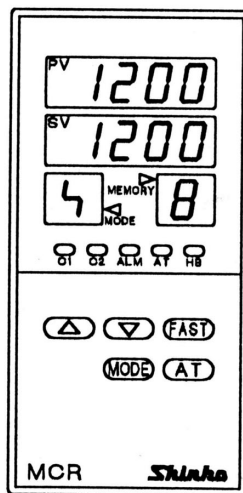# INSTRUCTION MANUAL
FOR
MICROCOMPUTER BASED
TEMPERATURE INDICATING CONTROLLER
MCR-100 series

Thank you for your purchase of our Microcomputer based Temperature Indicating Controller MCR-100 series.

This manual contains instructions for the mounting, the functions and operations of the MCR-100 series.

For your confirmation of the model and specifications of the controller, peruse and understand this instruction manual before starting operation.

> Please arrange to give this manual into the hands of the operator who actually uses our product.

▪ ▪ ▪ Notes to users ▪ ▪ ▪
Before operating this controller, you should understand about following matters.

┌─────────────────────< 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.

└──┘

┌─────────────────────< Notices >─────────────────────┐

▪ The instrument must be grounded.
▪ Do not operate the keys during warm-up status (for approx. 6 seconds
  after the power on), and do not turn the power on while the key is
  pressing, or the specification contents of the instrument will have
  possibles to change.
▪ Do not apply the voltage between the terminals ③ and ④ (See page 31),
  or there is a possibility that the transformer can be burning.

└──┘

○ PID auto-tuning does not function if setting value lock is designated
  by the mode in attached function setting mode.

As for addition of the options.

• If the option temperature alarm (A2 output) [code: AL2 to AL8] is applied,
  it is not available with a combination of the option heating and cooling
  control output [code: DR or DS].

CONTENTS

1. Model names
1.1 Standard models

MCR-1 □ . □ - □ / □				Series name: M C R - 1 0 0 series
Control action	3			PID action
Temperature alarm action	0			No alarm action
	2			High limit alarm (Deviation setting) ∗
	3			Low limit alarm (Deviation setting) ∗
	4			High/low limit alarm (Deviation setting) ∗
	6			High/low limit range alarm (Deviation setting)
	8			Process value alarm
Main output		R		Relay contact 1c
		S		Non-contact voltage 15Vdc ±5V (for SSR)
		A		Current 4 to 20mAdc
Input			E	Thermocouple K, J, PL-Ⅱ, R, S, B, C, T
			R	RTD Pt100, JPt100 (3-wire system)

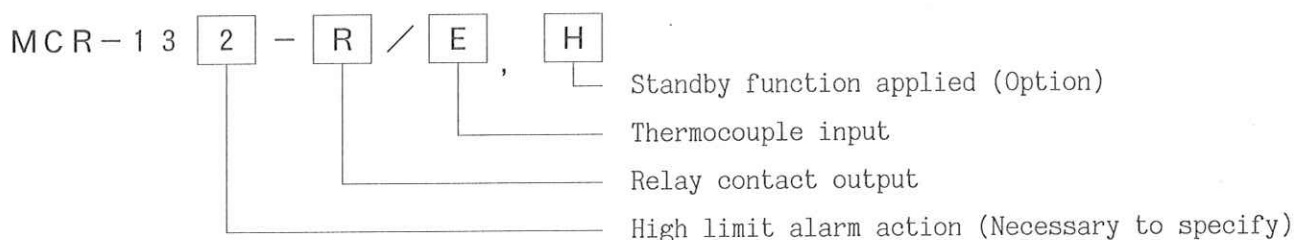Note: The standby function can be applied to the alarms marked ∗.

1.2 Optional specifications

Optional name	Code	Description
Temperature alarm with standby function	H	The standby alarm function disables alarm action until the temperature passes over the alarm setpoint on initial start.
Temperature alarm function (A2 output)	A L □	Additional temperature alarm besides the alarm of the standard specification. The action is specified in □. (AL2, AL3, AL4, AL6, AL8)
Temp. alarm (A2) function with standby	A L □ H	Standby function is added to temperature alarm function (A2), and the action is specified in □. (AL2H, AL3H, AL4H)
Heater burnout alarm function.	W	Watches heater current through CT (current transformer), and when the heater current goes down lower than setting value, it gives alarm. Current: 5A, 10A or 20A (specified) [This option cannot be applied together with (C5), (ECC).]
Heating/Cooling control output	D □	Control output individually works with heating and cooling control mode. Cooling output(C2) □: Relay contact [DR], Non-contact voltage [DS]
Setting value memory function	S M	The function which memorizes 8 kinds of data in 8 files. (Main setting value, PID each value, ARW value, Temperature alarm setting value, Auxiliary temperature alarm setting value and Dead band setting value)
Serial communication	C 5	The function to transmit the data with EIA RS-485. [This option cannot be applied together with (W), (ECC).]

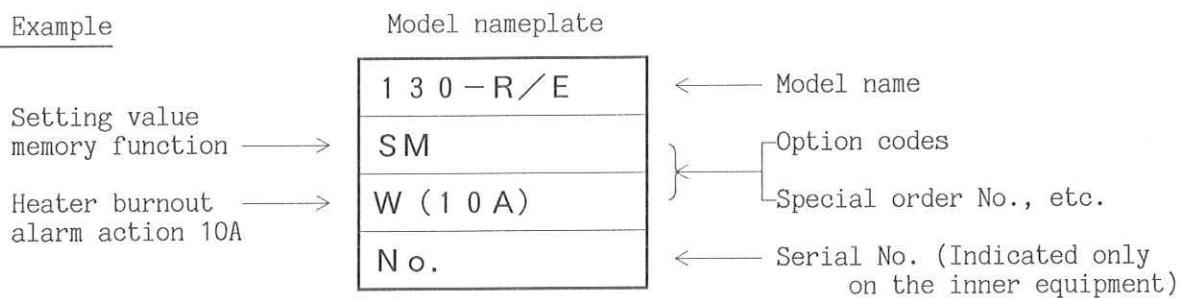| External setting | E C C | It does not memorize the main setting value command in digital signal (RS-485) from host device (PC-600 series, SVTC) into internal memory, and reads it directly. [This option cannot be applied together with (W), (C5).] |
| Color Black | B K | Face plate: Dark gray
Case, Base: Black |
| Screw type mounting bracket | B L | Mounting Panel thickness 1 to 8 mm.
(Standard mounting bracket is one touch system.) |

1.3 Explanation of model name

Discribed mark "□" in this manual such as R/□ or □/□ means an alphanumerical character which shows various functions or the kinds. (e.g. R/E or S/R)

$$MCR-13\ \boxed{2}\ -\ \boxed{R}\ /\ \boxed{E}\ ,\ \boxed{H}$$

- Standby function applied (Option)
- Thermocouple input
- Relay contact output
- High limit alarm action (Necessary to specify)

1.4 How to indicate optional specifications

① Optional specifications are specified by the option code (described in the preceding page) besides the model name.
② When two or more functions are specified, they are delimited with comma.
③ As to specified Heater burnout alarm action W, the specified value is to be indicated following to the option code in (A).

Example   Model nameplate

1 3 0 − R ∕ E	← Model name
S M	⎫ ⌐Option codes
W (1 0 A)	⎬ └Special order No., etc.
N o.	← Serial No. (Indicated only on the inner equipment)

Setting value memory function ──→ SM

Heater burnout ──→ W (1 0 A)
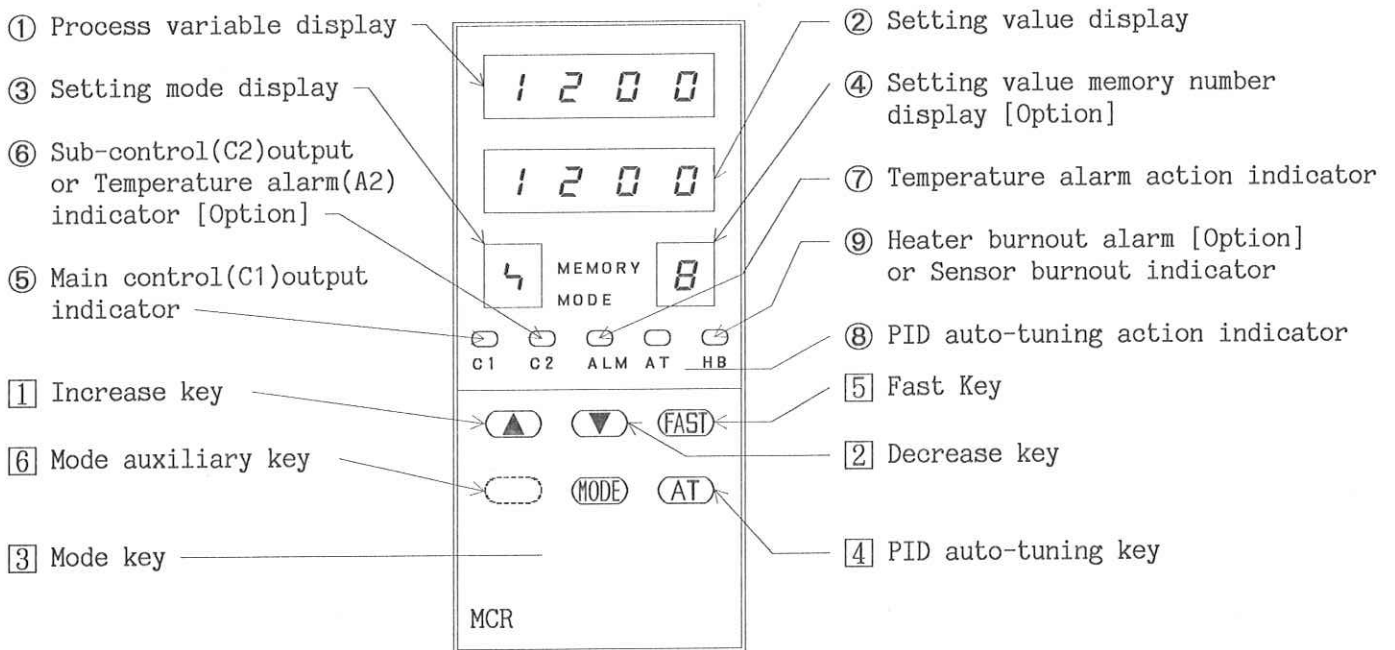alarm action 10A

Notes: ▪ Designation is required to apply the temperature alarm.
        ▪ When applying the standby function, designate the option.

─────< Warning >─────
Do not take the inner assembly out or touch the terminal when the power supply is ON status. If you touch the terminal, there is possibility of Electric Shock which can cause severe injury or death.

