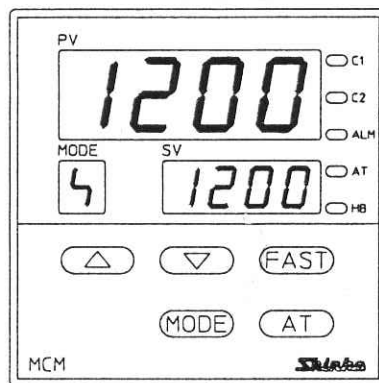


INSTRUCTION MANUAL
FOR
MICROCOMPUTER BASED
TEMPERATURE INDICATING CONTROLLER
MCM-100 SERIES



— CONTENTS —

1. Models referred to in this manual	2
2. Name and functions of the sections	4
3. Mounting to control panel	6
4. Wiring connections	7
5. Operations	9
5.1 Basic function setting mode	9
5.2 Attached function setting mode	14
5.3 Other functions	20
6. Control actions	21
6.1 Explanations of PID	21
6.2 Explanations of PID auto-tuning	21
6.3 PID auto-tuning performance	22
7. Running	23
8. Specifications	26
9. Character table	27

Thank you for your purchase of our Microcomputer based Temperature Indicating Controller **MCM-100 Series**.

This controller is delivered after its production and inspection on the basis of severe quality control in our factory.

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

Note:

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

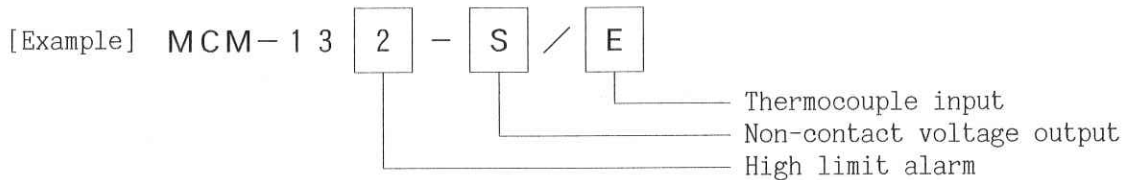
Warning

Turn the power supplied to the instrument OFF before wiring or checking. If working on the power ON status, there is possibility of Electric Shock which can cause severe injury or death. Moreover, the instrument must be grounded before the power supplied to the instrument is turned on.

1. Models referred to in this manual

1.1 Model name

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



(1) Standard models

MCM-1 □ □-□/□		Series name: MCM-100 series
Control action	3	PID action
Temperature alarm action	0	No alarm action
	2	High limit alarm
	3	Low limit alarm
	4	High/low limits alarm
	6	High/low limit range alarm
	8	Process value alarm
Output	R	Relay contact 1c
	S	Non-contact voltage 15Vdc (for SSR drive)
	A	Current 4 to 20mA dc
Input	E	Thermocouple K, J, PL-II, R, S, B, T, C
	R	RTD Pt100 (3-wire system)

(2) Optional specifications

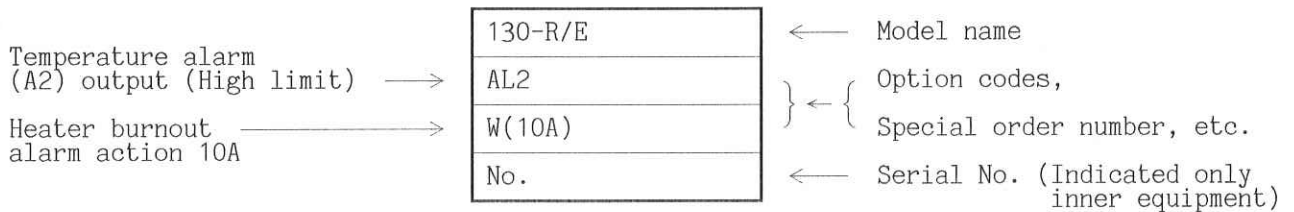
Optional name	Code	Description
Temperature alarm with standby function	H	The function to prevent the alarm action just after the power turned on or when main setting value has been changed. (Applicable to High limit, Low limit and High/Low limits alarm)
Temperature alarm function (A2 output)	AL□	To provide the additional temperature alarm besides the alarm of the standard specification. The action is specified in □. The model name is the same as standard.
Temperature alarm function (A2 output) with standby function	AL□H	The standby function is applied to the temperature alarm (A2 output). The action is specified in □. The model name is the same as standard.
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)
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]
Color Black	BK	Face plate: Dark gray, Case and Base: Black

1.2 How to indicate the model nameplate

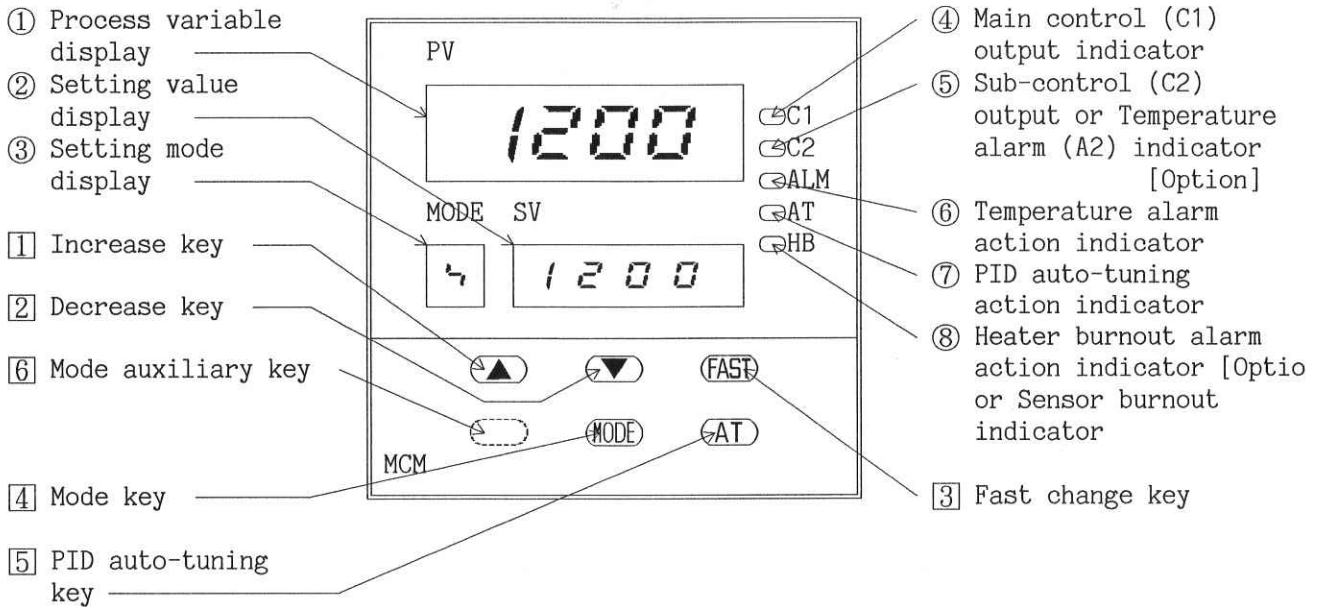
- Optional specifications are specified with above option code (preceding page) besides the model name.
- When two or more functions are specified, commas are used between the codes.
- As to specified Heater burnout alarm action W, the specified value is to be indicated following to the option code in (A).

