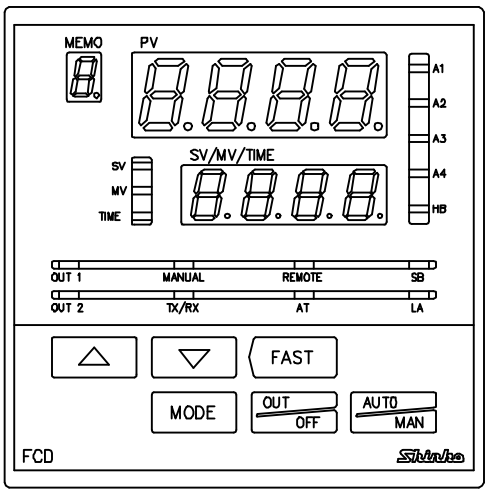
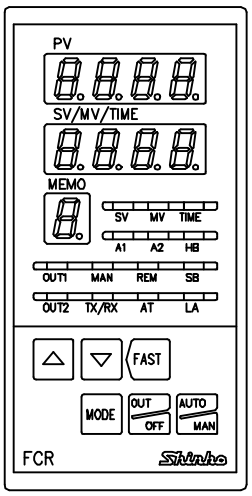
ON/OFF SERVO

DIGITAL INDICATING CONTROLLER

FCD-15A, FCR-15A

INSTRUCTION MANUAL





Shinko

Preface

Thank you for purchasing our ON/OFF SERVO digital indicating controller FCD-15A, FCR-15A. This manual contains instructions for the mounting, functions, operations and notes when operating the FCD-15A, FCR-15A. To prevent accidents arising from the misuse of this controller, please ensure the operator receives this manual.

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, external appearance of the FCD-15A, FCR-15A and the contents of this instruction manual are subject to change without notice.
- Care has been taken to ensure that the contents of this instruction manual are correct, but if there are any doubts, mistakes or questions, please inform our sales department.
- 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 2 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 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 protection 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 utilization 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℃ (32 to 122℉) that does not change rapidly, and without 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 the ambient temperature of this unit as well as the control panel must not exceed 50℃ (122℉) if mounted through the 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 bits of wire in the instrument, because they could cause fire or malfunction.
- Use the solderless terminal with an insulation sleeve in which an M3 screw fits when wiring the FCD-15A, FCR-15A.
- 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. Running and maintenance precautions

⚠ Caution

- It is recommended that PID auto-tuning be performed on the trial run.
- Do not touch live terminals. This may cause electric shock or operation problems.
- Turn the power supply OFF before retightening the terminal or 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** ---

Characters used in this manual

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

1 Model

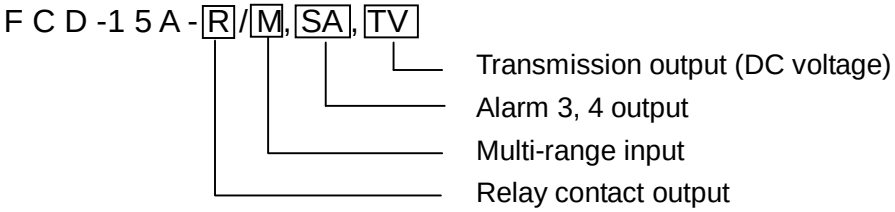
1.1 Model

Standard specifications

F C □ - 1	5	A -	R /	M	
Series D					FCD-15A: 96 x 96 x 110mm (W x H x D)
Series R					FCR-15A: 48 x 96 x 110mm (W x H x D)
Control action (OUT1)	5				ON/OFF servo *1
Alarm		A			Alarm action *2
Output			R		Relay contact output
Input				M	Multi-range input *3

*1: Fuzzy self-tuning PID and PID action are selectable by internal DIP switch.
*2: 12 types of alarm and no alarm action are selectable by internal rotary switch and DIP switch.
*3: 15 types of input (Thermocouple, RTD, DC Current and Voltage) are selectable by internal rotary switch and DIP switch.

Alphanumeric characters to represent functions or types are entered in the □.
(Example)



Optional specifications

Code	Specifications
SA	Alarm 3 (A3), Alarm 4 (A4) output (only for FCD-15A)
TA TV	Transmission output: PV, SV, Open/Closed output MV TA: DC current (4 to 20mA DC) TV: DC voltage (0 to 1V DC)
C5 C	C5: Serial communication (EIA RS-485) C: Serial communication (EIA RS-232C)
SM	Set value memory number external selection
EA EV	EA: External setting; DC current (0 to 20mA DC, 4 to 20mA DC) EV: External setting; DC voltage (0 to 1V DC, 1 to 5V DC)
LA	Loop break alarm
BK	Color: Black
BL	Screw type mounting brackets (only for FCR-15A)
IP	Dust-proof/Drip-proof (IP54)
TC	Terminal cover

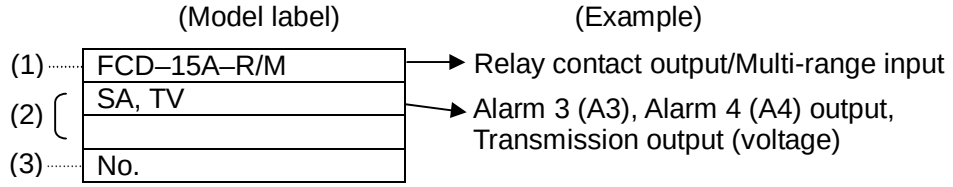
(See page 50 for the options in detail.)

1.2 How to read the model label

⚠ Warning

Do not take the inner assembly out nor touch the terminals with the power supply ON.
Touching the terminals with the power switched ON may result in severe injury or death due to Electric Shock.

Model labels are attached to the case and the left side of the inner assembly.

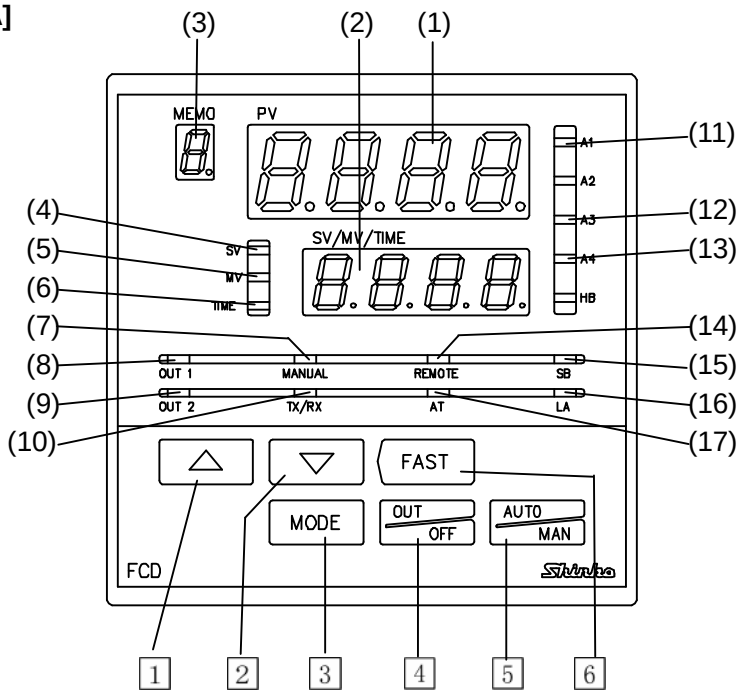


(1): Model
(2): Option codes
(3): Serial number (Indicated only on inner assembly)

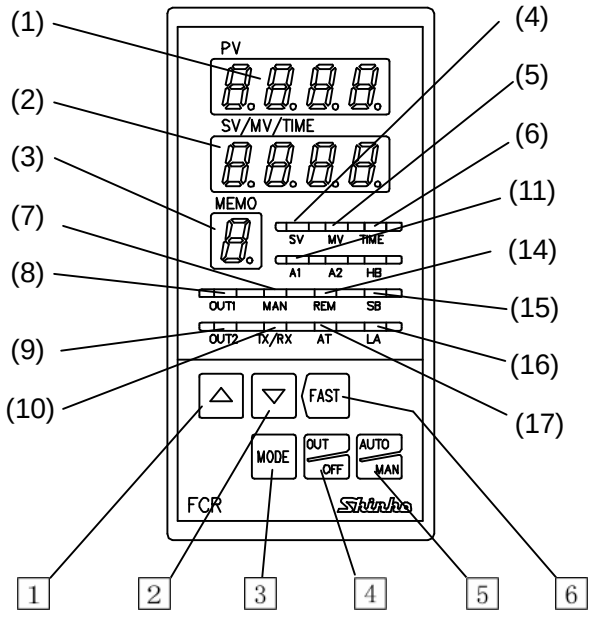
2 Name and functions of the sections

2.1 Name and displays

[FCD-15A]



[FCR-15A]



(1) **PV display**
Indicates the PV (process variable) with a red LED.
(2) **SV display**
Indicates the SV (desired value), Open/Closed output MV, TIME or set values (in the setting modes) with a green LED.
(3) **MEMO display**
Indicates the Set value memory number with a yellow LED.
(4) **SV indicator**
The green LED lights when the SV is displayed on the SV display.
(5) **MV indicator**
The red LED lights when the Open/Closed output MV is displayed on the SV display.
(6) **TIME indicator**
The yellow LED lights when Time is displayed on the SV display.
(7) **MANUAL control indicator**
The red LED lights for Manual control.
(8) **Control motor OPEN output ON indicator**
The green LED lights when the Control motor OPEN output is ON.
(9) **Control motor CLOSED output ON indicator**
The yellow LED lights when the Control motor CLOSED output is ON.
(10) **Serial communication indicator (Option)**
The green LED lights during serial communication (TX).
(11) **A1 indicator (including Pattern end output)**
The red LED lights when the Alarm 1 (A1) output or Pattern end output is ON.
(12) **A3 indicator (for FCD-15A) (Option)**
The red LED lights when the Alarm 3 (A3) output is ON.
(13) **A4 indicator (for FCD-15A) (Option)**
Then red LED lights when the Alarm 4 (A4) output is ON.
(14) **REMOTE indicator (Option)**
The red LED lights during Remote action.
(15) **SB (Sensor burnout) indicator**
The red LED lights when the Sensor is burnt out.
(16) **LA (Loop break alarm) indicator (Option)**
The red LED lights if any problems occur such as a Sensor burnout or Control motor trouble has been found on the loop.
(17) **AT (Auto-tuning) indicator**
The yellow LED flashes during auto-tuning.

Keys

Main functions are described below, however, the key has other functions in each mode. Refer to Section 6.1 Operation flowchart.

1 [▲] Increase key: Increases the numeric value on the SV display during setting mode. If pressed continuously, it makes the numerical value change faster.

2 [▼] Decrease key: Decreases the numeric value on the SV display during setting mode. If pressed continuously, it makes the numerical value change faster.

3 [MODE] Mode key: Selects a setting mode.

4 [OUT/OFF] OUT/OFF key: Turns the control output ON or OFF.
Starts or stops the program control.

5 [AUTO/MAN] Auto/Manual key: Switches Automatic or Manual control.

6 [FAST] Fast key: This makes the numerical value change faster by pressing the [FAST] key and the [▲] (or [▼]) key simultaneously.

3. Mounting to the control panel

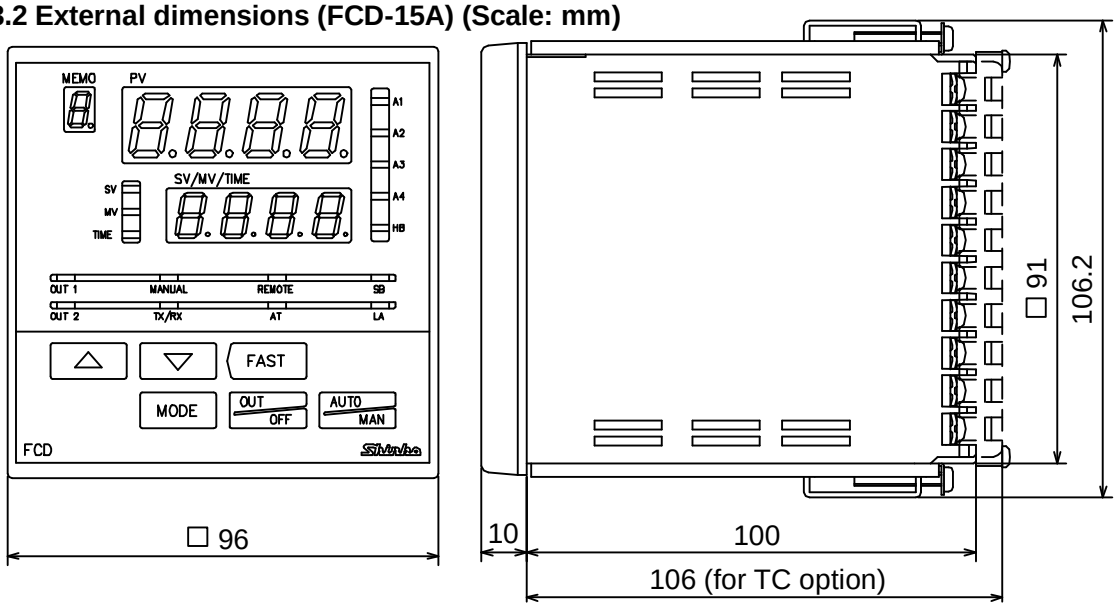
3.1 Site selection

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℃ (32 to 122℉) that does not change rapidly, and without icing
(5) An ambient non-condensing humidity of 35 to 85%RH
(6) No large capacity electromagnetic switches or cables through which large current is flowing
(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 the ambient temperature of this unit as well as the control panel must not exceed 50℃ (122℉) if mounted through the control panel. Otherwise the life of electronic components (especially electrolytic capacitor) may be shortened.

