INSTRUCTION MANUAL FOR FIR-201-M COMMUNICATION

[OPTION CODE: C, C5]

№FIR2CE2 2000.08

To prevent the accidents by mishandling of this controller, please arrange to give this manual into the hands of the operator who actually uses our products.

⚠ Warning

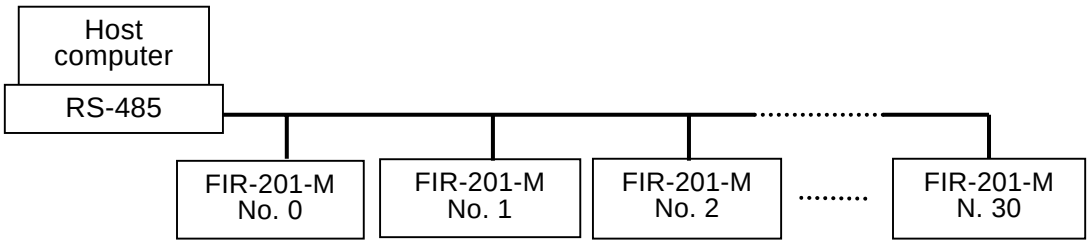
Turn the power supplied to the instrument OFF before wiring or checking.
If working or touching the terminal on the power ON status, there is a possibility of Electric Shock which can cause severe injury or death.

1. System configuration

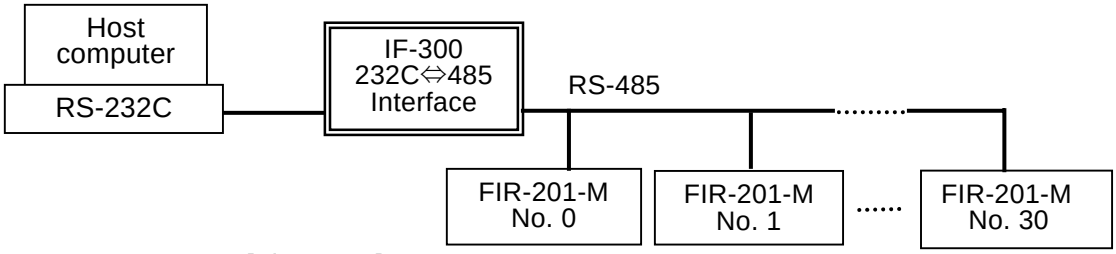
1.1 RS-232C [Option: C]

[Fig. 1.1-1]

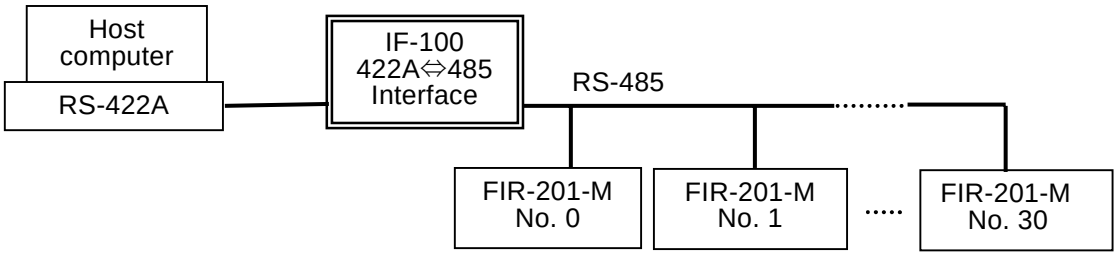
1.2 RS-485 Multi-point connection [Option code: C5]



[Fig. 1.2-1]



