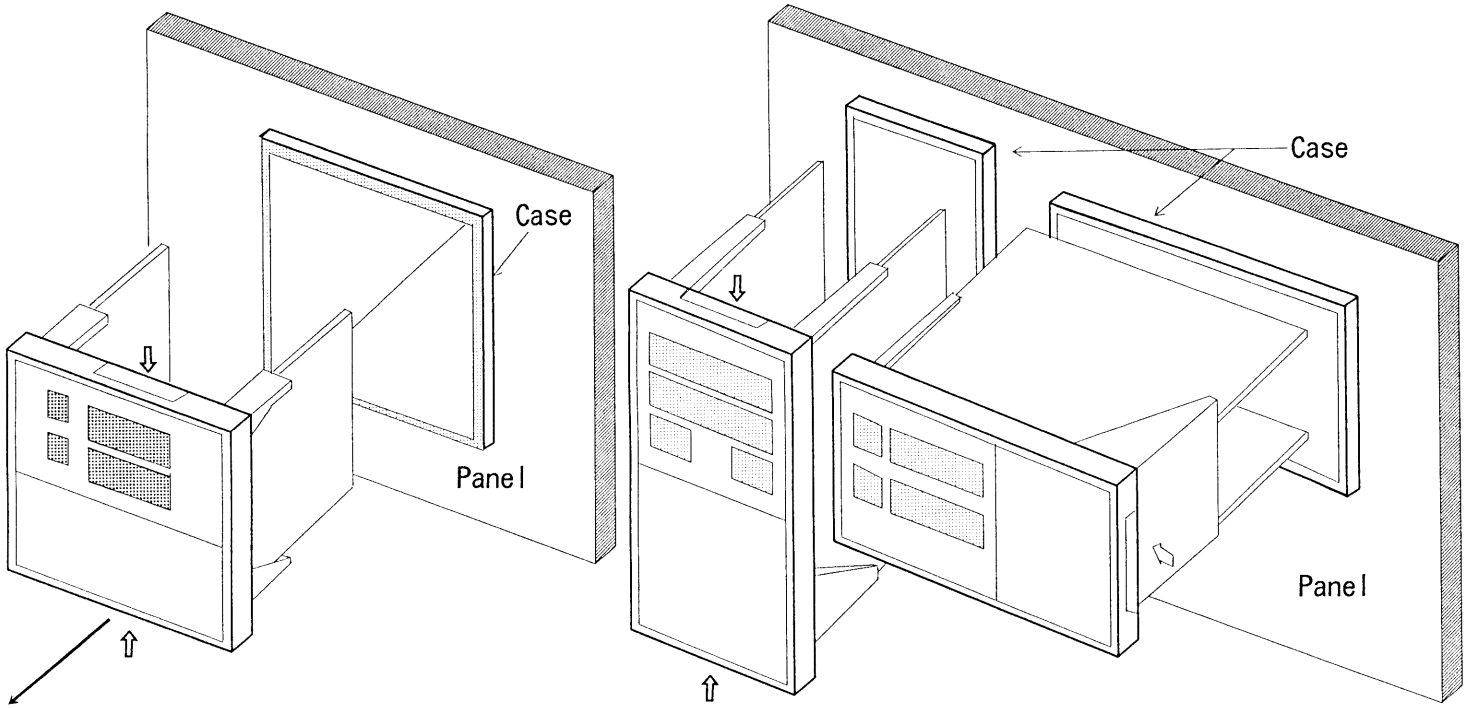## 2. Setting of the instrument
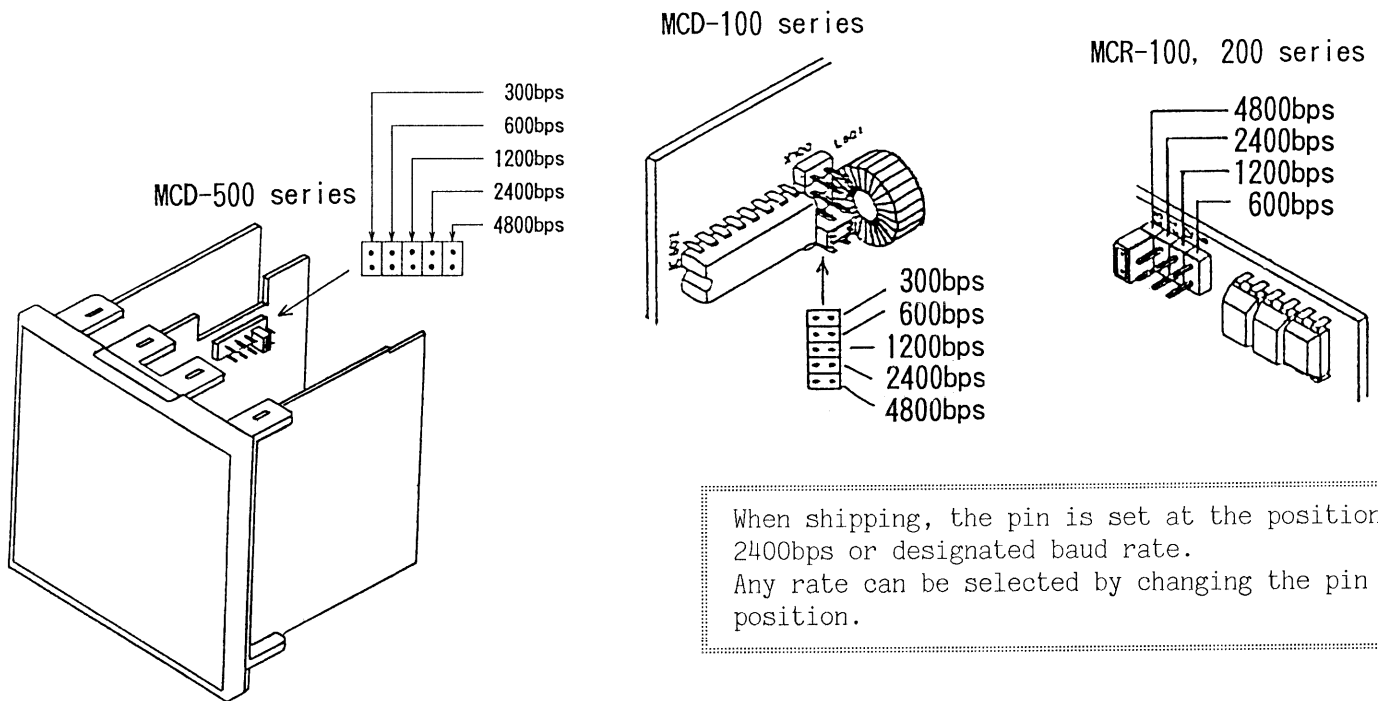Set the instrument by following procedure.