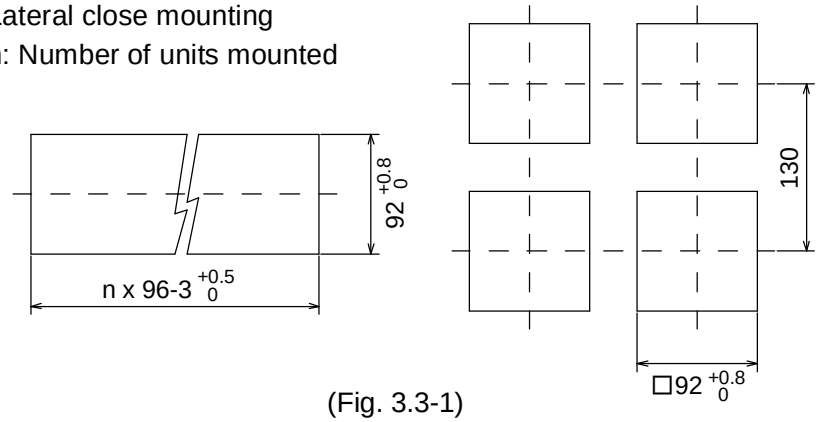
3.2 External dimensions (FCD-15A) (Scale: mm)



(Fig. 3.2-1)

3.3 Panel cutout (FCD-15A) (Scale: mm)

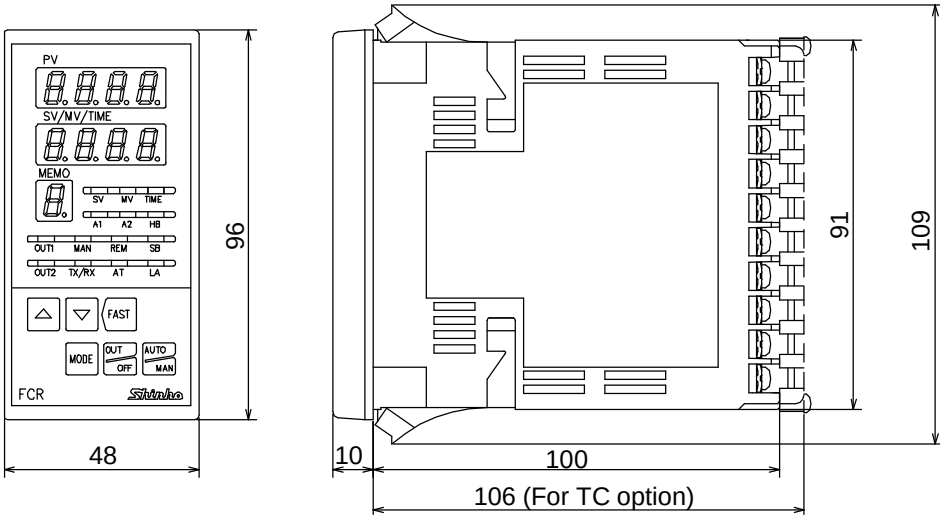
Lateral close mounting
n: Number of units mounted



(Fig. 3.3-1)

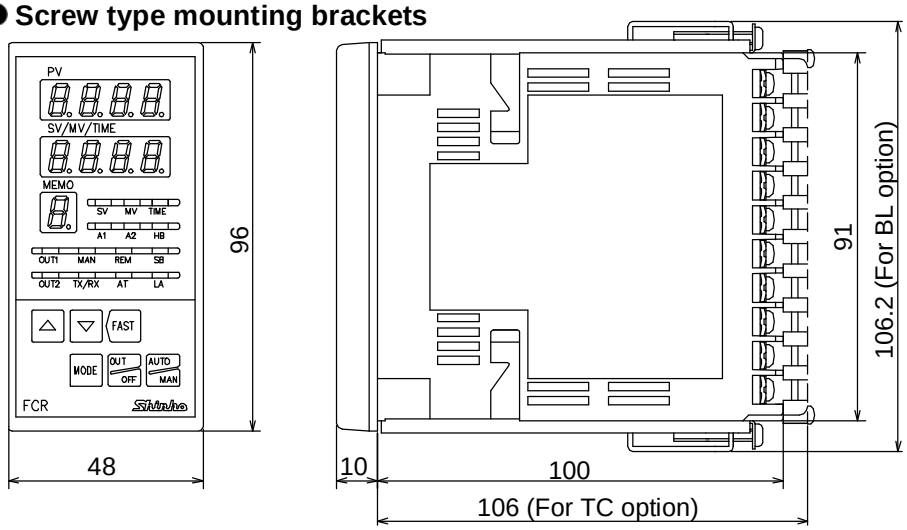
3.4 External dimensions (FCR-15A) (Scale: mm)

● **One-touch type mounting brackets**



(Fig. 3.4-1)

● **Screw type mounting brackets**

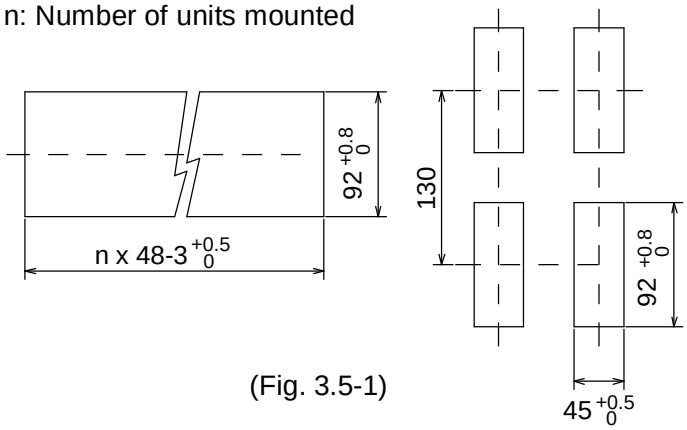


(Fig. 3.4-2)

3.5 Panel cutout (FCR-15A) (Scale: mm)

Lateral close mounting

n: Number of units mounted



(Fig. 3.5-1)

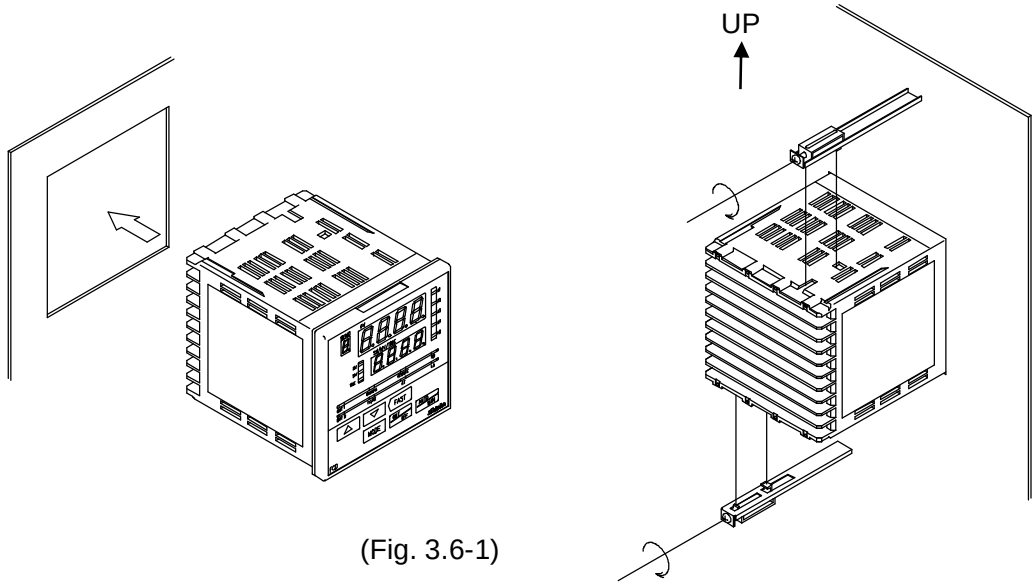
3.6 Mounting

⚠ Notice

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

[FCD-15A]

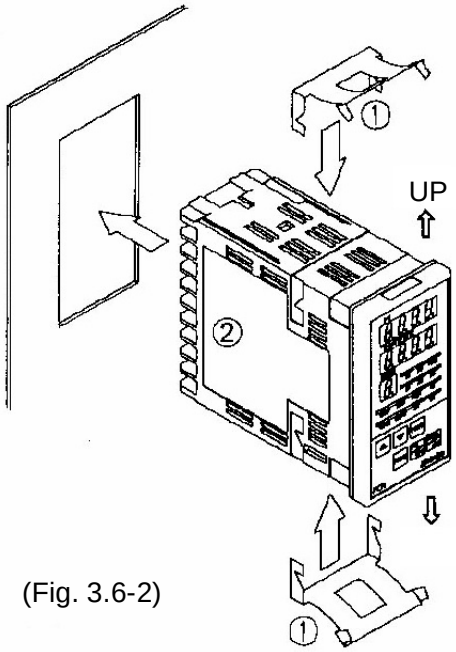
Insert the FCD-15A from the front of the panel. Slot the mounting bracket into the holes at the top and bottom of the case, and screw in place.
Mounting panel thickness: 1 to 8mm



(Fig. 3.6-1)

[FCR-15A]

Catch the mounting bracket ① to the top and bottom of the instrument first. Then, insert the FCR-15A ② from the front of the mounting panel.
Mounting panel thickness: 1 to 3mm.
When the Soft-type Front cover (FC-R) is used, mounting panel thickness is 1 to 2.5mm.



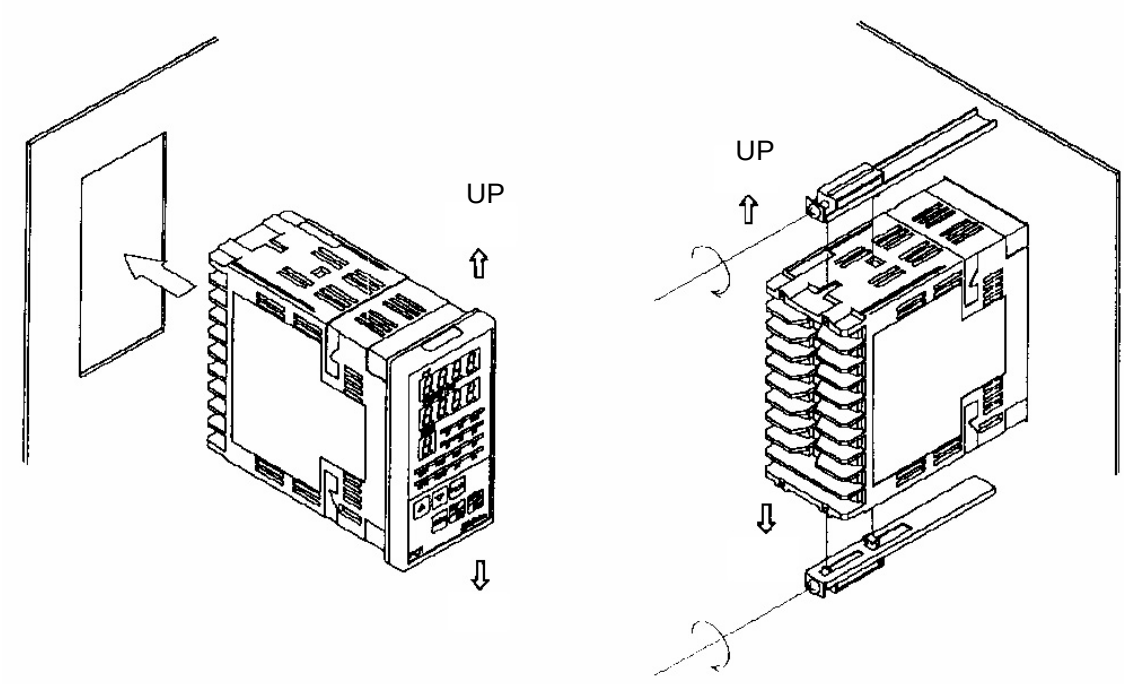
(Fig. 3.6-2)

● **When using screw type mounting brackets (BL option)**

⚠ Notice

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

Insert the FCx-15A from the front of the panel. Slot the mounting bracket into the holes at the top and bottom of the case, and screw in place.
Mounting panel thickness: 1 to 8mm



(Fig. 3.6-3)

4. Wiring

⚠ Warning

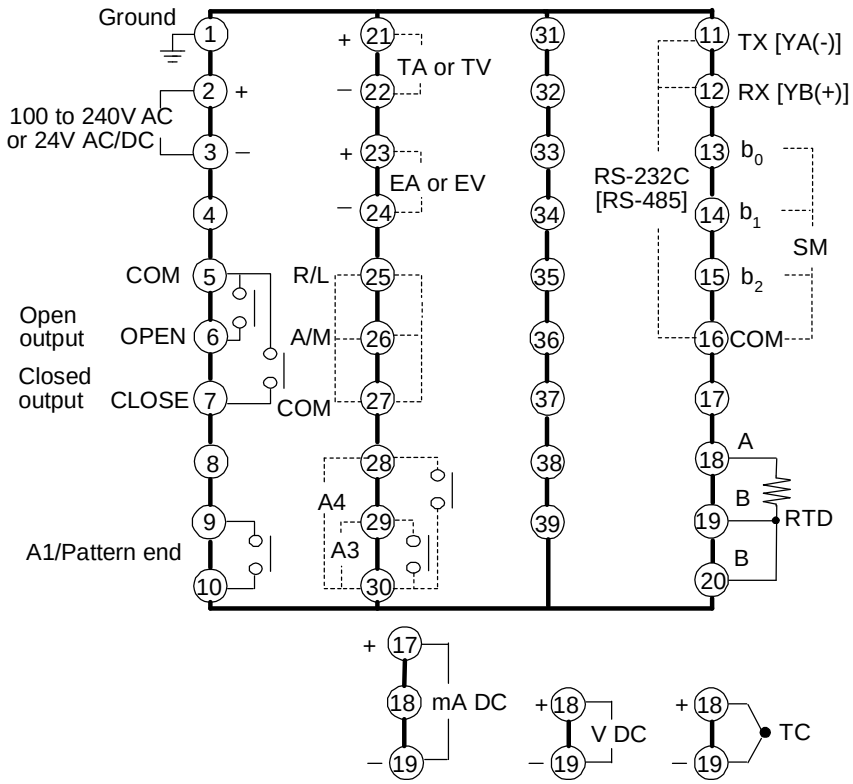
Turn the power supply to the instrument off before wiring or checking. Working or touching the terminal with the power switched on may result in severe injury or death due to Electric Shock.
Moreover, the instrument must be grounded before the power supply to the instrument is turned on.

⚠ Caution

- 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.
- Use a thermocouple and compensating lead wire according to the sensor input specifications of this controller.
- Use a 3-wire RTD according to the sensor input specifications of this controller.
- This controller has no built-in power switch or fuse. It is necessary to install them in the circuit near the external controller. (Recommended fuse: Time-lag fuse, rated voltage 250V AC, rated current 2A)
- For a 24V AC/DC of power source, do not confuse polarity when using a direct current (DC).
- When wiring, keep input wires (thermocouple, RTD, etc.) away from AC sources or load wires to avoid external interference.
- Use a thick wire (1.25 to 2.0mm^2) for grounding.
- Use an auxiliary electromagnetic switch between the FCx-15A and the control motor.
- Dotted lines show options. Option terminals are equipped only when they are added.

