① Serial communication [Option: C5]

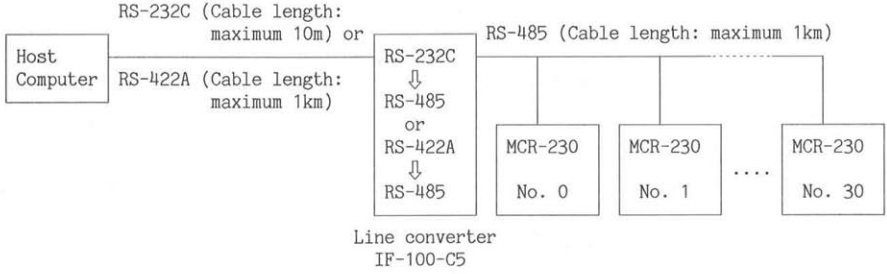
When controlling the MCR-200 by communication connecting with a host computer, the MCR-200 accorded with the instrument number receives the command from the computer, and performs the command.

- Setting and reading from the host computer

Main setting value	Main output proportional cycle setting value
Temperature alarm setting value	Sub-output proportional cycle setting value
Sub temperature alarm setting value	Sub-output proportional band setting value
Proportional band setting value	Main output differential setting value
Integral time setting value	Sub-output differential setting value
Derivative time setting value	Output high limit setting value
Anti-reset windup setting value	Output low limit setting value
Manual manipulating output value	

- Changing and reading of the status from the host computer
  - Setting value Lock/Unlock
  - Automatic/Manual control
  - PID auto-tuning Performance/Cancel
- Reading from the host computer
  - Input value from the sensor
  - Controlling output
  - Alarm output status

● Communication by RS-232C multidrop links



● Transmission system

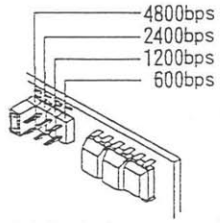
All commands consist of ASCII (JIS) code.

• Cable length	RS-485 1km maximum
• Communication method	Half-duplex
• Synchronous system	Start-stop synchronous
• Data transfer rate	600, 1200, 2400 and 4800bps selectable (*1)
• Code form	JIS 7 bits code
• Error detection	Parity check, Checksum
• Error correction	Command request repeat
• Data format	

Start	b1	b2	b3	b4	b5	b6	b7	Parity	Stop

Start bit: 1
Data bit : 7
Parity : Even parity
Stop bit : 1

● Transfer rate selection (*1)



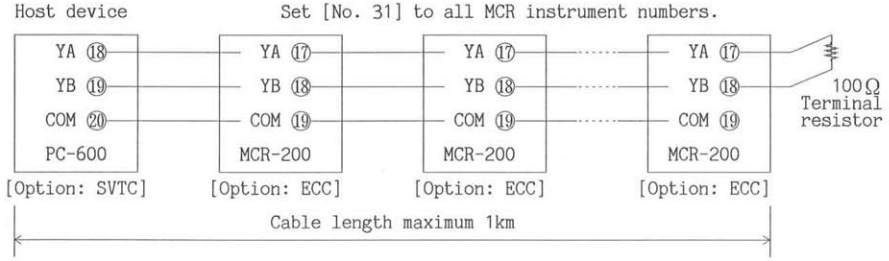
When shipped, the pin is set at 4800bps or the designated transfer rate position. Any transfer rate (baud rate) is selectable changing the pin position.

② External setting [Option: ECC]

It does not memorize the main setting value in digital signal (RS-485) from external host device (PC-600 option: SVTC) into internal memory of the MCR, and reads it directly. This function works when the Setting value lock designating mode is set to 3 "Loc 3".

Notes: • Transfer rate should be fit with host device (PC-600 option: SVTC).
• Refer to item 5.2 (page 14 and 15) for the setting method of mode 3 "Loc 3".
• All instrument numbers connected MCRs should be set to No. 31.
• When using, apply the power in order MCR ⇨ Host device (PC-600 option: SVTC).
• Connect 100Ω of terminal resistor for the last MCR.
• This option [ECC] cannot be applied together with option Heater burnout alarm [W] and/or serial communication [C5].

● Connection diagram for option ECC



⑬ Control type designating mode

A mode to designate the types (Heating[reverse] action or cooling[direct] action) of control.

[In the initial, heating[reverse] action is designated for main control (C1)]

(Setting mode display indicates [_])

Control type	SV display	PV display	Change of status
Heating[reverse] action	HEAT	cnt	" △ " key for heating action
Cooling[direct] action	cooL		" ▽ " key for cooling action

When changed this control type, cooling action of heating/cooling control output [Option] is also changed as follows.