2. Names and functions of the sections

① Process variable display

③ Setting mode display

⑥ Sub-control(C2)output
or Temperature alarm(A2)
indicator [Option]

⑤ Main control(C1)output
indicator

[1] Increase key

[6] Mode auxiliary key

[3] Mode key

② Setting value display

④ Setting value memory number
display [Option]

⑦ Temperature alarm action indicator

⑨ Heater burnout alarm [Option]
or Sensor burnout indicator

⑧ PID auto-tuning action indicator

[5] Fast Key

[2] Decrease key

[4] PID auto-tuning key

2.1 Explanations of display

① Process variable(PV) display: It Indicates the process variable. (Red LED)

② Setting value(SV) display   : It Indicates the setting value. (Green LED)

③ Setting mode display   : It Indicates the setting mode. (Yellow LED)
Each time the (MODE) key is pressed, the mode is chsnged.

④ Setting value memory number : It Indicates the setting value memory number being
display [Option]   controlled or setting.   (Red LED)

⑤ ○ Main control (C1) output : Green LED lights when the Main control output is ON.
   C1 indicator   (In case of current output, it always lights.)

⑥ ○ Sub-control (C2) output : Yellow LED lights when sub-control (C2) output
   C2 or Temperature alarm (A2) or Temperature alarm (A2) output is ON.
   output indicator [Option]

⑦ ○ Temperature alarm action : Red LED lights when temperature alarm output is ON.
   ALM indicator

⑧ ○ PID auto-tuning action : Yellow LED blinks during PID auto-tuning.
   AT indicator

⑨ ○ Heater burnout alarm   : Red LED lights when heater burnout alarm output is
   HB action indicator   ON [Option] or Sensor burnout alarm output is ON.

2.2 keys

Main function of each key is described here however, the key has other functions on the mode. Refer to item " 5. Operations"(Page 10 ff).

[1] (▲) Increase key: It increases the setting value (SV) being displayed.
(It attached function setting mode,it does other functions.)

[2] (▼) Decrease key: It decreases the setting value (SV) being displayed.
(It attached function setting mode,it does other functions.)

[3] (MODE) Mode key: It selects the setting mode, and registers the setting value.

[4] (AT) PID auto-tuning key: It performs or cancels the PID auto-tuning.

[5] (FAST) Fast key: It makes the numeric value change faster by pressing this key
while "(▲) or (▼)" key is being pressed.

[6] (⸏⸏⸏) Mode auxiliary key:If the "(MODE)" key is pressed while this key is being pressed,
the attached function setting mode is selected.

o In any mode, PID auto-tuning will be started by pressing the (AT) key.
It will not start if lock is specified by Setting value lock designating mode (See page 14).
If the (AT) key is pressed by mistake, press the key again to cancel the tuning.

o The setting value is registered by pressing the (MODE) key. If it is left without the (MODE)
key operation for approx. 30 seconds, the mode will return to PV/SV display mode auto-
matically and the values left will be registered.

3. Operations
　3.1 Basic (Basic function setting mode)

Process variable display (PV) indicates $\boxed{\bar{n}\mathcal{C}-}$ for approx. 6 seconds after the power turned ON. During this time, all outputs, digital displays 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.) After that, it displays actual temperature on the PV display, setting value on the SV display and starts control.
To select basic function setting mode, press the "(MODE)" key in PV/SV display mode.
Then it displays $\boxed{\mathrel{\mathop{\mathsf{L}}}}$ on setting mode display, and main setting mode is selected.
In this mode, set the desired temperature for control by increasing or decreasing the numeric of setting value display with "(▲), (▼)" keys, Moreover when using "(▲), (▼)" keys, if "(FAST)" key is simultaneously pressed, the change of numeric value becomes faster.
Further, each pressing the "(MODE)" key, the mode is selected as shown below figure, and the setting values necessary for each mode are settable.

```
        ┌──────────────────────────────┐
        │     Instrument power ON       │
        └──────────────────────────────┘
                       │
        ┌──────────────────────┬───────┐
        │   Warmup status      │  nC-  │   Displays the message
        └──────────────────────┴───────┘   for approx. 6 seconds.
   (1)                │
    ┌──> ┌──────────────────────────────┐
    │    │   PV,SV indicating mode       │
    │    └──────────────────────────────┘
    │                   │  (MODE) key
    │    ══════════════ Basic function setting mode ══════════════
    │
    │               Setting mode display
    │                   │
    │(2) ┌──────────────────────┬───────┐
    │    │   Main setting mode  │   ┐   │  Set the desired temperature.
    │    └──────────────────────┴───────┘
    │                   │  (MODE) key
    │(3) ┌──────────────────────┬───────┐
    │    │ Temperature alarm    │   A   │  Set the temperature alarm setting
    │    │ setting mode         │       │  value.      [Option: H, for w/standby]
    │    └──────────────────────┴───────┘
    │                   │  (MODE) key
    │(4) ┌──────────────────────┬───────┐
    │    │ Auxiliary temperature│   A.  │  Set the auxiliary temperature alarm
    │    │ alarm setting mode   │       │  setting value. [Option: AL□]
    │    └──────────────────────┴───────┘
    │                   │  (MODE) key
    │(5) ┌──────────────────────┬───────┐
    │    │ Proportional band    │   P   │  Set the proportional band.
    │    │ setting mode         │       │
    │    └──────────────────────┴───────┘
    │                   │  (MODE) key
    │(6) ┌──────────────────────┬───────┐
    │    │ Integral time        │   I   │  Set the integral time.
    │    │ setting mode         │       │
    │    └──────────────────────┴───────┘
    │                   │  (MODE) key
    │(7) ┌──────────────────────┬───────┐
    │    │ Derivative time      │   d   │  Set the derivative time.
    │    │ setting mode         │       │
    │    └──────────────────────┴───────┘
    │                   │  (MODE) key
    │(8) ┌──────────────────────┬───────┐
    │    │ ARW setting mode     │   Π   │  Set the ARW (Anti-reset windup) value.
    │    └──────────────────────┴───────┘
    │                   │  (MODE) key
    │(9) ┌──────────────────────┬───────┐
    │    │ Dead band setting    │   d'  │  Set the dead band value.  [Option: D□]
    │    │ mode                 │       │
    │    └──────────────────────┴───────┘
    │                   │  (MODE) key
    │(10)┌──────────────────────┬───────┐
    │    │ Heater burnout alarm │   b   │  Set the current value for heater
    │    │ setting mode         │       │  burnout alarm. [Option: W]
    │    └──────────────────────┴───────┘
    │                   │  (MODE) key
    └───────────────────┘
```

[Setting is not required to all modes. Set the values for only necessary modes. If PID auto-tuning is performed, the values for P, I, D and ARW are set automatically.]
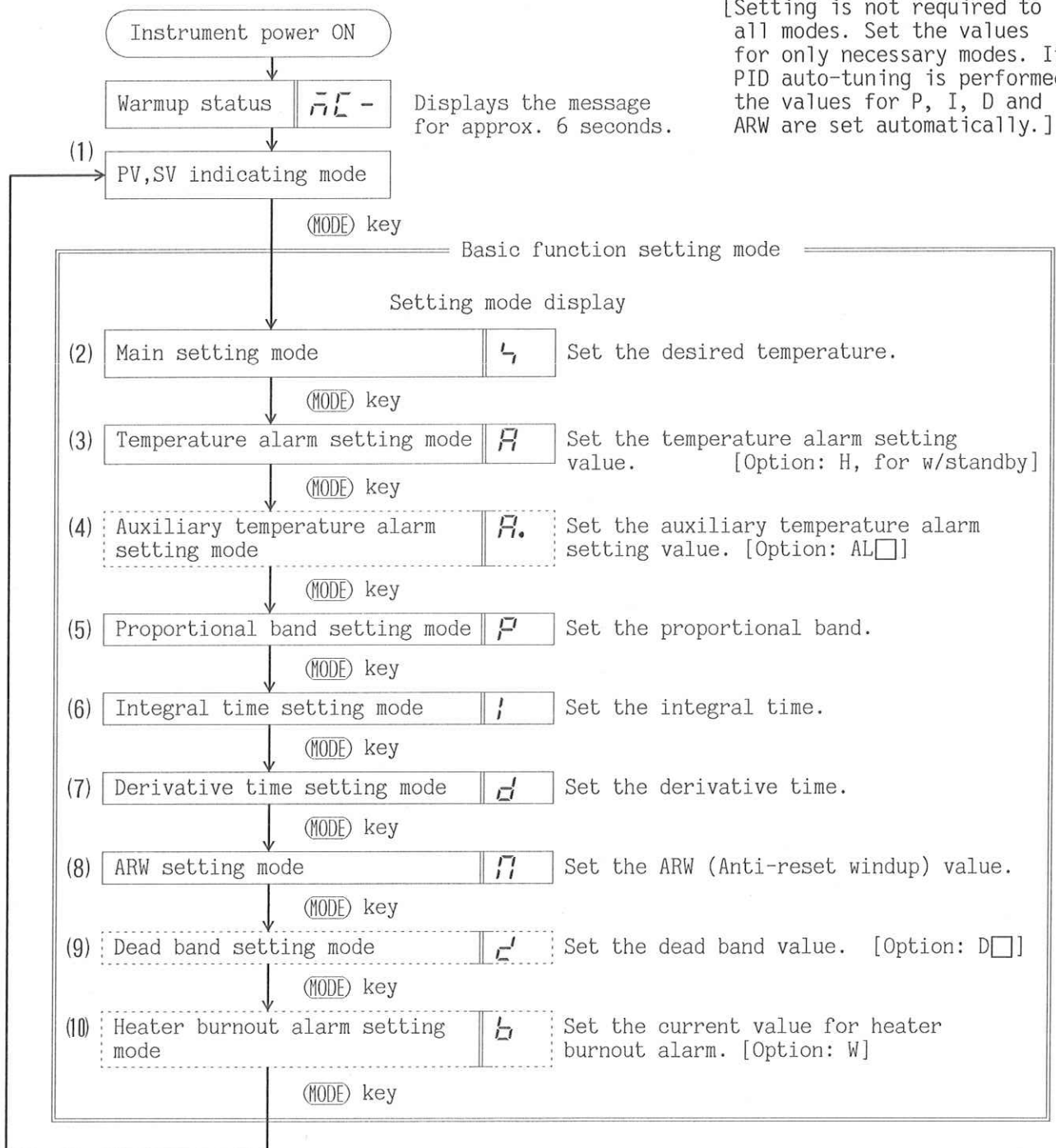
Notes: (for preceding page)

1. ⬜ means in case of option specification.
   (If the options are not designated, the modes cannot be selected.)

2. In any mode, if "(AT)" Key is pressed, auto-tuning will be started.
   However, if lock function is specified, the auto-tuning cannot work.

3. The indicated value selected by "(▲), (▼)" keys is registered after pressing
   "(MODE)" key. If the key operation is ended after the numeric value is set,
   approx. 30 seconds later the mode is automatically changed to PV, SV display mode
   and the setting values are registered.

