User's Manual

IR200/IR400 Infrared Gas Analyzer
Communication Functions (MODBUS)

IM 11G02P01-01E

YOKOGAWA
Yokogawa Electric Corporation

IM 11G02P01-01E
1st Edition

Introduction

This manual describes the communication function of model IR200 or IR400 Infrared Gas Analyzer.

Read this manual and understand Modbus communication specification before using this function.

Regarding main analyzer, refer IMs below.

For model IR200; IM 11G02M01-01E

For model IR400; IM 11G02N01-01E

IM No. IM 11G02P01-01E
1st Edition: Sept. 2002(YK)

Notices

■ Regarding This Manual

- This manual should be passed on to the end user.
- Read this manual carefully and fully understand how to operate this product before you start operation.
- This manual is intended to explain the functions of this product. Yokogawa Electric Corporation (hereinafter simply referred to as Yokogawa) does not warrant that the functions will suit a particular purpose of the user.
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  - failure of a part or parts indicated in the instruction manual or other literature as not covered by this warranty.
  - use of software, hardware or spare parts not supplied by the Seller.
  - improper and/or inadequate maintenance by the Purchaser.
  - retrofitting, overuse, misuse, or erroneous operation by the Purchaser not conforming to the standards approved by the Seller.
  - malfunction or damage from improper relocation of the product in question after delivery.
  - use of a power supply (voltage and/or frequency) not specified by the Seller or due to a failure in the power supply.
  - use of the product in question in a location not conforming to the standards specified by the Seller, or due to improper maintenance of the installation location.
  - reason of force majeure such as fires, earthquakes, storms/floods, thunder/lightening, or other natural disasters, or disturbances, riots, warfare, or radioactive contamination.

- The Seller shall not guarantee the suitability of the purchased product to any particular application of the Purchaser. Nor shall the Seller be liable for any damage to the product, direct or indirect, resulting from such an application.

- The Seller shall not be liable for any damage, direct or indirect, inflicted on the purchased product at any premises of the end user in the case where the Purchaser reassembles the purchased product into another product to transfer to the end user or resells the purchased product to the end user.

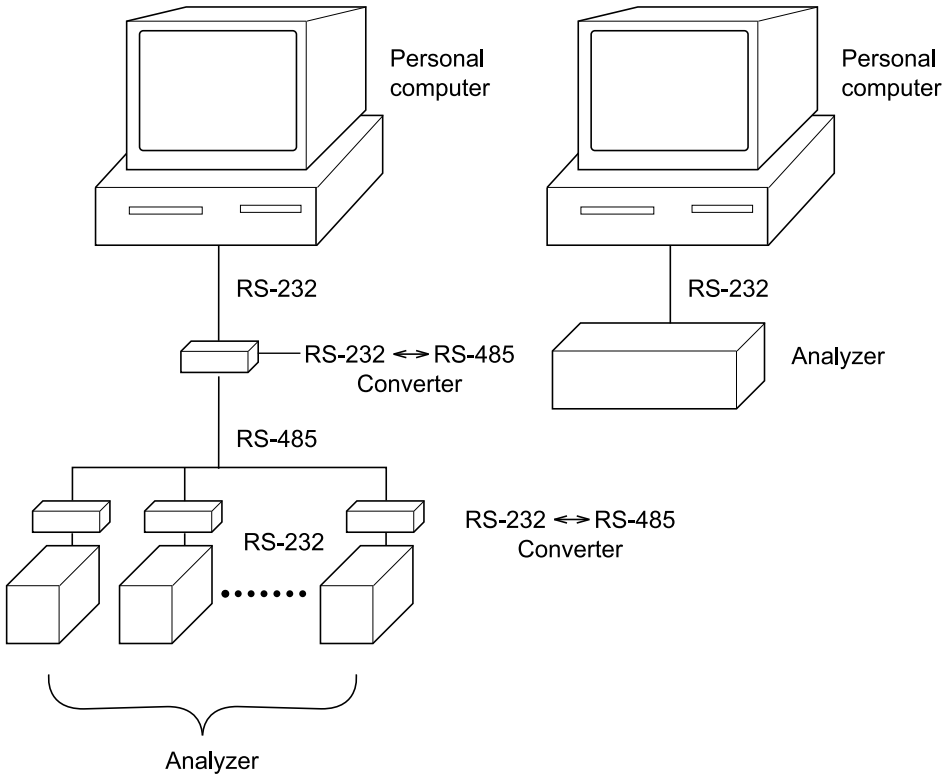
CONTENTS

1. COMMUNICATION FUNCTIONS

1.1 General

- This instrument provides a communication function through RS-232 interface, which allows data transmit to or receive from the host computer and other devices.
- The communication system is comprised of a master station and slave stations. One slave station (this instrument) can be connected to one master station.
  It is also possible to adapt the instrument to the environment of RS-485 interface using RS-232 ↔ RS-485 converter. In this case, up to 31 of slave station (present instrument) can be connected per master station.
- Because the master station can communicate with only one slave station at a time, the destination can be identified by the "Station No" set for each slave station.
- In order that the master station and the slave station can communicate, the format of the transmit/receive data must coincide. In this instrument, the format of the communication data is determined by the MODBUS protocol.

[RS-232 ↔ RS-485 converter] (recommended article)
Type: KS-485 (non-isolated type)/SYSTEM SACOM Corp.
Type: SI-30A (isolated type)/SEKISUI ELECTRONICS Co., Ltd.



2. SPECIFICATIONS

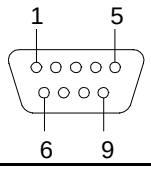
2.1 Communication specifications

Item	Specification	
Electrical specification	Based on EIA RS-232	
Transmission system	2-wire, semi-duplicate	
Synchronizing system	Start-stop synchronous system	
Connection format	1 : 1	
Number connectable units	1 unit (or 31 if RS-485 interface is used)	
Transmission speed	9600bps	
Data format	Data length	8 bits
	Stop bit	1 bit
	Parity	None
	X flow control	None
Transmission code	HEX value (MODBUS RTU mode)	
Error detection	CRC-16	
Isolation	No isolation between transmission circuit and others	

3. CONNECTION

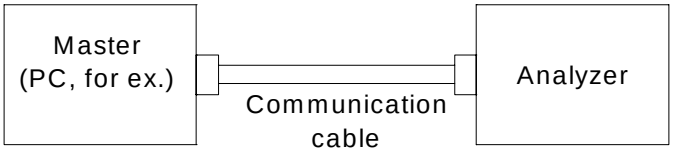
> ⚠ **WARNING**
>
> For avoiding electric shock and malfunctions, do not turn on the power supply untill all wiring have been completed.

3.1 Terminal allocation (Input/output terminal CN2)

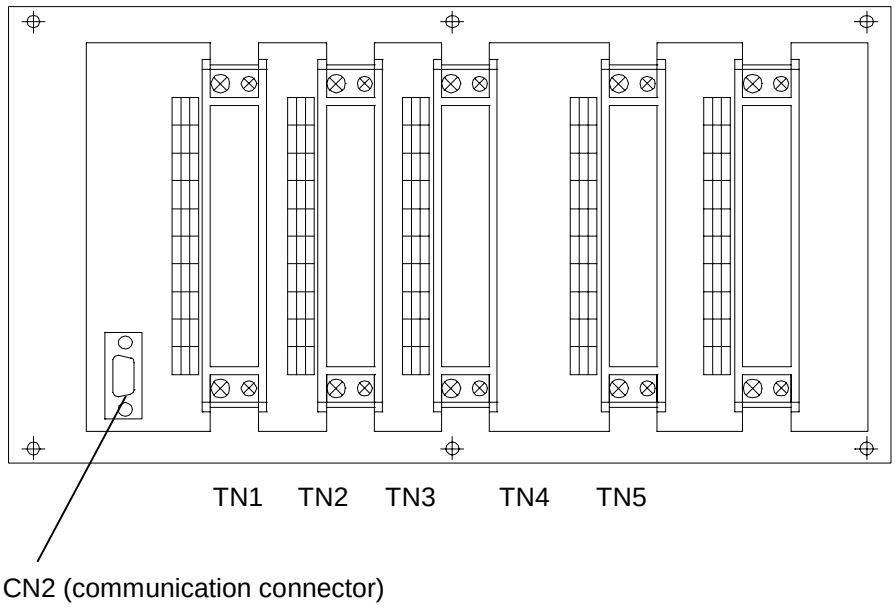
Terminal number	Signal name	Pin connection
2	Recive Data	 9-pin D-Sub (male)
3	Transmit Data	
5	Signal GND	
Others	NC	

3.2 Connection

As connecting cable, use a commercially available RS-232 reverse cable.



Connect the cable to CN2 on the input/output terminal block (on rear for model IR200, separate for model IR400).



4. SETTING OF COMMUNICATION CONDITION

In order that the master station and instrument can correctly communicate, following settings are required.

- All communication condition settings of the master station are the same as those of instruments.
- All instruments connected on a line are set to "Station Nos. (STno)" which are different from each other. (Any "Station No." is not shared by more than one instrument.)

4.1 Set items

The parameters to be set are shown in the following table. Set them by operating the front panel keys.

Item	Value at delivery	Setting range	Remarks
Transmission speed	9600bps	Fixed (can not be changed)	Set the same communication condition to the master station and all slave stations.
Data length	8 bits	Fixed (can not be changed)	
Stop bit	1 bit	Fixed (can not be changed)	
Parity setting	None	Fixed (can not be changed)	
Station No.	1	0 to 31 (0:communication function stop)	Set a different value to each station.

