SD Series Users' Manual

1 Model Types

① ② ③ ④ ⑤

SD-94M R R R N

① SIZE	Cutting size	② OUT1	③ OUT2	④OUT3	⑤ Communication
94 : W96*H48*D107(mm)	92*45 (+0.5)	R : RELAY	R : RELAY	R : Relay Output	**N** : No communication
49 : W48*H96*D107 "	45*92 "	A : Current	A : Current	S : SSR Output	**2** : 232 Comm.
72 : W72*H72*D107 "	68*68 "	S : SSR			**4** : 422 Comm.
48 : W48*H48*D100 "	45*45 "				**8** : 485 Comm.

(For SD-48M, ④ is not available and only 232 & 485 Comm. works among ⑤.)

2 Name & Function of Each Part

Real time value(PV) ←

Target value(SV) ←
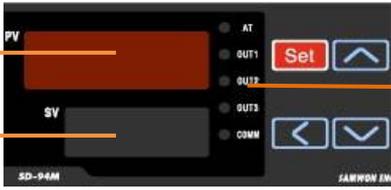
(LED Lamp's Usage)

AT : Auto Tuning

OUT1 : Output 1(Current output, if the lamp blink.)

OUT2 : Output 2(Current output, if the lamp blink.)

OUT3 : Output 3

COMM : Communication

Button Type	Use & Function
SET	▪ **If press it once, SV will flash. At that time, SV value changes by ▲ or ▼ button.** ▪ If press it for 3 secs, enter output group. ▸ Move among parameters in the group, if you press it once after entering output group.
≪	▪ Move digit position. (Press "SET" button and "<<" once to move digit position) ▪ Start or stop autotuing.
∧ ∨	▪ Change functions & values in each mode ▸ To change it fast, press it longer than 3 secs.

3 Input Type and Range

Input Signal	Input Type	Input Code	Range	Grade
RTD	PT	_Pt_	-199.9~600.0	±0.2% of total range
Thermocouple	K	_t_	-200~1370	±0.3% of total range
	K	_t.dot_	-199.9~600.0	
	J	_J_	-200~1200	
	T	_t_	-199.9~400.0	
	R	_r_	0~1700	
	B	_b_	600~1800	
	S	_S_	0~1700	
	C(W)	_C_	0~2300	
Humidity	HUM	_HUm_	0.0~100.0	±3% (Valid Range 20~90%)
DC Voltage	1-5V	_U15_	-1999~9999	
	0-10V	_U10_	-1999~9999	
DC Current	4-20mA	_mA20_	-1999~9999	

4 Product Specification

Sampling Period   250mS

Relay contact point output   Contact point capacity(main) : 240 VAC 5A, 30V DC 5A (Resistive load) Relay life : Over 500,000 times(Mechanical) , Over 100,000 times(Electrical)

SSR Output   ON Voltage: Approximately over 12 VDC(Load resistance over 300Ω, in case of short circuit, it is limited to 30mA currents)

Current Output   Current output range : 4~20mA DC,   Load resistance : Below 300Ω (For SD-72M, below 600Ω)

Voltage Output   If you connect 250Ω on each Current output terminal + -, it switches to voltage output(1-5V)

System requirements   Continuous vibration (5~14Hz) : Peak to peak : under 1.2mm, Normal operation condition : Ambient temperature 0~50℃, Ambient humidity :20~85%

Power supply voltage :   100~240V AC(within ±10%) 50-60Hz   Power consumption : Below 6.0W, MAX. 10VA

Digital letters of this equipment

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	Y	Z

• Input group contains sensor type option and auxiliary functions.(Refer to Output group for main function setting)

• To enter Input Group : Press **"SET" button** & **UP(▲) button** for 3 secs at the same time.

• Parameter shift among groups : Press " SET" button one time.

• Value (Function) Change : Press ▲ or ▼ button.

• Save and Return : Press **"SET" button** for 3 secs to save changed data and return.

• " ┄┄┄► " : Parameter on the dotted arrow route is not displayed, if the related function is not selected.