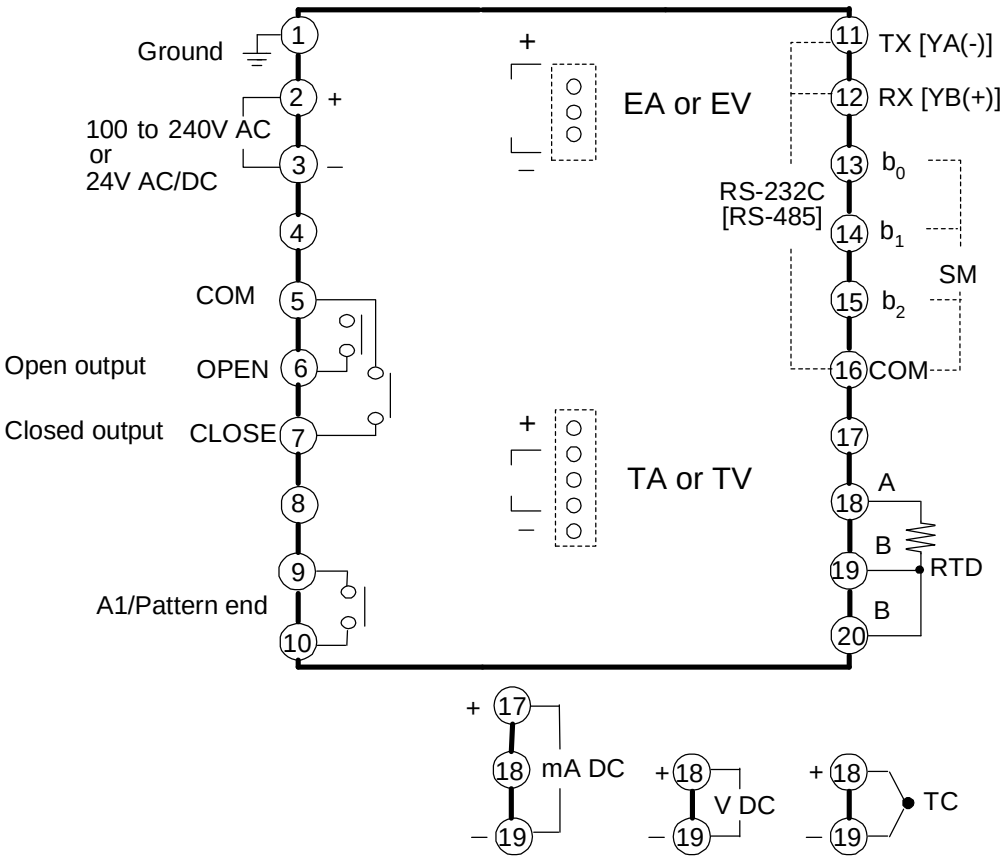
4.1 Terminal arrangement

[FCD-15A]



(Fig. 4.1-1)

[FCR-15A]



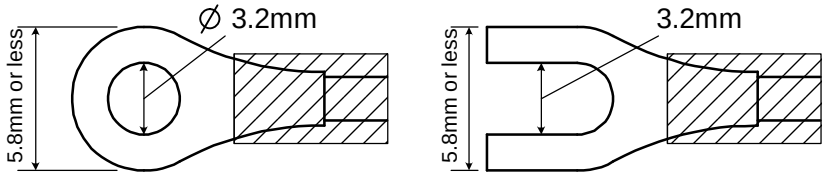
(Fig. 4.1-2)

A1 : Alarm 1 (A1) output
Pattern end: Pattern end output
TA, TV : Transmission output
EA, EV : External setting input
R/L : Remote/Local setting (External operation input) (for FCD-15A)
A/M : Auto/Manual control (External operation input) (for FCD-15A)
A3 : Alarm 3 (A3) output (for FCD-15A) (option)
A4 : Alarm 4 (A4) output (for FCD-15A) (option)
RS-232C : Serial communication EIA RS-232C
RS-485 : Serial communication EIA RS-485
SM : Set value memory external selection
TC : Thermocouple input
RTD : RTD input
V DC : DC voltage input
mA DC : DC current input

4.2 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 approximately 0.63N・m.

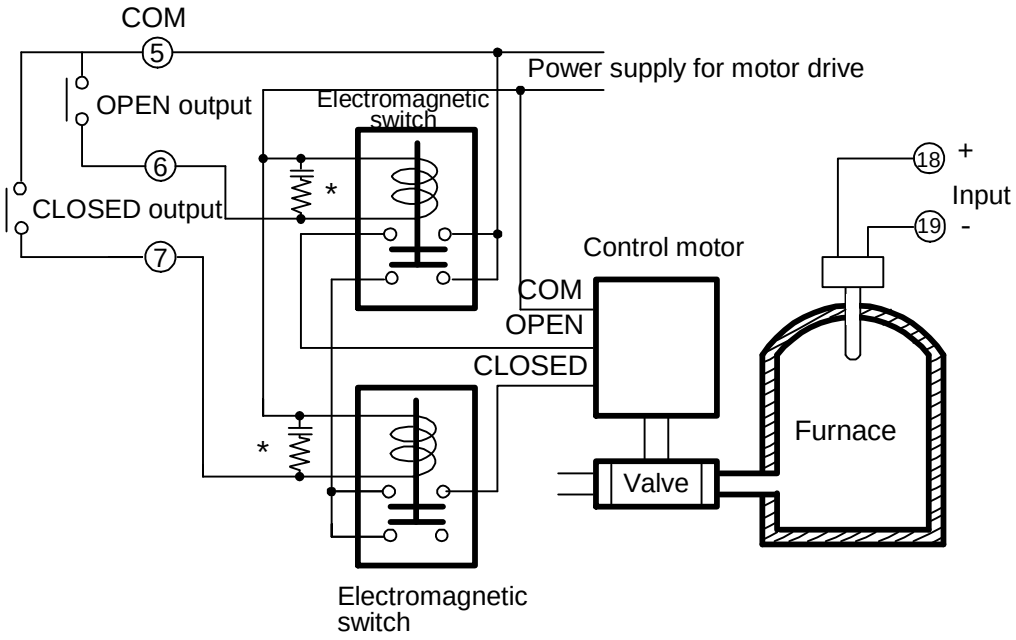
Solderless terminal	Manufacturer	Model	Tightening torque
Y type	Nichifu Terminal Industries CO.,LTD.	TMEV1.25Y-3	0.63N•m
	Japan Solderless Terminal MFG CO.,LTD.	VD1.25-B3A	
Round type	Nichifu Terminal Industries CO.,LTD.	TMEV1.25-3	
	Japan Solderless Terminal MFG CO.,LTD.	V1.25-3	



(Fig. 4.2-1)

4.3 Wiring examples

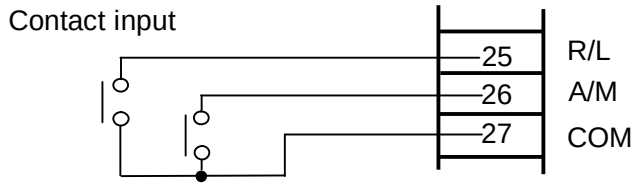
● **Wiring example of OPEN/CLOSED output**



(Fig. 4.3-1)

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

● **Wiring example of External operation input (Only for FCD-15A)**



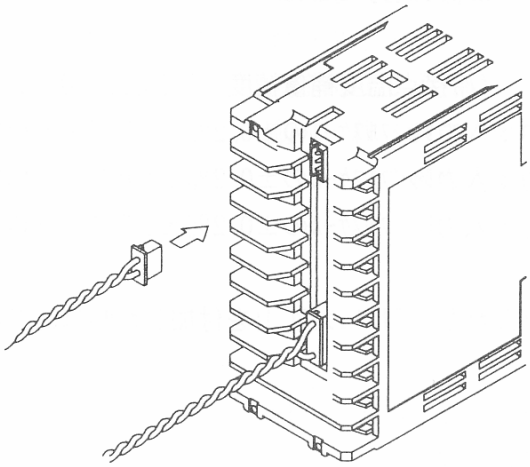
(Fig 4.3-2)

Remote/Local, Auto/Manual switching

Setting item	External operation	Key operation
Remote setting	25 - 27 Closed	Not required (invalid)
Local setting	25 - 27 Open	See p.27.
Manual control	26 - 27 Closed	Not required (invalid)
Automatic control	26 - 27 Open	See p.35.

External operation has priority.

● **Wiring example of External setting (EA, EV), Transmission output (TA, TV) (only for FCR-15A)**

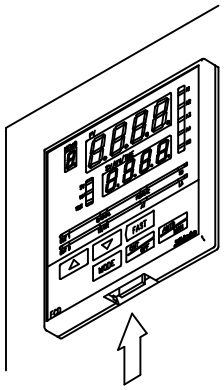


(Fig. 4.3-3)

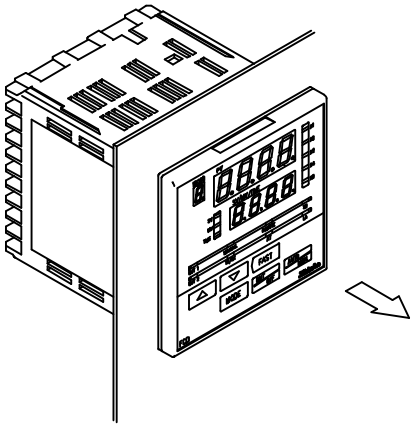
5. Setup

5.1 Taking the inner assembly out

Before the power supply to this instrument is turned on, take the internal assembly out from the case by pushing the hook (bottom of the instrument) in the direction as shown by the arrow and by holding the latches.



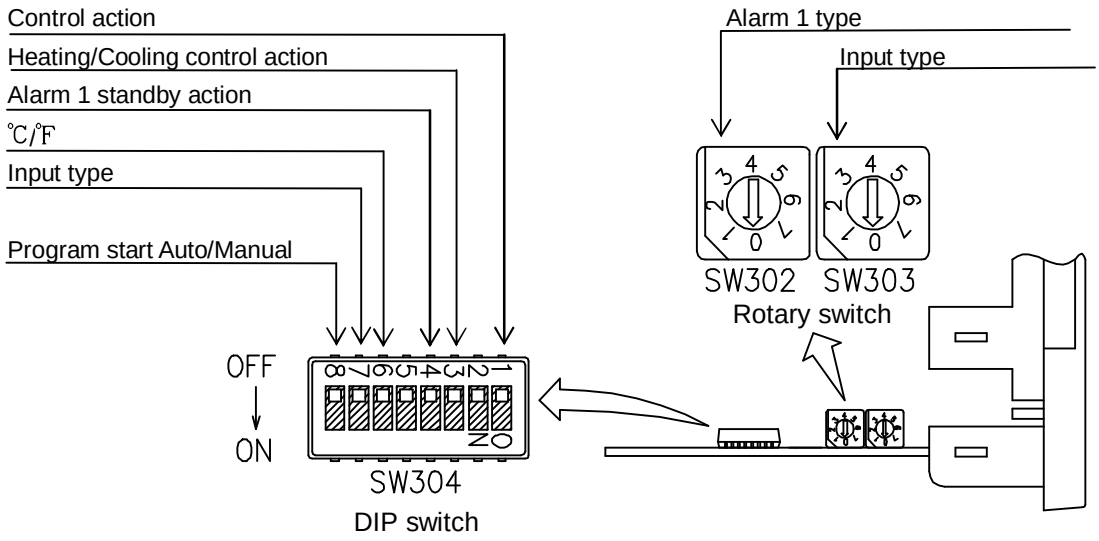
(Fig. 5.1-1)



(Fig. 5.1-2)

5.2 Switch setting (multi-function)

Using a small flat-head screwdriver or tweezers, set the **Input type, Alarm 1 type, Control action, Heating (reverse)/Cooling (direct) control action, Alarm 1 standby function, ℃/℉ and Program start Auto/Manual** by the rotary switch and DIP switch as follows.



(Fig. 5.2-1)

The following items can be selected by the DIP switch (SW304).
Default value: All switches OFF [ ].
(Table 5.2-1)

Item	DIP SW304 No.	Selection	Status
Control action	1	Fuzzy self-tuning PID action	OFF
		PID action	ON
Heating/Cooling control action	3	Heating (reverse) control action	OFF
		Cooling (direct) control action	ON
Alarm 1 (A1) standby action	4	Standby Disabled	OFF
		Standby Enabled	ON
℃/℉	6	℃	OFF
		℉	ON
Input type *1	7	K, J, R, B, N, PL-Ⅱ, Pt100, JPt100	OFF
		S, E, T, C, 4 to 20mA, 0 to 20mA, 0 to 1V	ON
Program start Auto/Manual *2	8	Manual start	OFF
		Automatic start	ON

Note: Switches No. 2 and 5 are not used. They will not function even if they are set to ON side.

*1: Use the rotary switch (SW303) as well.

*2: If **Automatic start** is selected, the unit proceeds to warm-up status for approx. 2 seconds after power-on, then program control starts automatically from step 1.
If **Manual start** is selected, the unit proceeds to warm-up status for approx. 2 seconds after power-on, then proceeds to standby status. In this status, if the OUT/OFF key is pressed, program control starts from step 1.

Select the input type with the rotary switch (SW303) and DIP switch (SW304).
Default: K (-200 to 1370℃) [ ].

(Table 5.2-2)

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

Alarm type and the pattern end output can be selected by the rotary switch (SW302).

When using the FCx-15A as a Simplified program controller, the Pattern end output can be selected instead of Alarm 1 (A1) type.
Default value: No alarm action, [ ].

(Table 5.2-3)

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

5.3 Insertion of the internal assembly

When the setup is completed, insert the internal assembly into the case.
Surely insert the assembly until it is locked by the hook at the bottom of the instrument. (Click sound audible)

⚠ Caution

Do not confuse the top and bottom of the internal assembly.
If inserting the assembly into the case forcibly in the wrong direction, the PCB may be damaged.

● **Note before operating keys**

- Pressing the OUT/OFF key for approx. 1 second from any mode turns the control output OFF.
- 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 OUT/OFF key again for approx. 1 second.
- Pressing the MODE key registers the set value and proceeds to the next setting item.
  If the MODE key is pressed for approx. 3 seconds from any mode, the unit reverts to the PV/SV display mode.

