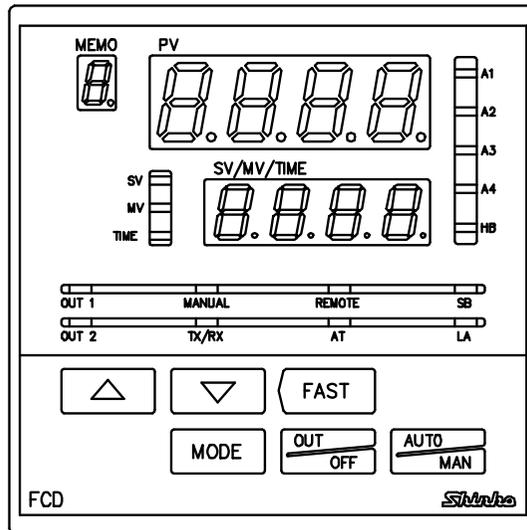


DIGITAL INDICATING CONTROLLER

FCD-13A

INSTRUCTION MANUAL



Shinko

Preface

Thank you for purchasing our Digital indicating controller FCD-13A.

This manual contains instructions for the mounting, functions, operations and notes when operating the FCD-13A.

To prevent accidents arising from the misuse of this controller, please ensure the operator receives this manual.

Abbreviations used in this manual

Symbol	Term
PV	Process variable
SV	Desired value
MV	Output manipulated variable
OUT1	Control output 1
OUT2	Control output 2 (option)
AT	Auto-tuning

Characters used in this manual:

Indication	-	0	1	2	3	4	5	6	7	8	9	°C	°F
Number, °C/°F	-1	0	1	2	3	4	5	6	7	8	9	°C	°F
Indication	A	B	C	D	E	F	G	H	I	J	K	L	M
Alphabet	A	B	C	D	E	F	G	H	I	J	K	L	M
Indication	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
Alphabet	N	O	P	Q	R	S	T	U	V	W	X	Y	Z

Notes

- This instrument should be used in accordance with the specifications described in the manual. If it is not used according to the specifications, it may malfunction or cause a fire.
- Be sure to follow the warnings, cautions and notices. If they are not observed, serious injury or malfunction may occur.
- Specifications of the FCD-13A and the contents of this instruction manual are subject to change without notice.
- Care has been taken to assure that the contents of this instruction manual are correct, but if there are any doubts, mistakes or questions, please inform our sales department.
- This instrument is designed to be installed through a control panel. If it is not, measures must be taken to ensure that the operator cannot touch power terminals or other high voltage sections.
- Any unauthorized transfer or copying of this document, in part or in whole, is prohibited.
- Shinko Technos CO., LTD. is not liable for any damage or secondary damage(s) incurred as a result of using this product, including any indirect damage.

SAFETY PRECAUTIONS (Be sure to read these precautions before using our products.)

The safety precautions are classified into categories: "Warning" and "Caution".

Depending on the circumstances, procedures indicated by  Caution may cause serious results, so be sure to follow the directions for usage.



Warning

Procedures which may lead to dangerous conditions and cause death or serious injury, if not carried out properly.



Caution

Procedures which may lead to dangerous conditions and cause superficial to medium injury or physical damage or may degrade or damage the product, if not carried out properly.



Warning

- To prevent an electric shock or fire, only Shinko or other qualified service personnel may handle the inner assembly.
- To prevent an electric shock, fire or damage to the instrument, parts replacement may only be undertaken by Shinko or other qualified service personnel.



SAFETY PRECAUTIONS

- To ensure safe and correct use, thoroughly read and understand this manual before using this instrument.
- This instrument is intended to be used for industrial machinery, machine tools and measuring equipment. Verify correct usage after consulting purpose of use with our agency or main office. (Never use this instrument for medical purposes with which human lives are involved.)
- External protection devices such as protective equipment against excessive temperature rise, etc. must be installed, as malfunction of this product could result in serious damage to the system or injury to personnel. Also proper periodic maintenance is required.
- This instrument must be used under the conditions and environment described in this manual. Shinko Technos Co., Ltd. does not accept liability for any injury, loss of life or damage occurring due to the instrument being used under conditions not otherwise stated in this manual.

Caution with respect to Export Trade Control Ordinance

To avoid this instrument from being used as a component in, or as being utilized in the manufacture of weapons of mass destruction (i.e. military applications, military equipment, etc.), please investigate the end users and the final use of this instrument.

In the case of resale, ensure that this instrument is not illegally exported.

1. Installation precautions



Caution

This instrument is intended to be used under the following environmental conditions (IEC61010-1): Overvoltage category II, Pollution degree 2

Ensure the mounting location corresponds to the following conditions:

- A minimum of dust, and an absence of corrosive gases
- No flammable, explosive gases
- No mechanical vibrations or shocks
- No exposure to direct sunlight, an ambient temperature of 0 to 50°C (32 to 122°F) that does not change rapidly, and no icing
- An ambient non-condensing humidity of 35 to 85%RH
- No large capacity electromagnetic switches or cables through which large current is flowing
- No water, oil or chemicals or where the vapors of these substances can come into direct contact with the unit
- Take note that ambient temperature of this unit must not exceed 50°C (122°F) if mounted through the face of a control panel. Otherwise the life of electronic components (especially electrolytic capacitors) may be shortened.

Note: Avoid setting this instrument directly on or near flammable material even though the case of this instrument is made of flame-resistant resin.

2. Wiring precautions



Caution

- Do not leave wire remnants in the instrument, because they could cause a fire or malfunction.
- Use the solderless terminal with an insulation sleeve in which an M3 screw fits when wiring the FCD-13A.
- The terminal block of this instrument is designed to be wired from the left side. The lead wire must be inserted from the left side of the terminal, and fastened with the terminal screw.
- Tighten the terminal screw within the specified torque. If excessive force is applied to the screw when tightening, the screw or case may be damaged.
- Do not apply a commercial power source to the sensor connected to the input terminal nor allow the power source to come into contact with the sensor, as the input circuit may be burnt out.
- This controller has no built-in power switch, circuit breaker or fuse. It is necessary to install them near the controller.
(Recommended fuse: Time-lag fuse, rated voltage 250V AC, rated current 2A)
- For a 24V AC/DC power source, do not confuse polarity when using direct current (DC).

3. Operation and maintenance precautions



Caution

- It is recommended that AT be performed during the trial run.
- Do not touch live terminals. This may cause electric shock or problems in operation.
- Turn the power supply to the instrument OFF when retightening the terminal and cleaning. Working or touching the terminal with the power switched ON may result in severe injury or death due to Electric Shock.
- Use a soft, dry cloth when cleaning the instrument.
(Alcohol based substances may tarnish or deface the unit.)
- As the display section is vulnerable, do not strike or scratch it with a hard object or press hard on it.

--- CONTENTS ---

1. Model	
1.1 Model -----	8
1.2 How to read the model label -----	9
2. Name and functions of sections	
2.1 Name of sections -----	10
2.2 Keys -----	11
3. Setup	
3.1 Taking the internal assembly out -----	12
3.2 Switch setting (multi-function) -----	12
3.3 Insertion of the internal assembly -----	15
4. Mounting to the control panel	
4.1 Site selection -----	16
4.2 External dimensions (Scale: mm) -----	16
4.3 Panel cutout (Scale: mm) -----	16
4.4 Current transformer (CT) dimensions (Scale: mm) -----	17
4.5 Mounting -----	17
5. Wiring	
5.1 Terminal arrangement -----	19
5.2 Wiring examples -----	20
6. Settings	
6.1 Operation flowchart -----	22
6.2 Settings	
6.2.1 Main setting mode -----	24
SV -----	24
6.2.2 Sub setting mode	
Set value memory number -----	25
AT Perform/Cancel -----	25
OUT1 proportional band -----	25
OUT2 proportional band -----	25
Integral time -----	25
Derivative time -----	25
OUT1 proportional cycle -----	26
OUT2 proportional cycle -----	26
Manual reset -----	26
A1 value -----	26
A2 value -----	26
A3 value -----	27
A4 value -----	27
Heater burnout alarm value -----	27
Loop break alarm time -----	27
Loop break alarm span -----	27

6.2.3 Auxiliary function setting mode 1	
Set value lock -----	28
SV high limit -----	29
SV low limit -----	29
Sensor correction -----	29
Overlap/Dead band -----	29
Remote/Local setting -----	30
Instrument number -----	30
Communication speed -----	30
Communication protocol -----	30
6.2.4 Auxiliary function setting mode 2	
Scaling high limit -----	31
Scaling low limit -----	31
Decimal point place -----	31
PV filter time constant -----	31
OUT1 high limit -----	31
OUT1 low limit -----	31
OUT1 ON/OFF hysteresis -----	32
OUT2 action mode -----	32
OUT2 high limit -----	32
OUT2 low limit -----	32
OUT2 ON/OFF hysteresis -----	32
A3 type -----	32
A4 type -----	33
A1 action Energized/De-energized -----	33
A2 action Energized/De-energized -----	33
A3 action Energized/De-energized -----	33
A4 action Energized/De-energized -----	33
A1 hysteresis -----	33
A2 hysteresis -----	33
A3 hysteresis -----	34
A4 hysteresis -----	34
A1 action delay timer -----	34
A2 action delay timer -----	34
A3 action delay timer -----	34
A4 action delay timer -----	34
External setting input high limit -----	35
External setting input low limit -----	35
Transmission output -----	35
Transmission output high limit -----	35
Transmission output low limit -----	35
Indication when control output OFF -----	35
SV rise rate -----	35
SV fall rate -----	36
Output status when input abnormal -----	36

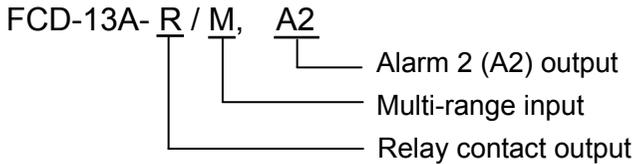
6.2.5 Program mode -----	36
Fixed value control/Program control switching -----	37
Step 1 time -----	37
Step 2 time -----	37
Step 3 time -----	37
Step 4 time -----	37
Step 5 time -----	37
Step 6 time -----	38
Step 7 time -----	38
6.2.6 Auto/Manual control switching -----	38
6.2.7 Control output OFF function -----	38
6.2.8 MV, Remaining step time indication -----	38
7. Set value memory function (SM option) -----	39
8. Operation	
8.1 When using the FCD-13A as a Temperature controller -----	40
8.2 When using the FCD-13A as a Simplified programmable controller -----	41
9. Action explanations	
9.1 OUT1 action -----	42
9.2 Heater burnout alarm action (option) -----	42
9.3 ON/OFF control -----	43
9.4 Pattern end action -----	43
9.5 OUT2 (Heating/Cooling control) action (DR, DS, DA option) -----	44
9.5.1 OUT2 (Heating/Cooling control) action -----	44
9.5.2 When setting Dead band -----	45
9.5.3 When setting Overlap band with Relay contact output -----	46
9.6 Alarm 1 (A1) to Alarm 4 (A4) action -----	47
10. Control actions	
10.1 Fuzzy self-tuning -----	49
10.2 PID -----	49
10.3 AT (auto-tuning) of this controller -----	50
11. Attached functions -----	51
12. Specifications	
12.1 Standard specifications -----	52
12.2 Optional specifications -----	56
13. Troubleshooting -----	60
14. Character table -----	62

1 Model

1.1 Model

Alphanumeric characters to represent the control output, input or options are entered where underlined.

[Example]



Standard model

F C D - 1 3 A - <input type="checkbox"/> / M <input type="checkbox"/>		Series name: FCD-13A
Control action	3	PID control *1
Alarm 1 (A1)	A	Alarm action *2
Control output (OUT1)	R	Relay contact
	S	Non-contact voltage
	A	DC current
Input	M	Multi-range input *3

*1: Fuzzy self-tuning PID, PID, PD and ON/OFF control are selectable by internal DIP switch.

*2: 12 types of alarm plus no alarm action are selectable by internal Rotary and DIP switches.

*3: 16 types of input are selectable by internal Rotary and DIP switches: Thermocouple (10 types), RTD (3 types), DC current (2 types) and DC voltage (1 type)

Optional specifications

Code	Name	
A2	Alarm 2 (A2) output (including Pattern end 2 output)	
SA	Alarm 3 (A3), Alarm 4 (A4) output	
DR	Heating/Cooling control output (OUT2)	Relay contact
DS		Non-contact voltage
DA		DC current
TA	Transmission output	DC current (4 to 20mA DC)
TV		DC voltage (0 to 1V DC)
C5	Serial communication	RS-485
C		RS-232C
SM	Set value memory number external selection	
EA	External setting	DC current (0 to 20mA DC, 4 to 20mA DC)
EV		DC voltage (0 to 1V DC, 1 to 5V DC)
W	Heater burnout alarm	Single-phase
W3		Three-phase
LA	Loop break alarm output	
P24	Insulated power output	
BK	Color: Black	
IP	Drip-proof/Dust-proof	
TC	Terminal cover	

(For options in detail, see Section "12.2 Optional specifications".)



Warning

Do not take the inner assembly out nor touch the terminal with the power supply ON.

Touching the terminal with the power switched ON may result in severe injury or death due to Electric Shock.

1.2 How to read the model label

Model labels are attached to the case and the inner assembly.

	[Model label]		[Example]
(1)	F C D - 1 3 A - R / M	→	Relay contact output, Multi-range input
(2) {	A 2	→	Alarm 2 output
	W (2 0 A)	→	Heater burnout alarm output (20A)
	MULTI RANGE		
(3)	N o .		

(1): Model

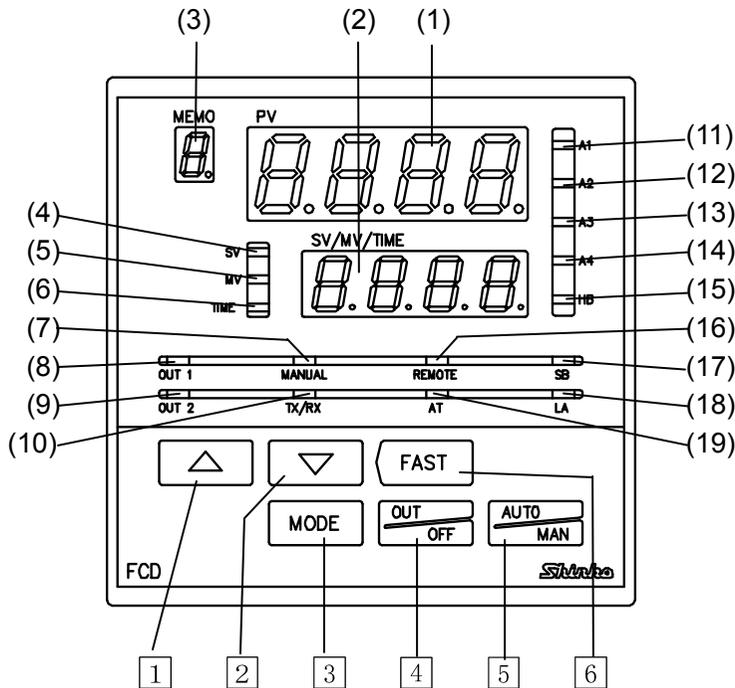
(2): Option codes

For the Heater burnout alarm, the specified current value is entered in ().

(3): Serial number

2 Name and functions of sections

2.1 Name of sections



(Fig. 2.1-1)

(1) PV display (Red)

Indicates the PV or setting characters in the setting mode.

(2) SV/MV/TIME display (Green)

Indicates the SV, MV, Time or each set value in the setting mode.

(3) MEMO display (Yellow)

Indicates the Set value memory number.

(4) SV indicator (Green)

Lights while the SV is indicated on the SV/MV/TIME display.

(5) MV indicator (Red)

Lights while the MV is indicated on the SV/MV/TIME display.

(6) TIME indicator (Yellow)

Lights while the Time is indicated on the SV/MV/TIME display.

(7) MAN indicator (Red)

Lights during Manual control.

(8) OUT1 indicator (Green)

Lights when the Control output (OUT1) is on.

(For the DC current output type, it flashes in 125ms cycles corresponding to the MV.)

(9) OUT2 indicator (Yellow) (Option)

Lights when the Control output (OUT2) is on.

(For the DC current output type, it flashes in 125ms cycles corresponding to the MV.)

(10) TX/RX indicator (Green) (Option)

Lights during Serial communication [TX (transmitting) output].

(11) A1 indicator (including Pattern end 1 output) (Red)

Lights when the Alarm 1 (A1) output or Pattern end 1 output is on.

(12) A2 indicator (including Pattern end 2 output) (Option) (Red)

Lights when the Alarm 2 (A2) output or Pattern end 2 output is on.

(13) A3 indicator (Red) (Option)

Lights when the Alarm 3 (A3) output is on.

(14) A4 indicator (Red) (Option)

Lights when the Alarm 4 (A4) output is on.

(15) HB indicator (Red) (Option)

Lights when the Heater burnout alarm output is on.

(16) REMOTE indicator (Red) (Option)

Lights during Remote action.

(17) SB indicator (Red)

Lights when Sensor is burnt out.

(18) LA indicator (Red) (Option)

Lights when the Loop break alarm output is on.

(19) AT indicator (Yellow)

Flashes during AT (auto-tuning).

2.2 Keys

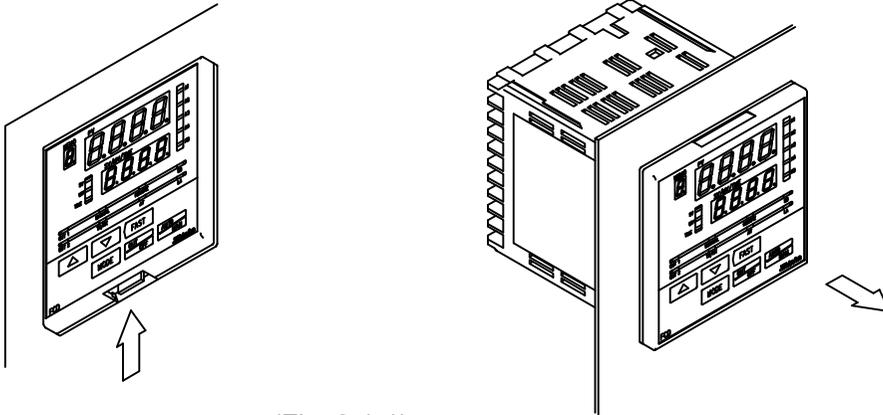
Main functions are described below, however, the keys have other functions depending on modes. Refer to Section “6.1 Operation flowchart”.