4.2 Setting operation

Set the station No. on the analyzer maintenance mode display (see the instruction manual below).

For model IR200; IM 11G02M01-01E

For model IR400; IM 11G02N01-01E

5. MODBUS COMMUNICATION PROTOCOL

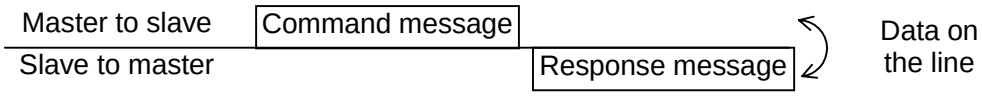
5.1 General

The communication system by the MODBUS protocol is that the communication is always started from the master station and a slave station responds to the received message.

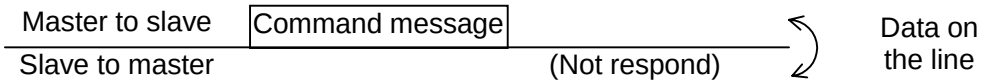
Transmission procedures is as shown below.

1) The master station sends a command message to a slave station.
2) The slave station checks that the station No. in the received message matches with the own station No. or not.
3) If matched, the slave station executes the command and sends back the response message.
4) If mismatched, the slave station leaves the command message and wait for the next command message.

a) In case when the station No. in the received command message matches with the own slave station No.



b) In case when the station No. in the received command message mismatches with the own slave station No.



The master station can individually communicate with any one of slave stations connected on the same line upon setting the station No. in the command message.

5.2 Composition of message

Command message and response message consist of 4 fields ; Station No., Function code, Data and Error check code. And these are send in this order.

Station No. (1 byte)
Function code (1 byte)
Data (2 to 133 bytes)
Error check code (CRC-16) (2 bytes)

Fig. 5-1 Composition of message

In the following, each field is explained.

(1) Station No.

Station No. is the number specifying a slave station. Only a slave station that corresponds to a value to which "Station No." is set on the analyzer maintenance mode display executes a command.

(2) Function code

This is a code to designate the function executed at a slave station.
For details, refer to section 5.4.

(3) Data

Data are the data required for executing function codes. The composition of data varies with function codes. For details, refer to chapter 6.

A register number is assigned to each data in the analyzer. For reading/writing the data by communication, designate the register number.

Note that the register number transmitted on message is expressed as its relative address.
The relative address is calculated by the following expression.

$$\boxed{\text{Relative address}} = \left(\text{The lower 4 digits of the } \boxed{\text{Register number}} \right) - 1$$

For example, when the resister number designated by a function code is 40003,

Relative address = (lower 4 digits of 40003) – 1
= 0002

is used on the message.

(4) Error check code

This is the code to detect message errors (change in bit) in the signal transmission.
On the MODUBUS protocol (RTU mode), CRC-16 (Cycric Redundancy Check) is applied.

For CRC calculation method, refer to section 5.5.

5.3 Response of slave station

(1) Response for normal command

To a relevant message, the slave station creates and sends back a response message which corresponds to the command message. The composition of message in this case is the same as in section 5.2.

Contents of the data field depend on the function code. For details, refer to Chapter 6.

(2) Response for abnormal command

If contents of a command message have an abnormality (for example, non-actual function code is designated) other than transmission error, the slave station does not execute that command but creates and sends back a response message at error detection.

The composition of response message at error detection is as shown in Fig. 5-2 The value used for function code field is function code of command message plus 80_H.

Table 5-1 gives error codes.

Station No.
Function code + 80_H
Error code
Error check(CRC-16)

Fig. 5-2 Response message at error detection

Table 5-1 Error code

Error code	Contents	Description
01H	Illegal function	Non-actual function code is designated. Check for the function code.
02H	Illegal data address	A relative address of a resister number to which the designated function code can not be used.
03H	Illegal data value	Because the designation of number is too much, the area where resister numbers do not exist is designated.

(3) No response

Under any of the following items, the slave station takes no action of the command message and sends back no response.

- A station number transmitted in the command message differs from the station number specified to the slave station.
- A error check code is not matched, or a transmission error (parity error, etc.) is detected.
- The time interval between the composition data of the message becomes longer than the time corresponding to 24 bits. (Refer to section 5.6 Transmission control procedure)

5.4 Function code

According to MODBUS protocol, register numbers are assigned by function codes.
Each function code acts on specific register number.

This correspondence is shown in Table 5-2, and the message length by function is shown in Table 5-3.

Table 5-2 Correspondence between function codes and objective address

Function code			⟷	Resister No.	
No.	Function	Object		No.	Contents
03_H	Read-out (continuously)	Holding register		4xxxx	Read-out/write-in word data
04_H	Read-out (continuously)	Input register		3xxxx	Read-out word data
06_H	Write-in	Holding register		4xxxx	Read-out/write-in word data
10_H	Write-in (continuously)	Holding register		4xxxx	Read-out/write-in word data

Table 5-3 Function code and message length [Unit : byte]

Function code	Contents	Number of designatable data	Command message		Response message	
			Minimum	Maximum	Minimum	Maximum
03_H	Read-out of word data	60 words	8	8	7	133
04_H	Read-out of word data (read-out only)	15 words	8	8	7	133
06_H	Write-in of word data	1 word	8	8	8	8
10_H	Write-in of continuous word data	60 words	11	137	8	8

5.5 Calculation of error check code (CRC-16)

CRC-16 is the 2-byte (16-bits) error check code. From the top of the message (station No.) to the end of the data field are calculated.

The slave station calculates the CRC of the received message, and does not respond if the calculated CRC is different from the contents of the received CRC code.

The following shows the calculation procedure for CRC-16.

(a) Store $FFFF_H$ into 16 bit register (CRC register).

(b) Subject the 1st byte (8 bits) of transmit message and CRC register contents to an exclusive logical summation (XOR), and store the result into the CRC register.

(c) Shift the CRC register contents 1 bit to the right. Store 0 at MSB.

(d) If LSB before shifting is 0, do nothing.
If LSB before shifting is 1, subject it and A001H to XOR, and store the result into the CRC register.

(e) Repeat the steps (c) and (d) 8 times (shift by 8 bits).

(f) Execute steps (b) to (e) for the next byte of the transmit message.
Likewise, successively repeat the steps to each byte of the transmit message.

(g) The CRC code that is retained is the value of CRC register that stands when the processing has ended for latest byte (latest data except error code) of the transmit message.

(h) As error check code of the transmit message, store this CRC value in the order of lower 8 bits and upper 8 bits.

Transmit message (ex.)

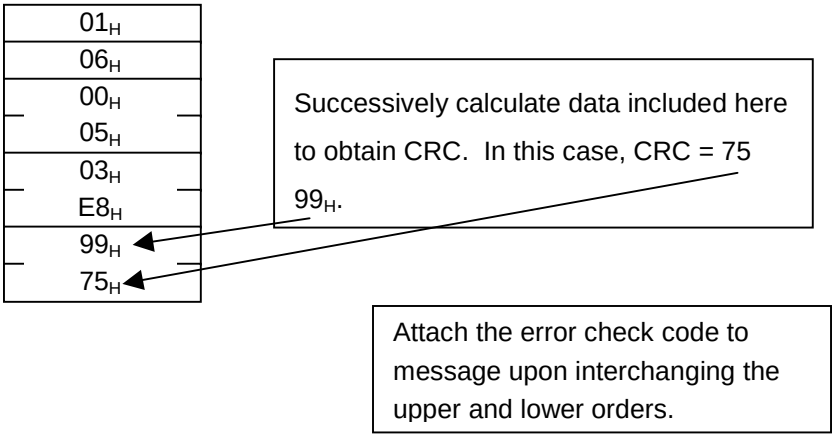
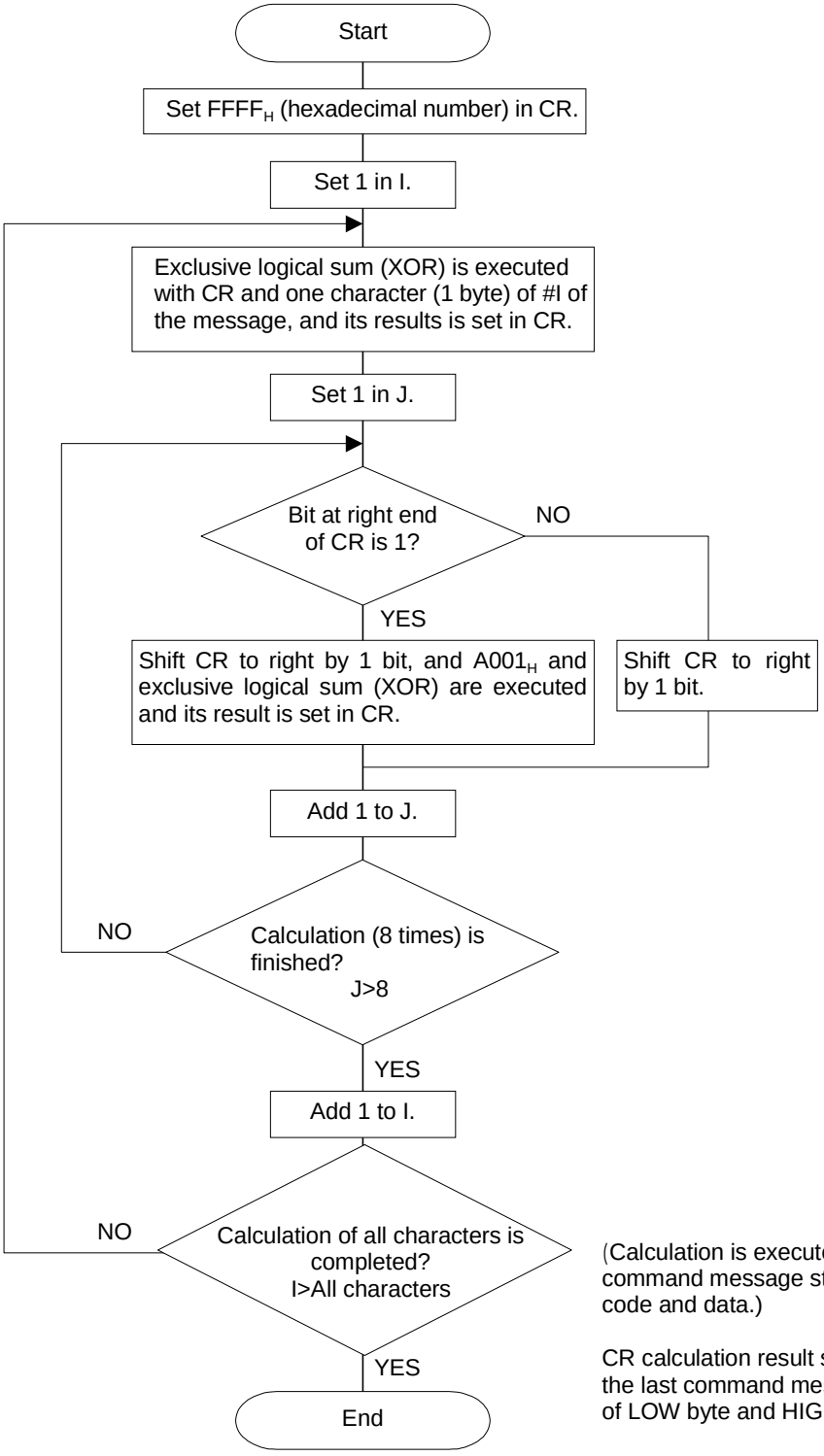