● **Turn the Power ON**

The PV display indicates the input type, and the SV display indicates input range high limit value selected during Input type selection for approx. 2 seconds after the power is turned on. See (Table 6.1-1) below.

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

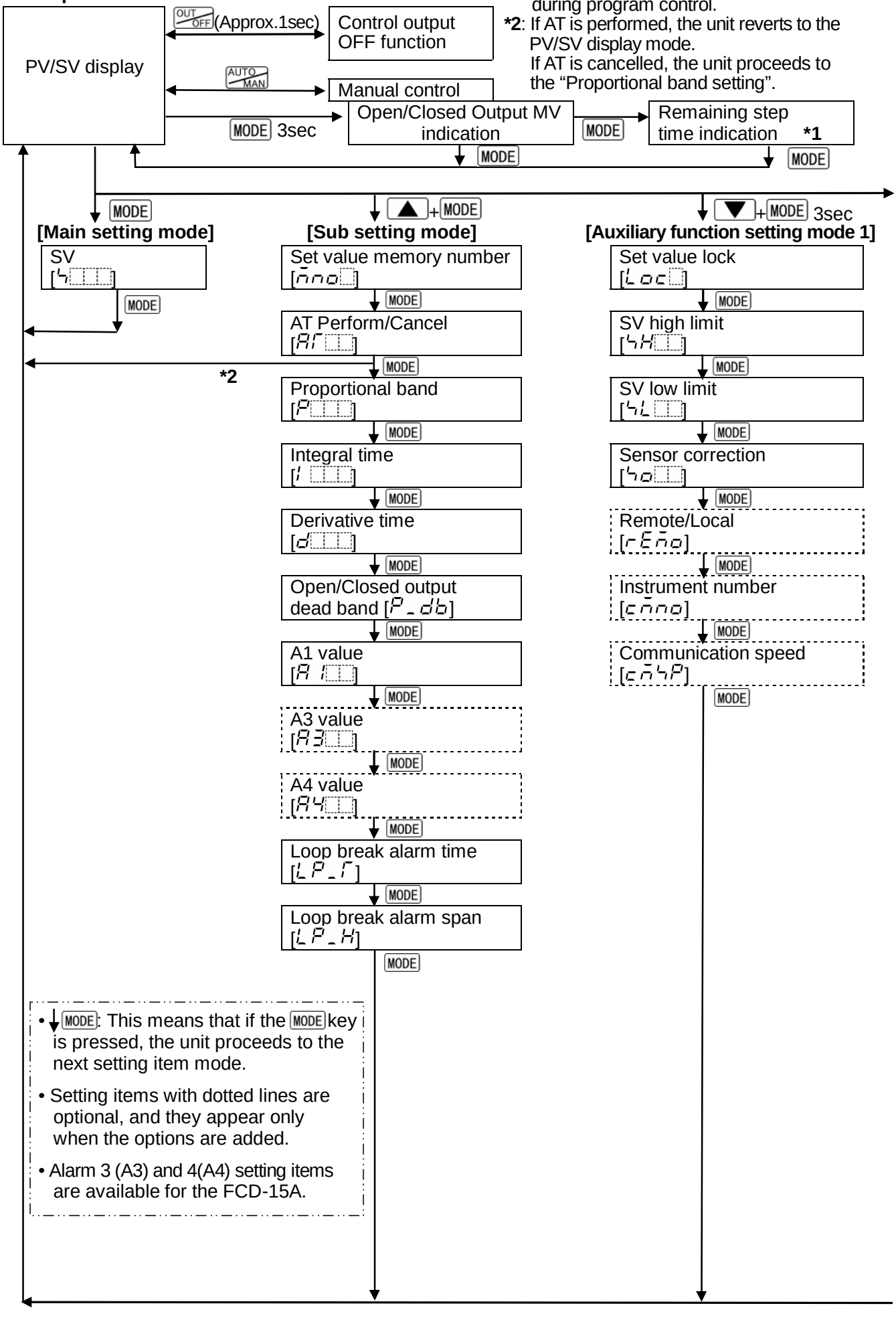
Control will then start indicating the PV (process variable) on the PV display and SV (desired value) on the SV display.

(Table 6.1-1)

Input	℃		℉	
	PV display	SV display	PV display	SV display
K	t□□C	1370	t□□F	2500
J	J□□C	1000	J□□F	1800
R	r□□C	1760	r□□F	3200
B	b□□C	1820	b□□F	3300
PL-Ⅱ	PL2C	1390	PL2F	2500
N	n□□C	1300	n□□F	2300
S	S□□C	1760	S□□F	3200
E	E□□C	1000	E□□F	1800
T	T□□C	400.0	T□□F	750.0
C	c□□C	2315	c□□F	4200
Pt100	Pt□C	850.0	Pt□F	999.9
JPt100	JPtC	500.0	JPtF	900.0
4 to 20mA DC	42A□	Scaling high limit value	42A□	Scaling high limit value
0 to 20mA DC	02A□		02A□	
0 to 1V DC	01V□		01V□	

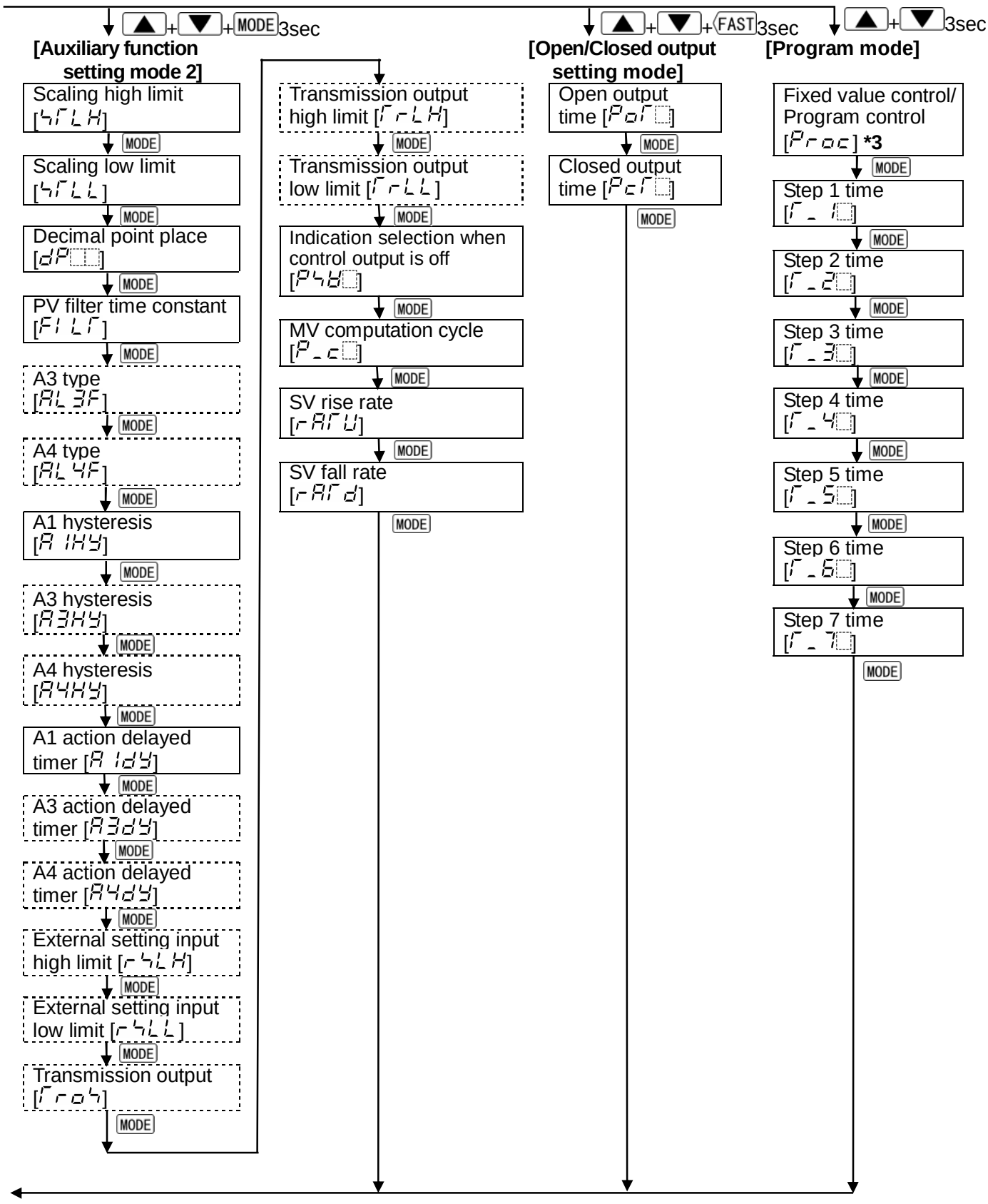
6. Operation

6.1 Operation flowchart



***3**: If oFF (Fixed value control) is selected during “Fixed value control/Program control selection” and the MODE key is pressed, the controller reverts to the PV/SV display mode.

▲+MODE: Press the MODE key while holding down the ▲ key.
▼+MODE 3sec: Press the MODE key for approx. 3 seconds while holding down the ▼ key.
▲+▼+MODE 3sec: Press the MODE key for approx. 3sec while holding down the ▲ and ▼ keys.
▲+▼+FAST 3sec: Press the FAST key for approx. 3sec while holding down the ▲ and ▼ keys.
▲+▼ 3sec: Pressing the ▲ key, press the ▼ key for approx. 3 seconds.



6.2 Main setting mode

In the PV/SV display mode, if the MODE key is pressed, the mode proceeds to the Main setting mode.
The SV can be increased or decreased normally by pressing the ▲, ▼, and faster with the FAST key.
If the MODE key is pressed, the SV will be registered and the controller will revert to the PV/SV display mode.

[SV] SV
- Sets SV.
- Setting range: SV low limit to SV high limit
- Default: 0℃

6.3 Sub setting mode

In the PV/SV display mode, if the MODE key is pressed while holding down the ▲ key, the unit proceeds to the Sub setting mode.
The set value can be increased or decreased normally by pressing the ▲, ▼ and faster with the FAST key.
Pressing the MODE key registers the set value, and proceeds to the next setting item.

[Amo] Set value memory number
- Selects the memory number to be set or to be retrieved.
- Selection range: 1 to 7
- Default: Memory number 1

[AT] AT (Auto-tuning) Perform/Cancel
- Sets AT (Auto-tuning) Perform or Cancel.
  If AT Perform is selected and the MODE key is pressed, the controller reverts to the PV/SV display mode.
- Selection item: ----: AT Cancel
  AT: AT Perform
- Default: AT Cancel

[Auto-tuning]
- Refer to Section 10.3.
- During auto-tuning, none of the settings can be performed.
- If the auto-tuning is cancelled during the process, P, I, D values revert to their previous value.

[P] Proportional band
- Sets the proportional band.
- Setting range: 0.1 to 999.9%
- Default: 2.5%

[I] Integral time
- Sets the integral time.
- Setting range: 1 to 3600 seconds
- Default: 200 seconds

[d] Derivative time
- Sets the derivative time.
  Setting the value to 0 disables the function. (PI action)
- Setting range: 0 to 3600seconds
- Default: 50 seconds

[P_db] Open/Closed output dead band
- Sets the dead band value of the Open output and Closed output
- Setting range: 0.1 to 100.0% of the proportional band
- Default: 3.0%

[A 1□□] A1 value
- Sets Alarm 1 (A1) value.
  Setting the value to 0 or 0.0 disables the function.
  (Excluding process high alarm and process low alarm)
- Not available if Rotary switch (SW302) is set to No.0 or No.7.
- Setting range: Refer to (Table 6.3-1).
- Default: 0℃

[A3□□] A3 value (for FCD-15A)
- Sets Alarm 3 (A3) value.
  Setting the value to 0 or 0.0 disables the function.
  (Excluding process high alarm and process low alarm)
- Not available if Alarm 3 (SA option) is not added or if [- - - -] is selected during Alarm 3 (A3) type selection.
- Setting range: Refer to (Table 6.3-1).
- Default: 0℃

[A4□□] A4 value (for FCD-15A)
- Sets Alarm 4 (A4) value.
  Setting the value to 0 or 0.0 disables the function.
  (Excluding process high alarm and process low alarm)
- Not available if Alarm 4 (SA option) is not added or if [- - - -] is selected during Alarm 4 (A4) type selection.
- Setting range: Refer to (Table 6.3-1).
- Default: 0℃

[LP_T] LA (Loop break alarm) time
- 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
- Default: 0 minutes

[LP_H] LA (Loop break alarm) span
- Sets the span to assess the Loop break alarm.
- Available only when Loop break alarm (LA option) is added
- Setting range:
  Thermocouple except T: 0 to 100℃
  T input, RTD input: 0.0 to 100.0℃
  DC input: 0 to 1000 (The placement of the decimal point follows the selection.)
- Default: 0℃

[Setting range of A1, A3 and A4] (including standby function)
(Table 6.3-1)

Alarm type	Setting range	
High limit alarm	–Input span to Input span	*1
Low limit alarm	–Input span to Input span	*1
High/Low limits alarm	0 to Input span	*1
High/Low limit range alarm	0 to Input span	*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

When input has a decimal point, 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.

6.4 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 normally by pressing the ▲, ▼, and faster with the FAST key.

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

[Loc□] Set value lock

- 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 PID or Auto-tuning (AT) will not function if Lock 1 or Lock 2 is selected.

[About Lock 3]

When using the unit 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. (Returns to the values before setting.)

When using the unit as a Program 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. (Returns to the values before setting.)
Set value change during running standby status will be invalidated.
(Running starts at the values memorized in the memory.)