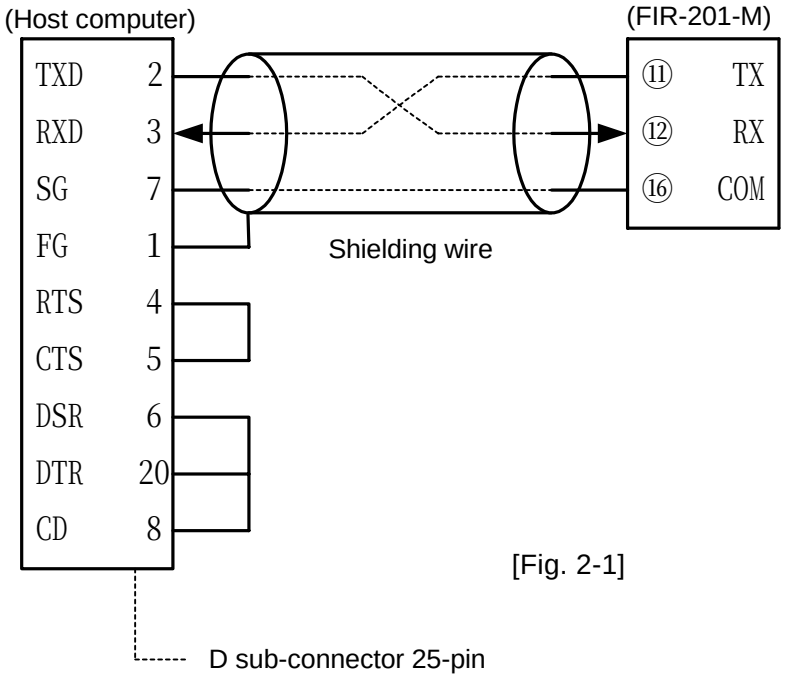
[Fig. 1.2-2]



[Fig. 1.2-3]

2. Connection

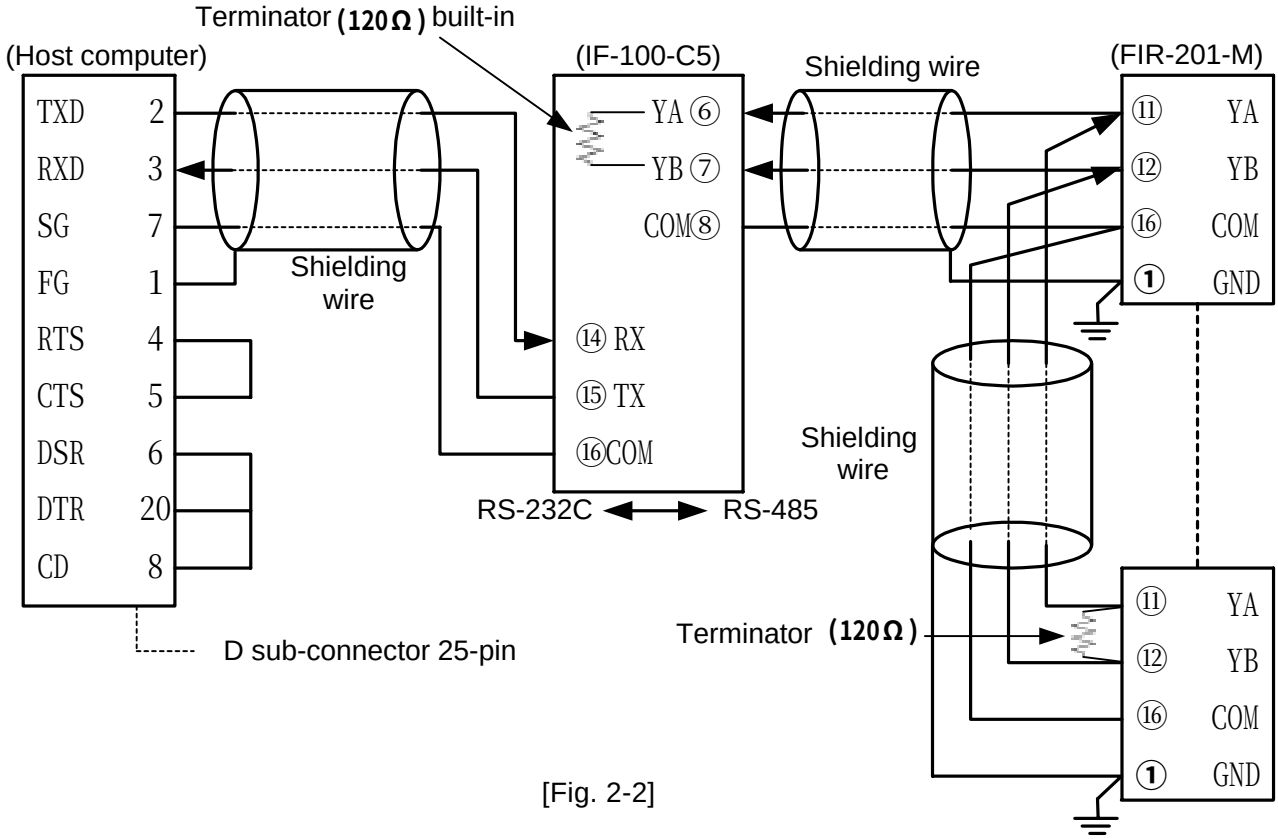
RS-232C [Option code: C]



