 = RESET (Alarm reset)
40031	03 06 16	R W W	Event function “EV1”	[Event basic function] 00h/01h/02h/ 03h/04h/05h/ 07h/08h/09h/0Ah (00h/01h/02h/ 03h/04h/05h/ 07h/08h/09h/0Ah) [Event expansion function] 00h/01h/02h/03h	0003h (Deviation alarm high limit)	READ/WRITE enabled with lower 8bit as [Basic function] and upper 8bit as [Expansion function] Upper 8bit / Lower 8bit [Expansion function] | [Basic function] └Event “EV1”┘ [Event basic function] 00 = Event action OFF (NON) 01 = Absolute value alarm high limit (PV_H) 02 = Absolute value alarm low limit (PV_L) 03 = Deviation alarm high limit (DV_H) 04 = Deviation alarm low limit (DV_L) 05 = Absolute value deviation alarm high limit (ADV_H) 06 = Absolute value deviation alarm low limit (ADV_L) 07 = Output value alarm high limit (OUT_H) 08 = Output value alarm low limit (OUT_L) 09 = Heater over-current alarm (CT_H) 10 = Heater disconnection alarm (CT_L) 11 = Timer 1 (TIM1) 12 = Timer 2 (TIM2) 13 = FAIL signal (FAIL) 14 = Constant value operation RUN status (RUN1) 15 = During preset output (PRSO) 16 = Constant value operation remote SV operation (REM) 17 = During SV rising (SVUP) 18 = During SV falling (SVDW) 19 = Step switching signal (STEP) 20 = Step 1 (STEP1) 21 = Step 2 (STEP2) 22 = Step 3 (STEP3) 23 = Step 4 (STEP4) 24 = Step 5 (STEP5)

FNC code: Applied function code, R/W: R is READ, W is WRITE.

Reference number	FNC code	R/W	Data name	Setting range (Range on communications)	Initial value	Description
40031	03 06 16	R W W	Event function “EV1”	[Event basic function] 00h/01h/02h/ 03h/04h/05h/ 07h/08h/09h/0Ah (00h/01h/02h/ 03h/04h/05h/ 07h/08h/09h/0Ah) [Event expansion function] 00h/01h/02h/03h	0003h (Deviation alarm high limit)	25 = Step 6 (STEP6) 26 = Step 7 (STEP7) 27 = Step 8 (STEP8) 28 = Step 9 (STEP9) 29 = Step 10 (STEP10) 30 = Step 11 (STEP11) 31 = Step 12 (STEP12) 32 = Program operation RUN (RUN2) 33 = Program operation STOP (STOP) 34 = Program operation ADVANCE (ADVANCE) 35 = Program operation RESET (RESET) 36 = Program operation END (END) 37 = During program operation SV constant value (CONST) [Event expansion function] 00 = Event expansion function OFF (NON) 01 = Alarm wait (WAIT) 02 = Alarm keep (KEEP) 03 = Alarm wait keep (WAIT + KEEP)
40032	03 06 16	R W W	Event deadband “EV1”	0.0 to 999.9 (0 to 9999)	2.0	• Decimal point position is for each event function. • SV decimal point + 1 digit for PV, DV, and ADV (Max 3 digits) • 1 digit after decimal point for OUT and CT • READ/WRITE disabled on TIM1, TIM2, FAIL, and status event
40033	03 06 16	R W W	Event output phase “EV1”	0/1 (0/1)	0 (Direct output)	0 = Direct output (NORMAL) 1 = Reverse output (REVERSE)
40036	03 06 16	R W W	Event function “EV2”	Same as Event function “EV1”	0004h (Deviation alarm Low limit)	• Same as Event function “EV1”
40037	03 06 16	R W W	Event deadband “EV2”	Same as Event deadband “EV1”	2.0	• Same as Event deadband “EV1”
40038	03 06 16	R W W	Event output phase “EV2”	0/1 (0/1)	0 (Direct output)	• Same as Event output phase “EV1”
40041	03 06 16	R W W	Event function “EV3”	Same as Event function “EV1”	0003h (Deviation alarm high limit)	• Same as Event function “EV1”
40042	03 06 16	R W W	Event deadband “EV3”	Same as Event deadband “EV1”	2.0	• Same as Event deadband “EV1”
40043	03 06 16	R W W	Event output phase “EV3”	0/1 (0/1)	0 (Direct output)	• Same as Event output phase “EV1”
40046	03 06 16	R W W	Event function “EV4”	Same as Event function “EV1”	0004h (Deviation alarm Low limit)	• Same as Event function “EV1”
40047	03 06 16	R W W	Event deadband “EV4”	Same as Event deadband “EV1”	2.0	• Same as Event deadband “EV1”

FNC code: Applied function code, R/W: R is READ, W is WRITE.

Reference number	FNC code	R/W	Data name	Setting range (Range on communications)	Initial value	Description
40048	03 06 16	R W W	Event output phase “EV4”	0/1 (0/1)	0 (Direct output)	• Same as Event output phase “EV1”

(2) Setup Parameter 2

FNC code: Applied function code, R/W: R is READ, W is WRITE.

Reference number	FNC code	R/W	Data name	Setting range (Range on communications)	Initial value	Description
40051	03 06 16	R W W	Transmission type	0/1/2/3 (0/1/2/3)	0 (SV)	WRITE enabled on addition of transmission signal output 0 = SV 1 = PV 2 = MV1 (OUT1) 3 = MV2 (OUT2) WRITE enabled on addition of Control output 2 for MV2
40052 40053	03 06 16	R W W	Transmission scale “Low limit” “High limit”	-1999 to 9999 (-1999 to 9999)	Every measurement range	WRITE enabled on addition of transmission signal output • Decimal point position is for each transmission type. • SV decimal point for PV and SV • 1 digit after decimal point for MV
40079	03 06 16	R W W	Communications transmission type	0/1/2/3 (0/1/2/3)	0 (SV)	• WRITE enabled on addition of communications 0 = SV 1 = PV 2 = MV1 (OUT1) 3 = MV2 (OUT2) • WRITE enabled on addition of Control output 2 for MV2
40085	03 06 16	R W W	Event function “EV5”	Same as Event function “EV1”	0000h (Event action OFF)	• Same as Event function “EV1”
40086	03 06 16	R W W	Event function “EV6”	Same as Event function “EV1”	0000h (Event action OFF)	• Same as Event function “EV1”
40087	03 06 16	R W W	Event function “EV7”	Same as Event function “EV1”	0000h (Event action OFF)	• Same as Event function “EV1”
40092	03 06 16	R W W	Power recovery action	0/1 (0/1)	0 (Constant value: RUN) (Program: RESET)	0 = RUN 1 = READY (RESET)
40093	03 06 16	R W W	On READY Event action	0/1 (0/1)	1 (Event action ON)	0 = Event action OFF 1 = Event action ON (CALC)
40095	03 06 16	R W W	Event output phase “EV5”	Same as Event output phase “EV1”	0 (Direct output)	• Same as Event output phase “EV1”
40096	03 06 16	R W W	Event output phase “EV6”	Same as Event output phase “EV1”	0 (Direct output)	• Same as Event output phase “EV1”
40097	03 06 16	R W W	Event output phase “EV7”	Same as Event output phase “EV1”	0 (Direct output)	• Same as Event output phase “EV1”

(3) Class 1 Parameter

FNC code: Applied function code, R/W: R is READ, W is WRITE.

Reference number	FNC code	R/W	Data name	Setting range (Range on communications)	Initial value	Description
40101	03 06 16	R W W	[Second output] Two output gap	-100.0 to 100.0 (-1000 to 1000)	0.0 %	• WRITE enabled on addition of Control output 2
40102	03 06 16	R W W	[Second output] PID•"P"	0.0 to 999.9 (0 to 9999)	5.0 %	• WRITE enabled on addition of Control output 2 • 0.0 is two-position control.
40103	03 06 16	R W W	[Second output] PID•"I"	0 to 9999 (0 to 9999)	60 sec.	• WRITE enabled on addition of Control output 2 • 0 = ∞
40104	03 06 16	R W W	[Second output] PID•"D"	0 to 9999 (0 to 9999)	15 sec.	• WRITE enabled on addition of Control output 2 • 0 = OFF
40105 40106	03 06 16	R W W	[Second output] Output limiter "Low limit" "High limit"	-5.0 to 100.0 (-50 to 1000) 0.0 to 105.0 % (0 to 1050)	0.0 % 100.0 %	• WRITE enabled on addition of Control output 2 • WRITE enabled when low limit is smaller than high limit
40113	03 06 16	R W W	PV abnormal output	-5.0 to 105.0 (-50 to 1050)	0.0 %	
40116 40117	03 06 16	R W W	SV slope "Falling" "Rising"	-1999 to 0 (-1999 to 0) 0 to 9999 (0 to 9999)	0 (Slope operation OFF) 0 (Slope operation OFF)	• 0 = SV Slope operation OFF • Decimal point position is SV decimal point.
40119	03 06 16	R W W	For constant value operation PV start	0/1 (0/1)	0 (OFF)	• 0 = OFF (SV start) • 1 = ON (PV start)
40121 40122	03 06 16	R W W	[Second output] SPLIT "DIRECT" "REVERSE"	0.0 to 60.0 (0 to 600) 40.0 to 100.0 (400 to 1000)	0.0 % 100.0 %	• WRITE enabled on addition of Control output 2 • WRITE enabled with two output control method of SPLIT formula
40123	03 06 16	R W W	[Second output] PID deadband	0.0 to 9.9 % (0 to 99)	0.0 %	• WRITE enabled on addition of Control output 2
40124	03 06 16	R W W	PID deadband	0.0 to 9.9 (0 to 99)	0.0 %	
40141	03 06 16	R W W	Operation initial screen	0/1/2/3/4 (0/1/2/3/4)	0 (PV/SV)	0 = PV/SV 1 = PV/pattern step 2 = PV/step time 3 = PV/OUT1 4 = PV/OUT2
40142	03 06 16	R W W	Operation screen SV display	0/1/2	0 (SV display)	0 = SV displayed 1 = SV not displayed 2 = Multiple display
40143	03 06 16	R W W	Remote/local switching	0/1 (0/1)	0 (Local SV)	• WRITE enabled on addition of communications 0 = Local SV (LOCAL) 1 = Remote SV (REMOTE)
40148	03 06 16	R W W	Control algorithm	0/1 (0/1)	0 (Position type PID)	0 = Position type PID control (PID1) 1 = Velocity type PID control (PID2)