- 1  Increase Key : Increases the numeric value on the SV/MV/TIME display during setting mode.
- 2  Decrease Key : Decreases the numeric value on the SV/MV/TIME display during setting mode.
- 3  Mode Key : Switches a setting mode and registers set values. (To register each set value, press this key.)
- 4  OUT/OFF Key : Performs the control output ON or OFF. Starts/Stops the program control.
- 5  Auto/Manual Key: Switches either Automatic control or Manual control.
- 6  Fast Key : Makes the numerical value change faster by pressing the  key with the  or  key simultaneously.

3. Setup

3.1 Taking the internal assembly out

Before the power supply to this instrument is turned on, take the internal assembly out from the case in the direction indicated by the arrow by pushing the latch (bottom of the instrument) while holding the instrument by the top and bottom.



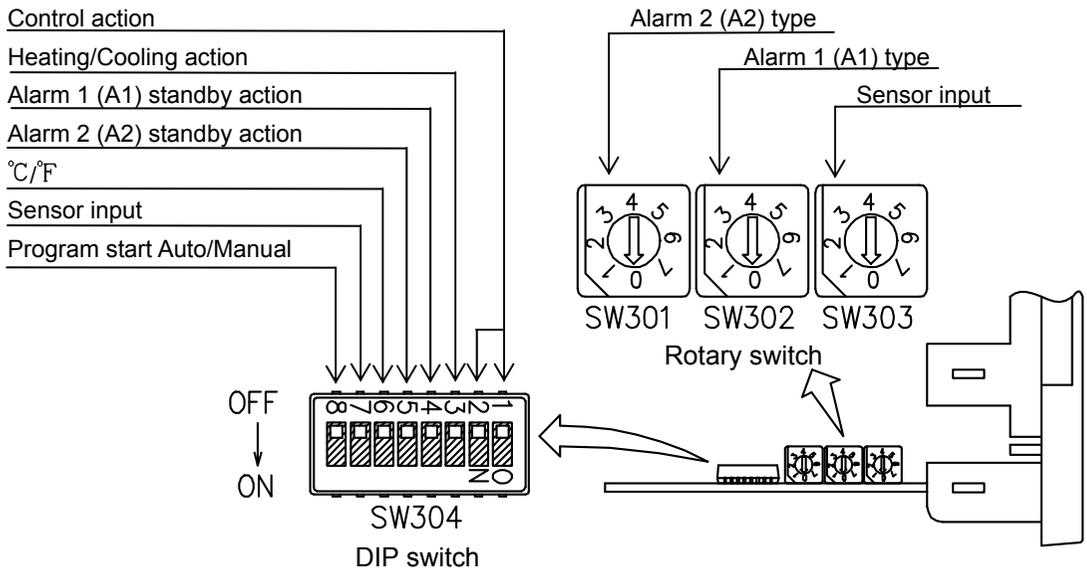
(Fig. 3.1-1)

3.2 Switch setting (multi-function)

Using a small flat blade screwdriver and tweezers, set the following with the DIP and Rotary switches.

Sensor input, Alarm 1 (A1) type, Alarm 2 (A2) type, Control action, Heating (reverse)/Cooling (direct) action, Alarm 1 (A1) and Alarm 2 (A2) standby function, Unit °C/°F and Program start Auto/Manual

Rotary switch (SW301) will be equipped only when A2 option is added.



(Fig. 3.2-1)

The following items can be selected by the DIP switch (SW304).

Default value: All switches OFF

(Table 3.2-1)

Item	DIP SW304 No.	Selection	Switch status	
			No.1: OFF	No.2: OFF
Control action	1 and 2	Fuzzy self-tuning PID control	No.1: OFF	No.2: OFF
		PID control	No.1: ON	No.2: OFF
		PD control	No.1: OFF	No.2: ON
		ON/OFF control	No.1: ON	No.2: ON
Heating/Cooling action	3	Heating (reverse) action	No.3: OFF	
		Cooling (direct) action	No.3: ON	
Alarm 1 (A1) standby action	4	No standby action	No.4: OFF	
		Standby action	No.4: ON	
Alarm 2 (A2) standby action (*1)	5	No standby action	No.5: OFF	
		Standby action	No.5: ON	
°C/°F	6	°C	No.6: OFF	
		°F	No.6: ON	
Sensor input (*2)	7	K, J, R, B, N, PL-II, Pt100, JPt100	No.7: OFF	
		S, E, T, C, 4 to 20mA, 0 to 20mA, 0 to 1V, Pt100	No.7: ON	
Program start Auto/Manual (*3)	8	Manual start	No.8: OFF	
		Automatic start	No.8: ON	

(*1): The standby function will work only when the A2 option is added.

(*2): Use the Rotary switch (SW303) and DIP switch (SW304) together for making a selection.

(*3): **Program start Auto/Manual: For program control**

Manual start : The preset program starts by pressing the  key.

Automatic start: The preset program automatically starts from Step 1 after 2 seconds of warm-up status after power-on.

Select a sensor type using the Rotary switch (SW303) and DIP switch (SW304).
 Default value: K -200 to 1370°C

Note: If the input type is changed, Scaling high/low limit, External setting input high/low limit (optional), Transmission output high/low limit (optional) will become the altered input range high/low limit value.

(Table 3.2-2)

Rotary SW303 No.	DIP SW304 No. 7	Sensor type	Scale range (DIP SW304 No.6)	
			OFF	ON
0	OFF	K	-200 to 1370°C	-320 to 2500°F
1	OFF	J	-200 to 1000°C	-320 to 1800°F
2	OFF	R	0 to 1760°C	0 to 3200°F
3	OFF	B	0 to 1820°C	0 to 3300°F
4	OFF	PL-II	0 to 1390°C	0 to 2500°F
5	OFF	N	0 to 1300°C	0 to 2300°F
6	OFF	Pt100	-199.9 to 850.0°C	-199.9 to 999.9°F
7	OFF	JPt100	-199.9 to 500.0°C	-199.9 to 900.0°F
0	ON	S	0 to 1760°C	0 to 3200°F
1	ON	E	0 to 1000°C	0 to 1800°F
2	ON	T	-199.9 to 400.0°C	-199.9 to 750.0°F
3	ON	C (W/Re5-26)	0 to 2315°C	0 to 4200°F
4	ON	4 to 20mA DC	-1999 to 9999	
5	ON	0 to 20mA DC	-1999 to 9999	
6	ON	0 to 1V DC	-1999 to 9999	
7	ON	Pt100	-200 to 850°C	-320 to 1560°F

The alarm type and the pattern end output for program control can be selected by the Rotary switch (SW302) and (SW301).

Rotary switch (SW301) will be equipped only when the A2 option is added.

Rotary SW302: Alarm 1 (A1) type or Pattern end 1 output

Rotary SW301: Alarm 2 (A2) type or Pattern end 2 output

Note: If an alarm type is changed, the alarm set value becomes 0 (0.0).

Default value: No alarm action

(Table 3.2-3)

Alarm 1 (A1) type	Rotary SW302 No.	Alarm 2 (A2) type	Rotary SW301 No.
No alarm action	0	No alarm action	0
High limit alarm	1	High limit alarm	1
Low limit alarm	2	Low limit alarm	2
High/Low limits alarm	3	High/Low limits alarm	3
High/Low limit range alarm	4	High/Low limit range alarm	4
Process high alarm	5	Process high alarm	5
Process low alarm	6	Process low alarm	6
Pattern end 1 output	7	Pattern end 2 output	7

3.3 Insertion of the internal assembly

After the setup is completed, insert the internal assembly into the case.

Firmly insert the assembly until it is locked by the latch at the bottom of the instrument.

(There will be a clicking sound.)



Caution

Do not confuse the top and bottom of the internal assembly.

If inserting the assembly into the case by force in the wrong direction, the PCB may be damaged.

4. Mounting to the control panel

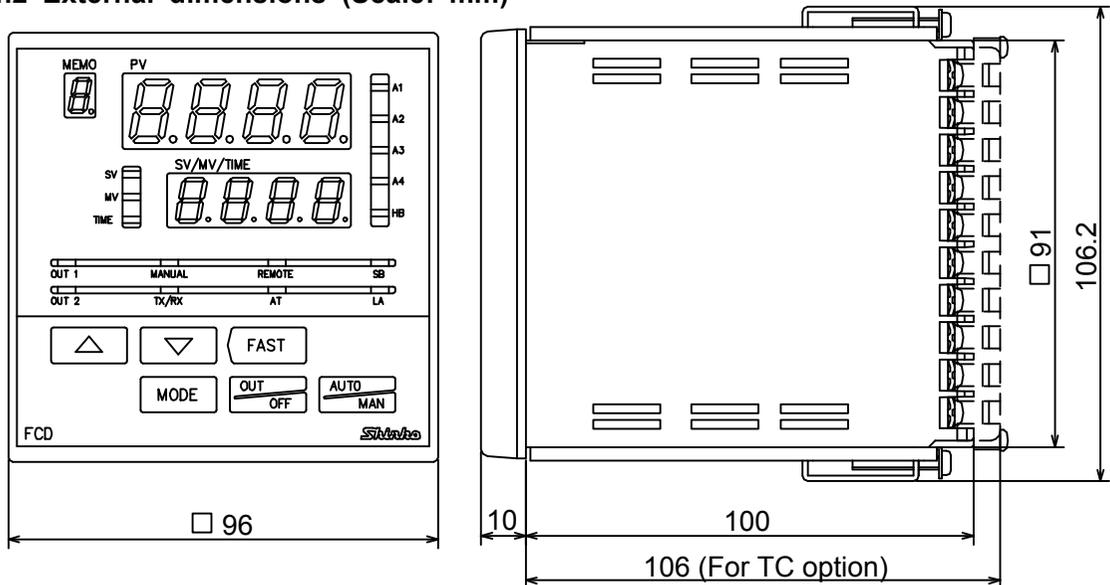
4.1 Site selection

This instrument is intended to be used under the following conditions (IEC61010-1):
 Overvoltage category II, Pollution degree 2

Ensure the mounting location corresponds to the following conditions:

- (1) A minimum of dust, and an absence of corrosive gases
- (2) No flammable, explosive gases
- (3) No mechanical vibrations or shocks
- (4) No exposure to direct sunlight, an ambient temperature of 0 to 50°C (32 to 122°F) that does not change rapidly, and no icing
- (5) An ambient non-condensing humidity of 35 to 85%RH
- (6) No large capacity electromagnetic switches or cables through which large current flows
- (7) No water, oil or chemicals or where the vapors of these substances can come into direct contact with the unit
- (8) Take note that ambient temperature of this unit must not exceed 50°C (122°F) if mounted through the face of a control panel. Otherwise the life of electronic components (especially electrolytic capacitors) may be shortened.

4.2 External dimensions (Scale: mm)

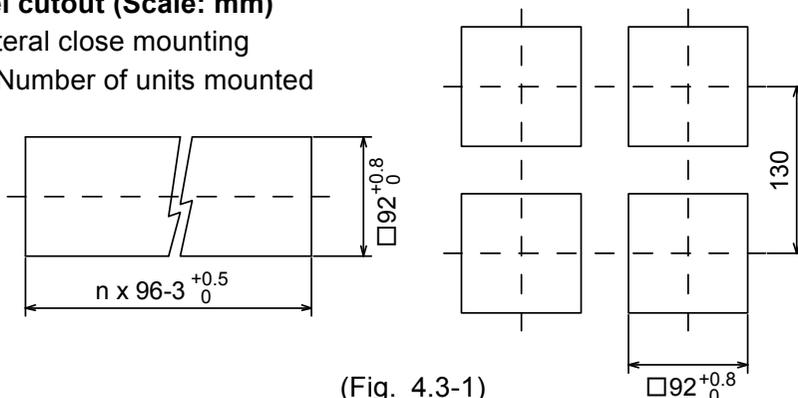


(Fig. 4.2-1)

4.3 Panel cutout (Scale: mm)

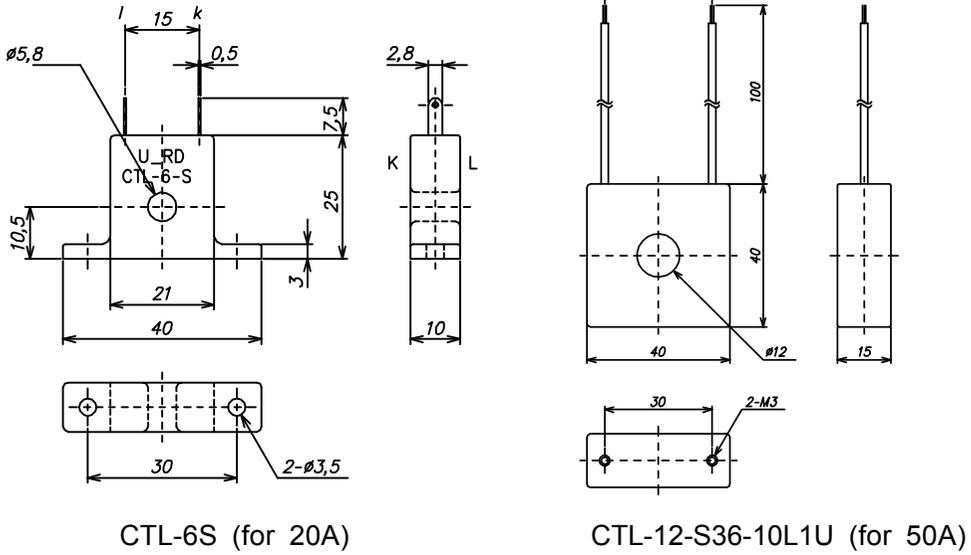
Lateral close mounting

n: Number of units mounted



(Fig. 4.3-1)

4.4 Current transformer (CT) dimensions (Scale: mm)



(Fig. 4.4-1)

4.5 Mounting

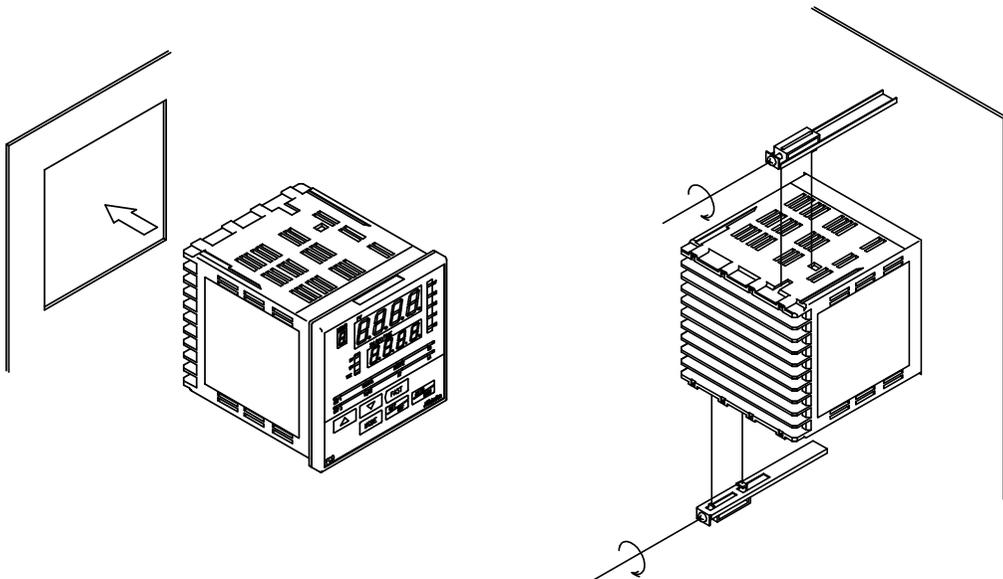
Mountable panel thickness is 1 to 8mm.

Insert the FCD-13A from the front of the panel.

Attach the mounting brackets to the slots at the top and bottom of the case, and secure the controller in place with the screws provided.

Notice

As the case is made of resin, do not use excessive force while screwing in the mounting bracket. The torque should be 0.12N·m.



(Fig. 4.5-1)

5. Wiring

Warning

Turn the power supply to the instrument off before wiring or checking.

Working or touching the terminal with the power switched on may result in severe injury or death due to Electric Shock.

Moreover, the instrument must be grounded before the power supply to the instrument is turned on.

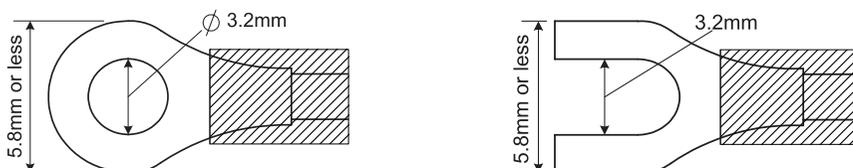
Caution

- Do not leave wire remnants in the instrument, because they could cause a fire or malfunction.
- Use a solderless terminal with an insulation sleeve in which the M3 screw fits when wiring the instrument.
- Tighten the terminal screw using the specified torque. If excessive force is applied to the screw when tightening, the terminal screw or case may be damaged.
- The terminal block of this instrument is designed to be wired from the left side. The lead wire must be inserted from the left side of the terminal, and fastened by the terminal screw.
- Do not apply a commercial power source to the sensor which is connected to the input terminal nor allow the power source to come into contact with the sensor.
- Use a thermocouple and compensating lead wire according to the sensor input specifications of this controller.
- Use a 3-wire RTD system corresponding to the input specifications of this controller.
- This controller does not have a built-in power switch, circuit breaker or fuse. Therefore, it is necessary to install them in a circuit near the external controller. (Recommended fuse: Time-lag fuse, rated voltage 250V AC, rated current 2A)
- For a 24V AC/DC power source, do not confuse polarity when using direct current (DC).
- When using a relay contact output type, use a relay according to the load capacity to protect the built-in relay contact.
- When wiring, keep input wires (thermocouple, RTD, etc.) away from AC sources or load wires.
- Use a thick wire (1.25 to 2.0mm²) for grounding.