(1) Draw the internal assembly out from the case.
Draw the internal assembly out by holding the notches at the top
and the bottom or the right and the left (MCR-200) of the panel.

(2) Select the transfer rate (baud rate).
Select the transfer rate of the MC series controller to match the rate of
the host computer.

MCD-100 series

MCR-100, 200 series

MCD-500 series

| 300bps |
| 600bps |
| 1200bps |
| 2400bps |
| 4800bps |

4800bps
2400bps
1200bps
600bps

300bps
600bps
1200bps
2400bps
4800bps

When shipping, the pin is set at the position
2400bps or designated baud rate.
Any rate can be selected by changing the pin
position.

(3) Put the internal assembly into the case.

(4) Set the instrument number.

① **Instrument power ON**

Turn the power supplied to this instrument ON.

② **Warmup status**

For approx. 6 seconds after the power on, [$\bar{n}\bar{L}$ -] is displayed on PV display.
During this time, all output, SV display and LED indicators are in their OFF status.

> Meanwhile, avoid key operations, and do not turn the power supply ON while the key is operated, or there is a possibility of change on the specification.

After that, it displays the actual temperature on the process variable (PV) display and setting value on the setting value (SV) display, and starts the control.

③ In PV/SV display mode, press the (MODE) key while the ⬭ (mode auxiliary key) is pressed, and the setting value lock designation mode [$Lock$] will be selected.

④ Press the (MODE) key until the instrument number setting mode [dno] is selected.

Instrument number setting mode
Instrument number setting range: 0 to 30   (Factory adjusted as 0)

Setting mode display	Setting value display (SV)	Process variable display (PV)	Change of the setting value
—	Instrument number setting value	dno	The number can be set with the (▲) and (▼) keys.

- The values selected by the (▲) and (▼) keys are registered by pressing the (MODE) key. If the system is left without key operation for approx. 30 seconds, the mode will be returned to PV/SV display mode automatically and the values at that time will be registered.

- The form of the keys of MCD-500 series are different from the MCD-100, MCR-100 and MCR-200, however, the key functions are the same each other.

> The function of the [⋀] key is the same as the (▲) key.
> The function of the [⋁] key is the same as the (▼) key.
> The function of the [MODE] key is the same as the (MODE) key.
> The function of the ⟨FAST| key is the same as the (FAST) key.