(1) PV, SV display mode

A mode to indicate a status of control.

Setting mode display	SV display	PV display	Change of setting value
------	Main setting value	Actual temperature	No contents of setting items nor setting values can be changed.

(2) Main setting mode

A mode to set a setting value of main control (C1).
The setting range covers the scaling low to high limit setting values.
The setting value is registered when "(MODE)" key is pressed.

[Factory adjusted as 0℃, 0℉]

Setting mode display	SV display	PV display	Change of setting value
↳	Main setting value	Actual temperature	The value can be increased or decreased by pressing the "(▲), (▼) and (FAST)" keys.

(3) Temperature alarm setting mode

A mode to set a temperature alarm setting value.
If the type MCR-130- ▯/▯ is selected, the alarm action cannot be applied.
Setting range is as follows. (Setting ranges differ from the alarm action
correspondent to the models. Factory adjusted as 0℃, 0℉.)
Value setting: Deviation setting against main setting, except Process value alarm.

      (MCR-130-) No alarm action
      (MCR-132-) High limit alarm   : -100 to 100℃, -200 to 200℉
      (MCR-133-) Low limit alarm   : -100 to 100℃, -200 to 200℉
      (MCR-134-) High/Low limit alarm   : $\pm(1$ to 100)℃, $\pm(1$ to 200℉) (*1)
      (MCR-136-) High/Low limit range alarm: $\pm(1$ to 100)℃, $\pm(1$ to 200℉) (*1)
      (MCR-138-) Process value alarm   : Scaling low to high limit setting value

[Option code: H, w/standby function]

  This standby function halts the alarm output until the deviation comes within alarm setting range after power ON, or if main setting is changed during control, and in case the deviation becomes larger than alarm setting range.

(MCR-132—□/□,H) High limit alarm w/standby function: −100 to 100℃, −200 to 200°F

(MCR-133—□/□,H) Low limit alarm   w/standby function: −100 to 100℃, −200 to 200°F

(MCR-134—□/□,H) Hi/Lo limit alarm w/standby function: ±(1 to 100)℃, ±(1 to 200°F) (*1)

Setting mode display	SV display	PV display	Change of setting value
A	Temperature alarm setting value	Actual temperature	The value can be increased or decreased by pressing the "(▲), (▼) and (FAST)" keys.

Notes: 1. Setting the alarm value to 0 disables the function.
         (However, in case of Process value alarm, it works even if 0 is set.)

      2. In case rated scale has a decimal point, the setting value is:
         −100.0 to 100.0℃,(−199.9 to 200.0°F)

      3. As for the alarm setting -134- or -136- marked by (*1), both + and − side are set simultaneously.

(4) Auxiliary temperature alarm setting mode [Option: AL□]

  This mode is applied when specified the auxiliary temperature alarm (AL□). Setting range, setting method and the function are the same as item (3).

Setting mode display	SV display	PV display	Change of setting value
A.	Auxiliary temp. alarm setting value	Actual temperature	The value can be increased or decreased by pressing the "(▲), (▼) and (FAST)" keys.

(5) Proportional band setting mode

  A mode to set a proportional band of main control (C1).
  (When PID auto-tuning is performed, the value is set automatically.)
  Setting range is 0.1 to 200.0%. (Factory adjusted as 2.5%.) Setting the proportional band to 0.0 causes the instrument to act as an ON/OFF controller, and when selected heating and cooling control [Option: D□], sub-control(C2) also turns to ON-OFF action.
  At this time, differential can be set in the differential setting mode of the attached function setting mode.

Setting mode display	SV display	PV display	Change of setting value
P	Proportional band setting value	Actual temperature	The value can be increased or decreased by pressing the "(▲), (▼) and (FAST)" keys.

(6) Integral time setting mode
　　A mode to set an integral time value.
　　(When PID auto-tuning is performed, the value is set automatically.)
　　Setting range is 0 to 3600 seconds. (Factory adjusted as 200 seconds.)
　　Setting the integral to 0 disables the function.

Setting mode display	SV display	PV display	Change of setting value
i	Integral time set-ting value	Actual temperature	The value can be increased or decreased by pressing the "(▲), (▼) and (FAST)" keys.

(7) Derivative time setting mode
　　A mode to set a derivative time value.
　　(When PID auto-tuning is performed, the value is set automatically.)
　　Setting range is 0 to 1800 seconds. (Factory adjusted as 50 seconds.)
　　Setting the derivative to 0 disables the function.

Setting mode display	SV display	PV display	Change of setting value
d	Derivative time set-ting value	Actual temperature	The value can be increased or decreased by pressing "(▲), (▼) and (FAST)" keys.

(8) ARW setting mode (Anti-reset windup)
　　A mode to set an ARW value.
　　(When PID auto-tuning is performed, the value is set automatically.)
　　Setting range is 0 to 100%.　　　(Factory adjusted as 50%.)

Setting mode display	SV display	PV display	Change of setting value
Π	ARW value	Actual temperature	The value can be increased or decreased by pressing "(▲), (▼) and (FAST)" keys.

(9) Dead band setting mode [Option: D☐]
　　A mode to set a overlap or dead band of the main(C1) and sub(C2) control.
　　This mode is selected when heating and cooling control output[Option: D☐] is specified.
　　When Heating and Cooling control output is applied, Auxiliary temperature alarm
　　[Option: AL☐] cannot be applied together with.
　　Overlap or Dead band setting range is −10.0 to 10.0% of scaling range full scale
　　　　　　　　　　　　　　　　　Overlap: (−) and Dead band: (+)
　　Cooling (Sub-) control proportional cycle: 1 to 120 sec.
　　Cooling (Sub-) control proportional band : 0.1 to 10 times of Heating (Main) control
　　　　　　　　　　　　　　　　　proportional band (See page 15)
　　Output: Relay contact [DR], Non-contact voltage [DS] (for SSR drive)

Setting mode display	SV display	PV display	Change of setting value
c	Dead band value	Actual temperature	The value can be increased or decreased by pressing "(▲), (▼) and (FAST)" keys.

● Heating and Cooling control output action

① Basic action   ② Overlap band   ③ Dead band
   P-band P-band
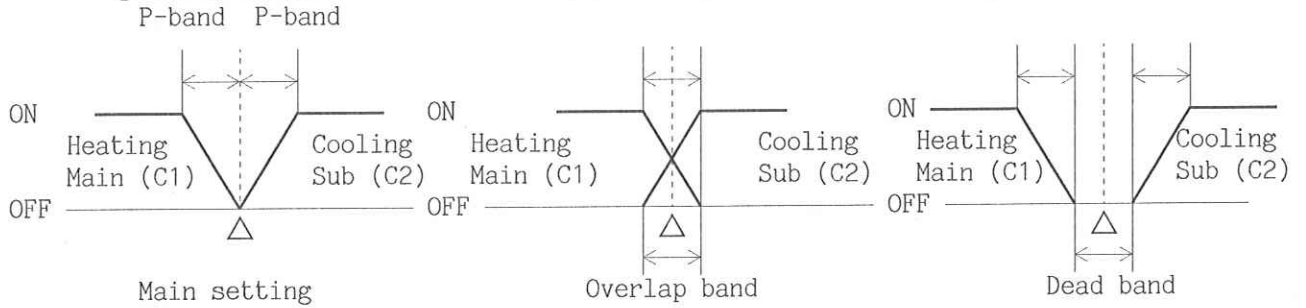
(10) Heater burnout alarm setting mode [Option: W]
A mode to set the heater current, and is applied when heater burnout alarm output [W] is specified.

$$\text{Action point(setting value)}\% = \frac{\text{Heater current}}{\text{Rated current}} \times 100\%$$

Heater current: Maximum current value during operation
Rated current : Specified current (5A, 10A or 20A)

Notes: 1. The setting value can be calculated with above mentioned, however, it is recommended to set 80% of the value. Setting range is 0 to 100%. (Factory adjusted as 0%)
Once alarm action operates, the output is held. To cancel the output, turn the power OFF and ON again, or set the value to 0, and set the value again.
2. This option [W] cannot be applied to the type "Current output" (-A/□).
3. This option [W] cannot be applied together with option [C5] and/or [ECC].

Setting mode display	SV display	PV display	Change of setting value
Ꮟ	Heater current set ting value	Actual temperature	The value can be increased or decreased by pressing the "(▲), (▼) and (FAST)" keys.

3.2 Key operation for attached function (Attached function setting mode)

In the PV,SV display mode, press the "(MODE)" key while pressing the "⬭" mode auxiliary key, then the mode is changed to attached function setting mode. Further, each pressing the " (MODE)" key ("⬭" mode auxiliary key is not pressed.) it changes the status as follows:

```
                    ↓
  ┌──→ ┌─────────────────────┐
  │    │ PV,SV display mode  │
  │    └─────────────────────┘
  │         ⬭+(MODE) keys          ┌══════ Attached function setting mode ══════┐
  │                                 │  ▢  is displayed on setting mode display. │
  │      (MODE) key                                                   PV display
  │    ┌─────────────────┐    ┌───────────────────────────────────────────────┐
  │    │ Basic function  │    │ (1) │ Setting value lock designation mode │ Loct│
  │    │ setting mode    │    │            (MODE) key                          │
  │    └─────────────────┘    │ (2) │ Main control(C1) proportional cycle setting mode │ cYc │
  │                           │            (MODE) key                          │
  │                           │ (3) │ Sub-control(C2) proportional cycle setting mode │ cYcc│
  │                           │            (MODE) key           [Option: D▢]   │
  │                           │ (4) │ Sub-control(C2) proportional band setting mode │ P-b │
  │                           │            (MODE) key           [Option: D▢]   │
  │                           │ (5) │ Main control(C1) differential setting mode │ dF A │
  │                           │            (MODE) key                          │
  │                           │ (6) │ Sub-control(C2) differential setting mode │ dF b │
  │                           │            (MODE) key           [Option: D▢]   │
  │                           │ (7) │ Scaling high limit setting mode │ ЧГLH │
  │                           │            (MODE) key                          │
  │                           │ (8) │ Scaling low limit setting mode │ ЧГLL │
  │                           │            (MODE) key                          │
  │                           │ (9) │ Output high limit setting mode │ oГLH │
  │                           │            (MODE) key                          │
  │                           │(10) │ Output low limit setting mode │ oГLL │
  │                           │            (MODE) key                          │
  │                           │(11) │ Sensor correction setting mode │ Чo │
  │                           │            (MODE) key                          │
  │                           │(12) │ Instrument number designating mode │ dno │
  │                           │            (MODE) key        [Option: C5, ECC] │
  │                           │(13) │ Control mode designating mode │ cnГ │
  │                           │            (MODE) key                          │
  └───────────────────────────└───────────────────────────────────────────────┘
```

Notes: 1. ┌┄┐ means in case of option specification.
          (If option is not designated, the mode cannot be selected.)