- Be sure to select Lock 3 when changing the set value frequently via communication function considering the life of non-volatile memory.
- Selection item:
  - ---- (Unlock): All set values can be changed.
  - Lc 1□ (Lock 1): None of the 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 the power is turned off because they are not saved in the non-volatile memory.
    This function is suitable when changing value temporarily.
    Since this function has no relation to the memory life, it is well suited when changing set values frequently using Shinko programmable controller (PC-900, PCD-33A with SVTC option).
    Do not change any setting item in Auxiliary function setting mode 2. If any item in the mode is changed, it will affect other setting items such as the SV and Alarm value.
- Default: Unlock

[SH□□] SV high limit

- Sets SV high limit value.
- Setting range: SV low limit to Input range high limit value
  (For DC input, the placement of the decimal point follows the selection.)
  DC input: SV low limit to Scaling high limit value
- Default: 400℃

[SL□□] SV low limit

- Sets SV low limit value.
- Setting range: Input range low limit value to SV high limit
  (The placement of the decimal point follows the selection.)
  For DC input: Scaling low limit to SV high limit
  (The placement of the decimal point follows the selection.)
- Default: 0℃

[So□□] Sensor correction

- Sets the sensor correction value.
- Setting range: –100.0 to 100.0℃ (℉)
- Default: 0.0℃

Sensor correction function

This corrects the input value from the sensor. When a sensor cannot be set at the exact location where control is desired, the sensor measured 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 differences 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)

[rEmo] Remote/Local

- SV can be set with either Remote or Local method.
- Available only when External setting (EA, EV option) is added.
- Selection item:
  LocA (Local setting) : The SV can be set by the front keypad operation.
  rEmo (Remote setting) : The SV can be set in analog by the remote operation externally.
- Default: Local setting

[cnno] Instrument number

- 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 applied
- Setting range: 0 to 95
- Default: 0

[cnSP] Communication speed

- Selects the communication speed of this instrument.
  (The communication speed of this instrument must be equal to that of the host computer, otherwise communication is impossible.)
- Available only when the Serial communication (C, C5 option) is applied
- Selection item:
  □□24 (2400bps)
  □□48 (4800bps)
  □□96 (9600bps)
  □192 (19200bps)
- Default: 9600bps

6.5 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 proceeds to Auxiliary function setting mode 2.
The set value can be increased or decreased normally by pressing the ▲, ▼, and faster with the FAST key.
Pressing the MODE key registers the set value, and proceeds to the next setting item.

[SCLH] Scaling high limit
- Sets scaling high limit value.
  Not available if thermocouple or RTD is selected during Input type selection.
- Setting range: Scaling low limit value to Input range high limit value
- Default: 9999

[SCLL] Scaling low limit
- Sets scaling low limit value.
  Not available if thermocouple or RTD is selected during Input type selection.
- Setting range: Input range low limit value to scaling high limit value
- Default: –1999

[dP□□] Decimal point place
- Selects the decimal point place.
- Not available if thermocouple or RTD is selected during Input type selection
- Selection item:
  □□□0 (No decimal point)
  □□0.0 (1 digit after the decimal point)
  □0.00 (2 digits after the decimal point)
  0.000 (3 digits after the decimal point)
- Default: No decimal point

[FILT] PV filter time constant
- Sets PV filter time constant.
  When PV fluctuates due to disturbance, find a value which does not fluctuate by gradually increasing the value. However, if the value is set too large, it affects control result due to the delay of response.
- Setting range: 0.0 to 10.0 seconds
- Default: 0.0 seconds

[AL3F] A3 type (for FCD-15A)
- Selects the Alarm 3 (A3) type.
- Available only when Alarm 3 (SA option) is added
- Default: No alarm action
- Selection item
  ----: No alarm action
  H□□□: High limit alarm
  H□□u: High limit alarm with standby
  L□□□: Low limit alarm
  L□□u: Low limit alarm with standby
  HL□□: High/Low limits alarm
  HL□u: High/Low limits alarm with standby
  oI d□: High/Low limit range alarm
  oI du: High/Low limit range alarm with standby
  PH□□: Process high alarm
  PH□u: Process high alarm with standby
  rPH□: Process low alarm
  rPHu: Process low alarm with standby

[AL4F] A4 type (for FCD-15A)

- Selects the Alarm 4 (A4) type.
- Available only when Alarm 4 (SA option) is added
- Selection items are the same as those of Alarm 3 (A3) type selection.
- Default: No alarm action

[A1HY] A1 hysteresis

- Sets Alarm 1 (A1) hysteresis.
- Not available if Rotary switch (SW302) is set to No.0 or No.7 during A1 type selection.
- Setting range: Thermocouple, RTD input: 0.1 to 100.0℃
  DC input: 1 to 1000 (The placement of the decimal point follows the selection.)
- Default: 1.0℃

[A3HY] A3 hysteresis (for FCD-15A)

- Sets Alarm 3 (A3) hysteresis.
- Not available if Alarm 3 (SA option) is not added, or if [----] is selected during Alarm 3 type selection even if SA option is added
- Setting range and default value are the same as those of A1 hysteresis setting.

[A4HY] A4 hysteresis (for FCD-15A)

- Sets Alarm 4 (A4) hysteresis.
- Not available if Alarm 4 (SA option) is not added, or if [----] is selected during Alarm 4 type selection even if SA option is added
- Setting range and default value are the same as those of A1 hysteresis setting.

[A1dY] A1 action delayed timer setting

- Sets A1 action delayed timer.
  When setting time has elapsed after the input enters the alarm output range, the alarm is activated.
- Not available if the Rotary switch (SW302) is set to No.0 or No.7 during A1 type selection.
- Setting range: 0 to 9999 seconds
- Default: 0 seconds

[A3dY] A3 action delayed timer (for FCD-15A)

- Sets A3 action delayed timer.
  When setting time has elapsed after the input enters the alarm output range, the alarm is activated.
- Not available if Alarm 3 (SA option) is not applied, or if [----] is selected during Alarm 3 type selection even if SA option is added
- Setting range and default value are the same as those of A1 action delayed timer setting.

[A4dY] A4 action delayed timer (for FCD-15A)

- Sets A4 action delayed timer.
  When setting time has elapsed after the input enters the alarm output range, the alarm is activated.
- Not available if Alarm 4 (SA option) is not applied, or if [----] is selected during Alarm 4 type selection even if SA option is added
- Setting range and default value are the same as those of A1 action delayed timer setting.

[rSLH] External setting input high limit

- Sets the high limit value for external setting input.
  For EA option (4 to 20mA), the value corresponds to 20mA input.
- Available only when External setting (EA or EV option) is added
- Setting range: External setting input low limit value to Input range high limit value
- Default: 400℃

[rSLL] External setting input low limit
- Sets the low limit value for external setting input.
  For EA option (4 to 20mA), the value corresponds to 4mA input.
- Available only when External setting (EA or EV option) is added
- Setting range: Input range low limit value to External setting input high limit value
- Default: 0℃

[trnS] Transmission output
- Selects the Transmission output type.
- Available only when Transmission output (TA or TV option) is added
- Selection item:
  PV□□: PV (process variable) transmission
  SV□□: SV (desired value) transmission
  MV□□: Open/Closed output MV (manipulated variable) transmission
- Default: PV transmission

[trLH] Transmission output high limit
- Sets the Transmission output high limit value.
  For TA option, the value correponds to 20mA output.
- Available only when Transmission output (TA or TV option) is added
- Transmission output during control standby:
  PV transmission: PV
  SV transmission: 0
  Open/Closed output MV transmission: 0
- Setting range: Transmission output low limit value to Input range high limit value
- Default: 400℃

[trLL] Transmission output low limit
- Sets the Transmission output low limit value.
  For TA option, the value correponds to 4mA output.
- Available only when Transmission output (TA or TV option) is applied
- Transmission output during control standby:
  PV transmission: PV
  SV transmission: 0
  Open/Closed output MV transmission: 0
- Setting range: Input range low limit value to Transmission output high limit value
- Default: 0℃

[PSB□] Indication selection when control output is OFF
- Selects the indication when control output is off.
- Selection item:
  oFF□: OFF is indicated on the PV display.
  AoFF: No indication (all unlit)
  PV□□: Only PV is indicated.
- Default: oFF□

[P_c□] MV computation cycle
- Sets MV computation cycle for Open/Closed output.
- Setting range: 1 to 120sec
- Default: 3sec

[r.RTU] SV rise rate

- Sets the SV rise rate (Rising value per minute).
  Setting the value to 0 or 0.0 disables the function.
- Setting range:
  Thermocouple except T, RTD without a decimal point : 0 to 9999℃/min (℉/min)
  Thermocouple T, RTD with a decimal point : 0.0 to 999.9℃/min (℉/min)
  DC input: 0 to 9999 (The placement of the decimal point follows the selection.)
- Default: 0℃/minute (℉/min)

[r.RTd] SV fall rate

- Sets the SV fall rate (Falling value per minute).
  Setting the value to 0 or 0.0 disables the function.
- Setting range and default value are the same as those of SV rise rate setting.

6.6 Open/Closed output time setting mode

In the PV/SV display mode, if the FAST key is pressed for approx. 3 seconds while holding down the ▲ and ▼ keys, the unit proceeds to Open/Closed output time setting mode.

The set value can be increased or decreased normally by pressing the ▲, ▼ and faster with the FAST key.

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

[Po□] Open output time

- Sets time from the valve fully closed to the valve fully open.
- Setting range: 0.1 to 999.9sec
- Default: 30.0sec

Automatic measuring method

(1) Check that the valve is at the fully closed position, and press the ▲ and ▼ keys simultaneously.
Time count starts from 0 seconds to measure open output time.
Control motor OPEN output will turn ON after count starts, and makes the valve open.

(2) Press the FAST key when the valve is fully open. Time count stops, open output time is registered, and the control motor OPEN output turns OFF.

[Pc□] Closed output time setting

- Sets time from the valve fully open to the valve fully closed.
- Setting range: 0.1 to 999.9sec
- Default: 30.0sec

Automatic measuring method

(1) Check that the valve is at the fully open position, and press the ▲ and ▼ keys simultaneously.
Time count starts from 0 seconds to measure the closed output time.
Control motor CLOSED output will turn ON after count starts, and makes the valve closed.

(2) Press the FAST key when the valve is fully closed. Time count stops, closed output time is registered, and the control motor CLOSED output turns OFF.

6.7 Program mode

In PV/SV display mode, if the ▼ key is pressed for approximately 3 seconds while holding down the ▲ key, the unit enters Program mode.

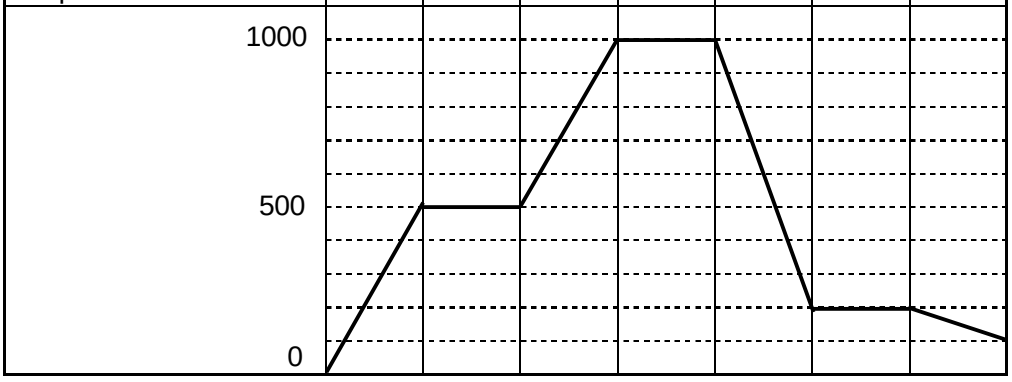
The set value can be increased or decreased normally by pressing the ▲, ▼ and faster with the FAST key.

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

- Each value of Set value memory numbers (1 to 7) set during the Fixed value control are assigned to the value for Steps 1 to 7.
  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 program control is performed, the Pattern end output is turned on when the program is completed.
- If the OUT/OFF key is pressed while the Pattern end output is on, the Pattern end output is turned off. If the OUT/OFF key is pressed again, the program will be performed.
- Set the step time to 00.00 for the unnecessary steps.

Program Example

Step number (Set value memory number)	1	2	3	4	5	6	7
SV	500	500	1000	1000	200	200	100
Proportional band	2.0	1.8	2.0	1.8	2.5	1.8	2.0
Integral time	180	80	180	80	200	80	200
Derivative time	30	20	30	20	50	20	50
Open/Closed dead band	1.0	1.0	1.0	1.0	1.0	1.0	1.0
Alarm 1 value	2	5	2	5	10	0	5
Alarm 3 value	2	5	2	5	10	0	5
Alarm 4 value	2	5	2	5	10	0	5
Step time	00:30	01:00	00:40	01:00	02:00	00:30	01:00



[Proc] Fixed value control/Program control

- Selects fixed value control or program control.
- If the MODE key is pressed in the fixed value control, the controller reverts to the PV/SV display mode.
  (If the controller is not set to program control mode, Step time setting (from Step 1 time) is impossible.
- Selection item: oFF (Fixed value control)
  Proc (Program control)
- Default: Fixed value control

If "Proc (program control)" is selected during Fixed value control/Program control selection mode and the MODE key is pressed, Steps 1 to 7 time can be set.

Steps 1 to 7 time setting (indicated only during program control)

[T_1] Step 1 time

- Sets Step 1 time. (Available only for program control)
- 00.00
  - Minute
  - Hour

  (e.g.) When setting 1 hour 58 minutes, set as [1.58].
- Setting range: 00.00 to 99.59
- Default: 00.00

[T_2] Step 2 time

- Sets Step 2 time. (Available only for program control)
- Setting range and default value are the same as those of Step 1 time setting.

[T_3] Step 3 time

- Sets Step 3 time. (Available only for program control)
- Setting range and default value are the same as those of Step 1 time setting.

[T_4] Step 4 time

- Sets Step 4 time. (Available only for program control)
- Setting range and default value are the same as those of Step 1 time setting.

[T_5] Step 5 time

- Sets Step 5 time. (Available only for program control)
- Setting range and default value are the same as those of Step 1 time setting.

[T_6] Step 6 time

- Sets Step 6 time. (Available only for program control)
- Setting range and default value are the same as those of Step 1 time setting.

[T_7] Step 7 time

- Sets Step 7 time. (Available only for program control)
- Setting range and default value are the same as those of Step 1 time setting.

6.8 Auto/Manual control

Manually output MV (manipulated variable) can be changed.
As the proportional action, the MV is automatically outputted in proportion to the deviation. This is an automoatic control.

As compared with the above, in the manual control, the value set by front keypad can be outputted regardless of the deviation.
The balance/bumpless function is provided to prevent rapid output change when the control mode is changed from Automatic to Manual and vice versa.
Each time the OUT/OFF key is pressed, the control changes from Automatic to Manual and vice versa.