[Example]

Model nameplate

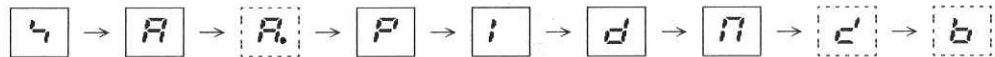


2. Name and functions of the sections









2.1 Explanations of display





- ① Process variable(PV) display Indicates the process variable in digital. (red LED display)
- ② Setting value(SV) display Indicates the setting value in digital. (green LED display)
- ③ Setting mode display Indicates the setting mode, and each time the **MODE** key is pressed, the mode is changed as follows. (yellow LED display)



- ④ Main control (C1) output ^{C1} indicator Green LED lights when the control output is ON. (In case of current output, always lights.)
- ⑤ Sub-control (C2) output ^{C2} or Temperature alarm (A2) output indicator [Option] Yellow LED lights when sub-control (C2) output or Temperature alarm (A2) output is ON.
- ⑥ Temperature alarm action ^{ALM} indicator Red LED lights when temperature alarm output is ON.
- ⑦ PID auto-tuning action ^{AT} indicator Yellow LED blinks when PID auto-tuning is performing.
- ⑧ Heater burnout alarm ^{HB} action indicator Red LED lights when heater burnout alarm output is ON [Option] or Sensor burnout alarm output is ON.

2.2 Explanations of keys

- ①  Increase key : Increases the setting value (SV) being displayed.
(When attached function setting mode is displayed, it works another function. See the explanation of each mode.)
When selected the setting value lock designating mode, it selects the lock status 1 [*Loc 1*] or lock status 2 [*Loc 2*]. When selected the control type designating mode, it turns the main control (C1) to heating (reverse) action status [*HEAT*].
- ②  Decrease key : Decreases the setting value (SV) being displayed.
(When attached function setting mode is displayed, it works another function. See the explanation of each mode.)
When selected the setting value lock designating mode, it selects the lock status 1 [*Loc 1*] or unlock (lock cancelled) status [- -]. When selected the control type designating mode, it turns the main control (C1) to cooling (direct) action status [*COOL*].
- ③  Fast change key : Makes the numeric value change fast by pressing this key while the  or  key is being pressed.
- ④  Mode key : Selects the mode as follows:

* Main setting	* Temperature alarm setting
* Proportional band setting	* Integral time setting
* Derivative time setting	* Anti-reset windup (ARW) setting
* [Dead band setting]	* [Heater burnout alarm setting]
- ⑤  PID auto-tuning key : Performs or cancels the PID auto-tuning.
- ⑥  Mode auxiliary key : If the  key is pressed while this key is being pressed, the attached function setting mode is selected.
(In this attached function setting mode, the mode is changed with only the  key as follows:

* Setting value lock designation	
* Main control (C1) proportional cycle setting	
* [Sub-control (C2) proportional cycle setting]	
* [Sub-control (C2) proportional band setting]	
* Main control (C1) differential setting	
* [Sub-control (C2) differential setting]	
* Scaling high limit setting	* Scaling low limit setting
* Output high limit setting	* Output low limit setting
* Sensor correction setting	* Control type designation

Note: [] indicates the option.

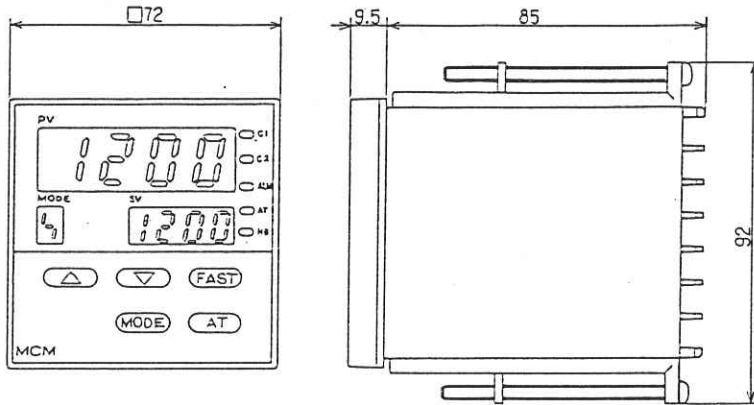
3. Mounting to control panel

3.1 Site selection

Mount the controller MCM-100 in a place with:

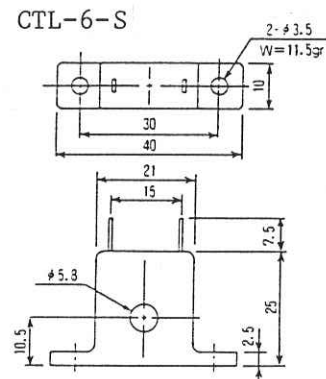
- (1) A minimum of dust, and an absence of corrosive gases.
- (2) An ambient humidity is 85%RH or less, and non-condensing.
- (3) No exposure to direct sunlight. An ambient temperature is 0°C to 50°C (32°F to 122°F), and it does not change suddenly.
- (4) No mechanical vibrations nor shocks.
- (5) The controller should be away from the electromagnetic switch of large capacity, or cables through which large current flows.
- (6) No water or oil and their vapor directly splash.

3.2 External dimension drawing



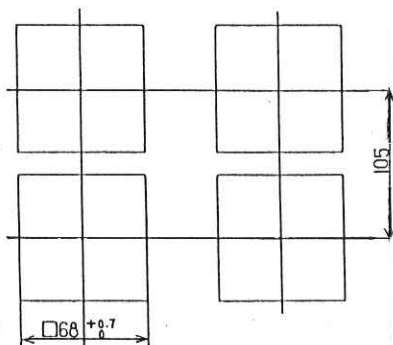
Mounting panel thickness is 1 to 15 mm.

