NOVA541

Digital Controller ST541

User's Manual

SAMWONTECH CO., Ltd.

Limitations in use

This product was designed and manufactured for general industrial equipments.
Special cares on safety is required in the case of using in following equipments.
Users should take precautionary measures on Fail Safe design, periodical checkup, safety of the whole system.

- Safety Devices for protecting human body.
- Direct control of vehicles (navigation, run and stop)
- Airplanes
- Self-control Equipments
- Nuclear Power Equipments

Do not use for any purpose which affects the human body.

Thank you very much for the purchase of SP541 PROGRAM CONTROLLER.
This User's Manual explains the Installation and Operation Procedures.
The safety considerations and the right way of use are also included in it. A designer of the control panel, an Engineer of maintenance and users should read it and understand the necessary items before use.
This manual is also necessary for repairing, trouble shooting as well as an installation.
Keep it near at hand and use it as a reference.

Important Safety Guide

To prevent an accident of injury, All the Installers and users should keep the safety rules in this manual.

SAFETY SYMBOL MARKS

(A) “Handle with Care” , “Precaution” : The operator must read and keep in mind the explanation because it is critical to protect a person or an instrument.

(1) On Product : The essential items the operator should know to prevent accidental injury or damage of the instrument.

(2) In User’s Manual : For the precautions necessary to prevent an accidental electric shock.

(B) “Protective Ground Terminal”.

Prior to operating, the terminal must be connected to the Ground.

(C) “Supplementary Explanations”.

Additional information on the operation and features of the product

(D) “Reference Information”

Further information on the current topic and pages to refer

Precautionary Remarks on this User’s Manual

(1) This manual should be passed on the end user and kept at a suitable place for easy review.

(2) Before using the product, the operator should read this book carefully and understand the operation procedure.

(3) This manual describes the functions of the product in detail. Samwontech does not

warrant that the functions will suit a particular purpose which is not described in this manual.

(4) Without permission, the contents of this manual cannot be transcribed or copied in part or wholly.

(5) The contents of this manual may be modified without previous notice.

(6) If any errors or omissions in this manual should come to the attention of the user, feel free to contact our sales representatives or our sales office.

Regarding Safety and Unauthorized Modification

(1) For the protection and safe use of the product and relevant system, all of the safety instructions and precautions are well recognized and strictly observed by all users.

(2) Samwontech does not guarantee safety if the product is not handled according to this manual.

(3) If additional safety circuits for protection of system is required, Install them at outside of this product not at inside.

(4) Don't try to disassemble, repair, or modify the product. It may become the cause of a trouble such as malfunction, electric shock, fire.

(5) When part replacement or consumables are needed, call to our sales office.

(6) Keep this product from moisture. It may become a cause of trouble.

(7) Be careful not to apply any shock or vibration to the product. It may cause damage or malfunction.

Regarding an exemption from responsibility

(1) Samwontech co., Ltd does not make any warranties regarding the product except Warranty conditions which mentioned in this manual.

(2) Samwontech assumes no liability to any party for any loss or damage, direct or indirect, caused by the use or any unpredictable defect of the product.

Regarding the Production Quality Assurance

(1) The guaranteed period of the production quality assurance is one year after end use by it and it will be free of charge to fix defective product under regular usage described in this manual.

(2) The fixing cost will be charged for defective product after warranty period. This charge will be the actual cost of the fixing estimated by Samwontech.

(3) It will be charged even if within warranty period for following cases.

(a) Defect by an operator or the user's default. (Initialize the product, forget password)

(b) Natural disaster (fire, flood)

(c) Additional shift after the first installation

(d) Improperly repaired, altered, or modified by the user.

(e) Power failure by unstable power supply

(4) If any A/S is required, feel free to contact our sales office or a representative.

Precautions on Environment and Installations

Environmental Precautions

(1) Be sure to power on and operate the controller after installation on a panel to prevent electric shock.

(2) Do not install the controller at following places or environment

- ■ Anybody may touch the terminal inadvertently
- ■ Mechanical vibration or shock
- ■ Corrosive gas or combustible gas
- ■ Temperature fluctuation
- ■ Too hot (> 50℃) or Cold (< 10℃)
- ■ Direct rays of light or heat radiation
- ■ Magnetic or electromagnetic noise
- ■ High humidity (> 85%)
- ■ Flammable materials
- ■ Wind blow, Dust with salt
- ■ Ultra violet rays

Precautions on Controller Mounting

(1) Keep the controller away from possible noise sources.

(2) Keep the controller in 10～50℃, 20～90%RH (non condensing) and be careful not to expose heat generating sources.

(3) Do not mount with a position that the front panel facing downward

(4) Storage should be within -25～70℃, 5～95%RH (non condensing). At a cold condition below 10℃, sufficient warming-up should be preceded by the control operation.

(5) Turn off the main power of the control unit before wiring to prevent electric shock.

(6) The power rating of the controller is 10 VA max. at 100~240VAC, 50/60Hz. Be sure to use suitable power source to prevent overheating or electric shock.

(7) Do not work with wet hands to prevent electric shock.

(8) The precautions and procedures in the manual should be kept to avoid a hazard such as fire, injury, and electric shock.

(9) Installation and Operation procedures should be done just as in this manual.

(10) Make the grounding connection according to the way in manual. Do not use a tap water piping, a gas pipe, a telephone line, a lightning rod to avoid possible accidents such as explosion or inflammation.

(11) Do not power on the controller before the wiring procedure is not completed.

(12) Do not block or wrap the heat vent holes in the case of the controller. That may cause a failure. Air gaps greater than 50 mm is necessary on the upper and bottom sides of the controller.

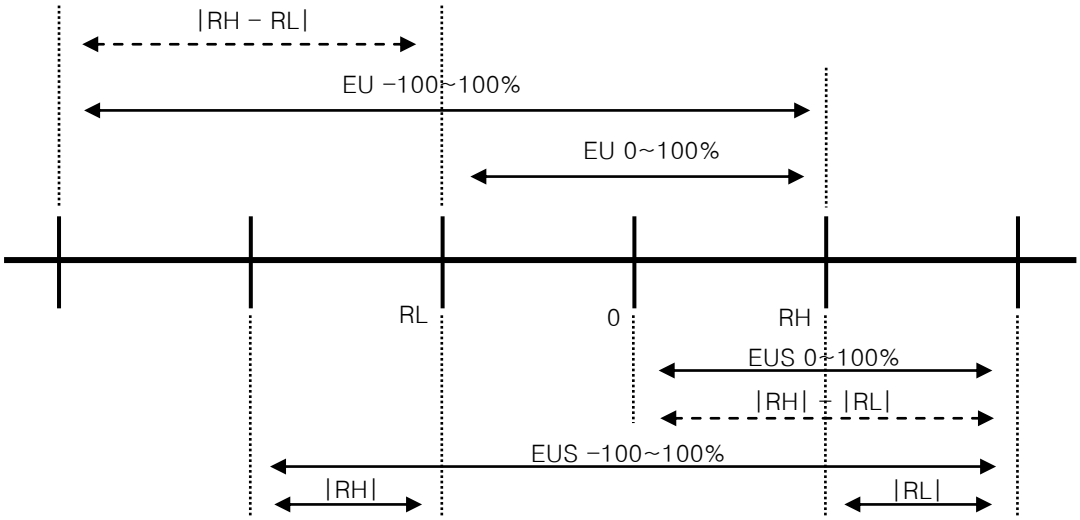
(13) Over-voltage protection category II and Pollution Degree II are rated for the controller.

Engineering Units – EU, EUS

▶ EU and EUS are used for the scaling of the parameters of the controller.

☞ EU( ) : The Range of the Instrument, Engineering Unit

☞ EUS( ) : The Range of the span of the Instrument, Engineering Unit



▶ The Range of EU( ), EUS( )

	RANGE	CENTER POINT
EU 0 ~ 100%	RL ~ RH	| RH – RL | / 2 + RL
EU –100 ~ 100%	– (| RH – RL | + | RL |) ~ RH	RL
EUS 0 ~ 100%	0 ~ | RH – RL |	| RH – RL | / 2
EUS –100 ~ 100%	– | RH – RL | ~ | RH – RL |	0

▶ INPUT = TC.K2

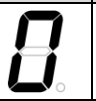
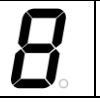
▶ RANGE = –200.0℃(RL) ~ 1370.0℃(RH)

	RANGE	CENTER POINT
EU 0 ~ 100%	- 200.0 ~ 1370.0℃	585.0℃
EU –100 ~ 100%	- 1770.0 ~ 1370.0℃	- 200.0℃
EUS 0 ~ 100%	0 ~ 1570.0℃	785.0℃
EUS –100 ~ 100%	- 1570.0 ~ 1570.0℃	0.0℃

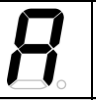
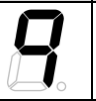
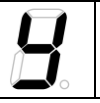
☞ ABS denotes absolute value and does not change with input.