Parameter	Function
In	• Input Sensor : **PT, K, (K.dot), J, T, R, B. S, C, HUM, V15 , V10 , MA20** (Enter same type of sensors connected with this equipment) ┌─────┐ │ PONT │ Decimal : Range 0~2 └─────┘ ┌─────┐ │ SCH │ Scale "High" └─────┘ ┌─────┐ │ SCL │ Scale "Low" └─────┘ Ex1) PONT:0 SCH :100 SCL:0 Display 0~100 Ex2) PONT:1 SCH :10.0 SCL:-10.0 Display -10.0~10.0 Ex3) PONT:2 SCH :10.00 SCL:1.00 Display 1.00~10.00 ▪ In case of selecting V15 , V10 and MA20, you can set Decimal, Scale "High" & Scale "Low".
FILt	• Measurement Value Filter (0~9) : Function to reduce the fluctuation of display value that might occur when it is installed at strong noise place, which is the characteristics of digital device. (The higher value, the less fluctuation with display speed slowing down.)
bIAS	• Measurement Value Compensation (-50~50) : Compensate the error due to too long or old sensor wire. Ex) Display 60 if you set BIAS at 10, when the current measurement value is 50. Display 40 if you set BIAS at -10, when the current measurement value is 50.
SEtH *SEtL*	• Set the Highest Limit : If you set SETH value, SV value cannot be set above SETH. • Set the Lowest Limit : SV value cannot be set below SETL. Ex) If set at SETH:100 , SETL:-10, SV can be set only between -10~100.
Conn	• Remote Control : **OFF** (Computer communication is not used) : **ON**(Communication is used) **Adr :** Communication ID Number (Assign 1~999 for each product) **bPS : Communication Speed** (Select among 2400, 4800 and 9600) • 255 units of products can be connected with one computer. * Refer to the website (www.31eng.co.kr) for protocol and monitoring program for demo.
C--F	**C :** Celcius(℃) **F :** Fahrenheit (℉)
LoC	▪ **OFF : Lock Cancelled** ▪ **IN** : Lock only Input group ▪ **ALL** : Lock Input, Output group * If set In or All, it is possible to enter the locked group but cannot change the value. * **Initialization setting** : **If press DOWN Key 7 times continuously, INIt is displayed on PV screen.** At that time, press "SET" button to initialize.

6 Output Group

■ Output group is main operationg group and sets control method, control range and alarm.
■ Press **"SET" button** for 3 secs to enter output group,.
■ Press **"SET" button** once to move into next parameters among group. Press ▲ or ▼ button to change output types and functions.
■ Press **"SET" button** for 3 secs after altering functions, and then changed data is saved and it returns to initial screen.

Output 1 (Relay Output)

Select onof or PID by ▲ or ▼ button

oUt1		oUt1	
onoF	Set ONOFF Control	PId	Set PID Control
tYP	HEAT	P	
HEAT COOL	COOL	0~999	Proportional
HYS	Deviation between	I	
0.1~99.9	ON & OFF	0~9999	Integral
dLt		d	
0~300 secs	Delay time	0~9999	Differential
		L	
		1~360	ON/OFF cycle

ON/OFF control Refer to 7-1

PId control Refer to 7-2

Output 1 (Currnet Option)

Select 4-20 or PV by ▲ or ▼ button

oUt1	oUt1
4-20	PV
P	FrH
Porportional	Range "High"
I	FrL
Integral	Reange"Low"
d	CAL
Differential	-1.00~1.00
mAH	Transmission output Refer to 7-4
Current limit "High"	
mAL	
Current limit "Low"	
SLS	
Slow start	

Current control Refer to 7 -3

Out2 can be set after last Out 1 parameter setting.

Output 2   (Relay Output)

Sub relay output (Select output type like alarm or timer by ▲ or ▼ button)

oUt2	oUt2	oUt2	oUt2	oUt2
onoF	tImE	AI.~A8	LbA	SbA
SU2	tSt		L.tIm	
tYP	StA		L.rnG	
HYS	oFF		mAL	
dLt	on			
	rPt			

OUT2 ON/OFF control Refer to 7-5

OUT2 Timer output Refer to 7-6

Refer to 8. Alarm

Loop Break Alarm Refer to 7 -7

Sensor Break Alarm Refer to 7 -7

Output 2 (Current Option)

Select 4-20 or PV

oUt2	oUt2
4-20	PV
P	FrH
I	FrL
d	CAL
mAH	
mAL	
SLS	

Same as current control of out 1

Same as transmission output of out1 Refer to 7-4

OUT3 can be set after last Out 2 parameter setting.