Control type	Standard specification		[Optional specification]	
	Main control(C1)	Sub-control(C2)	Main control(C1)	Sub-control(C2)
HEAT	Heating action	None	Heating action	Cooling action
cooL	Cooling action	None	Cooling action	Heating action

5.3 Setting value memory function [Option: SM]

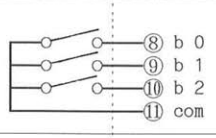
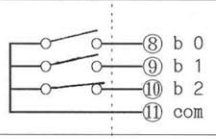
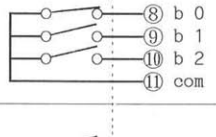
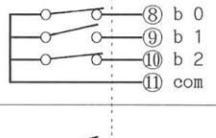
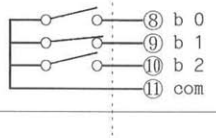
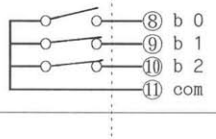
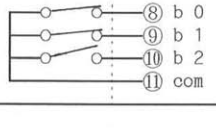
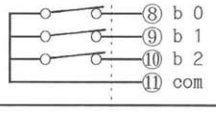
8 files of data can be memorized, and selecting a desired file from it, the desired control can be carried out.

In one (1) file, 7 kinds of data: Main setting value, PID each value, ARW value, Temperature alarm setting value and Dead band value can be set.

To select the setting value memory number, connect the terminals between each of 8 to 11 as shown below table.

(Use convenient switch MS-108, sold separately, to select the setting value memory number.)

Notes: 1. Memory numbers cannot be changed during setting mode and PID auto-tuning.
2. When 2 or more current output type of instruments (-A/□) applied the option SM are to be operated by setting value memory calling switch (MS-108), contact your shop where purchased or our agent.

Setting value memory number	Terminal connection		Setting value memory number	Terminal connection	
	Connection	Terminal No.		Connection	Terminal No.
1		⑧ b 0 ⑨ b 1 ⑩ b 2 ⑪ com	5		⑧ b 0 ⑨ b 1 ⑩ b 2 ⑪ com
2		⑧ b 0 ⑨ b 1 ⑩ b 2 ⑪ com	6		⑧ b 0 ⑨ b 1 ⑩ b 2 ⑪ com
3		⑧ b 0 ⑨ b 1 ⑩ b 2 ⑪ com	7		⑧ b 0 ⑨ b 1 ⑩ b 2 ⑪ com
4		⑧ b 0 ⑨ b 1 ⑩ b 2 ⑪ com	8		⑧ b 0 ⑨ b 1 ⑩ b 2 ⑪ com

＊ Setting value memory function operating procedure ＊

1. In PV/SV display mode, select the setting value memory number. (See above diagram.)
2. Select the setting mode, and set the Main setting value, Temperature alarm setting value, PID each value, ARW value and Dead band setting value [Option].
(See 5.1 Basic operation [Basic function setting mode])
3. Return the mode from setting to PV/SV display.
4. Selected memory number is displayed on setting value memory number display of this instrument, and starts the control with the setting value of which the number is displayed.

Note: If changed the connection during setting, indication of setting value memory number display does not change, and the value is to be set in the number indicating.

5.4 Other functions

(1) Tamper-proof function

In any mode excepting PV/SV display mode, if no keys are pressed for 30 seconds, the controller will automatically return to PV/SV display mode.

(2) Burnout alarm (upscale)

When burnout the thermocouple or RTD (between A and B), makes the main control output to output low limit value, and lights the ⬭ HB heater burnout alarm action indicator. And simultaneously PV display blinks [‾ ‾ ‾ ‾] . (upscale)

Once alarm action operates, the output is held until the power supply is turned OFF even if the sensor has been replaced to normal one and the temperature indication becomes properly.

Further, if input value exceeds 1.125 times of rated scale high limit value, it acts the same as above action. (overscale indication, upscale)

Note: In case heater burnout alarm function is specified, the alarm output is added and heater burnout alarm output turns ON as sensor burnout alarm output.

(3) Self-diagnostic function

Watches the CPU by watchdog timer, and when abnormal status has occurred, makes the controller to initial status making the all output off.

(4) Automatic cold junction temperature compensation (-□/E)

Detects the temperature at the connecting terminal between thermocouple and instrument, and always makes it the same status at which the reference junction located at 0℃ [32℉].