Alpha-numeric Displays of the product

Numbers in 7-Segment LED Display

0	1	2	3	4	5	6	7
							
8	9	.	-	/	Half -	Half 1	Half -1
							

Alphabets in 7-Segment LED Display

A, a	B, b	C, c	D, d	E, e	F, f	G, g	H, h
							
I, i	J, j	K, k	L, l	M, m	N, n	O, o	P, p
							
Q, q	R, r	S, s	T, t	U, u	V, v	W, w	X, x
							
Y, y	Z, z						
							

Note : Numeric 5 and alphabet S appear the same way

CONTENTS

1. INTRODUCTION

1-1. Product Outline

ST541 is a digital controller with advanced design and functions. Short body (78 mm) is convenient to install at a small space. More informative displays such as 5-digit PV display, 8 status lamps, and comprehensive display menus are equipped.

It can measure many types of analog signals including thermo couple, RTD, DC voltage (up to 10V) with high precision (±0.1%F.S). It is suitable for precise temperature control, because its advanced PID control algorithm and multiple output types, RELAY, SSR, 4-20 mA.

The Displays are composed of 3 screen categories, Operation, Menu, and Test. Menu has informative group titles and relevant parameters in each groups. The comprehensive parameter map enables users to understand the meaning easily and operate the controller safely. It is highly recommended that initial controller setting should be carried out as following sequence : " INPUT Group → OUTPUT Group → Other Group". Especially, the user should set the parameters in INPUT Group first of all, because they are the most influential to other group parameters.

▣ Features

Item	Feature
LED display	PV/SP : 7-Segment 4½ digit x 2 Status : LED(RED/GREEN) x 8
Sampling time	250ms
Input Precision	±0.1% of FS ±1 digit
Control loop	1 loop / Heating/Cooling control
RUN mode	AUTO / MAN
Set Point	4 ea, SP1, SP2, SP3, SP4
PID	4 sets (3 Zone PID / 1 Deviation PID)
Sensor Input	Universal input 1 port Types

	– Thermocouple (T/C): K, J, E, T, R, B, S, L, N, U, W, PLA II, C – RTD : PtA, PtB, PtC, PtD, JPtA, JPtB – DC Volt : 0.4 ~ 2V DC, 1 ~ 5V DC, 0 ~ 10V DC, -10 ~ 20mV DC, 0 ~ 100mV DC (4 ~ 20mA DC: 250Ω;0.1% shunting to 1~5V)
Control Output	Universal output (MAX 3 ports) Output Types – SSR (0 ~ 12V DC) 500Ω Min – SCR (4 ~ 20mA DC) 500Ω Max – RELAY (250V AC 1A, 30V DC 1A) : EV1 – DC current & voltage : OUT1(Option) (0 ~ 20mA DC, 0 ~ 5V DC, 1 ~ 5V DC, 0 ~ 10V DC, 0 ~ 100mV)
Relay Contact (EVENT)	2 Common 2 Points / 1 Common 3 Points (Option) Types : HEAT, COOL, ALM1, ALM2, ALM3, RUN, IS1, IS2 Relay Specification – Relay : Normal Open 30V DC 1A max, 250V AC 1A max
Retransmission	4 ~ 20mA DC Types : PV, SP, MV, Loop power supply
External Contact (DI)	1 Common 2 Points Specification – Mechanical contact : On-Off repeatability at 5 V Open voltage, 1mA Short circuit current – Open collector : ON state voltage 2V max, Leakage 100㎂ max
Heater Break	Precision : ±3% of FS ±1 digit CT spec. : CTL-6-S-H 또는 800:1 CT
Communication	RS485 (rear terminal) / RS232(front side : USB type port) Protocol : PC Link, MODBUS ASCII, MODBUS RTU, SYNC Master, SYNC Slave Baud rate : 4800, 9600, 19200, 38400 bps
Power Source	Rated Voltage : 100~240V AC, 50/60Hz Rated Power : Max 6VA
Operation Environment	Temperature : 10 ~ 50℃, Humidity : 20 ~ 90%RH
Weight	about 136 g

▣ Model and Suffix Code

Type	Suffix Code				Function
S*541 -					T : Digital Controller
Control Method	0 1				Normal Control Heat/Cool Control
Power Supply		0 1			100~240V AC(50/60Hz) 24V AC(50/60Hz) / 24V DC
Option1			/RS /SUB /DI /HBA		RS485/232 Dependent 3 Relay DI 2 Points HBA(50A)
Option2				/DCV1 /DCV2 /DCV3 /DCV4	0 ~ 20 mA DC(OUT1) 0 ~ 5 V DC(OUT1) 1 ~ 5 V DC(OUT1) 0 ~ 10 V DC(OUT1)

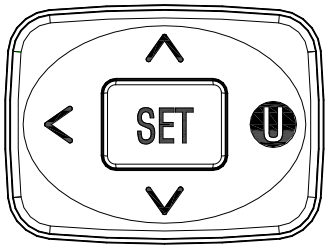
* When DCV1 Option selected, OUT2 is not available

▣ Standard and Options

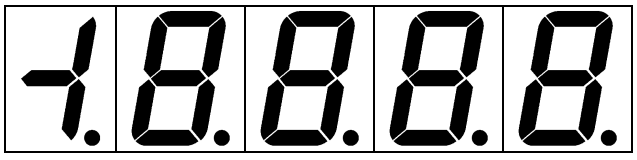
Function		Description
Control Method	Normal Control	Standard
	Heat/Cool	Option
Power Supply	100-240V AC	Standard
	24V AC/DC	Option
Option1	RS(RS485/232)	Option (selectable up to 3 ea) DI and HBA are exclusive
	SUB(3 Relay)	
	DI(DI2 point)	
	HBA(50A)	
Option2 (OUT1)	0-20mA, 0-5V, 1-5V, 0-10V	Option (only one of these)

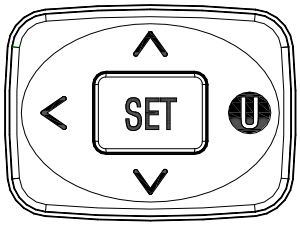
1-2. KEY operation

1-2-1 Parts names and functions

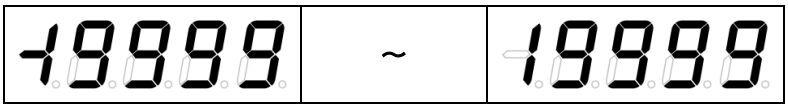
Name	Function
KEY	
"SET" (SET)	▪ To select a parameter or enter the setting value ▪ To change the display screen in RUN screen ▪ "SET" KEY press 3 sec at Run screen → MENU screen ▪ "SET" KEY press 3 sec at Menu screen → Run screen
"∧" (UP)	▪ To change the parameter value ▪ To move from a group to the next group (UP direction)
"∨" (DOWN)	▪ To change the parameter value ▪ To move from a group to the next group (DOWN direction)
"<" (SHIFT)	▪ To select a digit to modify when parameter value editing
"ⓤ" (USER)	▪ To operate user-defined key at PV display screen pressing 3 seconds ▪ At parameter editing menu screen Key click → To move to previous parameter Pressing 3 sec.→ To move to top group menu ▪ AT(Default), A/M, R/S selection

1-2-2 KEY operation



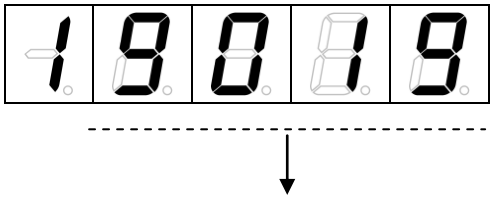


a) "∧", "∨" KEY : digit display limit



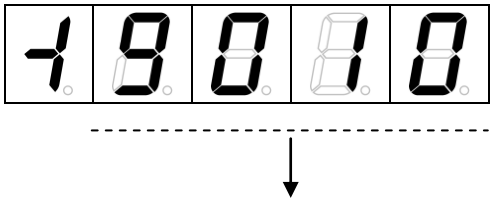
b) DIGIT carry operation when increasing or decreasing

▪ increasing



Pressing "∧" KEY at digit "9" (except 5D,4D position), carry digit is added to upper next digit.

▪ decreasing



① Positive number digits

Pressing "∨" KEY at "0" (except 5D position) the digit becomes “9” and the upper next digit decreases by one.