FNC code: Applied function code, R/W: R is READ, W is WRITE.

Reference number	FNC code	R/W	Data name	Setting range (Range on communications)	Initial value	Description
40149	03 06 16	R W W	Auto tuning method	0/1/2 (0/1/2)	2 (TYPE3)	0=TYPE1 1=TYPE2 2=TYPE3

(4) Running Parameter and Unique Parameter

FNC code: Applied function code, R/W: R is READ, W is WRITE.

Reference number	FNC code	R/W	Data name	Setting range (Range on communications)	Initial value	Description
40151	03	R	Running SV	Within SV limit range (Within SV limit range)	0.0	• Decimal point position is SV decimal point. • WRITE disabled
40156	03 06 16	R W W	Running PID•"P"	0.0 to 999.9 (0 to 9999)	5.0 %	• 0.0 is two-position control.
40157	03 06 16	R W W	Running PID•"I"	0 to 9999 (0 to 9999)	60 sec.	• 0=∞
40158	03 06 16	R W W	Running PID•"D"	0 to 9999 (0 to 9999)	15 sec.	• 0 = OFF
40159 40160	03 06 16	R W W	Running output limiter "Low limit" "High limit"	-5.0 to 100.0 (-50 to 1000) 0.0 to 105.0 (0 to 1050)	0.0 % 100.0 %	• WRITE enabled when low limit is smaller than high limit
40166	03 06 16	R W W	Running output preset	-100.0 to 100.0 (-1000 to 1000)	50.0 %	
40181 40183 40185 40187	03 06 16	R W W	Running event "EV1" "EV2" "EV3" "EV4"	-1999 to 9999 (-1999 to 9999)	4000 -1999 4000 -1999	• Decimal point position is for each event function. • SV decimal point for PV, DV, and ADV • 1 digit after decimal point for MV and CT • No decimal point for TIMER • READ/WRITE disabled for FAIL

(5) Parameter Group No. 1

FNC code: Applied function code, R/W: R is READ, W is WRITE.

Reference number	FNC code	R/W	Data name	Setting range (Range on communications)	Initial value	Description
40201	03 06 16	R W W	SV for constant values No. 1	SV limit range (SV limit range)	0.0	• Decimal point position is SV decimal point.
40206	03 06 16	R W W	PID No. 1 “P”	0.0 to 999.9 (0 to 9999)	5.0 %	• 0.0 is two-position control.
40207	03 06 16	R W W	PID No. 1 “I”	0 to 9999 (0 to 9999)	60 sec.	• 0=∞
40208	03 06 16	R W W	PID No. 1 “D”	0 to 9999 (0 to 9999)	15 sec.	• 0 = OFF
40209 40210	 03 06 16	 R W W	Output limiter No. 1 “Low limit” “High limit”	-5.0 to 100.0 (-50 to 1000) 0.0 to 105.0 (0 to 1050)	0.0 % 100.0 %	• WRITE enabled when low limit is smaller than high limit
40211 40212	03 06 16	R W W	Output variation limiter “Falling” “Rising”	-100.0 to -0.1 (-1000 to -1) 0.1 to 100.0 (1 to 1000)	-100.0 % 100.0 %	
40213	03 06 16	R W W	Sensor correction	-1999 to 9999 (-1999 to 9999)	0.00	• Decimal point position is SV decimal point + 1 digit (up to 4 digits).
40214 40215	03 06 16	R W W	A.R.W. “Low limit” “High limit”	-100.0 to 0.0 (-1000 to 0) 0.0 to 100.0 (0 to 1000)	-50.0 % 50.0 %	
40216	03 06 16	R W W	Output preset No. 1	-100.0 to 100.0 (-1000 to 1000)	50.0 %	
40231 40233 40235 40237	03 06 16	R W W	Event No. 1 “EV1” “EV2” “EV3” “EV4”	-1999 to 9999 (-1999 to 9999)	4000 -1999 4000 -1999	• Decimal point position is for each event function. • SV decimal point for PV, DV, and ADV • 1 digit after decimal point for MV and CT • No decimal point for TIMER • READ/WRITE disabled for FAIL and status event output
40246	03 06 16	R W W	Remote SV shift	-1999 to 9999 (-1999 to 9999)	0.00	• WRITE enabled on addition of communications • Decimal point position is SV decimal point + 1 digit. (up to 4 digits)

(6) Parameter Group No. 2

FNC code: Applied function code, R/W: R is READ, W is WRITE.

Reference number	FNC code	R/W	Data name	Setting range (Range on communications)	Initial value	Description
40251	03 06 16	R W W	SV for constant values No. 2	SV limit range (SV limit range)	0.0	• Decimal point position is SV decimal point.
40256	03 06 16	R W W	PID No. 2 “P”	0.0 to 999.9 (0 to 9999)	5.0 %	• 0.0 is two-position control.
40257	03 06 16	R W W	PID No. 2 “I”	0 to 9999 (0 to 9999)	60 sec.	• 0=∞
40258	03 06 16	R W W	PID No. 2 “D”	0 to 9999 (0 to 9999)	15 sec.	• 0 = OFF
40259 40260	03 06 16	R W W	Output limiter No. 2 “Low limit” “High limit”	-5.0 to 100.0 (-50 to 1000) 0.0 to 105.0 (0 to 1050)	0.0 % 100.0 %	• WRITE enabled when low limit is smaller than high limit
40266	03 06 16	R W W	Output preset No. 2	-100.0 to 100.0 (-1000 to 1000)	50.0 %	
40281 40283 40285 40287	03 06 16	R W W	Event No. 2 “EV1” “EV2” “EV3” “EV4”	-1999 to 9999 (-1999 to 9999)	4000 -1999 4000 -1999	• Decimal point position is for each event function. • SV decimal point for PV, DV, and ADV • 1 digit after decimal point for MV and CT • No decimal point for TIMER • READ/WRITE disabled for FAIL and status event output

(7) Parameter Group No. 3

FNC code: Applied function code, R/W: R is READ, W is WRITE.

Reference number	FNC code	R/W	Data name	Setting range (Range on communications)	Initial value	Description
40301	03 06 16	R W W	SV for constant values No. 3	SV limit range (SV limit range)	0.0	• Decimal point position is SV decimal point.
40306	03 06 16	R W W	PID No. 3 “P”	0.0 to 999.9 (0 to 9999)	5.0 %	• 0.0 is two-position control.
40307	03 06 16	R W W	PID No. 3 “I”	0 to 9999 (0 to 9999)	60 sec.	• 0 = ∞
40308	03 06 16	R W W	PID No. 3 “D”	0 to 9999 (0 to 9999)	15 sec.	• 0 = OFF
40309 40310	03 06 16	R W W	Output limiter No. 3 “Low limit” “High limit”	-5.0 to 100.0 (-50 to 1000) 0.0 to 105.0 (0 to 1050)	0.0 % 100.0 %	• WRITE enabled when low limit is smaller than high limit
40316	03 06 16	R W W	Output preset No. 3	-100.0 to 100.0 (-1000 to 1000)	50.0 %	
40331 40333 40335 40337	03 06 16	R W W	Event No. 3 “EV1” “EV2” “EV3” “EV4”	1999 to 9999 (-1999 to 9999)	4000 -1999 4000 -1999	• Decimal point position is for each event function. • SV decimal point for PV, DV, and ADV • 1 digit after decimal point for MV and CT • No decimal point for TIMER • READ/WRITE disabled for FAIL and status event output

(8) Parameter Group No. 4

FNC code: Applied function code, R/W: R is READ, W is WRITE.