● Lead wire solderless terminal

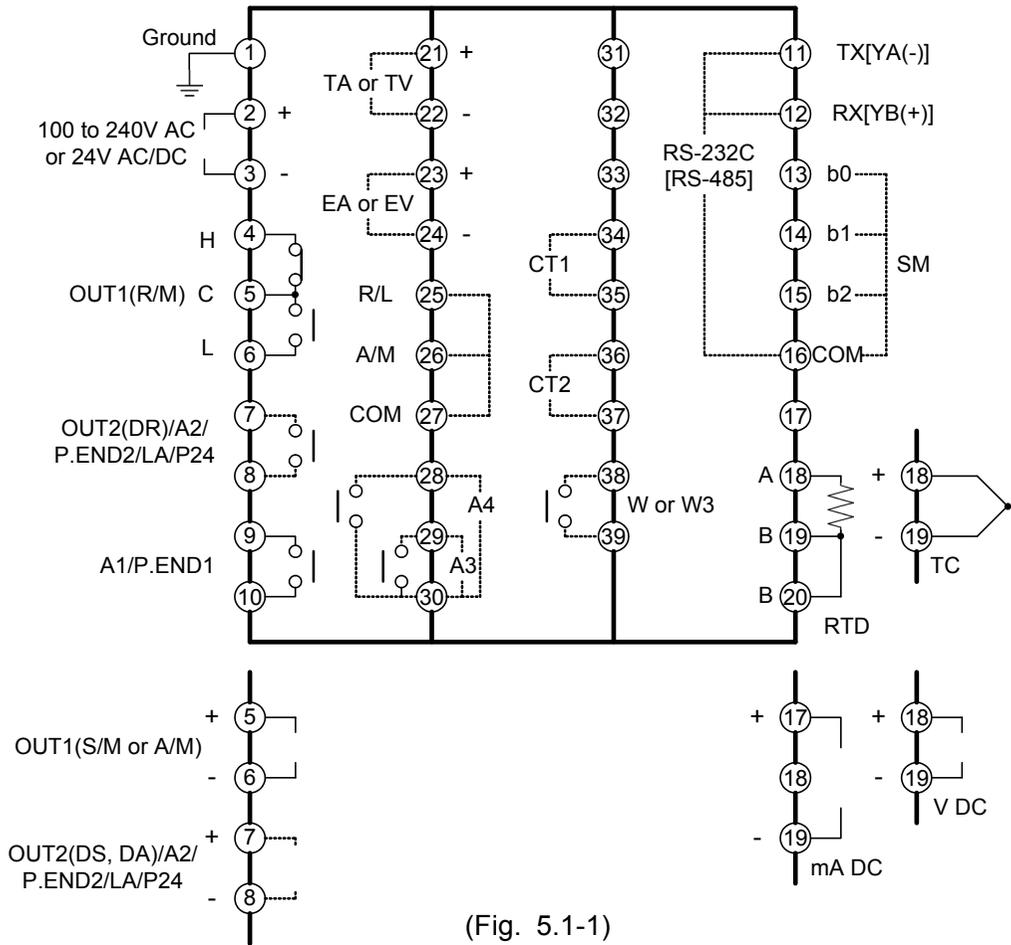
Use a solderless terminal with an insulation sleeve in which an M3 screw fits as shown below. The torque should be 0.63N•m.

Solderless terminal	Manufacturer	Model	Torque
Y type	Nichifu Terminal Industries CO.,LTD.	TMEV1.25Y-3	0.63N•m
	Japan Solderless Terminal MFG CO.,LTD.	VD1.25-B3A	
Ring type	Nichifu Terminal Industries CO.,LTD.	TMEV1.25-3	
	Japan Solderless Terminal MFG CO.,LTD.	V1.25-3	



(Fig. 5-1)

5.1 Terminal arrangement



(Fig. 5.1-1)

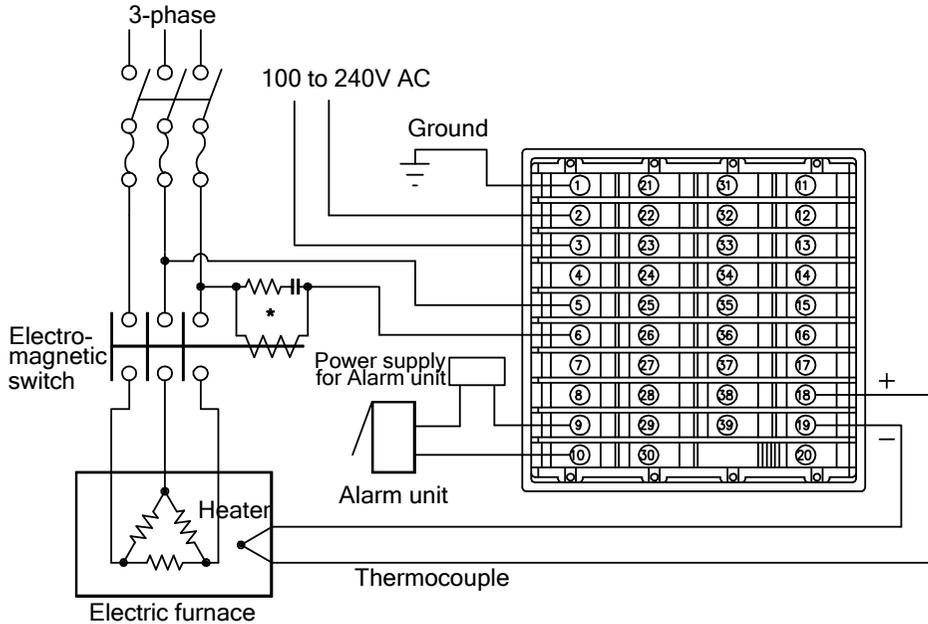
Dotted lines show options, and no terminal is equipped unless specified.

If Alarm 2 (Pattern end 2 output) and Loop break alarm are added together, they utilize common output terminals.

OUT1	Control output 1
OUT2	Control output 2
A1 to A4	Alarm 1 to Alarm 4 output
P.END1, 2	Pattern end 1, 2 output (simplified program controller function)
LA	Loop break alarm output
P24	Insulated power output
RS-232C[RS-485]	Serial communication
SM	Set value memory number external selection
TC	Thermocouple input
RTD	RTD input
DC	DC voltage, current input
TA or TV	Transmission output
EA or EV	External setting input
R/L, A/M	External operation: Remote/Local, Auto/Manual (EA, EV option should be added) (See p. 21.)
CT1, CT2	CT1 input (W, W3 option), CT2 input (W3 option)
W or W3	Heater burnout alarm output

5.2 Wiring examples

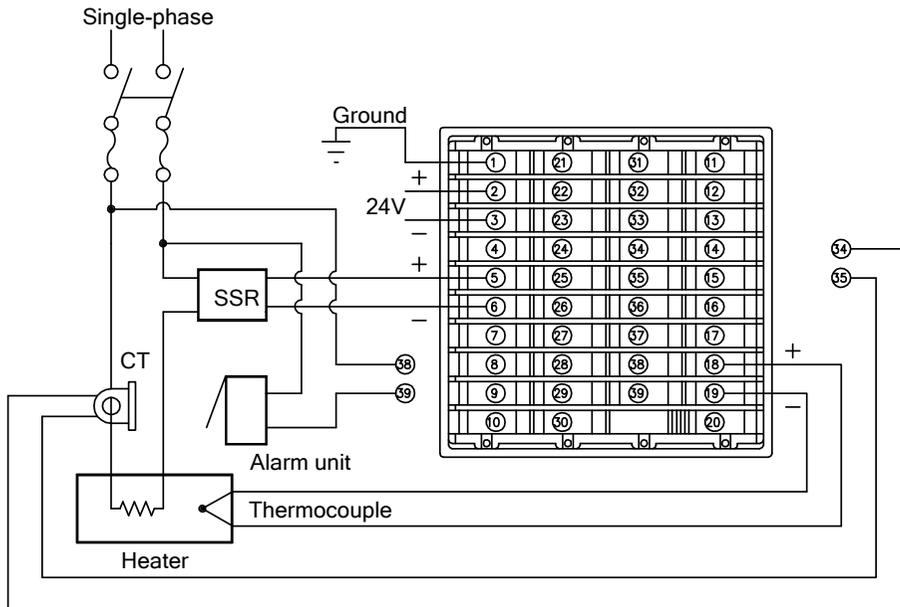
FCD-13A-R/M



* To prevent the unit from harmful effects of unexpected level noise, it is recommended that a surge absorber be installed between the electromagnetic switch coils.

(Fig. 5.2-1)

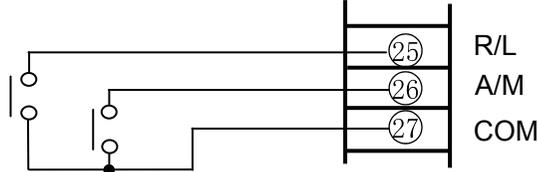
FCD-13A-S/M, W



- The connectable SSRs in parallel are 4 units if the Shinko SSRs (SA-300 series) are used.
- For a 24V AC/DC power source, do not confuse polarity when using direct current (DC).

(Fig. 5.2-2)

External operation input [Available only when External setting (EA, EV) option is added]



(Fig. 5.2-3)

Manual control : Close terminals 26 and 27.

Automatic control: Open terminals 26 and 27.

Remote setting : Close terminals 25 and 27.

Or open terminals 25 and 27, then select “Remote setting” using the keypad.

Local setting : Open terminals 25 and 27 and select “Local setting” using the keypad.

25-27 Closed: Always Remote setting (Keypad operation is invalid.)

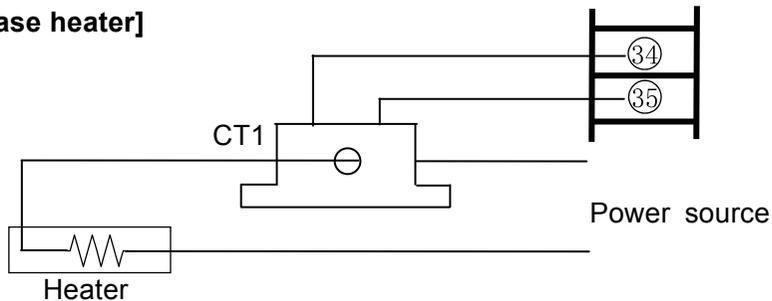
Current transformer 1, 2 (CT1, CT2) input (Option code: W, W3)

(1) This alarm is not available for detecting current under phase control.

(2) Use the current transformer (CT) provided, and pass one lead wire of the heater circuit into the hole of the CT.

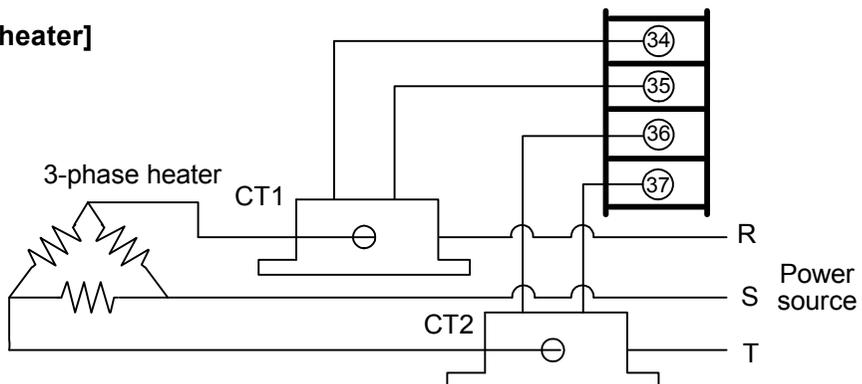
(3) When wiring, keep the CT wire away from AC sources and load wires to avoid the external interference.

[Single-phase heater]



(Fig. 5.2-4)

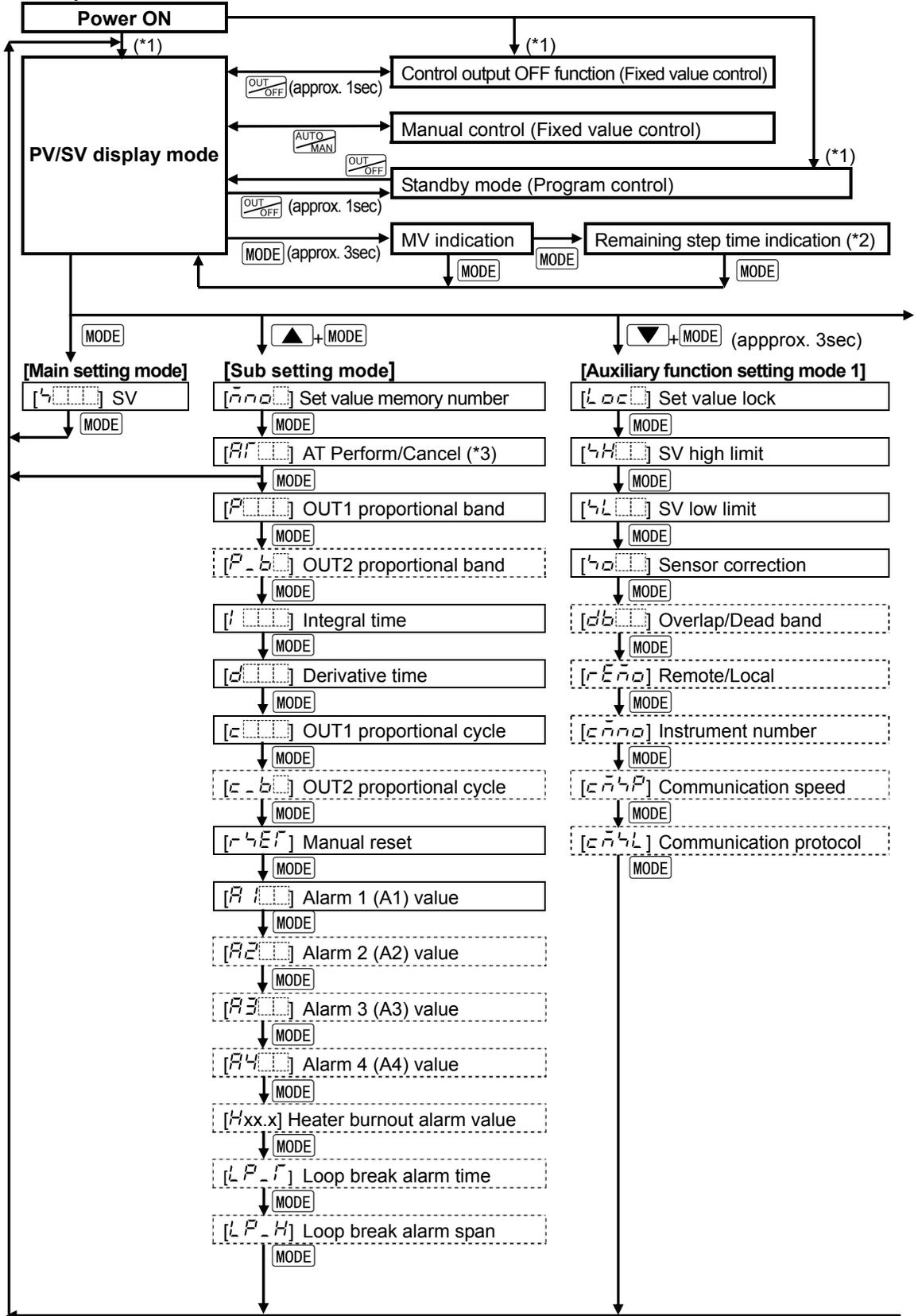
[3-phase heater]



(Fig. 5.2-5)

6. Settings

6.1 Operation flowchart



[] : Setting items with dotted lines are optional, and they appear only when the options are added.

↓ [MODE] : This means that if the [MODE] is pressed, the unit proceeds to the next setting item.

▲+[MODE] : Press the [MODE] key while holding down the ▲ key.

▼+[MODE] (approx.3sec) : Press the [MODE] key for approx. 3sec while holding down the ▼ key.

▲+▼+[MODE](approx.3sec): Press the [MODE] for approx.3 sec while holding down the ▲, ▼.

▲+▼ (approx.3sec) : Press the ▼ for 3 sec while holding down the ▲ key.

If the [MODE] is pressed for 3sec, the unit reverts to the PV/SV display mode from any mode.