2. The indicated value selected by "(▲), (▼)" keys is registered after pressing "(MODE)" key, and in case the key operation is ended setting the values, approx. 30 seconds later it is automatically changed to PV, SV display mode and setting values are registered.

(1) Setting value lock designating mode

A mode to designate a lock function of the setting value, and the functions are different from the designating status.

Mode 1: No setting values in basic function setting mode can be changed.

Mode 2: Only main setting value is changeable, and other values in basic function setting mode become lock status.

Mode 3: Exclusive use for option ECC, and it does not memorize the main setting value from host device (PC-600, option SVTC) into internal memory and reads the value directly.

Notes: • Do not use the Mode 3 in case the option ECC is not designated.
       • When the power supply is turned off, the main setting value turns "0" since internal memory is not used.

Unlock: A status of lock cancelled, and all setting values can be changed. This mode is used to perform the Auto-tuning by "(AT)" key.
(Factory adjusted as unlock [lock cancelled] status.)

Note: However, if "(AT)" key is pressed just after "L oc I" or "L oc 2" is displayed on SV display, auto-tuning will work, and turns to Lock mode after the auto-tuning is terminated.

Lock mode	SV display	PV display	Change of the status
Unlock	- -		With (▲) key
Mode 1	Loc 1	Lock	[- -] ⇒ [Loc 1] ⇒ [Loc 2] ⇒ [Loc 3]
Mode 2	Loc 2		With (▼) key
Mode 3	Loc 3		[Loc 3] ⇒ [Loc 2] ⇒ [Loc 1] ⇒ [- -]

(2) Main control (C1) proportional cycle setting mode.

(This mode is inapplicable to current output type.)
Proportional cycle can be set, in case control output of main control (C1) is relay contact or non-contact voltage output type.

[In case of ON-OFF action, this setting value becomes null.]
Setting range is 1 to 120 seconds. (Factory adjusted as 30 sec.-R/▯, or 3 sec.-S/▯)

Setting mode display	SV display	PV display	Change of setting value
-	Setting value of proportional cycle (C1)	c Yc	The value can be increased or decreased by pressing the "(▲), (▼) and (FAST)" keys.

(3) Sub-control (C2) proportional cycle setting mode [Option: D▢]

(This mode is inapplicable to current output type.)
This mode is to be selected additionally when heating/cooling control output
[Option: D▢] is specified, and proportional cycle can be set in case Sub-control
(C2) is relay contact or non-contact voltage output type.
In case of ON-OFF action, this setting value becomes null.
Setting range is 1 to 120 seconds. (Factory adjusted as 30 sec.-R/▢, or 3 sec.-S/▢)

Setting mode display	SV display	PV display	Change of setting value
-	Setting value of proportional cycle (C2)	$cYcc$	The value can be increased or decreased by pressing the "(▲), (▼) and (FAST)" keys.

(4) Sub-control (C2) proportional band setting mode [Option: D▢]

This mode is to be selected additionally when heating/cooling control output
[Option: D▢] is specified, and proportional band of Sub-control (C2) can be set.
Setting range is from −10 to 10　　　　　　　　(Factory adjusted as 1.)

Setting mode display	SV display	PV display	Change of setting value
-	Setting value of proportional band (C2)	$P-b$	The value can be increased or decreased by pressing the "(▲), (▼) and (FAST)" keys.

● Example to set Sub (C2) proportional band
・ In the case, rated scale is 0 to 400℃ and Main (C1) proportional band is 10.0% (40℃),
the sub (C2) proportional band should be set as follows.

[Example] If 8℃ is desired for Sub (C2) proportional band, the Sub (C2) proportional
band multiplying factor should be 1/5 (0.2), therefore, set the Sub (C2)
proportional band setting value to −5. (Refer to below table.)

[Formula] Main proportional band value × Sub proportional band setting value
= Sub proportional band value

40℃ [Main proportional band value] × 1/5 (0.2) [−5 (*1) Sub proportional
band setting value]= 8℃

Note (*1): Sub (C2) proportional band multiplying factor of
Sub (C2) proportional band setting value −5 is 1/5 [0.2].

Sub control Proportional band setting value	−10	−9	−8	−7	−6	−5	−4	−3	−2	−1	0
Sub control Proportional band multiplying factor	1/10	1/9	1/8	1/7	1/6	1/5	1/4	1/3	1/2	1/1	0
Sub control Proportional band value (℃)	4.0	4.4	5.0	5.7	6.7	8.0	10.0	13.3	20.0	40.0	0

Sub control Proportional band setting value	0	1	2	3	4	5	6	7	8	9	10
Sub control Proportional band multiplying factor	0	1	2	3	4	5	6	7	8	9	10
Sub control Proportional band value (℃)	0	40	80	120	160	200	240	280	320	360	400

Setting the proportional band to 0.0 causes the instrument to act as an ON-OFF controller,
and the differential can be set in (5) differential setting mode.
If main control (C1) proportional band is set to 0.0 (ON-OFF action), the setting (C2)
becomes null, and sub-control (C2) also acts ON-OFF action.

(5) Main control (C1) differential setting mode

In case main control (C1) acts ON-OFF action (Setting the Proportional band to 0.0), differential (Dead band of ON-OFF action) can be set in this mode.
Setting range is 0.0 to 100.0℃(200.0°F)　　　(Factory adjusted as 1.0℃[°F])

Setting mode display	SV display	PV display	Change of setting value
‒	Setting value of differential	dF A	The value can be increased or decreased by pressing the "(▲), (▼) and (FAST)" keys.

(6) Sub-control (C2) differential setting mode　[Option: D▢]

This mode is to be selected additionally when heating/cooling control output [Option: D▢] is specified. In case Sub-control (C2) acts ON-OFF action, [i.e., proportional band of main control (C1) or sub-control (C2) is set as 0.0] differential can be set.
Setting range is 0.0 to 100.0℃(200.0°F)　　　(Factory adjusted as 1.0℃[°F])

Setting mode display	SV display	PV display	Change of setting value
‒	Setting value of differential	dF b	The value can be increased or decreased by pressing the "(▲), (▼) and (FAST)" keys.

(7) Scaling high limit setting mode

A mode to set high limit of the scale value (rated scale).
Setting range differs from the kinds of sensor. See table 5.1 for the detail
(Factory adjusted as specified rated value.)

Setting mode display	SV display	PV display	Change of setting value
‒	High limit value of the scale	5rLH	The value can be increased or decreased by pressing the "(▲), (▼) and (FAST)" keys.

(8) Scaling low limit setting mode

A mode to set low limit of the scale value (rated scale).
Setting range differs from the kinds of sensor. See table 5.1 for the detail.
(Factory adjusted as specified rated value.)

Setting mode display	SV display	PV display	Change of setting value
‒	Low limit value of the scale	5rLL	The value can be increased or decreased by pressing the "(▲), (▼) and (FAST)" keys.

Table 5.1 Scaling setting value

Input	Setting range (low limit to high limit)		Minimum span	
K	0 to 1200°C,	0 to 2200°F	300°C,	550°F
J	0 to 800°C,	0 to 1600°F	300°C,	550°F
P L − Ⅱ	0 to 1300°C,	0 to 2400°F	300°C,	550°F
R, S	0 to 1600°C,	0 to 3200°F	800°C,	1500°F
B	0 to 1800°C,	0 to 3200°F	800°C,	1500°F
C (W/Re5-26)	0 to 2300°C,	0 to 4200°F	800°C,	1500°F
T	−199.9 to 400.0°C,	−199.9 to 750.0°F	300.0°C,	550.0°F
Pt100,JPt100	−199.9 to 400.0°C,	−199.9 to 999.9°F	100.0°C,	200.0°F

Note: When setting the scaling range narrower than the minimum span, the accurcy
becomes unwarrantable.

(9) Output high limit setting mode

A mode to set high limit value of control output. (Effective to main output only)
Setting range is output low limit value to 110%. (The value 100% or greater can
be applied only for current output type.)   (Factory adjusted as 100%.)

Setting mode display	SV display	PV display	Change of setting value
−	High limit value of the output	o⌐L H	The value can be increased or decreased by pressing the "(▲), (▼) and (FAST)" keys.

(10) Output low limit setting mode

A mode to set low limit value of control output. (Effective to main output only)
Setting range is −10% to output high limit value. (The value 0% or less can be
applied only for current output type.)   (Factory adjusted as 0%.)

Setting mode display	SV display	PV display	Change of setting value
−	Low limit value of the output	o⌐L L	The value can be increased or decreased by pressing the "(▲), (▼) and (FAST)" keys.

(11) Sensor correction setting mode

A mode to set the sensor correcting value.
Setting range is −30.0 to 30.0°C,(−50.0 to 50.0°F)

                                  (Factory adjusted as 0.0°C[°F].)

Setting mode display	SV display	PV display	Change of setting value
−	Correction value of the sensor	⅃o	The value can be increased or decreased by pressing the "(▲), (▼) and (FAST)" keys.

Explanation of sensor correction function

It corrects the input value from the sensor. When a sensor cannot be set at a location
where control is desired, the sensor measuring temperature may deviate from the temper-
ature in the controlled location, and when controlling with plural controllers, the
accuracy of sensors have influence on the control.
Therefore, sometimes measuring temperature (input value) does not accord with the same
setting value. In such a case, the control can be accorded with desired temperature by
shifting the input value of sensors.

(12) Instrument number designating mode [Option: C5] or [Option: ECC]

A mode to designate the instrument number to MCR-100 when serial communication (RS-485) [Option: C5] is applied. Settable from No. 0 to No. 30

＊ For the Option ECC, all instruments number should be No.31.
(Connectable maximum 31 of MCR-100, Factory adjusted as 0.)

Setting mode display	SV display	PV display	Change of setting value
―	Instrument number set-ting value	$d \Pi o$	The value can be increased or decreased by pressing the "(▲), (▼) and (FAST)" keys.

Notes: ▪ [Option: C5] cannot be applied together with [Option: ECC].
▪ [Option: C5] or [Option: ECC] cannot be applied together with [Option: W].

Refer to another copy "Instruction manual for serial communication" to the System configuration, Transmission system and Selection of transfer rate about the Serial communication [Option code: C or C5].

● External setting [Option code: ECC]

It does not memorize the main setting value in digital signal from PC-600 series

(option code: SVTC applied) into internal memory of the instrument (MCR-) and reads
it directly.