Reference number	FNC code	R/W	Data name	Setting range (Range on communications)	Initial value	Description
40351	03 06 16	R W W	SV for constant values No. 4	SV limit range (SV limit range)	0.0	• Decimal point position is SV decimal point.
40356	03 06 16	R W W	PID No. 4 “P”	0.0 to 999.9 (0 to 9999)	5.0 %	• 0.0 is two-position control.
40357	03 06 16	R W W	PID No. 4 “I”	0 to 9999 (0 to 9999)	60 sec.	• 0 = ∞
40358	03 06 16	R W W	PID No. 4 “D”	0 to 9999 (0 to 9999)	15 sec.	• 0 = OFF
40359 40360	03 06 16	R W W	Output limiter No. 4 “Low limit” “High limit”	-5.0 to 100.0 (-50 to 1000) 0.0 to 105.0 (0 to 1050)	0.0 % 100.0 %	• WRITE enabled when low limit is smaller than high limit
40366	03 06 16	R W W	Output preset No. 4	-100.0 to 100.0 (-1000 to 1000)	50.0 %	
40381 40383 40385 40387	03 06 16	R W W	Event No. 4 “EV1” “EV2” “EV3” “EV4”	-1999 to 9999 (-1999 to 9999)	4000 -1999 4000 -1999	• Decimal point position is for each event function. • SV decimal point for PV, DV, and ADV • 1 digit after decimal point for MV and CT • No decimal point for TIMER • READ/WRITE disabled for FAIL and status event output

(9) Parameter Group No. 5

FNC code: Applied function code, R/W: R is READ, W is WRITE.

Reference number	FNC code	R/W	Data name	Setting range (Range on communications)	Initial value	Description
40401	03 06 16	R W W	SV for constant values No. 5	SV limit range (SV limit range)	0.0	• Decimal point position is SV decimal point.
40406	03 06 16	R W W	PID No. 5 “P”	0.0 to 999.9 (0 to 9999)	5.0 %	• 0.0 is two-position control.
40407	03 06 16	R W W	PID No. 5 “I”	0 to 9999 (0 to 9999)	60 sec.	• 0 = ∞
40408	03 06 16	R W W	PID No. 5 “D”	0 to 9999 (0 to 9999)	15 sec.	• 0 = OFF
40409 40410	03 06 16	R W W	Output limiter No. 5 “Low limit” “High limit”	-5.0 to 100.0 (-50 to 1000) 0.0 to 105.0 (0 to 1050)	0.0 % 100.0 %	• WRITE enabled when low limit is smaller than high limit
40416	03 06 16	R W W	Output preset No. 5	-100.0 to 100.0 (-1000 to 1000)	50.0 %	
40431 40433 40435 40437	03 06 16	R W W	Event No. 5 “EV1” “EV2” “EV3” “EV4”	-1999 to 9999 (-1999 to 9999)	4000 -1999 4000 -1999	• Decimal point position is for each event function. • SV decimal point for PV, DV, and ADV • 1 digit after decimal point for MV and CT • No decimal point for TIMER • READ/WRITE disabled for FAIL and status event output

(10) Parameter Group No. 6

FNC code: Applied function code, R/W: R is READ, W is WRITE.

Reference number	FNC code	R/W	Data name	Setting range (Range on communications)	Initial value	Description
40451	03 06 16	R W W	SV for constant values No. 6	SV limit range (SV limit range)	0.0	• Decimal point position is SV decimal point.
40456	03 06 16	R W W	PID No. 6 “P”	0.0 to 999.9 (0 to 9999)	5.0 %	• 0.0 is two-position control.
40457	03 06 16	R W W	PID No. 6 “I”	0 to 9999 (0 to 9999)	60 sec.	• 0 = ∞
40458	03 06 16	R W W	PID No. 6 “D”	0 to 9999 (0 to 9999)	15 sec.	• 0 = OFF
40459 40460	03 06 16	R W W	Output limiter No. 6 “Low limit” “High limit”	5.0 to 100.0 (-50 to 1000) 0.0 to 105.0 (0 to 1050)	0.0 % 100.0 %	• WRITE enabled when low limit is smaller than high limit
40466	03 06 16	R W W	Output preset No. 6	-100.0 to 100.0 (-1000 to 1000)	50.0 %	
40481 40483 40485 40487	03 06 16	R W W	Event No. 6 “EV1” “EV2” “EV3” “EV4”	-1999 to 9999 (-1999 to 9999)	4000 -1999 4000 -1999	• Decimal point position is for each event function. • SV decimal point for PV, DV, and ADV • 1 digit after decimal point for MV and CT • No decimal point for TIMER • READ/WRITE disabled for FAIL and status event output

(11) Parameter Group No. 7

FNC code: Applied function code, R/W: R is READ, W is WRITE.

Reference number	FNC code	R/W	Data name	Setting range (Range on communications)	Initial value	Description
40501	03 06 16	R W W	SV for constant values No. 7	SV limit range (SV limit range)	0.0	• Decimal point position is SV decimal point.
40506	03 06 16	R W W	PID No. 7 “P”	0.0 to 999.9 (0 to 9999)	5.0 %	• 0.0 is two-position control.
40507	03 06 16	R W W	PID No. 7 “I”	0 to 9999 (0 to 9999)	60 sec.	• 0 = ∞
40508	03 06 16	R W W	PID No. 7 “D”	0 to 9999 (0 to 9999)	15 sec.	• 0 = OFF
40509 40510	03 06 16	R W W	Output limiter No. 7 “Low limit” “High limit”	-5.0 to 100.0 (-50 to 1000) 0.0 to 105.0 (0 to 1050)	0.0 % 100.0 %	• WRITE enabled when low limit is smaller than high limit
40516	03 06 16	R W W	Output preset No. 7	-100.0 to 100.0 (-1000 to 1000)	50.0 %	
40531 40533 40535 40537	03 06 16	R W W	Event No. 7 “EV1” “EV2” “EV3” “EV4”	-1999 to 9999 (-1999 to 9999)	4000 -1999 4000 -1999	• Decimal point position is for each event function. • SV decimal point for PV, DV, and ADV • 1 digit after decimal point for MV and CT • No decimal point for TIMER • READ/WRITE disabled for FAIL and status event output

(12) Parameter Group No. 8

FNC code: Applied function code, R/W: R is READ, W is WRITE.

Reference number	FNC code	R/W	Data name	Setting range (Range on communications)	Initial value	Description
40551	03 06 16	R W W	SV for constant values No. 8	SV limit range (SV limit range)	0.0	• Decimal point position is SV decimal point.
40556	03 06 16	R W W	PID No. 8 “P”	0.0 to 999.9 (0 to 9999)	5.0 %	• 0.0 is two-position control.
40557	03 06 16	R W W	PID No. 8 “I”	0 to 9999 (0 to 9999)	60 sec.	• 0 = ∞
40558	03 06 16	R W W	PID No. 8 “D”	0 to 9999 (0 to 9999)	15 sec.	• 0 = OFF
40559 40560	03 06 16	R W W	Output limiter No. 8 “Low limit” “High limit”	-5.0 to 100.0 (-50 to 1000) 0.0 to 105.0 (0 to 1050)	0.0 % 100.0 %	• WRITE enabled when low limit is smaller than high limit
40566	03 06 16	R W W	Output preset No. 8	-100.0 to 100.0 (-1000 to 1000)	50.0 %	
40581 40583 40585 40587	03 06 16	R W W	Event No. 8 “EV1” “EV2” “EV3” “EV4”	-1999 to 9999 (-1999 to 9999)	4000 -1999 4000 -1999	• Decimal point position is for each event function. • SV decimal point for PV, DV, and ADV • 1 digit after decimal point for MV and CT • No decimal point for TIMER • READ/WRITE disabled for FAIL and status event output

(13) Setting Parameter

FNC code: Applied function code, R/W: R is READ, W is WRITE.

Reference number	FNC code	R/W	Data name	Setting range (Range on communications)	Initial value	Description
40701 40702	03 06 16	R W W	[Second output] Output variation limiter "Falling" "Rising"	-100.0 to -0.1 (-1000 to -1) 0.1 to 100.0 (1 to 1000)	-100.0 % 100.0 %	• WRITE enabled on addition of Control output 2
40707	03 06 16	R W W	Preset manual	-5.0 to 105.0 (-50 to 1050)	0.0%	• WRITE enabled on addition of External signals input
40708	03 06 16	R W W	[Second output] Preset manual	-5.0 to 105.0 (-50 to 1050)	0.0%	• WRITE enabled on addition of Control output 2 and External signals input

(14) External Input

FNC code: Applied function code, R/W: R is READ, W is WRITE.