Manual control
MV 0.0% : Valve fully Closed
MV 100.0% : Valve fully Open
For the MV (0.1 to 99.9%) other than 0.0% and 100.0%, Open output ON time and Closed output ON time will be determined by the relation between the MV at the given time and set values (Open/Closed output dead band, MV computation cycle, Open output time, Closed output time, etc.).
• Setting range: 0.0 to 100.0%

6.9 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. "oFF" is indicated on the PV display while the function is working.
- Pressing the OUT/OFF key for approx. 1 second from any mode enables the control output OFF function. PV display indicates oFF, No indication or PV previously selected during "Indication selection when control output is OFF" mode.
  To cancel the function, press the OUT/OFF 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 OUT/OFF key again for approx. 1 second.
- During program control, the OUT/OFF key becomes the Program Start/Stop key, so the control output OFF function is disabled.

6.10 Open/Closed output MV, Remaining step time indication

In the PV/SV display mode, press the MODE key for approx. 3 seconds.
Keep pressing the MODE key until the Open/Closed output MV appears, though the main setting mode appears temporarily during the process.
The MV indicator lights, and the SV display indicates Open/Closed output MV.

In the fixed value control, when the MODE key is pressed again, the mode reverts to the PV/SV display.

In the program control, if the MODE key is pressed while an output MV(manipulated variable) is indicated, the unit changes to the Remaining step time indication mode.
The TIME indicator lights, and the SV display indicates remaining step time.
If the MODE key is pressed again, the mode reverts to the PV/SV display mode.

7. Set value memory function (SM option)

If the SM option is applied, Set value memory number can be selected externally.
A maximum of 7 files with 8 pieces of data (6 pieces for FCR-15A) can be memorized.
Control can be performed with the desired file.
In one file, 8 kinds of set value (SV, PID values, Open/Closed output dead band, A1, A3, A4 value) are included.
(A3, A4 values are applicable only to the FCD-15A.)
To select the set value memory number, connect terminals 13 to 16 as shown below.
Up to 50 units can be connected in parallel.

Terminal connection for Set value memory number

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.
- When selecting 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 (auto-tuning).

Operation procedures

(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, PID values, Open/Closed output dead band, A1, A3, A4 values
(3) After setting, press the MODE key to revert to the PV/SV display mode.

Registration

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

8. Running

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

8.1 When using the instrument as a Temperature controller

(1) Turn the power supply to the instrument ON.

For approx. 2sec after power-on, the input type and temperature unit selected during the Input type selection are indicated on PV display, and the input range high limit value is indicated on the SV display. See (Table 8.1-1).
During this time, all outputs and LED indicators are in OFF status.
After that, the instrument enters the PV/SV display mode.
While the Control output OFF function is working, the item selected during "Indication selection when control output is OFF" is displayed on the PV display.

(Table 8.1-1)

Input	℃		℉	
	PV display	SV display	PV display	SV display
K	t□□C	1370	t□□F	2500
J	J□□C	1000	J□□F	1800
R	r□□C	1760	r□□F	3200
B	b□□C	1820	b□□F	3300
PL-Ⅱ	PL2C	1390	PL2F	2500
N	n□□C	1300	n□□F	2300
S	S□□C	1760	S□□F	3200
E	E□□C	1000	E□□F	1800
T	T□□C	400.0	T□□F	750.0
C(W/Re5-26)	c□□C	2315	c□□F	4200
Pt100	Pt□C	850.0	Pt□F	999.9
	Pt□C	□850	Pt□F	1560
JPt100	JPtC	500.0	JPtF	900.0
4 to 20mA DC	42A□	Scaling high limit value	42A□	Scaling high limit value
0 to 20mA DC	02A□		02A□	
0 to 1V DC	0 1b□		0 1b□	

(2) Input the set value, referring to Chapter 6. Operation.

When controlling with Fuzzy self-tuning PID action, select "Perform" during Auto-tuning Perform/Cancel to start control in optimum 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 instrument as a Simplified program controller

(1) Turn the power supply to the instrument ON.

For approx. 2sec after power-ON, input characters and temperature unit selected during Input type selection are indicated on PV display, and the input range high limit value is indicated on the SV display (Table 8.1-1).

During this time, all outputs and LED indicators are in OFF status.
After that, the instrument enters PV/SV display mode.

While Control output OFF function is working, the item selected during “Indication selection when control output is OFF” is displayed on the PV display.

(2) Input SV and step time, referring to Chapter 6. Operation.

The PV display indicates actual temperature and the unit enters standby status.

(3) Turn the load circuit power ON.

(4) Program control start

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

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

While program control is performing, Step number change (Set value memory number) is invalidated.

To make the step time progress faster.

The step time progress becomes 60 times faster than usual while the FAST key is being pressed.

To end the program control in process.

The program control ends if the OUT/OFF key is pressed for approx. 1 second or longer.

PV/SV display, Open/Closed output MV, Remaining step time indication

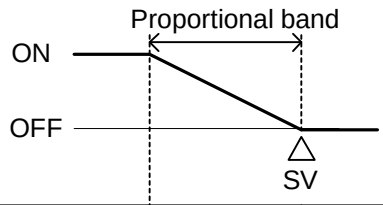
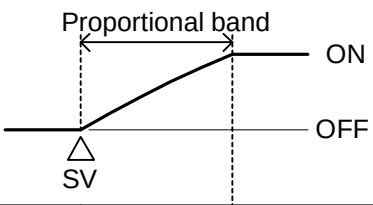
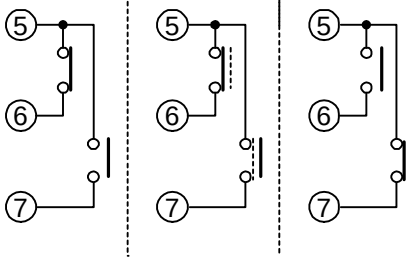
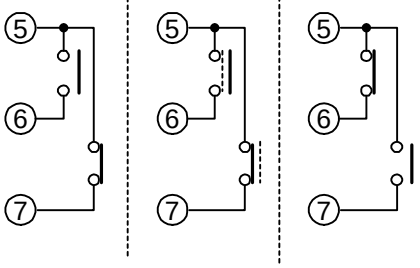
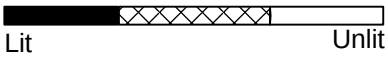
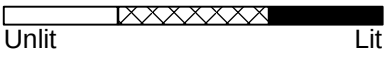
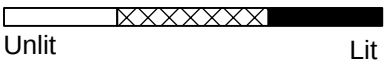
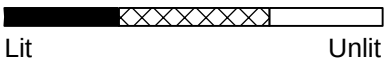
In the PV/SV display, if the MODE key is pressed for approximately 3 seconds, the unit indicates Open/Closed output MV (manipulated variable), and if the MODE key is pressed again, remaining step time will be indicated.

Instrument status when power is restored.

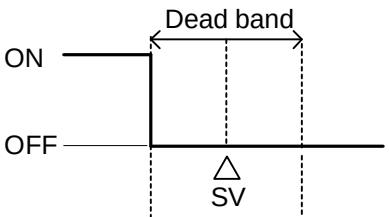
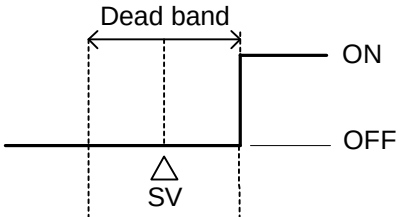
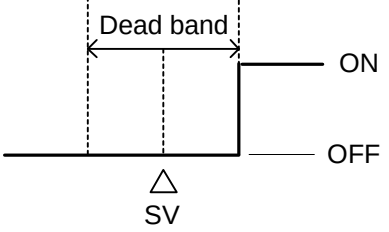
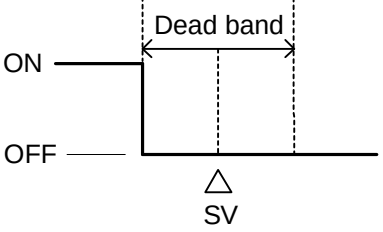
When power is restored during program control, the instrument resumes the program continuously.
The PV display flashes until the step at which the power failure occurred is finished.

9. Action explanations

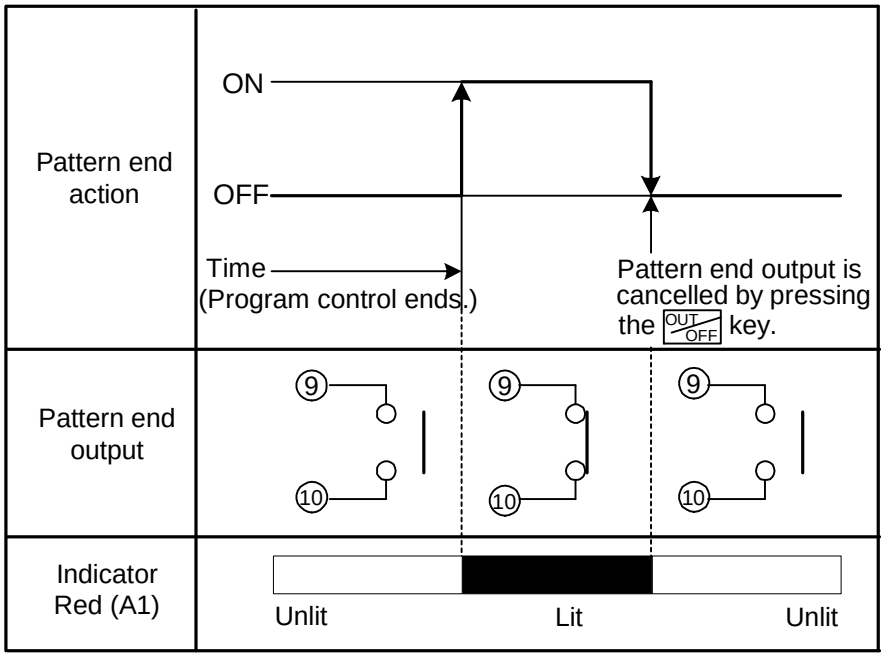
9.1 Standard action

	Heating (reverse) action	Cooling (direct) action
Control action		
Open output ⑤—⑥ Closed output ⑤—⑦	 Cycle action is performed according to deviation.	 Cycle action is performed according to deviation.
Indicator Open output Green		
Indicator Closed output Yellow		

9.2 Open/Closed output dead band action

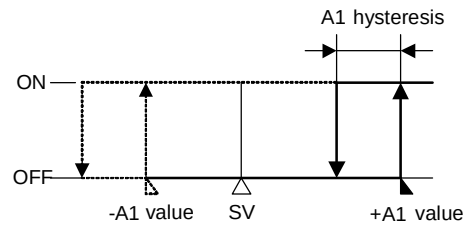
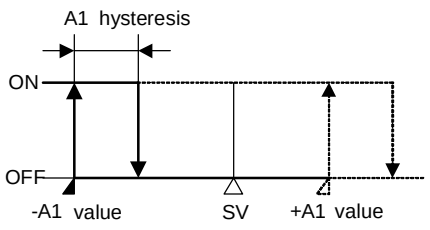
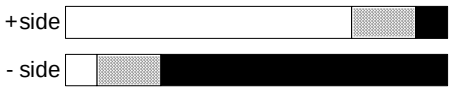
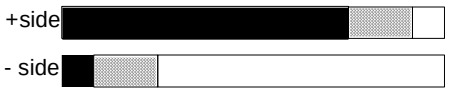
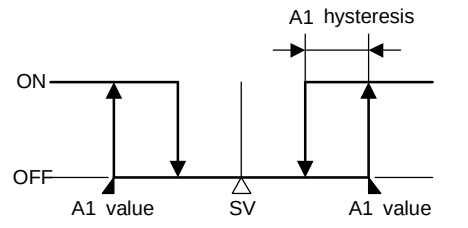
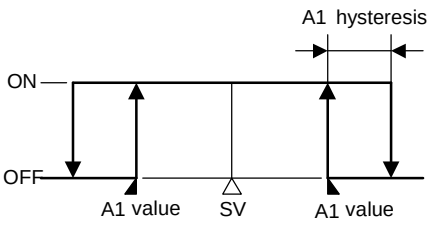
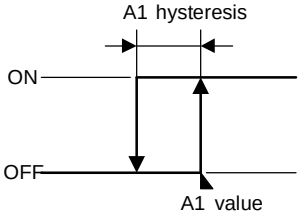
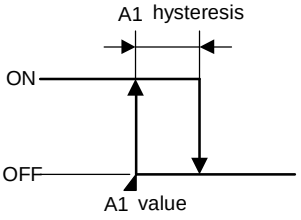
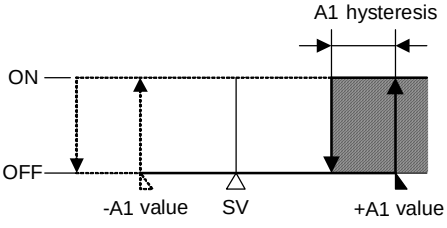
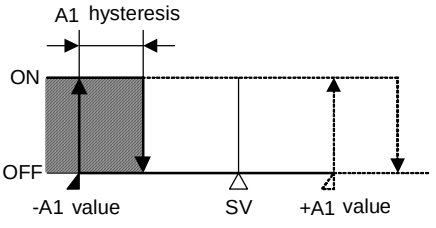
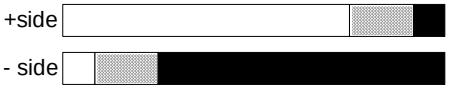
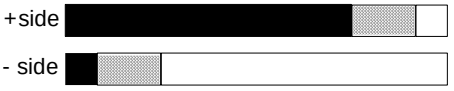
	Heating (reverse) action	Cooling (direct) action
Open output		
Closed output		

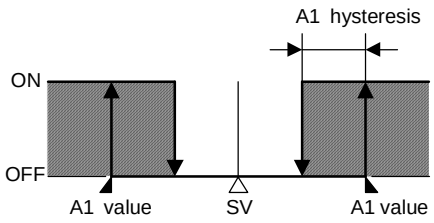
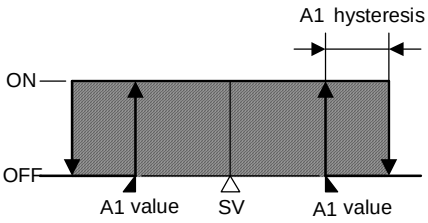
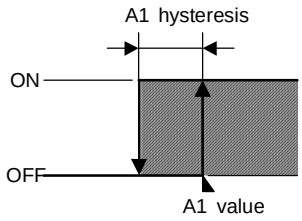
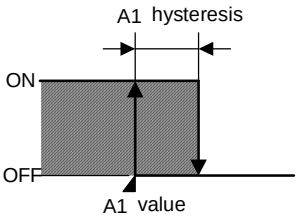
9.3 Pattern end action



Pattern end output is turned ON after program control ends, and it is not cancelled until the OUT/OFF key is pressed.