[Fig. 2-1]

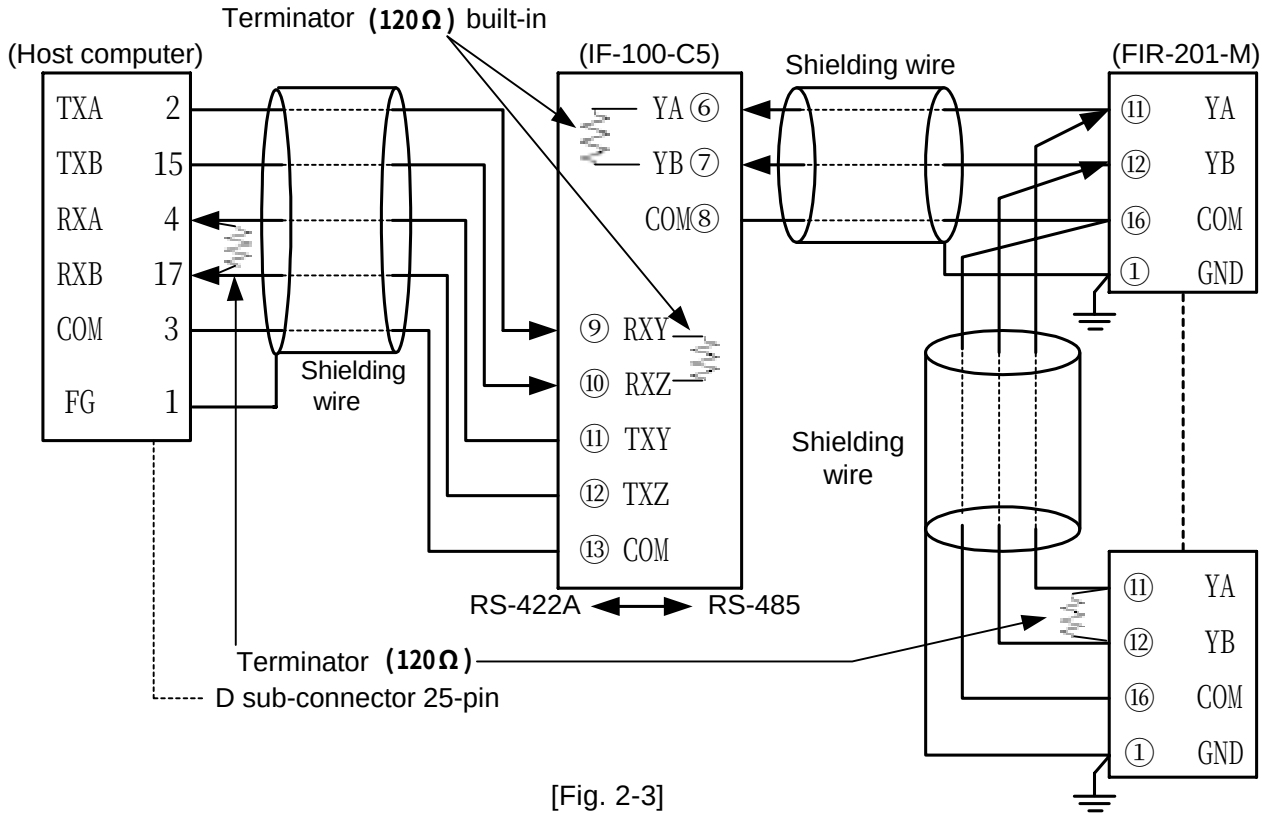
RS-485 [option code: C5]

- When the converter is IF-100-C5, and between the converter and host computer is connected by RS-232C.
  Connection: RS-232C ◄► RS-485 (Data transfer rate: 1200, 2400, 4800 or 9600bps)
  When communicating by the transfer rate **19200bps**, use **IF-300-C5** instead of IF-100-C5 for the converter.