Reference number	FNC code	R/W	Data name	Setting range (Range on communications)	Initial value	Description
48015 48016 48017 48018 48019 48024	03 06 16	R W W	External input "DI2" "DI3" "DI4" "DI5" "DI6" "DI1"	0 to 18 (0 to 18)	0 (External input action OFF)	• WRITE enabled on addition of External input 0 = External input action OFF (NON) 1 = Constant value operation RUN (RUN) 2 = Remote SV (RM.LC) 3 = Manual output operation (MN.AT) 4 = Preset output (PRST) 5 = Timer 1 (TIM1) 6 = Timer 2 (TIM2) 7 = Alarm event RESET (E.RST) 8 = Parameter group No. 1 (GRP1) 9 = Parameter group No. 2 (GRP2) 10 = Parameter group No. 4 (GRP4) 11 = Parameter group No. 8 (GRP8) 12 = Program operation (PRGM) 13 = Program operation RUN operation (P.RUN) 14 = Program operation ADVANCE action (P.ADV) 15 = Program operation RESET action (P.RST) 16 = Program pattern No. 1 (PTN1) 17 = Program pattern No. 2 (PTN2) 18 = Program pattern No. 4 (PTN4)

(15) Pattern Information

FNC code: Applied function code, R/W: R is READ, W is WRITE.

Reference number	FNC code	R/W	Data name	Setting range (Range on communications)	Initial value	Description
49003	03 06 16	R W W	Program pattern for reading/writing Pattern No.	1 to 4 (1 to 4)	1 (Pattern No. 1)	• Previous setting for reading/writing of program patterns (Reference 49005 - 49045) 1 = Pattern No. 1 | 4 = Pattern No. 4 • Setting is executed before reading/writing of pattern information. • Written pattern numbers are held until power OFF. • Reading/writing of pattern numbers of this reference is exclusive data for reading/writing of program pattern information on communications. • For reading/writing of pattern numbers during program operation, Reference 49066/30126 are used.
49004	03 06 16	R W W	Program pattern for reading/writing Step No.	0 to 13 (0 to 13)	0 (Starting SV)	• Previous setting for reading/writing of program patterns (Reference 49005 - 49045) 0 = Starting SV 1 = Step No. 1 | 13 = Step No. 12 • Setting is executed before reading/writing of pattern information. • Written pattern numbers are held until power OFF. • Reading/writing of pattern numbers of this reference is exclusive data for reading/writing of program pattern information on communications. • For reading of step numbers during program operation, Reference 30127 is used.
49006	03 06 16	R W W	Program pattern for reading/writing SV	Within SV limit range (Within SV limit range)	0	• Decimal point position is SV decimal point. • Reading/writing is executed after writing of Reference 49003 and 49004. • WRITE disabled from the last step of Reference 49004 or later.
49007	03 06 16	R W W	Program pattern for reading/writing Time “High-order 2 digits”	00 to 99 (0 to 99)	00	• Setting of HH side of Time HH:LL • Reading/writing is executed after writing of Reference 49003 and 49004. • WRITE disabled for the starting SV or the step following the last step (= the last step + 1) or later steps of Reference 49004. • When the step following the last step is written, a step is added to the end of the pattern.

FNC code: Applied function code, R/W: R is READ, W is WRITE.

Reference number	FNC code	R/W	Data name	Setting range (Range on communications)	Initial value	Description
49008	03 06 16	R W W	Program pattern for reading/writing Time “Low-order 2 digits”	00 to 59 (0 to 59)	00	• Setting of LL side of HH:LL • Reading/writing is executed after writing of Reference 49003 and 49004. • WRITE disabled for the starting SV or the step following the last step (= the last step + 1) or later steps of Reference 49004. • When the step following the last step is written, a step is added to the end of the pattern.
49010	03 06 16	R W W	Program pattern for reading/writing Parameter group No.	0 to 8 (0 to 8)	[Step 1] 1 (No. 1) [Step 2 or later] 0 (No. 0)	0 = No. 0 (Previous step No. is continued.) 1 - 8 = No. 1 - 8 • Reading/writing is executed after writing of Reference 49003 and 49004. • WRITE disabled from the last step of Reference 49004 or later.
49040	03 06 16	R W W	Program pattern for reading/writing Number of previous steps Final step No.	0 to 12 (0 to 12)	0 (No steps to be set) (Step 0)	0 No steps to be set | 12 = Number of steps to be set is 12. 0 = Starting SV (Step 0) | 12 = STP 12 (Step 12) • WRITE disabled • Reading/writing is executed after writing of Reference 49003. • Setting for step No. of Reference 49004 is not required.
49041	03 06 16	R W W	Program pattern for reading/writing Starting SV	Within SV limit range (Within SV limit range)	0	• Decimal point position is SV decimal point. • Reading/writing is executed after writing of Reference 49003. • Setting for step No. of Reference 49004 is not required.
49042	03 06 16	R W W	Program pattern for reading/writing With or without PV start	0/1 (0/1)	0 (PV start OFF)	0 = PV start OFF (SV start) 1 = PV start ON (PV start) • Reading/writing is executed after writing of Reference 49003. • Setting for step No. of Reference 49004 is not required.
49043	03 06 16	R W W	Program pattern for reading/writing Destination for pattern connection	0 to 4 (0 to 4)	0 (No connection)	0 = No connection 1 = Connected to Pattern No. 1 | 4 = Connected to Pattern No. 4 • Reading/writing is executed after writing of Reference 49003. • Setting for step No. of Reference 49004 is not required.

FNC code: Applied function code, R/W: R is READ, W is WRITE.

Reference number	FNC code	R/W	Data name	Setting range (Range on communications)	Initial value	Description
49044	03 06 16	R W W	Program pattern for reading/writing Output on program end of Control output 1	0/7FFFh (0/7FFFh)	7FFFh (Control continued)	0h = Output 0.0 % 7FFFh = Control continued (CONTROL) • Reading/writing is executed after writing of Reference 49003. • Setting for step No. of Reference 49004 is not required.
49045	03 06 16	R W W	[Second output] Program pattern for reading/writing Output on program end of Control output 2	0/7FFFh (0/7FFFh)	7FFFh (Control continued)	• WRITE enabled on addition of Control output 2 0h = Output 0.0 % 7FFFh = Control continued (CONTROL) • Reading/writing is executed after writing of Reference 49003. • Setting for step No. of Reference 49004 is not required.
49048	03 06 16	R W W	(Program unit of time)	0/1 (0/1)	0 (Hour:Minute)	0 = Hour:Minute (H:M) 1 = Minute:Second (M:S) • WRITE enabled during RESET of program operation
49049	03 06 16	R W W	SV on reset	Within SV limit range (Within SV limit range)	0	• WRITE enabled on addition of transmission signal output, addition of communications, and when communication function is TRANS.
49055	03 06 16	R W W	Pattern repeat	0 to 9999 (0 to 9999)	0	
49056	03 06 16	R W W	Running SV	Within SV limit range (Within SV limit range)	0.0	• Decimal point position is SV decimal point.
49057	03 06 16	R W W	Running time “High-order 2 digits”	00 to 99 (0 to 99)	00	• Setting of HH side of HH:LL • Unit = Every time unit
49058	03 06 16	R W W	Running time “Low-order 2 digits”	00 to 59 (0 to 59)	00	• Setting of LL side of HH:LL • Unit = Every time unit
49066	03 06 16	R W W	Pattern No. selection	1 to 4 (1 to 4)	1 (Pattern No. 1)	• Reading/writing of pattern No. which executes program operation 1 = Pattern No. 1 | 4 = Pattern No. 4 • WRITE enabled during RESET of program drive (Reference 49067) and also program operation (Reference 49521) is ON

FNC code: Applied function code, R/W: R is READ, W is WRITE.

Reference number	FNC code	R/W	Data name	Setting range (Range on communications)	Initial value	Description
49067	03 06 16	R W W	Program drive	[READ] 1/2/4/5 (1/2/4/5) [WRITE] 1/2/4/6 (1/2/4/6)	1 (RESET)	[READ] (FNC_03) 1 = Program RESET (RESET) 2 = Program RUN (RUN) 4 = Program STOP (STOP) 5 = Program END (END) [WRITE] (FNC_06, FNC_16)) 1 = Program RESET (RESET) 2 = Program RUN (RUN) 4 = Program STOP (STOP) 6 = Program stepping ADVANCE • WRITE enabled when program operation (Reference 49521) is ON. * WRITE disabled for ADV and STOP during RESET of program operation. * WRITE disabled for RUN, STOP, and ADV during END of program operation.
49094	03 06 16	R W W	Pattern clear	[READ] 0/1/2/3/4/5 (0/1/2/3/4/5) [WRITE] 0 to 4 (0 to 4)	–	[READ] (FNC_03) 0 = Unexecuted (OFF) 4 = Initialization of specified patterns 5 = Initialization of all patterns [WRITE] (FNC_06, FNC_16)) 0 = Initialization of all patterns (ALL) 1 = Initialization of pattern No. 1 (PTN1) | 4 = Initialization of pattern No. 4 (PTN4) • WRITE enabled during RESET of program operation * **Note: <u>If "0" is written, all pattern information is initialized.</u>**
49501	03 06 16	R W W	Key lock	0/1 (0/1)	0 (Key lock OFF)	0 = Key lock OFF 1 = Key lock ON
49502	03 06 16	R W W	Auto tuning	0/1/2 (0/1/2)	0 (AT end)	0 = AT end, AT for writing stop (END) 1 = AT at the first output side (STRT) 2 = AT at the second output side (STR.2) • WRITE enabled during END of auto tuning • WRITE disabled during RESET of program operation (Reference 49067) • WRITE enabled on addition of Control output 2 for AT2 • Writing of 0 (END) allows auto tuning stop.
49503	03 06 16	R W W	AUTO/MAN output switching	0/1 (0/1)	0 (AUTO)	0 = Automatic output operation (AUTO) 1 = Manual output operation (MAN)
49504	03 06 16	R W W	First output side Manual output value	-5.0 to 105.0 % (-50 to 1050)	–	• WRITE enabled when AUTO/MAN output switching (Reference 49505) is in manual output operation.