6. Control actions

6.1 Explanation of PID

(1) Proportional band (P)
Proportional action is the action of which the control output varies in proportion to the deviation between setting value and processing temperature. If the proportional band is narrowed, the output changes according to even by a slight variation of the processing temperature, and better control result can be obtained as the offset decreases. However, if when the proportional band is extremely far too narrowed, it may cause variation in the processing temperature even by slight disturbance, and turns into control such as ON/OFF action of the so called hunting phenomenon. Therefore, when the processing temperature comes to the balanced position near the setting value and a constant temperature is maintained, the most suitable value is selected by gradually narrowing the proportional band while observing the control results.

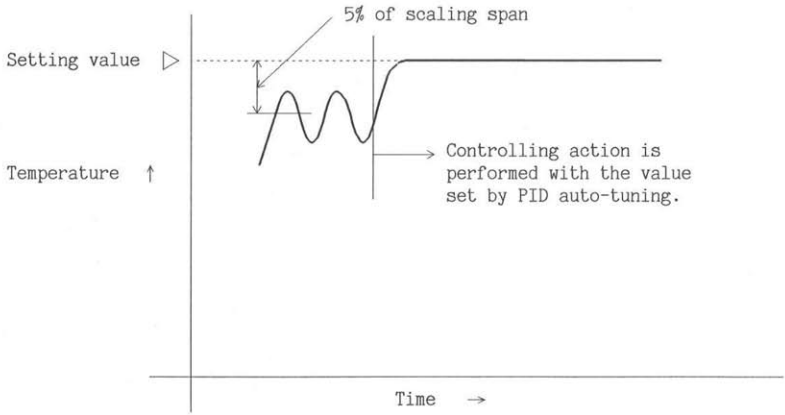
(2) Integral time (I)
Integral action is to eliminate offset. When the integral time is shortened, the returning speed to the setting point is quickened. However, the cycle of oscillation is also quickened and stability becomes unfavorable.

(3) Derivative time (D)
Derivative action is to restore the change of processing temperature according to the changing rate. It reduces the amplitude of overshoot and undershoot width. If the derivative time is shortened, restoring value comes small, and if the derivative time is adjusted longer, a phenomenon of returning too much may occur and the control system may be oscillated.

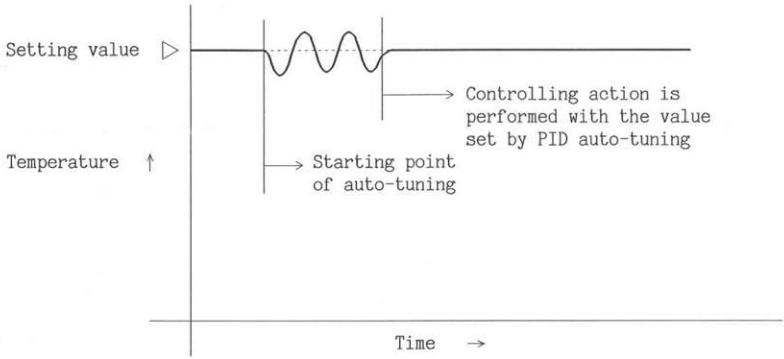
6.2 Explanations of PID auto-tuning

In order to decide each value of P, I, D and ARW automatically, this system gives the fluctuation to the control object by force. Three kinds of undermentioned systems are automatically selected by an instrument.

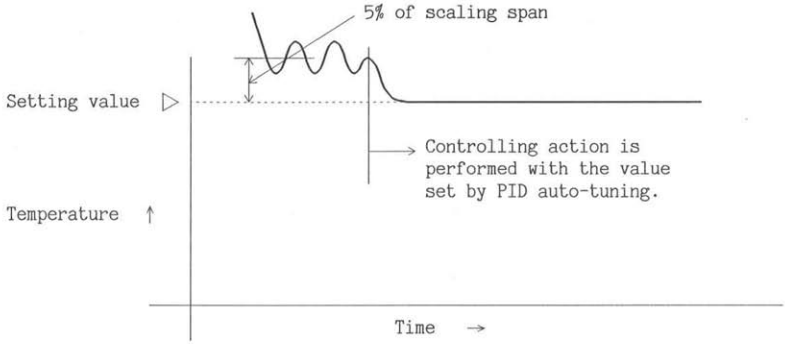
(1) In case the difference between setting value and processing temperature is large when the temperature rises.
Fluctuation is given at the temperature 5% of scaling span less than the setting value.



(2) In case of the stable situation during control or when control temperature is within ±10% of scaling span.
Fluctuation is given at the setting value.



(3) In case control temperature is 10% or more of scaling span.
Fluctuation is given at the temperature 5% of scaling span higher than the setting value.