With the type this option ECC is applied, it is shipped by designating the instrument
number to 31 [크 l]. Do not change the instrument number.

```
┌─────────────────< Notices >─────────────────┐
│ · When running, the setting value lock mode must be selected as Mode 3. │
│ · The instrument number 31 must not be changed.                         │
│ · If the option external setting [code: ECC] is applied, it is not       │
│   available with a combination of the option serial communication        │
│   [code: C or C5].                                                       │
└──────────────────────────────────────────────┘
```

○ Wiring example for option ECC

HOST   Instrument number 31 to all MCDs

YA ⑱	YA ⑰	YA ⑰	---------	YA ⑰
YB ⑲	YB ⑱	YB ⑱	---------	YB ⑱	100Ω of terminal resistor
COM ⑳	COM ⑲	COM ⑲	---------	COM ⑲
PC-600	MCR-100	MCR-100		MCR-100
Option: SVTC	Option: ECC	Option: ECC		Option: ECC

(13) Control mode designating mode

A mode to designate the modes (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 mode	SV display	PV display	Change of status
Heating[reverse] action	$HEAr$	cnr	"(▲)" key for heating action
Cooling[direct] action	$cooL$		"(▼)" key for cooling action

When changed this control mode, cooling action of heating/cooling control output
[Option: D☐] is also changed as follows.

Control mode	Standard specification		[Optional specification]	
	Main control(C1)	Sub-control(C2)	Main control(C1)	Sub-control(C2)
$HEAr$	Heating action	None	Heating action	Cooling action
$cooL$	Cooling action	None	Cooling action	Heating action

4. Setting value memory function [Option: SM]

8 files of data can be memorized, and selecting a desired file, the desired control can be performed.

In one (1) file, 8 kinds of data: Main setting value, PID each value, ARW value, Temperature alarm (ALM) setting value, Temperature alarm (A2) setting value [Option] Overlap band or Dead band value [Option] can be memorized and selectable.

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

We provide the switch **MS-108**, sold separately, to select the number easily.

Maximum 48 of MCD-130s can be connected by the switch.

<   Notes   >
- Memory number cannot be changed during setting mode and PID auto-tuning.
- If the terminals between ⑧ to ⑪ are not connected, the memory number is 1.
- With current output type instrument, when 2 or more controllers are operated using the switch (MS-108), contact us.

Setting value memory number	Terminal connection Connection	Terminal No.	Setting value memory number	Terminal connection 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 by connecting the terminals or changing the switch of the MS-108.

② In setting mode, set each setting value: Main setting, PID each value, ARW value, Temperature alarm (ALM), Temperature alarm (A2) and Overlap band/Dead band.
PID each value and ARW value are automatically set by PID auto-tuning.

③ After setting, press the (MODE) key to return to PV/SV display mode.

Registration

- The setting data is registered to the file number of which the number is displayed.
- With setting value memory number, the selected number by terminal connection or the switch (MS-108) is displayed, and the control is performed by the data of the file.
- To change the setting values, repeat the operation above-mentioned, and the values will be changed to new values.

5. 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, " $\bar{n}\bar{L}$ - " 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, it displays actual temperature on the process variable display, setting value on the display, and starts control.

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

(11) **PID auto-tuning (AT) performance**
PID auto-tuning is started by pressing the "(AT)" key in PV/SV display mode or basic function setting mode. During auto-tuning, auto-tuning indicator (Yellow LED) blinks and "(MODE)" key turns into ineffective and other settings cannot be set in this status. When the auto-tuning ends, the indicator will go off and PV/SV display mode will be selected. Now, other settings are settable. If "(AT)" key is pressed again during auto-tuning, the auto-tuning will be cancelled and starts the control.
After the auto-tuning is terminated, the Proportional band (P), Integral time (I), Derivative time (D) and ARW value correspond to the controlling process are set automatically. However, if the PID auto-tuning is cancelled on its halfway, proper PID parameters cannot be set, but returns to their former parameters.
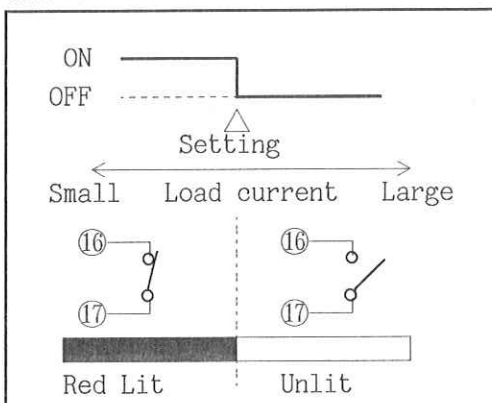
(Refer to item 7.3 for the detail.)

Notes:
1. When setting value memory [option code: SM] is applied, PID value obtained will be stored only into the file at memory number being displayed.
2. Auto-tuning will not function if lock mode 1 or 2 is specified in the setting value lock designation mode.
3. Each setting value, the Proportional band (P), the Integral time (I), the Derivative time (D) and the ARW value can be confirmed calling each setting mode.

(Refer to item 3.1 for the detail.)

6. Action explanations

6.1 Standard action drawings

Action		Heating action [$HEAr$]			Cooling action [$cooL$]		
Main control action		Proportional band — main control action, △ Setting			Proportional band — main control action, △ Setting		
Relay contact	Output	H ⑤ / C ⑥ / L ⑦	H ⑤ / C ⑥ / L ⑦	H ⑤ / C ⑥ / L ⑦	H ⑤ / C ⑥ / L ⑦	H ⑤ / C ⑥ / L ⑦	H ⑤ / C ⑥ / L ⑦
		Cycle action is performed according to deviation			Cycle action is performed according to deviation		
	Indication (Green) [C1]	Lit		Unlit	Unlit		lit
Non-contact voltage	Output	⑥ + 15Vdc ⑦ −	⑥ + 15/0Vdc ⑦ −	⑥ + 0Vdc ⑦ −	⑥ + 0Vdc ⑦ −	⑥ + 0/15Vdc ⑦ −	⑥ + 15Vdc ⑦ −
		Cycle action is performed according to deviation			Cycle action is performed according to deviation		
	Indication (Green) [C1]	Lit		Unlit	Unlit		lit
Current	Output	⑥ + 20mAdc ⑦ −	⑥ + 20 to 4mAdc ⑦ −	⑥ + 4mAdc ⑦ −	⑥ + 4mAdc ⑦ −	⑥ + 4 to 20mAdc ⑦ −	⑥ + 20mAdc ⑦ −
		Changes continuously according to deviation			Changes continuously according to deviation		
	Indication (Green) [C1]	Lit			Lit		

6.2 Heater burnout alarm action (Option: W)

ON
OFF

△ Setting

Small ← Load current → Large

⑯ / ⑰   ⑯ / ⑰

Red Lit   Unlit

6.3 Heating/Cooling control action drawings [Option: D]

Control action		Heating (reverse) action ($HEAT$)			Cooling (direct) action ($cooL$)		

Heating/Cooling control (Option):

- Heating (reverse) action: C1, P-band / C2, P-band — C1 Heating (Main control), Cooling (Sub control) — C2, △ Setting
- Cooling (direct) action: C2, P-band / C1, P-band — C2 Cooling (Sub control), Heating (Main control) — C1, △ Setting

Main output (C1)

Indication (Green C1) Relay contact:

H ⑤, C ⑥, L ⑦ — Cycle action is performed according to deviation

Indication (Green C1): Lit / Unlit | Unlit / Lit

Non-contact voltage ⑥ +, ⑦ −:
- Heating: 15Vdc | 15/0Vdc | 0Vdc
- Cooling: 0Vdc | 0/15Vdc | 15Vdc

Cycle action is performed according to deviation

Indication (Green C1): Lit / Unlit | Unlit / Lit

Current ⑥ +, ⑦ −:
- Heating: 20mAdc | 20~4mAdc | 4mAdc
- Cooling: 4mAdc | 4~20mAdc | 20mAdc

Changes continuously according to deviation

Indication (Green C1): Lit | Lit

Sub output (C2)

Indication (Yellow C2) Relay contact:

⑭, ⑮ — Cycle action is performed according to deviation

Indication (Yellow C2): Unlit / Lit | Lit / Unlit

Non-contact voltage ⑭ +, ⑮ −:
- Heating: 0Vdc | 0/15Vdc | 15Vdc
- Cooling: 15Vdc | 15/0Vdc | 0Vdc

Cycle action is performed according to deviation

Indication (Yellow C2): Unlit / Lit | Lit / Unlit

6.4 Heating/Cooling control action drawings [Option: D] (When setting the dead band.)

Control action		Heating (reverse) action ($HEAT$)	Cooling (direct) action ($cooL$)
Heating/ Cooling control (Option)		(P) (DB) (Pb) C1————Heating Cooling————C2 / Main control Sub control \ △ Setting	(Pb) (DB) (P) C2————Cooling Heating————C1 / Sub control Main control \ △ Setting
Main output (C1)	Relay contact	H ⑤ ⑤ ⑤ / C ⑥ ⑥ ⑥ / L ⑦ ⑦ ⑦ / Cycle action is performed according to deviation	⑤ ⑤ H ⑤ / ⑥ ⑥ C ⑥ / ⑦ ⑦ L ⑦ / Cycle action is performed according to deviation
	Indication (Green C1)	Lit Unlit	Unlit Lit
	Non-contact voltage	⑥+ ⑥+ ⑥+ / 15Vdc 15/0Vdc 0Vdc / ⑦− ⑦− ⑦− / Cycle action is performed according to deviation	⑥+ ⑥+ ⑥+ / 0Vdc 0/15Vdc 15Vdc / ⑦− ⑦− ⑦− / Cycle action is performed according to deviation
	Indication (Green C1)	Lit Unlit	Unlit Lit
	Current	⑥+ ⑥+ ⑥+ / 20mAdc 20~4mAdc 4mAdc / ⑦− ⑦− ⑦− / Changes continuously according to deviation	⑥+ ⑥+ ⑥+ / 4mAdc 4~20mAdc 20mAdc / ⑦− ⑦− ⑦− / Changes continuously according to deviation
	Indication (Green C1)	Lit	Lit
Sub output (C2)	Relay contact	⑭ ⑭ ⑭ / ⑮ ⑮ ⑮ / Cycle action is performed according to deviation	⑭ ⑭ ⑭ / ⑮ ⑮ ⑮ / Cycle action is performed according to deviation
	Indication (Yellow C2)	Unlit Lit	Lit Unlit
	Non-contact voltage	⑭+ ⑭+ ⑭+ / 0Vdc 0/15Vdc 15Vdc / ⑮− ⑮− ⑮− / Cycle action is performed according to deviation	⑭+ ⑭+ ⑭+ / 15Vdc 15/0Vdc 0Vdc / ⑮− ⑮− ⑮− / Cycle action is performed according to deviation
	Indication (Yellow C2)	Unlit Lit	Lit Unlit

Note: (P): Main control prop. band, (DB): Dead band, (Pb): Sub control prop. band

6.5 Temperature alarm action

Alarm type	High limit alarm	Low limit alarm
Temperature alarm action	Hysteresis / ON / OFF / Main setting Alarm	Hysteresis / ON / OFF / Alarm Main setting
Output / Indication	⑫ ⑬ ⑫ ⑬ Unlit Red Lit	⑫ ⑬ ⑫ ⑬ Red Lit Unlit
Alarm type	High limit alarm with standby	Low limit alarm with standby
Temperature alarm action	Hysteresis / ON / OFF / Main setting Alarm	Hysteresis / ON / OFF / Alarm Main setting
Output / Indication	⑫ ⑬ ⑫ ⑬ Unlit Red Lit	⑫ ⑬ ⑫ ⑬ Red Lit Unlit
Alarm type	High/Low limits alarm	High/Low limit range alarm
Temperature alarm action	Hysteresis Hysteresis / ON / OFF / Alarm Main setting Alarm	Hysteresis Hysteresis / ON / OFF / Alarm Main Alarm
Output / Indication	⑫ ⑬ ⑫ ⑬ ⑫ ⑬ Red Lit Unlit Red Lit	⑫ ⑬ ⑫ ⑬ ⑫ ⑬ Unlit Red Lit Unlit
Alarm type	High/Low limits alarm with standby	Process value alarm
Temperature alarm action	Hysteresis Hysteresis / ON / OFF / Alarm Main setting Alarm	Hysteresis / ON / OFF / Alarm setting
Output / Indication	⑫ ⑬ ⑫ ⑬ ⑫ ⑬ Red Lit Unlit Red Lit	⑫ ⑬ ⑫ ⑬ Unlit Red Lit

《Standby function works in ▨▨ part.》 (A2 alarm: Terminals ⑭ and ⑮. Yellow lights)

6.6 ON/OFF action drawings

In case the proportional band is set to "0.0".