Output 3 (Sub output for alarm and timer) Same function and setting as that of Out2 OUT3

oUt3	oUt3	oUt3	oUt3	oUt3
onoF	tImE	AI.~A8	LbA	SbA
SU3	tSt		L.tIm	
tYP	StA		L.rnG	
HYS	oFF			
dLt	on			
	rPt			

7-1. Relay output ON/OFF control

oUt1 / onoF · If press "SET" button for 3 secs on initial screen, **OUT1 at top screen and ONOF or PId** at bottom screen will be displayed.

▶**When want to ON/OFF control, press ▲ or ▼ button and set ONOF.**

tYP / HEAT COOL · Set as **ONOF at the previous step.**

And then if press "SET" button once, TYP at the top and HEAT or COOL at the bottom screen will be displayed.

· For Heating or Cooling control, press ▲ or ▼ button to set HEAT or **COOL.**

HYS / 0.1~99.9 · If press "SET" once after setting **TYP, HYS at top screen and numbers of 0.1~99.9 at bottom screen will be displayed.**

HYS represents the deviation between relay ON and relay OFF.

dLt / 0~300 · If press "SET" once after setting **HYS, dLt at top screen and unmber of 0~300 at bottom screen will be displayed.**

dLt operates after delayed time (sec) set in dLt.

(Diagram 1)

oUt1 / onoF → tYP / HEAT → HYS / 10.0 → dLt / 7

Diagram 1) Repeat On below 90℃ and Off over 100℃ (It operates after 7 secs delay at operating point.)

(Diagram 2)

oUt1 / onoF → tYP / COOL → HYS / 10.0 → dLt / 15

Diagram 2) Repeat On over 20℃ and Off under 10℃ (It operates after 15 secs delay at operating point.)
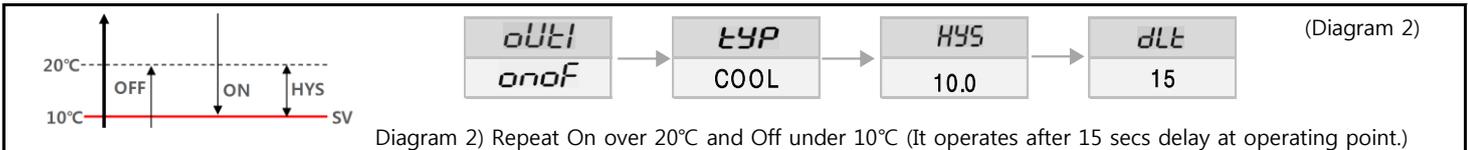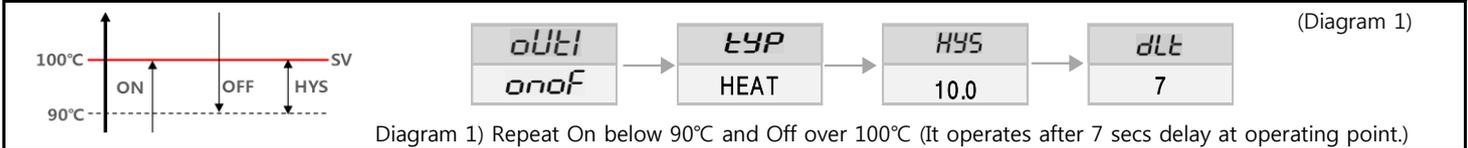
7-2. Relay output PID control (After auto tuning, proper PID value is saved automatically.

oUt1 / PId · Press "SET" button for 3 secs at initial screen, **OUT1 at top and ONOF or Pid at bottom will be displayed.**

For PId control (Heating PId), press ▲ or ▼ button to set PId and press "**SET**" button once to move to next step.

P / 0~999 · If time to reach target value is slow or excessive overshoot occurs after operating auto tuning,

you can adjust "P.I.D" value manually.

▶ **If P** value is set higher : the speed gets slower while over-shooting decreases.

▶ If **P** value is set lower : the speed gets faster while over-shooting increases.