* The methods (1) to (3) are automatically selected by the relation between control temperature and setting value. However, according to the process, if selected the timing to start auto-tuning, the merits mentioned below is applicable effectively.
  - The method (1) prevents control temperature from exceeding setting value during auto-tuning. This method is suitable to the systm high process gain such as process has high rise rate or the process have short lagged time.
  - The method (2) is possible to measure with small fluctuation, specially, suitable to the process of long lagged time.
  - The method (3) is suitable to be used as cooling (direct) action. It has no objection using to heating (reverse) action, however, hunting may often occur depending on the process.

6.3 How to get the duty factor for ARW when manual controlling.
In case of relay contact output or non-contact voltage output:

$$\text{Duty factor}(\%) = \frac{\text{ON time}}{\text{Proportional cycle}} \times 100$$

In case of current output:

$$\text{Duty factor}(\%) = \frac{\text{Output current (mA)} - 4}{16} \times 100$$

Set to 50%, if duty factor is unknown.

7. Running

After completion of the mounting to the control panel and wiring connections, start running in the following manner:

(1) Turn the power supplied to this instrument ON.
(Do not turn the power on while pressing the key, or the specification contents of the instrument may be changed.)

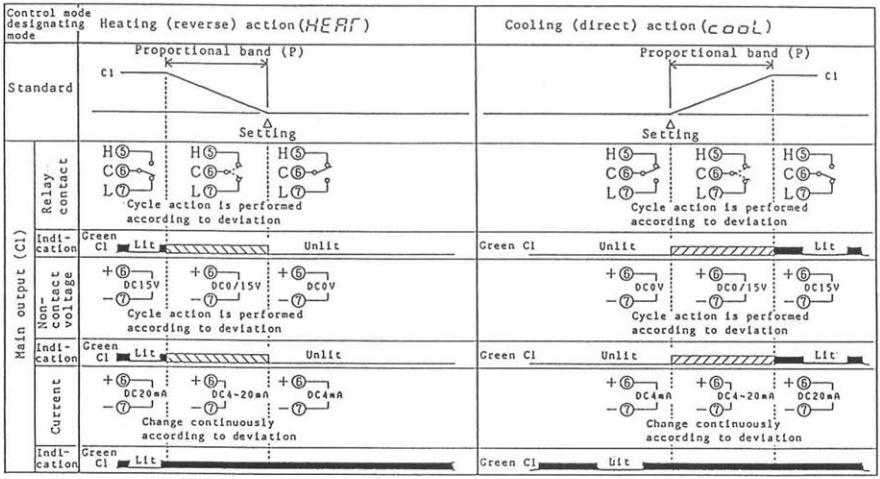
(2) Instrument (warmup status)
For approx. 6 seconds after power on, [- -] is displayed on process variable display. During this time, all output, digital display and LED indicators are in their OFF status.
(Key operations must not be executed during this time, or the specification of the instrument will have a possible to change.)
After that, displays actual temperature on the process variable display, setting value on the display, and starts control.

(3) Input the setting value, referring to " 5. Operations ".

(4) Turn the control circuit power ON.

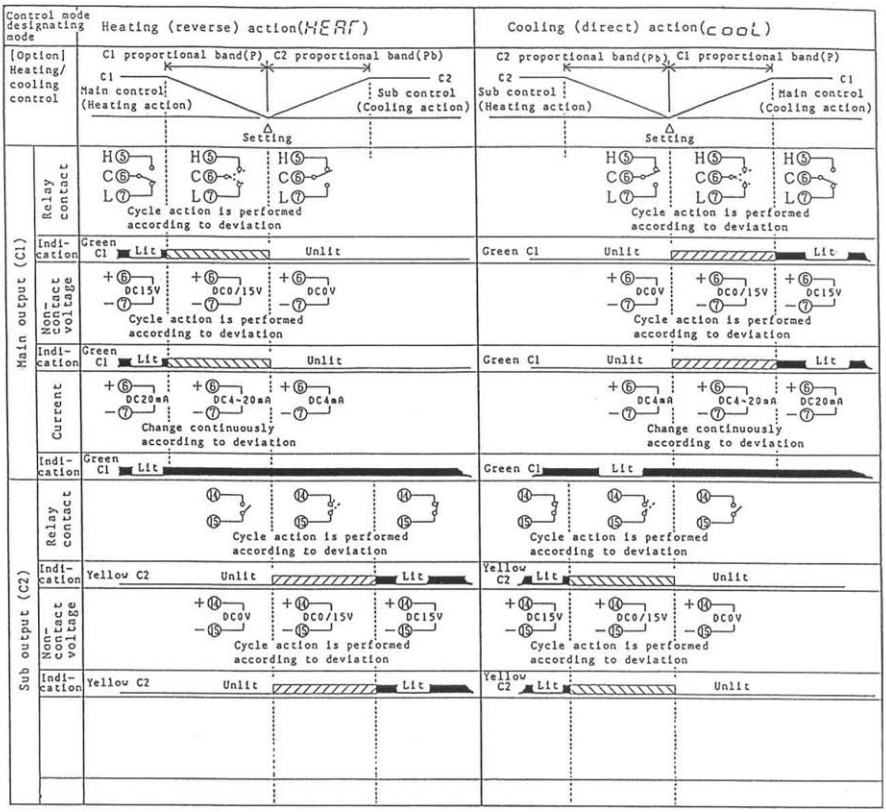
(5) The controller starts the following control action so as to maintain the controlled object at the setting value.