Fig. 5-3 shows the flow of the CRC-16 calculation system.



Explanation of variables
CR: CRC error check data (2 bytes)
I: Digits of calculation characters in command message
J: Check on the number of times of CR calculation

(Calculation is executed in the order of command message station No., function code and data.)

CR calculation result shall be added to the last command message in the order of LOW byte and HIGH byte.

Fig. 5-3 Flow of CRC-16 calculation

5.6 Transmission control procedure

(1) Transmission procedure of master station

The master station must proceed to a communication upon conforming to the following items.

(1-1) Before sending a command message, provide 48 bits time or more vacant status.

(1-2) For sending, the interval between bytes of a command message is below 24 bits time.

(1-3) Within 24 bits time after sending a command message, the receiving status is posted.

(1-4) Provide 48 bits time or more vacant status between the end of response message reception and beginning of next command message sending [same as in (1-1)].

(1-5) For ensuring the safety, make a confirmation of the response message and make an arrangement so as to provide 3 times or more retries in case of no response, error occurrence, etc.

Note) The above definition is for most unfavorable value. For ensuring the safety, it's recommended the program of the master to work with safety factors of 2 to 3. Concretely, it is advised to arrange the program for 9600 bps with 10 ms or more for vacant status (1-1), and within 1 ms for byte interval (1-2) and changeover from sending to receiving (1-3).

(2) Description

1) Detection of the message frame
The status on the line of the communication system is one of the 2 below.

(a) Vacant status (no data on line)

(b) Communication status (data is existing)
Instruments connected on the line are initially at a receiving status and monitoring the line. When 24 bits time or more vacant status has appeared on the line, the end of preceding frame is assumed and, within following 24 bits time, a receiving status is posted. When data appears on the line, instruments receive it while 24 bits time or more vacant status is detected again, and the end of that frame is assumed. I.e., data which appeared on the line from the first 24 bits time or more vacant status to the next 24 bits time or more vacant status is fetched as one frame.

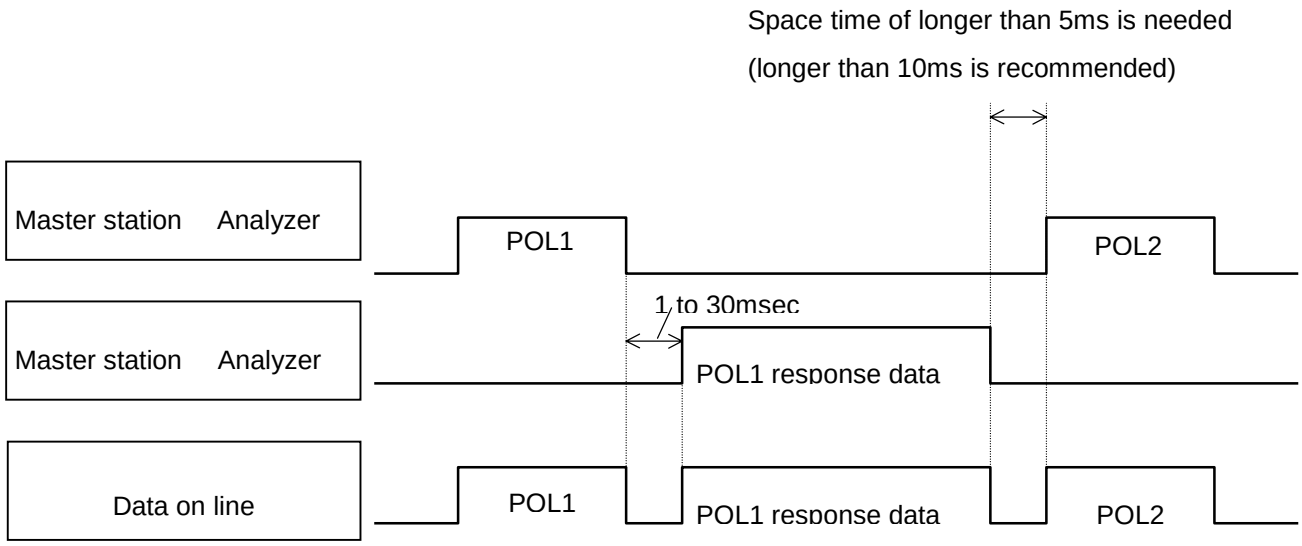
Therefore, one frame (command message) must be sent upon confirming the following.

(1-1) 48 bits time or more vacant status precedes before the command message sending.

(1-2) Interval between bytes of 1 command message is smaller than 24 bits time.

2) Response of this instrument
After a frame detection (24 bits time or more vacant status), this instrument carries out processing with that frame as a command message. If the command message is destined to the own station, a response message is returned. Its processing time is 1 to 30 ms (depends on contents of command message). After sending a command message, therefore, the master station must observe the following.

(1-3) Receiving status is posted within 24 bits time after sending a command message.


Space time of longer than 5ms is needed
(longer than 10ms is recommended)
Master station Analyzer
POL1
POL2
1 to 30msec
Master station Analyzer
POL1 response data
Data on line
POL1
POL1 response data
POL2

6. DETAILS OF MESSAGE

6.1 Read-out of word data [Function code:03_H]

Function code	Max. word number read-out in one message	Relative data address	Resister No.	Contents
03_H	64 words	0000_H $006D_H$	40001 40110	User setting

(1) Message composition

Command message composition (byte)

Station No.		
Function code		
Read-out start No. (relative address)	Upper	
	Lower	
Read-out word number	Upper	1 to 64
	Lower	
CRC data	Lower	
	Upper	

Response message composition (byte)

Station No.		
Function code		
Read-out byte number		Read-out word number×2
Contents of the first word data	Upper	
	Lower	
Contents of the next word data	Upper	
	Lower	
⋮		
Contents of the last word data	Upper	
	Lower	
CRC data	Lower	
	Upper	

* Arrangement of read-out word data

MSB LSB
Upper byte of contents of the first word data
Lower byte of contents of the first word data
Upper byte of contents of the next word data
Lower byte of contents of the next word data
⋮
Upper byte of contents of the last word data
Lower byte of contents of the last word data

(2) Function explanations

Word data of continuous word numbers from the read-out start No. can be read. Read-out word data are transmitted from the slave station in the order of upper and lower bytes.

(3) Message transmission (example)

The following shows an example of reading out from No. 1 station the setting CH2 (2nd component) range-1 zero and span calibration concentration.

Relative address of CH2 range-1 zero calibration concentration setting: 0004_H Data number: 02_H

Command message composition (byte)

Station No.		01_H
Function code		03_H
Read-out start No. (relative address)	Upper	00_H
	Lower	04_H
Read-out word number	Upper	00_H
	Lower	02_H
CRC data	Lower	85_H
	Upper	CA_H

Response message composition (byte)

Station No.		01_H
Function code		03_H
Read-out byte number		04_H
Contents of the first word data	Upper	00_H
	Lower	00_H
Contents of the next word data	Upper	03_H
	Lower	$E8_H$
CRC data	Lower	FA_H
	Upper	$8D_H$

* Meaning of read-out data

CH2 range-1 zero calibration concentration setting 00 00_H = 0
(contents of first word data)
CH2 range-1 span calibration concentration setting 03 $E8_H$ = 1000
(contents of next word data)

Provided decimal point position = 1, measurement unit = 1,
CH2 range-1 zero calibration concentration = 0.0 ppm
CH2 range-1 span calibration concentration =100.0 ppm

Point For handling of decimal point and unit, refer to Section 7.1.