[Fig. 2-2]

- In case the converter is IF-100-C5, and between the converter and host computer is connected by RS-422A.
  Connection: RS-422A ◀▶ RS-485 (Data transfer rate: 1200, 2400, 4800 or 9600bps)



[Fig. 2-3]

- **As for the shielding wire**
  - Connect the shielding wire **only one side** to FG or ground (GND) terminal so as not to flow the current into the shielding wire.

    If both sides of the wire are connected to the FG or ground terminal, the circuit is made between the wire and ground, and **the noise may easily occur by the current.**
  - The FG or ground terminal must be grounded.

- **As for the terminator (Terminal resistor)**
  - The more the communication line becomes long, the less the communication performs because **the transfer waveform becomes wrong owing to the echo**.
    To prevent this, connect the terminator.
  - The place to connect should be the physical terminal of the communication cable.

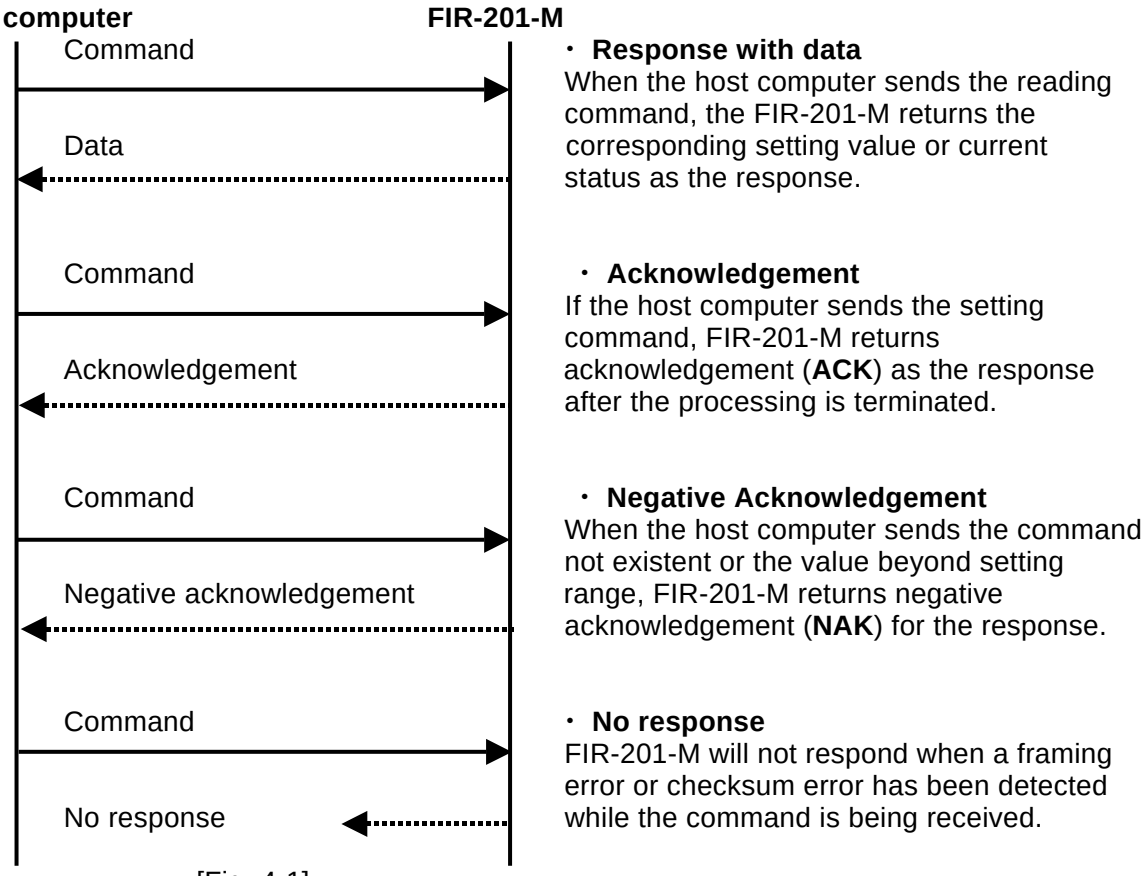
- Communication converter of [IF-100-C5] or [IF-300-C5] is provided **on separate sale**.