3. Communication procedure

● RS-232C (Option code: C), RS-485 (Option code: C5)

Communications between a host computer and the MC series are started by sending the command from the host computer, and terminated by receiving the response from the MC series.

Host computer   **MC series**

Command
———————————————————→
Data
←———————————————————

Command
———————————————————→
Acknowledgement
←———————————————————

Command
———————————————————→
Negative acknowledgement
←———————————————————

Command
———————————————————→

No response ←——

- **Response with data**
  When the host computer sends the reading command, MC series returns the corresponding setting value or the current status as the response.

- **Acknowledgement**
  If the host computer sends the setting command, the MC series will return acknowledgement (ACK) as the response after the processings are terminated.

- **Negative acknowledgement**
  When the host computer sends the command not existent or the value beyond settable range, MC series returns negative acknowledgement (NAK) for the response.

- **No response**
  MC series will not respond when framing error or checksum error has been detected while the command is being received.

● Transmission timing of RS-485 (Option code: C5)

(1) As to the MC series controller

- When the MC series starts the transmission to RS-485 communication line, the MC series 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 MC series is arranged so as to cut the transmitter off from communication line within the period of 1 character transmission after sending the response.

- The MC series is arranged so as to provide 2 characters transmission or more of period to avoid the collision of the transmission between host computer and MC series. It is arranged before the transmitter is connected with communication line to send the response after the MC series received the command.

(2) As to the Host computer

- 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 or response 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 communication line within the period of 1 character transmission after sending the command in preparation for reception of the response from the MC series.

- Make the program so that the host computer can provide 2 characters transmission or more of period to avoid the collision of the transmission between host computer and MC series. It should be arranged before the transmitter is connected with communication line to send the next command after the host computer received the response.

In case the host computer communicates with the MC series through the line converter (IF-100-C5), it is not requested to manage the transmission timings described above since the IF-100-C5 takes the timing interpreting the protocol automatically. (See RS-485 connection pp. 9,10)

4. Command structure

4.1 Command structure

All commands are composed with ASCII codes.
The command is started by header (STX) and terminated by delimiter (ETX).

① Command

Header	Instrument number	Command code	Data	Checksum	Delimiter

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

Instrument number: 0 to 30 (20H to 3EH)
                      Number by which the host computer discriminates the MC series.
                      The numbers 0 to 30 are used giving 20H of bias (20H to 3EH) since
                      0 to 30 (00H to 1EH) are used for control code.

Command code   : The first digit   (The code to discriminate the setting, changing and
                                          reading command.)
                      The second digit (The code to discriminate the objective item such
                                          as main setting, temperature alarm setting.)

Data   : The contents differ from the command (setting, reading, etc.)

Checksum   : 2-character of data to detect the communication error.
                      See page 16 for the calculation.

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

② Response to the command

Acknowledgement (Acknowledgement to the setting command or changing command)

Header

Header: ACK (06H) [Acknowledgement]

Negative acknowledgement (Negative acknowledgement to all commands)

Header

Header: NAK (15H) [Negative acknowledgement]

Response with data

Header	Instrument number	D,	Command code	Sign	Data	Checksum	Delimiter

Header   : STX (06H) [Acknowledgement]

Instrument number: 32 (40H) [In case of Response with data, it is fixed as 32 (40H).]

Command code   : The first digit (D (44H), the code of response command)
                   The second digit (The code to discriminate the objective item such
                                     as main setting, temperature alarm setting.)

Sign   : Sign of the reading value
                   In case the numerical value is positive number, the sign is " + " or
                   "   " (space) no sign.
                   In case the numerical value is negative number, the sign is " - ".

Data   : Reading value (4-digit)

Checksum   : 2-character of data to detect the communication error.
                   See page 16 for the calculation.

Delimiter   : ETX (03H)
                   End of text.
                   Control code to represent the ending of the command (text).
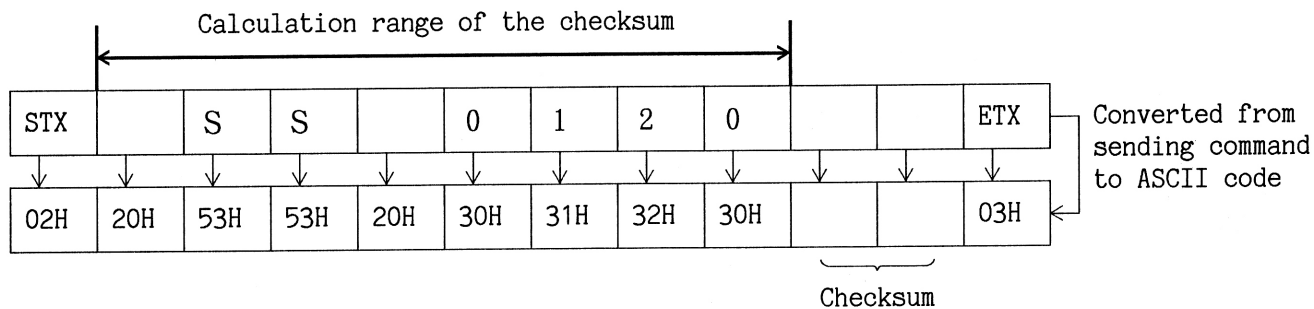
4.2 Checksum calculation