② Negative number digits

Pressing "∨" KEY at “9” (except 5D position) the digit becomes “0” and the upper next digit increases by one without changing sign.

c) MIN, MAX handling

- When the value reaches upper or lower limit, MAX or MIN value will be displayed..

ex) S-TM = OFF, 0.01 ~ 99.59 일 경우

If a user set a value higher than 99.60, the maximum value of S.TM, 99.59 will be set and displayed. If the user set -0.02, the minimum 0.00 will be set and displayed

d) "<" KEY

- The digit to be edited is BLINKING as a cursor.

e) SET KEY

① Run screen

- To move to other parameter or to enter the parameter value modified
- To move to parameter setup group by pressing SET key 3 seconds

② Parameter setup screen

- After editing a parameter value by the keys of "∧1", "∨2", "<S", pressing SET KEY, the changed value will be registered and the next parameter will appear. The value should be within the range of the limits.
- Pressing SET KEY repeatedly without touching other key, the next parameter item will appear in turn.
- To move to Run screen by pressing SET key 3 seconds

f) ⓤ KEY

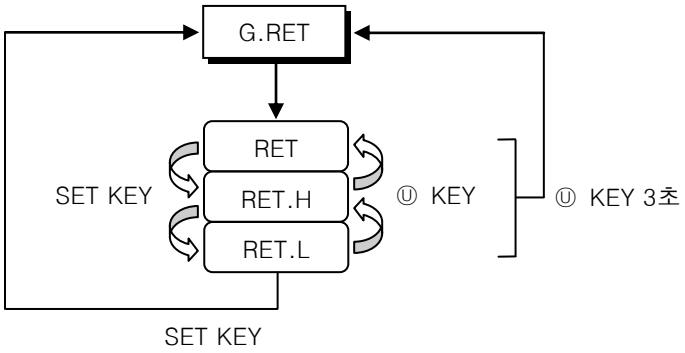
① Run screen

- To execute user-defined function by pressing this key 3 seconds

(AUTO TUNING, STEP, HOLD etc.)

② Parameter setup screen

ex) To visit around the parameters in reverse order by pressing the key repeatedly.



g) "- (MINUS)" position

In case MSD (the most significant digit) is in

1D, the position of (-) is 2D

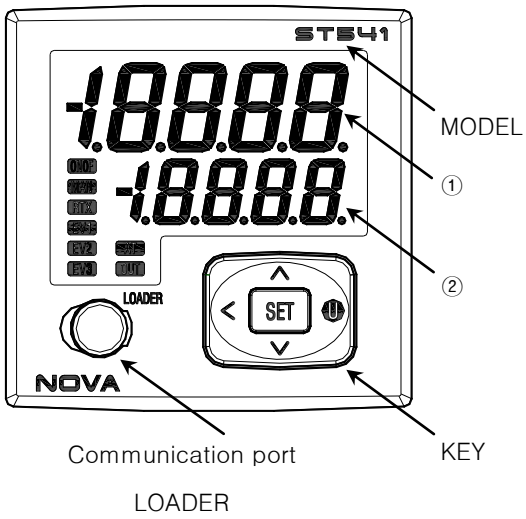
2D, the position of (-) is 3D

3D, the position of (-) is 4D

4D, the position of (-) is 5D

5D, the position of (-) is 5D (only -1)

1-2-3 Front panel and LED lamps



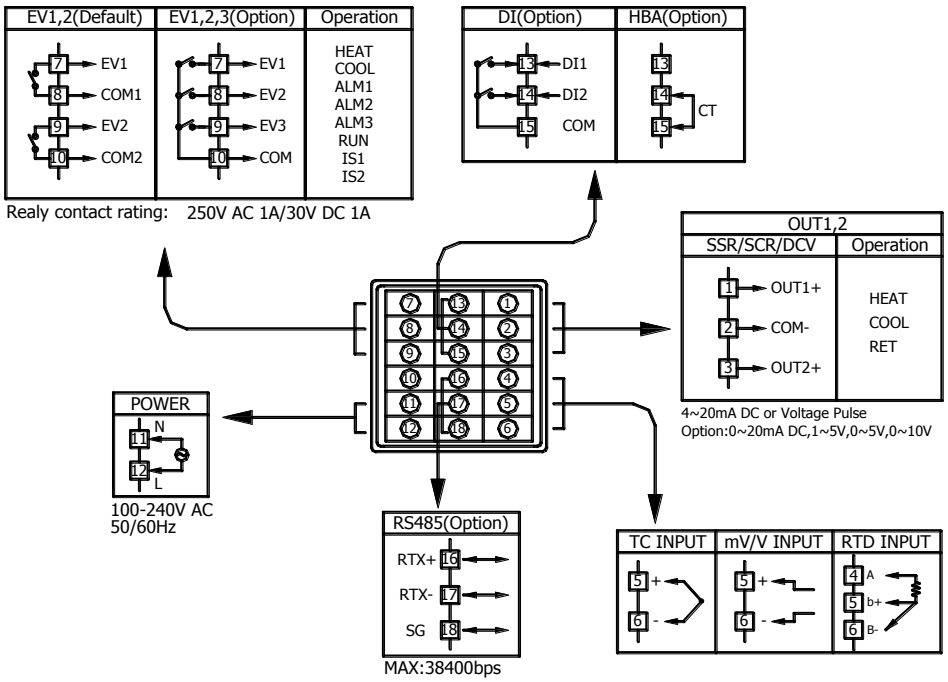
LED	Function
①	Displays Process Value (RED)
②	Displays Set Point (RED)
ONOF	On while PATTERN2 runs (GREEN)
MAN	On while HOLD state (GREEN)
RTX	Blink while communicating (YELLOW)
EV1	On while EVENT1 is active (RED)
EV2	On while EVENT2 is active (RED)
EV3	On while EVENT3 is active (RED)
AT	On while AUTO TUNING is progressing (GREEN)
OUT	On/Off with control output (GREEN)
LOADER	Communication port, LOADER

1-3. Terminal layout and diagram

1-3-1 Terminal Layout

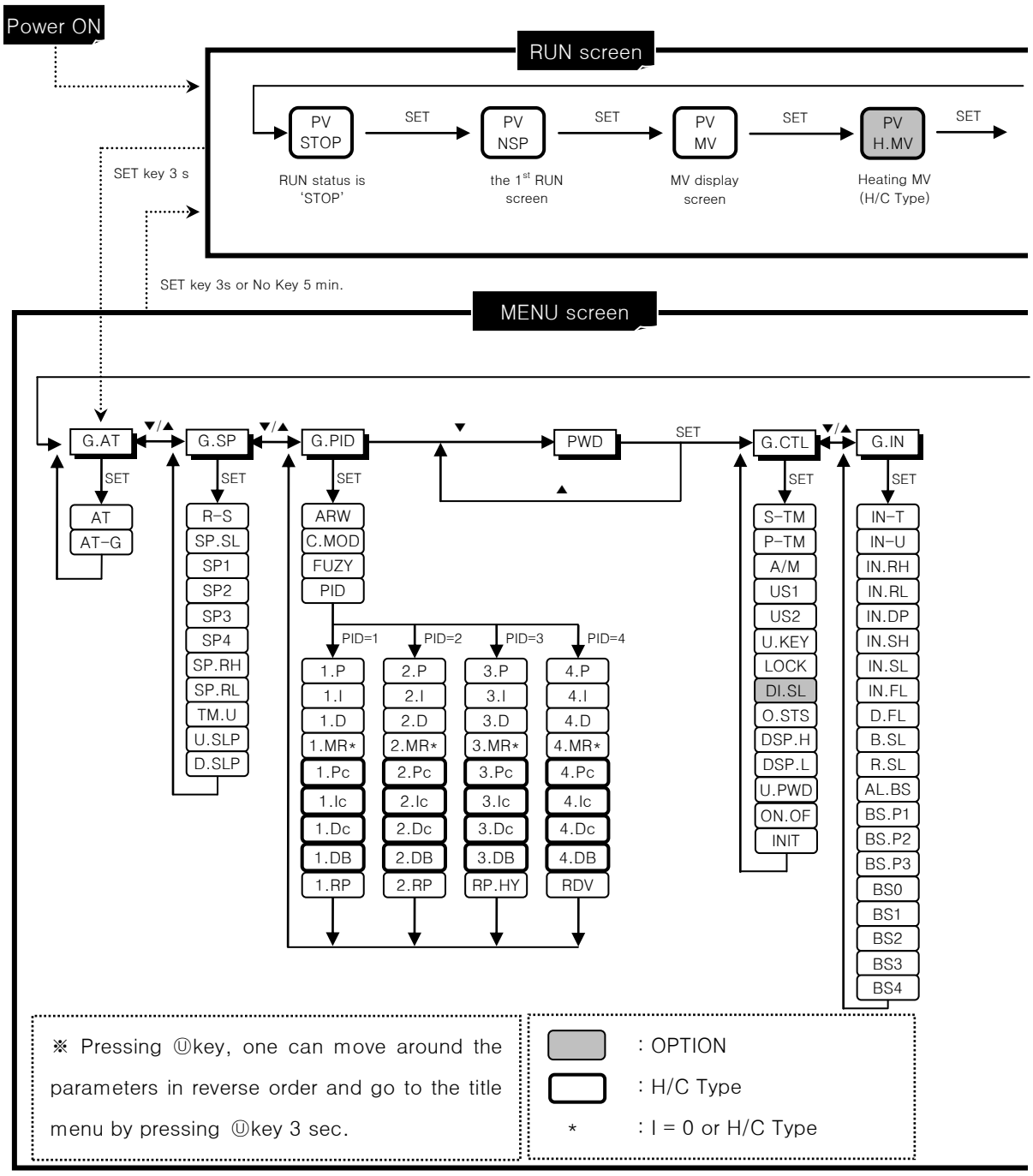
No.	Description					
	Standard	Option		Standard	Option	
1	OUT1+(SSR/SCR)	OUT1+(DCV)	11	POWER N		
2	OUT1,2-(SSR/SCR)	OUT1-(DCV)	12	POWER L		
3	OUT2+(SSR/SCR)	-	13	-	DI1	-
4	INPUT A		14	-	DI2	HBA
5	INPUT B+		15	-	COM	HBA
6	INPUT B-		16	-	RTX+	
7	EVENT1(RELAY)	EVENT1(RELAY)	17	-	RTX-	
8	EVENT1_COM1	EVENT2(RELAY)	18	-	SG	
9	EVENT2(RELAY)	EVENT3(RELAY)				
10	EVENT2_COM2	EVENT_COM				