3. As for the instrument setting

- When communicating by connecting plural FIR-201-M in serial communication [option C5], the instrument number should be set individually.
- Select the data transfer rate for the FIR-201-M to fit the rate of host computer.
- Refer to the instruction manual of FIR-201-M for the instrument number setting and data transfer rate selection.

4. Communication procedure

Communication between a host computer and FIR-201-M starts by sending the command from the host computer, and is terminated by receiving the response from the FIR-201-M.



[Fig. 4-1]

- **Communication timing of RS-485 [Option code: C5]**

  ・ **As to the FIR-201-M side**

  When the FIR-201-M starts transmission to RS-485 communication line, the FIR-201-M is arranged so as to provide 1 character transmission period or more of idle status (mark status) before sending the response to make the synchronous sure on the receiving side.

  The FIR-201-M is arranged so as to cut the transmitter off from the communication line within the period of 1 character transmission after sending the response.

  ・ **As to the host computer side**

  Make the program so that the host computer can provide 1 character transmission period or more of idle status (mark status) before sending the command to make the synchronous sure on the receiving side when the host computer starts the transmission to RS-485 communication line.

  Make the program so that the host computer can cut the transmitter off from the communication line within the period of 1 character transmission after sending the command in preparation for reception of the response from the FIR-201-M.

  To avoid the collision of transmission between the host computer and the FIR-201-M, send the next command after checking that the host computer surely received the response.

In case the host computer communicates with the FIR-201-M through the line converter (IF-100-C5, IF-300-C5, sold separately), it is not required to manage the transmission timing described above because the converter takes the timing interpreting the protocol automatically.

5. Command configuration

5.1 Command configuration

All commands are composed of ASCII codes.
The data (setting value) are converted to Hexadecimal number and ASCII codes are used for the command.
Negative number is represented by 2's complement.

(1) Command

Header	Address	Sub address	Command type	Data item				Data				Checksum		Deli-miter
				16^3	16^2	16^1	16^0	16^3	16^2	16^1	16^0			

[Fig. 5.1-1]

Header : STX (02H, fixed), Start of text.
Control code to represent the beginning of the command (text).

Address : Instrument number 0 to 95 (20H to 7FH)
The number by which the host computer identifies the FIR-201-M.
The numbers are used by giving 20H of bias (20H to 3FH), because 0 to 31 (00H to 1FH) are used for control code.
95 (7FH) is called as **Global address,** and is used when sending the same command to all the FIR-201-M connected.
However, the response is not returned.

Sub address : It is fixed as 20H.

Command type : Code to identify the reading command or setting command.
20H, Reading command
50H, Setting command

Data item : It represents the data sort for the command.
It is made up of 4 digits of hexadecimal number.
(Refer to the command table.)

Data : The contents of the data differ by the setting command.
It is made up of 4 digits of hexadecimal number.
(Refer to the command table.)
Reading command has no data.

Checksum : 2-character of data to detect a communication error.

Delimiter : ETX (03H, fixed), End of text.
Control code to represent the ending of the command (text).

(2) Response to the command

- **Response with data (Response to the reading command)**

Header	Address	Sub address	Command type	Data item				Data				Checksum		Deli-miter
				16^3	16^2	16^1	16^0	16^3	16^2	16^1	16^0			

[Fig. 5.1-2]

Header : ACK (06H, fixed), [Acknowledgement].
Control code to represent the beginning of the response.

Address : It represents the instrument number 0 to 95 (20H to 7FH).
The same code as the received command is used for the response.

Sub address : It is fixed as 20H

Command type : Code to identify the reading or setting command.
20H, Reading command
50H, Setting command
The same code as the received command is used for the response.

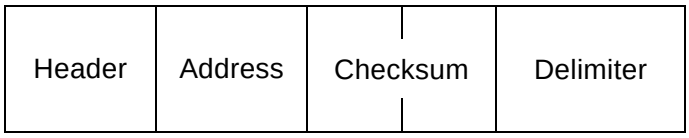
Data item : It represents the data sort for the command.
It is made up of 4 digits of hexadecimal number.
(Refer to the command table.)
The same code as the received command is used for the response.

