INST. No. INE-272K

CHINO

AL3000/AH3000 SERIES
HYBRID RECORDER
COMMUNICATION INTERFACES

INSTRUCTIONS

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

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

CHINO

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INTRODUCTION

This instruction manual describes the specifications and operation of three built-in communications interfaces (RS-232C, RS-422, and RS-485) of the AL3000/AH3000 series Hybrid Recorders.
The explanation for these interfaces are partly the same. However, their differences are explained separately in [In case of RS-232C] and [In case of RS-422A and RS-485]. Please read the required part carefully. Be sure to confirm the model code of the AL3000/AH3000 recorders you purchased as this determines the required communications interface type.

AL3000 Series Recorders

A L 3 □ □ □ – □ □ □

Communications interface
N: None
A: RS-422C
S: RS-485
R: RS-232C
E: Ethernet

AH3000 Series Recorders

A H 3 □ □ □ – □ □ □

Communications interface
N: None
A: RS-422A
S: RS-485
R: RS-232C
E: Ethernet

1. Other Instruction Manual to be consulted.

To understand the contents of this instruction, it is necessary to fully understand the operations and specifications of the AL3000/AH3000 series recorders.
This instruction manual is for the communications interface only. For the running and operation, please refer to the following instruction manuals:

1. AL3000 series Hybrid Recorders (Manual No. INE-270)
2. AH3000 series Hybrid Recorder (Manual No. INE-271)
3. AL3000 series (Pen Type) AH3000 series (Pen Type) Hybrid Recorders (Manual No. INE-308)
4. SC8-10 Line Converter (Manual No. INE-39)

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

2.Caution Display ⚠

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

⚠ Caution

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

1 GENERAL

There are three types of communication interfaces (RS-232C, RS-422A and RS-485) available between the AL3000/AH3000 recorders and personal computers (PCs).
PCs can be used to receive measured data from the AL3000/AH3000 recorders, program different parameters and issue control commands. The number of AL3000/AH3000 recorders that are connectable to a PC is one for the RS-232C and up to 31 for the RS-422A/485.

1.1 RS-232C Communications Interface

The RS-232C is the data communications standard being set and issued by EIA (Electronic Industries Association) in the USA and JIS C 6361 in Japan.
This standard is a basic interface between MODEM and connected data terminal units, and specifies electrical and mechanical specifications only. Most of the RS-232C communications interface is being used for personal computers and industrial instruments such as AL3000/AH3000 recorders do not completely conform to this standard at present, and have different signal wire numbers, connectors to those specified in the standard. Also, since this standard does not specify any software parts, or so-called [data transmission procedures], units having the RS-232C communications interface can not be interconnected with each other unconditionally. With these reasons, users must survey and check the specifications and transmission procedures in advance of units being connected. However, if the counter unit is for a personal computers or similar device which can optionally program the specifications, then all the units can be combined by having proper programs prepared by a program designer.

1.2 RS-422A/485 Communications Interface

The RS-422A and RS-485 communications interface can communicate with multiple AL3000/AH3000 recorders (up to 31 sets) in parallel by signals conforming to RS-422A and RS-485.
There are few personal computers which provide RS-422A or RS-485 communications interface. However, since these communications interfaces are characterized with serial communications, these are easily connectable to the personal computer having the RS-232C communications interface by using an RS-422A or RS-485 ⇔ RS-232C signal converting unit. A line converter (Model SC8-10: sold separately) is available for RS-422A and RS-485 ⇔ RS-232C signal conversion at CHINO.
Regarding the difference between RS-422A and RS-485 communications interfaces, the RS-422A needs four signal cables, while RS-485 needs only two signal cables.

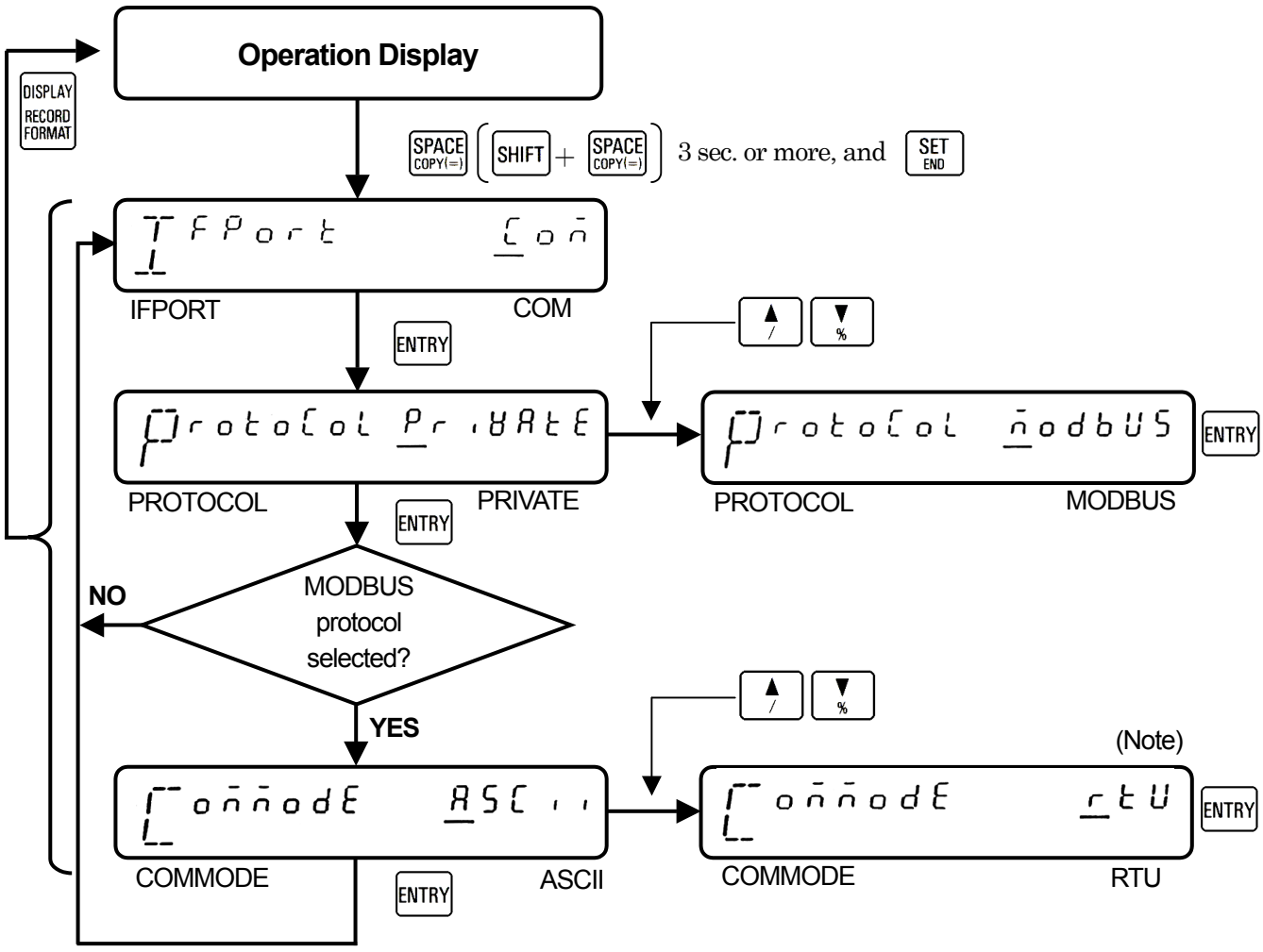
2 COMMUNICATIONS PROTOCOL

AL3000/AH3000 recorders have the following two communications protocols which can be selected by key programming.

(1) MODBUS Protocol (MODBUS is the registered trademark of Schneider Automation Inc.)
MODBUS Protocol has RTU mode and ASCII mode which can be selected by key programming. MODBUS protocol provides the function of transmitting measured data as well as the programming and operating function.

(2) Private Protocol
This protocol has only the function of transmitting measured data. It is compatible with our products AL56*, AL.66*, AH5**, AH6** and AH7** recorders.

2.1 Communications Protocol and Mode Switching



(Note) When switched from ASCII mode to RTU mode, the character configuration is forcibly changed to "8 bits, parity disabled, stop bit 1".

3 COMMUNICATIONS SPECIFICATIONS

* Half-duplex (polling selecting system)
* Protocol: MODBUS protocol/Private protocol
* Transmission speed: 19200, 9600, 4800, 2400, 1200 bps selectable (depending on protocol)
* Start bit: 1 bit
* Data length: 7 bits/8 bits selectable
* Parity bit: Even / Odd / Disabled selectable
* Stop bit: 1 bit / 2 bits selectable
* Transmission code : Binary / ASCII (depending on protocol)
* Error check: Depending on protocol
* External units given priority for communications
* Data transmission procedure: None
* Signals in use: Transmitted and received data only (no control signal in use)

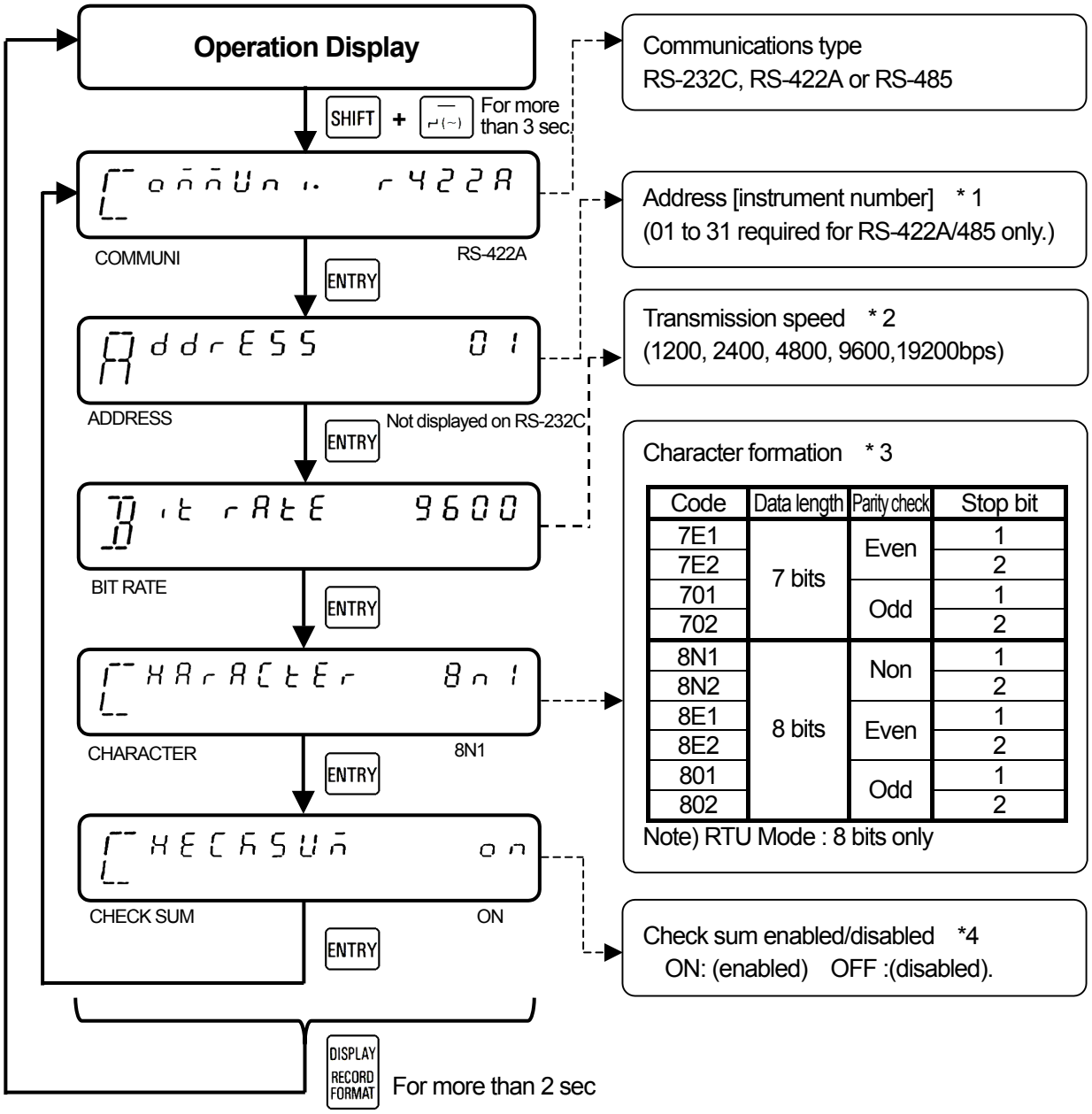
4 CHECK AND SETTING OF COMMUNICATIONS PARAMETERS

4.1 Check of Communications Parameters

By pressing SHIFT + ↵(~) keys for more than 3 sec. under the operation display condition, the [Communications parameters] check display appears and then program the parameters.

Checking flow chart (Displays shown are default values.)

The display of parameters is different by the communications type.



*1: When Private Protocol is selected, the programmable range of address is 01 to 99. The address is automatically programmed to “01” upon switching from Private to MODBUS protocol. There is no change in communications address when changing from MODBUS to Private Protocol.

*2: A selectable bit rate depends on the protocol in use. Bit rate is automatically changed to “9600 bps” upon changing from Private to MODBUS protocol. No change in bit rate when changing from MODBUS to Private Protocol.

*3: Character code is automatically changed to "8N1 (8 bits, parity disabled, stop bit 1)” upon changing from Private to MODBUS protocol. No change in character code when changing from MODBUS to Private protocol.

*4 : Not displayed when MODBUS protocol is selected.

4.2 Programming (Changing) Communications Parameters

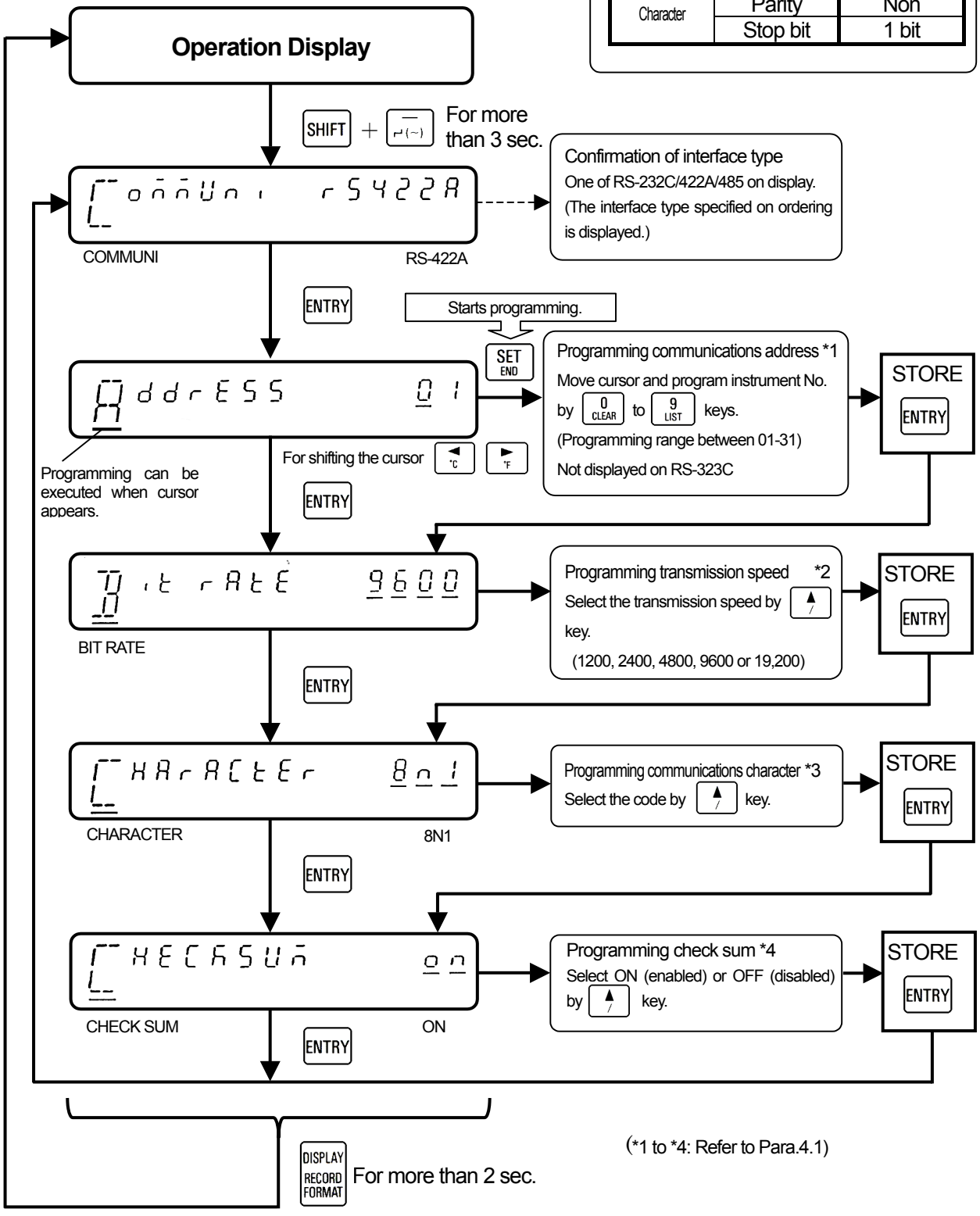
This procedure is used to match the communications protocols between PCs and AL3000/AH3000 recorders or program communications addresses (instrument Nos.).

Reference > Default Communications Parameters

Item		Parameters
Protocol		MODBUS
Communications Address		01
Transmission Speed		9600bps
Communications Character	Character length	8 bits
	Parity	Non
	Stop bit	1 bit

Programming Flow Chart (**Displays shown are default values.**)

The display of parameters is different for each communications type.

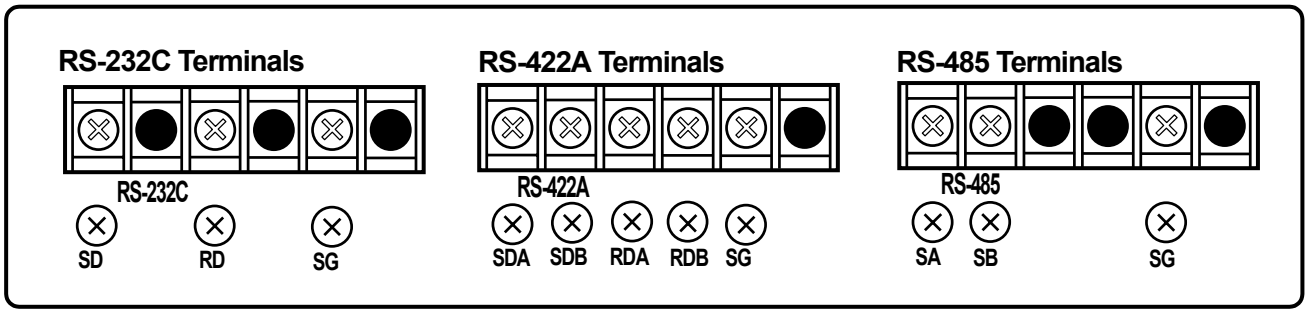


5 CONNECTIONS

5.1 Connection Precautions

5.1.1 Communication Terminals

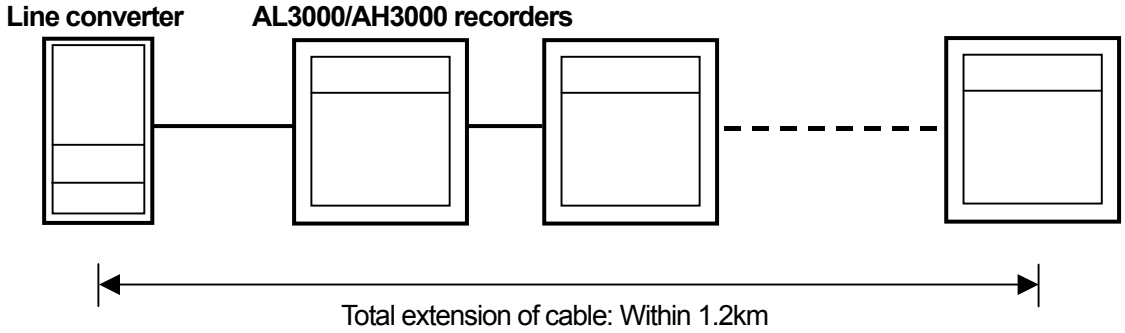
Disposition of terminals are different with each communications interface.



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

The wiring interval between each instrument is option, but the total extension distance of cable is within 1.2km.

(Line converter ⇐⇒ the final end of AL3000/AH3000 recorders)

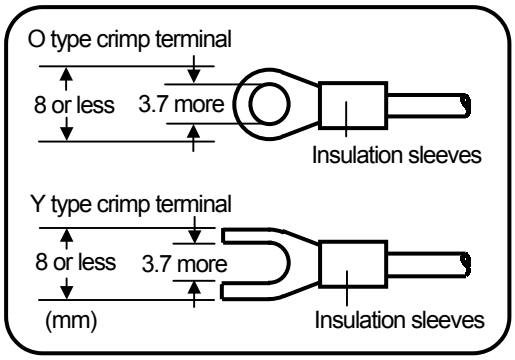


5.1.3 Noise preventive terminals

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

5.1.4 Crimp style terminals

Falling off of connections is one of communications failures. Terminate the communications cable with an [O] or [Y] type crimp style terminal having an insulation sleeve. (The terminal screws of AL3000/AH3000 recorders and line converters are M3.5mm.)



5.1.5 Mount an insulation resistor

For using the RS-422A or RS-485 communications interface, mount a 100 Ω resistor to the AL3000/AH3000 recorder connected at the final end. (For details, see Section 5.4)

[A general metal film resistor can be used. The resistor (sold separately) is available at CHINO.]