I / 0~9999 · Integral Value**(I)**: When hunting is occurred slowly, adjust I value.

▶ **High I value makes hunting low.**

d / 0~9999 · Differential Value : When the small periodic hunting occurs, please lower d value (Lower value -> Less hunting)

▶ Set **P, I** or **D** value for special cases. In general, it can be controlled appropriately by the result value of auto tuning.

L / 1~3600 · Control Period Cycle : The duration of time of one cycle in a repeating event ON and OFF.

▶ If you set the cycle short, you can control precisely but the relay life will be reduced. (Recommend 10~30 secs)

7-3. Current Output (Option)

oUt1 / 4-20 · If OUT1 is ordered as Current Output, either 4-20 or PV will be displayed in initial screen when pressing "SET" button

for 3 secs.   ▶ Select 4-20 pressing ▲ or ▼ button in case of using current control.

P / 0~999 · If press "SET" once in **4-20, P at top screen and numbers of 0~999.9 at bottom screen will be displayed.**

· If you operate Auto Tuning, appropriate PID value will be automatically saved after considering the heating

characteristics of the load.

P : Proportional Value   I : Integral Value   d : Differencial Value(Same operating method with relay pid control of 7-2)

MAH / 4~20 · Function to limit the maximum current value

Ex) If you set **MAH as 15, the maximum currnet value will not be higher than 15mA.**

MAL / 4~20 · Function to limit the minimum current value.

Ex) **If you set MAL as 8, the minimum current value will not be lower than 8mA**.

SLS 0~360	• Slow Start Function - Used for the device which can be damaged by excessive current when turning on • **SLS is time to output until maximum (20mA)**(Unit : Sec, Range : 0~3600 secs) Ex) If set SLS as 60, it takes 60 secs to output 20mA.

< If OUT2 is type of current control, operating concept is same as OUT1 current control(7-3) and SV is controlled by SV in initial screen.>

7-4. Transmission Output : Real time PV value on the equipment is switched to **4~20mA.**

oUt1 **PU**	• In case OUT1 is ordered as current output, press "SET" button for 3 secs at initial screen, OUT1 at top and 4-20 or PV at bottom will be displayed. Transmission output is set PV.

FrH • Transmission Output "High"   **FrL** • Transmission Output "Low"

    Ex) When you set **FrH: 100, FrL: 0, 4mA** current will be transmitted at **0℃** and 20mA current at **100℃.**

CAL -1.00~1.00	• Function to compensate the error when it occur. • With **1.00** input, displayed current increases as much as **1mA**. With **-1.00** input, current decrease as much as **1mA**. **<<Setting method of OUT2 Transmission output is same as that of OUT1.>>**

7-5. Output 2 ON/OFF Control (When you don't use out2, set until **out1 and press** "SET" button for 3 secs to return to initial screen.)

oUt2 **onoF**	• If **OUT2** is relay output, one of **ONOF, TIME, A1~A8, LbA, SbA** is displayed. • Set **ONOF** in case that **OUT 2** is used as ON/OFF.

SU2	• If press "SET" button once after setting ONOF in the previous step, SV2 at top screen and target value at bottom
	  screen will be displayed. SV2 is the target value of OUT2, which is seperated from SV(target value) of OUT1.
	  It operates separately with no regard to OUT1. Set **TYP,HYS,dLt same as OUT1**(Refer to 7-1).

7-6. Output 2 Timer Output

oUt2 **tInE**	• In case **OUT2** is used as timer, press ▲ or ▼ button & set as **TIME**

tSt • Set hour, minute, second unit ⌈**HH.MM**(99 Hours 59 Minutes),
                                   ⌊**MM.SS** (99 Minutes 59 Seconds)

StA oFF on	• **Set start type** **S.ON** : Start from ON, **S.OFF**: Start from OFF

oFF • Stopping Time of timer

on • Operating time of timer

rPt • Repeating number of Operation and Stop
    1: Repeat once ,   100: Repeat 100 times,   0: Repeat infinitely

> • Timer Operation Example
> Ex1) **TST** : HH.MM , **STA :** S.OFF , **OFF:** 04.00, **ON:** 00.20**, RPT**: 0
>   20 minutes operation after 4 hours stop repeating infinitely
>
> Ex2) **TST**: MM.SS , **STA**: S.OFF , **OFF**: 00.20, **ON**: 00.40, **RPT**: 5
>   40 seconds operation after 20 seconds stop repeating 5 times.
>
> Ex3**) TST**: HH.MM , **STA**: S.ON , **OFF**: 08.00, **ON**: 99.00 , **RPT**: 1
>   99 hours operation after 8 hours stop repeating once.