6.2 Read-out of read only word data [Function code:04_H]

Function code	Max. word number read-out in one message	Relative data address	Resister No.	Contents
04_H	64 words	0000_H $00BD_H$	30001 30190	Measurement value and status
		0425_H 0447_H	31062 31096	Fixed setting

(1) Message composition

Command message composition (byte)

Station No.	
Function code	
Read-out start No. (relative address)	Upper
	Lower
Read-out word number	Upper
	Lower
CRC data	Lower
	Upper

Response message composition (byte)

Station No.		
Function code		
Read-out byte number		Read-out word number×2
Contents of the first word data	Upper	
	Lower	
Contents of the next word data	Upper	
	Lower	
—		
Contents of the last word data	Upper	
	Lower	
CRC data	Lower	
	Upper	

* Arrangement of read-out word data

MSB LSB
Upper byte of contents of the first word data
Lower byte of contents of the first word data
Upper byte of contents of the next word data
Lower byte of contents of the next word data
—
Upper byte of contents of the last word data
Lower byte of contents of the last word data

(2) Function explanations

Word data of continuous word numbers from the read-out start No. can be read. Read-out word data are transmitted from the slave station in the order of upper and lower bytes.

(3) Message transmission (example)

The following shows an example of reading out from No. 1 station the CH5 measurement concentration, decimal point position and measurement unit.

Relative address of CH5 measurement concentration: $000C_H$ Data number: 03_H

Command message composition (byte)

Station No.		01_H
Function code		04_H
Read-out start No. (relative address)	Upper	00_H
	Lower	$0C_H$
Read-out word number	Upper	00_H
	Lower	03_H
CRC data	Lower	70_H
	Upper	08_H

Response message composition (byte)

Station No.		01_H
Function code		04_H
Read-out byte number		06_H
Contents of the first word data	Upper	04_H
	Lower	$B0_H$
Next word data contents	Upper	00_H
	Lower	02_H
Latest word data contents	Upper	00_H
	Lower	00_H
CRC data	Lower	81_H
	Upper	$0D_H$

* Meaning of read-out data

First word data contents	04	$B0_H$ = 1200
Next word data contents	00	02_H = 2 (decimal point position)
Latest word data contents	00	00_H = 0 (vol %)

In the above case, measurement concentration = 12.00 vol%

Point For handling of decimal point and unit, refer to Section 7.1.

6.3 Write-in of word data (1 word) [Function code:06_H]

Function code	Max. word number write-in in one message	Relative data address	Resister No.	Contents
06_H	1 word	0000_H $006D_H$	40001 40110	User setting
		$07D0_H$ $07D1_H$	42001 42002	Operation command

(1) Message composition

Command message composition (byte)

Station No.	
Function code	
Write-in designate No. (relative address)	Upper
	Lower
Write-in word data	Upper
	Lower
CRC data	Lower
	Upper

Response message composition (byte)

Station No.	
Function code	
Write-in designate No. (relative address)	Upper
	Lower
Write-in word data	Upper
	Lower
CRC data	Lower
	Upper

(2) Function explanation

Designated word data is written in write-in designate No. Write-in data are transmitted from master station in the order of upper and lower bytes.

(3) Message transmission (example)

The following shows an example of transmitting the "ZERO" key command to No. 1 station.
Key operation command Relative address: $07D0_H$

Command message composition (byte)

Station No.		01_H
Function code		06_H
Write-in designate No. (relative address)	Upper	07_H
	Lower	$D0_H$
Write-in word data	Upper	00_H
	Lower	40_H
CRC data	Lower	88_H
	Upper	$B7_H$

ZERO key command

Response message composition (byte)

Station No.		01_H
Function code		06_H
Write-in designate No. (relative address)	Upper	07_H
	Lower	$D0_H$
Write-in word data	Upper	00_H
	Lower	40_H
CRC data	Lower	88_H
	Upper	$B7_H$

6.4 Write-in of continuous word data [Function code:10_H]

Function code	Max. word number write-in in one message	Relative data address	Resister No.	Kind of data
10_H	64 words	0000_H $006D_H$	40001 40110	User setting

(1) Message composition

Command message composition (byte)

Station No.		
Function code		
Write-in start No. (relative address)	Upper	
	Lower	
Write-in word number	Upper	1 to 64
	Lower	
Write-in byte number		Write-in word number×2
First write-in word data	Upper	
	Lower	
Next write-in word data	Upper	
	Lower	
—		
Last write-in word data	Upper	
	Lower	
CRC data	Lower	
	Upper	

Response message composition (byte)

Station No.	
Function code	
Write-in start No. (relative address)	Upper
	Lower
Write-in word number	Upper
	Lower
CRC data	Lower
	Upper

* Arrangement of write-in word data

MSB LSB
Upper byte of contents of the first word data
Lower byte of contents of the first word data
Upper byte of contents of the next word data
Lower byte of contents of the next word data
—
Upper byte of contents of the last word data
Lower byte of contents of the last word data

(2) Function explanation

Word data of continuous word number is written from write-in start address. Write-in word data are transmitted from master station in the order of upper and lower bytes.

(3) Message transmission (example)

The following shows an example of writing the CH1 (1st component) alarm settings to No. 1 station.
CH1 range-1 high alarm setting = 1388_H (= 5000_D)
CH1 range-1 low alarm setting = $000A_H$ (= 10_D)
CH1 range-2 high alarm setting = $03E8_H$ (= 1000_D)
CH1 range-2 low alarm setting = $000A_H$ (= 10_D)

CH1 range-1 high alarm setting Relative address: 0023_H Data number: 04_H

Command message composition (byte)

Station No.		01_H
Function code		10_H
Write-in start No.	Upper	00_H
	Lower	23_H
Write-in word number	Upper	00_H
	Lower	04_H
Write-in byte number		08_H
First write-in word data	Upper	13_H
	Lower	88_H
Next write-in word data	Upper	00_H
	Lower	$0A_H$
Next write-in word data	Upper	03_H
	Lower	$E8_H$
Last write-in word data	Upper	00_H
	Lower	$0A_H$
CRC data	Lower	$E2_H$
	Upper	$A6_H$

Response message composition (byte)

Station No.		01_H
Function code		10_H
Write-in start No.	Upper	00_H
	Lower	23_H
Write-in word number	Upper	00_H
	Lower	04_H
CRC data	Lower	30_H
	Upper	00_H

Point Since the transmission data can not include a decimal point, data of 500.0 is transmitted as "5000".

For transmission format of each data, refer to the Address map (Chapter 7).

7. ADDRESS MAP AND DATA FORMAT

7.1 Data format

7.1.1 Transmission data format

The MODBUS protocol used in this instrument is RTU (Remote Terminal Unit) mode.
Transmitted data is "numeric value" and not ASCII code".

7.1.2 Handling of decimal point position and measurement unit

When transmitted, the calibration concentration setting, alarm's high and low limits and measurement concentration data have no decimal point nor measurement unit.

Calculate exact values of data upon point positioning as shown below.

(a) Calibration concentration setting (register No. 40001 to 40020)
Alarm setting (register No. 40036 to 40055)

You can know the point position for each CH (channel) and each range, and unit upon reading in the decimal point position data (register No. 31087 to 31096), and the unit data (register No. 31067 to 31076).

The decimal point position data has a value of 0, 1, 2 or 3. You can obtain an exact value by the following calculation.

Case 0: Calibration concentration setting data /1
Case 1: Calibration concentration setting data /10
Case 2: Calibration concentration setting data /100
Case 3: Calibration concentration setting data /1000

The unit data has a value of 0, 1, 2 or 3, that corresponds as follows.

Case 0: vol%
Case 1: ppm
Case 2: mg/m^3
Case 3: g/m^3

For example, if:

CH1 range-1 span calibration concentration setting (register No. 40002) = 2000,
CH1 range-1 decimal point position (register No. 31087) = 1, and
CH1 range-1 unit (register No. 31067) = 1,

the value is 200.0 ppm.

For writing-in, proceed in the reverse. To obtain 200.0 ppm, write 2000 as calibration concentration setting.

The decimal point position and unit are unchangeable because fixed to each CH and each range.

(b) Measurement concentration (register No. 30001 to 30036)
The decimal point position and measurement unit for each concentration are stored in registers following that of concentration, and can be known by reading them in.

The meaning of decimal point position data and measurement unit data values are the same as in (a) above.

For example, if:

CH3 measurement concentration (register No. 30007) = 1270,
CH3 decimal point position (register No. 30008) = 2,
CH3 measurement unit (register No. 30009) = 0,

the value is 12.70 vol%

7.1.3 Handling at measurement data over-range

Even if the measurement data is at over-range, with "— — — —" displayed on the screen, the concentration that stands then is transmitted as read-out measurement concentration.

7.2 Address map

For details of functions and settable ranges of different parameters, refer to the instruction manual for the analyzer. Relevant model: 2; for model IR200, 4; for model IR400.