5.1.6 Number of AL3000/AH3000 recorders connectable

For RS-232C: 1 set

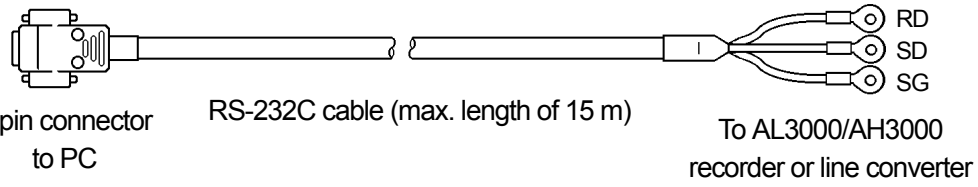
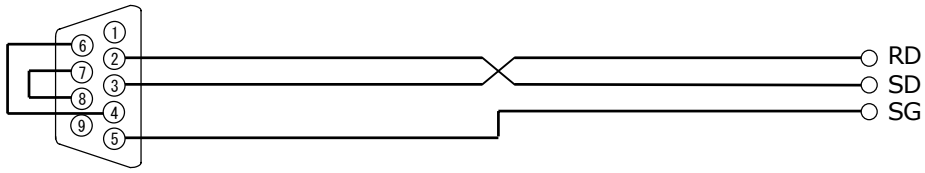
For RS-422A or RS-485: Up to 31 sets

5.2 Communications Cables

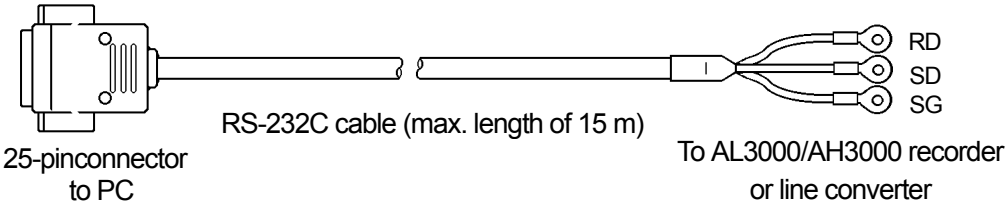
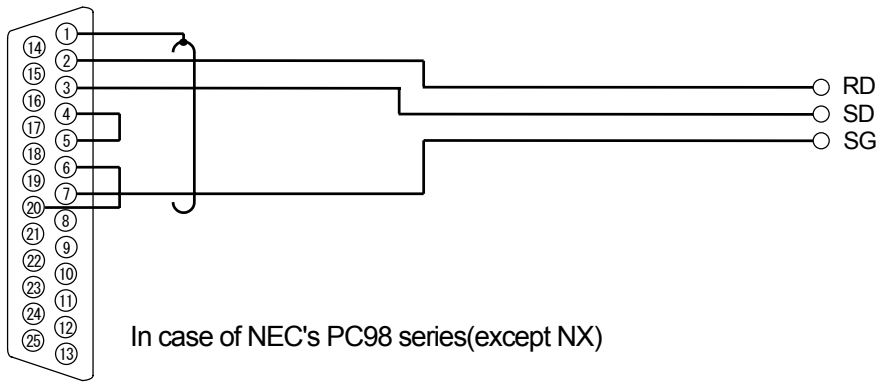
Make ready cables dedicated to communications before performing connection. Dedicated communications cables (sold separately) are available at CHINO.

5.2.1 Communications cables for RS-232SC

(1) Connection between PC (with 9 pin-terminal) and AL3000/AH3000 recorder and between PC (with 9 pin-terminal) and line converter.

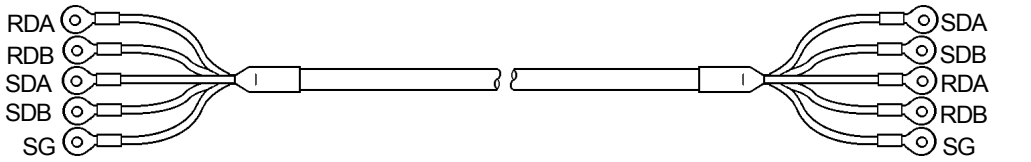
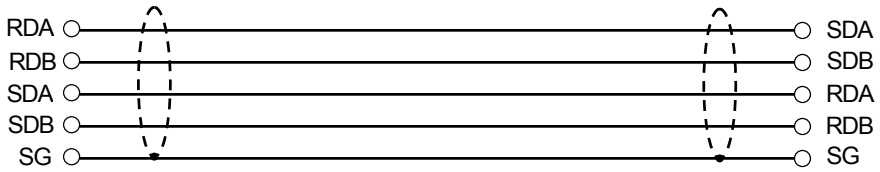
Cable	9-pin connector ⟷ RS-232C cable with O-shaped crimp terminal
Style	
Internal wiring	
Type code	**RZ-CRS6**□□ Cable length of 1 to 15 m (To be specified)

(2) Connection between PC (with 25 pin-terminal) and AL3000/AH3000 recorder and between PC(with 25 pin-terminal) and line converter.

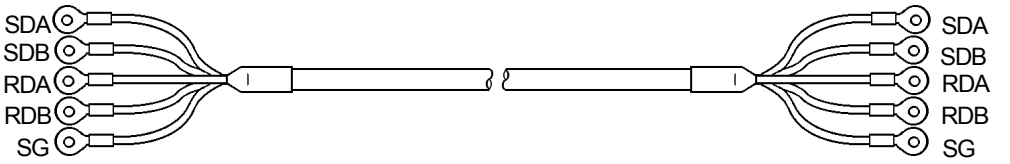
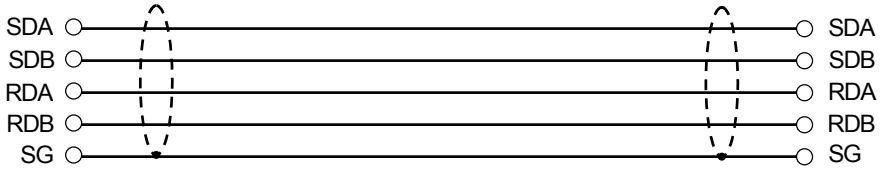
Cable	25-pin connector ⟷ RS-232C cable with O-shaped crimp terminal
Style	
Internal wiring	
Type code	**RZ-CRS2**□□ Cable length of 1 to 15 m (To be specified)

5.2.2 Communications cables for RS-422A

(1) Connection between line converter and AL3000/AH3000 recorder

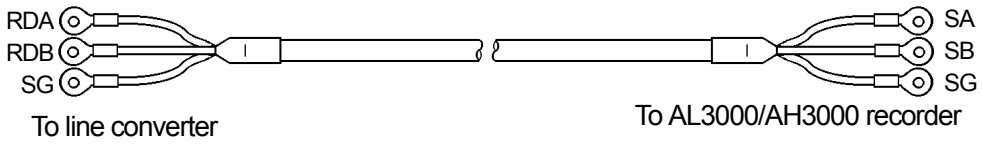
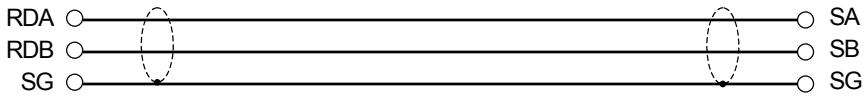
Cable	O-shaped crimp terminal ⟷ RS-422A cable with O-shaped crimp terminal (for line converter)
Style	 To line converter　　To AL3000/AH3000 recorder The cable consists of a pair of twisted dual-core CVVS wires with SG (signal grounding) wire at both ends. Cut off the SG wire on the line converter side because this has no SG terminal.
Internal wiring	
Type code	**RZ-CRA2**□□ Cable length of 1 to 99 m (To be specified)

(2) Connection between AL3000/AH3000 recorder and AL3000/AH3000 recorder

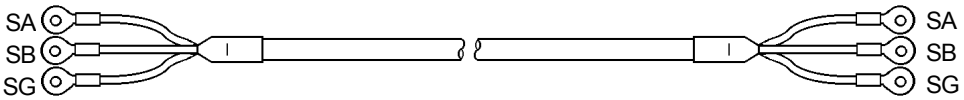
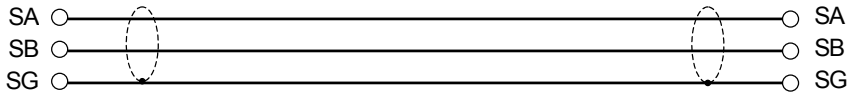
Cable	O-shaped crimp terminal ⟷ RS-422A cable with O-shaped crimp terminal (for parallel connection)
Style	 To AL3000/AH3000 recorder　　To AL3000/AH3000 recorder The cable consists of a pair of twisted dual-core CVVS wires with SG (signal grounding) wire at both ends.
Internal wiring	
Type code	**RZ-CRA1**□□ Cable length of 1 to 99 m (To be specified)

5.2.3 Communications cables for RS-485

(1) Connection between line converter and AL3000/AH3000 recorder

Cable	O-shaped crimp terminal ⟷ RS-485A cable with O-shaped crimp terminal (for line converter)
Style	 To line converter　　To AL3000/AH3000 recorder The cable consists of a twisted dual-core CVVS wires with SG (signal grounding) wire at both ends. Cut off the SG wire on the line converter side because this has no SG terminal.
Internal wiring	
Type code	**RZ-LED**□□□ (for line converter) Cable length of 1 to 200 m (To be specified)

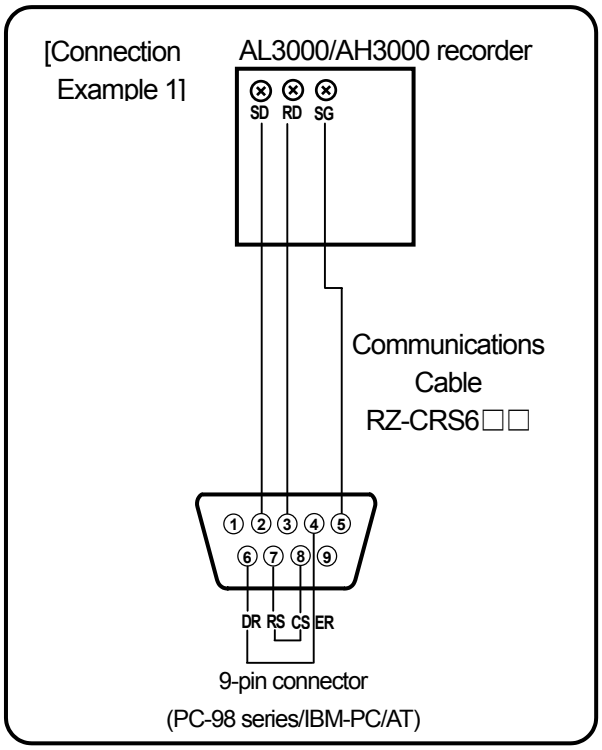
(2) Connection between AL3000/AH3000 recorder and AL3000/AH3000 recorder

Cable	O-shaped crimp terminal ⟷ RS-485 cable with O-shaped crimp terminal (for parallel connection)
Style	 To AL3000/AH3000 recorder　　To AL3000/AH3000 recorder The cable consists of a twisted dual-core CVVS wires with SG (signal grounding) wire at both ends.
Internal wiring	
Type code	**RZ-LEC**□□□ (For parallel connection) Cable length of 1 to 200 m (To be specified)

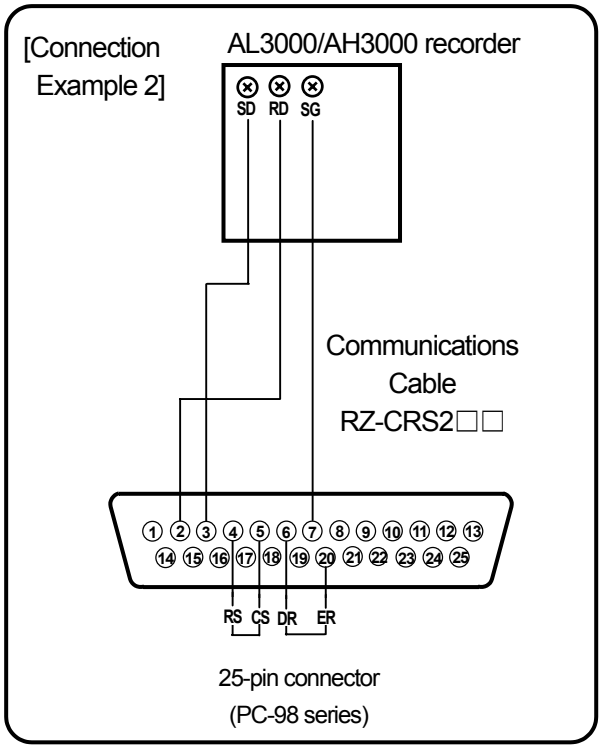
5.3 RS-232C Connections

The AL3000/AH3000 recorders use three control signals of Send(SD), Receive(RD), Signal ground (SG) only. Since general personal computers are controlled by control signals, the computer does not function by only connecting three signal cables without wiring processing inside the connectors. Wiring processing depends upon the control signals being controlled by the personal computer. For details, read the instruction manual for the personal computer used.

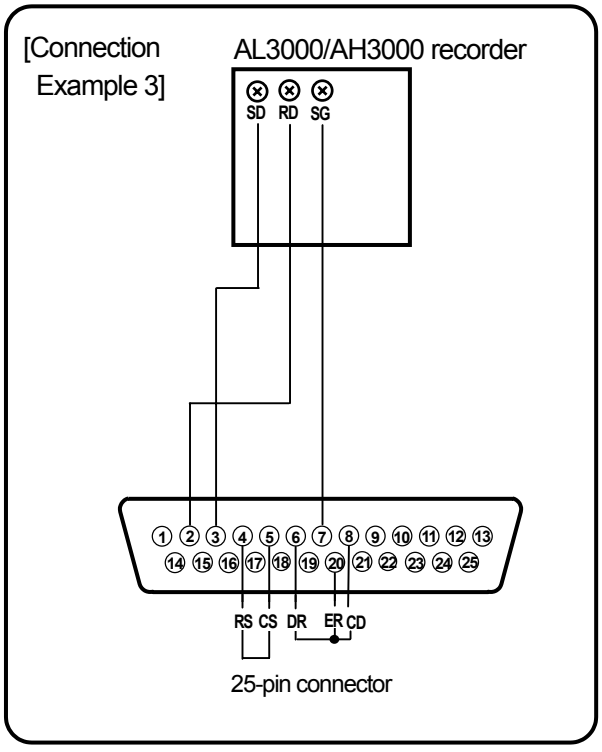
[Connection Example 1]



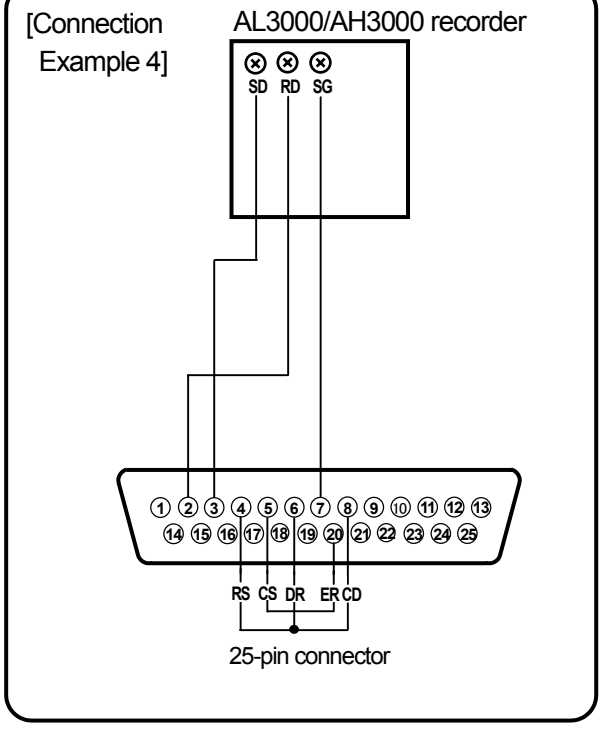
[Connection Example 2]



[Connection Example 3]



[Connection Example 4]

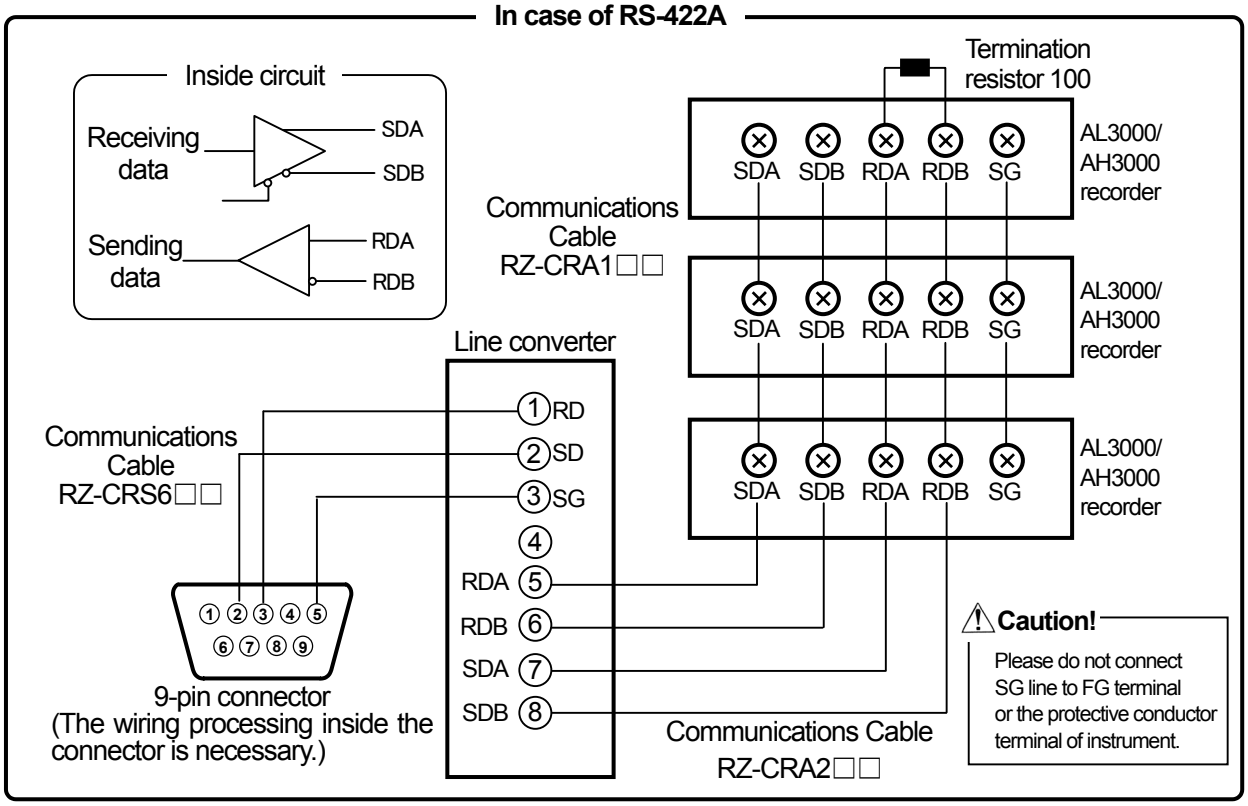


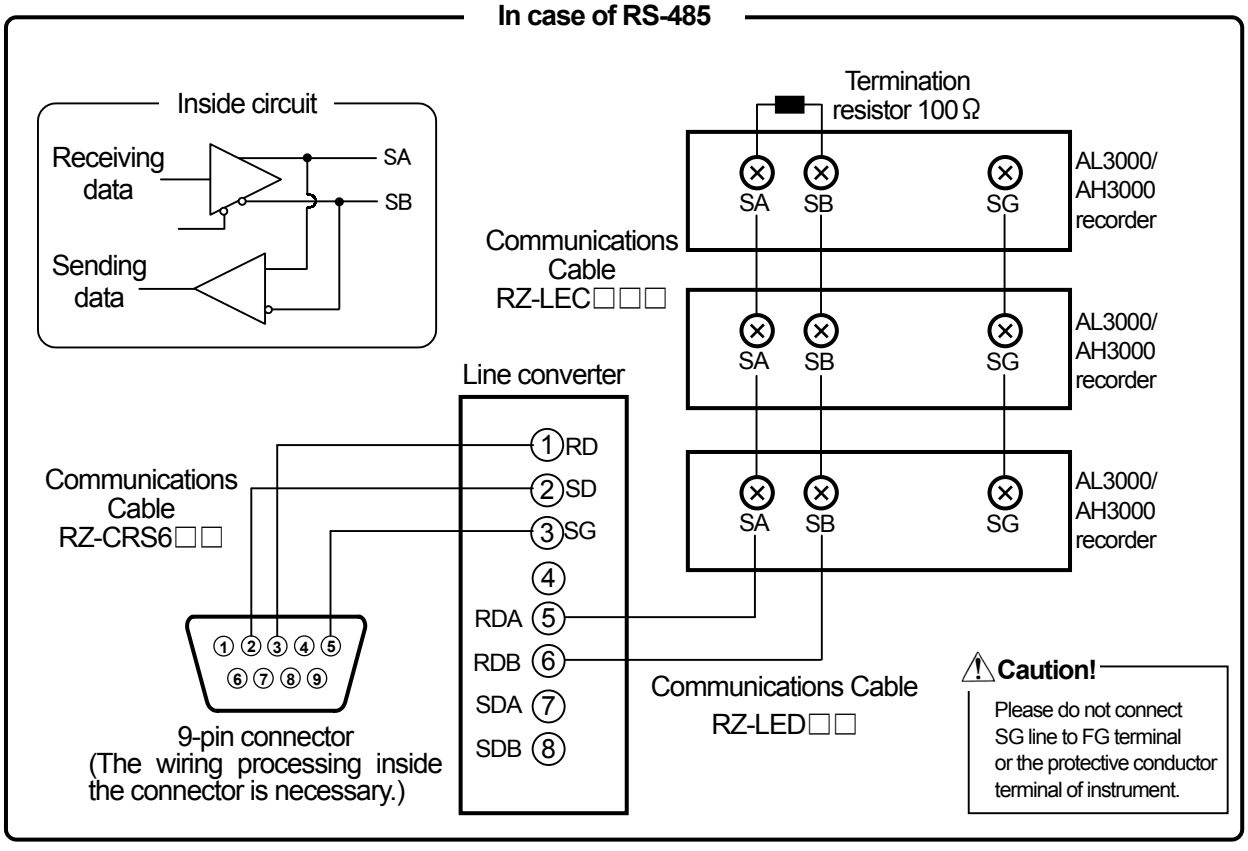
ATTENTION!

The RS-232C cable length is restricted to be within 15m. The connection for NEC PC98 series 9-pin connector is on [Connection sample 1] and for the 25-pin connector is on [Connection sample 2].

5.4 RS-422A, RS-485 Connections

This paragraph describes the method of connecting the RS-422/485 communications interface to the personal computer by using the line converter (Model SC8-10: sold separately). Since the line converter and the personal computer use three control signal of Send, Receive and Signal ground only, the wiring processing inside the connectors is necessary in the same way as in RS-232C connections.
[For details, read the instruction manual for line converter (Model SC8-10: sold separately).]





6 MODBUS PROTOCOL

Basic Procedures of Communications and Precautions

⚠ Attention!

1. A data request immediately after turning the power on will lead to an error.

The AL3000/AH3000 series recorders are always ready for communications. They are at anytime responsive to data requests from personal computers. However, immediately after turning the power on, the recorders do not deliver a normal response until the data of all channels is ready. It takes, for instance, about 20 seconds until all the data becomes ready for a 24-point type AH3000 series recorder. When receiving a data request during this period, the recorders return the error message No.12 (set mode error).

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

Since the AL3000-AH3000 series recorders' serial interfaces communicate freely without using any control line, a reception failure may occur under some conditions. Exercise care when resending a command.

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

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

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

For RS422A/RS-485 communications interface, multiple instruments are connected to the same communications line, only one instrument, of which instrument No. is specified by the PC, drives the communications line. The communications drive is turned off at a certain time (approx. 5 msec) after sending the last character so that all the characters are safely received by the personal computer. If the PC sends a command to the next unit before the communications drive is turned off, signals interfere with each other resulting in some communication failure. Exercise caution when you use a high-speed PC.