7-7. OUT2 LBA Output

oUt2 **LbA**	• **Press ▲ or ▼ to set LbA (Loop Break Alarm) in OUT2 group when OUT2 is used as LbA.**

L.tIn • **L.TIM : Loop Break Monitoring Time**   **L.rnG** • **L.rnG : Alarm Range**

> ▶LBA (Loop Break Alarm) : Function to check whether the controlled device has any problem or not.
> Ex) Controlled device : Heater   **L.Tim** : 60   **L.rNG** : 2
> LbA operates when there is no temperature change over 2℃ although heats for 60 secs continuously with full output.
> ▶Major cause of **LBA**   ① Disconnect of sensor wiring   ② Errors of external device such as magnet, sub relay ect.
> ③ Errors of external load like heater, cooler etc. ④ Disconnection or wrong connection of external wiring
> ▶**LBA will be OFF when the problem is solved and then make SV value= PV value or change LBA value.**

7-8. Sensor Break Alarm (SbA)

• **If select SbA (ON) at OUT2, 3, output mode becomes Sensor Break Alarm.**

  "---" will be displayed and SbA signal output through terminal when the sensor is opened or disconnected.

Set alarm with ▲ or ▼ and press "SET" button to move next parameter.

OUT2 , OUT3 Alarm (Common built-in Alarm)

A1.	*A2.*	*A3*	*A4*	*A5*	*Ab*	*A7*	*A8*
Absolute Alarm High	Alsolute Alarm Low	Variation Alarm High	Variation Alarm Low	Absolute Alarm High & Low	Variation Alarm High & Low	Absolute Alarm within Range	Absolute Alarm within Range
AH	*AL*	*AH*	*AL*	*AH*	*AH*	*AH*	*AH*
AHYS	*AHYS*	*AHYS*	*AHYS*	*AL*	*AL*	*AL*	*AL*
dAL	*dAL*	*dAL*	*dAL*	*AHYS*	*AHYS*	*AHYS*	*AHYS*
				dAL	*dAL*	*dAL*	*dAL*

Code	Alarm Type	Function
A1	Absolute Alarm High	• Alarm operates above the set value of **AH alarm.** Ex) If you set AH **at** 120, alarm works above 120. AH value is fixed at 120 even though SV value is changed, which is called "Absolute Alarm".
A2	Alsolute Alarm Low	• Alarm operates below the set value of AL alarm (Opposite concept with A1).
A3	Variation Alarm High	• Alarm operates above AH value with regard to changed SV value. Ex) If SV is set at 100 and **AH at** 5, alarm works above 105. When SV is changed into 200, alarm works above 205, which is called Variation Alarm.
A4	Variation Alarm Low	• Alarm operates below AL value with regard to changed SV value (Opposite concept with A3).
A5	Absolute Alarm High & Low	• Alarm operates both above and below the set value of AH and AL alarm each (A1 Alarm + A2 **AH** : Absolute Alarm High **AL** : Absolute Alarm Low Ex) If AH is set at 100 and AL 50, alarm works above 100 and below 50.
Ab	Variation Alarm High & Low	• Alarm operates both above AH and below AL value with regard to changed SV value (A3 Alarm+ A4 Alarm). **AH** : Variation Alarm High **AL** : Variation Alarm Low Ex) If SV is set at 100, AH at 8 and AL at 10, alarm works above 108 and below 90. When SV value is changed, alarm works according to the changed value.
A7	Absolute Alarm within Range	• Alarm operates between AH value and AL value. Ex) If AH is set at 100 and AL at 50, alarm works between 100 and 50. Tip) AH value should be higher than AL value.
A8	Variation Alarm within Range	• Alarm operates between AH value and AL value with regard to changed SV value. Ex) If SV is set at 100, AH at 8 and Al at 10, alarm works between 108 and 90.