Data : The contents of the data differ by the reading command.
It is made up of 4 digits of hexadecimal number.
(Refer to the command table.)

Checksum : 2-character of data to detect a communication error.

Delimiter : ETX (03H, fixed), End of text.
Control code to represent the ending of the response.

- **Acknowledgement**



[Fig. 5.1-3]

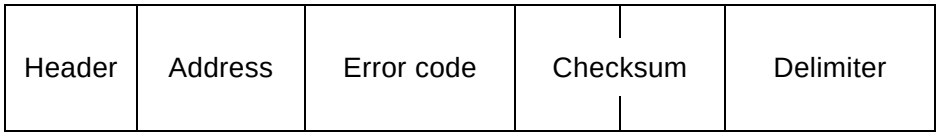
Header : ACK (06H, fixed), [Acknowledgement]
Control code to represent the beginning of the response.

Address : It represents the instrument number 0 to 95 (20H to 7FH).
The same code as the received command is used for the response.

Checksum : 2-character of data to detect a communication error.

Delimiter : ETX (03H, fixed), End of text.
Control code to represent the ending of the response.

- **Negative acknowledgement**



[Fig. 5.1-4]

Header : NAK (15H, fixed), [Negative acknowledgement]
Control code to represent the beginning of the response.

Address : It represents the instrument number 0 to 95 (20H to 7FH).
The same code as the received command is used for the response.

Error code : It represents the type of error.
It is made up of 1 digit of hexadecimal number.
1 (31H) When it is the command not existent
2 (32H) Not used
3 (33H) When setting is outside the range
4 (34H) When it is the status not settable
5 (35H) During the setting mode by key operation.

Checksum : 2-character of data to detect a communication error.

Delimiter : ETX (03H, fixed), End of text.
Control code to represent the ending of the response.

5.2 Checksum calculation

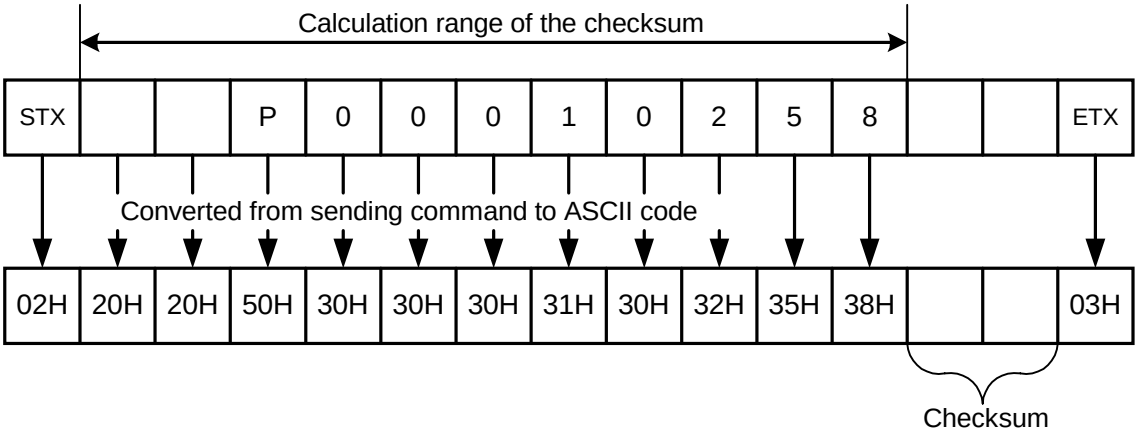
Checksum is used to detect a receiving error of the command or data.
Make the program for the host computer side as well to calculate the checksum of the response data from the FIR-201-M to check a communication error.

ASCII code (hexadecimal) corresponding to the character from the address (instrument number) to the character front of the checksum is converted to binary notation, and the total value is made.

The lower 2-digit of the total value are converted to 2's complements and further to hexadecimal, that is, ASCII code. This is the checksum.

Refer to the following example procedure.