Action	Heating action (reverse) $HEAr$	Cooling action (direct) $cool$	Heating and Cooling control (Option code: D□)	
Main control action	dFA Hysteresis ON OFF Main setting	dFA Hysteresis ON OFF Main setting	dFA Hysteresis Dead band [Heating] Main setting	dFb Hysteresis ON OFF [Cooling]
Relay contact / output	⑤ ⑥ ⑦ ／ ⑤ ⑥ ⑦	⑤ ⑥ ⑦ ／ ⑤ ⑥ ⑦	⑤ ⑥ ⑦ ／ ⑤ ⑥ ⑦	⑭ ⑮ ／ ⑭ ⑮
Relay contact / Indication	Green lit　　　Unlit	Unlit　　　Green lit	Green lit　　　Unlit	Yellow lit
Non-contact voltage / output	⑥ + 15Vdc ⑦ — ／ ⑥ + OVdc ⑦ —	⑥ + OVdc ⑦ — ／ ⑥ + 15Vdc ⑦ —	⑥ + 15Vdc ⑦ — ／ ⑥ + OVdc ⑦ —	⑭ + OVdc ⑮ — ／ ⑭ + 15Vdc ⑮ —
Non-contact voltage / Indication	Green lit　　　Unlit	Unlit　　　Green lit	Green lit　　　Unlit	Yellow lit
Current / output	⑥ + 20mAdc ⑦ — ／ ⑥ + 4mAdc ⑦ —	⑥ + 4mAdc ⑦ — ／ ⑥ + 20mAdc ⑦ —		
Current / Indication	Green lit	Green lit		

7. Control actions

7.1 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 vibration 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 speed. It reduces overshoot and vibration width.
If the derivative time is shortened, restoring value comes small, and if it is adjusted longer, a phenomenon of returning too much may occur and the control system may vibrate.

(4) Anti-reset windup (ARW)

ARW prevents overshoot caused due to the integral action. It is automatically set using auto-tuning. If operating by manual, duty factor of load for the setting is of standard value, to fix controlling aim. (Refer to the item 6.3)
The less ARW value is, the less excess integral action becomes at transition status, however, it needs time till stabilized.

Note:
After the auto-tuning is terminated, the Proportional band (P), Integral time (I), Derivative time (D) and ARW value correspond to the controlling process are set automatically.
When setting by manual, set the values referring abovementioned. [It is convenient to correct the value after the PID auto-tuning is performed.]

7.2 How to get the duty factor for ARW when manual controlling.
In case of SSR output or SSR driving 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.

7.3 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.
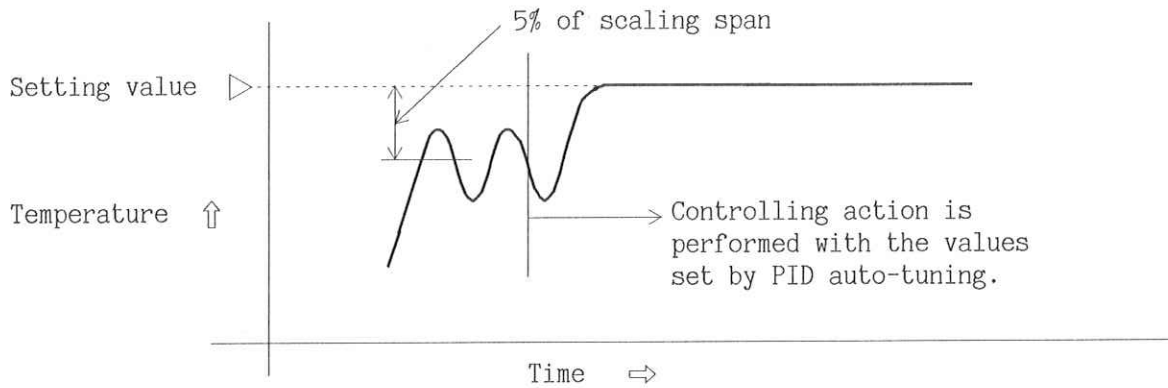
(2) In case of the stable situation during control or when control temperature is within ±10% of scaling span.
Fluctuation is given at the setting value.
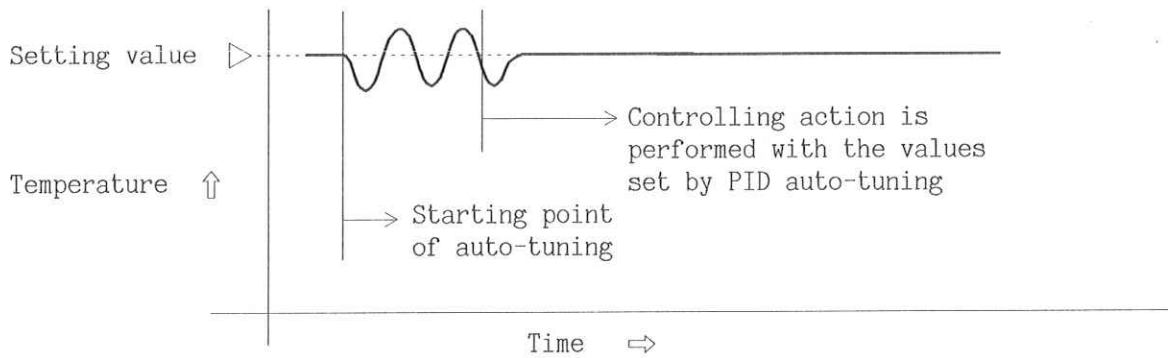
(3) In case control temperature is 10% or more of scaling span.
Fluctuation is given at the temperature 5% of scaling span higher than the setting value.
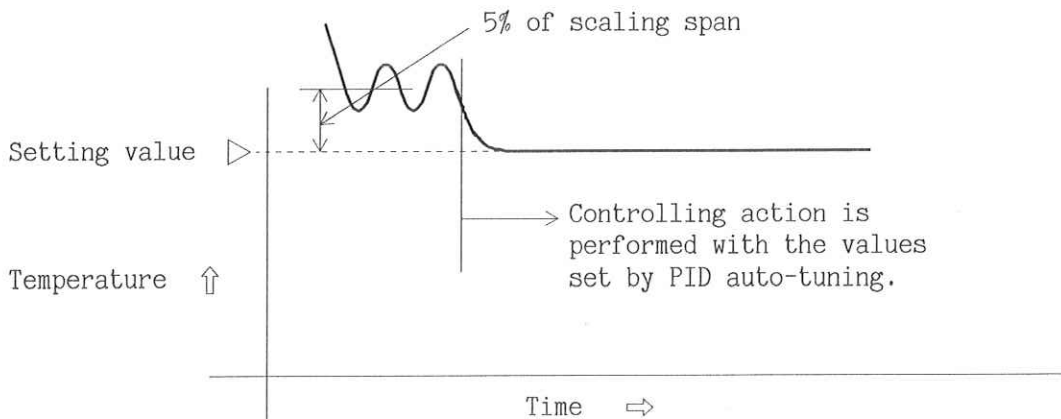
8. Other functions

(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 the thermocouple or RTD (between A and B) is burnout, it makes the main control output to OFF (output low limit value), and lights the ○ HB heater burnout alarm action indicator. Simultaneously PV display blinks " ‾ ‾ ‾ ‾ ". (upscale)

Notes: ① 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.

② 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)

(3) Self-diagnostic function

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

(4) Automatic cold junction temperature compensation (-[]/E)

It detects the temperature at the connecting terminal between thermocouple and the instrument, and always makes it the same status at which the reference junction is located at 0°C [32°F].

(5) Power failure countermeasure

In case the power failure time exceeds 20ms, the data are kept with non-volatile IC memory. If the power failure time is less than 20ms, the controller continues the control.

9. Mounting to control panel

9.1 Site selection

Mount the controller in a place with:
(1) A minimum of dust, and an absence of corrosive gases.
(2) An ambient humidity is 85%RH or less, and non-condensing.
(3) An ambient temperature is 0℃ to 50℃, 32℉ to 122℉.
(4) No exposure to direct sunlight.
(5) No mechanical vibrations or shocks.
(6) The controller should be away from the electromagnetic switch
of large capacity, or cables through which large current flows.
(7) No water or oil and their vapor directly splash.

9.2 External dimension drawing

* When one-touch mounting bracket is used:
Mounting panel thickness 1 to 3 mm.