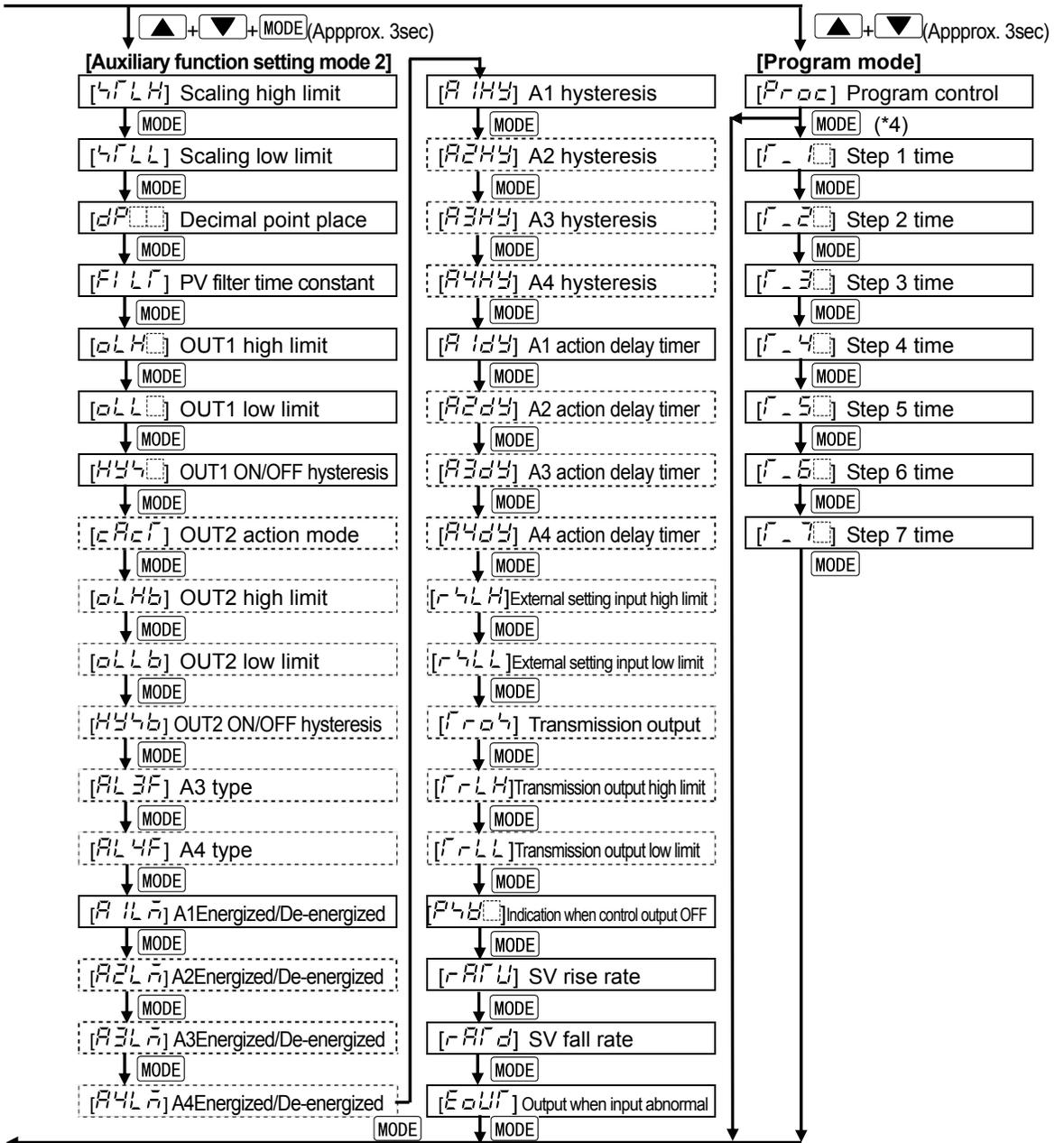
(*1): Warm-up status lasts 2sec after power-on, then starts from previous controller status (last shutdown).

(*2): Remaining step time is indicated only during program control.

(*3): If AT is performed, the unit reverts to the PV/SV display mode.

If AT is cancelled, the unit proceeds to the [OUT1 proportional band].

(*4): Select $\square FF \square$ in this mode and press the [MODE]. The unit reverts to the PV/SV display.



6.2 Settings

The PV display indicates the Sensor type selected during Sensor input selection, and the SV/MV/TIME display indicates input range high limit value or Scaling high limit value for approx. 2 seconds (warm-up status) after power-on.

See (Table 6.2-1).

During this time, all outputs and LED indicators are in OFF status.

Control will then start indicating PV on the PV display and SV on the SV/MV/TIME display.

While control output OFF function is working, the PV display indicates the item selected during "Indication when control output OFF".

(Table 6.2-1)

Input	°C		°F	
	PV display	SV/MV/TIME display	PV display	SV/MV/TIME display
K	ℓ00C	1370	ℓ00F	2500
J	ℓ00C	1000	ℓ00F	1800
R	ℓ00C	1760	ℓ00F	3200
B	ℓ00C	1820	ℓ00F	3300
PL-II	PL2C	1390	PL2F	2500
N	ℓ00C	1300	ℓ00F	2300
S	ℓ00C	1760	ℓ00F	3200
E	ℓ00C	1000	ℓ00F	1800
T	ℓ00C	4000	ℓ00F	7500
C(W/Re5-26)	ℓ00C	2315	ℓ00F	4200
Pt100	ℓ00C	8500	ℓ00F	9999
JPt100	ℓ00C	5000	ℓ00F	9000
Pt100	ℓ00C	0850	ℓ00F	1560
4 to 20mA DC	42A0	Scaling high limit value	42A0	Scaling high limit value
0 to 20mA DC	02A0		02A0	
0 to 1V DC	01A0		01A0	

Notes before key operation

- Pressing the  key for approx. 1 second from any mode enables the control output OFF function.

Once the control output OFF function is enabled, the function cannot be released even if the power to the instrument is turned OFF and ON again.

To cancel the function, press the  key again for approx. 1 second.

- If the  is pressed for 3sec, the unit reverts to the PV/SV display mode from any mode.

6.2.1 Main setting mode

In the PV/SV display mode, if the  key is pressed, the mode proceeds to the Main setting mode.

The SV can be increased or decreased using the ,  and  keys.

If the  key is pressed, the SV will be registered, and the controller will revert to the PV/SV display mode.

Character	Name, Function, Setting range	Default value
ℓ000	SV • Sets SV. • Setting range: SV low limit to SV high limit	0°C

6.2.2 Sub setting mode

In the PV/SV display mode, if the **MODE** key is pressed while holding down the **▲** key, the unit moves to the Sub setting mode.

The set value can be increased or decreased using the **▲**, **▼** and **FAST** keys. Pressing the **MODE** key registers the set value, and proceeds to the next setting item. Pressing the **MODE** key at the last setting item registers the set value, and the unit reverts to the PV/SV display mode.

Character	Name, Function, Setting range	Default value
$\bar{n}nd$	Set value memory number <ul style="list-style-type: none"> Sets the memory number (file), or selects the number (file) to be retrieved. Selection range: 1 to 7 	Memory number 1
Rf	AT Perform/Cancel <ul style="list-style-type: none"> Sets AT (Auto-tuning) Perform or Cancel. If the MODE key is pressed after selecting AT Perform, the unit reverts to the PV/SV display mode. Not available if ON/OFF or PD control is selected during Control action selection. During AT, none of the settings can be performed. If the AT is cancelled during the process, P, I, D values revert to their previous value. AT will be forced to stop if it has not been completed within 4 hours. Selection item: - - - -: AT Cancel Rf: AT Perform 	AT Cancel
P	OUT1 proportional band <ul style="list-style-type: none"> Sets OUT1 proportional band. Not available if ON/OFF control is selected during Control action selection Setting range: 0.1 to 999.9% 	2.5%
P_b	OUT2 proportional band <ul style="list-style-type: none"> Sets OUT2 proportional band. OUT2 becomes ON/OFF control when set to 0.0. Not available if Heating/Cooling control (DR, DS, DA option) is not added, or if ON/OFF control is selected during Control action selection Setting range: 0.0 to 10.0 times (Multiplying factor to OUT1 proportional band) 	1.0 times (2.5%)
i	Integral time <ul style="list-style-type: none"> Sets the integral time. Setting the value to 0 disables the function. (PD control) Not available if ON/OFF control or PD control is selected during Control action selection Setting range: 0 to 3600 seconds 	200 sec
d	Derivative time <ul style="list-style-type: none"> Sets the derivative time. Setting the value to 0 disables the function. (PI control) Not available if ON/OFF control is selected during Control action selection Setting range: 0 to 3600 seconds 	50 sec

Character	Name, Function, Setting range	Default value
c [] [] []	OUT1 proportional cycle <ul style="list-style-type: none"> • Sets OUT1 proportional cycle. • Not available for DC current output type or if ON/OFF control is selected during Control action selection • For the relay contact output type, if the proportional cycle time is decreased, the frequency of the relay action increases, and the life of the relay contact is shortened. • Setting range: 1 to 120 seconds 	R/M: 30 sec S/M: 3 sec
c - b [] []	OUT2 proportional cycle <ul style="list-style-type: none"> • Sets OUT2 proportional cycle. • Not available for DC current output type Not available if Heating/Cooling control (DR, DS, DA option) is not added, or if ON/OFF control is selected during Control action selection • For the relay contact output type, if the proportional cycle time is decreased, the frequency of the relay action increases, and the life of the relay contact is shortened. • Setting range: 1 to 120 seconds 	DR: 30sec DS: 3sec
r 4 E F	Manual reset <ul style="list-style-type: none"> • Sets the reset value to correct the offset (deviation between SV and PV in equilibrium status). • Available only when PD control is selected during Control action selection • Setting range: \pmProportional band converted value Thermocouple, RTD input: -199.9 to 999.9$^{\circ}$C DC voltage input: -1999 to 9999 (The placement of the decimal point follows the selection) How to set manual reset: When SV>PV, set the positive (+) value (SV–PV). When SV<PV, set the negative (–) value (SV–PV).	0.0 $^{\circ}$ C
R [] []	A1 value <ul style="list-style-type: none"> • Sets the action point of Alarm 1 (A1) output. • Setting the value to 0 or 0.0 disables the function (except Process high and Process low alarm). • Not available if Rotary switch is set to No.0 or No.7 • Setting range: Refer to (Table 6.2.2-1). 	0 $^{\circ}$ C
R2 [] []	A2 value <ul style="list-style-type: none"> • Sets the action point of Alarm 2 (A2) output. • Setting the value to 0 or 0.0 disables the function (except Process high and Process low alarm). • Not available if A2 output (option) is not added or if Rotary switch is set to No.0 or No.7 during A2 type selection even if A2 option is added. • Setting range: Refer to (Table 6.2.2-1). 	0 $^{\circ}$ C

Character	Name, Function, Setting range	Default value
A3□□	A3 value <ul style="list-style-type: none"> • Sets the action point of Alarm 3 (A3) output. • Setting the value to 0 or 0.0 disables the function (except Process high and Process low alarm). • Not available if SA option (A3, A4 output) is not added, or if [- - -] is selected during Alarm 3 type selection even if SA option is added. • Setting range: Refer to (Table 6.2.2-1). 	0°C
A4□□	A4 value <ul style="list-style-type: none"> • Sets the action point of Alarm 4 (A4) output. • Setting the value to 0 or 0.0 disables the function (except Process high and Process low alarm). • Not available if SA option (A3, A4 output) is not added, or if [- - -] is selected during Alarm 4 type selection even if SA option is added. • Setting range: Refer to (Table 6.2.2-1). 	0°C
H _{xx.x} (xx.x: Heater current value)	Heater burnout alarm value <ul style="list-style-type: none"> • Sets the heater current value for Heater burnout alarm. • Setting the value to 0.0 disables the function. • Available only when Heater burnout alarm (W, W3 option) is added • It is recommended to set approx. 80% of the heater current value (set value) considering the voltage fluctuation. • Upon returning to set limits, the alarm will stop. • Setting range: Rated current 20A: 0.0 to 20.0A (Indication: 0.0 to 50.0) Rated current 50A: 0.0 to 50.0A 	0.0A
LP_F	Loop break alarm time <ul style="list-style-type: none"> • Sets the time to assess the Loop break alarm. • Available only when Loop break alarm (LA option) is added • Setting range: 0 to 200 minutes 	0 min
LP_H	Loop break alarm span <ul style="list-style-type: none"> • Sets the span to assess the Loop break alarm. • Available only when Loop break alarm (LA option) is added • Setting range: Thermocouple, RTD without decimal point: 0 to 150°C Thermocouple, RTD with decimal point: 0.0 to 150.0°C DC input: 0 to 1500 (The placement of the decimal point follows the selection.) 	0°C

[Loop break alarm]

The alarm will be activated when the PV does not **rise** as much as the span or more within the time it takes to assess the loop break alarm after the MV has reached 100% or the output high limit value.

The alarm will also be activated when the PV does not **fall** as much value as the span or more within the time it takes to assess loop break alarm after the MV has reached 0% or the output low limit value.

When the control action is Direct (Cooling), read “**fall**” for “**rise**” and vice versa.

[A1, A2, A3 and A4 setting range]

Alarms with the standby function have the same setting range.

(Table 6.2.2-1)

Alarm type	Setting range
High limit alarm	–Input span to Input span °C(°F) *1
Low limit alarm	–Input span to Input span °C(°F) *1
High/Low limits alarm	0 to Input span °C(°F) *1
High/Low limit range alarm	0 to Input span °C(°F) *1
Process high alarm	Input range low limit to Input range high limit *2
Process low alarm	Input range low limit to Input range high limit *2

- For RTD input, the negative low limit value is –199.9.
- For DC input, the negative low limit value is –1999.
(The placement of the decimal point follows the selection.)

*1: For DC input, the Input span is the same as the Scaling span.

*2: For DC input, Input range low (or high) limit value is the same as the Scaling low (or high) limit value.

6.2.3 Auxiliary function setting mode 1

In the PV/SV display mode, if the **MODE** key is pressed for approx. 3 seconds while holding down the **▼** key, the unit proceeds to Auxiliary function setting mode 1. The set value can be increased or decreased by pressing the **▲**, **▼** and **FAST** keys.

Pressing the **MODE** key registers the set value and proceeds to the next setting item. If the **MODE** key is pressed at the last setting item, the set value will be registered and the unit will revert to the PV/SV display mode.

Character	Name, Function, Setting range	Default value
Loc□	<p>Set value lock</p> <ul style="list-style-type: none"> • Locks the set value to prevent setting errors. The setting item to be locked differs depending on the selection. • When selecting Lock, set the necessary items in the status Unlock, then select Lock 1, Lock 2 or Lock 3. • Fuzzy self-tuning or AT will not function if [Lc□] or [Lc2□] is selected. • Be sure to select Lock 3 when changing the set value frequently via communication function considering the life of non-volatile memory. • Selection item: <ul style="list-style-type: none"> ---- (Unlock): All set values can be changed. Lc□ (Lock 1): None of set values can be changed. Lc2□ (Lock 2): Only SV can be changed. Lc3□ (Lock 3): All set values can be changed temporarily. However, changed values revert to their previous value after power-off because they are not saved in the non-volatile memory. <p>Since this function has no relation to the memory life, it is well suited when using with Shinko programmable controllers (with SVTC option).</p>	Unlock

Character	Name, Function, Setting range	Default value
	<p>[About Lock 3]</p> <p>When using the FCD-13A as a Fixed value controller The set values of the selected Set value memory number can be changed temporarily. However, if the memory number is changed, the changed values of the previous number are cancelled and returns to the previous values.</p> <p>When using the FCD-13A as a Programmable controller The set values of the currently performing step number can temporarily be changed. However, if the step number is changed, the changed set values are cancelled and return to the previous values. During program standby status, set value changes will be invalidated. (Operation starts with stored values in the memory.)</p>	
4H□□	<p>SV high limit</p> <ul style="list-style-type: none"> • Sets SV high limit within the Scaling low limit value / Scaling high limit value range. • Setting range: SV low limit to Scaling high limit value (For DC input, the placement of the decimal point follows the selection.) 	400°C
4L□□	<p>SV low limit</p> <ul style="list-style-type: none"> • Sets SV low limit within the Scaling low limit value / Scaling high limit value range. • Setting range: Scaling low limit value to SV high limit (For DC input, the placement of the decimal point follows the selection.) 	0°C
40□□	<p>Sensor correction</p> <ul style="list-style-type: none"> • Sets the sensor correction value. • Setting range: -100.0 to 100.0°C (°F) <p>[Sensor correction function] This 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. When controlling with plural controllers, sometimes the measured temperatures (input value) do not concur due to difference in sensor accuracy or dispersion of load capacities. In such a case, the control can be set at the desired temperature by adjusting the input value of sensors. However, it is effective within the input rated range regardless of the sensor correction value. PV after sensor correction= Current PV+ (Sensor correction value)</p>	0.0°C
db□□	<p>Overlap/Dead band</p> <ul style="list-style-type: none"> • Sets the Overlap or Dead band for OUT1 and OUT2. • + Set value: Dead band – Set value: Overlap band • Not available if Heating/Cooling control (DR, DS, DA option) is not added, or if ON/OFF control is selected during Control action selection • Setting range: ±OUT1 proportional band converted value Thermocouple, RTD : -199.9 to 999.9 °C(°F) DC voltage, current : -1999 to 9999 (The placement of the decimal point follows the selection.) 	0.0°C

Character	Name, Function, Setting range	Default value
rEñø	Remote/Local setting <ul style="list-style-type: none"> SV can be set with either Remote or Local method. Available only when External setting (EA, EV option) is added. Selection item: <ul style="list-style-type: none"> LøçL: Local setting. The SV can be set by the front keypad as usual. rEñø: Remote setting. The SV can be set in analog by external remote operation. 	Local setting
cññø	Instrument number <ul style="list-style-type: none"> Sets the instrument number of this unit. (The instrument number should be set individually when communicating by connecting plural instruments in serial communication, otherwise communication is impossible.) Available only when the Serial communication (C, C5 option) is added Setting range: 0 to 95 	0
cñ4P	Communication speed <ul style="list-style-type: none"> Selects the communication speed of this instrument. (The communication speed of this instrument must be equal to that of host computer, otherwise communication is impossible.) Available only when the Serial communication (C, C5 option) is added Selection item: <ul style="list-style-type: none"> <input type="checkbox"/> 24 (2400bps) <input type="checkbox"/> 48 (4800bps) <input type="checkbox"/> 96 (9600bps) <input type="checkbox"/> 192 (19200bps) 	9600bps
cñ4L	Communication protocol <ul style="list-style-type: none"> Selects the communication protocol of this instrument. Available only when the Serial communication (C, C5 option) is applied Selection item: <ul style="list-style-type: none"> ñøñL (Shinko protocol) ñødP (Modbus ASCII mode) 	Shinko protocol

6.2.4 Auxiliary function setting mode 2

In the PV/SV display mode, if the **MODE** key is pressed for approx. 3 seconds while holding down the **▲** and **▼** keys, the unit will proceed to Auxiliary function setting mode 2.

The set value can be increased or decreased using the **▲**, **▼** and **FAST** keys. Pressing the **MODE** key registers the set value, and proceeds to the next setting item.

If the **MODE** key is pressed at the last setting item, the set value will be registered and the unit will revert to the PV/SV display mode.