Accessory for Option: W



Current transformer for "Heater burnout alarm"

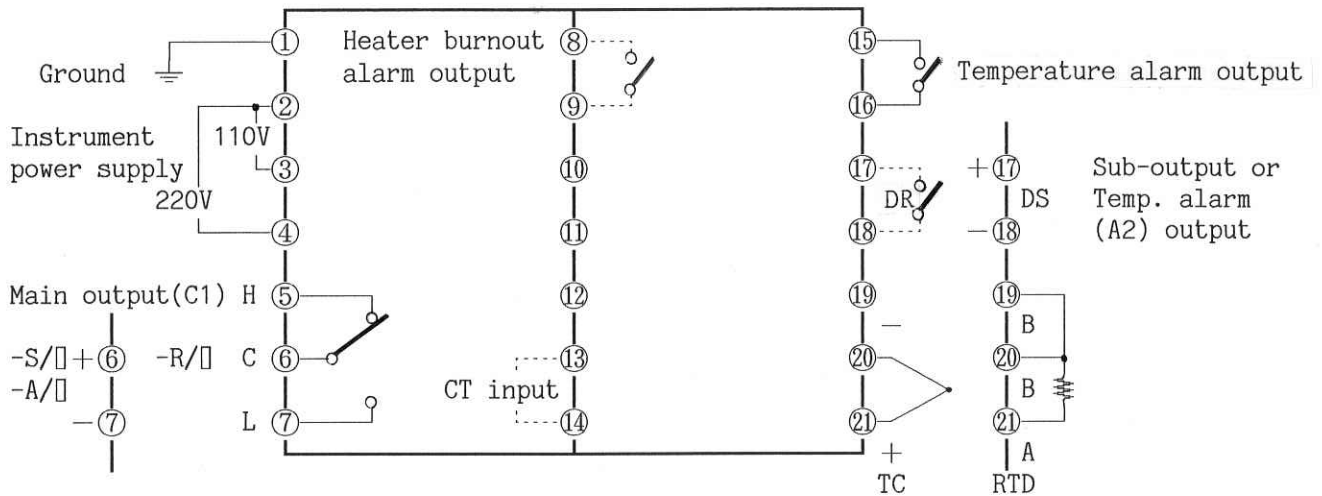
3.3 Panel cutout



Note: Do not screw with excessive force, or the case may be bent, since it is made of resin.

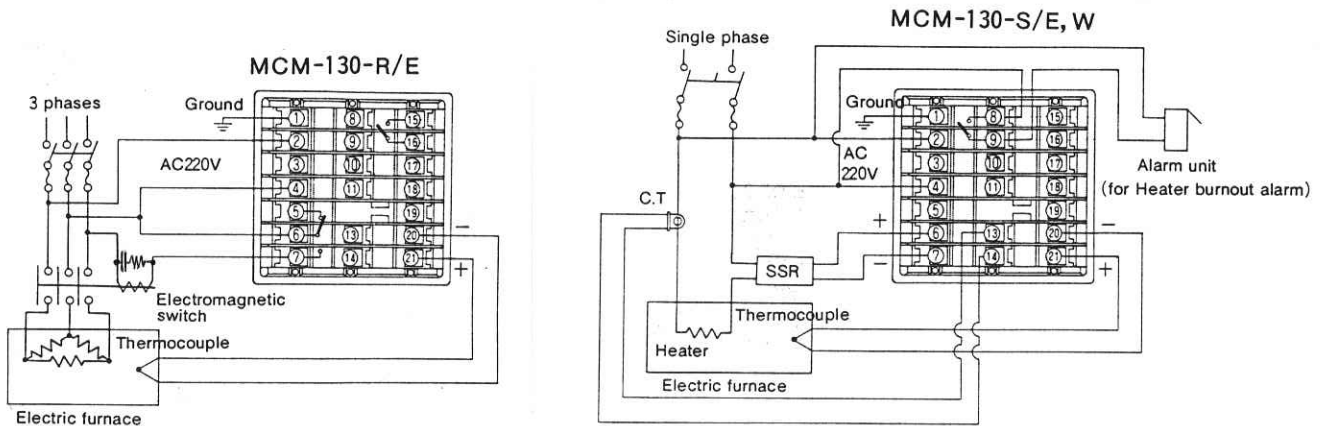
4. Wiring connection

4.1 Terminal arrangements



[Dotted line shows the case option designated, no terminal equipped if the option is not specified.]

4.2 Wiring connection examples



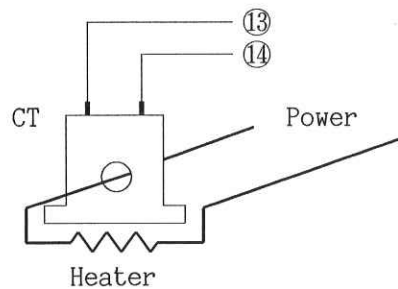
- Notes:
- ① Do not apply the voltage between terminals ③ and ④.
 - ② To prevent the instrument from a bad influence owing to the unexpected level noise, it is recommended that the surge absorber be provided between the coil of the external relay.
 - ③ The terminal block of this instrument is designed to wire from the left side. Lead wire must be inserted from the left side of the terminal, and fasten by terminal screw.

**** Notices ****

- 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 specifications (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 With relay output type of controller, it is recommended to provide proper relay to protect the built-in relay contact, even if the load capacity is smaller than the built-in contact capacity (considering rush current).
- ⑤ When wiring, keep input wire (Thermocouple, RTD, etc.) away from AC source and load wire to avoid external interference.

[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.