9.4 Alarm 1 (A1), Alarm 3 (A3) and Alarm 4 (A4) action

<table>
<tr><td></td><td>High limit alarm</td><td>Low limit alarm</td></tr>
<tr><td>Alarm action</td><td> 
</td><td> 
</td></tr>
<tr><td>Alarm output</td><td> 
</td><td> 
</td></tr>
<tr><td></td><td>High/ Low limits alarm</td><td>High/Low limit range alarm</td></tr>
<tr><td>Alarm action</td><td> 
</td><td> 
</td></tr>
<tr><td>Alarm output</td><td>  </td><td>  </td></tr>
<tr><td></td><td>Process high alarm</td><td>Process low alarm</td></tr>
<tr><td>Alarm action</td><td> 
</td><td> 
</td></tr>
<tr><td>Alarm output</td><td>  </td><td>  </td></tr>
<tr><td></td><td>High limit alarm with standby</td><td>Low limit alarm with standby</td></tr>
<tr><td>Alarm action</td><td> 
</td><td> 
</td></tr>
<tr><td>Alarm output</td><td> 
</td><td> 
</td></tr>
</table>

	High/Low limits alarm with standby	High/Low limit range 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.

For A3 (A4) output, read “A3 (A4)” for “A1”.

For A3 output, use terminals 29 and 30.
For A4 output, use terminals 28 and 30.

A1, A3 and A4 indicators light when their output terminals are connected, and go off when their output terminals are disconnected.
(A3 and A4 are applicable to the FCD-15A.)

10. Control actions

10.1 Fuzzy self-tuning

Fuzzy self-tuning is a function to perform a fine adjustment of PID values automatically. The stable control can be carried out even if the conditions of the production process are changed due to things like variation and variability.

> If Lock 1 or Lock 2 is selected, Fuzzy self-tuning or Auto-tuning does not work.
> In the control system in which load fluctuation periodically occurs, the Fuzzy self-tuning may malfunction.
> In such cases, use the controller with the PID auto-tuning mode.

(1) When the control initiates, the unit performs this function by the PID values previously adjusted.
(2) When the control result is disordered by disturbance or a change in the process, the controller checks the converging status, and performs a fine adjustment of PID values if necessary.

(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 changes the PID values to correct this.
(d) When hunting occurs, the controller checks its waveform and performs a fine adjustment of PID values.

The instrument is always 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, auto-tuning starts automatically.
When the auto-tuning “Perform” is selected by the keypad, auto-tuning initiates.
When the control is stabilized, the auto-tuning is released and the controller returns to self-tuning status.

The controller can be used without Fuzzy self-tuning by selecting the internal switch.
When using the controller without Fuzzy self-tuning, perform the PID auto-tuning or set the proper PID values by key operation.

10.2 Explanations of 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 PV (process variable).

If the proportional band is narrowed, even if the output changes by a slight variation of the PV (process variable), 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 PV (process variable), control action changes to ON/OFF action and the so-called hunting phenomenon occurs.

Therefore, when the PV (process variable) 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 the control becomes unstable.

(3) Derivative time (D)

Derivative action is used to restore the change in the PV (process variable) according to the rate of change. It reduces the amplitude of overshoot and undershoot width.

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

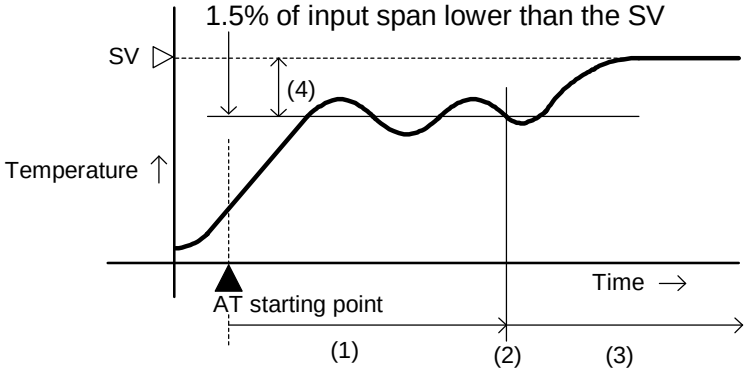
10.3 PID auto-tuning of this controller

In order to set each value of P, I, D and ARW automatically, the auto-tuning process should be made to fluctuate to obtain an optimal value.

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

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

The AT process will fluctuate at a temperature of 1.5% input span lower than the SV.

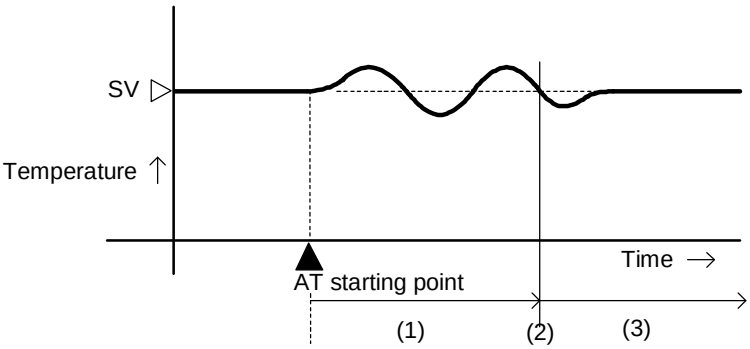


(1) Calculating PID constant
(2) PID constant calculated
(3) Controlled by the PID constant set by auto-tuning.
(4) 1.5% of input span

(Fig. 10.3-1)

(B) When the control is stable or when control temperature is within 1.5% of input span of the SV

The AT process will fluctuate around the SV.

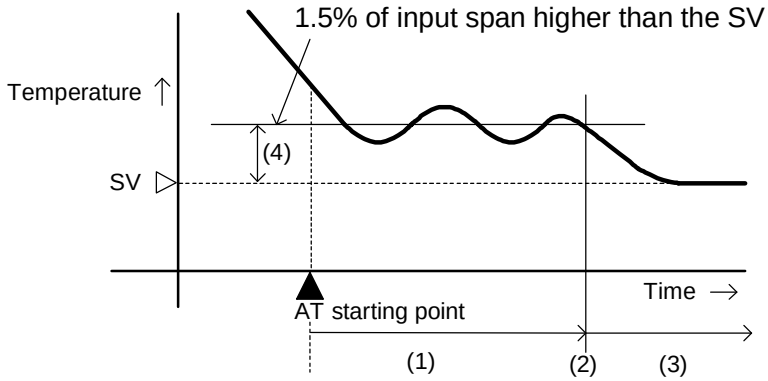


(1) Calculating PID constant
(2) PID constant calculated
(3) Controlled by the PID constant set by auto-tuning.

(Fig. 10.3-2)

(C) In the case of a large difference between the SV and PV (process variable) as the temperature is falling

The AT process will fluctuate at a temperature of 1.5% input span higher than the SV.



(1) Calculating PID constant
(2) PID constant calculated
(3) Controlled by the PID constant set by auto-tuning.
(4) 1.5% of input span

(Fig. 10.3-3)

11. Other functions

(1) Burnout

Overscale

When the thermocouple or RTD is burnt out, or if the input value exceeds [Input range high limit value +1% of input span], Open output is turned OFF (Closed output ON), and the PV display flashes "▔▔▔▔".
With the RTD Pt100 (℉) (with a decimal point), if the input value exceeds 999.9, the PV display flashes "▔▔▔▔", however, the control will perform to [Input range high limit value +1% of input span].

For DC input, if the input value exceeds [Scaling high limit value+10% of the scaling span], Open output is turned OFF (Closed output ON), and the PV display flashes "▔▔▔▔".
If the input exceeds 9999, the PV display flashes "▔▔▔▔", however, the control performs to [scaling high limit value +10% of scaling span].

Underscale

When the input value drops below [Input range low limit value -1% of input span], Open output is turned OFF (Closed output ON), and PV display flashes "▁▁▁▁".
With the Thermocouple T and RTD input, if the input value drops below -199.9, and the PV display flashes "▁▁▁▁". However, the control will perform to [Input range low limit value -1% of input span].

For DC input, if the input value drops below [Scaling low limit value -1% of the scaling span], Open output is turned OFF (Closed output ON), and the PV display flashes "▁▁▁▁".
If the input value drops below -199.9, the PV display flashes "▁▁▁▁". However, the control will perform to [Scaling low limit value -1% of scaling span].

(2) 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.

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

This detects the temperature at the connecting terminal between thermocouple and the instrument, and always keeps it at the same status as if the reference junction is located at 0℃ (32℉).

(4) Warm-up indication

For approximately 2 seconds after the power supply to the instrument is turned 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) on the SV display.

(5) SV (desired value) 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 (process variable) and approaches the SV by the rate of change.

12. Specifications

12.1 Standard specifications (Common to FCD-15A, FCR-15A)

Mounting : Flush

Setting : Input system using membrane sheet key

Display

[FCD-15A]

PV display : Red LED display 4 digits, size, 14.3(H) x 8(W)mm
SV/MV/TIME display: Green LED display 4 digits, size, 10(H) x 5.5(W)mm
MEMO display : Yellow LED display 1 digit, size, 8(H) x 4(W)mm

[FCR-15A]

PV display : Red LED display 4 digits, size, 8(H) x 4(W)mm
SV/MV/TIME display: Green LED display 4 digits, size, 8(H) x 4(W)mm
MEMO display : Yellow LED display 1 digit, size, 8(H) x 4(W)mm

Accuracy (Setting, Indication)

Thermocouple : Within ±0.2% of input span ±1digit
However,
K, J, T input, range less than 0℃ (32℉): Within ±0.4% of input span ±1digit
R, S input, range 0 to 200℃ (0 to 400℉): Within ±4℃(8℉)
(Cold junction temperature compensating accuracy: ±1℃, at 0 to 50℃)

RTD : Within ±0.2% of input span ±1digit

DC current : Within ±0.2% of input span ±1digit

DC voltage : Within ±0.2% of input span ±1digit

Input sampling period : 0.125 seconds (0.25 seconds for EA, EV option)

Input

Thermocouple : K, J, R, S, B, E, T, N, PL-Ⅱ, C (W/Re5-26),
External resistance, 100Ω or less
For input burnout, Overscale

RTD : Pt100, JPt100, 3-wire system
Allowable input lead wire resistance, 10Ω or less per wire
For input burnout, Overscale

DC current : 0 to 20mA DC, 4 to 20mA DC
Input impedance, 50Ω
Allowable input current, 100mA or less
For input burnout, 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
For input burnout, Overscale

Control output

Relay contact : 1a x 2
Control capacity, 3A 250V AC (resistive load)
1A 250V AC (inductive load $\cos\phi$=0.4)

Alarm 1 output

The alarm action point is set by ±deviation from the SV (desired value) (except Process alarm).
When the input is out of the range, the output turns ON or OFF (in the case of High/Low limit range alarm).
One alarm is selectable by the rotary switch and DIP switch from the choice of; High limit alarm, Low limit alarm, High/Low limits alarm, High/Low limit range alarm, Process high alarm and Process low alarm, and standby function is applied to them respectively, as well as No alarm action and Pattern end output.
Setting accuracy: Within ±0.2% of input span ±1digit
Action : ON/OFF action
Hysteresis:
Thermocouple, RTD input: 0.1 to 100.0℃ (℉)
DC input: 1 to 1000 (The placement of the decimal point place follows the selection.)
Output: Relay contact, 1a
Control capacity, 3A 250V AC (resistive load)
1A 250V AC (inductive load $\cos\phi$=0.4)

Controlling action

Fuzzy self-tuning PID or PID action is selectable by the DIP switch.

Fuzzy self-tuning PID action

Proportional band (P)	: Automatic
Integral time (I)	: Automatic
Derivative time (D)	: Automatic
MV computation cycle	: 1 to 120sec
Anti-reset windup (ARW)	: Automatic
Dead band	: 0.1 to 100.0% of proportional band
Open output time setting	: 0.1 to 999.9sec
Closed output time setting	: 0.1 to 999.9sec

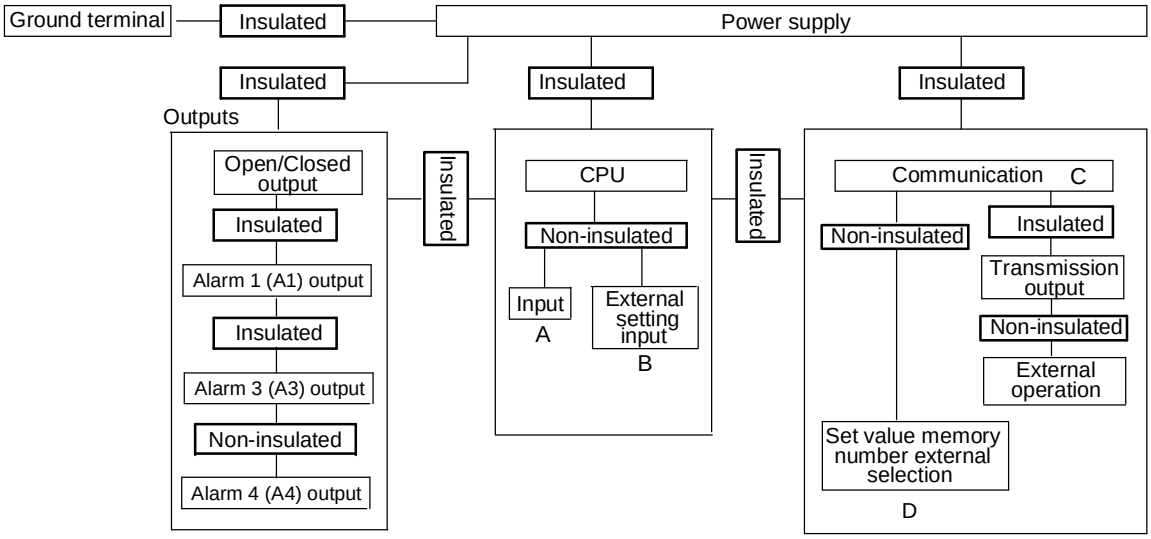
PID action (with auto-tuning function)