7.1 Standard actions



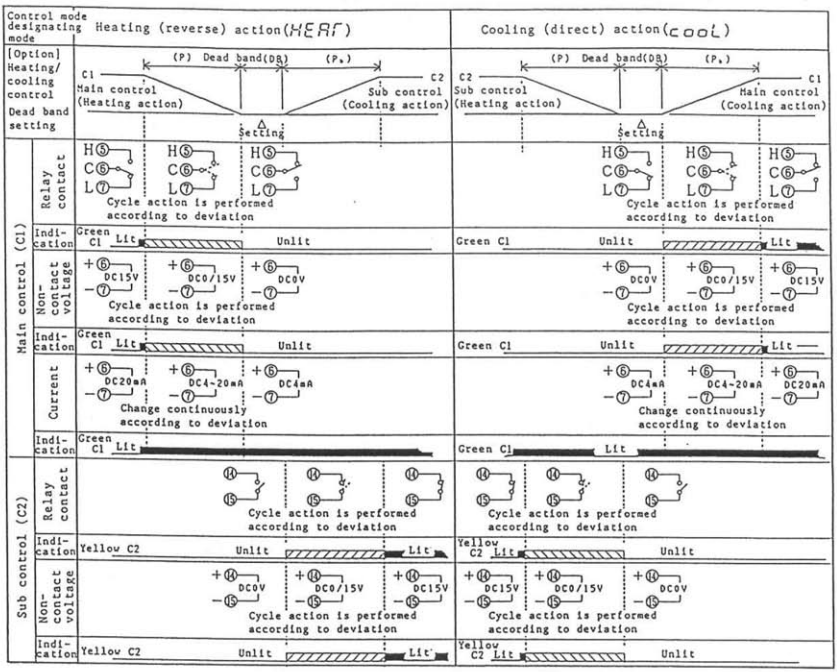
The position of proportional band mentioned above indicates the case of proportional action.

7.2 Heating/Cooling actions [Option: D]



The position of proportional band mentioned above indicates the case of proportional action.

7.3 Heating/Cooling actions [Option: D□] (When setting the dead band.)



The position of proportional band mentioned above indicates the case of proportional action.

7.4 Alarm actions

* Temperature alarm

Alarm mode	High limit alarm (-132-)	Low limit alarm (-133-)	High/low limit alarm (-134-)	High/low limit range alarm(-136-)	Absolute value alarm (-138-)
Standard mode	Dead band, ON, OFF, Main, Alarm	Dead band, ON, OFF, Alarm, Main	Dead band, ON, OFF, Alarm, Main, Alarm	Dead band, ON, OFF, Alarm, Main, Alarm	Dead band, ON, OFF, Alarm, Main
Output					
Indication	Unlit / Lit	Lit / Unlit	Lit / Unlit / Lit	Unlit / Lit / Unlit	Unlit / Lit
Alarm mode	High limit alarm (-132-)	Low limit alarm (-133-)	High/low limit alarm (-134-)		
With standby [Option]	Dead band, ON, OFF, Main, Alarm	Dead band, ON, OFF, Alarm, Main	Dead band, ON, OFF, Alarm, Main, Alarm		
Output					
Indication	Unlit / Lit	Lit / Unlit	Lit / Unlit / Lit		

Note: (1) Option code which has standby function is H.
(2) In ▨ parts, the standby function operates.
(3) This standby function holds the alarm output until the deviation comes within alarm setting range, after instrument power ON, or if main setting is changed when controlling and in case the deviation becomes larger than alarm setting range.

* Heater burnout alarm

Alarm action	Output	Indication
ON, OFF, Setting, Small Load current Large		Lit / Unlit

Note
(1) Once alarm action operates, the output is maintained until the instrument power is turned OFF.