5. Operations

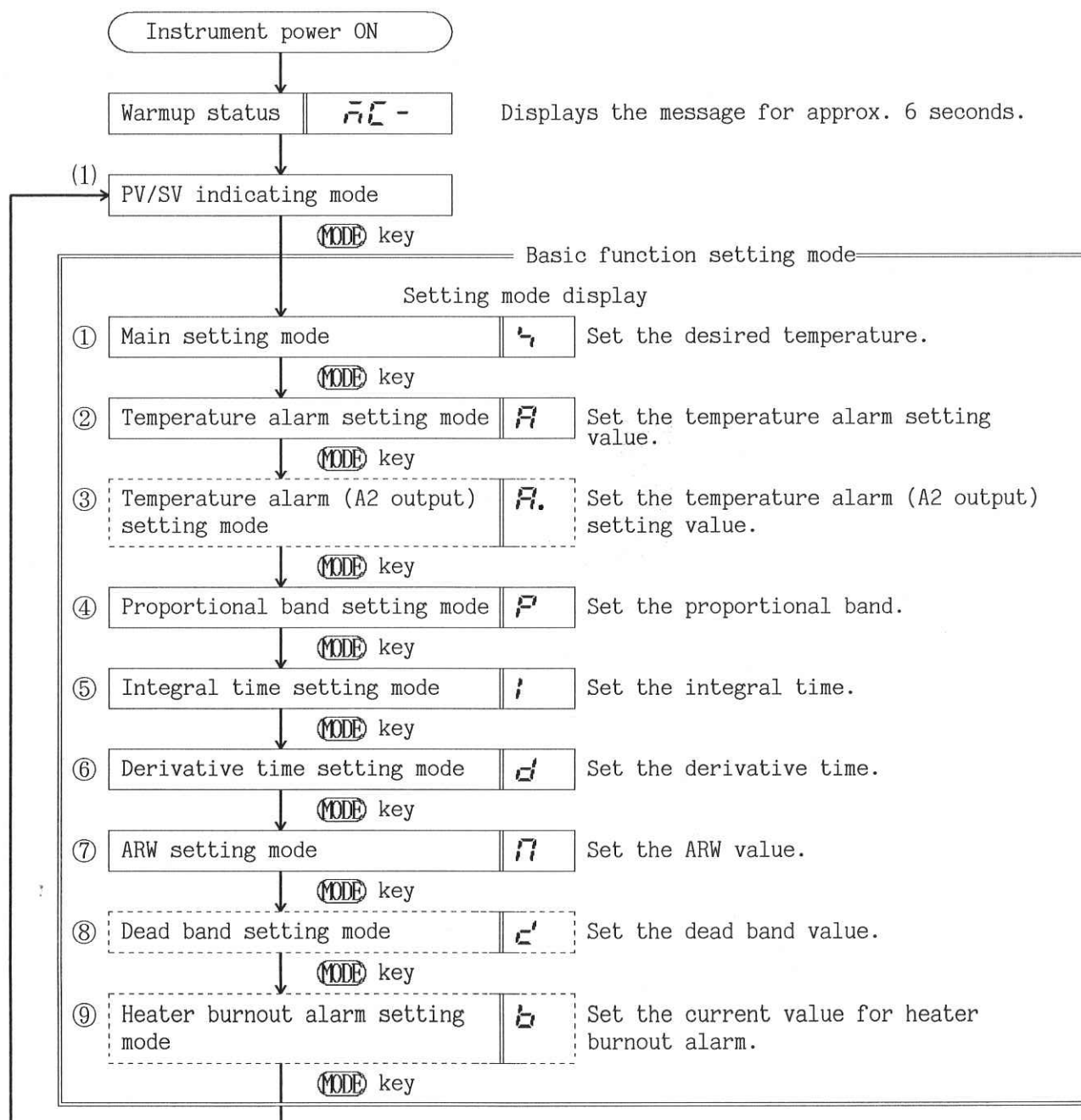
5.1 Basic operation

Process variable display (PV) indicates [$\bar{r}c$ -] for approx. 6 seconds after the power is 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 [\bar{r}] 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 the **(▲)** and **(▼)** keys. Moreover when using the **(▲)** and **(▼)** keys, if the **(FAST)** key is simultaneously pressed, the change of numeric value becomes faster.

Further, each time the **(MODE)** key is pressed, the mode is selected as shown below figure, and the setting values necessary for each mode are settable.



Notes: (for preceding page)

1. Dotted line means in case of option specification.
(If the options are not designated, the modes cannot be selected.)
2. In any mode, if the (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 the (▲) and (▼) key is registered after pressing the (MODE) key. If the key operation is ended after the numeric value was 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	No contents of setting items nor setting values can be changed.
Blank	Main setting value	Actual temperature	

(2) Basic function setting mode

① 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 the (MODE) key is pressed. (Hereinafter the same)
[Factory adjusted as 0°C, 0°F]

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.

② Temperature alarm setting mode

A mode to set a temperature alarm setting value.

Setting range is as follows. (Setting ranges differ from the alarm action correspondent to the models. Factory adjusted as 0°C, 0°F.)

Value setting: Deviation setting to the main setting, except Process value alarm.

- (MCM-130-) No alarm action
- (MCM-132-) High limit alarm : -100 to 100°C, -200 to 200°F
- (MCM-133-) Low limit alarm : -100 to 100°C, -200 to 200°F
- (MCM-134-) High/Low limits alarm : ±(1 to 100)°C, ±(1 to 200)°F (*1)
- (MCM-136-) High/Low limit range alarm : ±(1 to 100)°C, ±(1 to 200)°F (*1)
- (MCM-138-) Process value alarm : Scaling low to high limit setting value

[Option code: H, Standby function]

When power is initially applied to the controller, the function disables alarm action even if the input value is in the range in which the alarm action works, and this also prevents the alarm even if the alarm action point enters the above range as a result of the main setting value change during control.

Once the input value exceeds the alarm action point continuing the control, the standby function will be released and when the input value reaches the point again, the alarm action output will work.

- High limit alarm, with standby function : -100 to 100°C, -200 to 200°F
- Low limit alarm, with standby function : -100 to 100°C, -200 to 200°F
- High/Low limits alarm, w/standby function : ±(1 to 100)°C, ±(1 to 200)°F (*1)

Notes: (For preceding page)

1. Setting the alarm value to 0 disables the function.
(However, in case of Process value alarm, it works even if 0°C is set.)
2. In case rated scale has a decimal point, the setting range is: -100.0 to 100.0°C
(-200.0 to 200.0°F)
3. Both + and - values will be simultaneously set when applied only one value. (*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.

- ③ Temperature alarm (A2 output) setting mode [Option code: AL□]
 This mode is applied when specified the temperature alarm (A2 output). [Option] Setting range is the same as item ②.
 This temperature alarm can be applied the standby function the same as item ②. [Option code: AL□H]

Setting mode display	SV display	PV display	Change of setting value
A	Temperature alarm (A2) setting value	Actual temperature	The value can be increased or decreased by pressing the (▲), (▼) and (FAST) keys.

- ④ Proportional band setting mode
 A mode to set a proportional band of main control (C1).
 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.

- ⑤ Integral time setting mode
 A mode to set an integral time value.
 Setting range is 1 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 setting value	Actual temperature	The value can be increased or decreased by pressing the (▲), (▼) and (FAST) keys.

⑥ Derivative time setting mode

A mode to set a derivative time value.

Setting range is 1 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 setting value	Actual temperature	The value can be increased or decreased by pressing the ▲ , ▼ and FAST keys.

⑦ Anti-reset windup (ARW) setting mode

A mode to set an ARW value.

Setting range is 0 to 100%. (Factory adjusted as 50%.)