6.1 Message Transmission Modes

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

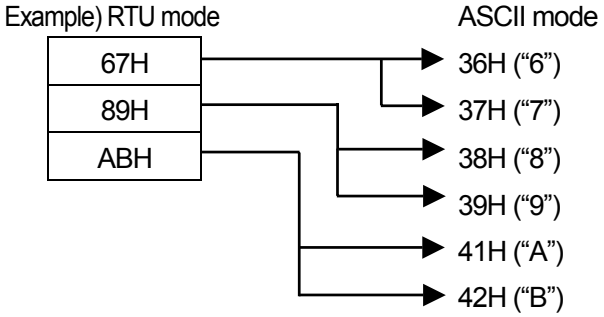
(Table 1 Comparison between RTU and ASCII modes)

Item		RTU mode	ASCII mode
Interface		RS-232C, RS-422A、RS-485	
Communications system		Half-duplex start-stop synchronization	
Transmission speed		9600, 19200bps	
Character code		Binary	ASCII
Error check	Vertical	Parity	
	Horizontal	CRC-16	LRC
Character Configuration	Start bit	1 bit	
	Data bit	8 bits	7 bits, 8 bits (Note)
	Parity bit	Disabled, even, odd	Disabled (Note), odd, even
	Stop bit	1,2 bit	
Message start code		None	: (Colon)
Message stop code		None	CR, LF
Data time interval		28 bit-time or less	1 second or less

(Note) 8 bits are also available at AL3000/AH3000 recorders.
(Note) "Parity disabled" is not available when data bits are 7.

6.1.1 Transmitted data

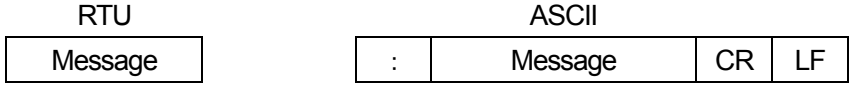
The RTU-mode data is transmitted in binary numbers. In ASCII mode, the 8-bit binary data of RTU is separated into higher-order 4 bits and lower-order 4 bits and both are turned into characters (0 - 9, A - F).



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

6.1.2 Message frame configuration

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



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

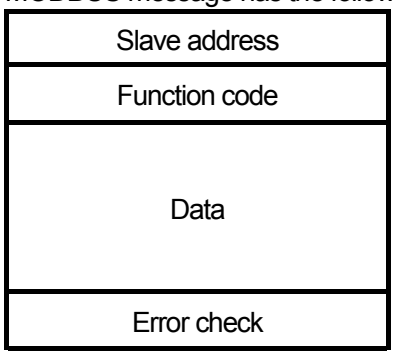
6.2 Data Time Interval

In RTU mode: Below 28 bit-time (2.8 msec. at 9600 bps, 1.4 msec. at 19200 bps)
In ASCII mode: Below 1 second

When sending a message, keep the time interval of data constituting one message not longer than the time specified above. When the time interval of data is longer than the above, the receiver unit (i.e., this recorder) recognizes that the data transmission from the sending unit is complete, so that the subsequent data is processed as an abnormally received message.
While the message characters must be consecutively sent in RTU mode, the ASCII modes allows for a maximum interval of 1 second between characters, making it possible to use a master unit (PC) with a relatively slow processing speed.

6.3 Message Configuration

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



6.3.1 Slave address

The slave address can be programmed in advance by key operation within a range between 1 and 31. The master unit usually communicates with one slave unit. While messages from the master unit are received commonly by all the units in connection, only the slave unit corresponding to the slave address included in the command message responds to the message sent.
In case of the RS-232C, send "1" as a slave address. This recorder also sends a slave address of "1".
The slave address "0" is used for a message from the master unit addressed to all the slave units (broadcast message). The slave units do not send a response back to the master unit.

6.3.2 Function code

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

(1) Digital parameters:	Parameters are mainly for changing the functions such as print ON/OFF and digital data print execution.
(2) Digital input data:	Parameters are such as remote contacts input status, input data status and alarm status.
(3) Analog parameters:	Information on various parameters. Numerical values should be kept within the 16-bit range between -32768 and 32767 (see the reference table for details). If the data cannot be expressed with 16-bit numbers, use floating data for reading and writing.
(4) Analog input data:	Information on measured data and instrument specifications. Numerical values within the range of 16-bits are delivered as an output. If the data cannot be expressed with 16-bit numbers, use floating data (floating-point data) for reading.
(5) Floating data:	If the data cannot be expressed with the numerical values within the 16-bit range (between –32768 and 32464), use floating data for its expression. This expression is not available in the standard MODBUS.

(Table 2. Function code table)

Code	Functions	Unit	MODBUS original functions (ref.)
01	Read digital (ON/OFF) parameter	1 bit	Read coil status
02	Read digital input data	1 bit	Read input relay status
03	Read analog parameter	16 bit	Read hold register contents
04	Read analog input data	16 bit	Read input register contents
05	Write digital parameter	1 bit	Change single coil status
06	Write analog parameter	16 bit	Write single hold register
08	Send received data (for diagnosis)		Loop-back test
16	Write two or more analog parameters		Write into two or more hold registers
70	Read floating data		Arbitrary command to vendor
71	Write floating data		Arbitrary command to vendor

6.3.3 Data section

Data configurations depend on the function codes. A master request consists of the code number of the data to be read or written (Relative No. to be calculated from the Reference No. described below) and the number of data pieces. Response from slave units consists of data responsive to the request.

Every MODBUS basic data consists of 16-bit integers, with or without codes depending on individual data. It is thus configured as integers with their decimal places assigned to separate addresses, or normalized with the upper and lower limits specified by the scale with fixed decimal places. The AL3000/AH3000 recorders employ the system of assigning the decimal places to separate addresses. Numerical data that cannot be expressed with 16-bit integers can be read and written using floating data. Note that floating data expression is not available in the standard MODBUS.

6.3.4 Reference Nos.

Data in the AL3000/AH3000 recorders have "Reference No." assigned to each of them which is required for reading and writing the data. The data in the AL3000/AH3000 recorders are classified into "Digital parameter", "Digital input data", "Analog input data", "Analog parameter" and "Floating (floating-point) data" depending on their type. The Nos. in the message are designated by the "Relative Nos." corresponding to the Reference Nos.

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

Data type	Reference No.	Relative No.	MODBUS original (for reference)
Digital parameter	1 to 10000	Reference No. – 1	Coil
Digital input data	10001 to 20000	Reference No. – 10001	Input relay
Analog input data	30001 to 40000	Reference No. – 30001	Input register
Analog parameter	40001 to 50000	Reference No. – 40001	Hold register
Floating data	50001 to 60000	Reference No. – 50001	

Example) Relative No. of Channel 1 data at "Reference No. 30101" is "100.

(Table 4　Quick search table for Reference Nos.)

Data type	Parameters	Reference No	Corresponding function code	Reference table
Digital parameter	Key lock Message1 printing Print ON/OFF Feed List printing Title printing Digital data printing Temperature unit High-speed trace printing Time-axis synchronization List printing 1 to 3 Alarm relay coil Alarm output latching	1 to 50	01(READ) 05(WRITE)	Section 6.9.1 (P.29 to 30)
Digital input data	Remote contacts status (contact input) Measured data status Alarm status	10001 to 10500	02(READ)	Section 6.9.2 (P.31 to 33)
Analog input data	Instrument information Measured data	30001 to 30050 30101 to 30200	04(READ)	Section 6.9.3 (P.33 to 36)
Analog parameter	Programming for all channels Clock Chart speed Periodic data printing Printing format selection Zone printing Alarm deadband Programming for each channel Range Scale Burnout Printing color Subtract printing Engineering unit Tag Alarm Math Printing scale Math parameter Compressed/expanded printing Digital filter Automatic range–shift printing Alarm relay (1 to 18) output mode Title printing Remote contacts function Message printing Data communications input	40001 to 40100 40101 to 42500 46301 to 46350 48001 to 48050 48051 to 48100 48201 to 48250 49001 to 49050	03(READ) 06(WRITE) 16(WRITE)	Section 6.9.4 (P.36 to 54)

Data type	Parameters	Reference No	Corresponding function code	Reference table
Floating data	Measured data Data communications input Programming for each channel Range Scale Alarm value Math Compressed/expanded printing Automatic range–shift printing	50101 to 50150 50201 to 50250 50301 to 51500	70(READ) 71(WRITE)	Section 6.9.5 (P.54 to 61)

6.3.5 Error check

Error check for transmission frames is different between the transmission modes.

RTU mode: CRC-16

ASCII mode: LRC

6.3.5.1 Calculation of CRC-16

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

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

The data from its slave address to its end is calculated in the following procedure.

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

Example) Since CRC-16 is 1241H for the data | 01H | 07H | , the error check data will be | 41H | 12H. |

Reference: CRC-16 Calculation Program

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

6.3.5.2 Calculation of LRC

The data from its slave address to its end is calculated in the following procedure.

1) Create a message in RTU mode.
2) Add the start (slave address) to end of the data. -- X
3) Complement X (bit reverse) -- X
4) Add 1 (X = X + 1)
5) Add X as an LRC to the end of the message.
6) Convert the whole data to ASCII characters.

Example) For the data | 02H | 07H | , LRC is F7H which will be | 02H | 07H | E7H | as a binary message,

so that the ASCII message will be | 30H | 32H | 30H | 37H | 46H | 37H | .

6.3.6 Precautions on data processing

(1) Since the measured data and decimal places are assigned to separate numbers, it is necessary to use both parts of the information when playing back the data.
(2) Since data is accessible (changeable) one by one, care must be taken when programming related data, for instance when initializing related data by changing the range number. Processing details are given in the Reference No. list.
(3) Programming through communications is not acceptable during programming execution by key (programming using the [SET END] key). To avoid this, perform key lock before programming through communications.
(4) Read or write the data within the range of Reference Nos. specified. If data is written on any Reference No. not specified, it is likely to affect the proper operation of the instruments.
(5) While it is possible to write data on two or more discreet Reference Nos., a start number with Reference No. not specified will result in an error (error No. 02H).
(6) When reading two or more Reference Nos., the data with Reference No. not specified becomes "0".
(7) When an error is detected during writing on two or more Reference Nos., all the programming becomes invalid.

6.4 Creating a Message

A message consists of (1) Slave address, (2) Function code, (3) Data section and (4) Error check code. (See Section 6.3)

The message readable or writable at one time is within the following range.

Data type	Number of data pieces
Floating data	60
Other than floating data	120

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

Example) Reading a measured data for AL3000/AH3000 recorder Channel 1 with "slave address 02".

6.4.1 RTU mode message

(1) Slave address : 02 (02H)

(2) Function code : 04 (04H)

The data type is "Read analog input data (read input register contents)". When the function code is "04", specify the “data's Relative No. by 2 bytes" and the "number of data pieces by 2 bytes" to be read from the data section. (See Section 6.5. See Section 6.5.4 for "Function code: 04".)

* It is necessary to make sure of the number of bytes of data.

(3) Data section :

Starting Relative No. 100 (00H | 64H) and Number of data pieces 2 (00H | 02H)

Measured data (analog input data) are stored in Reference Nos. "30001 to 40000" (See Table 3 in Section 6.3.4). The reference table shows that the integer part of CH1 is stored in "30101" and the decimal place in "30102". (See Section 6.7. See Section 6.7.3 for reading the measured data.)

The Relative No. of the starting "Reference No. 30101” is 30101 - 30001 = 100 that can be expressed by 2 bytes " 00H | 64H ". (See Table 3 of Section 6.3)

The number of data pieces to be read is "2" of the integer part of CH No.1 and the decimal place, which can be expressed by " 00H | 02H " in 2 bytes

(4) Error check: 2730H calculated with CRC-16 (30H | 27H)

Error check in RTU mode is calculated with CRC-16. (See Section 6.3.5.1)

The data in the core message is:

" 02H | 04H | 00H | 64H | 00H | 02H " according to (1) to (3), whose CRC-16 is 2730H.

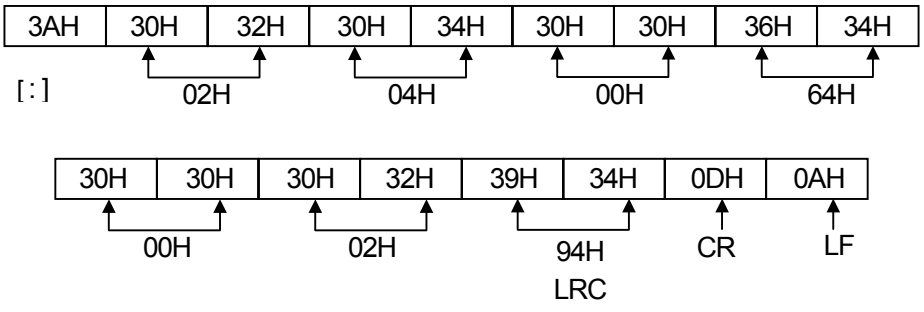
Error check data is therefore 30H | 27H .

(5) Message: 02H | 04H | 00H | 64H | 00H | 02H | 30H | 27H

Create a message according to the message configuration. (See Section 6.3)

6.4.2 Message in ASCII mode

Calculate the error check LRC from the core message. (See Section 6.4.1 (4)). LRC is 94H (See Section 6.5.3.2). Each data in the core message is converted to ASCII code. LRC is also converted to ASCII code to be added to the core message. Add a message starting character " : " and "CR" and "LF" to the end of the message.



6.5 Function Code

Responses by function code are given below. (See Table 2. Function code table in Section 6.3.2)
Note) See Section 6.6 for responses in abnormal status.

6.5.1 Read digital parameter (read coil status)

[Function code: 01 (01H)]

The specified number of "digital (ON/OFF) parameters" are read out consecutively commencing with the designated Reference No. For ON/OFF data, 8 Reference Nos. are placed in each data (1 byte) sequentially in number to constitute the response message data. The LSB (D0 side) of each data becomes the digital data with the smallest number. If the number of Reference No. is anything other than a multiple of 8, an unnecessary bit becomes 0.

Example) Reading 10 Reference Nos. from 17 to 26 of digital parameters for the slave unit 2.

Reference No	17	18	19	20	21	22	23	24	25	26
Data	ON	OFF	ON	OFF	OFF	—	—	—	OFF	ON
	Record ON	Feed OFF	List Run	Title OFF	Digital data printing OFF				Temper -ature ◦C	High speed trace print 2.5° sec.

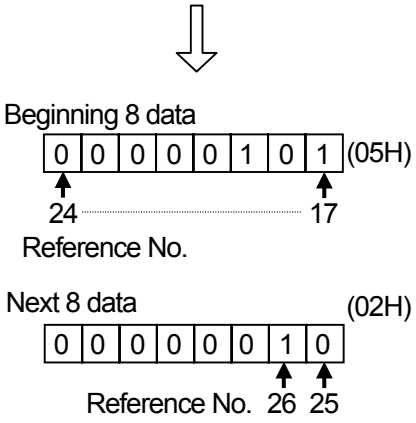
(RTU mode)

Master→Instruments

Slave address	02H
Function code	01H
Start No. (H)	00H
Start No. (L)	10H
Number of Reference No. (H)	00H
Number of Reference No. (L)	0AH
CRC (L)	BDH
CRC (H)	FBH

Instruments→Master (normal)

Slave address	02H
Function code	01H
No. of data	02H
1st 8 data	05H
Next 8 data	02H
CRC (L)	7FH
CRC (H)	6DH



(Error check in ASCII mode)

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

LRC	E3H

LRC	F4H

Note) Start No. (Relative No.) is given by "Reference No. - 1".
(Decimal number 16 (=17 - 1) ⟶ Hexadecimal 10H)

Note) No. of data is the number of data bytes.
(which is different from the requested number of Reference No. In the example given above, the requested number of Reference No. is10 and the number of data is 2).

6.5.2 Read digital input data (read input relay status)

[Function code. 02 (02H)]

The specified number of "digital (ON/OFF) input data" are read out consecutively commencing with the designated Reference No. For ON/OFF data, 8 Reference Nos. data are placed in one data (1 byte) sequentially in number to constitute the response message data. The LSB (on DO side) of each data is a digital data with the smallest number. If the number of Reference No. read is anything other than a multiple of 8, an unnecessary bit becomes 0. An example of response message is the same as in "Function code 01", though its start number (Relative No.) is "Reference No. - 10001".

6.5.3 Read analog set value (read hold register contents)

[Function code. 03 (03H)]

The specified number of "analog parameters (2 bytes: 16 bits)" are read out consecutively commencing with the designated Reference No. The data is split into higher-order 8 bits and lower-order 8 bits arranged sequentially in number to constitute a data of response message

Example) Reading clock information "Year/Month/Day" of the slave unit 2.
(Reading 3 Reference Nos. from 40001 to 40003 of analog parameters for the slave unit 2)

Reference No.	40001	40002	4003
Data	98 (3938H)	12 (3132H)	25 (3235H)

← Example: December 25, 1998.

(RTU mode)

Master→Instruments

Slave address	02H
Function code	03H
Start No. (H)	00H
Start No. (L)	00H
Number of Reference No. (H)	00H
Number of Reference No. (L)	03H
CRC (L)	05H
CRC (H)	F8H

Instruments→Master (normal)

Slave address	02H
Function code	03H
No. of data	06H
Year data (H)	39H
Year data (L)	38H
Month data (H)	31H
Month data (L)	32H
Day data (H)	32H
Day data (L)	35H
CRC (L)	EBH
CRC (H)	6DH

(Error check in ASCII mode)

LRC	F8H

LRC	BAH

Note) Start No. (Relative No.) is given by "Reference No. - 40001". (Decimal number 0 (=40001-40001) ⟶ Hexadecimal 00H)

Note) No. of data is the number of data bytes. (which is different from the requested number of data. In the example given above, the requested number of reference No. is 3 and the number of data is 6).

Note) The number of data of a message receivable at one time (that can be transmitted from the recorder) is limited. (See Section 6.4).

6.5.4 Read analog input data (read input register contents)

[Function code. 04 (04H)]

The specified number of " analog input (2 bytes: 16 bits)" are read out consecutively commencing with the designated Reference No. The data is split into higher-order 8 bits and lower-order 8 bits arranged sequentially in number to constitute a data of response message. The response example is the same as in "Function code 03", though its start number (Relative No.) is "Reference No. - 30001".

6.5.5 Write digital parameter (Change single coil status)

[Function code: 05 (05H)]

A digital parameter with specified numbers is brought into specified status (ON/OFF).

Example) Executing the title printing on the slave unit 2 (Turn on Reference No. 20 of digital parameter for the slave unit 2)

(RTU mode)

Master→Instruments

Slave address	02H
Function code	05H
Parameter No. (H)	00H
Parameter No. (L)	13H
Programming status (H)	FFH
Programming status (L)	00H
CRC (L)	7DH
CRC (H)	CCH

Instruments→ Master (normal)

Slave address	02H
Function code	05H
Parameter No. (H)	00H
Parameter No. (L)	13H
Programming status (H)	FFH
Programming status (L)	00H
CRC (L)	7DH
CRC (H)	CCH

(Error check in ASCII mode)

LRC	E7H

LRC	E7H

Note) The response is the same as command message in the case of a normal response.

Note) Parameter No. (Relative No.) is given by "Reference No. - 1".
(Decimal number 19 (=20-1) ⟶ Hexadecimal 13H)

Note) Upon execution, program "FF00H". In the key lock and print ON/OFF mode, program "0000H" for programming to OFF and "FF00H" for programming to ON.

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

6.5.6 Write analog parameter (write into a single hold register)

[Function code: 06 (06H)]

An analog parameter with specified numbers is brought into a specified value.

Example) Programming the alarm deadband of the slave unit 2 to 0.5 %.
(Program Reference No. 40081 of analog parameter to "5" for the slave unit 2.)
(RTU mode)

Master→Instruments

Slave address	02H
Function code	06H
Parameter No. (H)	00H
Parameter No. (L)	50H
Programming status (H)	00H
Programming status (L)	05H
CRC (L)	49H
CRC (H)	EBH

Instruments→Master (normal)

Slave address	02H
Function code	06H
Parameter No. (H)	00H
Parameter No. (L)	50H
Programming status (H)	00H
Programming status (L)	05H
CRC (L)	49H
CRC (H)	EBH

(Error check in ASCII mode)

LRC	A3H

LRC	A3H

Note) The response is the same as command message in case of normal response.

Note) Parameter No. (Relative No.) is given by "Reference No. - 40001". (Decimal number 80 (=40081 - 40001) ⟶ Hexadecimal 50H)

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

6.5.7 Loop back test

[Function code: 08 (08H)]

Checks transmission between master and slave units. Response is made according to a specified diagnosis code. With the diagnosis code fixed at “0000H”, the AL3000/AH3000 recorder performs a "return check” of unaltered received data transmissions.

Example 2) Executing "Loop back test" on the slave unit 2.

(RTU mode)

Master→Instruments

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

Instruments→ Master (normal)

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

6.5.8 Write multiple analog parameters (write into multiple hold registers)

[Function code: 16 (10H)]

A specified number of analog parameters from designated numbers are programmed to specified values. The data is split into higher-order 8 bits and lower-order 8 bits to be sent sequentially in number.

Example) Programming the time of the slave unit 2 to 30 minutes 00 second past 15 o'clock.

(Program 3 Reference Nos. from 40004 to 40006 of analog parameters for the slave unit 2)

Address	40004	40005	40006
Data	15 (3135H)	30 (3330H)	00 (3030H)

(RTU mode)

Master→Instruments

Slave address	02H
Function code	10H
Start No. (H)	00H
Start No. (L)	03H
Number of Reference No. (H)	00H
Number of Reference No. (L)	03H
Number of data	06H
1st data (H)	31H
1st data (L)	35H
2nd data (H)	33H
2nd data (L)	30H
3rd data (H)	30H
3rd data (L)	30H
CRC (L)	80H
CRC (H)	36H

Instruments→Master (normal)

Slave address	02H
Function code	10H
Start No. (H)	00H
Start No. (L)	03H
Number of Reference No. (H)	00H
Number of Reference No. (L)	03H
CRC (L)	70H
CRC (H)	3BH

(Error check in ASCII mode)

LRC	B9H

LRC	E8H

Note) Start No. (Relative value) is given by "Reference No. - 40001". (Decimal number 3 (=40004 - 40001) → Hexadecimal 03H)

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

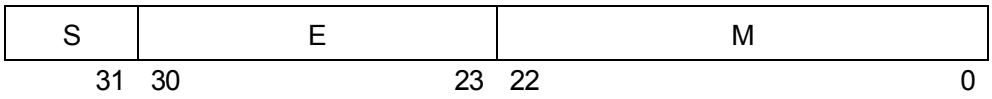
Note) The number of message data transmittable (receivable by this recorder) at one time is limited. (See Section 6.4.2)

6.5.9 Read floating data

[Function code: 70 (46H)]

A specified number of "floating data (floating-point data)" is read out of the designated numbers. This function code is not available in the standard MODBUS. 4 bytes of data (32 bits) constitute one floating data.