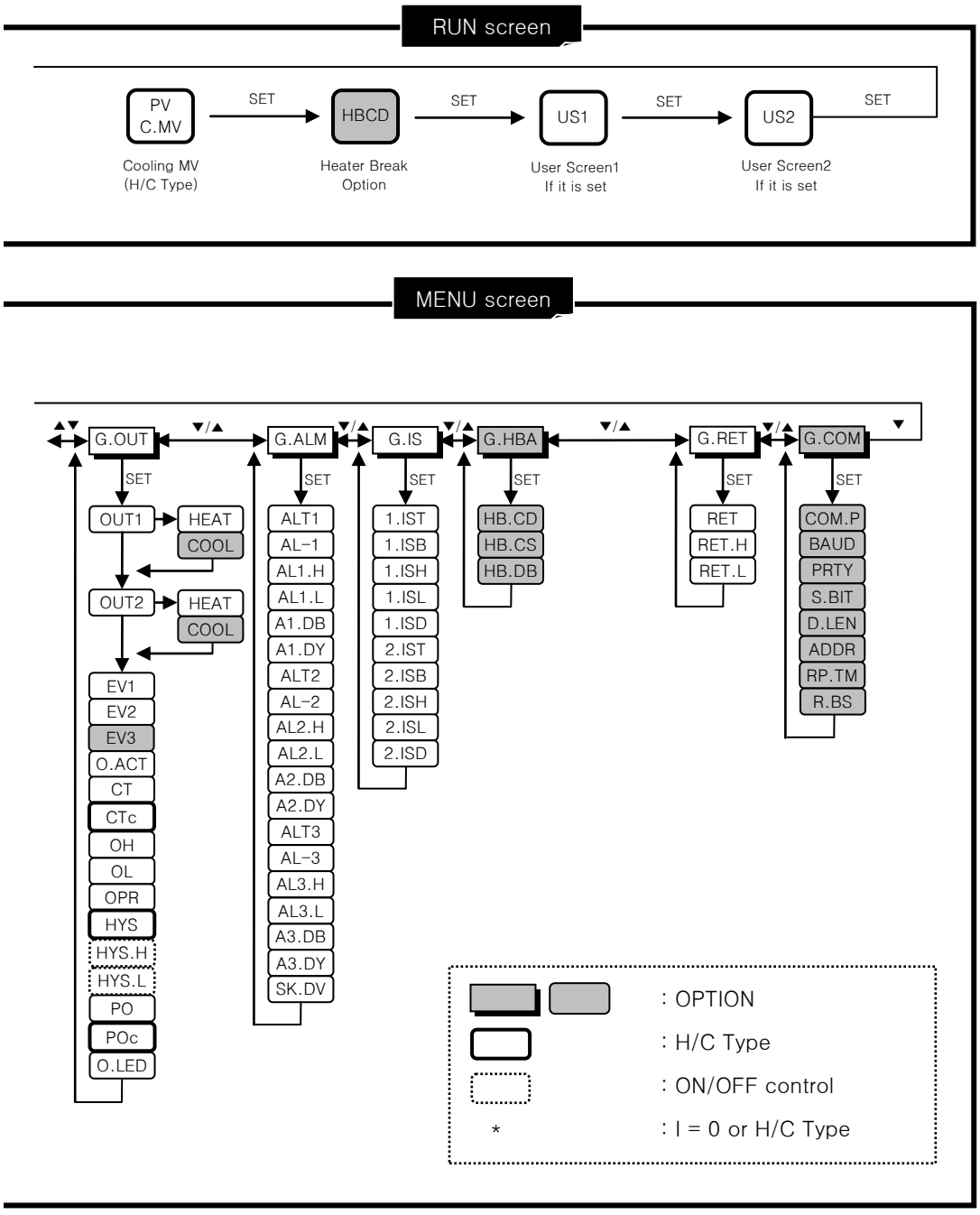
1-3-2 단자도



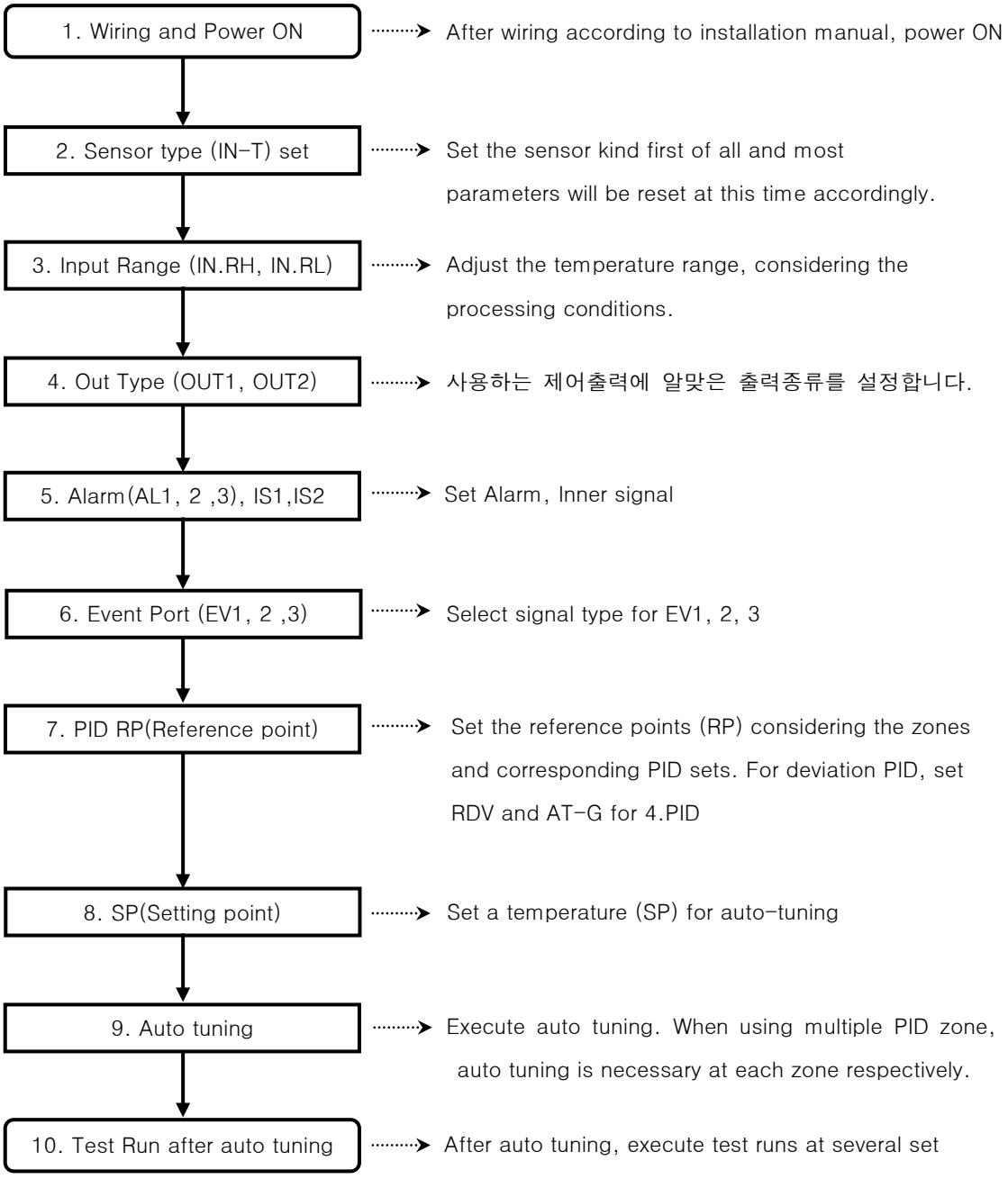
1-4. Parameter Map

1-4-1 Parameter Flow




RUN screen
PV
C.MV
SET
HBCD
SET
US1
SET
US2
SET
Cooling MV
(H/C Type)
Heater Break
Option
User Screen1
If it is set
User Screen2
If it is set
MENU screen
G.OUT
G.ALM
G.IS
G.HBA
G.RET
G.COM
SET
OUT1
HEAT
COOL
OUT2
HEAT
COOL
EV1
EV2
EV3
O.ACT
CT
CTc
OH
OL
OPR
HYS
HYS.H
HYS.L
PO
POc
O.LED
ALT1
AL-1
AL1.H
AL1.L
A1.DB
A1.DY
ALT2
AL-2
AL2.H
AL2.L
A2.DB
A2.DY
ALT3
AL-3
AL3.H
AL3.L
A3.DB
A3.DY
SK.DV
1.IST
1.ISB
1.ISH
1.ISL
1.ISD
2.IST
2.ISB
2.ISH
2.ISL
2.ISD
HB.CD
HB.CS
HB.DB
RET
RET.H
RET.L
COM.P
BAUD
PRTY
S.BIT
D.LEN
ADDR
RP.TM
R.BS
: OPTION
: H/C Type
: ON/OFF control
* : I = 0 or H/C Type

1-5. Initial parameter setting sequence



2. Electrical Wiring

CAUTION

Precaution

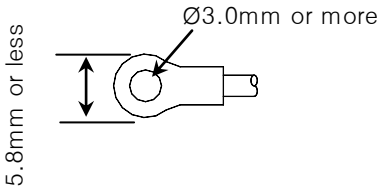
- Switch off the main power supply and make sure that no current flows in all the circuits before the wiring work.
- Do not touch the real terminal part while the power is on.
- Main circuit breaker must be kept in OFF state until all the wiring work is done

2-1 Power cable specification

▶ Vinyl-insulated shielding cable KSC 3304 0.9 ~ 2.0 ㎟

2-2 Terminal connector specification

A terminal with PVC insulating sleeve for M3.5 screw as shown in the following figure.



2-3 Countermeasures against noise

■ Noise source

(1) Relay and Electrical contacts

(2) Solenoid coil, Solenoid Valve

(3) Power Line

(4) Inductive load

(5) Inverter

(6) Rectifier of a Motor

(7) Phase-angle controlled SCR

(8) Wireless communication devices

(9) Welding machines

(10) High-tension magneto-Ignition system

■ Countermeasures against noise

Notice following guide while wiring work.

(1) The wires of input signal should be apart from power line and grounding line.

(2) Use a shielded wire to guard against a noise from electrostatic induction. Multi-point grounding should be avoided and connect the shield wire to ground terminal if necessary.