FNC code: Applied function code, R/W: R is READ, W is WRITE.

Reference number	FNC code	R/W	Data name	Setting range (Range on communications)	Initial value	Description
49506	03 06 16	R W W	[Second output] Second output side Manual output value	-5.0 to 105.0% (-50 to 1050)	–	• WRITE enabled on addition of Control output 2 • WRITE enabled when AUTO/MAN output switching (Reference 49505) is in manual output operation.
49510	03 06 16	R W W	RUN/READY switching	0/1 (0/1)	0 (RUN)	0=RUN 1=READY
49511	03 06 16	R W W	Parameter group No. select	1 to 8 (1 to 8)	1 (No.1)	1=No.1 | 8=No.8
49512	03 06 16	R W W	Remote SV	-1999 to 9999	–	• For writing, decimal point position is remote SV decimal point. • For reading, decimal point position is SV decimal point.
49521	03 06 16	R W W	Program operation	0/1 (0/1)	1 (Program operation OFF)	0 = Program operation ON 1 = Program operation OFF
49534	03 06 16	R W W	Operation screen Time display method	0/1 (0/1)	0 (Step elapsed time display)	0 = Step elapsed time display (PASS) 1 = Step remained time display (RMAI)
49589	03 06 16	R W W	Parameter memory	0/1 (0/1)	0 (EEP-ROM/ RAM)	0 = EEP-ROM/RAM 1 = RAM

5-7-2. Analog Input Data

FNC code: Applied function code, R/W: R is READ, W is WRITE.

Reference number	FNC code	R/W	Data name	Description
30101	04	R	PV	• Decimal point position is PV decimal point. 7FFFh = Excessively large input or burnout 8000h = Excessively small input
30102	04	R	PV status	0 = Normal 1 = Excessively large input or burnout .... " ¯ ¯ ¯ ¯" displayed 2 = Excessively small input ..... " _ _ _ _" displayed
30103	04	R	SV	• Decimal point position is SV decimal point.
30104	04	R	SV status	0 = Local SV 1 = Remote SV 2 = SV slope operation running
30105	04	R	MV1	• Control output value at the first output side -50 - 1050 = -5.0 to 105.0 %
30106	04	R	MV1 status	0 = Automatic output operation 1 = Manual output operation 2 = Auto tuning ongoing 3 = Output on program end 4 = PV abnormal output 6 = Program operation RESET
30107	04	R	[Second output] MV2	• READ enabled on addition of Control output 2 • Control output value at the second output side -50 - 1050 = -5.0 to 105.0 %
30108	04	R	[Second output] MV2 status	• READ enabled on addition of Control output 2 0 = Automatic output operation 1 = Manual output operation 2 = Auto tuning ongoing 3 = Output on program end 4 = PV abnormal output 6 = Program operation RESET
30109	04	R	Running SV	• Decimal point position is SV decimal point.
30110 30111 30112 30113	04	R	Running "EV1" Running "EV2" Running "EV3" Running "EV4"	• Decimal point position is for each event function. • SV decimal point for PV, DV, and ADV • 1 digit after decimal point for MV and CT • No decimal point for TIMER • READ disabled for FAIL and status output
30114 30115 30116	04	R	Running PID "P" Running PID "I" Running PID "D"	P: 0 - 9999 = 0.0 to 999.9 % I: 0 - 9999 = 0 to 9999 sec. D: 0 - 9999 = 0 to 9999 sec.
30117 30118	04	R	Running output limiter "Low limit" "High limit"	-50 - 1050 = -5.0 to 105.0 %
30124	04	R	Running parameter group No.	1 - 8 = No.1 - No.8
30126	04	R	Running pattern No.	1 - 4 = No.1 - No.4
30127	04	R	Running step No.	0 - 12 = No.0(Starting SV) - No.12
30128	04	R	Running step time "High-order 2 digits"	• Reading of HH side of HH:LL 0 - 99 = 00 - 99
30129	04	R	Running step time "Low-order 2 digits"	• Reading of LL side of HH:LL 0 - 59 = 00 - 59
30130	04	R	Running Operation screen time display method	0 = Step elapsed time display 1 = Step remained time display
30131	04	R	Running program unit of time	0 = Hour:Minute (H:M) 1 = Minute:Second (M:S)

FNC code: Applied function code, R/W: R is READ, W is WRITE.

<table>
<tr><th>Reference number</th><th>FNC code</th><th>R/W</th><th>Data name</th><th>Description</th></tr>
<tr><td>30133</td><td>04</td><td>R</td><td>CT measured value</td><td>• READ enabled on addition of heater disconnection alarm
0 - 500 = 0.0A to 50.0A
FFFFh = No measured value (measured value not obtained)
FFFEh = Measured value obtained (Waiting for measured value to be displayed on operation screen)</td></tr>
<tr><td>30141</td><td>04</td><td>R</td><td>Key lock</td><td>0 = Key lock OFF
1 = Key lock ON</td></tr>
<tr><td>30142</td><td>04</td><td>R</td><td>Event status</td><td>0h = Event OFF
1h = Event ON
2h = Alarm event reset (RESET) ongoing or standby (WAIT) ongoing
• 16bit data: bit 0 - 1 = EV1
bit 2 - 3 = EV2
bit 4 - 5 = EV3
bit 6 - 7 = EV4
bit 8 - 9 = EV5
bit 10 - 11 = EV6
bit 12 to 13= EV7
<table>
<tr><th colspan="2">–</th><th colspan="2">EV7</th><th colspan="2">EV6</th><th colspan="2">EV5</th><th colspan="2">EV4</th><th colspan="2">EV3</th><th colspan="2">EV2</th><th colspan="2">EV1</th></tr>
<tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td colspan="14"></td><td colspan="2"></td></tr>
<tr><td colspan="14">Event OFF (0h) .....</td><td>0</td><td>0</td></tr>
<tr><td colspan="14">Event ON (1h) .....</td><td>0</td><td>1</td></tr>
<tr><td colspan="14">Alarm event reset ongoing or standby ongoing (2h) .....</td><td>1</td><td>0</td></tr>
</table></td></tr>
<tr><td>30143</td><td>04</td><td>R</td><td>FAIL signal</td><td>0 = OFF (No abnormality)
1 = ON (Abnormality occurred)</td></tr>
</table>

5-7-3. Digital Setting Values

FNC code: Applied function code, R/W: R is READ, W is WRITE.

Reference number	FNC code	R/W	Data name	Setting range (Range on communications)	Initial value	Description
101	01 05 15	R W W	Auto tuning 1	0/1 [0000h/FF00h] (END/START) Inside of [ ] is for FNC code 05.	0 (AT end)	0 = AT end or unexecuted 1 = AT start or running • WRITE enabled during END of auto tuning • WRITE disabled during RESET of program operation (Reference 49067) • Writing of 0 allows auto tuning stop.

5-7-4. Digital Input Data

FNC code: Applied function code, R/W: R is READ, W is WRITE.

Reference number	FNC code	R/W	Data name	Description
10002	02	R	System error	0 = OFF (Normal) 1 = ON (Abnormal) • Judge input load abnormality (A/D error occurred), calibration data abnormality, etc.

5-8. Setting Example for MODBUS RTU

As reference, the reading procedure for SV, time, and parameter group number of Step No. 1 of Pattern No. 1 is explained.

(1) Set Pattern No. 1 and Step No. 1 to be read (command example = 0110232A000804000100016C53).

High-order instrument → Controller	Command	Description
Instrument number	01H	Set the instrument number (slave address).
Function code	10H	Set the function code 16 (= 10H) for multiple analog setting values writing.
Starting number (H)	23H	Specify the starting number (top number) of the reference for consecutive writings.
Starting number (L)	2AH	(Set the reference number 49003 (=49003-40001=9002=232AH).)
Number of items (H)	00H	(Set two items (=02H), the number of items for the reference number 49003
Number of items (L)	08H	(Pattern No.) - 49010 (Step No.).
Number of data items	04H	4 bytes (04H) = 2 items x 2 bytes data
Pattern No. (H)	00H	[Reference number 49003] Set the pattern number for writing.
Pattern No. (L)	01H	Set 01 (0001H) to write to Pattern 1.
Step No. (H)	00H	[Reference number 49004] Set the step number for writing.
Step No. (L)	01H	Set 01 (0001H) to write to Step 1.
CRC (L)	6CH	Setting of error check code.
CRC (H)	53H	For MODBUS_RTU protocol, set the error check value of CRC-16.