* *AHYS* (Alarm Hysteresis) : Set the range of 1-30 to prevent the realy vibration problem that results from the same starting
                 & finishing time.   AHYS is applied to all alarm equally.

* *dAL* (Delaying Alarm) : Alarm signal doesn't work when the value is within the set range of alarm output at the moment of
                 turning on.

  It works when the value accord with the set range of alarm output once again after detached from the range.

                 (All alarm equally applied)

          ON : DAL used   **OFF** : DAL not used

9-1 AUTO TUNING

A Purpose of Auto tuning

▪ **PID AUTO TUNIN**G is the control preparation that enables quick response and precise control. It is to calculate PID modification numbers for the optimal control and to set the value by measureing the thermal characteristics and thermal response speed of vairous controlled device.

▪ Auto tuning should be done at the first stage after attaching the controller. After tuning, operation runs automatically.

B Auto Tuning Operation Method

▪ If press "《 " for 3 secs at initial screen, TUNG at top and one of AT(Auto Tuning) or ST(Self Tuning) at bottom will be displayed.
  Set auto tuning as AT & self tuning as ST, and then press "SET" for 3 secs to save & retrun to initial screen.

▪ It operates by pressing "《 " for 3 secs after selecting one of PID, CPID, 4-20, 20-4 in OUT1 or OUT2.

▪ Auto tuning operates at 90% of SV value and it ends after PV value goes up & down 3 times. (Refer to Fig. A)

  During auto tuning, AT lamp on front blinks. Blinking stops when tuning ends.

▪ Press "《" for 3 secs to stop auto tuning while it is in progress.
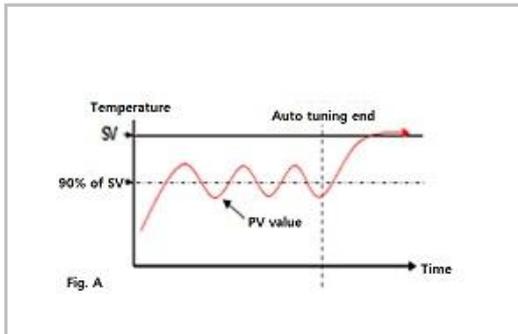
(Auto tuning Graph)
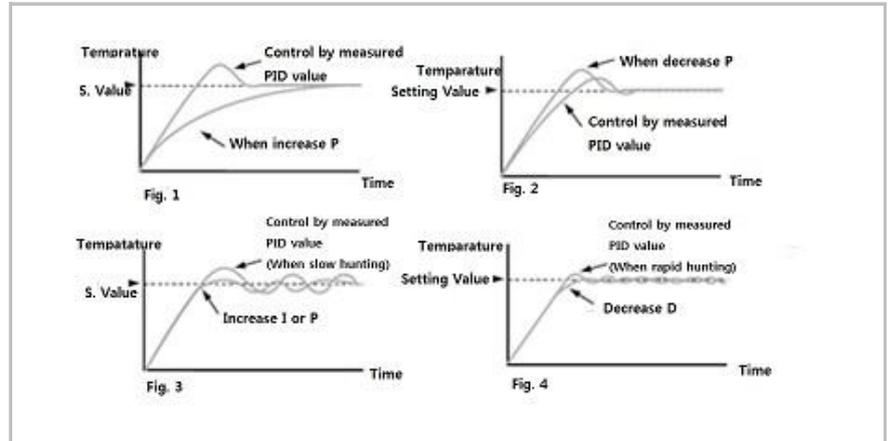
(PID Graph)

9-2 Self Tuning

A   Advantage of Self tuning

Self tuning is a function to change P.I.D value only changing SV set value otherwise auto tuning.

Auto tuning takes long time according to output (Heater) as it is a function to get P.I.D value using output ON/OFF compulsorily several times by setting temperature.

But self tuning can save time to get P.I.D. value as it is a function to get P.I.D. value by change of SV or power on

During self tuning ST lamp in front blinks & lamp turns off after tuning ends.

(Caution : Self tunig is applied in case of changing SV with communication.)

#### B Self tuning operation method

If press "《" for 3 secs at initial screen, enter **to tUnG setting mode. After that, press ▲ or ▼ for set tUnG as "ST"** between "ST" and "AT"

▪ Self tuning operation condition : It operates when there is a difference of over 30 degree with present PV as put power or change of SV value.