(3) It is effective to make the input wires as a twisted pair to prevent an electromagnetic noise.

(4) When using an auxiliary relay, refer to section 2-1-4-5.

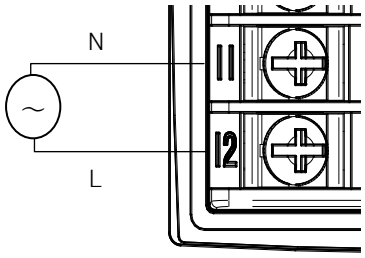
2-4 Wiring

2-4-1 Ground and power source

▶ Use a thick grounding wire (> 2㎟) and make short wiring (<20 m) so that the grounding resistance is less than 100 Ohm (class 3 or better).

▶ Make 1-point grounding from a ground terminal and avoid a wiring cross over the grounding wire.

▶ For power source wiring, use a vinyl-insulated wire (KSC 3304 or better).



2-4-2 Sensor input

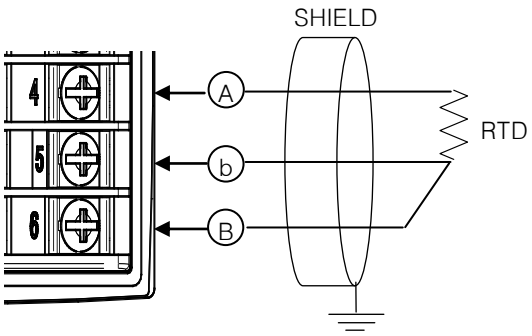
▶ Be careful of the polarity of the signal. The wrong connection may cause a trouble.

▶ Use a shielded wire for analog input and the shield should be 1-point grounded.

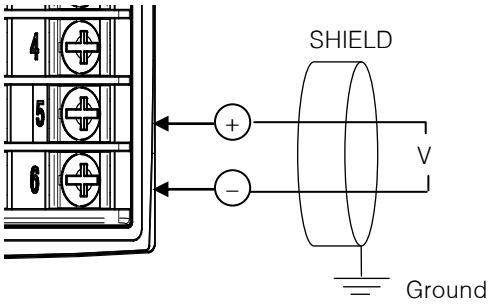
▶ The wires of input signal should be apart from power line and grounding line.

▶ Use a wire of low resistance. The resistance difference between the wires is unfavorable especially for a resistive sensor (ex. RTD).

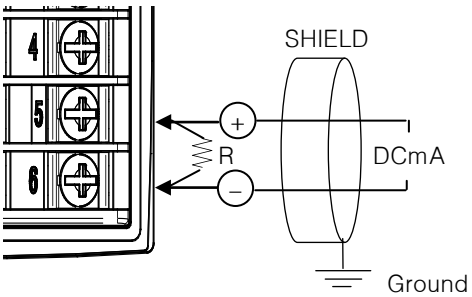
(가) 측온저항체 입력(RTD INPUT)



(나) 직류전압 입력(DC VOLTAGE INPUT)



(3) DC CURRENT INPUT



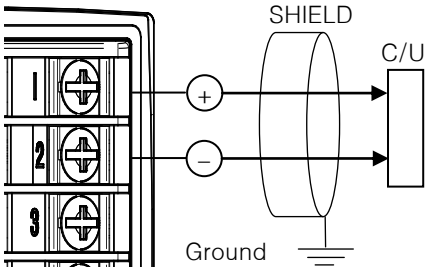
2-4-3 Control out

▶ Be careful of the polarity. The wrong wiring may cause a trouble in the product.

▶ Use a shielded wire for analog input and the shield should be 1-point grounded.

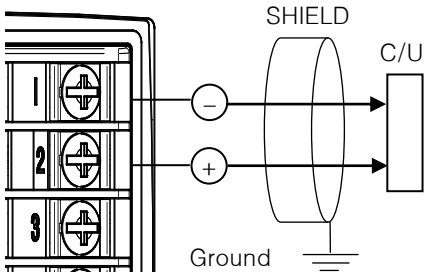
(1) Voltage pulse (SSR)/ Current Output (SCR)

▣ OUT1



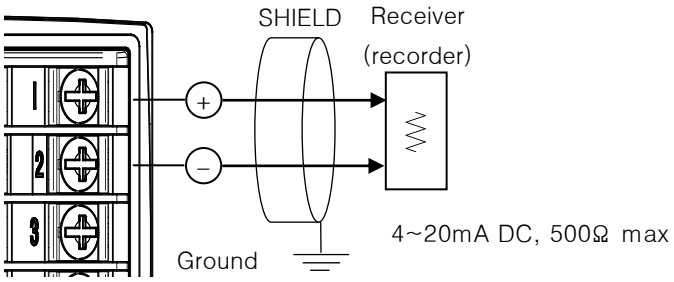
SSR : 12V DC min, 500Ω min
SCR : 4~20mA DC, 500Ω max
DCV : 0~20mA DC, 1~5V DC
0~5V DC, 0~10V DC

▣ OUT2



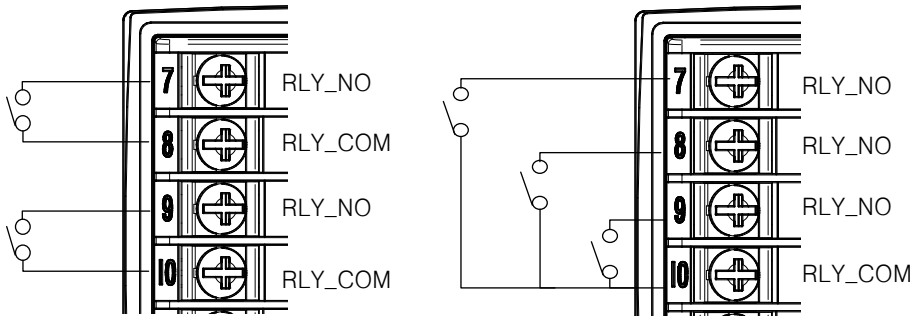
SSR : 12V DC min, 500Ω min
SCR : 4~20mA DC, 500Ω max

(2) Retransmission (RET)



2-4-4 Digital output and input

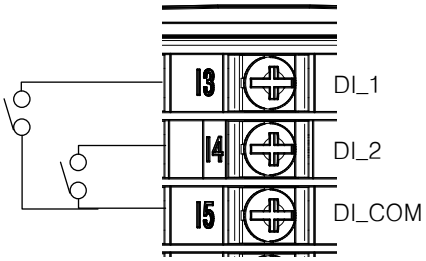
▶ RELAY : Normal Open 30VDC 1A max, 250VAC 1A max.