The format of floating data conforms to IEEE754.



S: Code bit of fixed-point part
E: Characteristic part (8 bits)
M: Fixed-point part (23 bits)

$$\text{Value} = (-1)^{S} \times 1.M \times 2^{E-127}$$

Example) Reading floating data of CH No.1 and CH No.2 of the slave unit 1.
(Read 2 Reference Nos. from 50101 to 50102 of floating data for the slave unit 1)

Address	50101	50102
Data	1234.5 (44H,9AH,50H,00H)	1.2345 (3FH,9FH,6FH,D2H)

(RTU data)

Master→Instruments

Slave address	01H
Function code	46H
Number of data	00H
Start No. (H)	00H
Start No. (L)	64H
Number of Reference No. (H)	00H
Number of Reference No. (L)	02H
CRC (L)	C5H
CRC (H)	78H

Instruments→Master

Slave address	01H
Function code	46H
Number of data	00H
Number of data	08H
1st data (1)	00H
1st data (2)	50H
1st data (3)	9AH
1st data (4)	44H
Next data (1)	D2H
Next data (2)	6FH
Next data (3)	9FH
Next data (4)	3FH
CRC (L)	28H
CRC (H)	3DH

(Error check in ASCII mode)

LRC	53H

LRC	64H

Note) Data type is fixed at 00H.

Note) Start No. (Relative No.) is given by "Reference No. - 50001". (Decimal number 100 (=50101 - 50001) ⟶ Hexadecimal 64H)

Note) No. of data is the number of data bytes.
(which is different from the requested number of data. In the example given above, the requested number of Reference No. is 2 and the number of data is 8).

Note) The floating-point data is transmitted from LSB.

6.5.10 Write floating data

[Function code: 71 (47H)]

A specified number of "floating data (floating-point data)" from the designated numbers is programmed to specified values. This function code is not available in the standard MODBUS. 4 bytes of data (32 bits) constitute one floating data.

Example) Writing input data of CH No.1 and CH No.2 of the slave unit1.

(Program 2 Reference Nos. from 50201 to 50202 of floating data to the following values for the slave unit 1.)

Address	50201	50202
Data	1234.5 (44H,9AH,50H,00H)	1.2345 (3FH,9FH,6FH,D2H)

(RTU data)

Master→Instrument

Slave address	01H
Function code	47H
Number of data	00H
Start No. (H)	00H
Start No. (L)	C8H
Number of Reference No. (H)	00H
Number of Reference No. (L)	02H
Number of data	08H
1st data (1)	00H
1st data (2)	50H
1st data (3)	9AH
1st data (4)	44H
Next data (1)	D2H
Next data (2)	6FH
Next data (3)	9FH
Next data (4)	3FH
CRC (L)	C1H
CRC (H)	B3H

Master → PC (normal)

Slave address	01H
Function code	47H
Number of data	00H
Start No. (H)	00H
Start No. (L)	C8H
Number of Reference No. (H)	00H
Number of Reference No. (L)	02H
CRC(L)	04H
CRC(H)	88H

(Error check in ASCII mode)

LRC	99H

LRC	EEH

Note) Data type is fixed at 00H.

Note) Start No. (Relative No.) is given by "Reference No. - 50001". (Decimal number 200 (=50201 - 50001) ⟶ Hexadecimal C8H)

Note) No. of data is the number of data bytes.
(which is different from the requested number of data. In the example given above, the requested number of Reference No. is 2 and the number of data is 8).

Note) Transmit the floating-point data from LSB.

6.6 Processing in Abnormal Status

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

6.6.1 Case of no response

The message is ignored with no response given when

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

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

(3) Data interval in messages is too long;

28 bits or more in RTU mode

1 second or more in ASCII mode

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

(5) The bytes of the received message exceeds 512.

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

6.6.2 Response error message

If the following failure is detected in a message from the master unit with no error specified in Section 6.6.1, the code indicating the error is responded as an "error message".

The error message format is as follows.

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

Function code	Function code + 80H
01	81H
02	82H
03	83H
04	84H
05	85H
06	86H
08	88H
16	90H
70	C6H
71	C7H

Error codes are as follows.

Error code	Description
01H	Function code failure When receiving an unspecified function code
02H	Relative No. (Reference No.) failure When the start No. or parameter No. received is not the specified number.
03H	Data pieces failure In any of the following cases that: (1) the function code received is not consistent with the number of data pieces ・with the function code "16", the "number of data" is not twice the "number of pieces"; ・with the function code "71", the "number of data" is not quadruple the "number of pieces"; ・with the function code "16" or "71", the number of data is not consistent with the "number of data received". (2) The number of data pieces to be transmitted in response to the message received exceeds a specified number. ・Floating data: Maximum 60 ・Other than floating data: Maximum 120
11H	Not in the programming range (set error) In any of the following cases (1) Not in the specified range (month, day, hour, minute, range No., etc.) (2) Programmed value (binary) exceeds the range between "-9999 to 30000". (3) Data communications input data (binary) exceeds the range between"-9999 to 32765".However,overrange data(32767 or –32767) and burnout data (32766) are acceptable. (4) Floating data exceeds the range between "-9999 to 99999". (5) Decimal-point data exceeds the range between "0 to 3". (6) Programming of time interval for periodic data printing is disabled because of chart speed. (7) Contradiction in the direction of increase/decrease at programming of automatic range-shift printing or compressed/expanded printing occurs. (8) For ranges other than thermocouple input, internal reference junction compensation is programmed.
12H	Programming disabled (1) When receiving a message in any of the following cases ・During initialization after turning the power on (with the "INITIAL" display on this unit) ・Scale calibration mode ・Check mode (2) When receiving a programming message in any of the following cases ・During programming with the front-panel keys ・When receiving "digital data printing", "list printing" or "feed" command in the Printing OFF status ・Receiving a parameter programming message for multiple channels during parameter programming on each channel ・When receiving a parameter programming message for an optional function not installed (A "0" response is given to a read message.)

6.7 Title Printing Function

Arbitrary characters can be printed on the chart of this recorder through communications.

(Printing Specifications)

	AH 3000 series	AL 3000 series
No. of print characters	Max. 72 characters	Max. 40 characters
Type of print characters	Alphanumeric characters (caps and lows), Symbols	
Print colors	Trace printing system: 6 colors of red, black, blue, green, brown and purple can be specified	
Feed selection	Printing interrupting trace printing or printing on trace printing can be selected	

(Procedure)

(1) Print colors, feed selection and print data are transmitted from the master to this unit. (see Reference Nos. 48001 to 48050)

(2) Execute message is transmitted from the master to this recorder (Reference No. 20. See Section 6.5.5)

Note) If (2) is executed without doing (1), the information printed last time will be printed again. No printing will take place if no title printing has ever been done.

6.8 Data Communication Input

This is the function of printing the "data" transmitted from the master unit through communications in the same manner as measured data. The transmitted data can be printed, operated (for alarms etc.) and output for communications exactly as measured data.

<Procedure>

(1) Transmit in advance operation No. of the channel for printing the data communications input and the printing range (maximum and minimum values) from the master to this recorder in advance. This programming can be executed through communications only. Once they are transmitted, there is no need for sending them again until any change in the printing range etc. is required. (See reference Nos. 40165 to 42500)

(2) The data to be printed is transmitted from the master unit.
(Reference Nos. 49001 to 49048, Floating data 50201 to 50224)

(3) The printed data is updated every time new data is sent from the master unit.

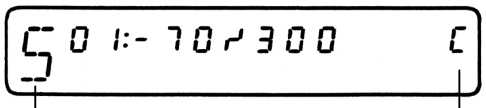
Note 1) Printed data becomes "------" until the first data is sent from the master unit after turning the power on.

Note 2) Even if the range has been programmed at the printing channel, measured data is replaced with the data communications input data. The Reference Nos. are therefore different when identifying the data transmitted from the master unit.
(Reference No.: 30101 to 30148, Floating data 50101 to 50124)

Note 3) If data is transmitted from the master unit without executing (1), an error code "12H" is given as a response.

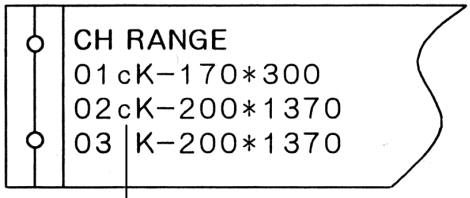
Note 4) The channel in which the data communications input has been programmed, “C” is displayed/printed on the programming scale and list printing.

(Example: Display on scale programming)



Scale programming “C” is displayed right side.

(Example: List printing)



Low character “c” is printed beside Channel No.

6.9 Table of Reference

6.9.1 Digital parameters

R/W……R:READ, W:WRITE

Reference No.	Applicable function code	R/W	Description	Details
01	01 05	R W	Key lock	0(0000h) = Key lock disabled 1(FF00h) = Key lock enabled ( ) for the function code of 05 Error code : 01H, 02H, 03H,11H,12H
10	01 05	R W	Message 1 printing *Pen-writing type only	0(0000h) = Print OFF 1(FF00h) = Print ON ( ) for the function code of 05 Error code : 01H, 02H, 03H,11H,12H
11	01 05	R W	Message 2 printing *Pen-writing type only	0 = Print not executed (execution completed) 1(FF00h) = Print being executed (execution started) ( ) for the function code of 05 Error code : 01H,02H,03H,11H,12H
12	01 05	R W	Message 3 printing *Pen-writing type only	0 = Print not executed (execution completed) 1(FF00h) = Print being executed (execution started) ( ) for the function code of 05 Error code : 01H,02H,03H,11H,12H
13	01 05	R W	Message 4 printing *Pen-writing type only	0 = Print not executed (execution completed) 1(FF00h) = Print being executed (execution started) ( ) for the function code of 05 Error code : 01H,02H,03H,11H,12H
14	01 05	R W	Message 5 printing *Pen-writing type only	0 = Print not executed (execution completed) 1(FF00h) = Print being executed (execution started) ( ) for the function code of 05 Error code : 01H,02H,03H,11H,12H
17	01 05	R W	Print ON/OFF	0(0000h) = Print OFF 1(FF00h) = Print ON ( ) for the function code of 05 Error code : 01H, 02H, 03H,11H,12H
18	01 05	R W	Feed execution	0 = Print not executed (execution completed) 1(FF00h) = Print being executed (execution started) ( ) for the function code of 05 10 mm feed for every reception of execution Error code : 01H, 02H, 03H,11H,12H
19	01 05	R W	List printing	0 = Print not executed (execution completed) 1(FF00h) = Print being executed (execution started) ( ) for the function code of 05 Error code : 01H,02H,03H,11H,12H
20	01 05	R W	Title printing	0 = Print not executed (execution completed) 1(FF00h) = Print being executed (execution started) ( ) for the function code of 05 Error code : 01H, 02H, 03H,11H,12H

R/W……R:READ, W:WRITE

Reference No.	Applicable function code	R/W	Description	Details
21	01 05	R W	Digital data printing	0 = Print not executed (execution completed) 1(FF00h) = Print being executed (execution started) ( ) for the function code of 05 Error code : 01H, 02H, 03H,11H,12H
25	01 05	R W	Temperature unit	0(0000h) = °C 1(FF00h) = °F ( ) for the function code of 05 Error code : 01H, 02H, 03H,11H,12H
26	01 05	R W	High-speed trace printing *Multi-point type only	0(0000h) = Standard (Approx. 5 sec/dot) 1(FF00h) = Fast (Approx. 2.5 sec/dot) ( ) for the function code of 05 Error code : 01H, 02H, 03H,11H,12H
27	01 05	R W	Time-axis synchronization *Pen-writing type only	0(0000h) = Normal mode 1(FF00h) = Time-axis synchronization mode ( ) for the function code of 05 Error code : 01H, 02H, 03H,11H,12H
33	01 05	R W	List 1 printing *Pen-writing type only	0 = Print not executed (execution completed) 1(FF00h) = Print being executed (execution started) ( ) for the function code of 05 Error code : 01H,02H,03H,11H,12H
34	01 05	R W	List 2 printing *Pen-writing type only	0 = Print not executed (execution completed) 1(FF00h) = Print being executed (execution started) ( ) for the function code of 05 Error code : 01H,02H,03H,11H,12H
35	01 05	R W	List 3 printing *Pen-writing type only	0 = Print not executed (execution completed) 1(FF00h) = Print being executed (execution started) ( ) for the function code of 05 Error code : 01H,02H,03H,11H,12H
49	01 05	R W	Alarm relay coil *Pen-writing type only	0 = Not energized 1(FF00h) = Energized ( ) for the function code of 05 Error code : 01H,02H,03H,11H,12H
50	01 05	R W	Alarm output latching *Pen-writing type only	0 = Not holding 1(FF00h) = Holding ( ) for the function code of 05 Error code : 01H,02H,03H,11H,12H

6.9.2 Digital input data

R/W……R:READ, W:WRITE

Reference No.	Applicable function code	R/W	Description	Details
10009 10010 10011 10012	02	R	Remote contacts 1 status Remote contacts 2 status Remote contacts 3 status Remote contacts 4 status	Status of remote contacts input 0 : OFF 1 : ON
10101 10102	02	R	CH1 Status 1	Status expression with 2 BIT 00 : Measured value 01 : Operation data 10 : Communications input data Error code : 01H, 02H, 03H
10105 10106 10107 10108	02	R	CH1 Status 2	Status expression with 4 BIT 0000 : Normal data 0001 : + Over range 0010 : - Over range 0100 : Burnout 1000 : Invalid data (initialization, during data logging, no range programming) Error code : 01H, 02H, 03H
10109 10110 10111 10112	02	R	CH1 Alarm level 1 CH1 Alarm level 2 CH1 Alarm level 3 CH1 Alarm level 4 Status	0 : No alarm 1 : Alarm on Error code : 01H, 02H, 03H
10117 10118	02	R	CH2Status 1	Status expression with 2 BIT 00 : Measured value 01 : Operation data 10 : Communications input data Error code : 01H, 02H, 03H
10121 10122 10123 10124	02	R	CH2Status 2	Status expression with 4 BIT 0000 : Normal data 0001 : + Over range 0010 : - Over range 0011 : Burnout 1000 : Invalid data (initialization, during data logging, no range programming) Error code : 01H,02H,03H
10125 10126 10127 10128	02	R	CH2 Alarm level 1 CH2 Alarm level 2 CH2 Alarm level 3 CH2 Alarm level 4 Status	0 : No alarm 1 : Alarm on Error code : 01H, 02H, 03H

R/W……R:READ, W:WRITE

Reference No.	Applicable function code	R/W	Description	Details
10133 to 10134	02	R	CH3 Status 1	Same as CH1
10137 to 10140	02	R	CH3 Status 2	Same as CH1
10141 to 10144	02	R	CH3 Alarm level 1 to CH3 alarm level 4 status	Same as CH1
10149 to 10150	02	R	CH4 Status 1	Same as CH1
10153 to 10156	02	R	CH4 Status 2	Same as CH1
10157 to 10160	02	R	CH4 Alarm level 1 to CH4 alarm level 4 status	Same as CH1
10165 to 10166	02	R	CH5 Status 1	Same as CH1
10169 to 10172	02	R	CH5 Status 2	Same as CH1
10173 to 10177	02	R	CH5 Alarm level 1 to CH5 alarm level 4 status	Same as CH1
10181 to 10182	02	R	CH6 Status 1	Same as CH1
10185 to 10188	02	R	CH6 Status 2	Same as CH1
10189 to 10192	02	R	CH6 Alarm level 1 to CH6 alarm level 4 status	Same as CH1
10197 to 10198	02	R	CH7 Status 1	Same as CH1
10201 to 10204	02	R	CH7 Status 2	Same as CH1
10205 to 10208	02	R	CH7 Alarm level 1 to CH7 alarm level 4 status	Same as CH1
10213 to 10214	02	R	CH8 Status 1	Same as CH1
10217 to 10220	02	R	CH8 Status 2	Same as CH1
10221 to 10224	02	R	CH8 Alarm level 1 to CH8 alarm level 4 status	Same as CH1
10229 to 10230	02	R	CH9 Status 1	Same as CH1
10233 to 10236	02	R	CH9 Status 2	Same as CH1
10237 to 10240	02	R	CH9 Alarm level 1 to CH9 alarm level 4 status	Same as CH1
10245 to 10246	02	R	CH10 Status 1	Same as CH1
10249 to 10252	02	R	CH10 Status 2	Same as CH1
10253 to 10256	02	R	CH10 Alarm level 1 to CH10 alarm level 4 status	Same as CH1
10261 to 10262	02	R	CH11 Status 1	Same as CH1
10265 to 10268	02	R	CH11 Status 2	Same as CH1
10269 to 10272	02	R	CH11 Alarm level 1 to CH11 alarm level 4 status	Same as CH1
10277 to 10278	02	R	CH12 Status 1	Same as CH1
10281 to 10284	02	R	CH12 Status 2	Same as CH1
10285 to 10288	02	R	CH12 Alarm level 1 to CH12 alarm level 4 status	Same as CH1
10293 to 10294	02	R	CH13 Status 1	Same as CH1
10297 to 10300	02	R	CH13 Status 2	Same as CH1
10301 to 10304	02	R	CH13 Alarm level 1 to CH13 alarm level 4 status	Same as CH1
10309 to 10310	02	R	CH14 Status 1	Same as CH1
10313 to 10316	02	R	CH14 Status 2	Same as CH1
10317 to 10320	02	R	CH14 Alarm level 1 to CH14 alarm level 4 status	Same as CH1
10325 to 10326	02	R	CH15 Status 1	Same as CH1
10329 to 10332	02	R	CH15 Status 2	Same as CH1
10333 to 10336	02	R	CH15 Alarm level 1 to CH15 alarm level 4 status	Same as CH1
10341 to 10342	02	R	CH16 Status 1	Same as CH1
10345 to 10348	02	R	CH16 Status 2	Same as CH1
10349 to 10352	02	R	CH16 Alarm level 1 to CH16 alarm level 4 status	Same as CH1

R/W……R:READ, W:WRITE

Reference No.	Applicable function code	R/W	Description	Details
10357 to 10358	02	R	CH17 Status 1	Same as CH1
10361 to 10364	02	R	CH17 Status 2	Same as CH1
10365 to 10368	02	R	CH17 Alarm level 1 to CH17 alarm level 4 status	Same as CH1
10373 to 10374	02	R	CH18 Status 1	Same as CH1
10377 to 10380	02	R	CH18 Status 2	Same as CH1
10381 to 10384	02	R	CH18 Alarm level 1 to CH18 alarm level 4 status	Same as CH1
10389 to 10390	02	R	CH19 Status 1	Same as CH1
10393 to 10396	02	R	CH19 Status 2	Same as CH1
10397 to 10400	02	R	CH19 Alarm level 1 to CH19 alarm level 4 status	Same as CH1
10405 to 10406	02	R	CH20 Status 1	Same as CH1
10409 to 10412	02	R	CH20 Status 2	Same as CH1
10413 to 10416	02	R	CH20 Alarm level 1 to CH20 alarm level 4 status	Same as CH1
10421 to 10422	02	R	CH21 Status 1	Same as CH1
10425 to 10428	02	R	CH21 Status 2	Same as CH1
10429 to 10432	02	R	CH21 Alarm level 1 to CH21 alarm level 4 status	Same as CH1
10437 to 10438	02	R	CH22 Status 1	Same as CH1
10441 to 10444	02	R	CH22 Status 2	Same as CH1
10445 to 10448	02	R	CH22 Alarm level 1 to CH22 alarm level 4 status	Same as CH1
10453 to 10454	02	R	CH23 Status 1	Same as CH1
10457 to 10460	02	R	CH23 Status 2	Same as CH1
10461 to 10464	02	R	CH23 Alarm level 1 to CH23 alarm level 4 status	Same as CH1
10469 to 10470	02	R	CH24 Status 1	Same as CH1
10473 to 10476	02	R	CH24 Status 2	Same as CH1
10477 to 10480	02	R	CH24 Alarm level 1 to CH24 alarm level 4 status	Same as CH1

6.9.3 Analog input data

1) Read the instrument specifications

R/W……R:READ, W:WRITE

Reference No.	Applicable function code	R/W	Description	Details
30001	04	R	Instrument name characters 1,2	ASCII "AL" or "AH (model name) Error code : 01H, 2H, 03H,12H
30002	04	R	Instrument name characters 3,4	ASCII "37" fixed Error code : 01H, 2H, 03H,12H
30003	04	R	Instrument name characters 5,6	ASCII 1st digit... 6: 6 points 2, 2: 12 points, 4: 24 points 2nd digit...AL: 5(fixed), AH VFD: 0, LCD: 5 Pen-writing type:P(fixed) Error code : 01H, 2H, 03H,12H
30009	04	R	ROM Version characters 1,2	ASCII 2 digits Error code : 01H, 2H, 03H,12H
30010	04	R	ROM Version characters 3,4	ASCII 2 digits Error code : 01H, 2H, 03H,12H
30011	04	R	ROM Version characters 5,6	ASCII 2 digits Error code : 01H, 2H, 03H,12H

R/W……R:READ, W:WRITE

Reference No.	Applicable function code	R/W	Description	Details
30017	04	R	Number of inputs	No. of channels Error code : 01H, 2H, 03H,12H
30025	04	R	No. of alarm outputs	0 : None, 6, 12, 24 Error code : 01H, 2H, 03H,12H
30026	04	R	Remote contacts	0 : None, 1 : Provided Error code : 01H, 2H, 03H,12H
30027	04	R	Type of communications	0 : None, 1 : RS232C、2 : RS422A、3 : RS485 Error code : 01H, 2H, 03H,12H
30028	04	R	Option information	0 : None, 1 : Printing format + High-speed trace printing Error code : 01H, 2H, 03H,12H

2) Read measured data

R/W……R:READ, W:WRITE

Reference No.	Applicable function code	R/W	Description	Details
30101	04	R	CH1 data	DATA : -9999～32765 -32768 : 2 Binary expression over 32767 : + Over range -32767 : -Over range 32766 : Burnout data -32766 : Invalid data Error code : 01H, 2H, 03H,12H
30102	04	R	CH1 Decimal point	0 to 3 Error code : 01H, 2H, 03H,12H
30103	04	R	CH2 data	Same as CH1 Error code : 01H, 02H, 03H,12H
30104	04	R	CH2 Decimal point	0 to 3 Error code : 01H, 02H, 03H,12H
30105	04	R	CH3 data	Same as CH1 Error code : 01H, 02H, 03H,12H
30106	04	R	CH3 Decimal point	0 to 3 Error code : 01H, 02H, 03H,12H
30107	04	R	CH4 data	Same as CH1 Error code : 01H, 02H, 03H,12H
30108	04	R	CH4 Decimal point	0 to 3 Error code : 01H, 02H, 03H,12H
30109	04	R	CH5 data	Same as CH1 Error code : 01H, 02H, 03H,12H
30110	04	R	CH5 Decimal point	0 to 3 Error code : 01H, 02H, 03H,12H
30111	04	R	CH6 data	Same as CH1 Error code : 01H, 02H, 03H,12H
30112	04	R	CH6 Decimal point	0 to 3 Error code : 01H, 02H, 03H,12H
30113	04	R	CH7 data	Same as CH1 Error code : 01H, 02H, 03H,12H
30114	04	R	CH7 Decimal point	0 to 3 Error code : 01H, 02H, 03H,12H