Word data [read-out/write-in]: Function code [03_H, 06_H, 10_H]

User settings

Relative address	Register No.	Data type	Memory contents	Read-out/write-in data	Remarks or corresponding parameter	Relevant model
0000_H	40001	Word	CH1 range-1 zero calibration concentration	0 to 9999	Calibration value	2/4
0001_H	40002	Word	CH1 range-1 span calibration concentration	Decimal point position depends on range		2/4
0002_H	40003	Word	CH1 range-2 zero calibration concentration			2/4
0003_H	40004	Word	CH1 range-2span calibration concentration			2/4
0004_H	40005	Word	CH2 range-1zero calibration concentration			2/4
0005_H	40006	Word	CH2 range-1 span calibration concentration			2/4
0006_H	40007	Word	CH2 range-2 zero calibration concentration			2/4
0007_H	40008	Word	CH2 range-2 span calibration concentration			2/4
0008_H	40009	Word	CH3 range-1 zero calibration concentration			2/4
0009_H	40010	Word	CH3 range-1 span calibration concentration			2/4
$000A_H$	40011	Word	CH3 range-2 zero calibration concentration			2/4
$000B_H$	40012	Word	CH3 range-2 span calibration concentration			2/4
$000C_H$	40013	Word	CH4 range-1 zero calibration concentration			2/4
$000D_H$	40014	Word	CH4 range-1 span calibration concentration			2/4
$000E_H$	40015	Word	CH4 range-2 zero calibration concentration			2/4
$000F_H$	40016	Word	CH4 range-2 span calibration concentration			2/4
0010_H	40017	Word	CH5 range-1 zero calibration concentration			4
0011_H	40018	Word	CH5 range-1 span calibration concentration			4
0012_H	40019	Word	CH5 range-2zero calibration concentration			4
0013_H	40020	Word	CH5 range-2 span calibration concentration			4

Word data [read-out/write-in]: Function code [03_H, 06_H, 10_H]

User settings

Relative address	Register No.	Data type	Memory contents	Read-out/write-in data	Remarks or corresponding parameter	Relevant model
0014_H	40021	Word	CH1 auto calibration switch	0, 1 (0: Do not calibrate in auto calibration 1: Calibrate in auto calibration)	Auto calibration component	2/4
0015_H	40022	Word	CH2 auto calibration switch			2/4
0016_H	40023	Word	CH3 auto calibration switch			2/4
0017_H	40024	Word	CH4 auto calibration switch			2/4
0018_H	40025	Word	CH5 auto calibration switch			4
0019_H	40026	Word	CH1 zero calibration switch	0,1 (0: Selectable zero calibration, 1: Zero calibration at once)	About zero calibration	2/4
$001A_H$	40027	Word	CH2 zero calibration switch			2/4
$001B_H$	40028	Word	CH3 zero calibration switch			2/4
$001C_H$	40029	Word	CH4 zero calibration switch			2/4
$001D_H$	40030	Word	CH5 zero calibration switch			4
$001E_H$	40031	Word	CH1 calibration range switch	0,1 (0: Calibrate indicated range only, 1: Calibrate both ranges at same time)	About calibration range	2/4
$001F_H$	40032	Word	CH2 calibration range switch			2/4
0020_H	40033	Word	CH3 calibration range switch			2/4
0021_H	40034	Word	CH4 calibration range switch			2/4
0022_H	40035	Word	CH5 calibration range switch			4
0023_H	40036	Word	CH1 range-1 high alarm setting	0 to 9999 Decimal point position depends on range	Alarm setting	2/4
0024_H	40037	Word	CH1 range-1 low alarm setting			2/4
0025_H	40038	Word	CH1 range-2 high alarm setting			2/4
0026_H	40039	Word	CH1 range-2 low alarm setting			2/4
0027_H	40040	Word	CH2 range-1 high alarm setting			2/4
0028_H	40041	Word	CH2 range-1 low alarm setting			2/4
0029_H	40042	Word	CH2 range-2 high alarm setting			2/4
$002A_H$	40043	Word	CH2 range-2 low alarm setting			2/4
$002B_H$	40044	Word	CH3 range-1 high alarm setting			2/4
$002C_H$	40045	Word	CH3 range-1 low alarm setting			2/4
$002D_H$	40046	Word	CH3 range-2 high alarm setting			2/4
$002E_H$	40047	Word	CH3 range-2 low alarm setting			2/4
$002F_H$	40048	Word	CH4 range-1 high alarm setting			2/4
0030_H	40049	Word	CH4 range-1 low alarm setting			2/4
0031_H	40050	Word	CH4 range-2 high alarm setting			2/4
0032_H	40051	Word	CH4 range-2 low alarm setting			2/4
0033_H	40052	Word	CH5 range-1 high alarm setting			4
0034_H	40053	Word	CH5 range-1 low alarm setting			4
0035_H	40054	Word	CH5 range-2 high alarm setting			4
0036_H	40055	Word	CH5 range-2 low alarm setting			4

Word data [read-out/write-in]: Function code [03_H, 06_H, 10_H]

User settings

Relative address	Register No.	Data type	Memory contents	Read-out/write-in data	Remarks or corresponding parameter	Relevant model
0037_H	40056	Word	CH1 alarm mode	0,1,2	Alarm setting	2/4
0038_H	40057	Word	CH2 alarm mode	(0: High limit alarm,		2/4
0039_H	40058	Word	CH3 alarm mode	1: Low limit alarm,		2/4
$003A_H$	40059	Word	CH4 alarm mode	2: High or low limit)		2/4
$003B_H$	40060	Word	CH5 alarm mode			4
$003C_H$	40061	Word	CH1 alarm switch	0,1		2/4
$003D_H$	40062	Word	CH2 alarm switch	(0: Alarm OFF,		2/4
$003E_H$	40063	Word	CH3 alarm switch	1: Alarm ON)		2/4
$003F_H$	40064	Word	CH4 alarm switch			2/4
0040_H	40065	Word	CH5 alarm switch			4
0041_H	40066	Word	Alarm hysteresis	0000H to 0014H (0 to 20%FS)		2/4
0042_H	40067	Word	Auto calibration start time(day)	00H to 06H (Sun. to Sat.)	Setting of auto calibration	2/4
0043_H	40068	Word	Auto calibration start time(hour)	00H to 23H (BCD code)		2/4
0044_H	40069	Word	Auto calibration start time(min)	00H to 59H (BCD code)		2/4
0045_H	40070	Word	Auto calibration cycle			2/4
0046_H	40071	Word	Auto calibration cycle unit	0,1 (0: h, 1: days)		2/4
0047_H	40072	Word	Auto calibration switch	0,1 (0: OFF, 1: ON)		2/4
0048_H	40073	Word	Auto calibration gas flow time	003CH to 0257H (60 to 599 sec)		2/4
0049_H	40074	Word	Key lock switch	0,1 (0: OFF, 1: ON)	Key lock	2/4
$004A_H$	40075	Word	Remote range switch	0,1 (0: OFF, 1: ON)	Remote range	2/4
$004B_H$	40076	Word	Response time 1	0000H to 0063H (0 to 99 sec) *(a)	Response time	2/4
$004C_H$	40077	Word	Response time 2			2/4
$004D_H$	40078	Word	Response time 3			2/4
$004E_H$	40079	Word	Response time 4			4
$004F_H$	40080	Word	Response time 5			4
0050_H	40081	Word	Response time 6			4
0051_H	40082	Word	Response time 7			4
0052_H	40083	Word	Response time 8			4
0053_H	40084	Word	Oxygen meter response time			2/4
0054_H	40085	Word	1st order moving average period	0000H to 003bH	Average period	2/4
0055_H	40086	Word	2nd order moving average period	(0 to 59 min or 1 to 4 h)		2/4
0056_H	40087	Word	3rd order moving average period			2/4
0057_H	40088	Word	4th order moving average period			4
0058_H	40089	Word	1st order moving average period unit	0,1		2/4
0059_H	40090	Word	2nd order moving average period unit	(0: h, 1: min)		2/4
$005A_H$	40091	Word	3rd order moving average period unit			2/4
$005B_H$	40092	Word	4th order moving average period unit			4

Word data [read-out/write-in]: Function code [03_H, 06_H, 10_H]

User settings

Relative address	Register No.	Data type	Memory contents	Read-out/write-in data	Remarks or corresponding parameter	Relevant model
$005C_H$	40093	Word	Hold switch	0,1 (0: OFF, 1: ON)	Output hold	2/4
$005D_H$	40094	Word	Oxygen conversion reference value	01H to 13H(1% to 19%)	Oxygen conversion reference value	2/4
$005E_H$	40095	Word	Peak alarm switch	0,1 (0: OFF, 1: ON)	Setting of peak alarm	
$005F_H$	40096	Word	Peak alarm concentration	0064H to 03e8H (100 to 1000ppm)		
0060_H	40097	Word	Peak alarm count	0001H to 0063H (1 to 99 times)		2/4
0061_H	40098	Word	Peak alarm hysteresis	0000H to 0014H (0 to 20%FS)		2/4
0062_H	40099	Word	Auto zero calibration start (day)	00H to 06H (Sun. to Sat.)	Setting of auto zero calibration	2/4
0063_H	40100	Word	Auto zero calibration start (hour)	00H to 23H (BCD code)		2/4
0064_H	40101	Word	Auto zero calibration start (min)	00H to 59H (BCD code)		2/4
0065_H	40102	Word	Auto zero calibration cycle			2/4
0066_H	40103	Word	Auto zero calibration cycle unit	0,1 (0: h, 1: days)		2/4
0067_H	40104	Word	Auto zero calibration switch	0,1 (0: OFF, 1: ON)		2/4
0068_H	40105	Word	Auto zero calibration gas flow time	003CH to 0257H (60 to 599 sec)		2/4
0069_H	40106	Word	CH1 range change setting	0,1 (0: range-1, 1: range-2.)	Range changeover (disabled if remote range ON)	2/4
$006A_H$	40107	Word	CH2 range change setting			2/4
$006B_H$	40108	Word	CH3 range change setting			2/4
$006C_H$	40109	Word	CH4 range change setting			2/4
$006D_H$	40110	Word	CH5 range change setting			4