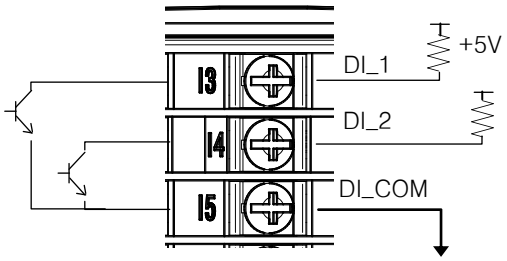
▶ Use a mechanical contactor (non-voltage type) as relay for the digital input (DI).

▶ The relay for DI must have sufficient on-off repeatability at 5V open voltage and 1 mA short circuit current.

▶ The open collector for DI should have low ON state voltage (<2V) and low leakage current less than 100μA at OFF state.



External RELAY contact



TRANSISTOR Input contact

2-4-5 Auxiliary Relay

CAUTION

Precaution

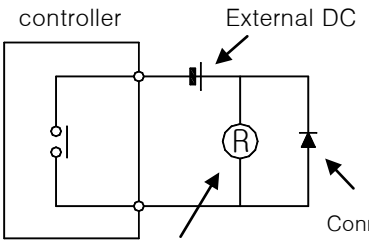
- If the wattage of the load is greater than the rating of output relay, an auxiliary relay should be used to on/off power on the load.

▶ When an inductive switch as a relay and a solenoid valve is used, it may be a noise source. A protective circuit should be installed to suppress a surge. CR filter (AC) or Diode (DC) should be connected with the mechanical contact in parallel.

▶ CR FILTER recommended

- Sung Ho Electronics (Korea) : BSE104R120 25V (0.1μ+120Ω)
- HANA PARTS CO. : HN2EAC
- Matsuo Electric Co., LTD (Japan) : CR UNIT 953, 955 etc
- Shizuki Electric Co., Inc.(Japan) : SKV, SKVB etc
- Rubycon Co. (Japan) : CR-CFS, CR-U etc

① DC RELAY



CAUTION

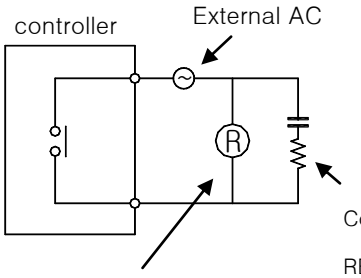
CAUTION

※ RELAY

The rating of RELAY COIL should be less than that of OUT relay of the controller

Connect the DIODE to the RELAY COIL terminal directly.

② AC RELAY



CAUTION

CAUTION

※ RELAY

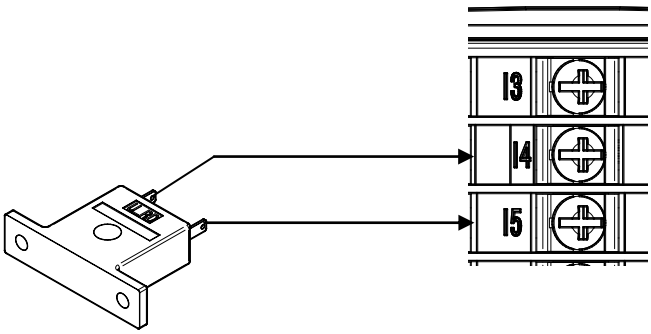
The rating of RELAY COIL should be less than that of OUT relay of the controller

Connect the CR FILTER to the RELAY COIL terminal directly.

2-4-6 CT sensor for detecting Heater Break

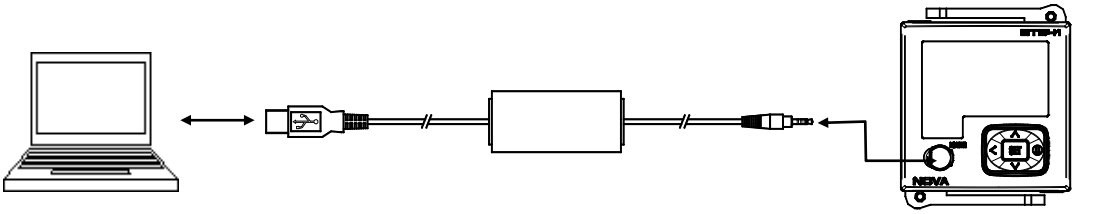
- This function is available only when OUT type is SSR or RELAY.
- The winding ratio of CT Sensor should be 800:1.
- To detect the heater current, the output pulse width should be longer than 200 ms.

  If the cycle time of SSR OUT is 2 sec, MV should be greater than 10% to detect the heater current.



2-4-7 Front communication port

- It is necessary to purchase LOADER(Option) cable to use the front communication.
- Rear communication (RS485) will be disabled automatically when using front LOADER.
- Parameter setting and monitoring is available with the bundle software program.

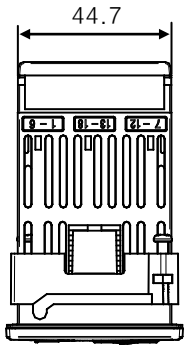


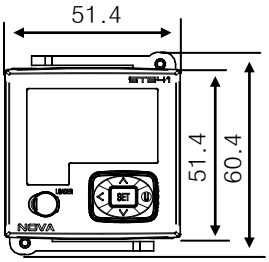
3. Mounting

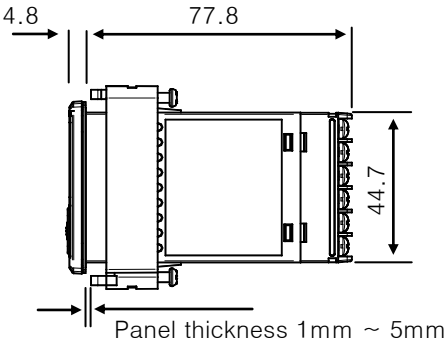
CAUTION Precautions

- To prevent an accident or trouble, the environmental operation conditions should be observed the specifications specified in the manual (temperature, humidity, voltage, vibration, shock, mounting, atmosphere)
- Do not block any vent hole on the controller to prevent a fire or a failure.

3-1. Dimensions

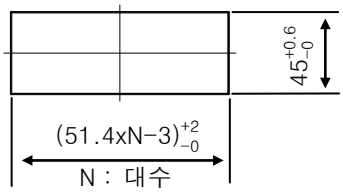




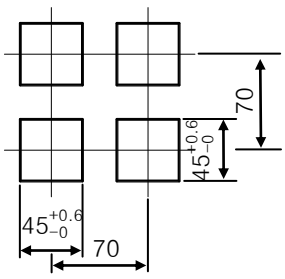


3-2. Panel cut-out size

3-2-1 Close-packed mounting



3-2-2 General mounting



▶ When close mounting more than 3 ea., the ambient temperature should be kept below 40℃.

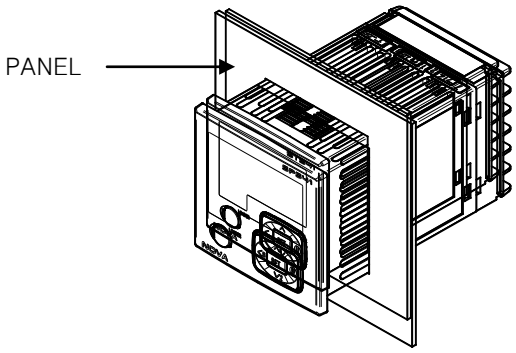
▶ The gap in vertical direction should be greater than 50mm.

3-3. Mounting procedure

▶ Mounting slope angle is allowed within 10 degree from horizontal position in both up and down directions.