R/W……R:READ, W:WRITE

Reference No.	Applicable function code	R/W	Description	Details
30115	04	R	CH8 data	Same as CH1 Error code : 01H, 02H, 03H,12H
30116	04	R	CH8 Decimal point	0 to 3 Error code : 01H, 02H, 03H,12H
30117	04	R	CH9 data	Same as CH1 Error code : 01H, 02H, 03H,12H
30118	04	R	CH9 Decimal point	0 to 3 Error code : 01H, 02H, 03H,12H
30119	04	R	CH10 data	Same as CH1 Error code : 01H, 02H, 03H,12H
30120	04	R	CH10 Decimal point	0 to 3 Error code : 01H, 02H, 03H,12H
30121	04	R	CH11 data	Same as CH1 Error code : 01H, 02H, 03H,12H
30122	04	R	CH11 Decimal point	0 to 3 Error code : 01H, 02H, 03H,12H
30123	04	R	CH12 data	Same as CH1 Error code : 01H, 02H, 03H,12H
30124	04	R	CH12 Decimal point	0 to 3 Error code : 01H, 02H, 03H,12H
30125	04	R	CH13 data	Same as CH1 Error code : 01H, 02H, 03H,12H
30126	04	R	CH13 Decimal point	Same as CH1 Error code : 01H, 02H, 03H,12H
30127	04	R	CH14 data	Same as CH1 Error code : 01H, 02H, 03H,12H
30128	04	R	CH14 Decimal point	0 to 3 Error code : 01H, 02H, 03H,12H
30129	04	R	CH15 data	Same as CH1 Error code : 01H, 02H, 03H,12H
30130	04	R	CH15 Decimal point	0 to 3 Error code : 01H, 02H, 03H,12H
30131	04	R	CH16 data	Same as CH1 Error code : 01H, 02H, 03H,12H
30132	04	R	CH16 Decimal point	0 to 3 Error code : 01H, 02H, 03H,12H
30133	04	R	CH17 data	Same as CH1 Error code : 01H, 02H, 03H,12H
30134	04	R	CH17 Decimal point	0 to 3 Error code : 01H, 02H, 03H,12H
30135	04	R	CH18 data	Same as CH1 Error code : 01H, 02H, 03H,12H
30136	04	R	CH18 Decimal point	0 to 3 Error code : 01H, 02H, 03H,12H
30137	04	R	CH19 data	Same as CH1 Error code : 01H, 02H, 03H,12H
30138	04	R	CH19 Decimal point	0 to 3 Error code : 01H, 02H, 03H,12H

R/W……R:READ, W:WRITE

Reference No.	Applicable function code	R/W	Description	Details
30139	04	R	CH20 data	Same as CH1 Error code : 01H, 02H, 03H,12H
30140	04	R	CH20 Decimal point	0 to 3 Error code : 01H, 02H, 03H,12H
30141	04	R	CH21 data	Same as CH1 Error code : 01H, 02H, 03H,12H
30142	04	R	CH21 Decimal point	0 to 3 Error code : 01H, 02H, 03H,12H
30143	04	R	CH22 data	Same as CH1 Error code : 01H, 02H, 03H,12H
30144	04	R	CH22 Decimal point	0 to 3 Error code : 01H, 02H, 03H,12H
30145	04	R	CH23 data	Same as CH1 Error code : 01H, 02H, 03H,12H
30146	04	R	CH23 Decimal point	0 to 3 Error code : 01H, 02H, 03H,12H
30147	04	R	CH24 data	Same as CH1 Error code : 01H, 02H, 03H,12H
30148	04	R	CH24 Decimal point	0 to 3 Error code : 01H,02H,03H,12H

6.9.4 Analog parameters

1) Parameters common to channels (1)

R/W……R:READ, W:WRITE

Reference No.	Applicable function code	R/W	Description	Details
40001	03 06 16	R W W	Clock programming (year)	ASCII 2 digits (space code available for 1st digit) 00 to 97 : 2000 to 2097 years 98 to 99 : 1998 to 1999 years Error code : 01H, 02H, 03H,11H
40002	03 06 16	R W W	Clock programming (month)	ASCII 2 digits (space code available for 1st digit) 01 to 12 Error code : 01H, 02H, 03H,11H
40003	03 06 16	R W W	Clock programming (date)	ASCII 2 digits (space code available for 1st digit) 01 to 31 Identifying leap year, Identifying between longer and shorter months. Error code : 01H, 02H, 03H,11H
40004	03 06 16	R W W	Clock programming (hour)	ASCII 2 digits (space code available for 1st digit) 00 to 23 Error code : 01H, 02H, 03H,11H
40005	03 06 16	R W W	Clock programming (minute)	ASCII 2 digits (space code available for 1st digit) 00 to 59 Error code : 01H, 02H, 03H,11H
40006	03 06 16	R W W	Clock programming (second)	ASCII 2 digits (space code available for 1st digit) 00 to 59 Error code : 01H, 02H, 03H,11H
40007	03	R	Upper 2 digits of the year	ASCII 2 digits 19,20 Error code : 01H, 02H, 03H,12H

R/W……R:READ, W:WRITE

Reference No.	Applicable function code	R/W	Description	Details
40008	03	R	Lower 2 digits of the year	ASCII 2 digits 00 to 99 Error code : 01H, 02H, 03H,12H
40017	03	R	Execute chart No.	1 to 3 Valid for read only Error code : 01H, 02H, 03H,11H,12H
40019	03 06 16	R W W	Chart speed 1 programming	1 to 1500 : 1 to 1500mm/h 1mm Step Error code : 01H, 02H, 03H,11H
40022	03 06 16	R W W	Chart speed 2 programming	1 to 1500 : 1 to 1500mm/h 1mm Step Write valid only for the external drive option provided Error code : 01H, 02H, 03H,11H
40025	03 06 16	R W W	Chart speed 3 programming	1 to 1500 : 1 to 1500mm/h 1mm Step Write valid only for the external drive option provided Error code : 01H, 02H, 03H,11H
40034	03 06 16	R W W	Data interval programming Interval (hour)	ASCII 2 digits (space code available for 1st digit) 00 to 24 Error code : 01H, 02H, 03H,11H
40035	03 06 16	R W W	Data interval programming Interval (minute)	ASCII 2 digits (space code available for 1st digit) 00 to 59 Error code : 01H, 02H, 03H,11H
40036	03 06 16	R W W	Data interval programming Start Time (hour)	ASCII 2 digits (space code available for 1st digit) 00 to 23 Error code : 01H, 02H, 03H,11H
40037	03 06 16	R W W	Data interval programming Start Time (minute)	ASCII 2 digits (space code available for 1st digit) 00 to 59 Error code : 01H, 02H, 03H,11H
40049	03 06 16	R W W	Printing format type	0 : Standard、1 : Automatic range-shift 2 : Compressed/expanded、3 : Zone Error code : 01H, 02H, 03H,11H,12H
40050	03 06 16	R W W	Zone printing No. of areas	AL : 2、AH : 2 to 4 Error code : 01H, 02H, 03H,11H,12H
40051	03 06 16	R W W	Zone printing 1st Area programming CH1	ASCII 2 digits (space code available for 1st digit) 01 to No. of channels、00H : No set Error code : 01H, 02H, 03H,11H,12H
40052	03 06 16	R W W	Zone printing 1st Area division 1	0 : No programming , 1 : / , 2 : ~ (to) Error code : 01H, 02H, 03H,11H,12H
40053	03 06 16	R W W	Zone printing 1st Area programming CH2	ASCII 2 digits (space code available for 1st digit) 01 to No. of channels、00H : No programming Error code : 01H, 02H, 03H,11H,12H
40054	03 06 16	R W W	Zone printing 1st Area division 2	0 : No programming , 1 : / , 2 : ~ (to) Error code : 01H, 02H, 03H,11H,12H

R/W……R:READ, W:WRITE

Reference No.	Applicable function code	R/W	Description	Details
40055	03 06 16	R W W	Zone printing 1st Area programming CH3	ASCII 2 digits (space code available for 1st digit) 01 to No. of channels、00H : No programming Error code : 01H, 02H, 03H,11H,12H
40056	03 06 16	R W W	Zone printing 2nd Area programming CH1	ASCII 2 digits (space code available for 1st digit) 01 to No. of channels、00H : No programming Error code : 01H, 02H, 03H,11H,12H
40057	03 06 16	R W W	Zone printing 2nd Area division 1	0 : No programming , 1 : / , 2 : ~ (to) Error code : 01H, 02H, 03H,11H,12H
40058	03 06 16	R W W	Zone printing 2nd Area programming CH2	ASCII 2 digits (space code available for 1st digit) 01 to No. of channels、00H : No programming Error code : 01H, 02H, 03H,11H,12H
40059	03 06 16	R W W	Zone printing 2nd Area division 2	0 : No programming , 1 : / , 2 : ~ (to) Error code : 01H, 02H, 03H,11H,12H
40060	03 06 16	R W W	Zone printing 2nd Area programming CH3	ASCII 2 digits (space code available for 1st digit) 01 to No. of channels、00H : No programming Error code : 01H, 02H, 03H,11H,12H
40061	03 06 16	R W W	Zone printing 3rd Area programming CH1	ASCII 2 digits (space code available for 1st digit) 01 to No. of channels、00H : No programming Error code : 01H, 02H, 03H,11H,12H
40062	03 06 16	R W W	Zone printing 3rd Area division 1	0 : No programming, 1 : / , 2 : ~ Error code : 01H,02H,03H,11H,12H
40063	03 06 16	R W W	Zone printing 3rd Area programming CH2	ASCII 2 digits (space code available for 1st digit) 01 to No. of channels、00H : No programming Error code : 01H, 02H, 03H,11H,12H
40064	03 06 16	R W W	Zone printing 3rd Area division 2	0 : No programming, 1 : / , 2 : ~ (to) Error code : 01H, 02H, 03H,11H,12H
40065	03 06 16	R W W	Zone printing 3rd Area programming CH3	ASCII 2 digits (space code available for 1st digit) 01 to No. of channels、00H : No programming Error code : 01H, 02H, 03H,11H,12H
40066	03 06 16	R W W	Zone printing 4th Area programming CH4	ASCII 2 digits (space code available for 1st digit) 01 to No. of channels、00H : No programming Error code : 01H, 02H, 03H,11H,12H
40067	03 06 16	R W W	Zone printing 4th Area division 1	0 : No programming, 1 : / , 2 : ~ (to) Error code : 01H, 02H, 03H,11H,12H
40068	03 06 16	R W W	Zone printing 4th Area programming CH2	ASCII 2 digits (space code available for 1st digit) 01 to No. of channels、00H : No programming Error code : 01H, 02H, 03H,11H,12H
40069	03 06 16	R W W	Zone printing 4th Area division 2	0 : No programming, 1 : / , 2 : ~ (to) Error code : 01H, 02H, 03H,11H,12H
40070	03 06 16	R W W	Zone printing 4th Area programming CH3	ASCII 2 digits (space code available for 1st digit) 01 to No. of channels、00H : No programming Error code : 01H, 02H, 03H,11H,12H

R/W……R:READ, W:WRITE

Reference No.	Applicable function code	R/W	Description	Details
40081	03 06 16	R W W	Alarm deadband	01 to 99 (Decimal point 1digit fixed) Error code : 01H, 02H, 03H,11H,12H

* Up to 2 areas can be programmed on AL3000
* Zone printing programming: Same set as key operation

(Example) 1st area programming In case of 01 to 03/06

Reference No. 40051	01	(3031H)
Reference No. 40051	~ (to)	(0002H)
Reference No. 40051	03	(3033H)
Reference No. 40051	/	(0001H)
Reference No. 40051	06	(3036H)

2) Programming parameters per channel

(Note) Writing multiple parameters across two or more channels will constitute an error (error code 12H)

R/W……R:READ, W:WRITE

Reference No.	Applicable function code	R/W	Description	Details
40102	03 06 16	R W W	CH1 Range No	ASCII 2 digits (space code available for 1st digit) 00H : No programming Error code : 01H, 02H, 03H,11H,12H
40103	03 06 16	R W W	CH1 RJ internal/external	0 : External, 1 : Internal * For inputs other than thermocouple, “0:External” is fixed. Error code : 01H, 02H, 03H,11H,12H
40104	03 06 16	R W W	CH1 Range minimum value	-9999 to 30000 * Up to 9 digits including max. value, min, value and symbols. Error code : 01H, 02H, 03H,11H,12H
40105	03 06 16	R W W	CH1 Range maximum value	-9999 to 30000 * Up to 9 digits including max. value, min, value and symbols. Error code : 01H, 02H, 03H,11H,12H
40106	03 06 16	R W W	CH1 Range DP	Range decimal places * Same decimal place for both max. and min. value Error code : 01H, 02H, 03H,11H,12H
40107	03 06 16	R W W	CH1 Scale minimum value	-9999 to 30000 Error code : 01H, 02H, 03H,11H,12H
40108	03 06 16	R W W	CH1 Scale maximum value	-9999 to 30000 Error code : 01H, 02H, 03H,11H,12H
40109	03 06 16	R W W	CH1 Scale DP	Scale decimal places * Same decimal place for both max. and min. value Error code : 01H, 02H, 03H,11H,12H
40110	03 06 16	R W W	CH1 Burnout	0 : Disabled, 1 : Up-burnout、2 : Down-burnout Error code : 01H, 02H, 03H,11H,12H

R/W……R:READ, W:WRITE

Reference No.	Applicable function code	R/W	Description	Details
40112	03 06 16	R W W	CH1 Printing color	1 : Red, 2 : Black, 3 : Blue, 4 : Green, 5 : Brown, 6 : Purple Error code : 01H, 02H, 03H,11H,12H
40113	03 06 16	R W W	CH1 Subtract printing reference channel	ASCII 2 digits (space code available for 1st digit) 01 to No. of channels、00H : No set Error code : 01H, 02H, 03H,11H,12H
40114	03 06 16	R W W	CH1 Subtract printing subtracted channel	ASCII 2 digits (space code available for 1st digit) 01~No. of channels、00H : No programming Error code : 01H, 02H, 03H,11H,12H
40115	03 06 16	R W W	CH1 Subtract printing reference value	-9999~ to 30000(Scale decimal point of reference channel used for decimal place) * Valid when Subtracted channel is set to 00H (No programming) Error code :01H, 02H,0 3H,11H,12H
40116	03 06 16	R W W	CH1 Subtract printing minimum value	-9999~ to 30000(Scale decimal point used for decimal place) Error code :01H, 02H,0 3H,11H,12H
40117	03 06 16	R W W	CH1 Subtract printing maximum value	-9999~ to 30000(Scale decimal point used for decimal place) Error code :01H, 02H,0 3H,11H,12H
40119	03 06 16	R W W	CH1 Unit character 1, 2	ASCII code 1 digit (00H for no programming) Error code : 01H, 02H, 03H,11H,12H
40120	03 06 16	R W W	CH1 Unit character 3, 4	ASCII code 1 digit (00H for no programming) Error code : 01H, 02H, 03H,11H,12H
40121	03 06 16	R W W	CH1 Unit character 5	ASCII code 1 digit (00H for no programming) 00H for 2nd digit Error code : 01H, 02H, 03H,11H,12H
40125	03 06 16	R W W	CH1 Tag character 1,2	ASCII code 2 digits (00H for no programming Error code : 01H, 02H, 03H,11H,12H
40126	03 06 16	R W W	CH1 Tag character 3,4	ASCII code 2 digits (00H for no programming) Error code : 01H, 02H, 03H,11H,12H
40127	03 06 16	R W W	CH1 Tag Character 5,6	ASCII code 2 digits (00H for no programming) Error code : 01H, 02H, 03H,11H,12H
40128	03 06 16	R W W	CH1 Tag character 7,8	ASCII code 2 digits (00H for no programming Error code : 01H, 02H, 03H,11H,12H
40129	03 06 16	R W W	CH1 Tag character 9	ASCII code 1 digit (00H for no programming) 00H for 2nd digit Error code : 01H, 02H, 03H,11H,12H
40133	03 06 16	R W W	CH1 Level 1 alarm mode	0 : No programming, 1 : H, 2 : L, 3 : U, 4 : D 5 : B, 6 : S Error code : 01H, 02H, 03H,11H,12H
40134	03 06 16	R W W	CH1 Level 1 alarm alarm value	-9999 to 30000(Scale decimal point used for decimal place) Error code : 01H, 02H, 03H,11H,12H

R/W……R:READ, W:WRITE

Reference No.	Applicable function code	R/W	Description	Details
40135	03 06 16	R W W	CH1 Level 1 alarm output relay	ASCII 2 digits (space code available for 1st digit) 01 to No. of alarm outputs, 00H : No programming Error code : 01H, 02H, 03H,11H,12H
40137	03 06 16	R W W	CH1 Level 1 alarm reference CH	ASCII 2 digits (space code available for 1st digit) 01 to No. of channels, 00H: No programming *Valid for differential alarm Error code : 01H, 02H, 03H,11H,12H
40138	03 06 16	R W W	CH1 Level 2 alarm No. of samples	ASCII 2 digits (space code available for 1st digit) 01 to 09, 00H : No programming *Valid for rate-of-change alarm Error code : 01H, 02H, 03H,11H,12H
40141	03 06 16	R W W	CH1 Level 2 alarm mode	0 : No programming, 1 : H, 2 : L, 3 : U, 4 : D 5 : B, 6 : S Error code : 01H, 02H, 03H,11H,12H
40142	03 06 16	R W W	CH1 Level 2 alarm programming value	-9999 to 30000(Scale decimal point used for decimal place) Error code : 01H, 02H, 03H,11H,12H
40143	03 06 16	R W W	CH1 Level 2 alarm output relay	ASCII 2 digits (space code available for 1st digit) 01 to No. of alarm outputs、00H : No programming Error code : 01H, 02H, 03H,11H,12H
40145	03 06 16	R W W	CH1 Level 2 alarm reference CH	ASCII 2 digits (space code available for 1st digit) 01 to 09, 00H : No programming *Valid for differential alarm Error code : 01H, 02H, 03H,11H,12H
40146	03 06 16	R W W	CH1 Level 2 alarm No. of samples	ASCII 2 digits (space code available for 1st digit) 01 to 09, 00H : No programming *Valid for rate-of-change alarm Error code : 01H, 02H, 03H,11H,12H
40149	03 06 16	R W W	CH1 Level 3 alarm mode	0 : No programming, 1 : H, 2 : L, 3 : U, 4 : D 5 : B, 6 : S Error code : 01H, 02H, 03H,11H,12H
40150	03 06 16	R W W	CH1 Level 3 alarm alarm value	-9999 to 30000(Scale decimal point used for decimal place) Error code : 01H, 02H, 03H,11H,12H
40151	03 06 16	R W W	CH1 Level 3 alarm output relay	ASCII 2 digits (space code available for 1st digit) 01 to No. of alarm outputs, 00H : No programming Error code : 01H, 02H, 03H,11H,12H
40153	03 06 16	R W W	CH1 Level 3 alarm reference CH	ASCII 2 digits (space code available for 1st digit) 01 to No. of channels, 00H : No programming *Valid for differential alarm Error code : 01H, 02H, 03H,11H,12H
40154	03 06 16	R W W	CH1 Level 3 alarm No. of samples	ASCII 2 digits (space code available for 1st digit) 01 to 09, 00H : No programming *Valid for rate-of-change alarm Error code : 01H, 02H, 03H,11H,12H
40157	03 06 16	R W W	CH1 Level 4 alarm mode	0 : No programming, 1 : H, 2 : L, 3 : U, 4 : D 5 : B, 6 : S Error code : 01H, 02H, 03H,11H,12H
40158	03 06 16	R W W	CH1 Level 4 alarm alarm value	-9999 to 30000(Scale decimal point used for decimal place) Error code : 01H, 02H, 03H,11H,12H
40159	03 06 16	R W W	CH1 Level 4 alarm output relay	ASCII 2 digits (space code available for 1st digit) 01 to No. of alarm outputs, 00H : No programming Error code : 01H, 02H, 03H,11H,12H

R/W……R:READ, W:WRITE

Reference No.	Applicable function code	R/W	Description	Details
40161	03 06 16	R W W	CH1 Level 4 alarm reference CH	ASCII 2 digits (space code available for 1st digit) 01 to 09, 00H : No programming *Valid for differential alarm Error code : 01H, 02H, 03H,11H,12H
40162	03 06 16	R W W	CH1 Level 4 alarm No. of samples	ASCII 2 digits (space code available for 1st digit) 01 to 09, 00H : No programming *Valid for rate-of-change alarm Error code : 01H, 02H, 03H,11H,12H
40165	03 06 16	R W W	CH1 Operation No.	0: No maths expression. 1: Square Root. 2: Natural logarithm, 3: Logarithm, 4: Totalising. 5: Temperature/humidity. 6: Data communications input. 7: Arithmetic 1. 8: Arithmetic 2. 9: Maximum value. 10: Minimum value. 11: Average value. 12: Exponential Error code: 01H, 02H, 03H, 11H, 12 H
40166	03 06 16	R W W	CH1 Printing scale minimum value	-9999 to 30000 Error code : 01H, 02H, 03H,11H,12H
40167	03 06 16	R W W	CH1 Print scale maximum value	-9999 to 30000 Error code : 01H, 02H, 03H,11H,12H
40168	03 06 16	R W W	CH1 Print scale decimal point	0 to 3 * Same decimal place for both max. and min. value Error code : 01H, 02H, 03H,11H,12H
40169	03 06 16	R W W	CH1 Maths expression parameter A	Arithmetic 1 or 2: -9999 to 30000 Totalising, Max, Min or Ave: Interval (time) ASCII 2-digit (00 to 24, 99: For totalising only.) 00H with other mathematics operations. Error code: 01H, 02H, 03H, 11H, 12H
40170	03 06 16	R W W	CH1 Maths expression parameter A decimal point	Arithmetic 1 or 2: 0 to 3 Other is 00H. Error code: 01H, 02H, 03H, 11H, 12H
40171	03 06 16	R W W	CH1 Maths expression parameter B	Arithmetic 1 or 2: -9999 to 30000 Totalising, Max, Min or Ave: Interval (time) ASCII 2-digit (00 to 59. The 1st digit can be a space code.) 00H with other maths expressions Error code: 01H, 02H, 03H, 11H, 12H
40172	03 06 16	R W W	CH1 Maths expression parameter B decimal point	Arithmetic 1 or 2: 0 to 3 Other is 00H. Error code: 01H, 02H, 03H, 11H, 12H
40173	03 06 16	R W W	CH1 Maths expression parameter C	Arithmetic 1 or 2: -9999 to 30000 Totalising, Max, Min or Ave: Interval (time) ASCII 2-digit (00 to 23,99: For totalising only.) 00H with other maths expressions Error code: 01H, 02H, 03H, 11H, 12H
40174	03 06 16	R W W	CH1 Maths expression parameter C decimal point	Arithmetic 1 or 2: 0 to 3 Other is 00H. Error code: 01H, 02H, 03H, 11H, 12H
40175	03 06 16	R W W	CH1 Maths expression parameter D	Arithmetic 1 or 2: -9999 to 30000 Totalising, Max, Min or Ave: Interval (time) ASCII 2-digit (00 to 59. The 1st digit can be a space code.) 00H with other maths expressions Error code: 01H, 02H, 03H, 11H, 12H