Word data [write-in] : Function code [06_H]

Operation command

Relative address	Register No.	Data type	Memory contents	Write-in data	Remarks or corresponding parameter	Relevant model
$07D0_H$	42001	Word	Keying command	01H:MODE 02H: Side, 04H: Up, 08H: Down 10H: ESC, 20H: ENT 40H: ZERO, 80H: SPAN	Sending a value simulates keying	2/4
$07D1_H$	42002	Word	Display change	1: Return to measurement mode display	Force to return to measurement mode	2/4

Word data [read-out only] : Function code[04_H]

Measurement value and status

Relative address	Register No.	Data type	Memory contents	Read-out data	Remarks or corresponding parameter	Relevant model
0000_H	30001	Word	CH1 concentration	Concentration: -9999 to 9999 (value corresponding to indication without decimal point) Decimal point position: 0,1,2,3 (0; concentration/1 1; concentration/10 2; concentration/100 3; concentration/1000) Measurement unit: 0, 1, 2, 3 (0; vol% 1; ppm 2; mg/m^3 3; g/m^3) Transmit values under current measurement conditions		2/4
0001_H	30002	Word	CH1 decimal point position			2/4
0002_H	30003	Word	CH1 measurement unit			2/4
0003_H	30004	Word	CH2 concentration			2/4
0004_H	30005	Word	CH2 decimal point position			2/4
0005_H	30006	Word	CH2 measurement unit			2/4
0006_H	30007	Word	CH3 concentration			2/4
0007_H	30008	Word	CH3 decimal point position			2/4
0008_H	30009	Word	CH3 measurement unit			2/4
0009_H	30010	Word	CH4 concentration			2/4
$000A_H$	30011	Word	CH4 decimal point position			2/4
$000B_H$	30012	Word	CH4 measurement unit			2/4
$000C_H$	30013	Word	CH5 concentration			2/4
$000D_H$	30014	Word	CH5 decimal point position			2/4
$000E_H$	30015	Word	CH5 measurement unit			2/4
$000F_H$	30016	Word	CH6 concentration			2/4
0010_H	30017	Word	CH6 decimal point position			2/4
0011_H	30018	Word	CH6 measurement unit			2/4
0012_H	30019	Word	CH7 concentration			2/4
0013_H	30020	Word	CH7 decimal point position			2/4
0014_H	30021	Word	CH7 measurement unit			2/4
0015_H	30022	Word	CH8 concentration			2/4
0016_H	30023	Word	CH8 decimal point position			2/4
0017_H	30024	Word	CH8 measurement unit			2/4
0018_H	30025	Word	CH9 concentration			4
0019_H	30026	Word	CH9 decimal point position			4
$001A_H$	30027	Word	CH9 measurement unit			4
$001B_H$	30028	Word	CH10 concentration			4
$001C_H$	30029	Word	CH10 decimal point position			4
$001D_H$	30030	Word	CH10 measurement unit			4
$001E_H$	30031	Word	CH11 concentration			4
$001F_H$	30032	Word	CH11 decimal point position			4
0020_H	30033	Word	CH11 measurement unit			4
0021_H	30034	Word	CH12 concentration			4
0022_H	30035	Word	CH12 decimal point position			4
0023_H	30036	Word	CH12 measurement unit			4

Word data [read-out only] : Function code[04_H]

Measurement value and status

Relative address	Register No.	Data type	Memory contents	Read-out data	Remarks or corresponding parameter	Relevant model
0024_H	30037	Word	Peak count	0 to 100 times/hour		2/4
0025_H	30038	Word	CH1 current range	0, 1		2/4
0026_H	30039	Word	CH2 current range	(0; range-1, 1;range-2)		2/4
0027_H	30040	Word	CH3 current range			2/4
0028_H	30041	Word	CH4 current range			2/4
0029_H	30042	Word	CH5 current range			4
$002A_H$	30043	Word	CH1 high/low limit alarm	0, 1, 2	Whether or how alarm is currently produced.	2/4
$002B_H$	30044	Word	CH2 high/low limit alarm	(0: No alarm,		2/4
$002C_H$	30045	Word	CH3 high/low limit alarm	1: High limit alarm,		2/4
$002D_H$	30046	Word	CH4 high/low limit alarm	2: Low limit alarm		2/4
$002E_H$	30047	Word	CH5 high/low limit alarm			4
$002F_H$	30048	Word	Peak count alarm	0,1 (0: No, 1: Yes)		2/4
0030_H	30049	Word	Auto (Auto zero) calibration in progress	0,1 (0: No, 1: Yes)		2/4
0031_H	30050	Word	CH1 zero calibration in progress	0,1 (0: No, 1: Yes)		2/4
0032_H	30051	Word	CH2 zero calibration in progress			2/4
0033_H	30052	Word	CH3 zero calibration in progress			2/4
0034_H	30053	Word	CH4 zero calibration in progress			2/4
0035_H	30054	Word	CH5 zero calibration in progress			4
0036_H	30055	Word	CH1 span calibration in progress			2/4
0037_H	30056	Word	CH2 span calibration in progress			2/4
0038_H	30057	Word	CH3 span calibration in progress			2/4
0039_H	30058	Word	CH4 span calibration in progress			2/4
$003A_H$	30059	Word	CH5 span calibration in progress			4
$003B_H$	30060	Word	Instrument error	0,1 (0; No, 1; Yes)	Whether error is produced	2/4
$003C_H$	30061	Word	Calibration error	0,1 (0; No, 1; Yes)	Whether error is produced	2/4
$003D_H$	30062	Word	Latest error No.	-1 to 9 (Error No.-1) * (b)	Error log contents	2/4
$003E_H$	30063	Word	Latest error WEEK	0 to 6 (Sun. to Sat.)		2/4
$003F_H$	30064	Word	Latest error HOUR	0 to 23 (hours)		2/4
0040_H	30065	Word	Latest error MIN	0 to 59 (min)		2/4
0041_H	30066	Word	Latest error TARGET	0 to 4		2/4

Word data [read-out only] : Function code[04_H]

Measurement value and status

Relative address	Register No.	Data type	Memory contents	Read-out data	Remarks or corresponding parameter	Relevant model
0042_H	30067	Word	The previous error No.	-1 to 9 (Error No.-1)		2/4
0043_H	30068	Word	The previous error WEEK	0 to 6 (Sun. to Sat.)		2/4
0044_H	30069	Word	The previous error HOUR	0 to 23 (hours)		2/4
0045_H	30070	Word	The previous error MIN	0 to 59 (min)		2/4
0046_H	30071	Word	The previous error TARGET	0 to 4		2/4
						2/4
						2/4
$007E_H$	30127	Word	Oldest error No.	-1 to 9 (Error No.-1)		2/4
$007F_H$	30128	Word	Oldest error WEEK	0 to 6 (Sun. to Sat.)		2/4
0080_H	30129	Word	Oldest error HOUR	0 to 23 (hour)		2/4
0081_H	30130	Word	Oldest error MIN	0 to 59 (min)		2/4
0082_H	30131	Word	Oldest error TARGET	0 to 4		2/4
0083_H	30132	Word	Error 1	0,1 (0: No, 1: Yes)	Whether error is currently produced	2/4
0084_H	30133	Word	Error 2			2
0085_H	30134	Word	Error 3			2
0086_H	30135	Word	Error 10			2/4
0087_H	30136	Word	CH1 Error 4	0,1 (0: No, 1: Yes)		2/4
0088_H	30137	Word	CH1 Error 5			2/4
0089_H	30138	Word	CH1 Error 6			2/4
$008A_H$	30139	Word	CH1 Error 7			2/4
$008B_H$	30140	Word	CH1 Error 8			2/4
$008C_H$	30141	Word	CH1 Error 9			2/4
						2/4
						2/4
0099_H	30154	Word	CH4 Error 4	0,1 (0: No, 1: Yes)		2/4
$009A_H$	30155	Word	CH4 Error 5			2/4
$009B_H$	30156	Word	CH4 Error 6			2/4
$009C_H$	30157	Word	CH4 Error 7			2/4
$009D_H$	30158	Word	CH4 Error 8			2/4
$009E_H$	30159	Word	CH4 Error 9			2/4
$009F_H$	30160	Word	CH5 Error 4	0,1 (0: No, 1: Yes)		4
$00A0_H$	30161	Word	CH5 Error 5			4
$00A1_H$	30162	Word	CH5 Error 6			4
$00A2_H$	30163	Word	CH5 Error 7			4
$00A3_H$	30164	Word	CH5 Error 8			4
$00A4_H$	30165	Word	CH5 Error 9			4