[Option]

CTL-6-S
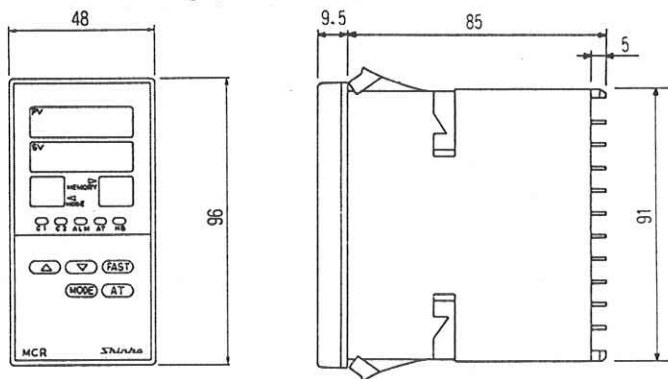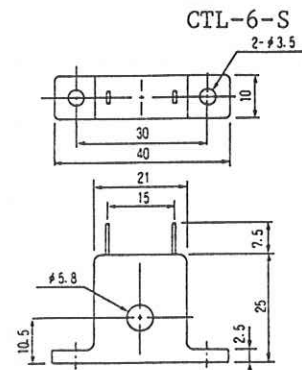
Current transformer for
"Heater burnout alarm"

* When screw type mounting bracket is used:
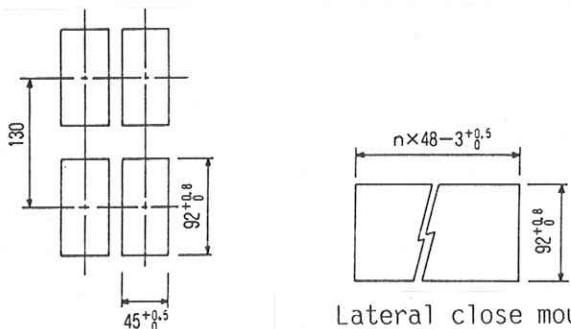Mounting panel thickness 1 to 8 mm.
[Option:BL]
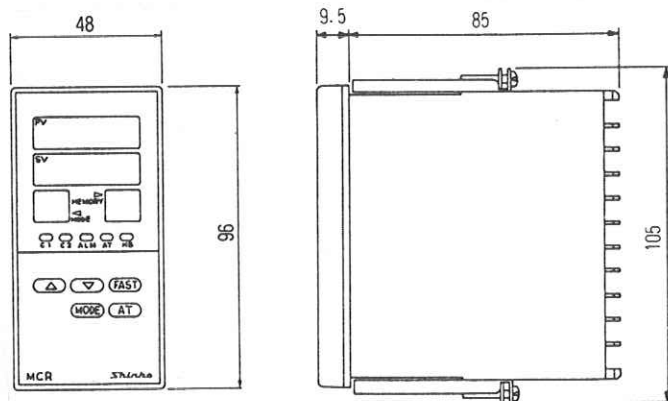
Notes:
· Do not screw with excessive force,
or the case may be bent, since it
is made of resin.

· Mount one-touch mounting bracket to
the body in advance, and then insert
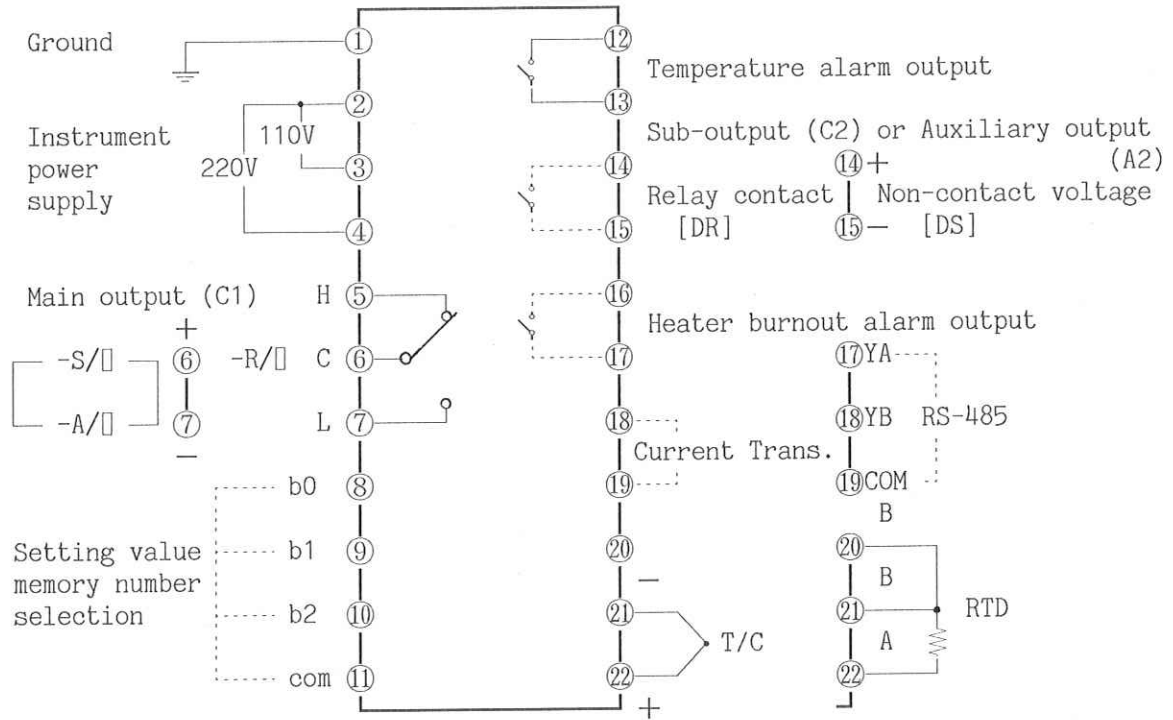MCR-100 from the front of panel.
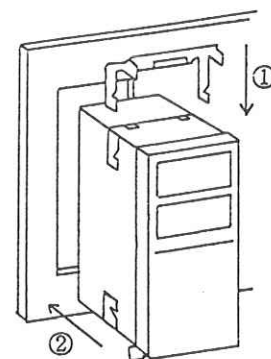
9.3 Panel cutout

Lateral close mounting
n: Number of units mounted

10. Wiring connection
10.1 Terminal arrangements

Ground ①

Instrument power supply　110V ②　220V ③　④

Main output (C1)　H ⑤
+
[-S/□ ⑥　-R/□　C ⑥
　-A/□ ⑦　L ⑦]
−

Setting value memory number selection
b0 ⑧
b1 ⑨
b2 ⑩
com ⑪

⑫
⑬ Temperature alarm output

⑭ Sub-output (C2) or Auxiliary output
⑮ Relay contact [DR]　⑭+ (A2)　⑮− Non-contact voltage [DS]

⑯
⑰ Heater burnout alarm output

⑱ Current Trans.
⑲

⑳
㉑ −
㉒ + T/C

⑰YA
⑱YB　RS-485
⑲COM
B
⑳ B
㉑ A RTD
㉒

Notes: 1. Dotted line shows the case option designated, if the option is not specified, the terminal is not equipped.
2. When specified option [C5] and/or [ECC], supply voltage 110V or 220V should be specified.

10.2 Wiring connection examples

MCR-130-R/E

MCR-130-S/E, W

MCR-132-R/E
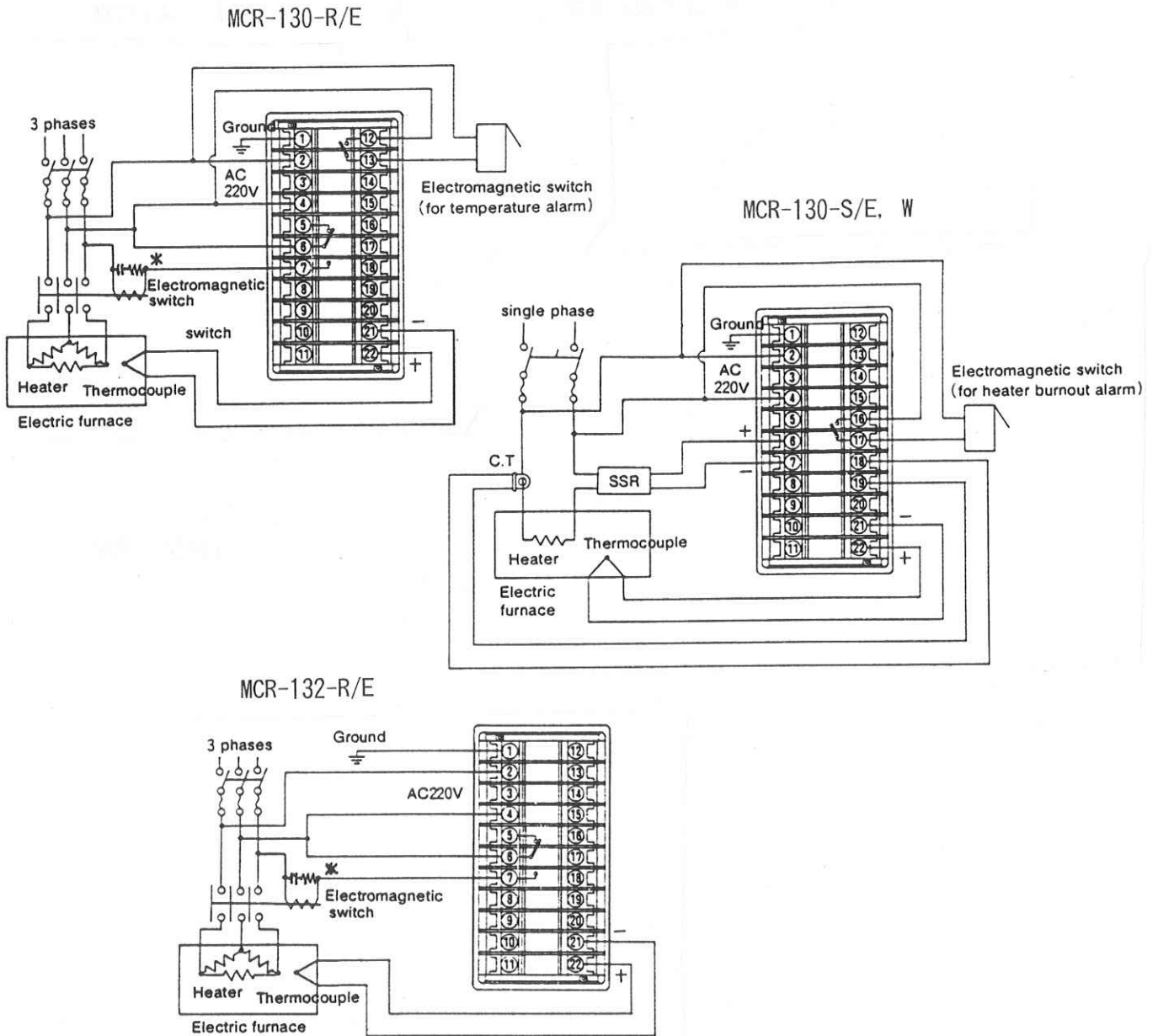
*To prevent from a bad influence to the instrument owing to the unexpected level noise, it is recommended that the surge absorber be provided between the coil of the external relay.

Note: The terminal block of this instrument is designed to wire from the left side. Lead wire must be inserted from the left side of the terminal, and fasten by

** Notice **

① Use a thermocouple and compensating lead wire applicable to the input specifications (K, J, etc.) of this controller.
② Use a 3-wire system of RTD applicable to the input spcifications (Pt100) of this controller.
③ Check the specified voltage indicated on the voltage nameplate. This controller has no built-in power switch nor fuse. It is therefore recommended that these unit be provided in the circuit near the external controller.
④ When wiring, keep input wire (Thermocouple, RTD, etc.) away from AC source and load wire to avoid external interference.
⑤ With relay output type of controller, it is recommended to provide applicable relay to protect the built-in relay contact, even if the load capacity is smaller than the built-in contact capacity (considering rush current).