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

**** Explanation of ARW setting mode ****

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.

The less ARW value is, the less excess integral action becomes at transition status, however, it needs time till stabilized.

⑧ Dead band setting mode [Option]

A mode to set the overlap and dead band of main(C1) and sub(C2) control. This mode is to be selected additionally when heating and cooling control output [Option: D] is specified.

Setting range is -10.0% to 10.0% of full scale (equivalent temperature).

Overlap : -10.0 to 0.0%

Dead band: 0.0 to 10.0%

(Factory adjusted as 0%)

Note: If the control action is selected as ON/OFF action, the overlap and dead band of main control (C1) or sub-control (C2) become null.

Setting mode display	SV display	PV display	Change of setting value
z'	Overlap or Dead band value	Actual temperature	The value can be increased or decreased by pressing the ▲ , ▼ and FAST keys.

⑨ Heater burnout alarm setting mode [Option code: 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)

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%)

Setting the heater current to 0 disables the function.

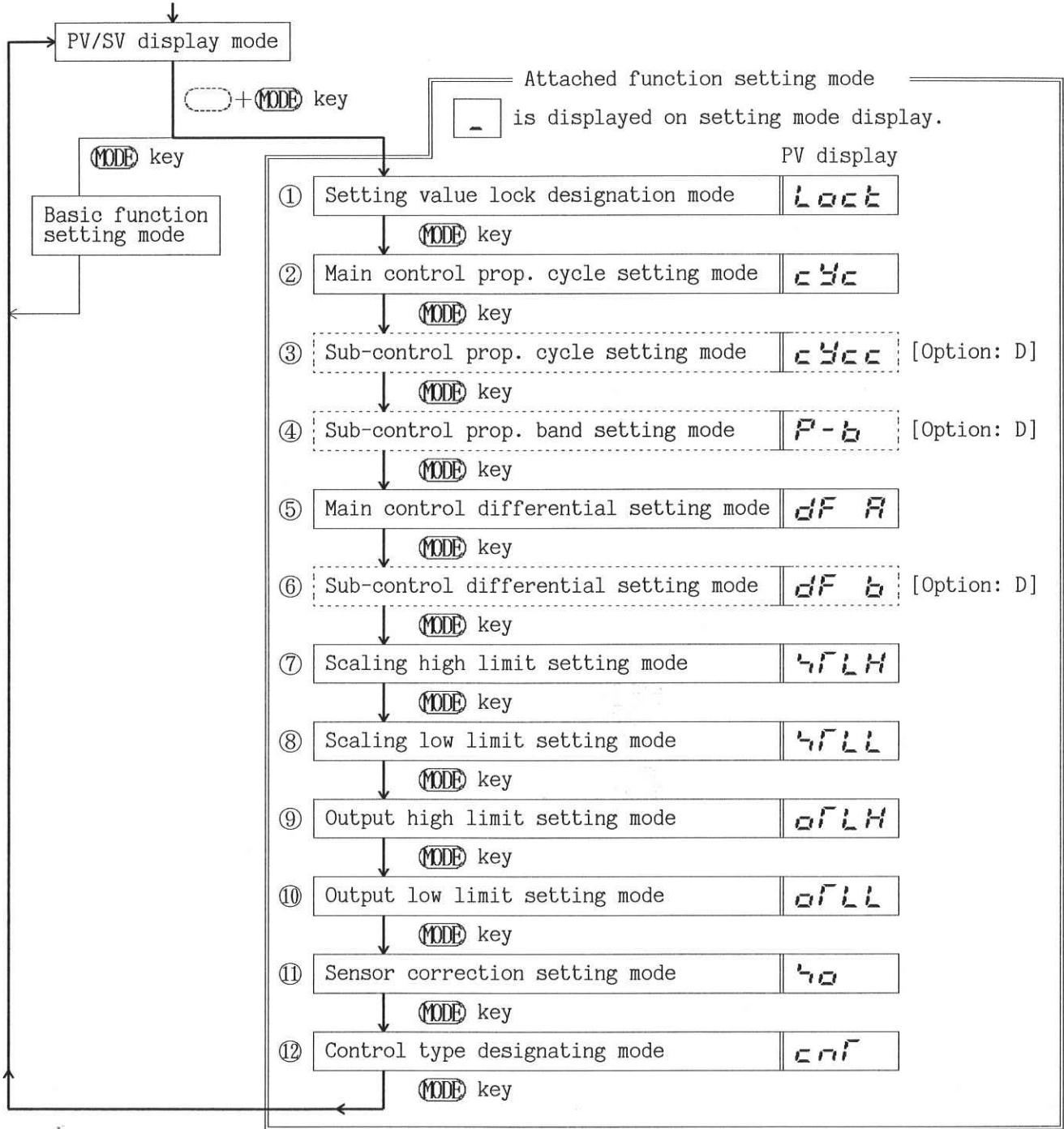
- * Once alarm action operates, the output is held. To cancel the output, turn the power OFF, and ON again, or set the value to 0, and set the value again.
- * In case sensor burnout works, HB indicator lights and " - - - " blinks on PV display. If the sensor is fixed, the display turns to process variable.

Setting mode display	SV display	PV display	Change of setting value
b	Heater current setting value	Actual temperature	The value can be increased or decreased by pressing the  ,  and FAST keys.

5.2 Key operation for attached function

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, and the setting value lock designating mode will be selected.

Further, each time the **MODE** key alone is pressed, the mode changes as follows:



- Notes:
1. Dotted line means in case of option.
[Preceding page] (If the option is not designated, the mode cannot be selected.)
 2. The indicated value selected by the (▲) and (▼) keys is registered after pressing the (MODE) key. In case the key operation is ended setting the values, approx. 30 seconds later it is automatically changed to PV/SV mode and setting values are registered.

(1) Attached function setting mode

① Setting value lock designating mode

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

Mode 1: No setting values in Basic function setting mode can be changed. Auto-tuning cannot work by the (AT) key operation, too.

Mode 2: Only main setting value is changeable, and others in Basic function setting mode become lock status.

Auto-tuning cannot work by the (AT) key operation either.

Unlock: A status of lock cancelled, and all setting values can be changed.

This mode is used to perform the Auto-tuning by the (AT) key. (Factory adjusted as unlock [lock cancelled] status.)

Designation	SV display	PV display	Change of setting value	
Lock mode 1	Loc 1	Lock	with the (▲) key	with the (▼) key
Lock mode 2	Loc 2		Unlock ⇔ Mode 1 ⇔ Mode 2 ⇔ Mode 3	Mode 3 ⇔ Mode 2 ⇔ Mode 1 ⇔ Unlock
Lock mode 3	Loc 3			
Unlock	--			

Note: Lock mode 3 is not provided to this controller, therefore do not designate the mode.