R/W……R:READ, W:WRITE

Reference No.	Applicable function code	R/W	Description	Details
40176	03 06 16	R W W	CH1 Maths expression parameter D decimal point	Arithmetic 1 or 2: 0 to 3 Other is 00H. Error code: 01H, 02H, 03H, 11H, 12H
40177	03 06 16	R W W	CH1 Maths expression object XCH	ASCII 2-digit (The 1st digit can be a space code.) 01 to No. of channels, 00H: No programming Error code: 01H, 02H, 03H, 11H, 12H
40178	03 06 16	R W W	CH1 Maths expression object YCH	ASCII 2-digit (The 1st digit can be a space code.) 01 to No. of channels, 00H: No programming Error code: 01H, 02H, 03H, 11H, 12H
40181	03 06 16	R W W	CH1 Partial Compressed/expanded printing 0 % Value	-9999 to 30000 (Scale decimal point used for decimal place) Error code : 01H, 02H, 03H,11H,12H
40182	03 06 16	R W W	CH1 Partial Compressed/expanded printing 1st break point	0 to 99 0 : No programming Error code : 01H, 02H, 03H,11H,12H
40183	03 06 16	R W W	CH1 Compressed/expanded printing 1st break point	-9999 to 30000 (Scale decimal point used for decimal place) Error code : 01H, 02H, 03H,11H,12H
40184	03 06 16	R W W	CH1 Compressed/expanded printing 2nd break point %	0 to 99 0: No programming on 2nd break point Error code : 01H, 02H, 03H,11H,12H
40185	03 06 16	R W W	CH1 Compressed/expanded printing 2nd break point value	-9999 to 30000 (Scale decimal point used for decimal place) Error code : 01H, 02H, 03H,11H,12H
40186	03 06 16	R W W	CH1 Compressed/expanded printing 100% values	-9999 to 30000 (Scale decimal point used for decimal place) Error code : 01H, 02H, 03H,11H,12H
40187	03 06 16	R W W	CH1 Digital filter *Pen-writing type only	0 to 10 Error code : 01H, 02H, 03H,11H,12H
40189	03 06 16	R W W	CH1 Automatic range-shift 1st range Min. value	-9999 to 30000 (Scale decimal point used for decimal place) -30000 : No programming Error code : 01H, 02H, 03H,11H,12H
40190	03 06 16	R W W	CH1 Automatic Range-shift 1st Range Max. value	-9999 to 30000 (Scale decimal point used for decimal place) -30000 : No programming (Error occurs when "-30000" is selected while low limit value setting is valid.) Error code : 01H, 02H, 03H,11H,12H
40191	03 06 16	R W W	CH1 Automatic Range-shift 2nd Range Max. value	-9999 to 30000 (Scale decimal point used for decimal place) -30000 : No programming Error code : 01H, 02H, 03H,11H,12H
40192	03 06 16	R W W	CH1 Automatic Range-shift 3rd Range Max. value	-9999 to 30000 (Scale decimal point used for decimal place) -30000 : No programming Error code : 01H, 02H, 03H,11H,12H

R/W……R:READ, W:WRITE

Reference No.	Applicable function code	R/W	Description	Details
40193	03 06 16	R W W	CH1 Automatic range-shift 4th range max. value	-9999 to 30000 (Scale decimal point used for decimal place) -30000 : No programming Error code : 01H, 02H, 03H,11H,12H
40194	03 06 16	R W W	CH1 automatic range-shift 5th range max. value	-9999 to 30000 (Scale decimal point used for decimal place) -30000 : No programming Error code : 01H, 02H, 03H,11H,12H
40202 to 40294	03 06 16	R W W	CH2 Programming parameter	Same as CH1 parameters (40102 to 40194) CH1 + 100
40302 to 40394	03 06 16	R W W	CH3 Programming parameter	Same as CH1 parameters (40102 to 40194) CH1 + 200
40402 to 40494	03 06 16	R W W	CH4 Programming parameter	Same as CH1 parameters (40102 to 40194) CH1 + 300
40502 to 40594	03 06 16	R W W	CH5 Programming parameter	Same as CH1 parameters (40102 to 40194) CH1 + 400
40602 to 40694	03 06 16	R W W	CH6 Programming parameter	Same as CH1 parameters (40102 to 40194) CH1 + 500
40702 to 40794	03 06 16	R W W	CH7 Programming parameter	Same as CH1 parameters (40102 to 40194) CH1 + 600
40802 to 40894	03 06 16	R W W	CH8 Programming parameter	Same as CH1 parameters (40102 to 40194) CH1 + 700
40902 to 40994	03 06 16	R W W	CH9 Programming parameter	Same as CH1 parameters (40102 to 40194) CH1 + 800
41002 to 41094	03 06 16	R W W	CH10 Programming parameter	Same as CH1 parameters (40102 to 40194) CH1 + 900
41102 to 41194	03 06 16	R W W	CH11 Programming parameter	Same as CH1 parameters (40102 to 40194) CH1 + 1000
41202 to 41294	03 06 16	R W W	CH12 Programming parameter	Same as CH1 parameters (40102 to 40194) CH1 + 1100
41302 to 41394	03 06 16	R W W	CH13 Programming parameter	Same as CH1 parameters (40102 to 40194) CH1 + 1200
41402 to 41494	03 06 16	R W W	CH14 Programming parameter	Same as CH1 parameters (40102 to 40194) CH1 + 1300
41502 to 41594	03 06 16	R W W	CH15 Programming parameter	Same as CH1 parameters (40102 to 40194) CH1 + 1400
41602 to 41694	03 06 16	R W W	CH16 Programming parameter	Same as CH1 parameters (40102 to 40194) CH1 + 1500
41702 to 41794	03 06 16	R W W	CH17 Programming parameter	Same as CH1 parameters (40102 to 40194) CH1 + 1600

R/W……R:READ, W:WRITE

Reference No.	Applicable function code	R/W	Description	Details
41802 to 41894	03 06 16	R W W	CH18 Programming parameter	Same as CH1 parameters (40102 to 40194) CH1 + 1700
41902 to 41994	03 06 16	R W W	CH19 Programming parameter	Same as CH1 parameters (40102 to 40194) CH1 + 1800
42002 to 42094	03 06 16	R W W	CH20 Programming parameter	Same as CH1 parameters (40102 to 40194) CH1 + 1900
42102 to 42194	03 06 16	R W W	CH21 Programming parameter	Same as CH1 parameters (40102 to 40194) CH1 + 2000
42202 to 42294	03 06 16	R W W	CH22 Programming parameter	Same as CH1 parameters (40102 to 40194) CH1 + 2100
42302 to 42394	03 06 16	R W W	CH23 Programming parameter	Same as CH1 parameters (40102 to 40194) CH1 + 2200
42402 to 42494	03 06 16	R W W	CH24 Programming parameter	Same as CH1 parameters (40102 to 40194) CH1 + 2300

2) Parameters common to channels (2)

R/W……R:READ, W:WRITE

Reference No.	Applicable function code	R/W	Description	Details
46301	03 06 16	R W W	Alarm relay 1 output mode *Pen-writing type only	0=OR 1=AND Error code : 01H, 02H, 03H,11H,12H
46302	03 06 16	R W W	Alarm relay 2 output mode *Pen-writing type only	0=OR 1=AND Error code : 01H, 02H, 03H,11H,12H
46303	03 06 16	R W W	Alarm relay 3 output mode *Pen-writing type only	0=OR 1=AND Error code : 01H, 02H, 03H,11H,12H
46304	03 06 16	R W W	Alarm relay 4 output mode *Pen-writing type only	0=OR 1=AND Error code : 01H, 02H, 03H,11H,12H
46305	03 06 16	R W W	Alarm relay 5 output mode *Pen-writing type only	0=OR 1=AND Error code : 01H, 02H, 03H,11H,12H
46306	03 06 16	R W W	Alarm relay 6 output mode *Pen-writing type only	0=OR 1=AND Error code : 01H, 02H, 03H,11H,12H

R/W……R:READ, W:WRITE

Reference No.	Applicable function code	R/W	Description	Details
46307	03 06 16	R W W	Alarm relay 7 output mode *Pen-writing type only	0=OR 1=AND Error code : 01H, 02H, 03H,11H,12H
46308	03 06 16	R W W	Alarm relay 8 output mode *Pen-writing type only	0=OR 1=AND Error code : 01H, 02H, 03H,11H,12H
46309	03 06 16	R W W	Alarm relay 9 output mode *Pen-writing type only	0=OR 1=AND Error code : 01H, 02H, 03H,11H,12H
46310	03 06 16	R W W	Alarm relay 10 output mode *Pen-writing type only	0=OR 1=AND Error code : 01H, 02H, 03H,11H,12H
46311	03 06 16	R W W	Alarm relay 11 output mode *Pen-writing type only	0=OR 1=AND Error code : 01H, 02H, 03H,11H,12H
46312	03 06 16	R W W	Alarm relay 12 output mode *Pen-writing type only	0=OR 1=AND Error code : 01H, 02H, 03H,11H,12H
46313	03 06 16	R W W	Alarm relay 13 output mode *Pen-writing type only	0=OR 1=AND Error code : 01H, 02H, 03H,11H,12H
46314	03 06 16	R W W	Alarm relay 14 output mode *Pen-writing type only	0=OR 1=AND Error code : 01H, 02H, 03H,11H,12H
46315	03 06 16	R W W	Alarm relay 15 output mode *Pen-writing type only	0=OR 1=AND Error code : 01H, 02H, 03H,11H,12H
46316	03 06 16	R W W	Alarm relay 16 output mode *Pen-writing type only	0=OR 1=AND Error code : 01H, 02H, 03H,11H,12H
46317	03 06 16	R W W	Alarm relay 17 output mode *Pen-writing type only	0=OR 1=AND Error code : 01H, 02H, 03H,11H,12H
46318	03 06 16	R W W	Alarm relay 18 output mode *Pen-writing type only	0=OR 1=AND Error code : 01H, 02H, 03H,11H,12H

4) Title printing

Titles up to 40 characters with AL3000 and up to 72 characters with AH3000 can be printed through communications. Print character programming is accomplished here. Printing is executed with the title printing command of Reference No. 20.

R/W……R:READ, W:WRITE

Reference No.	Applicable function code	R/W	Description	Details
48001	06 16	W W	Title printing Colors	1 : Red, 2 : Black, 3 : Blue, 4 : Green, 5 : Brown, 6 : Purple Error code : 01H, 02H, 03H,11H,12H
48002	06 16	W W	Title printing Feed to be specified	0 : No print , 1 : Print (Analog print is interrupted for title printing.) Error code : 01H, 02H, 03H,11H,12H
48003	06 16	W W	Title printing Characters 1, 2	ASCII code 2 characters * Characters after 00H are invalid. Error code : 01H, 02H, 03H,11H,12H
48004	06 16	W W	Title printing Characters 3, 4	ASCII code 2 characters Error code : 01H, 02H, 03H,11H,12H
48005	06 16	W W	Title printing Characters 5, 6	ASCII code 2 characters Error code : 01H, 02H, 03H,11H,12H
48006	06 16	W W	Title printing Characters 7, 8	ASCII code 2 characters Error code : 01H, 02H, 03H,11H,12H
48007	06 16	W W	Title printing Characters 9, 10	ASCII code 2 characters Error code : 01H, 02H, 03H,11H,12H
48008	06 16	W W	Title printing Characters 11, 12	ASCII code 2 characters Error code : 01H, 02H, 03H,11H,12H
48009	06 16	W W	Title printing Characters 13, 14	ASCII code 2 characters Error code : 01H, 02H, 03H,11H,12H
48010	06 16	W W	Title printing Characters 15, 16	ASCII code 2 characters Error code : 01H, 02H, 03H,11H,12H
48011	06 16	W W	Title printing Characters 17, 18	ASCII code 2 characters Error code : 01H, 02H, 03H,11H,12H
48012	06 16	W W	Title printing Characters 19, 20	ASCII code 2 characters Error code : 01H, 02H, 03H,11H,12H
48013	06 16	W W	Title printing Characters 21, 22	ASCII code 2 characters Error code : 01H, 02H, 03H,11H,12H
48014	06 16	W W	Title printing Characters 23, 24	ASCII code 2 characters Error code : 01H, 02H, 03H,11H,12H
48015	06 16	W W	Title printing Characters 25, 26	ASCII code 2 characters Error code : 01H, 02H, 03H,11H,12H
48016	06 16	W W	Title printing Characters 27, 28	ASCII code 2 characters Error code : 01H, 02H, 03H,11H,12H
48017	06 16	W W	Title printing Characters 29, 30	ASCII code 2 characters Error code : 01H, 02H, 03H,11H,12H
48018	06 16	W W	Title printing Characters 31, 32	ASCII code 2 characters Error code : 01H, 02H, 03H,11H,12H
48019	06 16	W W	Title printing Characters 33, 34	ASCII code 2 characters Error code : 01H, 02H, 03H,11H,12H
48020	06 16	W W	Title printing Characters 35, 36	ASCII code 2 characters Error code : 01H, 02H, 03H,11H,12H
48021	06 16	W W	Title printing Characters 37, 38	ASCII code 2 characters Error code : 01H, 02H, 03H,11H,12H

R/W……R:READ, W:WRITE

Reference No.	Applicable function code	R/W	Description	Details
48022	06 16	W W	Title printing Characters 39, 40	ASCII code 2 characters Error code : 01H, 02H, 03H,11H,12H *
48023	06 16	W W	Title printing Characters 41, 42	ASCII code 2 characters (Valid for AH) Error code : 01H, 02H, 03H,11H,12H
48024	06 16	W W	Title printing Characters 43, 44	ASCII code 2 characters (Valid for AH) Error code : 01H, 02H, 03H,11H,12H
48025	06 16	W W	Title printing Characters 45, 46	ASCII code 2 characters (Valid for AH) Error code : 01H, 02H, 03H,11H,12H
48026	06 16	W W	Title printing Characters 47, 48	ASCII code 2 characters (Valid for AH) Error code : 01H, 02H, 03H,11H,12H
48027	06 16	W W	Title printing Characters 49, 50	ASCII code 2 characters (Valid for AH) Error code : 01H, 02H, 03H,11H,12H
48028	06 16	W W	Title printing Characters 51, 52	ASCII code 2 characters (Valid for AH) Error code : 01H, 02H, 03H,11H,12H
48029	06 16	W W	Title printing Characters 53, 54	ASCII code 2 characters (Valid for AH) Error code : 01H, 02H, 03H,11H,12H
48030	06 16	W W	Title printing Characters 55, 56	ASCII code 2 characters (Valid for AH) Error code : 01H, 02H, 03H,11H,12H
48031	06 16	W W	Title printing Characters 57, 58	ASCII code 2 characters (Valid for AH) Error code : 01H, 02H, 03H,11H,12H
48032	06 16	W W	Title printing Characters 59, 60	ASCII code 2 characters (Valid for AH) Error code : 01H, 02H, 03H,11H,12H
48033	06 16	W W	Title printing Characters 61, 62	ASCII code 2 characters (Valid for AH) Error code : 01H, 02H, 03H,11H,12H
48034	06 16	W W	Title printing Characters 63, 64	ASCII code 2 characters (Valid for AH) Error code : 01H, 02H, 03H,11H,12H
48035	06 16	W W	Title printing Characters 65, 66	ASCII code 2 characters (Valid for AH) Error code : 01H, 02H, 03H,11H,12H
48036	06 16	W W	Title printing Characters 67, 68	ASCII code 2 characters (Valid for AH) Error code : 01H, 02H, 03H,11H,12H
48037	06 16	W W	Title printing Characters 69, 70	ASCII code 2 characters (Valid for AH) Error code : 01H, 02H, 03H,11H,12H
48038	06 16	W W	Title printing Characters 71, 72	ASCII code 2 characters (Valid for AH) Error code : 01H, 02H, 03H,11H,12H

* For pen-writing type AL recorders, titles up to 39 characters can be printed.

5)Parameters common to channels (3)

R/W……R:READ, W:WRITE

Reference No.	Applicable function code	R/W	Description	Details
48069	03 06 16	R W W	Remote contacts 1 function *Pen-writing type only	0=No function, 1=Chart drive, 2=Message (1, 2), 3=Message (1, 2, 3, 4, 5), 4=Act-A, 5=Act-B, 6=Act-C, 7=Act-D, 8=Data printing, 9=List 1 printing, 10=List 2 printing, 11=List 3 printing, 12=Totaliser reset *When the chart drive is specified, the same settings are required for the remote contacts 1 and 2. *When the message (1, 2) is specified, the same settings are required for the remote contacts 1 and 2. *When the message (1, 2, 3, 4, 5) is specified, the same settings are required for the remote contacts 1 to 4. Error code : 01H, 02H, 03H,11H,12H
48070	03 06 16	R W W	Remote contacts 2 function *Pen-writing type only	0=No function, 3=Message (1, 2, 3, 4, 5), 4=Act-A, 5=Act-B, 6=Act-C, 7=Act-D, 8=Data printing, 9=List 1 printing, 10=List 2 printing, 11=List 3 printing, 12=Totaliser reset *When the chart drive is specified, the same settings are required for the remote contacts 1 and 2. *When the message (1, 2) is specified, the same settings are required for the remote contacts 1 and 2. *When the message (1, 2, 3, 4, 5) is specified, the same settings are required for the remote contacts 1 to 4. Error code : 01H, 02H, 03H,11H,12H
48071	03 06 16	R W W	Remote contacts 3 function *Pen-writing type only	0=No function, 3=Message (1, 2, 3, 4, 5), 4=Act-A, 5=Act-B, 6=Act-C, 7=Act-D, 8=Data printing, 9=List 1 printing, 10=List 2 printing, 11=List 3 printing, 12=Totaliser reset *When the message (1, 2, 3, 4, 5) is specified, the same settings are required for the remote contacts 1 to 4. Error code : 01H, 02H, 03H,11H,12H
48072	03 06 16	R W W	Remote contacts 4 function *Pen-writing type only	0=No function, 3=Message (1, 2, 3, 4, 5), 4=Act-A, 5=Act-B, 6=Act-C, 7=Act-D, 8=Data printing, 9=List 1 printing, 10=List 2 printing, 11=List 3 printing, 12=Totaliser reset *When the message (1, 2, 3, 4, 5) is specified, the same settings are required for the remote contacts 1 to 4. Error code : 01H, 02H, 03H,11H,12H

6) Title Printing

R/W……R:READ, W:WRITE

Reference No.	Applicable function code	R/W	Description	Details
48201	03 06 16	R W W	Message 1 printing Characters 1, 2 *Pen-writing type only	ASCII code 2 characters *Characters after 00H are invalid. Error code : 01H, 02H, 03H,11H,12H
48202	03 06 16	R W W	Message 1 printing Characters 3, 4 *Pen-writing type only	ASCII code 2 characters Error code : 01H, 02H, 03H,11H,12H
48203	03 06 16	R W W	Message 1 printing Characters 5, 6 *Pen-writing type only	ASCII code 2 characters Error code : 01H, 02H, 03H,11H,12H
48204	03 06 16	R W W	Message 1 printing Characters 7, 8 *Pen-writing type only	ASCII code 2 characters Error code : 01H, 02H, 03H,11H,12H
48205	03 06 16	R W W	Message 1 printing Characters 9, 10 *Pen-writing type only	ASCII code 2 characters Error code : 01H, 02H, 03H,11H,12H
48206	03 06 16	R W W	Message 1 printing Characters 11, 12 *Pen-writing type only	ASCII code 2 characters Error code : 01H, 02H, 03H,11H,12H
48207	03 06 16	R W W	Message 1 printing Characters 13, 14 *Pen-writing type only	ASCII code 2 characters Error code : 01H, 02H, 03H,11H,12H
48208	03 06 16	R W W	Message 1 printing Characters 15 *Pen-writing type only	ASCII code 1 character * 2nd character is fixed by 00H. Error code : 01H, 02H, 03H,11H,12H
48209 to 48216	03 06 16	R W W	Message 2 printing Characters 1 to 15 *Pen-writing type only	Same as Message 1 printing Error code : 01H, 02H, 03H,11H,12H
48217 to 48224	03 06 16	R W W	Message 3 printing Characters 1 to 15 *Pen-writing type only	Same as Message 1 printing Error code : 01H, 02H, 03H,11H,12H
48225 to 48232	03 06 16	R W W	Message 4 printing Characters 1 to 15 *Pen-writing type only	Same as Message 1 printing Error code : 01H, 02H, 03H,11H,12H
48233 to 48240	03 06 16	R W W	Message 5 printing Characters 1 to 15 *Pen-writing type only	Same as Message 1 printing Error code : 01H, 02H, 03H,11H,12H

7) Data communications input

Printing takes place according to the communications input data from the master unit. This is made valid when the operation No. of the programming parameters per channel is programmed to the data communications input 6. Printing is decided by max. and min. values of printing scale. Data is "0" until the first data is received through communications after the power supply is turned on.