Character	Name, Function, Setting range	Default value
4FLH	Scaling high limit <ul style="list-style-type: none"> Sets scaling high limit value. If scaling high limit value is changed, SV high limit also alters to the scaling high limit value. Setting range: Scaling low limit to Input range high limit value 	1370°C
4FL	Scaling low limit <ul style="list-style-type: none"> Sets scaling low limit value. If scaling low limit value is changed, SV low limit also alters to the scaling low limit value. Setting range: Input range low limit to scaling high limit value 	-200°C
dP□□	Decimal point place <ul style="list-style-type: none"> Selects the decimal point place. Not available if RTD or thermocouple is selected during Sensor input selection Selection item: <ul style="list-style-type: none"> □□ . (No decimal point) □□ □ (1 digit after the decimal point) □□ □□ (2 digits after the decimal point) □□ □□□ (3 digits after the decimal point) 	No decimal point
FILF	PV filter time constant <ul style="list-style-type: none"> Sets PV filter time constant. However, if the set value is set too large, it affects control result due to the delay of response. Setting range: 0.0 to 10.0 sec 	0.0 sec
oLH□	OUT1 high limit <ul style="list-style-type: none"> Sets the high limit value for OUT1. Not available if ON/OFF control is selected during Control action selection Setting range: OUT1 low limit value to 100% (DC current output: OUT1 low limit value to 105%) 	100%
oLL□	OUT1 low limit <ul style="list-style-type: none"> Sets low limit value for OUT1. Not available if ON/OFF control is selected during Control action selection Setting range: 0% to OUT1 high limit value (DC current output: -5% to OUT1 high limit value) 	0%

Character	Name, Function, Setting range	Default value
<i>HY4</i>	OUT1 ON/OFF hysteresis <ul style="list-style-type: none"> • Sets ON/OFF hysteresis for OUT1. • Available only when ON/OFF control is selected during Control action selection • Setting range: 0.1 to 100.0°C(°F) 	1.0°C
<i>cAct</i>	OUT2 action mode <ul style="list-style-type: none"> • Selects OUT2 action from a choice of: Air cooling, oil cooling and water cooling. • Available only when Heating/Cooling control (DR, DS, DA option) is added • Selection item: <ul style="list-style-type: none"> <i>ALr</i> (Air cooling, linear characteristic) <i>oLL</i> (Oil cooling, 1.5th power of the linear characteristic) <i>wAF</i> (Water cooling, 2nd power of the linear characteristic) 	Air cooling
<i>oLHb</i>	OUT2 high limit <ul style="list-style-type: none"> • Sets the high limit value for OUT2. • Not available if Heating/Cooling control (DR, DS, DA option) is not added, or if OUT2 is ON/OFF control • Setting range: OUT2 low limit value to 100% (DC current output: OUT2 low limit value to 105%) 	100%
<i>oLLb</i>	OUT2 low limit <ul style="list-style-type: none"> • Sets the low limit value for OUT2. • Not available if Heating/Cooling control (DR, DS, DA option) is not added, or if OUT2 is ON/OFF control • Setting range: 0% to OUT2 high limit value (DC current output: -5% to OUT2 high limit value) 	0%
<i>HY4b</i>	OUT2 ON/OFF hysteresis <ul style="list-style-type: none"> • Sets ON/OFF hysteresis for OUT2. • Not available if Heating/Cooling control (DR, DS, DA option) is not added, or if OUT2 is PID or PD control • Setting range: 0.1 to 100.0°C(°F) 	1.0°C
<i>AL3F</i>	A3 type <ul style="list-style-type: none"> • Selects an Alarm 3 (A3) type. Note: If an alarm type is changed, the alarm set value becomes 0(0.0). • Available only when SA option (A3, A4 output) is added • Default: No alarm action • Selection item <ul style="list-style-type: none"> ----: No alarm action <i>H</i> : High limit alarm <i>H</i> : High limit alarm with standby <i>L</i> : Low limit alarm <i>L</i> : Low limit alarm with standby <i>HL</i> : High/Low limits alarm <i>HL</i> : High/Low limits alarm with standby <i>ul d</i> : High/Low limit range alarm <i>ul du</i> : High/Low limit range alarm with standby <i>A4</i> : Process high alarm <i>A4</i> : Process high alarm with standby <i>rA4</i> : Process low alarm <i>rA4</i> : Process low alarm with standby 	No alarm action

Character	Name, Function, Setting range	Default value
<i>RL4F</i>	A4 type <ul style="list-style-type: none"> Selects an Alarm 4 (A4) type. <p>Note: If an alarm type is changed, the alarm set value becomes 0 (0.0).</p> <ul style="list-style-type: none"> Available only when SA option (A3, A4 output) is added Selection items are the same as those of Alarm 3 (A3) type selection. 	No alarm action
<i>RLA</i>	A1 action Energized/De-energized <ul style="list-style-type: none"> Selects A1 action Energized/De-energized. Not available if Rotary switch is set to No.0 or No.7 during A1 type selection. Selection item: <input type="checkbox"/> <i>non</i> (Energized) <input type="checkbox"/> <i>EB</i> (De-energized) 	Energized
<i>RA2A</i>	A2 action Energized/De-energized <ul style="list-style-type: none"> Selects A2 action Energized/De-energized. Not available if A2 option is not added or if Rotary switch is set to No.0 or No.7 during A2 type selection even if A2 option is added Selection items are the same as those of A1 action Energized/De-energized selection. 	Energized
<i>RA3A</i>	A3 action Energized/De-energized <ul style="list-style-type: none"> Selects A3 action Energized/De-energized. Not available if SA option (A3, A4 output) is not added, or if [- - -] is selected during Alarm 3 type selection even if SA option is added Selection items are the same as those of A1 action Energized/De-energized selection. 	Energized
<i>RA4A</i>	A4 action Energized/De-energized <ul style="list-style-type: none"> Selects A4 action Energized/De-energized. Not available if SA option (A3, A4 output) is not added, or if [- - -] is selected during Alarm 4 type selection even if SA option is added Selection items are the same as those of A1 action Energized/De-energized selection. 	Energized
<i>RA1H</i>	A1 hysteresis <ul style="list-style-type: none"> Sets A1 hysteresis. Not available if Rotary switch is set to No.0 or No.7 during A1 type selection Setting range: Thermocouple, RTD input: 0.1 to 100.0°C DC input: 1 to 1000 (The placement of the decimal point follows the selection.) 	1.0°C
<i>RA2H</i>	A2 hysteresis <ul style="list-style-type: none"> Sets A2 hysteresis. Not available if A2 option is not added Not available if Rotary switch is set to No.0 or No.7 during A2 type selection even if A2 option is added Setting range: The same as those of the A1 hysteresis setting. 	1.0°C

Character	Name, Function, Setting range	Default value
<i>R3H4</i>	A3 hysteresis <ul style="list-style-type: none"> • Sets A3 hysteresis. • Not available if SA option (A3, A4 output) is not added, or if [- - -] is selected during Alarm 3 type selection even if SA option is added • Setting range: The same as those of the A1 hysteresis setting. 	1.0°C
<i>R4H4</i>	A4 hysteresis <ul style="list-style-type: none"> • Sets A4 hysteresis. • Not available if SA option (A3, A4 output) is not added, or if [- - -] is selected during Alarm 4 type selection even if SA option is added • Setting range: The same as those of the A1 hysteresis setting. 	1.0°C
<i>R1d4</i>	A1 action delay timer <ul style="list-style-type: none"> • Sets A1 action delay timer. When setting time has elapsed after the input enters the alarm output range, the alarm is activated. • Not available if the Rotary switch is set to No.0 or No.7 during A1 type selection. • Setting range: 0 to 9999 seconds 	0 sec
<i>R2d4</i>	A2 action delay timer <ul style="list-style-type: none"> • Sets A2 action delay timer. When setting time has elapsed after the input enters the alarm output range, the alarm is activated. • Not available if A2 option is not added or if the Rotary switch is set to No.0 or No.7 during A2 type selection even if A2 option is added. • Setting range: The same as that of A1 action delay timer setting 	0 sec
<i>R3d4</i>	A3 action delay timer <ul style="list-style-type: none"> • Sets A3 action delay timer. When setting time has elapsed after the input enters the alarm output range, the alarm is activated. • Not available if SA option (A3, A4 output) is not added, or if [- - -] is selected during Alarm 3 type selection even if SA option is added • Setting range: The same as that of A1 action delay timer setting 	0 sec
<i>R4d4</i>	A4 action delay timer <ul style="list-style-type: none"> • Sets A4 action delay timer. When setting time has elapsed after the input enters the alarm output range, the alarm is activated. • Not available if SA option (A3, A4 output) is not added, or if [- - -] is selected during Alarm 4 type selection even if SA option is added • Setting range: The same as that of A1 action delay timer setting 	0 sec

Character	Name, Function, Setting range	Default value
<i>r4LH</i>	External setting input high limit <ul style="list-style-type: none"> • Sets External setting input high limit value. For EA option (4 to 20mA), the value corresponds to 20mA input. • Available only when External setting (EA, EV option) is added • Setting range: External setting input low limit to Input range high limit value 	400°C
<i>r4LL</i>	External setting input low limit <ul style="list-style-type: none"> • Sets External setting input low limit value. For EA option (4 to 20mA), the value corresponds to 4mA input. • Available only when External setting (EA, EV option) is added • Setting range: Input range low limit to External setting input high limit value 	0°C
<i>r004</i>	Transmission output <ul style="list-style-type: none"> • Selects a Transmission output type. • Available only when Transmission output (TA, TV option) is added • Selection item: <i>Pb</i><input type="checkbox"/>: PV transmission <i>4b</i><input type="checkbox"/>: SV transmission <i>nb</i><input type="checkbox"/>: MV transmission 	PV transmission
<i>r7LH</i>	Transmission output high limit <ul style="list-style-type: none"> • Sets the Transmission output high limit value. For TA option, the value corresponds to 20mA output. • Available only when Transmission output (TA, TV option) is added • Setting range: Transmission output low limit to Input range high limit value 	400°C
<i>r7LL</i>	Transmission output low limit <ul style="list-style-type: none"> • Sets the Transmission output low limit value. For TA option, the value corresponds to 4mA output. • Available only when Transmission output (TA, TV option) is added • Setting range: Input range low limit to Transmission output high limit value 	0°C
<i>P4b</i> <input type="checkbox"/>	Indication when control output OFF <ul style="list-style-type: none"> • Selects the indication when the control output is OFF. • Selection item: <i>oFF</i><input type="checkbox"/>: OFF is indicated on the PV display. <i>RoFF</i>: No indication <i>Pb</i><input type="checkbox"/>: Only PV is indicated. 	OFF is indicated on the PV display.
<i>rRrU</i>	SV rise rate <ul style="list-style-type: none"> • Sets the SV rise rate (Rising value per minute). Setting the value to 0 or 0.0 disables the function. • Setting range: 0 to 9999°C/min. With a decimal point: 0.0 to 999.9°C/min. DC input: 0 to 9999 (The placement of the decimal point follows the selection.) 	0°C/minute

Character	Name, Function, Setting range	Default value
rAfd	SV fall rate <ul style="list-style-type: none"> • Sets the SV fall rate (Falling value per minute). Setting the value to 0 or 0.0 disables the function. • Setting range: 0 to 9999°C/min. With a decimal point: 0.0 to 999.9°C/min. DC input: 0 to 9999 (The placement of the decimal point follows the selection.) 	0°C/minute
Eouf	Output status when input abnormal <ul style="list-style-type: none"> • Selects control output status when DC input is in overscale or underscale. • Available only for DC input • Selection item: <ul style="list-style-type: none"> - OFF : Outputs OFF(4mA) or OUT1(OUT2) low limit value. - ON : Outputs a value between OFF(4mA) and ON(20mA) or between OUT1(OUT2) low limit value and OUT1(OUT2) high limit value, depending on a deviation. 	Outputs OFF(4mA) or OUT1(OUT2) low limit value.

Alarm 1 to 4 Energized/De-energized function

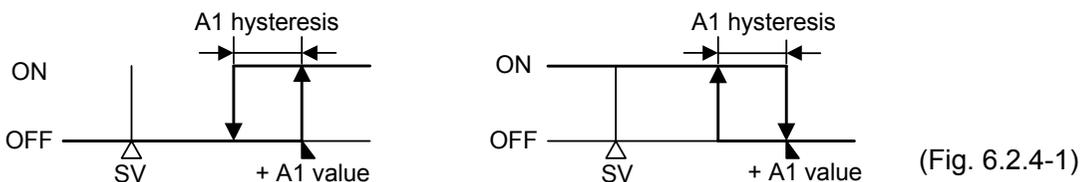
[If the alarm action Energized is selected]

When the alarm output indicator is lit, the alarm output (terminals 7-8, 9-10, 28-30, 29-30) is conducted (ON). When the alarm output indicator is unlit, the alarm output is not conducted (OFF).

[If the alarm action De-energized is selected]

When the alarm output indicator is lit, the alarm output (terminals 7-8, 9-10, 28-30, 29-30) is not conducted (OFF). When the alarm output indicator is unlit, the alarm output is conducted (ON).

High limit alarm (when Energized is set) High limit alarm (when De-energized is set)



A1: Alarm 1. For A2 (A3, A4), read "A2 (A3, A4)" for "A1".

6.2.5 Program mode

In PV/SV display mode, if the key is pressed for approximately 3 seconds while holding down the key, the units moves to the Program mode.

The , and keys increase or decrease the set values (numeric value).

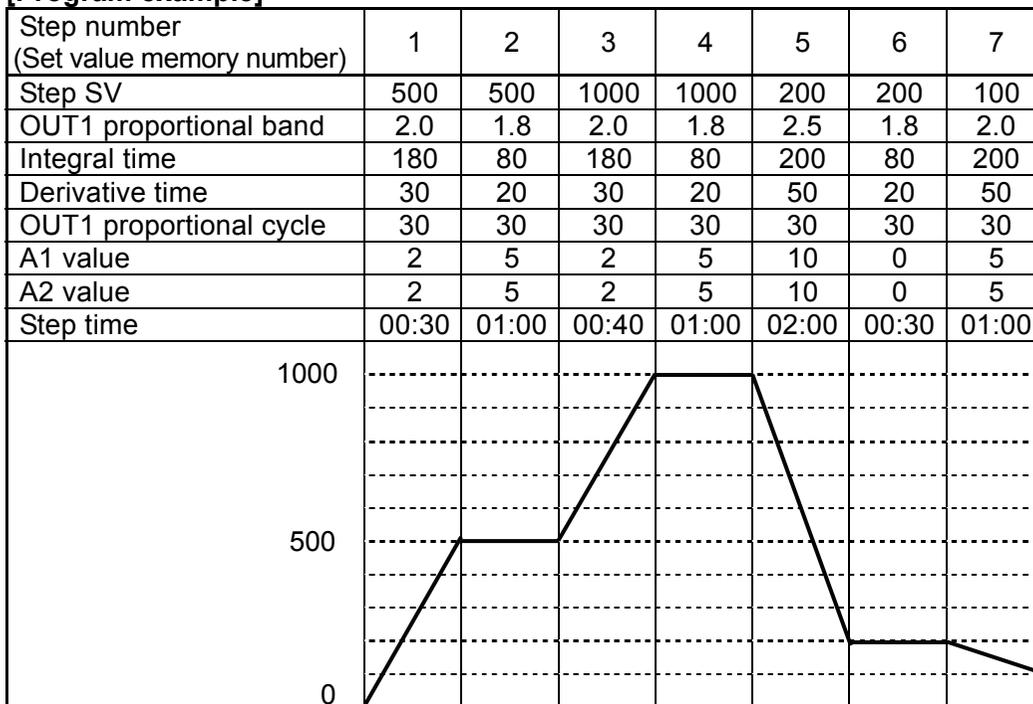
Pressing the key registers the set value, and proceeds to the next setting item.

If the key is pressed at the last setting item, the set value is registered, and the unit reverts to the PV/SV display mode.

- Each set value of Set value memory numbers (1 to 7) set during the Fixed value control are assigned to the values for Steps 1 to 7 respectively.
For example, values of Set value memory number 1 become Step 1 values, and values of Set value memory number 2 become Step 2 values.
- If the Pattern end output is selected and the program control is performed, the Pattern end output is turned on when the program is completed.
- If the key is pressed while the Pattern end output is on, the Pattern end output is turned off. If the key is pressed again, the program will be performed.

- The following shows the program pattern example.
Set the step time to 00.00 for any unnecessary steps.

[Program example]



Character	Name, Function, Setting range	Default value
<i>P_{roc}</i>	Fixed value control/Program control switching <ul style="list-style-type: none"> Fixed value control or program control can be selected. If the [MODE] key is pressed after selecting the fixed value control, the controller reverts to the PV/SV display mode. If the [MODE] key is pressed after selecting the program control, step time from Step 1 to Step 7 can be set. Selection item: <i>OFF</i>: Fixed value control <i>P_{roc}</i>: Program control 	Fixed value control
<i>r_1</i>	Step 1 time <ul style="list-style-type: none"> Sets Step 1 time. (Available only for program control) (e.g.) When setting 1 hour 58 minutes, set as [<i>1 58</i>]. Setting range: 00.00 to 99.59 	00.00
<i>r_2</i>	Step 2 time <ul style="list-style-type: none"> Sets Step 2 time. (Available only for program control) Setting range: 00.00 to 99.59 	00.00
<i>r_3</i>	Step 3 time <ul style="list-style-type: none"> Sets Step 3 time. (Available only for program control) Setting range: 00.00 to 99.59 	00.00
<i>r_4</i>	Step 4 time <ul style="list-style-type: none"> Sets Step 4 time. (Available only for program control) Setting range: 00.00 to 99.59 	00.00
<i>r_5</i>	Step 5 time <ul style="list-style-type: none"> Sets Step 5 time. (Available only for program control) Setting range: 00.00 to 99.59 	00.00

Character	Name, Function, Setting range	Default value
	Step 6 time <ul style="list-style-type: none"> • Sets Step 6 time. (Available only for program control) • Setting range: 00.00 to 99.59 	00.00
	Step 7 time <ul style="list-style-type: none"> • Sets Step 7 time. (Available only for program control) • Setting range: 00.00 to 99.59 	00.00

6.2.6 Auto/Manual control switching

MV can be changed manually.

As a proportional action, the MV is automatically outputted in proportion to the deviation. This is called an automatic control.

In comparison with the above, in the manual control, the value set by front keypad can be outputted regardless of the deviation.

If control action is switched from automatic to manual and vice versa, balanceless-bumpless function works to prevent sudden change of MV.