Word data [read-out only] : Function code[04_H]

Measurement value and status

Relative address	Register No.	Data type	Memory contents	Read-out data	Remarks or corresponding parameter	Relevant model
$00A5_H$	30166	Word	CH1 auto zero calibration in progress	0,1 (0: No, 1: Yes)		2/4
$00A6_H$	30167	Word	CH1 auto span calibration in progress			2/4
$00A7_H$	30168	Word	CH1 hold in progress	0,1 (0: No, 1: Yes)		2/4
						2/4
						2/4
$00AE_H$	30175	Word	CH4 auto zero calibration in progress	0,1 (0: No, 1: Yes)		2/4
$00AF_H$	30176	Word	CH4 auto span calibration in progress			2/4
$00B0_H$	30177	Word	CH4 hold in progress	0,1 (0: No, 1: Yes)		2/4
$00B1_H$	30178	Word	CH5 auto zero calibration in progress	0,1 (0: No, 1: Yes)		4
$00B2_H$	30179	Word	CH5 auto span calibration in progress			4
$00B3_H$	30180	Word	CH5 hold in progress	0,1 (0: No, 1: Yes)		4
$00B4_H$	30181	Word	Display information (1)	* (c)		2/4
$00B5_H$	30182	Word	Display information (2)			2/4
$00B6_H$	30183	Word	Display information (3)			2/4
$00B7_H$	30184		(Do not use)			
$00B8_H$	30185		(Do not use)			
$00B9_H$	30186		(Do not use)			
$00BA_H$	30187		(Do not use)			
$00BB_H$	30188		(Do not use)			
$00BC_H$	30189	Word	Manual calibration channel	Cursor CH-1 * (d)		2/4
$00BD_H$	30190		(Do not use)			

Word data [read-out only] : Fuction code[04_H]

Fixed setting

Relative address	Register No.	Data type	Memory contents	Read-out data	Remarks or corresponding parameter	Relevant model
0425_H	31062	Word	CH1 range numbers	1, 2		2/4
0426_H	31063	Word	CH2 range numbers	(1: 1 range,		2/4
0427_H	31064	Word	CH3 range numbers	2: 2 ranges)		2/4
0428_H	31065	Word	CH4 range numbers			2/4
0429_H	31066	Word	CH5 range numbers			4
$042A_H$	31067	Word	CH1 range-1 unit	0,1,2,3		2/4
$042B_H$	31068	Word	CH1 range-2 unit	(0;vol%		2/4
$042C_H$	31069	Word	CH2 range-1 unit	1; ppm		2/4
$042D_H$	31070	Word	CH2 range-2 unit	2; mg/m^3		2/4
$042E_H$	31071	Word	CH3 range-1 unit	3; g/m^3)		2/4
$042F_H$	31072	Word	CH3 range-2unit			2/4
0430_H	31073	Word	CH4 range-1 unit			2/4
0431_H	31074	Word	CH4 range-2 unit			2/4
0432_H	31075	Word	CH5 range-1 unit			4
0433_H	31076	Word	CH5 range-2 unit			4
0434_H	31077	Word	CH1 range-1 value	1 to 9999		2/4
0435_H	31078	Word	CH1 range-2 value			2/4
0436_H	31079	Word	CH2 range-1 value			2/4
0437_H	31080	Word	CH2 range-2 value			2/4
0438_H	31081	Word	CH3 range-1 value			2/4
0439_H	31082	Word	CH3 range-2 value			2/4
$043A_H$	31083	Word	CH4 range-1 value			2/4
$043B_H$	31084	Word	CH4 range-2 value			2/4
$043C_H$	31085	Word	CH5 range-1 value			4
$043D_H$	31086	Word	CH5 range-2 value			4
$043E_H$	31087	Word	CH1 range-1 decimal point position	0,1,2,3		2/4
$043F_H$	31088	Word	CH1 range-2 decimal point position	(0: Nothing below decimal point,		2/4
0440_H	31089	Word	CH2 range-1 decimal point position	1: 1 digit below decimal point,		2/4
0441_H	31090	Word	CH2 range-2 decimal point position	2: 2 digits below decimal point,		2/4
0442_H	31091	Word	CH3 range-1 decimal point position	3: 3 digits below decimal point.		2/4
0443_H	31092	Word	CH3 range-2 decimal point position			2/4
0444_H	31093	Word	CH4 range-1 decimal point position			2/4
0445_H	31094	Word	CH4 range-2 decimal point position			2/4
0446_H	31095	Word	CH5 range-1 decimal point position			4
0447_H	31096	Word	CH5 range-2 decimal point position			4

Notes

1. Relevant model: 2; Model IR200, 4; Model IR400

   For data for which only 4 or 2 is indicated, there is no data for the other model.

2. For contents of *(a) to *(d), refer to Section 7.3 "Supplements to address map".

7.3 Supplement to address map

* (a) Register No. 40076 to 40083 (response time 1 to 8)
The following shows signals corresponding to response time 1 to 8.

• Model IR200

Response time 1	1st component detector signal
Response time 2	2nd component detector signal
Response time 3	3rd component detector signal
Response time 4 to 8	Unused

The above does not include sensor signals of oxygen.

• Model IR400

Response time 1	1st component measurement detector signal
Response time 2	1st component interference compensation detector signal
Response time 3	2nd component measurement detector signal
Response time 4	2nd component interference compensation detector signal
Response time 5	3rd component measurement detector signal
Response time 6	3rd component interference compensation detector signal
Response time 7	4th component measurement detector signal
Response time 8	4th component interference compensation detector signal

The above does not include sensor signals of oxygen.

* (b) Register No. 30062 to 30131 (error log)
Up to 14 errors logged can be read in the order from the latest to older ones.
The contents are as follows.

Error No.: No. of produced error. Stored value is error number minus 1.
Error WEEK: Day when error occurred.
Error HOUR: Indicates at what o'clock error occurred.
Error MIN: Indicates at what minutes error occurred.
Error TARGET: No. of CH where error occurred.

CH No. minus 1 is stored.
0 at error No. 1, 2, 3 or 10.
No. of optical system where error occurred minus 1 if error No. is 1 in case of model IR400.

* (c) Register numbers 30181, 30182, 30183 (display information (1), (2), (3))
The display information is values for knowing the current display status of the instrument.

• Contents of values of display information (1) (status of each setting panel)

0: Measurement mode display (manual calibration display included)
1: Menu mode display
2: Changeover of range display
3: Calibration setting display
4: Alarm setting display
5: Automatic calibration setting display
6: Peak alarm setting display
7: Parameter setting display
8: Maintenance mode display
9: Factory mode display
10: Auto zero calibration setting display

• Contents of values of display information (2) (status at manual calibration)

0: Measurement mode display
4: Channel selection display at manual zero calibration
5: Zero calibration wait display at manual zero calibration
6: Zero calibration in progress display at manual zero calibration
7: Channel selection display at manual span calibration
8: Span calibration wait display at manual span calibration
9: Span calibration in progress display at manual span calibration
10: Error contents indication display

• Contents of values of display information (3)

Correspond to value of CH (channel) from which the measurement mode is displayed.
Top channel number minus 1 is stored.

* (d) Register number 30189 (manual calibration channel)

Data for knowing a channel (component) which the cursor is positioned at to carry out a calibration at when a manual calibration is under way.

Channel number to carry out a calibration at minus 1 is stored.

8. SAMPLE PROGRAM

This chapter concerns data read-out/write-in sample program which operates on N88-Japanese BASIC (*2) for PC-9801 (*1) or compatible PCs.

Note that the program shown here is for reference for you to create a program and not for guaranteeing all actions.

Before executing the program, make sure of the communication conditions in the following procedure.

- Communication speed (baud rate):
  Match the conditions with this instrument using SWITCH command and SPEED command of MS-DOS (*3).

  For SWITCH command and SPEED command, refer to the reference manual of MS-DOS.

- Data length, stop bits and parity:
  Set in this program. Match the conditions with this instrument.

*1 PC-9801 series are products of NEC Corporation.

*2 N88-Japanese BASIC is a registered trade mark of NEC Corporation.

*3 MS-DOS is a registered trade mark of Microsoft Corporation.