- **Checksum calculation example** is shown as follows.
  Main setting value: 600℃
  Instrument number: 0 (20H)



[Hexadecimal]	[Binary notation]
20H	0010 0000
20H	0010 0000
50H	0101 0000
30H	0011 0000
30H	0011 0000
30H	0011 0000
31H	0011 0001
30H	0011 0000
32H	0011 0010
35H	0011 0101
+ 38H	0011 1000
	10 0010 0000

1's complements:
Make each bit of binary 0 and 1 reverse.
2's complements:
Add 1 to the 1's complements.

(1's complements) 1101 1111
\+ 1
(2's complements) 1110 0000
(Converted to the hexadecimal)
(ASCII code) 45H ("E") 30H ("0")

[Code to be transmitted]

02H	20H	20H	50H	30H	30H	30H	31H	30H	32H	35H	38H	45H	30H	03H	: ASCII code
STX	(Space)	(Space)	P	0	0	0	1	0	2	5	8	E	0	ETX	: ASCII character

6. Contents of the command

6.1 Notices for setting and reading command

- Though lock mode is designated by Setting value lock, the setting by setting command is effective.
- Even if the option is not applied, it is possible to set by setting command, however, the setting is ineffective.
- The life of memory is approximately 1 000 000 (one million) in number of times of writing. If the number of times exceeds the limit, it cannot memorize the data.
- When connecting plural FIR-201-M, the same instrument numbers should not be applied to the plural FIR-201-M.
- When sending the command by Global address [95 (7FH)], the same command is sent to all FIR-201-M connected. However, the response is not returned.
- The instrument number and data transfer rate of FIR-201-M cannot be set by communication. Set them by front key operations of the FIR-201-M.

- **As to setting command**
  - The settable range is the same as that of key operation. Refer to the Command table for the communication command.
  - All commands are composed of ASCII codes.
  - The data (setting value) is converted to hexadecimal number, and ASCII code is used. Negative number is represented by 2's complement.
  - When the data (setting value) has a decimal point, make the value 10 times as much value as the setting.

- **As to reading command**
  - All commands are composed of ASCII codes.
  - The data (setting value) is converted to hexadecimal number, and ASCII code is used. Negative number is represented by 2's complement.
  - When the setting value has a decimal point, it returns the value by making10 times as much value as the setting.

6.2 Command table

・ Table below describes data item, data and command type.
When the setting value for the data has a decimal point, make the value 10 times as much value as the setting and convert to hexadecimal.

Data item		Data	Command type
0001H	Alarm 1 [A1] setting	Setting value	20H/50H
0002H	Alarm 2 [A2] setting	Setting value	20H/50H
0003H	Alarm 3 [A3] setting	Setting value	20H/50H
0004H	Setting value lock designation **When lock mode 3 is selected, set data are not saved in the memory. By the power supply off, the setting values return to the former one.**	0000H: Unlock 0001H: Lock 1 0002H: Lock 2 0003H: Lock 3	20H/50H
0005H	Sensor correction setting	Setting value	20H/50H
0006H	Scaling high limit setting	Setting value	20H/50H
0007H	Scaling low limit setting	Setting value	20H/50H
0008H	Decimal point place selection	0000H: xxxx (Without decimal point) 0001H: xxx.x (1 digit below the decimal point) 0002H: xx.xx (2 digits below the decimal point) 0003H: x.xxx (3 digits below the decimal point)	20H/50H
0009H	PV filter time constant setting	Setting value	20H/50H
000AH	Alarm 1 [A1] hysteresis setting	Setting value	20H/50H
000BH	Alarm 2 [A2] hysteresis setting	Setting value	20H/50H
000CH	Alarm 3 [A3] hysteresis setting	Setting value	20H/50H
000DH	Alarm 1 [A1] action selection **When alarm action type is changed, alarm setting value becomes 0, and alarm output status is initialized.**	0000H: No alarm 0001H: High limit alarm 0002H: Low limit alarm	20H/50H
000EH	Alarm 2 [A2] action selection **When alarm action type is changed, alarm setting value becomes 0, and alarm output status is initialized.**	0000H: No alarm 0001H: High limit alarm 0002H: Low limit alarm	20H/50H
000FH	Alarm 3 [A3] action selection **When alarm action type is changed, alarm setting value becomes 0, and alarm output status is initialized.**	0000H: No alarm 0001H: High limit alarm 0002H: Low limit alarm	20H/50H
0010H	Transmission output high limit setting	Setting value	20H/50H
0011H	Transmission output low limit setting	Setting value	20H/50H
0012H	Alarm 1 [A1] action Energized/ Deenergized selection	0000H: Alarm energized 0001H: Alarm deenergized	20H/50H
0013H	Alarm 2 [A2] action Energized/ Deenergized selection	0000H: Alarm energized 0001H: Alarm deenergized	20H/50H
0014H	Alarm 3 [A3] action Energized/ Deenergized selection	0000H: Alarm energized 0001H: Alarm deenergized	20H/50H
0015H	Alarm 1 [A1] action delayed timer setting	Setting value	20H/50H
0016H	Alarm 2 [A2] action delayed timer setting	Setting value	20H/50H