▪ Press " 《 " for 3 secs to stop self tuning while it is in progress.
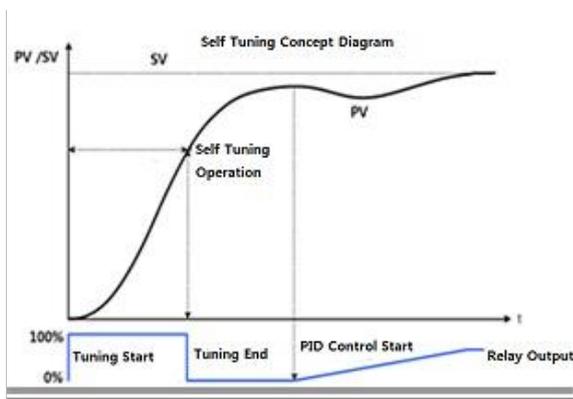
SD94/49M
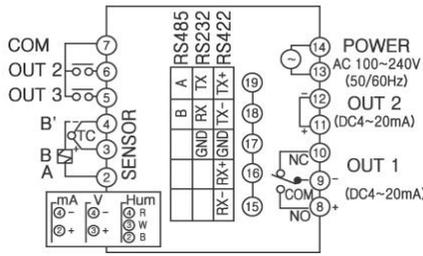
- Thermocouple : 8+ 7-
- RTD Sensor : Connect A with a single wire if other colors,
  Connect B and B' with two wires of the same color.
- Current Input : 9+ , 7-
- Voltage Input : 8+ , 7-
- Humidity Sensor Input : 9 with black, 8 with white & 7 with red
- OUT1 Current Output : 20+ , 19-
- OUT1 Relay Output : 19 , 20

SD72M
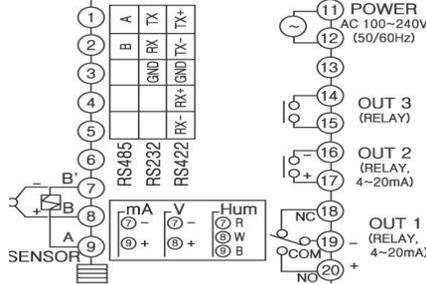
- Thermocouple : 3+ , 4-
- RTD Sensor : Connect A with a single wire of other colors,
  Connect B and B' with two wires of the same color.
- Current Input : 2+ , 4-
- Voltage Input : 3+ , 4-
- Humidity Sensor Input : 2 with black, 3 with white & 4 with red.
- OUT1 Current Output : 8+ , 9-
- OUT1 Relay Output : 8, 9

SD48M
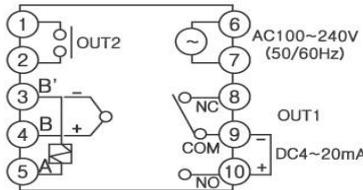
- Thermocouple : 4+ 3-
- RTD Sensor : Connect A with a single wire of other colors.
  Connect B and B' with two wires of the same color.
- Current Input : 5+ , 3-
- Voltage Input : 4+ , 3-
- Humidity Sensor Input : 5 with black, 4 with white & 3 with red
- OUT1 Current Output : 10+ , 9-
- OUT1 relay Output : 10, 9

11-1.   **CPId Control** (Cooling Pid Control) - **Only relay output**

- **How to enter CPId** : Enter output group and **press both** ▲+▼ at the same time for 3 secs in OUT1 PID. If so, it will be switched to CPID.

(To switch to PID or ONOFF from **CPID, select by pressing** ▲ or ▼)

- Sub parameters of CPID & PID are same.
- Press "SET" for 3 secs to save & return to initial screen after setting up.

11-2.   **Cooling Current Control** - Current output

- **How to enter 2**(

(To switch to 4-20 from 20-4, select 4-20 by pressing ▲ or ▼)

- Sub parameters of 20-4 & 4-20 are same.
- Press "SET" for 3 secs to save & return to main screen after setting up.

11-3. Check current value : Press "HIGH" 5 times continuously at initial screen, OUT1 current will be displayed. If press one more time, OUT2 current will be displayed. (Only for current option built-in product)