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 30s [-R/□], 3s [-S/□])

Setting mode display	SV display	PV display	Change of setting value
-	Setting value of proportional cycle	c 4 c	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 30s [-R/□], 3s [-S/□])

Setting mode display	SV display	PV display	Change of setting value
-	Setting value of proportional cycle	c 4 c c	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 -10 to 10. (See below table)

(Factory adjusted as 1.)

Setting mode display	SV display	PV display	Change of setting value
-	Setting value of proportional band (-10 to 10)	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°C and Main (C1) proportional band is 10.0% (40°C), the Sub (C2) proportional band should be set as follows.

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

[Formula] Sub proportional band value

$$= \text{Main proportional band value} \times \text{Sub proportional band setting value}$$

$$8^\circ\text{C} = 40^\circ\text{C} [\text{Main proportional band value}] \times 1/5 [-5 (*1) \text{Sub proportional band setting value}]$$

Note (*1): Sub proportional band multiplying factor of Sub proportional band setting value -5 is 1/5.

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 (°C) [e.g.]	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 (°C) [e.g.]	0	40	80	120	160	200	240	280	320	360	400

Setting the proportional band to 0.0 causes the Sub-control of the instrument to act as an ON/OFF controller, and the differential can be set in (6) 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°C(200.0°F) (Factory adjusted as 1.0°C[°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°C(200.0°F) (Factory adjusted as 1.0°C[°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 scale value (rated scale).
 Setting range differs from the types 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	4FLH	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 scale value (rated scale).
 Setting range differs from the types 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	4FLl	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
PL-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	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
Pt-100	-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 accuracy becomes unwarrantable.



⑨ Output high limit setting mode

A mode to set the high limit of the control output. Effective to only main output. Setting range is from output low limit value to 100%. [Indication: to 110 (%)] (With Current output type, it is from output low limit value to 110%.) (Factory adjusted as 100%)

Setting mode display	SV display	PV display	Change of setting value
-	High limit value of the output	oFLH	The value can be increased or decreased by pressing the  ,  and (FAST) keys.



⑩ Output low limit setting mode

A mode to set the low limit of the control output. Effective to only main output. Setting range is from 0% to output high limit value. [Indication: from -10 (%)] (With Current output type, it is from -10% to output high limit value.) (Factory adjusted as 0%)

Setting mode display	SV display	PV display	Change of setting value
-	Low limit value of the output	oFLl	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	So	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 temperature in the controlled location. And when controlling with plural controllers, the accuracy of sensors or the difference of load capacities 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 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	<i>HEAT</i>	<i>err</i>	▲ key for heating action
Cooling [direct] action	<i>cool</i>		▼ 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)
<i>HEAT</i>	Heating action	None	Heating action	Cooling action
<i>cool</i>	Cooling action	None	Cooling action	Heating action

5.3 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 \square HB heater burnout alarm action indicator. Simultaneously PV display blinks [$\bar{\quad}\bar{\quad}\bar{\quad}\bar{\quad}$]. (upscale)

Once alarm action operates, the output is held even if the sensor is exchanged with normal one. To release the output, turn the output OFF, and ON again or set the value to 0.

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 the sensor burnout alarm output.

(3) Self-diagnostic function

Watches the CPU by watchdog timer, and when any abnormal status has occurred on the CPU, it 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°C.

(5) Power failure back up

In case the power failure time exceeds 30ms, the data are kept with non-volatile IC memory.

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 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 rate. It reduces amplitude of overshoot and undershoot. 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.

(4) Anti-reset windup (ARW)

ARW prevents overshoot caused due to the integral action. If operating by manual, duty factor of load for the setting is of standard value, to fix controlling aim. The less ARW value is, the less excess integral action becomes at transition status, however, it needs time till stabilized.

* How to get the duty factor for ARW when manual controlling.

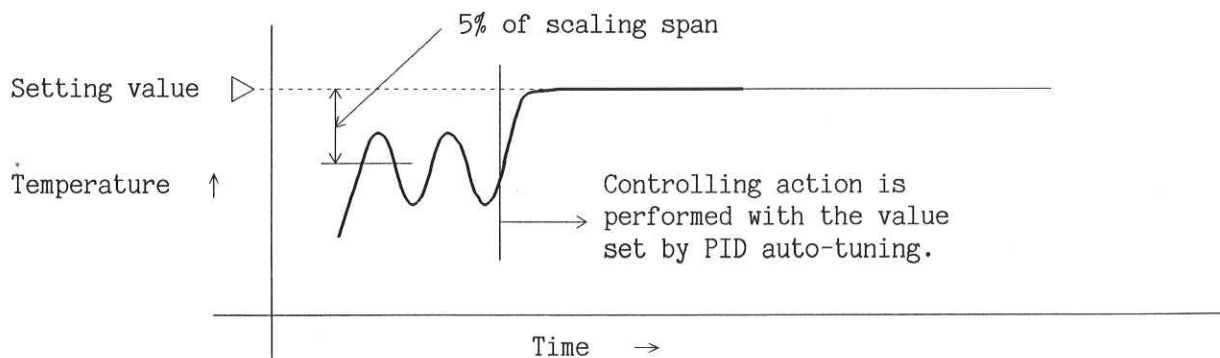
$$\text{Duty factor(\%)} = \frac{\text{ON action time}}{\text{Proportional cycle}} \times 100(\%)$$

Set to 50% (factory adjusted value) on trial run, if duty factor is unknown.

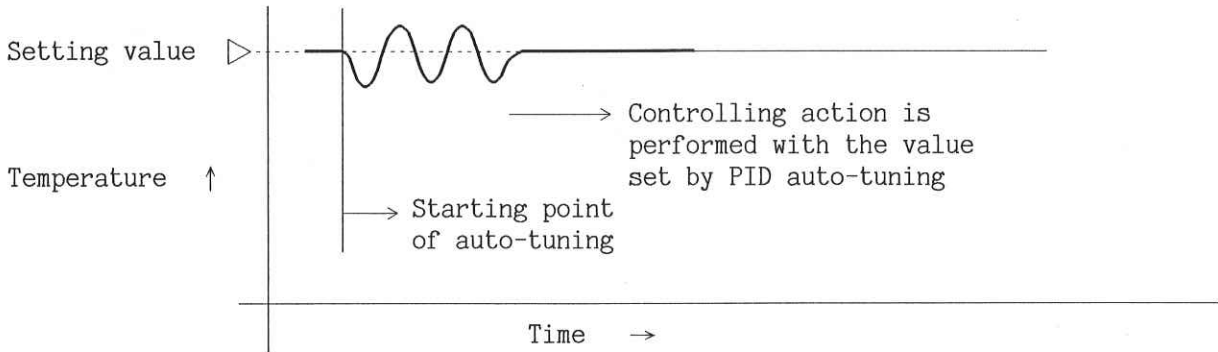
6.2 Explanations of PID auto-tuning

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.