(2) Specify reading of SV, time, and parameter group number to be read (command example =0103232D00051E44).

High-order instrument → Controller	Command	Description
Instrument number	01H	Set the instrument number (slave address).
Function code	03H	Set the function code 03 (=03H) for reading of analog setting values.
Starting number (H)	23H	Specify the starting number (top number) of the reference for consecutive writings.
Starting number (L)	2DH	(Set the reference number 49006 (=49006-40001=9005=232DH).)
Number of items (H)	00H	(Set five items (=05H), the number of items for the reference number 49006 (SV) -
Number of items (L)	05H	49010 (PID No.).
CRC (L)	1EH	Setting of error check code.
CRC (H)	44H	For MODBUS_RTU protocol, set the error check value of CRC-16.

(3) Acquire SV111.1, time 22:33 (H:M), parameter group NO. 4 to be read.
(command response example = 01030A045700160021000000047555)

Controller → High-order instrument	Command	Description
Instrument number	01H	Set the instrument number (slave address).
Function code	03H	Set the function code 03 (= 03H) for reading of analog setting values.
Number of data items	0AH	10 bytes (0AH) = 5 items × 2 bytes data
SV (H)	04H	[Reference number 49006] Acquire SV.
SV (L)	57H	0457H → (Decimal number) → 1111 → (SV decimal point 1) → 111.1
Time, hour or minute (H)	00H	[Reference number 49007] Acquire high-order (HH:) of time.
Time, hour or minute (L)	16H	0016H → (Decimal number) → 22
Time, minute or second (H)	00H	[Reference number 49008] Acquire low-order (:LL) of time.
Time, minute or second (L)	21H	0021H → (Decimal number) → 33
[Not Use]	00H	[Reference number 49009] Unused reference number.
[Not Use]	00H	Discard the stored data because it is undefined data.
Parameter group No. (H)	00H	[Reference number 49010] Acquire parameter group No..
Parameter group No. (L)	04H	04H → (Decimal number) → 4
CRC (L)	75H	Setting of error check code.
CRC (H)	55H	For MODBUS_RTU protocol, set the error check value of CRC-16.

5-9. When Communications Are Disabled

Execute the loop back test to check that communications can be performed normally. If not, check the following items.

Item	Description
(1) Wiring check	• Check that wiring between “SAs”, “SBs”, or “SGs” is correct. • If a line converter is used, check that wiring between the line converter and CP350/CP370 is correct.
(2) High-order instrument check	• Check that setting of the communications port of the high-order instrument is correct.
(3) Line converter	• Check that setting of the line converter is correct.
(4) CP350/CP370	• Check the setting of CP350/CP370. Communications protocol: Conform to the high-order instrument. Communications function: Select “High-order instrument”. Communications instrument number: Between “01” to “99”, no overlapping Communications transmission speed: Conform to the high-order instrument and line converter. Communications character: Conform to the high-order instrument.
(5) Use environment check	• For long communications cables, check that they are not affected by noise. • “SG” of communications cables must not be grounded.

5-10. Reference Table

Analog setting value							
Setup parameter 1		Setup parameter 2		Class 1 parameter		Running parameter and unique parameter	
No.	Parameter	No.	Parameter	No.	Parameter	No.	Parameter
40001	Input type	40051	Transmission type	40101	Two output gap	40151	Running SV (Read only)
40002		40052	Transmission scale: Low limit	40102	Second PID: P	40152	
40003		40053	Transmission scale: High limit	40103	Second PID: I	40153	
40004	Measurement range: Low limit	40054		40104	Second PID: D	40154	
40005	Measurement range: High limit	40055		40105	Second output limiter: Low limit	40155	
40006	Linear scale: Low limit	40056		40106	Second output limiter: High limit	40156	Running PID: P
40007	Linear scale: High limit	40057		40107		40157	Running PID: I
40008	SV/Linear scale: Decimal point	40058		40108		40158	Running PID: D
40009	SV limiter: Low limit	40059		40109		40159	Running output limiter: Low limit
40010	SV limiter: High limit	40060		40110		40160	Running output limiter: High limit
40011		40061		40111		40161	
40012	PV filter	40062		40112		40162	
40013		40063		40113	PV abnormal output	40163	
40014	SV filter	40064		40114		40164	
40015		40065		40115		40165	
40016		40066		40116	SV slope: Falling	40166	Running output preset
40017		40067		40117	SV slope: Rising	40167	
40018		40068		40118		40168	
40019		40069		40119	PV start for constant value operation	40169	
40020	Remote SV decimal point	40070		40120		40170	
40021	Control action	40071		40121	SPLIT: DIRECT	40171	
40022	Pulse cycle	40072		40122	SPLIT: REVERSE	40172	
40023		40073		40123	Second PID deadband	40173	
40024		40074		40124	PID deadband	40174	
40025		40075		40125		40175	
40026	Second control action	40076		40126		40176	
40027	Second pulse cycle	40077		40127		40177	
40028	Two output control method	40078		40128		40178	
40029		40079	Communications transmission type	40129		40179	
40030	Alarm event RESET	40080		40130		40180	
40031	EV1: Event function	40081		40131		40181	EV1: Event
40032	EV1: Event deadband	40082		40132		40182	
40033	EV1: Event output phase	40083		40133		40183	EV2: Event
40034		40084		40134		40184	
40035		40085	EV5: Event function	40135		40185	EV3: Event
40036	EV2: Event function	40086	EV6: Event function	40136		40186	
40037	EV2: Event deadband	40087	EV7: Event function	40137		40187	EV4: Event
40038	EV2: Event output phase	40088		40138		40188	
40039		40089		40139		40189	
40040		40090		40140		40190	
40041	EV3: Event function	40091		40141	Operation initial screen	40191	
40042	EV3: Event deadband	40092	Power recovery action	40142	Operation screen SV display	40192	
40043	EV3: Event output phase	40093	Event action on READY	40143	Remote/local switching	40193	
40044		40094		40144		40194	
40045		40095	EV5: Event output phase	40145		40195	
40046	EV4: Event function	40096	EV6: Event output phase	40146		40196	
40047	EV4: Event deadband	40097	EV7: Event output phase	40147		40197	
40048	EV4: Event output phase	40098		40148	Control algorithm	40198	
40049		40099		40149	Auto tuning method	40199	
40050		40100		40150		40200	

Analog setting value							
Parameter group No. 1		Parameter group No. 2		Parameter group No. 3		Parameter group No. 4	
No.	Parameter	No.	Parameter	No.	Parameter	No.	Parameter
40201	SV for constant value	40251	SV for constant value	40301	SV for constant value	40351	SV for constant value
40202		40252		40302		40352	
40203		40253		40303		40353	
40204		40254		40304		40354	
40205		40255		40305		40355	
40206	PID: P	40256	PID: P	40306	PID: P	40356	PID: P
40207	PID: I	40257	PID: I	40307	PID: I	40357	PID: I
40208	PID: D	40258	PID: D	40308	PID: D	40358	PID: D
40209	Output limiter: Low limit	40259	Output limiter: Low limit	40309	Output limiter: Low limit	40359	Output limiter: Low limit
40210	Output limiter: High limit	40260	Output limiter: High limit	40310	Output limiter: High limit	40360	Output limiter: High limit
40211	Output variation limiter: Falling	40261		40311		40361	
40212	Output variation limiter: Rising	40262		40312		40362	
40213	Sensor correction	40263		40313		40363	
40214	A.R.W.: Low limit	40264		40314		40364	
40215	A.R.W.: High limit	40265		40315		40365	
40216	Output preset	40266	Output preset	40316	Output preset	40366	Output preset
40217		40267		40317		40367	
40218		40268		40318		40368	
40219		40269		40319		40369	
40220		40270		40320		40370	
40221		40271		40321		40371	
40222		40272		40322		40372	
40223		40273		40323		40373	
40224		40274		40324		40374	
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	EV1: Event	40281	EV1: Event	40331	EV1: Event	40381	EV1: Event
40232		40282		40332		40382	
40233	EV2: Event	40283	EV2: Event	40333	EV2: Event	40383	EV2: Event
40234		40284		40334		40384	
40235	EV3: Event	40285	EV3: Event	40335	EV3: Event	40385	EV3: Event
40236		40286		40336		40386	
40237	EV4: Event	40287	EV4: Event	40337	EV4: Event	40387	EV4: Event
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	Remote SV shift	40296		40346		40396	
40247		40297		40347		40397	
40248		40298		40348		40398	
40249		40299		40349		40399	
40250		40300		40350		40400	