Each time the  key is pressed, the control switches from Automatic to Manual and vice versa.

- Setting range: OUT1 low limit to OUT1 high limit value
When Heating/ Cooling control (DR, DS, DA option) is added: OUT2 low limit to OUT1 high limit value

6.2.7 Control output OFF function

- A function to pause the control action or turn the control output of the unused instrument of the plural units OFF even if the power to the instrument is supplied.
- Pressing the  key for approx. 1 second from any mode enables the control output OFF function. The PV display indicates the one selected during [Indication when control output OFF].

To cancel the function, press the  key again for approx. 1 second.

- Once the control output OFF function is enabled, the function cannot be released even if the power to the instrument is turned OFF and ON again.

To cancel the function, press the  key again for approx. 1 second.

- During program control, the  key becomes the Program Start/Stop key, and the control output OFF function is disabled.

6.2.8 MV, Remaining step time indication

MV indication

In the PV/SV display mode, press the  key for approx. 3 seconds.

Keep pressing the  key until the MV appears, though the SV setting mode appears during the process.

(MV indicator lights. The SV/MV/TIME display indicates output MV. The 2nd decimal point from the right on the SV/MV/TIME display flashes.)

For the fixed value control, when the  key is pressed again, the unit reverts to the PV/SV display.

Remaining step time indication

For the program control, if the  key is pressed while in MV indication, remaining step time will be indicated on the SV/MV/TIME display. The TIME indicator lights. By pressing the  key again, the unit reverts to the PV/SV display mode.

7. Set value memory function (SM option)

If the SM option (Set value memory number external selection) is added, a maximum of 7 files (14 pieces of data per one file) of data can be memorized. Control can be performed by selecting the desired file.

One file comprises 14 kinds of set value:

SV, OUT1 proportional band, Integral time, Derivative time, OUT2 proportional band, Alarm values (A1 to A4), Overlap/Dead band, OUT1 high limit value, OUT1 low limit value, OUT2 high limit value, OUT2 low limit value

To select the set value memory number (file number), connect terminals 13 to 16 as shown below (Table 7-1).

Up to 50 units of the FCD-13A can be connected in parallel.

Terminal connection for Set value memory number selection (Table 7-1)

Set value memory No. / Connecting terminals	1	2	3	4	5	6	7
13 - 16 (b0-COM)	–	O	–	O	–	O	–
14 - 16 (b1-COM)	O	–	–	O	O	–	–
15 - 16 (b2-COM)	O	O	O	–	–	–	–

–: Closed O: Open

- If the Set value memory number is selected externally, the number cannot be selected by front keypad.
- To select the memory number by front keypad, all terminals (b0, b1, b2 and COM) should be open.
- Set value memory number cannot be changed during setting mode or AT.

Operation procedures for Set value memory function

- (1) In the PV/SV display mode, select a set value memory number by connecting terminals.
- (2) In the setting mode, set each value:
SV, OUT1 proportional band, Integral time, Derivative time, OUT2 proportional band, Alarm values (A1 to A4), Overlap/Dead band, OUT1 high limit value, OUT1 low limit value, OUT2 high limit value, OUT2 low limit value.
- (3) After settings are complete, press the **MODE** key to revert to the PV/SV display mode.

Registration

- Each set value is registered in the file of which number is indicated on the MEMO display.
- When any number is retrieved by connecting terminals, the selected number is indicated, and the control is performed using data (set values) of the indicated file number.
- To change set values, repeat the Operation procedures above.

8 Operation

After the controller is mounted to the control panel and wiring is completed, operate the unit following the procedures below.

8.1 When using the FCD-13A as a Temperature controller

(1) Turn the power supply to the FCD-13A ON.

For approx. 2sec after power-on, the sensor characters and the temperature unit selected during Sensor input selection will be indicated on the PV display, and input range high limit value or Scaling high limit value will be indicated on the SV/MV/TIME display. See (Table 8.1-1).

During this time, all outputs and LED indicators are in OFF status.

After that, control starts indicating PV on the PV display and SV on the SV/MV/TIME display.

When the Control output OFF function is working, the item selected during the [Indication when control output OFF] mode is indicated on the PV display.

(Table 8.1-1)

Input	°C		°F	
	PV display	SV/MV/TIME display	PV display	SV/MV/TIME display
K	600C	1370	600F	2500
J	700C	1000	700F	1800
R	700C	1760	700F	3200
B	600C	1820	600F	3300
PL-II	PL2C	1390	PL2F	2500
N	700C	1300	700F	2300
S	400C	1760	400F	3200
E	800C	1000	800F	1800
T	700C	4000	700F	7500
C(W/Re5-26)	200C	2315	200F	4200
Pt100	PT0C	8500	PT0F	9999
JPt100	JPTC	5000	JPTF	9000
Pt100	PT0C	0850	PT0F	1560
4 to 20mA DC	42A0	Scaling high limit value	42A0	Scaling high limit value
0 to 20mA DC	02A0		02A0	
0 to 1V DC	01V0		01V0	

(2) Input each set value.

Refer to Section "6. Settings".

When controlling by Fuzzy self-tuning PID action, select "Perform" during the "AT Perform/Cancel" mode to start control in optimal conditions.

(3) Turn the load circuit power ON.

Control action starts so as to keep the control target at the SV (desired value).

8.2 When using the FCD-13A as a Simplified programmable controller

(1) Turn the power supply to the FCD-13A ON.

For approx. 2sec after power-on, the sensor type and the temperature unit selected during the Sensor input selection are indicated on the PV display, and input range high limit value or scaling high limit value is indicated on the SV/MV/TIME display. See (Table 8.1-1).

During this time, all outputs and LED indicators are in OFF status.

After that, the unit enters the PV/SV display mode.

When the Control output OFF function is working, the item selected during the [indication when control output OFF] mode is indicated on the PV display.

(2) Input each set value and step time

Refer to Section "6. Settings".

The PV display indicates the PV, and the unit enters Standby mode.

(3) Turn the load circuit power ON.

(4) Program control start

If "Automatic start" is selected during Program start Auto/Manual selection, the unit will switch to warm-up status for approx. 2 seconds after power-on, then program control automatically starts from Step 1.

If "Manual start" is selected during Program start Auto/Manual selection, the unit will switch to warm-up status for approx. 2 seconds after power-on, then it proceeds to standby status. In this status, if the  key is pressed, the program control starts from Step 1.

During program control (RUN), the Step number (Set value memory number) change is not effective.

To make the step time progress faster

The step time progress becomes 60 times faster than usual when the  key is pressed.

To terminate the program control during the process

The program control will be terminated if the  key is pressed for approx. 1 second or longer.

To switch the indication of MV and Remaining step time

In the PV/SV display, if the  key is pressed for approximately 3 seconds, the MV (manipulated variable) is indicated. If the  key is pressed again, the remaining step time will be indicated.

Instrument status when power is restored

When power is restored during program control, the FCD-13A resumes program performance from where it stopped.

The PV flashes until the power failure step finishes.

9 Action explanations

9.1 OUT1 action

	Heating (reverse) action	Cooling (direct) action
Control action		
R/□	<p>Cycle action is performed according to deviation.</p>	<p>Cycle action is performed according to deviation.</p>
S/□	<p>Cycle action is performed according to deviation.</p>	<p>Cycle action is performed according to deviation.</p>
A/□	<p>Changes continuously according to deviation.</p>	<p>Changes continuously according to deviation.</p>
Indicator (OUT1) Green		

: Acts ON (lit) or OFF (unlit).

9.2 Heater burnout alarm action (option)

Heater burnout alarm action	
Heater burnout alarm output	
Indicator (HB) Red	

9.3 ON/OFF control

	Heating (reverse) action		Cooling (direct) action	
Control action				
R/□				
S/□	+ (5) 12V DC - (6)	+ (5) 0V DC - (6)	+ (5) 0V DC - (6)	+ (5) 12V DC - (6)
A/□	+ (5) 20mA DC - (6)	+ (5) 4mA DC - (6)	+ (5) 4mA DC - (6)	+ (5) 20mA DC - (6)
Indicator (OUT1) Green				

: Acts ON (lit) or OFF (unlit).

9.4 Pattern end action

Pattern end action	
Pattern end output	
Indicator (A1) Red	

Pattern end output is turned ON when the program control is completed, and it is released when the key is pressed.

Use terminals 7 and 8 for Pattern end 2 output.

The A2 indicator lights when Pattern end 2 output is ON.

9.5 OUT2 (Heating/Cooling control) action (DR, DS, DA option)

9.5.1 OUT2 (Heating/Cooling control) action

Control action			
R/□	<p>Cycle action is performed according to deviation.</p>		
DR	<p>Cycle action is performed according to deviation.</p>		
S/□	<p>Cycle action is performed according to deviation.</p>		
DS	<p>Cycle action is performed according to deviation.</p>		
A/□	<p>Changes continuously according to deviation.</p>		
DA	<p>Changes continuously according to deviation.</p>		
Indicator (OUT1) Green	<p>Lit Unlit</p>		
Indicator (OUT2) Yellow	<p>Unlit Lit</p>		

: Acts ON (lit) or OFF (unlit).

————— : Represents Heating control action.

- - - - - : Represents Cooling control action.

9.5.2 When setting Dead band

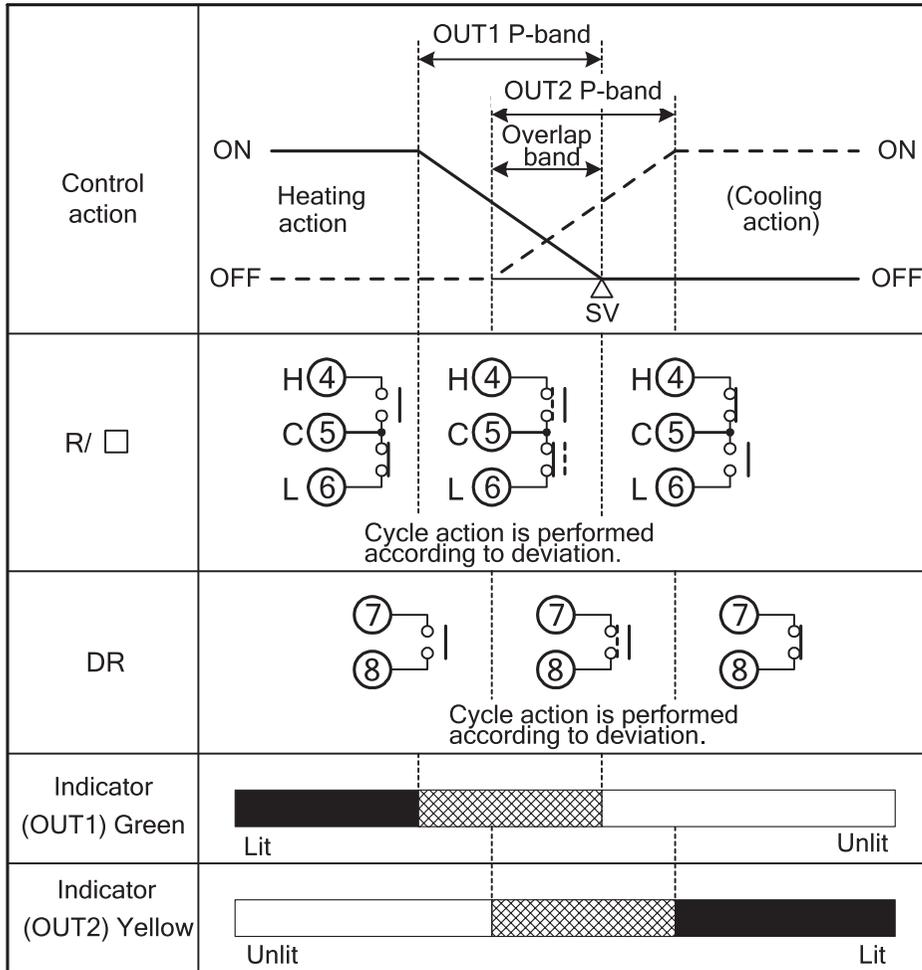
Control action	<p>ON ——— Heating action ———> ON (Cooling action) ———> ON</p> <p>OFF - - - - -> OFF</p> <p>OUT1 P-band Dead band (OUT2 P-band)</p> <p>SV</p>		
R/ □	<p>H(4) C(5) L(6)</p> <p>Cycle action is performed according to deviation.</p>		
DR	<p>7 8</p> <p>Cycle action is performed according to deviation.</p>		
S/ □	<p>+ (5) 12V DC - (6)</p> <p>+ (5) 12/0V DC - (6)</p> <p>+ (5) 0V DC - (6)</p> <p>Cycle action is performed according to deviation.</p>		
DS	<p>+ (7) 0V DC - (8)</p> <p>+ (7) 0/12V DC - (8)</p> <p>+ (7) 12V DC - (8)</p> <p>Cycle action is performed according to deviation.</p>		
A/ □	<p>+ (5) 20mA DC - (6)</p> <p>+ (5) 20 to 4mA DC - (6)</p> <p>+ (5) 4mA DC - (6)</p> <p>Changes continuously according to deviation.</p>		
DA	<p>+ (7) 4mA DC - (8)</p> <p>+ (7) 4 to 20mA DC - (8)</p> <p>+ (7) 20mA DC - (8)</p> <p>Changes continuously according to deviation.</p>		
Indicator (OUT1) Green	<p>Lit Unlit Unlit</p>		
Indicator (OUT2) Yellow	<p>Unlit Unlit Lit</p>		

: Acts ON (lit) or OFF (unlit).

————— : Represents Heating control action.

- - - - - : Represents Cooling control action.

9.5.3 When setting Overlap band with Relay contact output.



: Acts ON (lit) or OFF (unlit).

———— : Represents Heating control action.

----- : Represents Cooling control action.

9.6 Alarm 1 (A1) to Alarm 4 (A4) action

	High limit alarm	Low limit alarm
Alarm action	<p>ON</p> <p>OFF</p> <p>-A1 value SV +A1 value</p> <p>A1 hysteresis</p>	<p>ON</p> <p>OFF</p> <p>-A1 value SV +A1 value</p> <p>A1 hysteresis</p>
Alarm output	<p>+side </p> <p>-side </p>	<p>+side </p> <p>-side </p>
	High/Low limits alarm	High/Low limit range alarm
Alarm action	<p>ON</p> <p>OFF</p> <p>A1 value SV A1 value</p> <p>A1 hysteresis</p>	<p>ON</p> <p>OFF</p> <p>A1 value SV A1 value</p> <p>A1 hysteresis</p>
Alarm output		
	Process high alarm	Process low alarm
Alarm action	<p>ON</p> <p>OFF</p> <p>A1 value</p> <p>A1 hysteresis</p>	<p>ON</p> <p>OFF</p> <p>A1 value</p> <p>A1 hysteresis</p>
Alarm output		
	High limit alarm with standby	Low limit alarm with standby
Alarm action	<p>ON</p> <p>OFF</p> <p>-A1 value SV +A1 value</p> <p>A1 hysteresis</p>	<p>ON</p> <p>OFF</p> <p>-A1 value SV +A1 value</p> <p>A1 hysteresis</p>
Alarm output	<p>+side </p> <p>-side </p>	<p>+side </p> <p>-side </p>

	High/Low limits alarm with standby	High/Low limit range alarm with standby
Alarm action		
Alarm output		
	Process high alarm with standby	Process low alarm with standby
Alarm action		
Alarm output		

- : A1 output terminals 9 and 10 are connected.
- : A1 output terminals 9 and 10 are connected or disconnected.
- : A1 output terminals 9 and 10 are disconnected.
- : Standby functions.

A2 output terminals: 7 and 8
A3 output terminals: 29 and 30
A4 output terminals: 28 and 30

A1, A2, A3 and A4 indicators light when their output terminals are connected, and go off when their output terminals are disconnected.

For A2 (A3, A4), read "A2 (A3, A4)" for "A1".

10 Control actions

10.1 Fuzzy self-tuning

Fuzzy self-tuning is a function to perform a fine adjustment of PID values automatically.

Stable control can be carried out even if the conditions of the production process are changed due to various external factors (types and rates of production).

- (1) When using the controller for the first time, perform the AT (auto-tuning) or set the proper PID values by keypad operation.
- (2) When the control initiates, the controller performs this function by the PID values previously adjusted.
- (3) When the control result is disordered by disturbance or a change in the process, the controller checks the convergence status, and performs a fine adjustment of PID values if required.
 - (a) If the convergence is performed smoothly, the PID values are not changed.
 - (b) If the convergent speed is slow, the controller corrects the PID values to accelerate the convergence.
 - (c) When overshoot is generated during the convergence, the controller corrects the PID values to correct overshoot.
 - (d) When hunting occurs, the controller checks its waveform and performs a fine adjustment of PID values.

The instrument is constantly in self-tuning status, and when deviation occurs, the tuning starts. Even in Fuzzy self-tuning status, when very large hunting occurs and the control is not stabilized, AT automatically starts.

When the AT "Perform" is selected by the keypad, AT initiates, and when the control is stabilized, the AT is released and the controller returns to self-tuning status.

When lock mode [L C] or [L C] is selected, Fuzzy self-tuning or AT does not work.

With a control system in which load fluctuation periodically occurs, the Fuzzy self-tuning PID control may malfunction.

In such a case, use the controller with the PID control.

10.2 PID

(1) Proportional band (P)

Proportional action is the action which the control output varies in proportion to the deviation between the SV (desired value) and the processing temperature (PV).

If the proportional band is narrowed, even if the output changes by a slight variation of the processing temperature, better control results can be obtained as the offset decreases.

However, if the proportional band is narrowed too much, even slight disturbances may cause variation in the processing temperature, and control action changes to ON/OFF action and the so-called hunting phenomenon occurs. Therefore, when the processing temperature comes to the balanced position near the SV 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 used to eliminate offset. When the integral time is shortened, the returning speed to the setting point is accelerated. However, the cycle of oscillation is also accelerated and control becomes unstable.

(3) Derivative time (D)

Derivative action is used to restore the change in the processing temperature according to the rate-of-change. It reduces the amplitude of overshoot and undershoot width.

If the derivative time is shortened, the restoring value becomes small, and if the derivative time is extended, an excessive returning phenomenon may occur and the control system may oscillate.