Checksum is used to detect the 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 MC series to confirm the communication error.

The Checksum is 2's complement of the total value (low byte) from the instrument number to the character front of the checksum, and it is indicated with 2 digits of Hex-ASCII characters.

Calculation example of the setting command for main setting [S, S] (53H, 53H) is shown as follows.

Main setting value: 120℃
Instrument number : 0 (20H)

Calculation range of the checksum

STX		S	S		0	1	2	0			ETX	Converted from sending command to ASCII code
02H	20H	53H	53H	20H	30H	31H	32H	30H			03H	

Checksum

[Hexadecimal] [Binary notation]

```
      20H      0010  0000
      53H      0101  0011
      53H      0101  0011
      20H      0010  0000
      30H      0011  0000
      31H      0011  0001
      32H      0011  0010
  +   30H      0011  0000
           1  1010  1001  ─────────→    0101  0110   (1's complements)
                                    +            1
                                       ─────────────
                                        0101  0111   (2's complements)
                                          ↓     ↓
                                          5     7     (Hexadecimal)
                                          ↓     ↓     ↓
                                         35H   37H    (ASCII code)
```

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

[Code to be transmitted]

02H	20H	53H	53H	20H	30H	31H	32H	30H	35H	37H	03H

5. Contents of the command

Notes: • When connecting plural controllers of MC series, the same instrument numbers should not be applied to the plural controllers.
- The settable range is the same as key operation.
- The setting value less than 4 digits should be made to 4 digits by closing to the right and by filling the space with the "0".
- The reading value less than 4 digits is made to 4 digits by closing to the right and by filling the space with the "0", and responded to the command.
- When the setting range has a decimal point, make the value 10 times as much as the setting value.
- In case the numerical value is positive number, the sign is " + " or "   " (space) no sign. When it is negative number, the sign is " − ".
- The setting value change by communication is possible even if the values are protected by the setting value lock or during auto-tuning.
- If the setting value is changed during auto-tuning, it may cause an error to the auto-tuning result, therefore, do not change the setting value during auto-tuning.

5.1 Setting command
(1) Main setting

Command code : S S (53H, 53H)

Setting range: Scaling low limit setting value to Scaling high limit setting value

STX (02H)	No.	S	S	Sign	Main setting value	Checksum	ETX (03H)

● Command examples

When setting the main setting value to 120℃. (Instrument number: 0)

STX (02H)	(20H)	S (53H)	S (53H)	(20H)	0 (30H)	1 (31H)	2 (32H)	0 (30H)	5 (35H)	7 (37H)	ETX (03H)

1 2 0 ℃

When setting the main setting value to −100.0℃. (Instrument number: 0)

STX (02H)	(20H)	S (53H)	S (53H)	− (2DH)	1 (31H)	0 (30H)	0 (30H)	0 (30H)	4 (34H)	C (43H)	ETX (03H)

− 1 0 0. 0 ℃

● Response

Acknowledgement   (When the communication is normally performed.)

ACK	(06H)

Negative acknowledgement (When the communication is abnormally performed.)

NAK	(15H)

(2) Temperature alarm [A1] setting

Command code : S A (53H, 41H)

Setting range:

Alarm type		Thermocouple or RTD input
High limit	[-132-]	−100 to 100℃,　−200 to 200℉
Low limit	[-133-]	−100 to 100℃,　−200 to 200℉
High/Low limits	[-134-]	±(1 to 100)℃,　±(1 to 200)℉
High/Low limit range	[-136-]	±(1 to 100)℃,　±(1 to 200)℉
Process value	[-138-]	Scaling low to high limit setting value