R/W……R:READ, W:WRITE

Reference No.	Applicable function code	R/W	Description	Details
49001	06 16	W W	Data communications input CH 1 Data	DATA : -9999 to 32765, 32767 : + Over range,-32767 : -Over range 32766 : Burnout data Error code : 01H, 02H, 03H,11H,12H
49002	06 16	W W	Data communications input CH1 Decimal point	0 to 3 Error code : 01H, 02H, 03H,11H,12H
49003	06 16	W W	Data Communications input CH 2 Data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
49004	06 16	W W	Data Communications input CH2 Decimal point	0 to 3 Error code : 01H, 02H, 03H,11H,12H
49005	06 16	W W	Data Communications input CH 3 Data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
49006	06 16	W W	Data Communications input CH3 Decimal point	0 to 3 Error code : 01H, 02H, 03H,11H,12H
49007	06 16	W W	Data Communications input CH 4 Data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
49008	06 16	W W	Data Communications input CH4 Decimal point	0 to 3 Error code : 01H, 02H, 03H,11H,12H
49009	06 16	W W	Data Communications input CH 5 Data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
49010	06 16	W W	Data Communications input CH5 Decimal point	0 to 3 Error code : 01H, 02H, 03H,11H,12H
49011	06 16	W W	Data Communications input CH 6 Data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
49012	06 16	W W	Data Communications input CH6 Decimal point	0 to 3 Error code : 01H, 02H, 03H,11H,12H

R/W……R:READ, W:WRITE

Reference No.	Applicable function code	R/W	Description	Details
49013	06 16	W W	Data Communications input CH 7 Data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
49014	06 16	W W	Data Communications input CH7 Decimal point	0 to 3 Error code : 01H, 02H, 03H,11H,12H
49015	06 16	W W	Data Communications input CH 8 Data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
49016	06 16	W W	Data Communications input CH8 Decimal point	0 to 3 Error code : 01H, 02H, 03H,11H,12H
49017	06 16	W W	Data Communications input CH 9 Data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
49018	06 16	W W	Data Communications input CH9 Decimal point	0 to 3 Error code : 01H, 02H, 03H,11H,12H
49019	06 16	W W	Data Communications input CH 10 Data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
49020	06 16	W W	Data Communications input CH10 Decimal point	0 to 3 Error code : 01H, 02H, 03H,11H,12H
49021	06 16	W W	Data Communications input CH 11 Data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
49022	06 16	W W	Data Communications input CH11 Decimal point	0 to 3 Error code : 01H, 02H, 03H,11H,12H
49023	06 16	W W	Data Communications input CH 12 Data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
49024	06 16	W W	Data Communications input CH12 Decimal point	0 to 3 Error code : 01H, 02H, 03H,11H,12H
49025	06 16	W W	Data Communications input CH 13 Data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
49026	06 16	W W	Data Communications input CH13 Decimal point	0 to 3 Error code : 01H, 02H, 03H,11H,12H

R/W……R:READ, W:WRITE

Reference No.	Applicable function code	R/W	Description	Details
49027	06 16	W W	Data Communications input CH 14 Data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
49028	06 16	W W	Data Communications input CH14 Decimal point	0 to 3 Error code : 01H, 02H, 03H,11H,12H
49029	06 16	W W	Data Communications input CH 15 Data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
49030	06 16	W W	Data Communications input CH15 Decimal point	0 to 3 Error code : 01H, 02H, 03H,11H,12H
49031	06 16	W W	Data Communications input CH 16 Data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
49032	06 16	W W	Data Communications input CH16 Decimal point	0 to 3 Error code : 01H, 02H, 03H,11H,12H
49033	06 16	W W	Data Communications input CH 17 Data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
49034	06 16	W W	Data Communications input CH17 Decimal point	0 to 3 Error code : 01H, 02H, 03H,11H,12H
49035	06 16	W W	Data Communications input CH 18 Data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
49036	06 16	W W	Data Communications input CH18 Decimal point	0 to 3 Error code : 01H, 02H, 03H,11H,12H
49037	06 16	W W	Data Communications input CH 19 Data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
49038	06 16	W W	Data Communications input CH19 Decimal point	0 to 3 Error code : 01H, 02H, 03H,11H,12H
49039	06 16	W W	Data Communications input CH 20 Data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
49040	06 16	W W	Data Communications input CH20 Decimal point	0 to 3 Error code : 01H, 02H, 03H,11H,12H

R/W……R:READ, W:WRITE

Reference No.	Applicable function code	R/W	Description	Details
49041	06 16	W W	Data Communications input CH 21 Data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
49042	06 16	W W	Data Communications input CH21 Decimal point	0 to 3 Error code : 01H, 02H, 03H,11H,12H
49043	06 16	W W	Data Communications input CH 22 Data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
49044	06 16	W W	Data Communications input CH22 Decimal point	0 to 3 Error code : 01H, 02H, 03H,11H,12H
49045	06 16	W W	Data Communications input CH 23 Data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
49046	06 16	W W	Data Communications input CH23 Decimal point	0 to 3 Error code : 01H, 02H, 03H,11H,12H
49047	06 16	W W	Data Communications input CH 24 Data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
49048	06 16	W W	Data Communications input CH24 Decimal point	0 to 3 Error code : 01H, 02H, 03H,11H,12H

6.9.5 Floating data

1)Measured data

Displayed values are output as floating data. Numbers at the smaller digits than displayed are therefore rounded off. (The data may be different from the numerical values entered through data communications.)

R/W……R:READ, W:WRITE

Reference No.	Applicable function code	R/W	Description	Details
50101	70	R	CH1 Data	DATA : -9999 to 99999 +100000 :+Over range, -100000 : -Over range +200000 : Burnout data, -200000 : Invalid data Error code : 01H, 02H, 03H,12H
50102	70	R	CH2 Data	Same as CH1 Error code : 01H, 02H, 03H,12H
50103	70	R	CH3 Data	Same as CH1 Error code : 01H, 02H, 03H,12H
50104	70	R	CH4 Data	Same as CH1 Error code : 01H, 02H, 03H,12H
50105	70	R	CH5 Data	Same as CH1 Error code : 01H, 02H, 03H,12H

R/W……R:READ, W:WRITE

Reference No.	Applicable function code	R/W	Description	Details
50106	70	R	CH6 Data	Same as CH1 Error code : 01H, 02H, 03H,12H
50107	70	R	CH7 Data	Same as CH1 Error code : 01H, 02H, 03H,12H
50108	70	R	CH8 Data	Same as CH1 Error code : 01H, 02H, 03H,12H
50109	70	R	CH9 Data	Same as CH1 Error code : 01H, 02H, 03H,12H
50110	70	R	CH10 Data	Same as CH1 Error code : 01H, 02H, 03H,12H
50111	70	R	CH11 Data	Same as CH1 Error code : 01H, 02H, 03H,12H
50112	70	R	CH12 Data	Same as CH1 Error code : 01H, 02H, 03H,12H
50113	70	R	CH13 Data	Same as CH1 Error code : 01H, 02H, 03H,12H
50114	70	R	CH14 Data	Same as CH1 Error code : 01H, 02H, 03H,12H
50115	70	R	CH15 Data	Same as CH1 Error code : 01H, 02H, 03H,12H
50116	70	R	CH16 Data	Same as CH1 Error code : 01H, 02H, 03H,12H
50117	70	R	CH17 Data	Same as CH1 Error code : 01H, 02H, 03H,12H
50118	70	R	CH18 Data	Same as CH1 Error code : 01H, 02H, 03H,12H
50119	70	R	CH19 Data	Same as CH1 Error code : 01H, 02H, 03H,12H
50120	70	R	CH20 Data	Same as CH1 Error code : 01H, 02H, 03H,12H
50121	70	R	CH21 Data	Same as CH1 Error code : 01H, 02H, 03H,12H
50122	70	R	CH22 Data	Same as CH1 Error code : 01H, 02H, 03H,12H
50123	70	R	CH23 Data	Same as CH1 Error code : 01H, 02H, 03H,12H
50124	70	R	CH24 Data	Same as CH1 Error code : 01H, 02H, 03H,12H

2)Data Communications Input

R/W……R:READ, W:WRITE

Reference No.	Applicable function code	R/W	Description	Details
50201	71	W	Data communications input CH1 Input data	DATA：-9999 to 99999 +100000：+Over range, -100000：-Over range +200000：Burnout data Error code : 01H, 02H, 03H,11H,12H
50202	71	W	Data communications input CH2 Input data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
50203	71	W	Data communications input CH3 Input data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
50204	71	W	Data communications input CH4 Input data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
50205	71	W	Data communications input CH5 Input data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
50206	71	W	Data communications input CH6 Input data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
50207	71	W	Data communications input CH7 Input data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
50208	71	W	Data communications input CH8 Input data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
50209	71	W	Data communications input CH9 Input data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
50210	71	W	Data communications input CH10 Input data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
50211	71	W	Data communications input CH11 Input data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
50212	71	W	Data communications input CH12 Input data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
50213	71	W	Data communications input CH13 Input data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H

R/W……R:READ, W:WRITE

Reference No.	Applicable function code	R/W	Description	Details
50214	71	W	Data communications input CH14 Input data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
50215	71	W	Data communications input CH15 Input data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
50216	71	W	Data communications input CH16 Input data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
50217	71	W	Data communications input CH17 Input data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
50218	71	W	Data communications input CH18 Input data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
50219	71	W	Data communications input CH19 Input data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
50220	71	W	Data communications input CH20 Input data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
50221	71	W	Data communications input CH21 Input data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
50222	71	W	Data communications input CH22 Input data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
50223	71	W	Data communications input CH23 Input data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H
50224	71	W	Data communications input CH24 Input data	Same as CH1 Error code : 01H, 02H, 03H,11H,12H

3)Parameters per channel

(Note) Writing multiple programming values across two or more channels constitutes an error (error code 12H)

R/W……R:READ, W:WRITE

Reference No.	Applicable function code	R/W	Description	Details
50301	71 70	W R	CH1 Range Minimum value	-9999 to 99999 Error code : 01H, 02H, 03H,11H,12H
50302	71 70	W R	CH1 Range Minimum value	-9999 to 99999 Error code : 01H, 02H, 03H,11H,12H
50303	71 70	W R	CH1 Range Decimal point	0 to 3 Same decimal point for both max. and min. values. Error code : 01H,02H,03H,11H,12H
50304	71 70	W R	CH1 Scale Minimum value	-9999 to 99999 Error code : 01H, 02H, 03H,11H,12H
50305	71 70	W R	CH1 Range Minimum value	-9999 to 99999 Error code : 01H, 02H, 03H,11H,12H
50306	71 70	W R	CH1 Scale Decimal point	0 to 3 Same decimal point for both max. and min. values. Error code : 01H, 02H, 03H,11H,12H
50307	71 70	W R	CH1 Alarm Level 1 alarm value	-9999 to 99999 * Use scale decimal point. Error code : 01H, 02H, 03H,11H,12H
50308	71 70	W R	CH1 Alarm Level 2 alarm value	-9999 to 99999 * Use scale decimal point. Error code : 01H, 02H, 03H,11H,12H
50309	71 70	W R	CH1 Alarm Level 3 alarm value	-9999 to 99999 * Use scale decimal point. Error code : 01H, 02H, 03H,11H,12H
50310	71 70	W R	CH1 Alarm Level 4 programming value	-9999 to 99999 * Use scale decimal point. Error code : 01H, 02H, 03H,11H,12H
50313	71 70	W R	CH1 Print scale Minimum value	-9999 to 99999 Error code : 01H, 02H, 03H,11H,12H
50314	71 70	W R	CH1 Print scale Maximum value	-9999 to 99999 Error code : 01H, 02H, 03H,11H,12H
50315	71 70	W R	CH1 Print scale Decimal point	0 to 3 Same decimal point for both max. and min. values. Error code : 01H, 02H, 03H,11H,12H
50316	71 70	W R	CH1 Maths expression parameter A	-9999 to 99999 Error code: 01H, 02H, 03H, 11H, 12H

R/W……R:READ, W:WRITE

Reference No.	Applicable function code	R/W	Description	Details
50317	71 70	W R	CH1 Maths expression parameter A decimal point	0 to 3 Error code: 01H, 02H, 03H, 11H, 12H
50318	71 70	W R	CH1 Maths expression parameter B	-9999 to 99999 Error code: 01H, 02H, 03H, 11H, 12H
50319	71 70	W R	CH1 Maths expression parameter B decimal point	0 to 3 Error code: 01H, 02H, 03H, 11H, 12H
50320	71 70	W R	CH1 Maths expression parameter C	-9999 to 99999 Error code: 01H, 02H, 03H, 11H, 12H
50321	71 70	W R	CH1 Maths expression parameter C decimal point	0 to 3 Error code: 01H, 02H, 03H, 11H, 12H
50322	71 70	W R	CH1 Maths expression parameter D	-9999 to 99999 Error code: 01H, 02H, 03H, 11H, 12H
50323	71 70	W R	CH1 Maths expression parameter D decimal point	0 to 3 Error code: 01H, 02H, 03H, 11H, 12H
50325	71 70	W R	CH1 SP, 0% Value	-9999 to 99999 * Use scale decimal point. Error code : 01H, 02H, 03H,11H,12H
50326	71 70	W R	CH1 SP, 1st break point %	0 to 99 0 : No programming Error code : 01H, 02H, 03H,11H,12H
50327	71 70	W R	CH1 SP, 1st break point value	-9999 to 99999 * Use scale decimal point. Error code : 01H, 02H, 03H,11H,12H
50328	71 70	W R	CH1 SP, 2nd break point %	0 to 100 Error code : 01H, 02H, 03H,11H,12H
50329	71 70	W R	CH1 SP, 2nd break point value	-9999 to 99999 * Use scale decimal point. Error code : 01H, 02H, 03H,11H,12H
50330	71 70	W R	CH1 SP ・ 100% value	-9999 to 99999 * Use scale decimal point. Error code : 01H, 02H, 03H,11H,12H
50332	71 70	W R	CH1 Subtract printing reference value	-9999 to 99999. (Scale decimal point of reference channel used for decimal place.) * Effective when there is no channel (no programming) to be subtracted. Error code : 01H, 02H, 03H,11H,12H

R/W……R:READ, W:WRITE

Reference No.	Applicable function code	R/W	Description	Details
50333	71 70	W R	CH1 Subtracted data printing range minimum value	-9999 to 99999 * Use scale decimal point. Error code : 01H, 02H, 03H,11H,12H
50334	71 70	W R	CH1 Subtracted data printing range maximum value	-9999 to 99999 * Scale decimal point used Error code : 01H,02H,03H,11H,12H
50337	71 70	W R	CH1 AU 1st Range minimum value	-9999 to 99999, -30000: No programming * Use scale decimal point. Error code : 01H, 02H, 03H,11H,12H
50338	71 70	W R	CH1 AU 1st Range maximum value	-9999 to 99999 (Error if –30000 is programmed.) * Use scale decimal point. Error code : 01H, 02H, 03H,11H,12H
50339	71 70	W R	CH1 AU 2nd Range minimum value	-9999 to 99999, -30000: No programming * Use scale decimal point. Error code : 01H, 02H, 03H,11H,12H
50340	71 70	W R	CH1 AU 3rd Range maximum value	-9999 to 99999, -30000: No programming * Use scale decimal point. Error code : 01H, 02H, 03H,11H,12H
50341	71 70	W R	CH1 AU 4th Range maximum value	-9999 to 99999, -30000: No programming * Use scale decimal point. Error code : 01H, 02H, 03H,11H,12H
50342	71 70	W R	CH1 AU 5th Range maximum value	-9999 to 99999, -30000: No programming * Use scale decimal point. Error code : 01H, 02H, 03H,11H,12H
50351 to 50392	71 70	W R	CH2 Floating-point programming parameter	Same as CH1 parameters (50301 to 50342) CH1 + 50
50401 to 50442	71 70	W R	CH3 Floating-point programming parameter	Same as CH1 parameters (50301 to 50342) CH1 + 100
50451 to 50492	71 70	W R	CH4 Floating-point programming parameter	Same as CH1 parameters (50301 to 50342) CH1 + 150
50501 to 50542	71 70	W R	CH5 Floating-point programming parameter	Same as CH1 parameters (50301 to 50342) CH1 + 200
50551 to 50592	71 70	W R	CH6 Floating-point programming parameter	Same as CH1 parameters (50301 to 50342) CH1 + 250
50601 to 50642	71 70	W R	CH7 Floating-point programming parameter	Same as CH1 parameters (50301 to 50342) CH1 + 300
50651 to 50692	71 70	W R	CH8 Floating-point programming parameter	Same as CH1 parameters (50301 to 50342) CH1 + 350

R/W……R:READ, W:WRITE

Reference No.	Applicable function code	R/W	Description	Details
50701 to 50742	71 70	W R	CH9 Floating-point programming parameter	Same as CH1 parameters (50301 to 50342) CH1 + 400
50751 to 50792	71 70	W R	CH10 Floating-point programming parameter	Same as CH1 parameters (50301 to 50342) CH1 + 450
50801 to 50842	71 70	W R	CH11 Floating-point programming parameter	Same as CH1 parameters (50301 to 50342) CH1 + 500
50851 to 50892	71 70	W R	CH12 Floating-point programming parameter	Same as CH1 parameters (50301 to 50342) CH1 + 550
50901 to 50942	71 70	W R	CH13 Floating-point programming parameter	Same as CH1 parameters (50301 to 50342) CH1 + 600
50951 to 50992	71 70	W R	CH14 Floating-point programming parameter	Same as CH1 parameters (50301 to 50342) CH1 + 650
51001 to 51042	71 70	W R	CH15 Floating-point programming parameter	Same as CH1 parameters (50301 to 50342) CH1 + 700
51051 to 51092	71 70	W R	CH16 Floating-point programming parameter	Same as CH1 parameters (50301 to 50342) CH1 + 750
51101 to 51142	71 70	W R	CH17 Floating-point programming parameter	Same as CH1 parameters (50301 to 50342) CH1 + 800
51151 to 51192	71 70	W R	CH18 Floating-point programming parameter	Same as CH1 parameters (50301 to 50342) CH1 + 850
51201 to 51242	71 70	W R	CH19 Floating-point programming parameter	Same as CH1 parameters (50301 to 50342) CH1 + 900
51251 to 51292	71 70	W R	CH20 Floating-point programming parameter	Same as CH1 parameters (50301 to 50342) CH1 + 950
51301 to 51342	71 70	W R	CH21 Floating-point programming parameter	Same as CH1 parameters (50301 to 50342) CH1 + 1000
51351 to 51392	71 70	W R	CH22 Floating-point programming parameter	Same as CH1 parameters (50301 to 50342) CH1 + 1050
51401 to 51442	71 70	W R	CH23 Floating-point programming parameter	Same as CH1 parameters (50301 to 50342) CH1 + 1100
51451 to 51492	71 70	W R	CH24 Floating-point programming parameter	Same as CH1 parameters (50301 to 50342) CH1 + 1150

7 PRIVATE PROTOCOL

Basic Procedures of Communications and Precautions

⚠ Attention!

1. A data request immediately after turning the power on will lead to an error.

AL3000/AH3000 are always ready for communications. They are at anytime responsive to data requests from a personal computer. However, immediately after turning the power on, the recorders do not deliver a normal response until the data of all channels is ready. It takes, for instance, about 20 seconds until all the data becomes ready for a 24-point AH3000 recorder. When receiving a data request during this period, the recorders return the error message No. 9 (busy).

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

Since the AL3000-AH3000 recorders' serial interfaces communicate without using any control line, a reception failure may occur under some conditions. Exercise care when resending a command.

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

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

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

For RS422A/RS-485 communications interface, there are multiple instruments connected to the same communication line, only one of which specified by the personal computer drives the communications line. The line drive is turned off at a certain time after sending the last character so that all the characters are safely received by the personal computer. If the personal computer sends a command to the next instrument before the communications drive is turned off, signals interfere with each other resulting in some communications failure. Exercise caution when you use a high-speed personal computer.

7.1 Basics of the Communications Sequence

When establishing communications, be sure to observe the sequence of sending a data request command from the personal computer to AL3000/AH3000 and then receiving a response to this request from AL3000/AH3000.

7.2 Control Character Code

Use the following character codes in the communications format.

Characters	Meaning	Hexadecimal data
ENQ	Inquiry	05H
ACK	Affirmative response	06H
EOT	Abandon data link	04H
STX	Text start	02H
ETX	Text end	03H
CR	Return	0DH
LF	Line feed	0AH

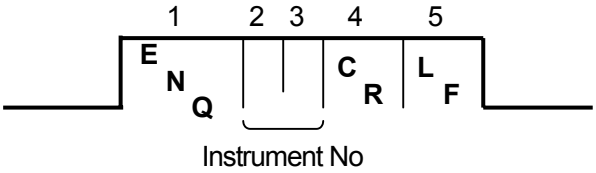
7.3 Data Link

Since multiple AL3000/AH3000 units are connected in parallel to the RS-422A/485, it is necessary to identify a particular unit used for communications (establish a data link). The RS-232C is on the other hand connected to the personal computer on a one-to-each basis, so that there is no need of establishing a data link. You have only to establish communications according to "5.4 Data Transmission and Reception".

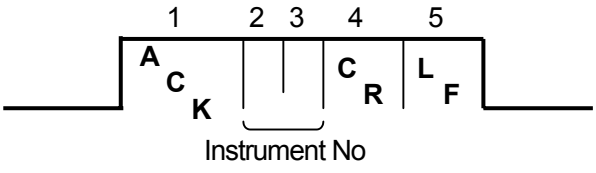
7.3.1 Establishing a data link

Only a unit found to have a corresponding instrument No. according to the following sequence has the right to execute communications.

● PC ⇨ AL3000/AH3000



● AL3000/AH3000 ⇨ PC

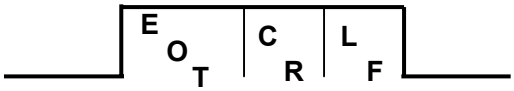


(1) No response is received from AL3000/AH3000 without a designated Instrument No.
(2) Once a data link is established, communications take place according to "5.4 Data Transmission and Reception".

7.3.2 Abandon data link

(1) Data link to one AL3000/AH3000 is abandoned when a link to another is established.
(Abandoned when another Instrument No. is recognized with ENQ)
(2) Abandoned when receiving EOT .

● PC ⇨ AL3000/AH3000



AL3000/AH3000 ⇨ No response from PC

7.4 Data Transmission and Reception

7.4.1 Commands

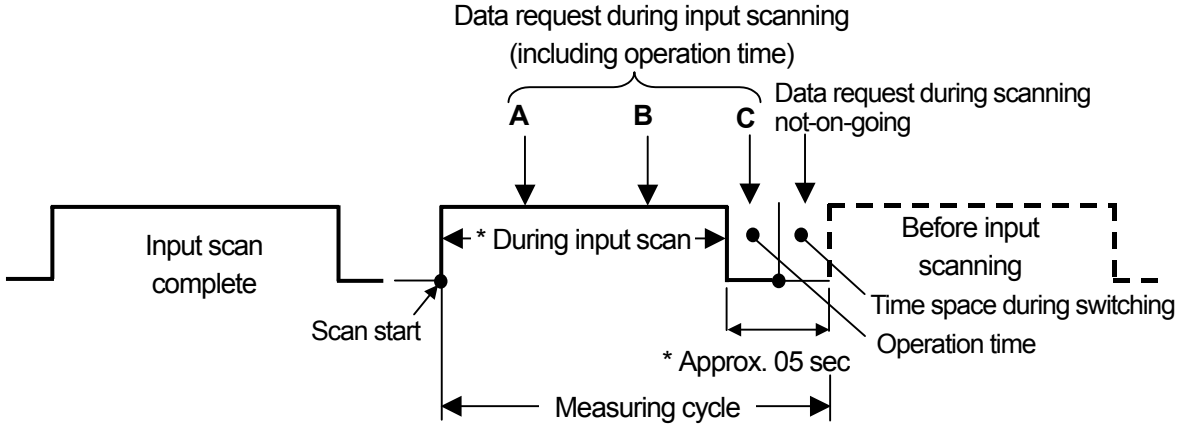
The following commands are available in AL3000/AH3000 to allow a number of data requests. Note that the four commands "LR", "HR", "LO" and "HO" are used exclusively for the 24-point AH3000 recorder. Do not use them for anything other than the 24 point recorder.

1. In the case of the 24 point recorder. the reception buffer may overflow if the number of transmitted characters exceeds 256.
   In this case, request data for 1 to 12 CH and 13 to 24 CH separately using the commands dedicated to the 24 point recorder, "LR・LO (1 to12 CH) and "HR・HO (13 to 24 CH)".
2. Note that using these commands for anything other than the 24 point recorder will result in a format error.