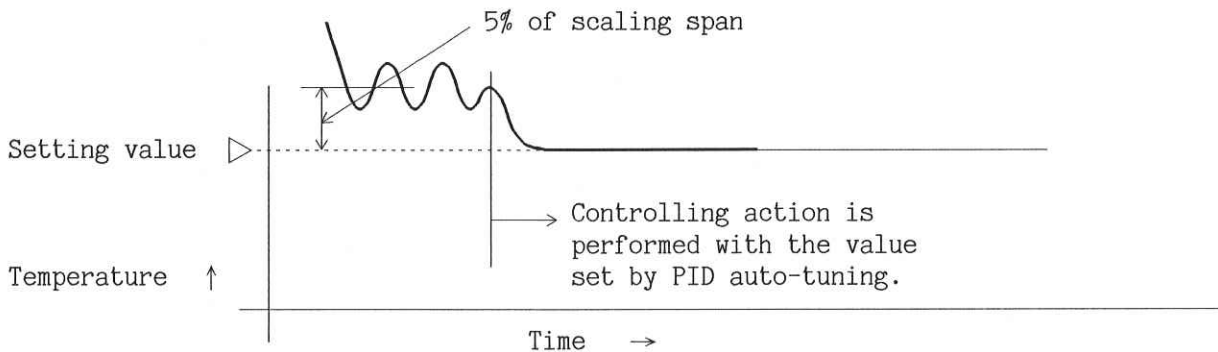
- (1) In case the difference between setting value and processing temperature is large when the temperature rises. Fluctuation is given at the temperature 5% of scaling span less than the setting value.



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



- (3) In case control temperature is 10% or more of scaling span higher than the setting value. 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 system 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 PID auto-tuning performance

Auto-tuning starts by pressing the (AT) key in PV/SV display mode or basic function setting mode. During auto-tuning is operated, auto-tuning indicator blinks.

Auto-tuning is released when pressed the (AT) key again during auto-tuning performance. After auto-tuning is completed, the Proportional band, the Integral time, the Derivative time and the ARW value are set automatically.

- Notes: 1. The (MODE) key becomes null during PID auto-tuning, and other setting cannot be operated.
 2. If lock mode 1 or lock mode 2 is designated with setting lock designating mode, auto-tuning cannot work.

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 the key is pressed, or the specification contents of the instrument may be changed.)
- (2) Instrument (warmup status)
For approx. 6 seconds after power on, [\overline{r} -] 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 as the controller.
- (3) Input the setting value, referring to " 5. Operation ".
- (4) Turn the control circuit power ON.
- (5) The controller will start the following control action so as to maintain the controlled object at the setting value.

• Standard actions

Control mode designating mode		Heating (reverse) action (<i>HEAT</i>)			Cooling (normal) action (<i>COOL</i>)		
Standard							
	Setting			Setting			
Main output Cl	Relay contact	<p>Cycle action is performed according to deviation</p>			<p>Cycle action is performed according to deviation</p>		
	Indication	Green Cl	Lit	Unlit	Green Cl	Unlit	Lit
	Non-contact voltage	<p>Cycle action is performed according to deviation</p>			<p>Cycle action is performed according to deviation</p>		
	Indication	Green Cl	Lit	Unlit	Green Cl	Unlit	Lit
	Current	<p>Change continuously according to deviation</p>			<p>Change continuously according to deviation</p>		
Indication	Green Cl	Lit		Green Cl	Lit		

The positions of above Proportional band indicate in case of "P" actions.

• Heating/Cooling control actions [Option: D]

Control mode designating mode		Heating (reverse) action (HEAT)			Cooling (direct) action (COOL)		
Heating & cooling control [Option]							
		Setting			Setting		
Main output C1	Relay contact	<p>Cycle action is performed according to deviation</p>			<p>Cycle action is performed according to deviation</p>		
	Indication	Green C1	Lit	Unlit	Green C1	Unlit	Lit
	Non-contact voltage	<p>Cycle action is performed according to deviation</p>			<p>Cycle action is performed according to deviation</p>		
	Indication	Green C1	Lit	Unlit	Green C1	Unlit	Lit
	Current	<p>Change continuously according to deviation</p>			<p>Change continuously according to deviation</p>		
	Indication	Green C1	Lit	Unlit	Green C1	Lit	Unlit
Sub output C2	Relay contact	<p>Cycle action is performed according to deviation</p>			<p>Cycle action is performed according to deviation</p>		
	Indication	Yellow C2	Unlit	Lit	Yellow C2	Lit	Unlit
	Non-contact voltage	<p>Cycle action is performed according to deviation</p>			<p>Cycle action is performed according to deviation</p>		
	Indication	Yellow C2	Unlit	Lit	Yellow C2	Lit	Unlit

The positions of above Proportional band indicate in case of "P" actions.

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

Control mode designating mode		Heating (reverse) (HEAT)			Cooling (direct) action (COOL)		
Heating & cooling control dead band setting [Option]							
Main output C1	Relay contact	<p>Cycle action is performed according to deviation</p>			<p>Cycle action is performed according to deviation</p>		
	Indication	Green Cl Lit	Unlit	Green Cl	Unlit	Lit	
	Non-contact voltage	+⑥ DC15V -⑦	+⑥ DC0/15V -⑦	+⑥ DC0V -⑦	+⑥ DC0V -⑦	+⑥ DC0/15V -⑦	+⑥ DC15V -⑦
	Current	+⑥ DC20mA -⑦	+⑥ DC4-20mA -⑦	+⑥ DC4mA -⑦	+⑥ DC4mA -⑦	+⑥ DC4-20mA -⑦	+⑥ DC20mA -⑦
	Indication	Green Cl Lit	Unlit	Green Cl	Unlit	Lit	
Sub output C2	Relay contact	<p>Cycle action is performed according to deviation</p>			<p>Cycle action is performed according to deviation</p>		
	Indication	Yellow C2	Unlit	Yellow C2 Lit	Unlit	Lit	
	Non-contact voltage	+⑰ DC0V -⑱	+⑰ DC0/15V -⑱	+⑰ DC15V -⑱	+⑰ DC15V -⑱	+⑰ DC0/15V -⑱	+⑰ DC0V -⑱
	Indication	Yellow C2	Unlit	Yellow C2 Lit	Unlit	Lit	

The positions of above Proportional band indicate in case of "P" actions.