Alarm type		RTD input with decimal point
High limit	[-132-]	−100.0 to 100.0℃,　−200.0 to 200.0℉
Low limit	[-133-]	−100.0 to 100.0℃,　−200.0 to 200.0℉
High/Low limits	[-134-]	±(1.0 to 100.0)℃,　±(1.0 to 200.0)℉
High/Low limit range	[-136-]	±(0.1 to 100.0)℃,　±(0.1 to 200.0)℉
Process value	[-138-]	Scaling low to high limit setting value

STX (02H)	No.	S	A	Sign	Temperature alarm [A1] setting value	Checksum	ETX (03H)

● Command examples

When setting the Temperature alarm [A1] setting value to 10℃.
(Instrument number: 0)

STX (02H)	(20H)	S (53H)	A (41H)	(20H)	0 (30H)	0 (30H)	1 (31H)	0 (31H)	6 (36H)	B (42H)	ETX (03H)

１０℃

When setting the Temperature alarm [A1] setting value to −10.0℃.
(Instrument number: 0)

STX (02H)	(20H)	S (53H)	A (41H)	− (2DH)	0 (30H)	1 (31H)	0 (30H)	0 (30H)	5 (35H)	E (45H)	ETX (03H)

−１０．０℃

● Response

Acknowledgement　　　　　(When the communication is normally performed.)

ACK	(06H)

Negative acknowledgement (When the communication is abnormally performed.)

NAK	(15H)

(3) Temperature alarm [A2] setting
(This item is not available to the MCD-150 series and MCD-550 series.)

Command code : S a (53H, 61H)

Setting range:

Alarm type [Option code]	Thermocouple or RTD input
High limit [AL2]	−100 to 100℃, −200 to 200°F
Low limit [AL3]	−100 to 100℃, −200 to 200°F
High/Low limits [AL4]	±(1 to 100)℃, ±(1 to 200)°F
High/Low limit range [AL6]	±(1 to 100)℃, ±(1 to 200)°F
Process value [AL8]	Scaling low to high limit setting value

Alarm type	RTD input with decimal point
High limit [AL2]	−100.0 to 100.0℃, −200.0 to 200.0°F
Low limit [AL3]	−100.0 to 100.0℃, −200.0 to 200.0°F
High/Low limits [AL4]	±(1.0 to 100.0)℃, ±(1.0 to 200.0)°F
High/Low limit range [AL6]	±(0.1 to 100.0)℃, ±(0.1 to 200.0)°F
Process value [AL8]	Scaling low to high limit setting value

STX (02H)	No.	S	a	Sign	Temperature alarm [A2] setting value	Checksum	ETX (03H)

● Command examples

When setting the Temperature alarm [A2] setting value to 10℃.
(Instrument number: 0)

STX (02H)	(20H)	S (53H)	a (61H)	(20H)	0 (30H)	0 (30H)	1 (31H)	0 (30H)	4 (34H)	B (42H)	ETX (03H)

10℃

When setting the Temperature alarm [A2] setting value to −5℃.
(Instrument number: 0)

STX (02H)	(20H)	S (53H)	a (61H)	− (2DH)	0 (30H)	0 (30H)	0 (30H)	5 (35H)	3 (33H)	A (41H)	ETX (03H)

−5℃

● Response

Acknowledgement   (When the communication is normally performed.)

ACK	(06H)

Negative acknowledgement (When the communication is abnormally performed.)

NAK	(15H)

(4) Proportional band (P) setting

Command code : S P (53H, 50H)

Setting range: 0.1 to 200.0%

STX (02H)	No.	S	P	Sign	Proportional band setting value		Checksum	ETX (03H)

● Command example

When setting the Proportional band value to 2.5%. (Instrument number: 0)

STX (02H)	(20H)	S (53H)	P (50H)	(20H)	0 (30H)	0 (30H)	2 (32H)	5 (35H)	5 (35H)	6 (36H)	ETX (03H)

2. 5%

● Response

Acknowledgement   (When the communication is normally performed.)

ACK	(06H)

Negative acknowledgement (When the communication is abnormally performed.)

NAK	(15H)

(5) Integral time (I) setting

Command code : S I (53H, 49H)

Setting range: 1 to 3600 seconds

STX (02H)	No.	S	I	Sign	Integral time setting value		Checksum	ETX (03H)

● Command example

When setting the Integral time value to 200 seconds (Instrument number: 0)

STX (02H)	(20H)	S (53H)	I (49H)	(20H)	0 (30H)	2 (32H)	0 (30H)	0 (30H)	6 (36H)	2 (32H)	ETX (03H)

200 seconds

● Response

Acknowledgement   (When the communication is normally performed.)

ACK	(06H)

Negative acknowledgement (When the communication is abnormally performed.)

NAK	(15H)