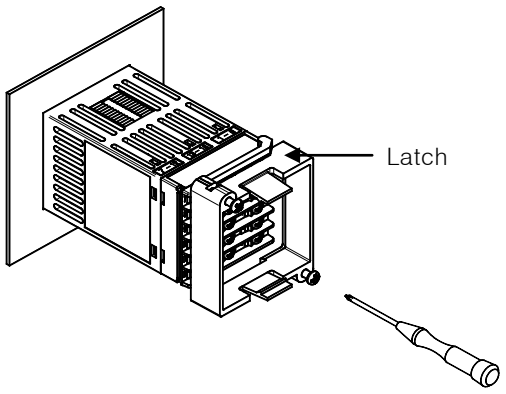
▶ Panel should be a rigid metal plate with the thickness greater than 2mm.

① ① The controller should be inserted from the front side.

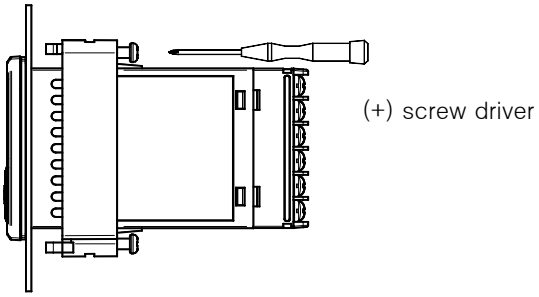


② Put the clamping latch on the controller from the rear side.

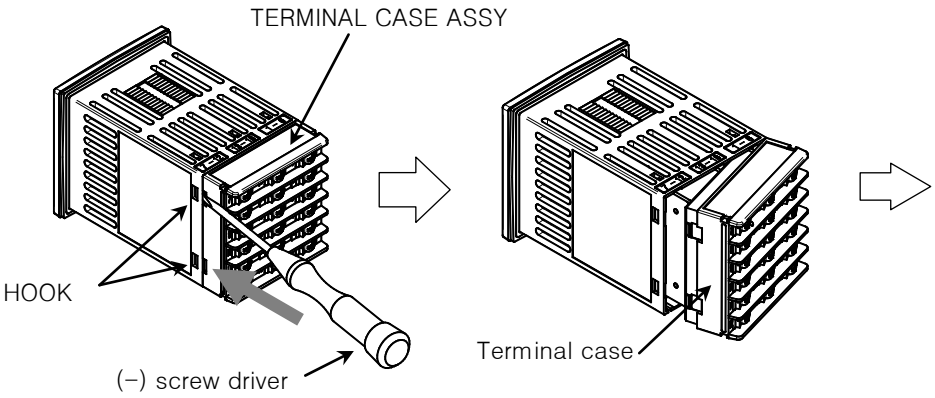
③ Push forward the clamping latch to be fixed around the controller.



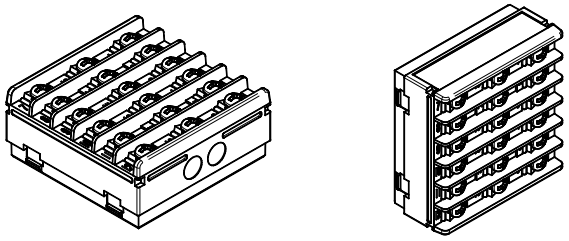
④ Fasten the screw bolts in the top and bottom.



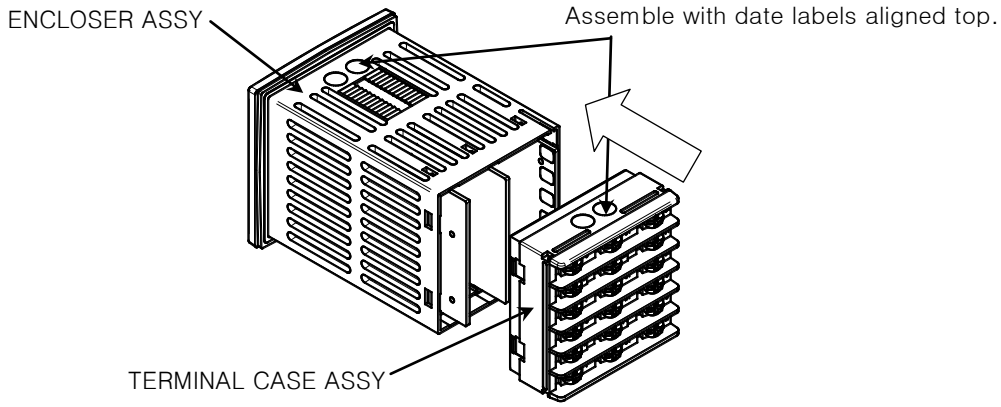
3-4. Disassembly of TERMINAL CASE ASSY



▶ Wedge off the two hooks with a (-) screw driver and open up the terminal case assay.



▶ The wiring work can be done with TERMINAL CASE ASSY separated.



▶ After the wiring work, TERMINAL CASE ASSY is fitted to ENCLOSER ASSY aligning the date marks in the same direction.

4. Functions

4-1. Sensor input (G.IN)

Input Type (IN-T) : Thermocouple (TC), Resistive thermal detector (RTD), DC volt (DCV)

In case of TC or RTD, the sensor type and temperature range should be selected.

In case of DCV, the input types are classified with the range of input voltage.

Table 1. Input types

GROUP	DISPLAY	INPUT TYPE	RANGE(℃)	RANGE(°F)
TC	TC.K1	K1	-200 ~ 1370	-300 ~ 2500
	TC.K2	K2	-200.0 ~ 1370.0	-300.0 ~ 1900.0
	TC.J	J	-200.0 ~ 1200.0	-300.0 ~ 1900.0
	TC.E	E	-200.0 ~ 1000.0	-300.0 ~ 1800.0
	TC.T	T	-200.0 ~ 400.0	-300.0 ~ 750.0
	TC.R	R	0.0 ~ 1700.0	32 ~ 3100
	TC.B	B	0.0 ~ 1800.0	32 ~ 3300
	TC.S	S	0.0 ~ 1700.0	32 ~ 3100
	TC.L	L	-200.0 ~ 900.0	-300 ~ 1600
	TC.N	N	-200.0 ~ 1300.0	-300 ~ 2400
	TC.U	U	-200.0 ~ 400.0	-300.0 ~ 750.0
	TC.W	W	0 ~ 2300	32 ~ 4200
	TC.PL	Platinel II	0.0 ~ 1390.0	32 ~ 2500
	TC.C	C	0 ~ 2320	32 ~ 4200
RTD	PTA	PTA	-200.0 ~ 850.0	-300.0 ~ 1560.0
	PTB	PTB	-200.0 ~ 500.0	-300.0 ~ 1000.0
	PTC	PTC	-50.00 ~ 150.00	-148.0 ~ 300.0
	PTD	PTD	-200 ~ 850	-300 ~ 1560
	JPTA	JPTA	-200.0 ~ 500.0	-300.0 ~ 1000.0
	JPTB	JPTB	-50.00 ~ 150.00	-148.0 ~ 300.0
DCV	2V	0.4 ~ 2.0V	0.400 ~ 2.000 V	
	5V	1 ~ 5V	1 ~ 5 V	
	10V	0 ~ 10V	0 ~ 10 V	
	20MV	-10 ~ 20mV	-10 ~ 20 ㎷	
	100MV	0 ~ 100mV	0 ~ 100 ㎷	

▪ Display range : -5% ~ +105% of above range

4-1-1 Input type

- Select the input type to use, considering sensor type and input range.
- Refer to Table 1 as a guide of sensor type and input range.

Symbol	Parameter	Setting range	Display	Unit	Default
IN-T	Input Sensor Type	Table1	Always	ABS	TC.K1

4-1-2 Temperature Unit (UNIT)

- Choose a temperature unit between "℃" and "°F".
- Changing IN-U, the temperature range will be converted automatically.
- IN-U parameter appears only when IN-T is one of TC or RTD group.

Symbol	Parameter	Setting range	Display	Unit	Default
IN-U	Input Unit	℃, °F	IN-T = TC IN-T = RTD	ABS	℃

4-1-3 Input range

- Setting the high and low limits of the sensor input range
  - ◦ TC, RTD Input

    When a RANGE CODE is selected, the range is set as Table 1. The range can be modified with IN.RH and IN.RL parameters. Decimal point position cannot be change by these parameters.
  - ◦ DCV, mV Input

    The input range can be determined by selecting a RANGE CODE and adjusted by modifying the parameters, IN.RH, IN.RL.

Symbol	Parameter	Setting range	Display	Unit	Default
IN.RH	Input Range High	Table 1 (IN.RH > IN.RL)	Always	EU	EU(100.0%)
IN.RL	Input Range Low				EU(0.0%)

CAUTION Setting Example

- When the range code TC.K1(-200~1370℃) is selected and setting IN.RL = -100 and IN.RH = 500, the input is limited in the range of -100~500℃.

4-1-4 Decimal point

- Determine decimal point place.
- When IN-T is one of TC, RTD group, IN.DP will skip.
- Decimal point place can be adjusted with IN.DP parameter when IN-T is one of DCV, mV.