Data item		Data	Command type
0017H	Alarm 3 [A3] action delayed timer setting	Setting value	20H/50H
0070H	Clearing setting value change flag	0000H: No clearing 0001H: Clearing all flags	50H
0080H	Reading current PV	Current PV	20H
0081H	Reading output status 1	0000 0000 0000 0000 2^{15} to 2^0 2^0 digit: Alarm 1 [A1] output 0: OFF, 1: ON 2^1 digit: Alarm 2 [A2] output 0: OFF, 1: ON 2^2 digit: Alarm 3 [A3] output 0: OFF, 1: ON 2^3 digit: Upscale 0: OFF, 1: ON 2^4 digit: Downscale 0: OFF, 1: ON 2^5 digit: Hold type 1: Hold 2^6 digit: Hold type 1: Peak hold 2^7 digit: Hold type 1: Bottom hold 2^8 to 2^{15} digit: Always 0	20H
0082H	Reading output status 2	0000 0000 0000 0000 2^{15} to 2^0 2^0 digit: Alarm 1 [A1] output 0: OFF, 1: ON 2^1 digit: Alarm 2 [A2] output 0: OFF, 1: ON 2^2 digit: Alarm 3 [A3] output 0: OFF, 1: ON 2^3 digit: Upscale 0: OFF, 1: ON 2^4 digit: Downscale 0: OFF, 1: ON 2^5 digit: Hold 0: OFF, 1: ON 2^6 digit: Peak hold 0: OFF, 1: ON 2^7 digit: Bottom hold 0: OFF, 1: ON 2^8 to 2^{14} digit: Always 0 2^{15} digit: Setting value change flag 0: Not changed 1: Changed	20H
00A3H	Reading the data item changed by key operation **The data item code changed by key operation is read.** **When plural items are changed, the smallest data item code are read in order.** **After being read, the code is cleared.**	Data item code When not changed, 0(0000H)	20H

7. Specifications

Communication system : Half-duplex
Data transfer rate : 9600bps (2400, 4800, 9600, 19200bps). Selectable by key operation.
Synchronous system : Start-stop
Code form : ASCII
Error detection : Parity check, Checksum
Error correction : Command request repeat system
Data format : Start bit 1
Data bit 7
Parity Even parity
Stop bit 1

Start bit	Data bit	Parity	Stop bit

8. When troubled

When troubled, make sure the following items after checking the power supply of the host computer and the FIR-201-M.

- **Phenomenon: If it is unable to communicate.**

Check the following
The connection. (Refer to Fig. 2-1 to 2-3.)
The burnout or imperfect contact on the communication cable and the connector.
Data transfer rate of the FIR-201-M and the host computer.
The data bit, parity and stop bit of the host computer whether they accord with those of the FIR-201-M.
Whether the instrument number of the FIR-201-M accords with that of the command.
The same instrument numbers whether used in plural FIR-201-M.
When communicating by RS-485 (option: C5) without IF-100-C5 or IF-300-C5 (communication converter), make sure that the program is proper for the transmission timing.

- **Phenomenon: Though it is able to communicate, 'NAK' is responded.**

Check the following
The command code is surely existent or not.
With the setting command, whether the setting value exceeds the setting range or not.
The operation mode whether being under the setting mode by the key operation.

If happened unclear phenomenon other than above mentioned, make inquiries about the matters at our agency or the shop where you purchased the unit.

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