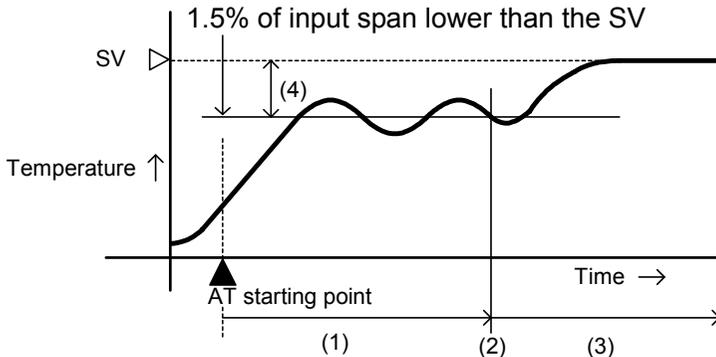
10.3 AT (auto-tuning) of this controller

In order to set each value of P, I and D automatically, AT process should be made to fluctuate to obtain an optimal value.

Sometimes the AT process will not fluctuate if AT is performed at or near room temperature. Therefore AT might not finish normally.

(A) In the case of a large difference between the SV and PV as the temperature is rising

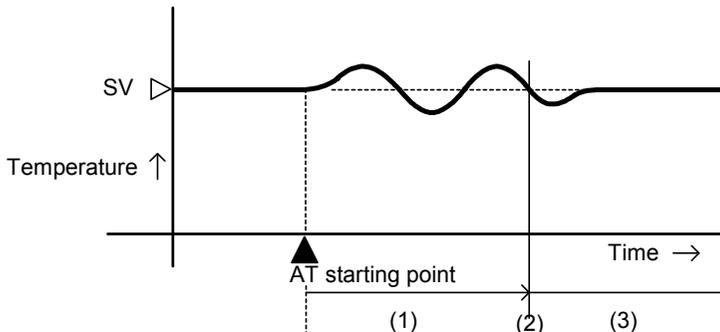
The AT process will fluctuate at the temperature 1.5% of input span lower than the SV. (DC input: 1.5% of scaling span)



(Fig. 10.3-1)

(B) When the control is stable or when PV is within $SV \pm (1.5\% \text{ of input span})$.

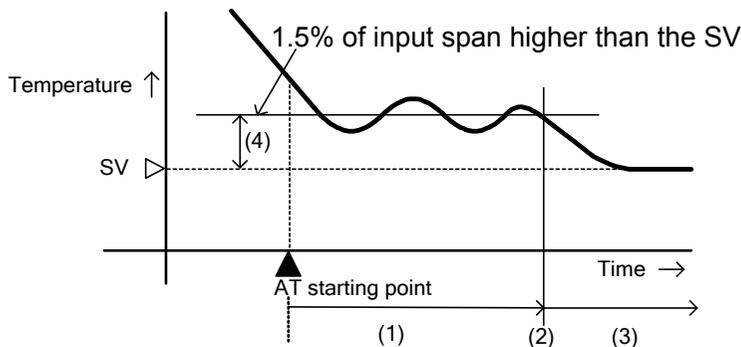
The AT process will fluctuate around the SV. (DC input: 1.5% of scaling span)



(Fig. 10.3-2)

(C) When the PV is 1.5% of input span higher than the SV

The AT process will fluctuate at the temperature 1.5% of input span higher than the SV. (DC input: 1.5% of scaling span)



(Fig. 10.3-3)

11 Attached functions

(1) Burnout

When the thermocouple or RTD input is burnt out, OUT1 and OUT2 are turned off (for DC current output type, OUT1, OUT2 low limit value), and the PV display flashes “- - - -”. For manual control, the preset manipulated variable (MV) is outputted.

When DC input is disconnected, PV display flashes “- - - -” for 4 to 20mA DC input, and “- - - -” for 0 to 1V DC input.

For 0 to 20mA DC, the PV display indicates the value corresponding with 0mA input.

(2) Input abnormality indication

Output status when input abnormal (*1)	Contents and indication	Output status			
		OUT1		OUT2	
		Direct action	Reverse action	Direct action	Reverse action
 -OFF	Overscale Measured value has exceeded indication range high limit value. “- - - -” flashes.	ON (20mA) or OUT1 high limit value (*2)	OFF(4mA) or OUT1 low limit value	OFF(4mA) or OUT2 low limit value	ON(20mA) or OUT2 high limit value (*2)
OFF (4mA) or OUT1 low limit value		OFF(4mA) or OUT2 low limit value			
 -OFF	Underscale Measured value has dropped below indication range low limit value. “- - - -” flashes.	OFF (4mA) or OUT1 low limit value	ON (20mA) or OUT1 high limit value(*2)	ON (20mA) or OUT2 high limit value(*2)	OFF(4mA) or OUT2 low limit value
OFF(4mA) or OUT1 low limit value			OFF(4mA) or OUT2 low limit value		

(*1) This is available only for DC input.

For manual control, the preset MV is outputted.

(*2) Outputs a value between OFF (4mA) and ON (20mA) or between OUT1 (or OUT2) low limit value and OUT1 (or OUT2) high limit value, depending on deviation.

TC, RTD inputs

Input	Input range	Indication range	Control range
T	-199.9 to 400.0°C	-199.9 to 405.0°C	-205.0 to 405.0°C
	-199.9 to 750.0°F	-199.9 to 759.0°F	-209.0 to 759.0°F
Pt100	-199.9 to 850.0°C	-199.9 to 860.0°C	-210.0 to 860.0°C
	-200 to 850°C	-210 to 860°C	-210 to 860°C
	-199.9 to 999.9°F	-199.9 to 999.9°F	-211.0 to 1010.9°F
	-320 to 1560°F	-338 to 1578°F	-338 to 1578°F
JPt100	-199.9 to 500.0°C	-199.9 to 506.0°C	-206.0 to 506.0°C
	-199.9 to 900.0°F	-199.9 to 910.9°F	-211.0 to 910.9°F

Indication range and Control range for thermocouple inputs other than the above:
 [Input range low limit value – Input span x 1%] to [Input range high limit value + Input span x 1%]

• DC input

Indication range : [Scaling low limit value – Scaling span x 1%] to [Scaling high limit value + Scaling span x 10%]

However, if the input value is out of the range –1999 to 9999, the PV display flashes “- - - -” or “- - - -”.

Control range : [Scaling low limit value – Scaling span x 1%] to [Scaling high limit value + Scaling span x 10%]

(3) Self-diagnosis

The CPU is monitored by a watchdog timer, and when an abnormal status is found on the CPU, the controller is switched to warm-up status.

(4) Automatic cold junction temperature compensation (Thermocouple input type)

This detects the temperature at the connecting terminal between the thermocouple and the instrument, and always maintains it at the same status as if the reference junction location temperature was at 0°C (32°F).

(5) Warm-up indication

For approximately 2sec after power-on, the input type and the temperature unit are indicated on the PV display, and the input range high limit value (for DC input, scaling high limit value) is indicated on the SV/MV/TIME display.

(6) SV ramp function

When the SV is adjusted, it approaches the new SV by the preset rate-of-change.

When the power is turned on, the control starts from the PV and approaches the SV by the rate-of-change.

For the program control, this function will not work.

12 Specifications

12.1 Standard specifications

Mounting : Flush

Setting : Input system using membrane sheet key

Display

PV display : Red LED, 4 digits, character size, 14.3(H) x 8(W)mm

SV/MV/TIME display: Green LED, 4 digits, character size, 10(H) x 5.5(W)mm

MEMO display (Set value memory number):

Yellow LED, 1 digit, character size, 8(H) x 4(W)mm

Accuracy (Indication, setting)

Thermocouple : Within $\pm 0.2\%$ of each input span ± 1 digit

K, J, T input, range less than 0°C (32°F):

Within $\pm 0.4\%$ of each input span ± 1 digit

R, S input, range 0 to 200°C (0 to 400°F): Within $\pm 4^\circ\text{C}$ (8°F)

B input, range 0 to 300°C (0 to 600°F): Accuracy is not guaranteed.

RTD : Within $\pm 0.2\%$ of each input span ± 1 digit

DC current : Within $\pm 0.2\%$ of each input span ± 1 digit

DC voltage : Within $\pm 0.2\%$ of each input span ± 1 digit

Input sampling period : 125ms

(When EA/EV or W/W3 option is added: 500ms)

Input

Thermocouple : K, J, R, S, B, E, T, N, PL-II, C (W/Re5-26)

External resistance, 100Ω or less

In case of input burnout, Overscale

RTD : Pt100, JPt100, 3-wire system

Allowable input lead wire resistance: 10Ω or less per wire

In case of input burnout, Overscale

DC current : 0 to 20mA DC, 4 to 20mA DC

Input impedance, 50Ω

Allowable input current, 100mA or less

In case of input disconnection:

0 to 20mA: The same as 0mA

4 to 20mA: Underscale

DC voltage : 0 to 1V DC

Input impedance, 1MΩ or more

Allowable input voltage, 5V or less

Allowable signal source resistance, 2kΩ or less

In case of input disconnection, Overscale

OUT1 (Control output 1)

Relay contact : 1a1b
Control capacity,
3A 250V AC (resistive load)
1A 250V AC (inductive load $\cos\phi=0.4$)
Electrical life: 100,000 cycles
Non-contact voltage : For SSR drive
12₀⁺²V DC maximum 40mA DC (short circuit protected)
DC current : 4 to 20mA DC (Isolated type)
Load resistance, maximum 550Ω

Alarm 1 output

The alarm action point is set by the \pm deviation from the SV (except Process alarm).
[When the alarm action is set as Energized]

When the input goes outside the range, the output turns ON or OFF (in the case of High/Low limit range alarm).

[When the alarm action is set as De-energized]

The output acts conversely.

One alarm can be selected by Rotary switch and DIP switch from 13 types of alarm, plus Pattern end output: High limit alarm, Low limit alarm, High/Low limits alarm, High/Low limit range alarm, Process high alarm and Process low alarm, the standby function which is applied to them respectively, as well as No alarm and Pattern end output.

Setting accuracy : The same as Indication accuracy

Action : ON/OFF action

Hysteresis : Thermocouple, RTD input: 0.1 to 100.0°C (°F)
DC input: 1 to 1000 (The placement of the decimal point follows the selection.)

Output : Relay contact 1a
Control capacity, 3A 250V AC (resistive load)
1A 250V AC (inductive load $\cos\phi =0.4$)
Electrical life: 100,000 cycles

Controlling action

The fuzzy self-tuning PID, PID, PD or ON/OFF control is selectable by DIP switch.

Fuzzy self-tuning PID control

Proportional band (P) : Automatic
Integral time (I) : Automatic
Derivative time (D) : Automatic
Anti-reset windup (ARW) : Automatic
Proportional cycle : 1 to 120 sec
Output high/low limit : 0 to 100% (DC current output: -5 to 105%)

PID control (with AT function)

Proportional band (P) : 0.1 to 999.9%
Integral time (I) : 0 to 3600 sec (off when set to 0)
Derivative time (D) : 0 to 3600 sec (off when set to 0)
Anti-reset windup (ARW) : Automatic
Proportional cycle : 1 to 120 sec
Output high/low limit : 0 to 100% (DC current output, -5 to 105%)

PD control

Proportional band (P) : 0.1 to 999.9%
 Derivative time (D) : 0 to 3600sec (off when set to 0)
 Proportional cycle : 1 to 120sec
 Reset : ±Proportional band converted value
 Thermocouple, RTD input: -199.9 to 999.9°C (°F)
 DC input: -1999 to 9999 (The placement of the decimal point follows the selection.)

Output high/low limit : 0 to 100% (DC current output: -5 to 105%)

ON/OFF control

Hysteresis : Thermocouple, RTD input: 0.1 to 100.0°C (°F)
 DC input: 1 to 1000 (The placement of the decimal point follows the selection.)

Supply voltage

: 100 to 240V AC, 50/60Hz, 24V AC/DC, 50/60Hz

Allowable voltage fluctuation

: 100 to 240V AC : 85 to 264V AC
 24V AC/DC : 20 to 28V AC/DC

Ambient temperature

: 0 to 50°C (32 to 122°F)

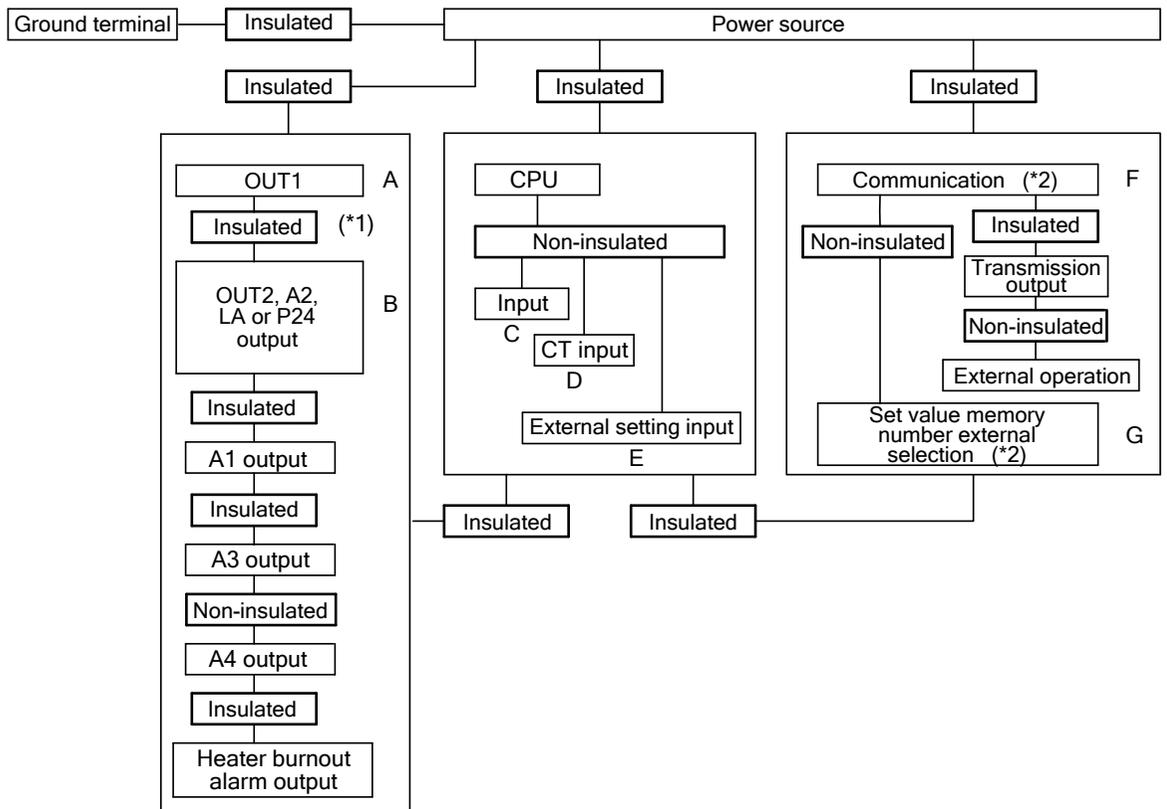
Ambient humidity

: 35 to 85%RH (non-condensing)

Power consumption

: Approx. 15VA

Circuit insulation configuration



(*1) When both OUT1 and OUT2 are DC current output type or Non-contact voltage output type, A is not electrically insulated from B.

(*2) When OUT1 is DC current output type or Non-contact voltage output type, A is not electrically insulated from F, and A is not electrically insulated from G. When OUT2 is DC current output type or Non-contact voltage output type, B is not electrically insulated from F, and B is not electrically insulated from G.

Insulation resistance

10MΩ or more, at 500V DC

An insulation test **must not** be carried out between A-B in the case of (*1) above, and between A-F, B-F, A-G, B-G, C-D-E and F-G in the case of (*2) above because they are not electrically insulated from each other.

Dielectric strength

Between input terminal and ground terminal, 1.5kV AC for 1 minute

Between input terminal and power terminal, 1.5kV AC for 1 minute

Between output terminal and ground terminal, 1.5kV AC for 1 minute

Between output terminal and power terminal, 1.5kV AC for 1 minute

Between power terminal and ground terminal, 1.5kV AC for 1 minute

Weight : Approx. 500g

External dimensions: 96 x 96 x 100mm (W x H x D)

Material : Case: Flame-resistant resin

Color : Case: Light gray

Attached functions :

- Control output OFF function
- Set value lock
- SV high/low limit
- Sensor correction
- Multi-range
- Multi-function
- Simplified programmable controller
- Power failure countermeasure
- Self-diagnosis
- Automatic cold junction temperature compensation
- Sensor burnout (Overscale, Underscale)
- Warm-up display
- SV ramp

Accessories :

- Mounting brackets 1 set
- Instruction manual 1 copy
- Unit label 1 label
- Current transformer 1 piece each
 - (CTL-6S) (When W (20A) option is added.)
 - (CTL-12-S36-10L1U) (When W (50A) option is added.)
- Current transformer 2 pieces each
 - (CTL-6S) (When W3 (20A) option is added.)
 - (CTL-12-S36-10L1U) (When W3 (50A) option is added.)
- Terminal cover 2 pieces (When TC option is added.)
- Gasket 1 piece (When IP option is added)
- Auxiliary frame 1 piece (When IP option is added)

12.2 Optional specifications

Alarm 2 (Option code: A2)

The alarm action point is set by the \pm deviation from the SV (except Process alarm).

[When the alarm action is set as Energized]

When the input goes outside the range, the output turns ON or OFF (in the case of High/Low limit range alarm).

[When the alarm action is set as De-energized]

The output acts conversely.

One alarm can be selected by Rotary switch and DIP switch from 13 types of alarm plus Pattern end output: High limit alarm, Low limit alarm, High/Low limits alarm, High/Low limit range alarm, Process high alarm and Process low alarm, the standby function which is applied to them respectively, as well as No alarm and Pattern end output.

When Alarm 2 (A2 option) and Loop break alarm (LA option) are added together, they utilize common output terminals.

If Alarm 2 (A2 option) is added, Heating/Cooling control (DR, DS, DA option) or Insulated power output (P24 option) cannot be added together.