Analog setting value							
Parameter group No. 5		Parameter group No. 6		Parameter group No. 7		Parameter group No. 8	
No.	Parameter	No.	Parameter	No.	Parameter	No.	Parameter
40401	SV for constant value	40451	SV for constant value	40501	SV for constant value	40551	SV for constant value
40402		40452		40502		40552	
40403		40453		40503		40553	
40404		40454		40504		40554	
40405		40455		40505		40555	
40406	PID: P	40456	PID: P	40506	PID: P	40556	PID: P
40407	PID: I	40457	PID: I	40507	PID: I	40557	PID: I
40408	PID: D	40458	PID: D	40508	PID: D	40558	PID: D
40409	Output limiter: Low limit	40459	Output limiter: Low limit	40509	Output limiter: Low limit	40559	Output limiter: Low limit
40410	Output limiter: High limit	40460	Output limiter: High limit	40510	Output limiter: High limit	40560	Output limiter: High limit
40411		40461		40511		40561	
40412		40462		40512		40562	
40413		40463		40513		40563	
40414		40464		40514		40564	
40415		40465		40515		40565	
40416	Output preset	40466	Output preset	40516	Output preset	40566	Output preset
40417		40467		40517		40567	
40418		40468		40518		40568	
40419		40469		40519		40569	
40420		40470		40520		40570	
40421		40471		40521		40571	
40422		40472		40522		40572	
40423		40473		40523		40573	
40424		40474		40524		40574	
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	EV1: Event	40481	EV1: Event	40531	EV1: Event	40581	EV1: Event
40432		40482		40532		40582	
40433	EV2: Event	40483	EV2: Event	40533	EV2: Event	40583	EV2: Event
40434		40484		40534		40584	
40435	EV3: Event	40485	EV3: Event	40535	EV3: Event	40585	EV3: Event
40436		40486		40536		40586	
40437	EV4: Event	40487	EV4: Event	40537	EV4: Event	40587	EV4: Event
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							
Setting parameter		External input		Program patterns information		Program patterns information	
No.	Parameter	No.	Parameter	No.	Parameter	No.	Parameter
40701	Second output variation limiter: Falling	48001		49001		49051	
40702	Second output variation limiter: Rising	48002		49002		49052	
40703		48003		49003	No. of pattern for reading/writing	49053	
40704		48004		49004	No. of step for reading/writing	49054	
40705		48005		49005		49055	Pattern repeat
40706		48006		49006	SV	49056	Running SV
40707	Preset output	48007		49007	Time: High-order 2 digits	49057	Running time: High-order 2 digits
40708	Second preset output	48008		49008	Time: Low-order 2 digits	49058	Running time: Low-order 2 digits
40709		48009		49009		49059	
40710		48010		49010	Parameter group No.	49060	
40711		48011		49011		49061	
40712		48012		49012		49062	
40713		48013		49013		49063	
40714		48014		49014		49064	
40715		48015	DI2	49015		49065	
40716		48016	DI3	49016		49066	Pattern No. selection
40717		48017	DI4	49017		49067	Program drive
40718		48018	DI5	49018		49068	
40719		48019	DI6	49019		49069	
40720		48020		49020		49070	
40721		48021		49021		49071	
40722		48022		49022		49072	
40723		48023		49023		49073	
40724		48024	DI1	49024		49074	
40725		48025		49025		49075	
40726		48026		49026		49076	
40727		48027		49027		49077	
40728		48028		49028		49078	
40729		48029		49029		49079	
40730		48030		49030		49080	
40731		48031		49031		49081	
40732		48032		49032		49082	
40733		48033		49033		49083	
40734		48034		49034		49084	
40735		48035		49035		49085	
40736		48036		49036		49086	
40737		48037		49037		49087	
40738		48038		49038		49088	
40739		48039		49039		49089	
40740		48040		49040	Number of steps	49090	
40741		48041		49041	Starting SV	49091	
40742		48042		49042	PV start	49092	
40743		48043		49043	Connection pattern destination	49093	
40744		48044		49044	Output on program end	49094	Pattern clear
40745		48045		49045	Output on second program end	49095	
40746		48046		49046		49096	
40747		48047		49047		49097	
40748		48048		49048	Program unit of time	49098	
40749		48049		49049	SV on RESET	49099	
40750		48050		49050		49100	

Analog setting value				Analog input data	
Program pattern information		Program pattern information		Running data	
No.	Parameter	No.	Parameter	No.	Parameter
49501	Key lock	49551		30101	PV
49502	Auto tuning	49552		30102	PV status
49503	AUTO/MAN output switching	49553		30103	SV
49504	Manual output value	49554		30104	SV status
49505		49555		30105	MV1
49506	Second manual output value	49556		30106	MV1 status
49507		49557		30107	MV2
49508		49558		30108	MV2 status
49509		49559		30109	Running SV
49510	RUN/READY switching	49560		30110	Running “EV1”
49511	Parameter group No. select	49561		30111	Running “EV2”
49512	Remote SV	49562		30112	Running “EV3”
49513		49563		30113	Running “EV4”
49514		49564		30114	Running PID “P”
49515		49565		30115	Running PID “I”
49516		49566		30116	Running PID “D”
49517		49567		30117	Running output limiter: Low limit
49518		49568		30118	Running output limiter: High limit
49519		49569		30119	
49520		49570		30120	
49521	Program operation	49571		30121	
49522		49572		30122	
49523		49573		30123	
49524		49574		30124	Running parameter group No.
49525		49575		30125	
49526		49576		30126	Running pattern No.
49527		49577		30127	Running step No.
49528		49578		30128	Running step time: High-order 2 digits
49529		49579		30129	Running step time: Low-order 2 digits
49530		49580		30130	Running time display method
49531		49581		30131	Running program unit of time
49532		49582		30132	
49533		49583		30133	CT measured value
49534	Time display method	49584		30134	
49535		49585		30135	
49536		49586		30136	
49537		49587		30137	
49538		49588		30138	
49539		49589	Parameter memory	30139	
49540		49590		30140	
49541		49591		30141	Key lock
49542		49592		30142	Event status
49543		49593		30143	FAIL signal
49544		49594		30144	
49545		49595		30145	
49546		49596		30146	
49547		49597		30147	
49548		49598		30148	
49549		49599		30149	
49550		49600		30150	

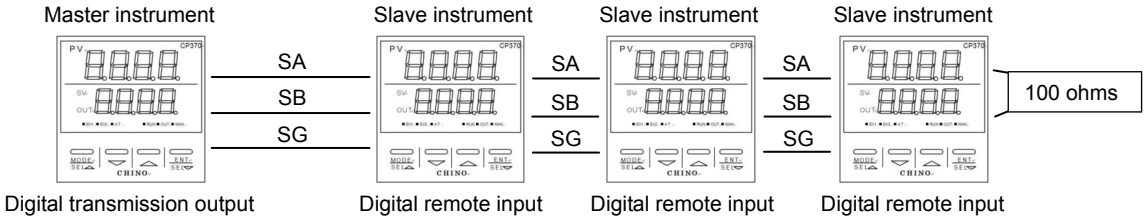
Digital setting value		Digital input data	
Tuning		System status	
No.	Parameter	No.	Parameter
101	Auto tuning 1	10001	
102		10002	System error
103		10003	
104		10004	
105		10005	
106		10006	
107		10007	
108		10008	
109		10009	
110		10010	
111		10011	
112		10012	
113		10013	
114		10014	
115		10015	
116		10016	
117		10017	
118		10018	
119		10019	
120		10020	
121		10021	
122		10022	
123		10023	
124		10024	
125		10025	
126		10026	
127		10027	
128		10028	
129		10029	
130		10030	
131		10031	
132		10032	
133		10033	
134		10034	
135		10035	
136		10036	
137		10037	
138		10038	
139		10039	
140		10040	
141		10041	
142		10042	
143		10043	
144		10044	
145		10045	
146		10046	
147		10047	
148		10048	
149		10049	
150		10050	

6. Digital Transmission Output and Digital Remote Input

6-1. Overview

CHINO's controllers can communicate with CHINO's other controllers with the use of digital transmission output and digital remote input functions as well as communications with high-order instruments.
For example, if you wish to operate multiple controllers under the same SV conditions, SV can be transmitted from a controller with digital transmission output setting as a master instrument, to a controller with digital remote input setting as a slave instrument through communications.

SVs of slave instruments follow according to SV of a master instrument as follows:



Therefore, if you use this function, you can realize zone control for multiple units at relatively low price.