• Alarm actions

(1) Temperature alarm

Alarm mode	High limit alarm (-132-)	Low limit alarm (-133-)	High/Low limits alarm (-134-)	High/Low limit range alarm (-136-)	Absolute value alarm (-139-)
Standard mode					
Output					
Indication	Unlit Lit	Lit Unlit	Lit Unlit Lit	Unlit Lit Unlit	Unlit Lit
[Option] With standby				<p>Notes:</p> <p>(1) Optional code of with Standby function is H.</p> <p>(2) Parts operate Standby function.</p> <p>(3) This 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.</p>	
Output					
Indication	Unlit Lit	Lit Unlit	Lit Unlit Lit	Unlit Lit	

(2) Heater burnout alarm

Alarm action		Note:
Output		As for this function, once it operates, the output is maintained until the instrument power turned OFF.
Indication	Lit Unlit	

8. Specifications

- Mounting : Flush
- Setting : Input system using membrane sheet key
- Display : Process variable display, Red LED, 4 digits, Size 14.3(H)×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
- Accuracy : [Thermocouple], Within $\pm 0.3\%$ of scaling range full scale ± 1 digit or within $\pm 2^\circ\text{C}$ [Whichever is greater]
 However, in case of R and S type of input, within $\pm 4^\circ\text{C}$ for 0 to 200°C , and B and C type of input, unwarrantable for 0 to 300°C .
 [RTD], Within $\pm 0.3\%$ of scaling range full scale ± 1 digit or within $\pm 1^\circ\text{C}$ [Whichever is greater]
- Input : [Thermocouple], K, J, PL-II, R, S, B, C, T (100Ω or less)
 [RTD], Pt100 3-wire system (resistance per wire 4Ω max.)
- Output : [Relay contact] 1c 220Vac 3A (resistive load)
 220Vac 1A (inductive load $\cos\phi = 0.4$)
 [Non-contact voltage] (for SSR drive)
 15Vdc (at load resistance $1.5k\Omega$)
 20mA (short-circuit protected)
 [Current] 4 to 20mA dc (load resistance max. 600Ω)
 Temperature alarm (-132, -133, -134, -136, -138) Relay contact 1a
 220Vac 0.5A (resistive load)
 220Vac 0.2A (inductive load $\cos\phi = 0.4$)
- Control system : PID action (with auto-tuning function)
 Proportional band 0.1 to 200.0% (acts ON/OFF when set to 0)
 Integral time 1 to 3600 seconds (off when set to 0)
 Derivative time 1 to 1800 seconds (off when set to 0)
 Anti-reset windup 0 to 100%
 Proportional cycle 1 to 120 seconds (not available for -A/[])
 Temperature alarm (-132, -133, -134, -136, -138)
 ON/OFF action Dead band 1°C
- Supply voltage : 110/220Vac, 50/60Hz, Allowable voltage fluctuation within $\pm 10\%$
- Ambient temperature : 0 to 50°C (32 to 122°F)
- Ambient humidity : 35 to 85%RH (non-condensing)
- Power consumption : Approx. 5W
- Weight : Approx. 300g
- Attached functions : * Scaling function
 (scaling high limit setting, scaling low limit setting)
 * Output limiting function
 * Sensor correcting function
 * Setting value lock function
 * Control type 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)
- Accessories : Mounting brackets 1 set
 Instruction manual 1 copy
 Current transformer, Model CTL-6-S 1 set [for option W]

8.2 Optional specifications	[code]	
Temperature alarm output with standby function	[H]	Temperature alarm (applied for only High limit, Low limit and High/Low limits alarm)
Temperature alarm (A2 output)	[AL□]	The additional temperature alarm besides the standard alarm. Designation of action characteristic is the same as standard and indicated following to AL. e.g. AL2: It shows that Temperature alarm (A2) and acts as High limit alarm action.
Temperature alarm (A2) with standby function	[AL□H]	Temperature alarm [A2] (applied for only High limit, Low limit and High/Low limits alarm)
Heater burnout alarm output	[W]	0 to 100% (current 5A, 10A or 20A, specified)
Heating/cooling control output	[D]	Prop. band: 0.1 to 10 times of main control(C1) Prop. cycle: 1 to 120 seconds (for DR or DS) Overlap and dead band setting range: -10.0 to 10.0% of full scale
	[DR]	Relay contact: 1c 220Vac 3A (resistive) 220Vac 1A (inductive $\cos\phi=0.4$)
	[DS]	Non-contact voltage: 15Vdc \pm 3V (at load resistance 1.5k Ω) 20mA (short circuit protected)
Color Black	[BK]	Appearance black (Face plate, Dark gray Base, case, Black)

9. Character table

Character	Description	Character	Description
<i>nc -</i>	Initial setting	- -	Setting value lock is not designated
<i>4</i>	Main setting mode	<i>cyc</i>	Main control(C1) proportional cycle setting mode
<i>A</i>	Temperature alarm setting mode	<i>cyc c</i>	Sub-control(C2) proportional cycle setting mode
<i>A.</i>	Temperature alarm (A2) setting mode	<i>P-b</i>	Sub-control(C2) proportional band setting mode
<i>P</i>	Proportional band setting mode <Main control(C1)>	<i>df A</i>	Main control(C1) differential setting mode
<i>i</i>	Integral time setting mode	<i>df b</i>	Sub-control(C2) differential setting mode
<i>d</i>	Derivative time setting mode	<i>4FLH</i>	Scaling high limit setting mode
<i>n</i>	ARW setting mode	<i>4FLl</i>	Scaling low limit setting mode
<i>d'</i>	Dead band setting mode	<i>ofLH</i>	Output high limit setting mode
<i>b</i>	Heater burnout alarm setting mode	<i>ofLl</i>	Output low limit setting mode
<i>Lock</i>	Setting value lock designating mode	<i>4o</i>	Sensor correction setting mode
<i>Loc 1</i>	Setting value lock designating mode 1	<i>cnf</i>	Control type designating mode
<i>Loc 2</i>	Setting value lock designating mode 2	<i>HEAT</i>	Heating (reverse) action
<i>Loc 3</i>	Not available to this controller.	<i>cool</i>	Cooling (direct) action

• • • 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 MCM-130-R/E
 - Temperature specification 0 to 1200°C
 - 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.

For inquiry about the specification change of this products, please contact the agent mentioned below.

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