Setting accuracy : The same as Indication accuracy

Action : ON/OFF action

Hysteresis : Thermocouple, RTD input: 0.1 to 100.0°C (°F)
DC input: 1 to 1000 (The placement of the decimal point follows the selection.)

Output : Relay contact, 1a
Control capacity, 3A 250V AC (resistive load)
1A 250V AC (inductive load $\cos\phi=0.4$)
Electrical life: 100,000 cycles

Alarm 3, Alarm 4 (Option code: SA)

The alarm action point is set by the \pm deviation from the SV (except Process alarm).

[When the alarm action is set as Energized]

When the input goes outside the range, the output turns ON or OFF (in the case of High/Low limit range alarm).

[When the alarm action is set as De-energized]

The output acts conversely.

Alarm 3 and Alarm 4 are selectable by keypad from 13 types of alarm: High limit alarm, Low limit alarm, High/Low limits alarm, High/Low limit range alarm, Process high alarm and Process low alarm, the standby function which is applied to them respectively, as well as No alarm.

Setting accuracy : The same as Indication accuracy

Action : ON/OFF action

Hysteresis : Thermocouple, RTD input: 0.1 to 100.0°C (°F)
DC input: 1 to 1000 (The placement of the decimal point follows the selection.)

Output : Relay contact 1a x 2
Control capacity, 3A 250V AC (resistive load)
1A 250V AC (inductive load $\cos\phi=0.4$)
(However, A3 and A4 common terminal, maximum 3A)
Electrical life: 100,000 cycles

Heating/Cooling control (Option code: DR, DS, DA)

If this option is added, Alarm 2 (A2 option), Loop break alarm (LA option) or Insulated power output (P24 option) cannot be added together.

OUT2 proportional band : 0.0 to 10.0 times OUT1 proportional band
(ON/OFF control when setting the value to 0.0.)

OUT2 integral time : The same as OUT1 integral time

OUT2 derivative time : The same as OUT1 derivative time

OUT2 proportional cycle: 1 to 120sec

Overlap/Dead band : \pm OUT1 proportional band converted value

Thermocouple, RTD input: -199.9 to 999.9°C ($^{\circ}\text{F}$)

DC input: -1999 to 9999 (The placement of the decimal point follows the selection.)

Output [DR] Relay contact 1a

Control capacity, 3A 250V AC (resistive load)

1A 250V AC (inductive load $\cos\phi=0.4$)

Electrical life: 100,000 cycles

[DS] Non-contact voltage (for SSR drive)

$12^{\pm 2}_0$ V DC Maximum 40mA DC (short circuit protected)

[DA] DC current

4 to 20mA DC (Isolated type)

Load resistance: Maximum 550 Ω

OUT2 action mode selection: Selectable by keypad

Air cooling (Linear characteristic),

Oil cooling (1.5th power of the linear characteristic)

Water cooling (2nd power of the linear characteristic).

Transmission output (Option code: TA, TV)

Converting the value (PV transmission, SV transmission, MV transmission) to analog signal every 125ms, outputs the value in current or voltage.

One transmission output (PV, SV, MV) can be selected by keypad.

Resolution : 1/10000

Current (TA) : 4 to 20mA DC (load resistance maximum 500 Ω)

Voltage (TV) : 0 to 1V DC (load resistance minimum 100k Ω)

Output accuracy: Within $\pm 0.3\%$ of Transmission output span

Serial communication (Option code: C5, C)

The following operations can be executed from an external computer.

(1) Reading and setting of the SV, PID values and various set values.

(2) Reading of the PV and the action status.

(3) Function change

Communication line : EIA RS-485 (C5 option)

EIA RS-232C (C option)

Communication method : Half-duplex communication

Synchronization method : Start-stop synchronization

Communication speed : 2400, 4800, 9600, 19200bps (Selectable by keypad)

Data format Start bit : 1

Data bit : 7

Parity : Even parity

Stop bit : 1

Communication protocol : Shinko protocol, Modbus ASCII (Selectable by keypad)
(When Modbus protocol is selected, the digital external setting is not usable.)

Shinko communication converter IF-400 is available for the Modbus protocol.

Digital external setting : Receives digital set value from Shinko Programmable controller PC-900, PCD-33A (with SVTC option).

Set value memory number external selection (Option code: SM)

Selects the set value memory number from 7 files (the undermentioned data as one file) by external terminals:

SV, OUT1 proportional band, Integral time, Derivative time, OUT2 proportional band, Alarm values (A1 to A4), Overlap/Dead band, OUT1 high limit value, OUT1 low limit value, OUT2 high limit value, OUT2 low limit value

Memory number: 1 to 7 (7 files)

Data : 14

External setting (Option code: EA, EV)

SV can be set by External analog signal.

Setting signal : DC current [EA]

0 to 20mA DC, 4 to 20mA DC

Input impedance, 50Ω (non-isolated from input)

: DC voltage [EV]

0 to 1V DC, 1 to 5V DC

Allowable input voltage, 5V or less

Input impedance, 100kΩ (non-isolated from input)

Setting signal sampling period: 0.5 seconds (If this External setting function is added, the input sampling period also changes to 0.5 seconds.)

External operation: When this option (EA, EV) is added, external change of Remote/Local setting and Auto/Manual control can be executed.

Terminals 25-27 { Closed : Remote setting

Open : Local setting

Terminals 26-27 { Closed : Manual control

Open : Automatic control

Heater burnout alarm (Option code: W, W3)

Watches the heater current with CT (current transformer), and detects the burnout. (This option cannot be added to the DC current output type.)

Rated current : 20A [W (20A), W3 (20A) option], or
50A [W (50A), W3 (50A) option] Must be specified

Setting range : 20A: 0.0 to 20.0A (however, the indication is 0.0 to 50.0)
(Setting the value to 0.0 disables the function.)
50A: 0.0 to 50.0A (Setting the value to 0.0 disables the function.)

Setting accuracy : Within $\pm 5\%$ of heater rated current

Action : ON/OFF action

Output : Relay contact, 1a

Control capacity, 3A 250V AC (resistive load)

1A 250V AC (inductive load, $\cos\phi=0.4$)

Electrical life: 100,000 cycles

Loop break alarm (Option code: LA)

Detects the breaking status on the loop such as heater burnout, sensor burnout or actuator trouble.

When Loop break alarm (LA option) and Alarm 2 (A2 option) are added together, they utilize common output terminals.

If this option is added, Heating/Cooling control (DR, DS, DA option) or Insulated power output (P24 option) cannot be added together.

Output Relay contact 1a

Control capacity, 3A 250V AC (resistive load)

1A 250V AC (inductive load, $\cos\phi=0.4$)

Electrical life: 100,000 cycles

Insulated power output (Option code: P24)

Can be used as a small capacity power source for each sensor and converter.
If this option is added, Alarm 2 (A2 option), Heating/Cooling control (DR, DS, DA option) or Loop break alarm (LA option) cannot be added.

Output voltage : $24 \pm 3V$ DC (when the load current is 30mA.)

Ripple voltage : Within 200mV (when the load current is 30mA.)

Max load current : 30mA

Color black (Option code: BK)

Front panel: Dark gray

Case : Black

Terminal cover (Option code: TC)

Electrical shock protection terminal cover

Drip-proof/Dust-proof (Option code: IP)

Drip-proof and Dust-proof specification (IP54)

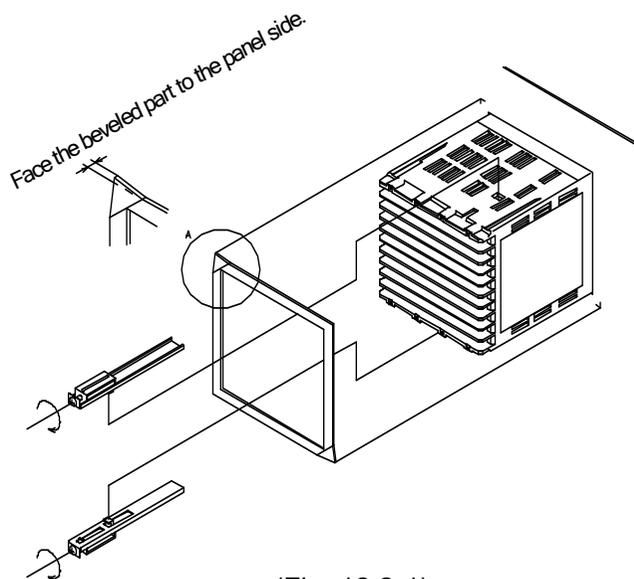
Effective only for panel surface, case section is excluded.

To protect the controller from water leaks between control panel and controller, take note of the following.

(1) The panel cutout dimensions should be proper and have no burr(s).

(2) The control panel surface to be mounted should be vertical.

The front cover (soft type, sold separately) is recommended for comprehensive Dust-proof/Drip-proof protection.



(Fig. 12.2-1)

User specified

Input, Scale range : Shipped as specified range.

Alarm type : Shipped as specified alarm type (A1, Options: A2, A3, A4).

Control action : Shipped as specified control action.

OUT2 action mode : Shipped as specified action mode (DR, DS, DA option).

Transmission output : Shipped as specified output (TA, TV option).

External setting input : Shipped as specified input (EA, EV option).

Transmission output scaling: Shipped as specified scaling range.

13 Troubleshooting

If any malfunctions occur, refer to the following items after checking the power and the wiring.



Warning

Turn the power supply to the instrument off before wiring or checking. Working or touching the terminal with the power switched on may result in severe injury or death due to Electric Shock.

<Indication>

Problem	Presumed cause and solution
The PV display is indicating [FF], no indication or only PV.	<ul style="list-style-type: none"> Control output OFF function is working. To release the function, press the  key for approx. 1 sec.
The PV display is flashing [- - - -].	<ul style="list-style-type: none"> Thermocouple or RTD is burnt out. Change each sensor. <ul style="list-style-type: none"> [In the case of thermocouple] <ul style="list-style-type: none"> If the input terminals of the instrument are shorted, and if a value around room temperature is indicated, the instrument is likely to be operating normally, however, the sensor may be burnt out. [In the case of RTD] <ul style="list-style-type: none"> If approximate 100Ω of resistance is connected to the input terminals between A-B of the instrument and between B-B is shorted, and if a value around 0°C (32°F) is indicated, the instrument is likely to be operating normally, however, the sensor may be burnt out. Check whether the lead wire of thermocouple or RTD is securely mounted to the instrument input terminals.
The PV display is flashing [- - - -].	<ul style="list-style-type: none"> Check if polarity of thermocouple or compensating lead wire is correct. Check whether codes (A, B, B) of RTD match with the instrument terminals.
The indication of the PV display is irregular or unstable.	<ul style="list-style-type: none"> Selection of the Sensor input is incorrect. Set the Sensor input properly using Rotary switch (SW303) and the DIP switch (SW304). Temperature unit (°C or °F) is not correct. Set it to a suitable unit with the DIP switch. Sensor correction value is not suitable. Set it to a suitable value. Specification of the Thermocouple or RTD is improper. AC leaks into thermocouple or the RTD circuit. Use an ungrounded type sensor. There may be equipment that interferes with, or makes noise near the controller. Keep equipment that interferes with or makes noise away from the controller.

<Key operation>

Problem	Presumed cause and solution
The setting mode cannot be selected.	<ul style="list-style-type: none"> Manual control is selected. Change the mode to Automatic control.
The mode cannot be changed from Manual control to Automatic control by keypad.	<ul style="list-style-type: none"> The mode has been set to "Manual control" by External operation. External operation has priority.
The mode cannot be changed from Remote setting to Local setting by keypad.	<ul style="list-style-type: none"> The mode has been set to "Remote setting" by External operation. External operation has priority.
<ul style="list-style-type: none"> Unable to set the SV, P, I, D, OUT1 proportional cycle, alarm value, etc. The values do not change by the ,  keys. 	<ul style="list-style-type: none"> Set value lock (Lock 1 or Lock 2) is selected. Release the lock selection. AT (Auto-tuning) is performing. Cancel AT.
The setting indications do not change within the input range even if the  ,  keys are pressed, and new values are unable to be set.	<ul style="list-style-type: none"> SV high limit or SV low limit in [Auxiliary function setting mode 1] may be set at the point where the value does not change. Set it to a suitable value during Auxiliary function setting mode 1.
Program control does not start even if the  key is pressed in the Program mode.	<ul style="list-style-type: none"> Step time has not been set. Set the step time.

<Control>

Problem	Presumed cause and solution
PV does not rise.	<ul style="list-style-type: none"> Thermocouple or RTD is out of order. Replace the sensor. Check whether sensor or control output terminals are securely connected to the input or output terminals of the instrument. Ensure that the wiring of sensor and control output terminals are correct.
Control is not performing. (Only PV display is indicated)	<ul style="list-style-type: none"> Control output OFF function is working. Cancel the function by pressing the  key for approx. 1 sec. Program mode is selected. To start Program control, press the  key. To perform Fixed value control, select the Fixed value control mode by pressing the  key for approx. 3sec while holding down the  key.
OUT1 or OUT2 remains in an ON status.	<ul style="list-style-type: none"> OUT1 low limit value or OUT2 low limit value is set to 100% or higher in Auxiliary function setting mode 2. Set it to a suitable value.
OUT1 or OUT2 remains in an OFF status.	<ul style="list-style-type: none"> OUT1 high limit value or OUT2 high limit value is set to 0% or less in Auxiliary function setting mode 2. Set it to a suitable value.

For all other malfunctions, please contact our main office or dealers.

14 Character table

<Main setting mode>

Character	Item	Default	Data
4□□□	SV	0°C	

<Sub setting mode>

Character	Item	Default	Data
ñno□	Set value memory number	1	
AT□□	AT Perform/Cancel	AT Cancel	
P□□□	OUT1 proportional band	2.5%	
P_b□	OUT2 proportional band	1.0 times	
I□□□	Integral time	200 sec	
d□□□	Derivative time	50 sec	
c□□□	OUT1 proportional cycle	R/M: 30 sec S/M: 3 sec	
c_b□	OUT2 proportional cycle	DR: 30 sec DS: 3 sec	
r4ET	Manual reset	0.0°C	
A1□□	Alarm 1 value	0°C	
A2□□	Alarm 2 value	0°C	
A3□□	Alarm 3 value	0°C	
A4□□	Alarm 4 value	0°C	
Hxx.x XX.X: Heater current value	Heater burnout alarm value	0.0A	
LP_r	Loop break alarm time	0 minutes	
LP_H	Loop break alarm span	0°C	

<Auxiliary function setting mode 1>

Character	Item	Default	Data
Lac□	Set value lock	Unlock	
4H□□	SV high limit	400°C	
4L□□	SV low limit	0°C	
4o□□	Sensor correction	0.0°C	
db□□	Overlap/Dead band	0.0°C	
rEño	Remote/Local setting	Local	
cñno	Instrument number	0	
cñ4P	Communication speed	9600bps	
cñ4L	Communication protocol	Shinko protocol	

<Auxiliary function setting mode 2>

Character	Item	Default	Data
4FLH	Scaling high limit	1370°C	
4FLl	Scaling low limit	-200°C	
dP□□	Decimal point place	No decimal point	

<i>F1LF</i>	PV filter time constant	0.0 sec	
<i>oLH□</i>	OUT1 high limit	100%	
<i>oLL□</i>	OUT1 low limit	0%	
<i>H4□</i>	OUT1 ON/OFF hysteresis	1.0°C	
<i>cAcF</i>	OUT2 action mode	Air cooling	
<i>oLHb</i>	OUT2 high limit	100%	
<i>oLLb</i>	OUT2 low limit	0%	
<i>H4b</i>	OUT2 ON/OFF hysteresis	1.0°C	
<i>AL3F</i>	Alarm 3 type	No alarm action	
<i>AL4F</i>	Alarm 4 type	No alarm action	
<i>A1Lā</i>	Alarm 1 action Energized/De-energized	Energized	
<i>A2Lā</i>	Alarm 2 action Energized/De-energized	Energized	
<i>A3Lā</i>	Alarm 3 action Energized/De-energized	Energized	
<i>A4Lā</i>	Alarm 4 action Energized/De-energized	Energized	
<i>A1H4</i>	Alarm 1 hysteresis	1.0°C	
<i>A2H4</i>	Alarm 2 hysteresis	1.0°C	
<i>A3H4</i>	Alarm 3 hysteresis	1.0°C	
<i>A4H4</i>	Alarm 4 hysteresis	1.0°C	
<i>A1d4</i>	Alarm 1 action delay timer	0 sec	
<i>A2d4</i>	Alarm 2 action delay timer	0 sec	
<i>A3d4</i>	Alarm 3 action delay timer	0 sec	
<i>A4d4</i>	Alarm 4 action delay timer	0 sec	
<i>r4LH</i>	External setting input high limit	400°C	
<i>r4LL</i>	External setting input low limit	0°C	
<i>rro4</i>	Transmission output	PV transmission	
<i>r-rLH</i>	Transmission output high limit	400°C	
<i>r-rLL</i>	Transmission output low limit	0°C	
<i>P4B□</i>	Indication when control output OFF	OFF on the PV display	
<i>rRFU</i>	SV rise rate	0°C/minute	
<i>rRFd</i>	SV fall rate	0°C/minute	
<i>EoUF</i>	Output status when input abnormal	Outputs OFF(4mA) or OUT1(OUT2) low limit value.	

<Program mode>

Character	Item	Default	Data
<i>Prac</i>	Fixed value control/Program control	Fixed value control	
<i>r_1□</i>	Step 1 time	00.00	
<i>r_2□</i>	Step 2 time	00.00	
<i>r_3□</i>	Step 3 time	00.00	
<i>r_4□</i>	Step 4 time	00.00	
<i>r_5□</i>	Step 5 time	00.00	
<i>r_6□</i>	Step 6 time	00.00	
<i>r_7□</i>	Step 7 time	00.00	

***** Inquiry *****

For any inquiries about this unit, please contact the vendor where you purchased the unit after checking the following.

[Example]

- Model ----- FCD-13A-R/M
- Input type ----- K
- Option ----- A2, TV, C5, W (20A)
- Serial number ----- No. xxxxxx

In addition to the above, please let us know the details of the malfunction, if any, and the operating conditions.

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