6-2. Protocol Difference and Transmission Data

<table>
<tr><th>Protocol</th><th>Description</th></tr>
<tr><td>MODBUS</td><td>
• MODBUS protocol
• A master instrument transmissions "RUN/READY status", "Parameter group No.", and "Remote SV (no decimal point information)", and a slave instrument receives them.
<table>
<tr><th>Master instrument</th><th>Slave instrument</th></tr>
<tr><td>Transmission of RUN, READY, and RESET statuses</td><td>Reception as RUN and READY statuses</td></tr>
<tr><td>Transmission of parameter group No.</td><td>Reception a parameter group No.</td></tr>
<tr><td>Transmission of data selected with communications transmission type</td><td>Reception as Remote SV</td></tr>
</table>
</td></tr>
<tr><td>PRIVATE</td><td>
• PRIVATE protocol
• A master instrument transmissions "Remote SV (with decimal point information)", and a slave instrument receives it.
<table>
<tr><th>Master instrument</th><th>Slave instrument</th></tr>
<tr><td>Transmission of data selected with communications transmission type</td><td>Reception as Remote SV</td></tr>
</table>
</td></tr>
</table>

6-3. Communications Specifications

- Communications method : Asynchronous method
- Communications speed : 9600, 19200, 38400 bps selectable
- Start bit : 1bit
- Data length : 7bit (ASCII/PRIVATE), 8bit (RTU/ASCII)
- Parity bit : None (ASCII/PRIVATE), even (RTU/ASCII/PRIVATE), odd (RTU/ASCII)
- Stop bit : 1bit (RTU/ASCII/PRIVATE), 2bit (RTU/ASCII)
- Transmission code : ASCII(ASCII/PRIVATE), binary (RTU)
- Error check : Checksum (PRIVATE), CRC-16(RTU), LRC(ASCII)
- Used signal : Transmitted data, received data

6-4. Setting

After wiring of specified terminals, set a master instrument and slave instrument.
For digital transmission output and digital remote input, instruments operate with arbitrary instrument numbers (slave addresses).

6-4-1. Master Instrument Setting Example

Item	Description
(1) Communications protocol	• Select “MODBUS RTU” (can be “MODBUS ASCII” or “PRIVATE”). * Conform to the slave instrument.
(2) Communications function	• Select “Digital transmission output”.
(3) Communications transmission speed	• Select “9600” (can be “19200” or “38400”). * Conform to the slave instrument.
(4) Communications character	• Set “8n1” (can be other setting values conforming to communications protocol). * Conform to the slave instrument.
(5) Communications transmission type	• Select “SV”.

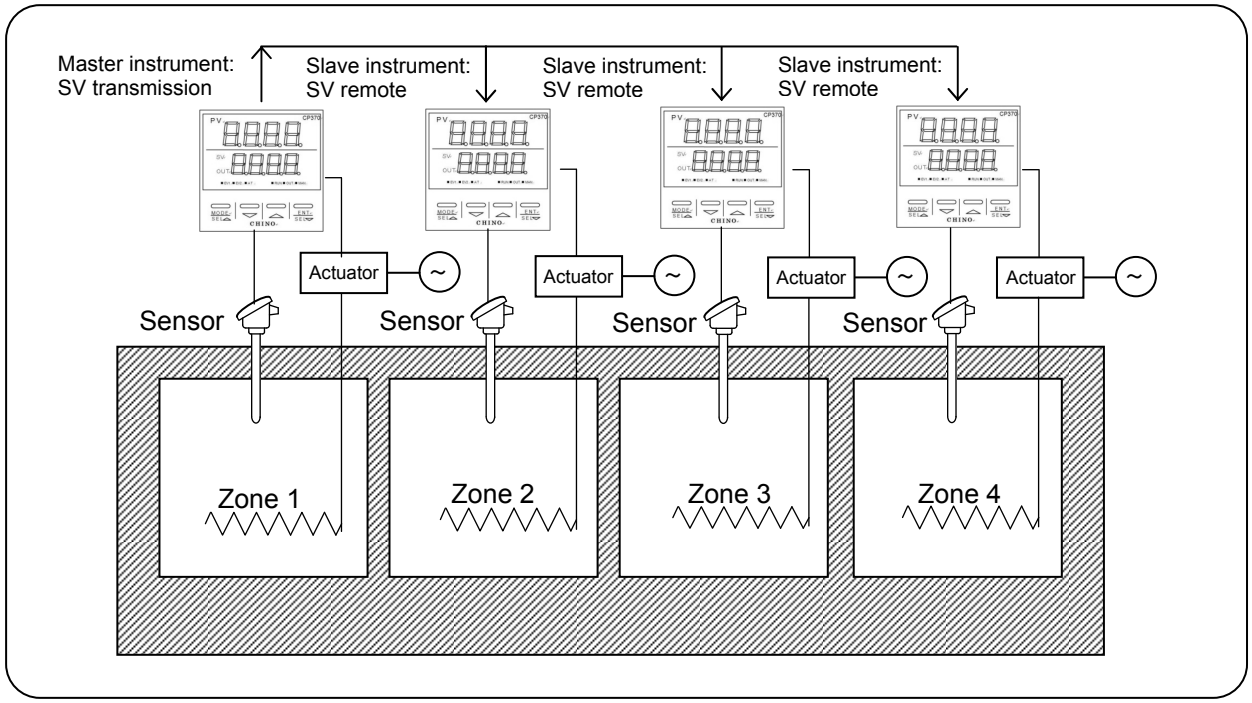
6-4-2. Slave Instrument Setting Example

Item	Description
(1) Communications protocol	• Select “MODBUS RTU” (can be “MODBUS ASCII” or “PRIVATE”). * Conform to the master instrument.
(2) Communications function	• Select “digital remote input”.
(3) Communications transmission speed	• Select “9600” (can be “19200” or “38400”). * Conform to the master instrument.
(4) Communications character	• Set “8n1” (can be other setting values conforming to communications protocol). * Conform to the master instrument.
(5) Remote/local switching	• Select “Remote SV”. * If “Local SV” is selected, local SV operation is executed with SV of selected parameter group number, and if “Remote SV” is selected, Remote SV operation is executed with Remote SV. * Turning the signal ON with allocation of “Remote SV” with external input also allows switching to Remote SV.
(6) Remote SV decimal point	• Set a decimal point which corresponds to SV of the master instrument if needed. * Set SV decimal point position of the slave instrument which meets SV decimal point position of the master instrument. At the master instrument, Remote SV decimal point can be set to meet one of the slave instrument.

6-5. Application Example

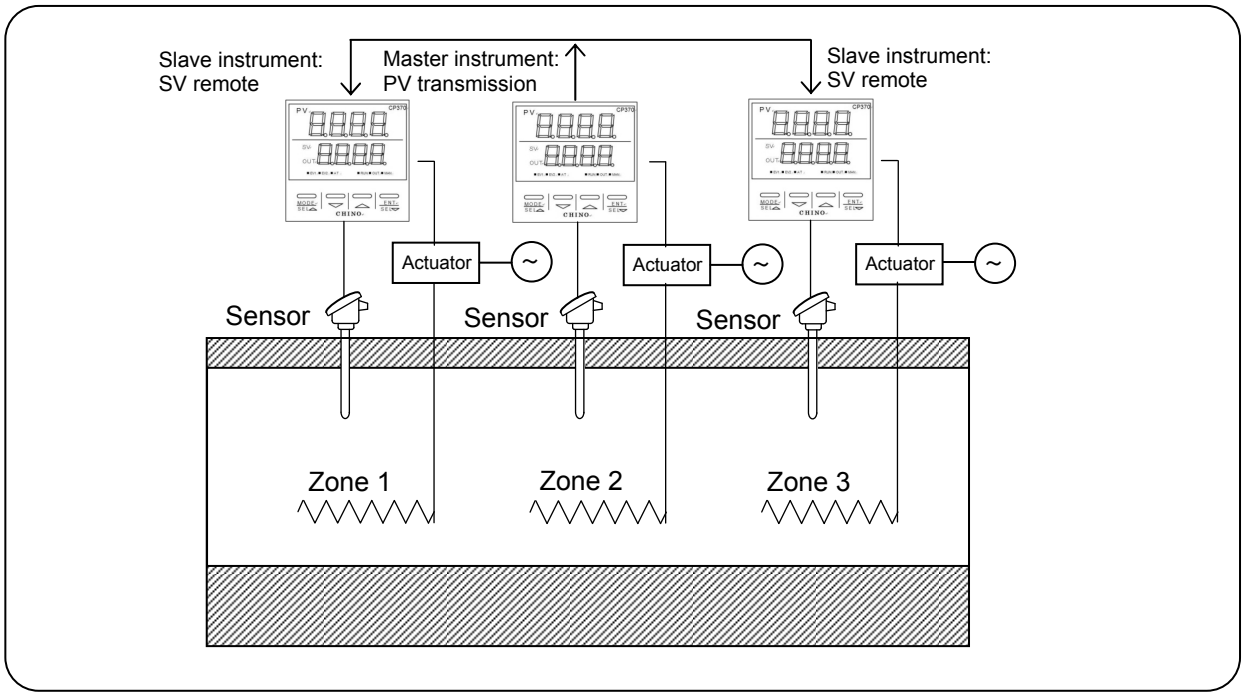
6-5-1. Temperature Control in Multizone

The master instrument transmits SV with communications transmission, and the slave instrument receives SV with communications remote.
No error of analog part allows sensitive remote control. In addition, if Remote SV shift is used, temperature slope is generated in multizone.



6-5-2. Zone Control in Burning Furnace

Control is executed with the central master instrument which transmits PV with communications transmission, and the slave instruments of both ends which receive PV as SV with communications remote. With this method, control with good soaking property can be realized.



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