[Option W: Heater burnout alarm function]
① This alarm is not available for detecting current under phase control.
② When using Current transformer (CT), select an accessory one.
③ Pass a lead wire of heater circuit into the hole of the CT.
④ When wiring, keep CT wire away from AC source and load wire.
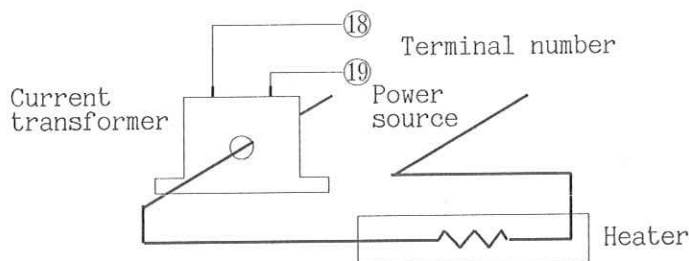
⑱ Terminal number
⑲ Power source
Current transformer
Heater

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.

11. Specifications

11.1 Standard specifications

Mounting	: Flush
Setting	: Input system using membrane sheet key

Display
: Process variable display   Red LED, 4 digits
         Size 8(H)×3.8(W) mm

     Setting value display   Green LED, 4 digits
         Size 8(H)×3.8(W)mm

     Setting mode display   Yellow LED, 1 digit
         Size 8(H)×3.8(W)mm

     Setting value memory   Red LED, 1 digit
     number display   Size 8(H)×3.8(W)mm

Accuracy
: Within ±0.3% of scaling range full scale ±1 digit,
or ±2℃ (R/E), ±1℃ (R/R) [whichever is greater]
In case of R, S input, ±4℃   for 0 to 200℃
     B, C input, unwarrantable for 0 to 300℃

Input
: Thermocouple K, J, PL-Ⅱ, R, S, B, C(W/Re5-26), T(100Ω or less)
RTD   Pt100, JPt100
     3-wire system, resistance per wire 4Ω max.

Output
: Relay contact 1c 220Vac 3A (resistive load)
     220Vac 1A (inductive load cos ϕ=0.4)

     Non-contact voltage (for SSR drive)
         15 ±5Vdc(at load resistance 1.5k Ω)
         20 mA   (short-circuit protected)

     Current   4 to 20mAdc (load resistance max. 600Ω
         isolation type)

AIam output
: Relay contact 1a 220Vac 0.5A (resistive load)
     220Vac 0.2A (inductive load cos ϕ=0.4)

Control system
: Main control action, PID action (with auto-tuning function)

     Proportional band   0.1 to 200.0% (acts ON-OFF when set to 0)
     Integral time   1 to 3600s (off when set to 0)
     Derivative time   1 to 1800s (off when set to 0)
     Anti-reset windup   0 to 100%
     Proportional cycle 1 to 120s (not applied for -A /▢)
     ON-OFF action, differential 0.0 to 100.0℃
     Temperature alarm   ON-OFF action   Dead band 1℃

Allowable voltage fluctuation range	: ±10%

Supply voltage
: 110/220Vac, 50/60Hz

     Instantaneous power failure within 30ms
     When option C5 or ECC is designated, the voltage 110 or 220
     should be specified.

Ambient temperature	: 0 to 50℃ (32 to 122°F)
Ambient humidity	: 35 to 85%RH (non-condensing)
Power consumption	: Approx. 3W
Weight	: Approx. 310g
Material	: Front frame, Polycarbonate resin Case, Polycarbonate resin
Color	: Front frame, Light-gray Case, Light-gray

Insulation resistance: 10MΩ or more at 500Vdc (However, voltage must not be applied to the terminal between input and output.)

Dielectric strength : Between Input terminal - Ground terminal: 500Vac for 1 minute
                        Between Power terminal - Ground terminal: 1.5kVac for 1 minute
                        Between Output terminal - Ground terminal: 1.5kVac for 1 minute
                                       (However, voltage must not be applied to the terminal for the type -S/□ or -A/□)

Attached functions   : Scaling function (scaling high limit and low limit setting),
                        Sensor correcting function, Setting value lock function,
                        Control mode direct/reverse changing function,
                        Power failure countermeasures
                          (data back-up by non-volatile IC memory),
                        Self-diagnostic function
                          (watchdog timer, instrument source abnormal watch, RAM check),
                        Automatic cold junction temperature compensation (-□/E)
                        Burnout function (up scale)
                        Output limit function
                          (range 0 to 100%, current output type -10 to 110%)

Accessories   : Mounting brackets   1 set
                        Instruction manual   1 copy
                        Current transformer, Model CTL-6-S 1 set [when the option W
                                                                      is applied]

11.2 Optional specifications

Temperature alarm   : [Code: H]
output with   Temperature alarm (applied for only High limit, Low limit and
standby function   High/Low limit alarm) with standby function.

Aux. Temperature   : [Code: AL□]
alarm function (A2)   The additional temperature alarm besides the standard temperature
output   alarm. Designation of action characteristic is the same as the
                         number of standard specification and indicated following to AL.
                         e.g. AL2: It shows that Aux. temperature alarm (A2) acts as
                         High limit alarm action.

Aux. Temperature   : [Code: AL□H]
alarm function (A2)   Standby function is applied to Aux. Temperature alarm (for only
output with   High limit, Low limit and High/Low limit alarm)
standby function   e.g. AL2H: It shows that Aux. temperature alarm (A2) acts as
                         High limit alarm action with standby function.

Heater burnout alarm   : [Code: W]
output   1 to 100% (current 5A, 10A or 20A, specified)
                         Setting accuracy   ±5%
                         Control system   ON-OFF action
                         Output   Relay contact 1a
                                             220Vac 0.5A (resistive load)
                                             220Vac 0.2A (inductive load, cos ϕ =0.4)

Heating/cooling control output	: [Code: D□] Proportional band, 0.1 to 10 times of main control(C1) proportional band Proportional cycle, 1 to 120 seconds (when the code is DR or DS) Integral time and derivative time are applied correspondingly to the main control. Overlap and dead band setting range, -10.0 to 10.0% of full scale

[Code: DR] Output, Relay contact, 1a
   220Vac 3A (resistive load)
   220Vac 1A (inductive load $\cos\phi$ =0.4)

[Code: DS] Output, Non-contact voltage,
   15 $\pm$5Vdc (at load resistance 1.5kΩ)
   20mA (short circuit protected)

Setting value memory function	: [Code: SM] It memorizes 8 kinds of data (Main setting value, PID each value, ARW value, Temperature alarm setting value, Auxiliary temperature alarm setting value and Dead band setting value) as 1 file. [max. 8 files]

Serial communication : [Code: C5]
Transmission by RS-485

Communication method	Half-duplex
Synchronous system	Start-stop synchronous
Data transfer rate	4800bps (600, 1200, 2400bps) selectable
Code form	JIS 7 bits code
Error detection	Parity check, Checksum
Error correction	Command request repeat
Data format	Start bit: 1
	Data bit : 7
	Parity : Even parity
	Stop bit : 1

External setting	: [Code: ECC] It receives the setting value in digital signal from the outside.
Color Black	: [Code: BK] Face plate: Dark gray, Base and Case: Black
Screw type mounting bracket	: [Code: BL] Mounting Panel thickness 1 to 8 mm

12. When troubled

- The external factors for the improper action of controller are shown as follows.

Phenomenon	Instrument status		Estimated trouble
	Digital display	Indicator	
Temperature does not rise.	Displays far above the setting value.	C1 unlit	Breaking of wire on thermocouple, compensating lead wire or RTD. Improper connection of input terminal.
	Displays the room temperature.	C1 lit	Heater breakage or improper connection Troubles of control device such as electromagnetic switch or trigger.
Temperature rises too high.	Displays (−) or around 0.	C1 lit	Short circuit of thermocouple or RTD. (including the circuit) Wrong installation (insertion) of thermocouple or RTD. Reverse polarity of thermocouple or compensating lead wire. Wrong specification or deterioration of RTD. (resistance changes)
Action unstable	Unstable display	Unstable	Influence of inductive fault or noise. AC leaks into thermometer detector. Wrong connection of terminals. (Looseness of terminal screw, etc.)

＊ If happened unclear phenomenon other than above mentioned, make inquiries at our agent about the matters.

13. CHARACTER TABLE

Character	Description	Option applied
ПЄ -	Warmup status	
५	Main setting mode	
Я	Temperature alarm setting mode	
Я.	Auxiliary temperature alarm setting mode	Option [AL□]
P	Proportional band setting mode for Main control(C1)	
I	Integral time setting mode	
d	Derivative time setting mode	
Π	ARW setting mode	
ठ	Dead band setting mode	Option [D□]
b	Heater burnout alarm setting	Option [W]
Lock	Setting value lock designating mode	
- -	Setting value lock is not designated1	
Loc 1	Setting value lock designating mode 1	
Loc2	Setting value lock designating mode 2	Option [ECC]
Loc3	External setting [Exclusive use for ECC]	
cYc	Main control(C1) proportional cycle setting mode	
cYcc	Sub-control(C2) proportional cycle setting mode	Option [D□]
P-b	Sub-control(C2) proportional band setting mode	Option [D□]
dF Я	Main control(C1) differential setting mode	
dF b	Sub-control(C2) differential setting mode	Option [D□]
५ΓLH	Scaling high limit setting mode	
५ΓLL	Scaling low limit setting mode	
oΓLH	Output high limit setting mode	
oΓoL	Output low limit setting mode	
५o	Sensor correction setting mode	
dno	Instrument number designating mode	Option [C5,ECC]
cnF	Control mode designating mode	
HEΑΓ	Heating (reverse) action	
cooL	Cooling (direct) action	
- - - -	When sensor is burnt out or input value exceeds.	

Character	Description	Option applied
५		0°C
A		
A.		
P		2.5%
I		200S
d		50S
⊓		50%
⊂		
b		
Loc 1		
Loc2		
Loc3		
- -		
c५c		R/□30S, S/□3S
c५cc		R/□30S, S/□3S
P-b		1
dF A		1.0°C
dF b		1.0°C
५⌐LH		
५⌐LL		
o⌐LH		100%
o⌐LL		0%
५o		0.0°C
dno		0
HEA⌐		
cool		

· · · Inquiry · · ·

For any inquiry of this controller, after checking the following as to the controller, please contact your shop where purchased, or our agent.

```
                                          [Example]
· Model  ......................  MCR-130-R/E
· Temperature specification  .....  0 to 1200℃
· Type of input  .................  K
```

In addition to the above, let us know the details of malfunction, if any, and the operating conditions specifically on job site.