Command	Function	Description
DR (LR (1 to 12CH) HR (13 to 24CH))	Data request only once	Immediately send the most recent, newest data and close
DO (LO (1 to 12CH) HO (13 to 24CH)	Data request only once	(1) When data is requested during input scanning, send the characters "SCB", then send data after scanning and close.
		(2) When data is requested without input scanning ongoing, immediately send the most recent, newest data and close.
ST	Data request upon every input scanning	(1) When data is requested during input scanning, send the characters "SCB", then send data after scanning and close. Thereafter, send data every time scanning is complete.
		(2) When data is requested without input scanning ongoing, immediately send the most recent data in hand. Thereafter, send data every time scanning is complete.
DS	Close data sending upon every input scanning	Close data sending every time scanning is complete using ST command.

Reference

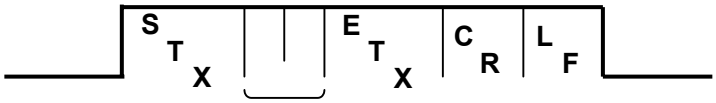
When a data request is received during input scanning, the time until sending data depends on the position of A, B and C.



* The time varies with the number of input.

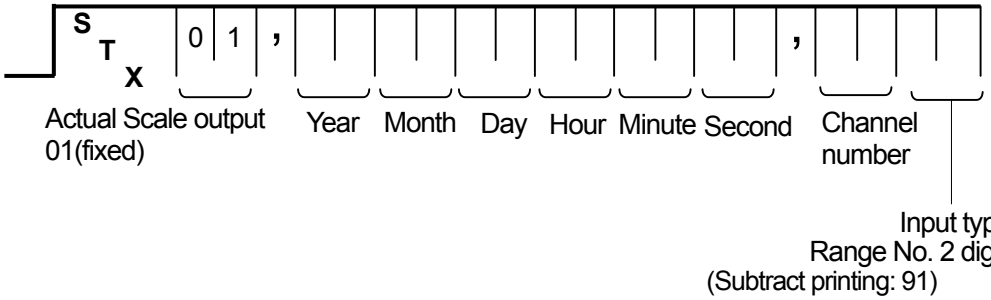
7.4.2. COMMAND FORMAT

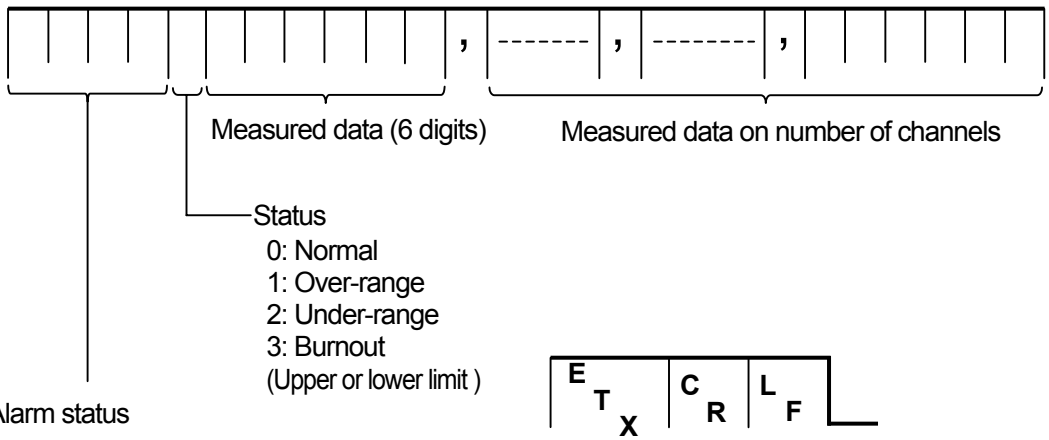
PC ⇨ AL3000/AH3000



7.4.3 COMMAND RESPONSE

1. AL3000/AH3000 ⇨ PC

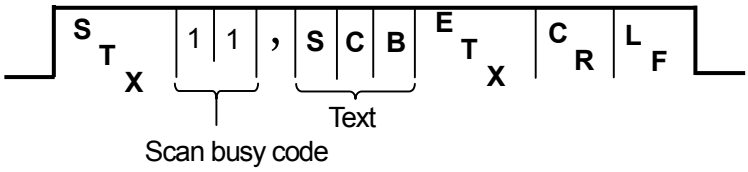




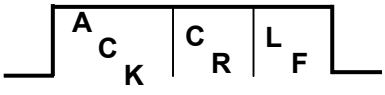
Attention!

1. A comma "," serves as the delimiter for the type, date and each measured data.
2. In case of either over-range, under-range, burnout (upper or lower scale), measured data are displayed as " 9 9 9 9 9 9 ".
3. The above example shows a format without checksum. For a format with Checksum, refer to section 7.5.

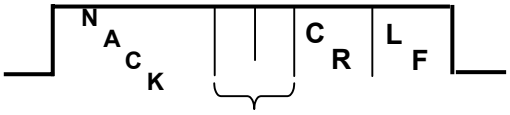
2. Scan busy output



3. Normal response (Response to DS command received)



4. Abnormal response



01: Framing error
02: Overrun error
03: Parity error
04: Checksum error
06: Time out for waiting ETX
09: Instrument busy
10: Format error

7.5 Checksums

AL3000/AH3000 can add checksum data to check transmission errors. A checksum is the sum of characters after STX up to ETX, the lower-order 8 bits of which are divided into higher and lower-order 4 bits and converted to 0 to F characters. They are transmitted and received sequentially from higher order to lower order bits. Such a checksum is added to both transmitted and received data for checking.
When the transmitted or received data is altered due to noise or the like, the checksum data compares the changed data with the value calculated on the receiver side to detect such an alteration.

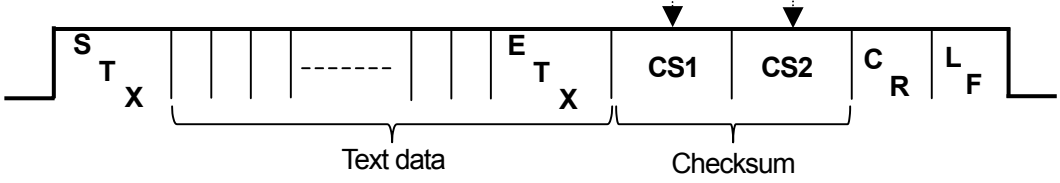
[What is the checksum data?]
The checksum is the sum of lower-order 8 bits of text data as binary numbers which is transmitted in the 2-digit hexadecimal expression (excluding STX and including "," (comma) and "ETX".

(Example) When the lower-order 8 bits of the sum is | 1 | 0 | 1 | 1 | 0 | 1 | 0 | 1 | ,

the checksum is | B | 5 | , which will be 5B when transmitted as a check sum list.

| 5 | B |

As a communications data



(Example) In case of DO

DATA	CODE
D	44H
O	4FH
ETX	03H
Total	96H

⟶ CS1=36H (6), CS2=39H (9)

(Reference)

DR : 99H ⟶ CS1=39H (9), CS2=39H (9)
LR : A1H ⟶ CS1=31H (1), CS2=41H (A)
HR : 9DH ⟶ CS1=44H (D), CS2=39H (9)
DO : 96H ⟶ CS1=36H (6), CS2=39H (9)
LO : 9EH ⟶ CS1=45H (E), CS2=39H (9)
HO : 9AH ⟶ CS1=41H (A), CS2=39H (9)
ST : AAH ⟶ CS1=41H (A), CS2=41H (A)
DS : 9AH ⟶ CS1=41H (A), CS2=39H (9)

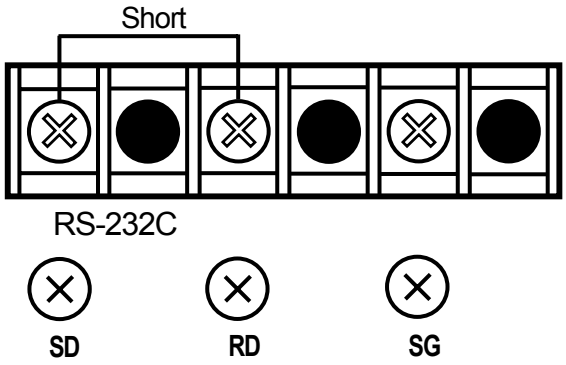
8 HARDWARE CHECK FOR COMMUNICATIONS FUNCTION

If the communications function of the AL3000/AH3000 does not work normally, perform a hardware check by removing the communications lines of the individual AL3000/AH3000 units.

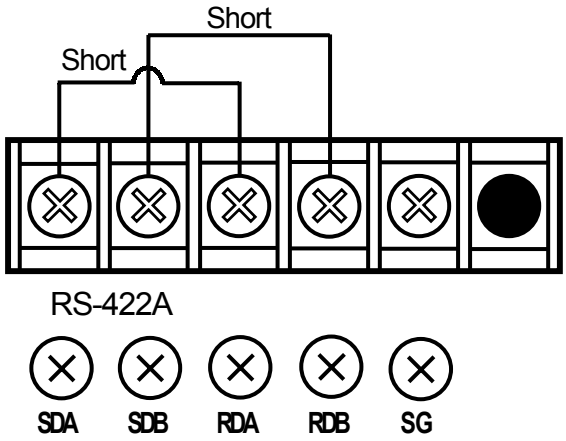
8.1 Connection

Connect the communications terminals of AL3000/AH3000 as indicated below:

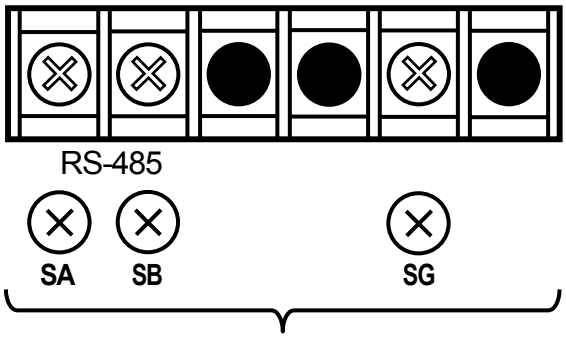
1. In case of RS-232C



2. In case of RS-422A



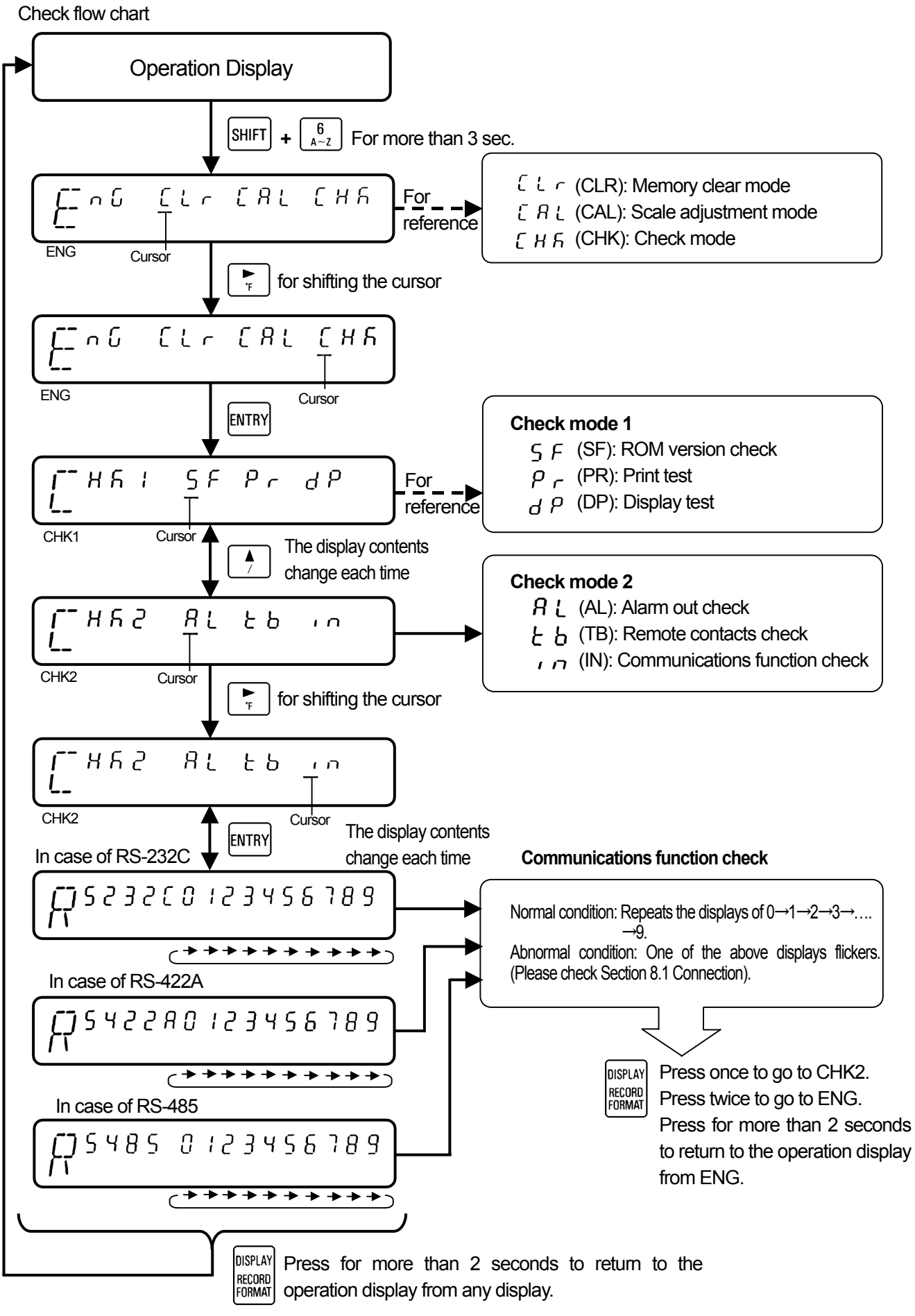
3. In case of RS-485



Open all terminals.

8.2 HARDWARE CHECK PROCEDURE

Check flow chart



9 HOW TO CHANGE THE COMMUNICATIONS PORT

The default communications port of the AL3000/AH3000 is "for host communications". When programming parameters, etc. using engineering software (sold separately), change the port to "Engineering". Note that such a change is necessary only when the engineering software is used.

Continue pressing SHIFT + SPACE COPY(=) for at least 3 seconds on the Operation Display to show the checking screen of “Communications port”.

Reference **Engineering port**

Port to be used when configurating with the engineering software.
Communications with PC cannot be established when changed to "Engineering Port".

Communications Port Select

There are 2 kinds of communications port.

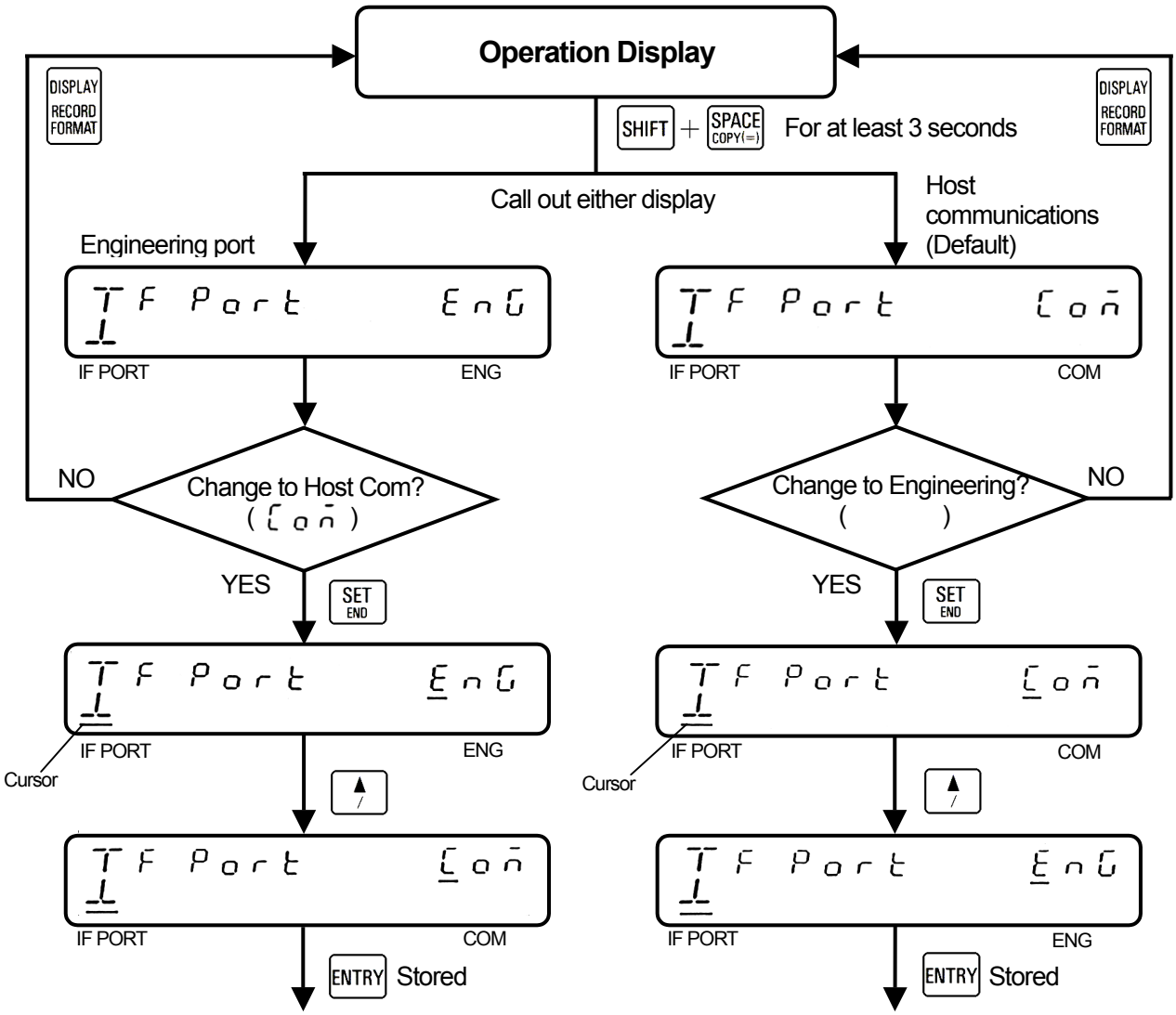
(1) Host communications (Con)

(2) Engineering (EnG)

Default port is programmed to Con. No change to is necessary if you do not program parameters, etc. using the engineering software.

Programming Flow Chart

The character type on display is different depending on models.



Refer to Section 2.1.

When EnG is selected and then MODBUS is selected, it is fixed to RTU mode.
For using PASS, select MODBUS.

10 SAMPLE PROGRAM (For Private Protocol)

* For MODBUS protocol, use the software programs of 「Data Logging Software "KIDS"」and 「Parameter Programming Software “PASS”」which are compatible with Windows95/NT4.0

10. 1 Sample Program for RS-232C Communications Interface

Program name: RSMNAH (IBM AT)

This program is used to check the communications status easily.

Enter a specified communications command through the keyboard and press [↵], and the communications command is transmitted from the PC to the AL3000/AH3000 recorder so that the communications data from the recorder is displayed on the CRT.

```
10    ' ************************************************************************
20    '
30    ' RS232C SAMPLE PROGRAM
            FOR AL3000 & AH3000  ---IBM AT 5170099
40    '                            "RSMNAH"
50    '
60    '
70    ' ************************************************************************
80    '
100     CLS
110     STX$=CHR$(2):ETX$=CHR$(3):ACK$=CHR$(6):NAK$=CHR$(15)
120     OPEN "COM1:4800,N,8,1,LF" AS #1
130     ON COM(1) GOSUB 300
140     COM(1) ON
150   '
160   ' *WAITING COMMAND FROM KEYBOARD
170      KY$=""
180      Y$=INKEY$
190      IF Y$=CHR$(13) THEN 230
200      KY$=KY$+Y$
210      GOTO 180
220   '
230   ' *COMMAND OUT
240      AFLG=1:PRINT KY$
250      OC$=KY$:OC$=STX$+CO$+ETX$
260      PRINT #1 , OC$
270      FOR I=0 TO 5000 :NEXT 1
280      GOTO 160
290   '
300   ' *INCOMING CHARACTERS
310      IF LOC(1) <2 THEN RETURN
320      LINE INPUT #1,A$
330      PRINT A$ :AFLG=0
340      RETURN
350   '
360      END
```

10.2 Sample Program for RS-422A/485 Communications Interface

Program name: RAMNAH (IBM AT)

This program is used to check the communications status easily. By pressing [↵] key after entering [02] from the keyboard, a data link is established. By pressing [↵] key without any entry, the data link is abandoned. By pressing [↵] key after entering the specified communications command from the keyboard after establishing a data link, the communications command is transmitted from the PC to AL3000/AH3000 recorders, and the communications data from AL3000/AH3000 recorders are displayed on the CRT.

```
10    ' ********************************************************************
20    '
30    ' RS422A/485 SAMPLE PROGRAM
            FOR AL3000 & AH3000 ---IBM AT 5170099
40    '                          "RAMNAH"
50    '
60    '
70    ' ********************************************************************
80    '
90      CLS
100     STX$=CHR$(2):ETX$=CHR$(3):ACK$=CHR$(6):NAK$=CHR$(15)
110     OPEN "COM1:4800,N,8,1,LF" AS #1
120     ON COM(1) GOSUB 460
130     COM(1) ON
140   '
150     PRINT  "PLEASE SET!!  ADDRESS OF AL3000 OR AH3000 =02"
160   ' *WAITING COMMAND FROM KEYBOARD
170      KY$=""
180      Y$=INKEY$
190      IF Y$=CHR$(13) THEN 230
200      KY$=KY$+Y$
210      GOTO 180
220   '
230   ' *COMMAND OUT
240      IF KY$="" THEN 400
250      IF KY$="02" THEN 330
260      AFLG=1:PRINT KY$
270      OC$=KY$:OC$=STX$+OC$+ETX$
280      PRINT #1 ,OC$
290      FOR I=0 TO 5000 :NEXT I
300      IF AFLG=1 THEN PRINT #1 ,OC$ :PRINT OC$
310      GOTO 160
320   '
330   ' *DATA LINK (ENQ)
340      OC$=CHR$(5)+KY$
350      PRINT "ENQ"KY$
360      PRINT #1,OC$ :AFLG=1
370      FOR I=1 TO 5000 :NEXT I
380      IF AFLG=1 THEN PRINT #1,OC$
390      GOTO 160
400   '
410   ' *EOT
420      OC$=CHR$(4)
430      PRINT "EOT" :PRINT#1,OC$
```

```
440      GOTO 160
450   '
460   ' *INCOMING CHARACTERS
470      IF LOC(1) <2 THEN RETURN
480      LINE INPUT #1,A$
490      PRINT A$ :AFLG=0
500      RETURN
510   '
520      END
```

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