Proportional band (P)	: 0.1 to 999.9%
Integral time (I)	: 1 to 3600sec
Derivative time (D)	: 0 to 3600sec (off when set to 0)
MV computation cycle	: 1 to 120sec
Anti-reset windup (ARW)	: Automatic
Dead band	: 0.1 to 100.0% of proportional band
Open output time	: 0.1 to 999.9sec
Closed output time	: 0.1 to 999.9sec

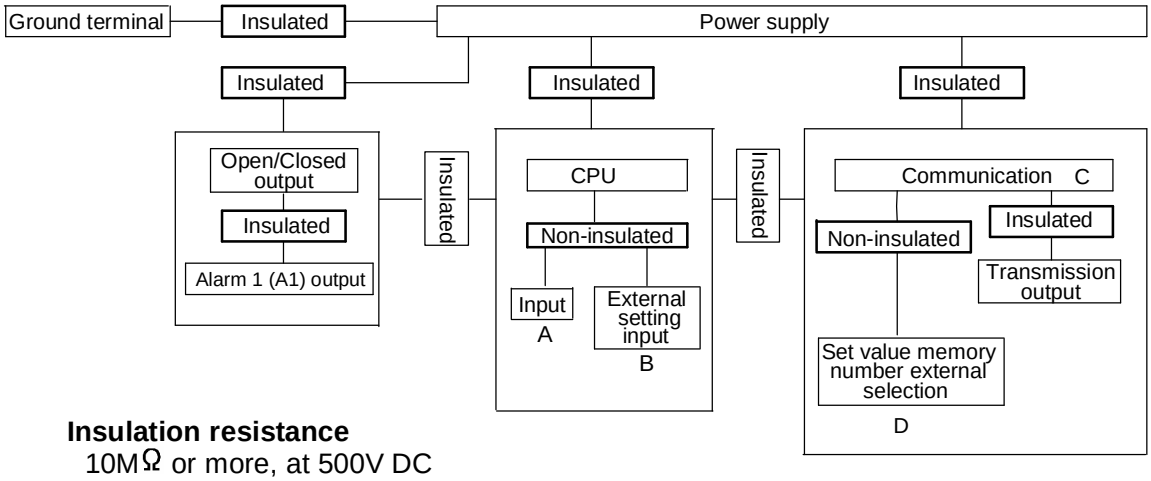
Supply voltage	: 100 to 240V AC, 50/60Hz, 24V AC/DC, 50/60Hz
Allowable voltage fluctuation	: 100 to 240V AC : 85 to 264V AC 24V AC/DC : 20 to 28V AC/DC
Ambient temperature	: 0 to 50℃ (32 to 122℉)
Ambient humidity	: 35 to 85%RH (non-condensing)
Power consumption	: Approx. 15VA

Circuit insulation configuration

[FCD-15A]



[FCR-15A]



Insulation resistance

10MΩ or more, at 500V DC

Insulation test **must not** be carried out between A-B and C-D of Circuit insulation configuration, because they are not 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 power terminal and ground terminal,	1.5kV AC for 1 minute
Open/Closed output terminal and ground terminal,	1.5kV AC for 1 minute
Open/Closed output terminal and power terminal,	1.5kV AC for 1 minute

Weight : FCD-15A: Approx. 500g

FCR-15A: Approx. 320g

External dimensions: FCD-15A: 96 x 96 x 110mm (W x H x D)

FCR-15A: 48 x 96 x 110mm (W x H x D)

Material : Base and Case: Flame-resistant resin

Color : Base and Case: Light gray

Attached functions : Control output OFF, Set value lock,
Sensor correction, Multi-range input,
Alarm action delayed timer, Multi-function,
Simplified program controller, Set value memory,
Power failure countermeasure, Self-diagnosis,
SV ramp, Burnout function,
Warm-up display function,
Loop break alarm indicating function,
Automatic cold junction temperature compensation

A**ccessories** : Mounting brackets 1 set
Instruction manual 1 copy
Unit label 1
Terminal cover: FCD-15A: 2 pieces (When TC option is added)
FCR-15A: 1 piece (When TC option is added)
Wire harness: 3m 1 length (For FCR-15A with TA, TV, EA, EV option)

12.2 Optional specifications

Alarm 3, 4 output (Option code: SA) (for FCD-15A)

The alarm action point is set by ±deviation from the SV (except Process alarm), and when the input exceeds the range, the output turns ON or OFF (in the case of High/Low limit range alarm).
Alarm 3 and 4 are selectable by key operation 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, and standby function is applied to them respectively, as well as No alarm action.
Setting accuracy: Within ±0.2% of input span ±1digit
Action : ON/OFF action
Hysteresis:
Thermocouple, RTD input: 0.1 to 100.0℃ (℉)
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 cosϕ=0.4)
(However, terminals common to A3 and A4: maximum 3A)

Transmission output (Option code: TA, TV)

Converting the value (PV transmission, SV transmission, Open/Closed output MV transmission) to analog signal every 0.125 seconds, outputs the value in current or voltage.
Transmission output (PV, SV, Open/Closed output MV) can be selected by keypad.

Resolution	1/10000
Current (TA)	4 to 20mA DC (load resistance, maximum 550Ω)
Voltage (TV)	0 to 1V DC (load resistance, minimum 100kΩ)
Output accuracy	Within ±0.3% of input span

Serial communication (Option code: C5, C)

Following operations can be executed from the 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) Change of the functions

Communication line	EIA RS-485 (C5) or EIA RS-232C (C)
Communication method	Half-duplex communication
Synchronization method	Start-stop synchronization

Communication speed 2400, 4800, 9600, 19200bps (Selectable by key operation)
Data format Start bit : 1
Data bit : 7
Parity : Even parity
Stop bit : 1

Digital external setting:
Receives digital set value from Shinko programmable controllers such as PCD-33A (with SVTC option) or PC-900 (with SVTC option).
Be sure to select Lock 3 during the Set value lock selection for the FCx-15A.

Set value memory number external selection (Option code: SM)
Selects the set value memory number from 7 files (mentioned below is 1 file) by external terminals.
(SV, PID values, Open/Closed dead band, Alarm 1, 3 and 4 values)
Memory numbers: 1 to 7 (7 files)
Data : FCD-15A: 8 pieces of data
FCR-15A: 6 pieces of data

External setting (Option code: EA, EV)
The SV (desired value) can be set using the external analog signal.
Setting signal : DC current (EA)
0 to 20mA DC, 4 to 20mA DC
Input impedance, 50Ω (Not insulated from the input)
: DC voltage (EV)
0 to 1V DC, 1 to 5V DC
Allowable input voltage, 5V or less for 0 to 1V DC
10V or less for 1 to 5V DC
Input impedance, 100kΩ (Not insulated from the input)
Setting signal sampling period: 0.25 seconds (If this function is applied, the input sampling period will also change to 0.25 seconds.)

External operation:
If External setting option is applied, Remote/Local setting and Auto/Manual control can be switched externally.

Terminals 25 - 27	Closed	: Remote setting
	Open	: Local setting
Terminals 26 - 27	Closed	: Manual control
	Open	: Automatic control

Color black (Option code: BK)
Front panel : Dark gray
Case : Black

Screw type mounting bracket (Option code: BL)
Mounting panel thickness: 1 to 8mm

Terminal cover (Option code: TC)
Electrical shock protection terminal cover

Dust-proof/Drip-proof (IP)
Dust-proof and Drip-proof specification (IP54)
- Effective for only front panel surface, case section is excluded.
- Effective only when the FCx-15A is mounted vertically.

User specified

Input, Scale range	: Shipped at specified range
Alarm action	: Shipped at specified alarm action (A1, A3, A4)
Control action	: Shipped at specified control action (PID)
Transmission output	: Shipped at specified output (e.g.) SV transmission 0-20mA DC (Transmission output option)
External setting	: Shipped at specified input. (e.g.) 1-5V DC (External setting option)

13. Troubleshooting

If any malfunctions occur, refer to the following after checking the power supply to the controller.

⚠ 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.

<Indication>

Problem	Presumed cause and solution
[oFF] is indicated on the PV display.	• Control output OFF function is working. Press the OUT/OFF key for approx. 1sec to release the function.
[- - - -] is flashing on the PV display.	• Burnout of thermocouple, RTD or disconnection of DC voltage (0 to 1V DC). Change each sensor. **How to check whether the sensor is burnt out** [Thermocouple] 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. [RTD] If approx. 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℃ (32℉) is indicated, the instrument is likely to be operating normally, however, the sensor may be burnt out. [DC voltage (0 to 1V DC)] If the input terminals of the instrument are shorted, and if a scaling low limit value is indicated, the instrument is likely to be operating normally, however, the signal wire may be disconnected. • Check whether the input terminals of thermocouple, RTD or DC voltage (0 to 1V DC) are securely mounted to the instrument input terminals.
[- - - -] is flashing on the PV display.	• Check if polarity of thermocouple or compensating lead wire is correct. • Check whether codes (A, B, B) of RTD agree with the instrument terminals. • For 4-20mA DC input, if the input to the input terminals of the instrument is 4mA DC and if a scaling low limit value is indicated, the instrument is likely to be operating normally, however, the signal wire may be disconnected. • For 0-20mA DC input, check whether the signal wire is securely connected to the instrument input terminals.
The indication of the PV display is abnormal or unstable.	• Designation of the sensor input is not proper. Set the input type properly with the Rotary switch (SW303) and DIP switch (SW304). • Check whether the temperature unit (℃ or ℉) is correct. Set the unit properly with the DIP switch (SW304). • Sensor correction value is not suitable. Set it to a suitable value. • Check whether the specification of the sensor is correct. • AC is leaking into the thermocouple or 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
Setting mode cannot be selected.	• Manual control is selected. Change the mode to Automatic control.
It is impossible to change the mode from Remote setting to Local setting by key operation.	• Remote setting has been selected using the External setting (EA or EV option). External operation has priority.
The mode cannot be changed from Manual control to Automatic control by key operation.	• Manual control has been selected using an External setting (EA or EV option). External operation has priority.
Settings are impossible. The value does not change by the ▲, ▼ keys.	• Lock 1 or Lock 2 is selected during Set value lock selection. Release the lock. • During PID auto-tuning. Cancel auto-tuning if necessary.
The setting indication does not change in the input range even if the ▲, ▼ keys are pressed, and new values are unable to be set.	• SV high limit or low limit may be set at the point where the value does not change. Set it to a suitable value while in Auxiliary function setting mode 1.
Program control does not start even if the OUT/OFF key is pressed in the Program mode.	• Step time has not been set. Set the step time.

<Control>

Problem	Presumed cause and solution
PV (Temperature) does not rise.	• Sensor is out of order. Replace the sensor. • Check whether the Sensor is securely mounted to the instrument input terminals. Ensure that the sensor is securely mounted to the instrument input terminals. • Check whether the wiring of sensor is correct.
Control does not start. (The PV display is indicated)	• Program mode is selected. If running by Program mode, press the OUT/OFF key. When performing by Fixed value control, press the ▼ key for approx. 3sec while holding down the ▲ key to select the Fixed value control mode.
The value is fully open or fully closed regardless of the controlling temperature high or low.	• Check whether Open/Closed output time is set suitably. Set the time to a suitable value.

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

14. Character table

Photocopiable material

Alarm 3 and Alarm 4 (value, type, hysteresis, delayed timer) are applicable to the FCD-15A.

<Main setting mode>

Character	Item	Default	Data
SV	SV	0℃	

<Sub setting mode>

Character	Item	Default	Data
mno	Set value memory number	1	
AT	AT (Auto-tuning) Perform/Cancel	Cancel	
P	Proportional band	2.5%	
I	Integral time	200sec	
d	Derivative time	50sec	
P_db	Open/Closed output dead band	3.0%	
A1	Alarm 1 value	0℃	
A3	Alarm 3 value	0℃	
A4	Alarm 4 value	0℃	
LP_T	Loop break alarm time	0 min	
LP_H	Loop break alarm span	0℃	

<Auxiliary function setting mode 1>

Character	Item	Default	Data
Loc	Set value lock	Cancel	
SH	SV high limit	400℃	
SL	SV low limit	0℃	
Sb	Sensor correction	0.0℃	
rEmo	Remote/Local	Local	
cmno	Instrument number	0	
cmSP	Communication speed	9600bps	

<Auxiliary function setting mode 2>

Character	Item	Default	Data
SrLH	Scaling high limit	9999	
SrLL	Scaling low limit	−1999	
dP	Decimal point place	No decimal point	
FILT	PV filter time constant	0.0sec	
AL3F	Alarm 3 type	No alarm	
AL4F	Alarm 4 type	No alarm	
A1HY	Alarm 1 hysteresis	1.0℃	
A3HY	Alarm 3 hysteresis	1.0℃	
A4HY	Alarm 4 hysteresis	1.0℃	
A1dY	Alarm 1 delayed timer	0sec	
A3dY	Alarm 3 delayed timer	0sec	
A4dY	Alarm 4 delayed timer	0sec	
rSLH	External setting high limit	400℃	
rSLL	External setting low limit	0℃	

rtrn	Transmission output	PV (PV)	
trtH	Transmission output high limit	400℃	
trtL	Transmission output low limit	0℃	
PtHd	Indication selection when control output is OFF	oFFd	
P_cd	MV computation cycle	3sec	
rAtU	SV rise rate	0℃/minute	
rAtd	SV fall rate	0℃/minute	

<Open/Closed output time setting mode>

Character	Item	Default	Data
Potd	Open output time	30.0sec	
Pctd	Closed output time	30.0sec	

<Program mode>

Character	Item	Default	Data
Prgc	Fixed value control/Program control	Fixed value	
t_1d	Step 1 time	00.00	
t_2d	Step 2 time	00.00	
t_3d	Step 3 time	00.00	
t_4d	Step 4 time	00.00	
t_5d	Step 5 time	00.00	
t_6d	Step 6 time	00.00	
t_7d	Step 7 time	00.00	

***** Inquiry *****

For any inquiries about this controller, after checking the following as to the controller, please contact the shop where you purchased the unit or our agency.

(Example)

Model ---------- FCD-15A-R/M
Input type ---------- K
Option ---------- SA, TV
Serial number --------- No. xxxxxx

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

SHINKO TECHNOS CO.,LTD.
OVERSEAS DIVISION

Reg. Office : 2-5-1, Senbahigashi, Minoo, Osaka, Japan
URL : http://www.shinko-technos.co.jp
E-mail : overseas@shinko-technos.co.jp
Tel : 81-72-727-6100
Fax: 81-72-727-7006

FCDR12E7 2008.08