(a) Example of data read-out

Operation: Read-out CH1 measurement concentration value.
(Continuous word read-out from read-out only area)

Used function code : 04H
Read-out start register No. : 30001
Read-out word number : 3

```
1000 '-----------------------------------------------------
1010 '   READ CONTINUOUS WORDS    SAMPLE PROGRAM
1020 '-----------------------------------------------------
1030 '
1040 ' Transmission speed = 9600 bps (selected with SPEED command and SWITCH command of MS-DOS)
1050 '
1060 CLS
1070 DIM CC(255)
1080 '
1100 '-------------- Send data setting -----------------------
1110 CC(1)=&H01         'Station No.    = 1
1120 CC(2)=&H04         'Function code = 04H
1130 CC(3)=&H00         'Upper byte of relative address(0000H) of resister No.30001
1140 CC(4)=&H00         'Lower byte of relative address(0000H) of resister No.30001
1150 CC(5)=&H00         'Upper byte of read-out word data(0003H)
1160 CC(6)=&H03         'Lower byte of read-out word data(0003H)
1170 COUNT=6
1200 '
1210 '------------- CRC code calculation of send data --------------
1220 GOSUB *CRC.CALC
1230 CC(7)=CRC.L        'Lower byte of CRC calculation result → Upper byte in message
1240 CC(8)=CRC.H        'Upper byte of CRC calculation result → Lower byte in message
1250 COUNT=COUNT+2
1300 '
1310 '------------- Send data -----------------------------
1320 PRINT " Sending data > ";
1330 OPEN "COM1:N81NN" AS #1        ' No parity ••• "N81NN""
1340
1350
1360 FOR I=1 TO COUNT
1370   PRINT #1,CHR$(CC(I));                'Writing in transmission port
1380   PRINT RIGHT$("0"+HEX$(CC(I)),2);" ";  'Displaying on screen
1390 NEXT I
1400 '
1410 FOR I=O TO 12000 :NEXT I                ' Interval time
1500 '
```

```
1510 '------------- Data receive  ---------------------------
1520 PRINT
1530 LENGTH=LOC(1)                          'Number of data in receiving buffer
1540 IF LENGTH=0 THEN PRINT "No answer" :END
1550 PRINT " Receiving data < ";
1560 FOR I=1 TO LENGTH
1570   X$=INPUT$(1,#1)                      'Taking data from receiving buffer
1580   CC(I)=ASC(X$)                        'Digitizing and storing
1590   PRINT RIGHT$("0"+HEX$(CC(I)),2);" ";  'Displaying on screen
1600 NEXT I
1610 CLOSE #1
1620 COUNT=LENGTH-2
1630 GOSUB *CRC.CALC
1700 '
1710 '------------- Transmission error check ----------------------
1720 PRINT
1730 CRC.L$=RIGHT$("0"+HEX$(CRC.L),2)
1740 CRC.H$=RIGHT$("0"+HEX$(CRC.H),2)
1750 PRINT "CRC calculation = ";CRC.L$;" ";CRC.H$
1760 IF CC(LENGTH-1)<>CRC.L THEN GOTO *ER.MESSAGE
1770 IF CC(LENGTH)<>CRC.H THEN GOTO *ER.MESSAGE
1780 GOTO *PRT.RESULT
1790 *ER.MESSAGE
1800  PRINT "Communication error"
1810 END
1900 '
1910 '------------- Display of result --------------------------
1920 *PRT.RESULT
1930
1940  PRINT
1950  VALUE=HEX$(CC(4))+RIGHT$("0"+HEX$(CC(5)),2)    '2byte   1word
1960  DE$=HEX$(CC(6))+RIGHT$("0"+HEX$(CC(7)),2)    '2byte   1word
1970  UN$=HEX$(CC(8))+RIGHT$("0"+HEX$(CC(9)),2)    '2byte   1word
1980
1990  Select Case Val("&H"+DE$)
2000         Case 0
2010              CONC=Val("&H"+Value$)/1
2020         Case 1
2030              CONC=Val("&H"+Value$)/10
2040         Case 2
2050              CONC=Val("&H"+Value$)/100
2060         Case 3
2070              CONC=Val("&H"+Value$)/1000
2080  End Select
2090
2100  Select Case Val("&H"+UN$)
2110         Case 0
2120              UNIT="vol%"
2130         Case 1
2140              UNIT="ppm%"
```

```
2150         Case 2
2160              UNIT="mg/m3"
2170         Case 3
2180              UNIT="g/m3"
2190 End Select
2200
2210  Print "CH1 measurement concentration =";CONC;UNIT
2220
2230 END
3000 '
3010 '------------ CRC calculation  -----------------------------
3020 *CRC.CALC                          ' For contents, refer to CRC calculation flow chart
3030  CR=&HFFFF
3040  FOR I=1 TO COUNT
3050   CR=CR XOR CC(I)
3060   FOR J=1 TO 8
3070    CT=CR AND &H1
3080    IF CR<0 THEN CH=1 ELSE CH=0:GOTO *CRC.CALC.10
3090     CR=CR AND &H7FFF
3100    *CRC.CALC.10
3110     CR=INT(CR/2)
3120     IF CH=1 THEN CR=CR OR &H4000
3130     IF CT=1 THEN CR=CR XOR &HA001
3140   NEXT J
3150  NEXT I
3160  CRC.L=CR AND &HFF                          ' Lower byte of CRC calculation
3170  CRC.H=((CR AND &HFF00)/256 AND &HFF)     ' Upper byte of CRC calculation
3180 RETURN
```

(b) Data write-in example

Operation : Change CH1 measurement range via communication
(Single word write-in)

Used function code : 06H

Write-in register No. : 40106

Write-in data : 1 (changeover from range 1 to range 2)

```
1000 '-----------------------------------------------------
1010 '   WRITE 1 WORD     SAMPLE PROGRAM
1020 '-----------------------------------------------------
1030 '
1040 ' Transmission speed = 9600 bps (selected with SPEED command and SWITCH command of MS-DOS)
1050 '
1060 CLS
1070 DIM CC(255)
1080 '
1100 '-------------- Send data setting -----------------------
1110 CC(1)=&H01         ' Station No.      = 1
1120 CC(2)=&H06         ' Function code = 06H
1130 CC(3)=&H00         ' Upper byte of relative address(0069H) of resister No.40106
1140 CC(4)=&H69         ' Lower byte of relative address(0069H) of resister No.40106
1150 CC(5)=&H00         ' Upper byte of Write-in word data(0001H)
1160 CC(6)=&H01         ' Lower byte of Write-in word data(0001H)
1170 COUNT=6
1200 '
1210 '------------- CRC code calculation of send data --------------
1220 GOSUB *CRC.CALC
1230 CC(7)=CRC.L        ' Lower byte of CRC calculation result → Upper byte in message
1240 CC(8)=CRC.H        ' Upper byte of CRC calculation result → Lower byte in message
1250 COUNT=COUNT+2
1300 '
1310 '------------- Send data -----------------------------
1320 PRINT "Sending data > ";
1330 OPEN "COM1:N81NN" AS #1        ' No parity ••• "N81NN "
1340
1350
1360 FOR I=1 TO COUNT
1370   PRINT #1,CHR$(CC(I));                ' Writing transmission port
1380   PRINT RIGHT$("0"+HEX$(CC(I)),2);" ";  ' Displaying on screen
1390 NEXT I
1400 '
1410 FOR I=O TO 12000 :NEXT I                ' Interval time
1500 '
```

```
1510 '------------- Data receive  ---------------------------
1520 PRINT
1530 LENGTH=LOC(1)                          'Number of data in receiving buffer
1540 IF LENGTH=0 THEN PRINT "No answer" :END
1550 PRINT "Receiving data < ";
1560 FOR I=1 TO LENGTH
1570   X$=INPUT$(1,#1)                      'Taking data from receiving buffer
1580   CC(I)=ASC(X$)                        'Digitizing and storing
1590   PRINT RIGHT$("0"+HEX$(CC(I)),2);" ";  'Displaying on screen
1600 NEXT I
1610 CLOSE #1
1620 COUNT=LENGTH-2
1630 GOSUB *CRC.CALC
1700 '
1710 '------------- Transmission error check  ----------------------
1720 PRINT
1730 CRC.L$=RIGHT$("0"+HEX$(CRC.L),2)
1740 CRC.H$=RIGHT$("0"+HEX$(CRC.H),2)
1750 PRINT "CRC calculation = ";CRC.L$;" ";CRC.H$
1760 IF CC(LENGTH-1)<>CRC.L THEN GOTO *ER.MESSAGE
1770 IF CC(LENGTH)<>CRC.H THEN GOTO *ER.MESSAGE
1780 GOTO *PRT.RESULT
1790 *ER.MESSAGE
1800  PRINT "Communication error"
1810 END
1900 '
1910 '------------- Display of result  ---------------------------
1920 *PRT.RESULT
1930  PRINT
1940  PRINT "  Range change ended "
1950 END
3000 '
3010 '------------ CRC calculation  -----------------------------
3020 *CRC.CALC                                 'For contents, refer to CRC calculation flow
3030  CR=&HFFFF
3040  FOR I=1 TO COUNT
3050   CR=CR XOR CC(I)
3060   FOR J=1 TO 8
3070    CT=CR AND &H1
3080    IF CR<0 THEN CH=1 ELSE CH=0:GOTO *CRC.CALC.10
3090     CR=CR AND &H7FFF
3100    *CRC.CALC.10
3110     CR=INT(CR/2)
3120     IF CH=1 THEN CR=CR OR &H4000
3130     IF CT=1 THEN CR=CR XOR &HA001
3140  NEXT J
3150  NEXT I
3160  CRC.L=CR AND &HFF                        'Lower byte of CRC calculation
3170  CRC.H=((CR AND &HFF00)/256 AND &HFF)     'Upper byte of CRC calculation
3180 RETURN
```

9. TROUBLESHOOTING

If the communication is unavailable, check the following items.

Whether all devices related to communication are turned on.

Whether connections are correct.

Whether the number of connected instruments and connection distance are as specified

Whether communication conditions coincide between the master station (host computer) and slave stations (instrument)

Transmission speed	:	9600bps
Data length	:	8 bits
Stop bit	:	1 bit
Parity	:	None

Whether send/receive signal timing conforms to Section 5.6 in this manual.

Whether the station No. designated as send destination by the master station coincides with the station No. of the connected instrument.

Whether more than one instrument connected on the same transmission line shares the same station No.

Whether the station No. of instruments is set at other than 0.
If it’s 0, the communication function does not work.

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