Symbol	Parameter	Setting Range	Display	Unit	Default
IN.DP	Input Dot Position	0 ~ 4	IN-T = DCV	ABS	1

CAUTION Precaution on changing decimal point

- Changing IN.DP, the decimal point of other parameters as well as PV will be changed.
  The affected parameters are SP, Alarm, Event, Deviation related parameters.

4-1-5 PV display range

- Set the high and low limits of the scaled data of the input.
- TC, RTD : IN.SH, IN.SL will not appear.
- DCV, mV : The input signal is scaled with IN.SH and IN.SL value.
  (100% input is scaled to IN.SH and 0% input is scaled to IN.SL with linear transformation)

Symbol	Parameter	Setting range	Display	Unit	Default
IN.SH	Input Scale High	-10000 ~ 19999	IN-T = DCV	ABS	100.0
IN.SL	Input Scale Low	(IN.SH > IN.SL)			0.0

CAUTION Setting Example

- Input type is DCV and the range is 1~5V and scaled display need to be 0~100
  IN-T : 5V
  IN.SH : 100 (5V input is scaled to "100" display)
  IN.SL : 0 (1V input is scaled to "0" display)

4-1-6 Input filter (IN.FL)

- When the noise level of the input signal is high, input filter reduces the effect of the noise.
- When PV fluctuation is significant, control is unstable, or PV ripples due to some vibration, the change rate of PV decreases with increasing the filter value.

PV = Sensor Input × (1/1 + IN.FL)

IN.FL : OFF, 1～120 sec

Symbol	Parameter	Setting Range	Display	Unit	Default
IN.FL	Input Sensor Filter	OFF, 1 ~ 120	Always	ABS	OFF

4-1-7 Display filter (D.FL)

- Reduce the fluctuation of PV display in FND.
- The control is not affected by D.FL value.

Symbol	Parameter	Setting Range	Display	Unit	Default
D.FL	Display Filter	OFF, 1 ~ 120	Always	ABS	OFF

4-1-8 Burn-out Detection (B.SL)

- When Sensor signal input is interrupted because of sensor burn-out or line break-off , PV will be set a certain value so that the operations, alarm action, PV retransmission, control output should be set with the PV.
- B.SL is used when the input type is in TC, RTD group.

B.SL (Burn-Out selection)		Up (Up Scale)	Down (Down Scale)	OFF (Off)
TC/RTD (invalid for DCV)	Detection	O	O	X
	PV set	105%	-5%	Indefinite
Remark			May be +105% temporarily for RTD	

- Detection case (B.SL = UP, DOWN) : retransmission and alarm action is affected.
  MV should be Preset Output value.
- Non-Detection case (B.SL = OFF) : PV will be Indefinite
  Preset Output will not work.

Symbol	Parameter	Setting range	Display	Unit	Default
B.SL	Burnout Select	OFF, UP, DOWN	Always	ABS	UP

4-1-9 Reference Junction Compensation (R.SL)

- Compensation of reference junction temperature for TC input group is automatically done.
- In most cases, R.SL should be “ON” because the TC voltage decreases by the emf of terminal temperature. If R.SL = OFF, the deviation in PV by terminal temperature will appear.
- In RJC ERROR situation, error message and PV is displayed in PV FND alternately and the control will continue with RJC = 0℃.

(Refer to page77, “Error display and correction”)

Symbol	Parameter	Setting range	Display	Unit	Default
R.SL	RJC Select	OFF, ON	IN-T = TC	ABS	ON

4-1-10 Entire-range correction (AL.BS)

▪ Adjust offset of PV display in entire range.

PV = Input + Bias in the whole range(AL.BS)

Symbol	Parameter	Setting range	Display	Unit	Default
AL.BS	All Bias Value	EUS(-100.0 ~ 100.0%)	Always	EUS	EUS(0.0%)

4-1-11 Piecewise correction

▪ Adjust 5 offsets of PV display by piecewise correction method.

Symbol	Parameter	Setting range	Display	Unit	Default
BS.P1	Reference Bias Point 1	EU(0.0 ~ 100.0%)	Always	EU	EU(100.0%)
BS.P2	Reference Bias Point 2	IN.RL ≤ BS.P1 ≤ BS.P2			
BS.P3	Reference Bias Point 3	≤ BS.P3 ≤ IN.RH			
BS0	Bias Value for IN.RL Point	EUS(-100.0 ~ 100.0%)	Always	EUS	EUS(0.0%)
BS1	Bias Value for BS.P1 Point				
BS2	Bias Value for BS.P2 Point				
BS3	Bias Value for BS.P3 Point				
BS4	Bias Value for IN.RH Point				

Piecewise input correction

▪ Getting corrected temperature at a temperature by piecewise correction

▪ R.PV = the input temperature, B.PV = temperature after correction,

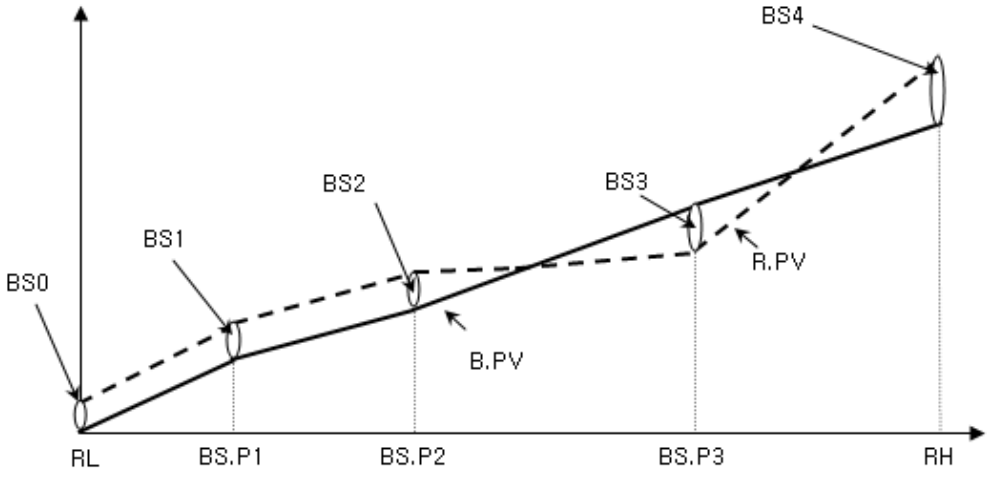
IN.RL = low limit, IN.RH = high limit

▪ IN.RL ~ BS.P1 : $B.PV = R.PV + (R.PV - IN.RL) \times \frac{(BS1 - BS0)}{(BS.P1 - IN.RL)} + BS0$

▪ BS.P1 ~ BS.P2 : $B.PV = R.PV + (R.PV - BS.P1) \times \frac{(BS2 \sim BS1)}{(BS.P2 \sim BS.P1)} + BS1$

▪ BS.P2 ~ BS.P3 : $B.PV = R.PV + (R.PV - BS.P2) \times \frac{(BS3 \sim BS2)}{(BS.P3 \sim BS.P2)} + BS2$

▪ BS.P3 ~ IN.RH : $B.PV = R.PV + (R.PV - BS.P3) \times \frac{(BS4 - BS3)}{(IN.RH - BS.P3)} + BS3$



4-1-12 PV LIMITER

▪ If PV is less than EU(-5%) or greater than EU(- 105%), PV will be -OVR or OVR.

▪ For internal operation, PV will be set -5% when PV < -5% and PV will be set 105% when PV > 105%.

PV > EU(105%)	:	PV = 105%, PV 표시 = OVR
EU(-5%) ≤ PV ≤ EU(105%)	:	PV = PV
PV < EU(-5%)	:	PV = -5%, PV 표시 = -OVR

Precaution

- If IN-T is changed, The parameters such as RH, RL, SH, SL will be initialized.
- The parameters of EU and EUS unit will be scaled with the sensor input range, therefore The parameters in G.IN should be set above all.

Setting Example

- Pt100Ω sensor is used in the range of -50.0~500.0℃ and display 1 decimal place.
- IN-T = PTA ☞ PTA (-200.0~850.0℃)
- IN-U = ℃ ☞ Display unit is ℃.
- IN.RH = 500.0
- IN.RL = -50.0
- B.SL = UP ☞ When sensor BURN OUT occurs, PV will be regarded as 500℃ (UP scale).
- R.SL = ON ☞ TC RJC (reference junction compensation) function will be activated.

4-2. Control Output (G.OUT)

- The kinds of output is determined by the parameters in G.OUT, OUT1, OUT2, EV1, EV2, EV3.
- As the type of output, SSR and SCR are available for OUT1, OUT2 and RELAY for EV1, EV2, EV3. (DCV can be provided for OUT1 as an option)

Table 2. Output kinds

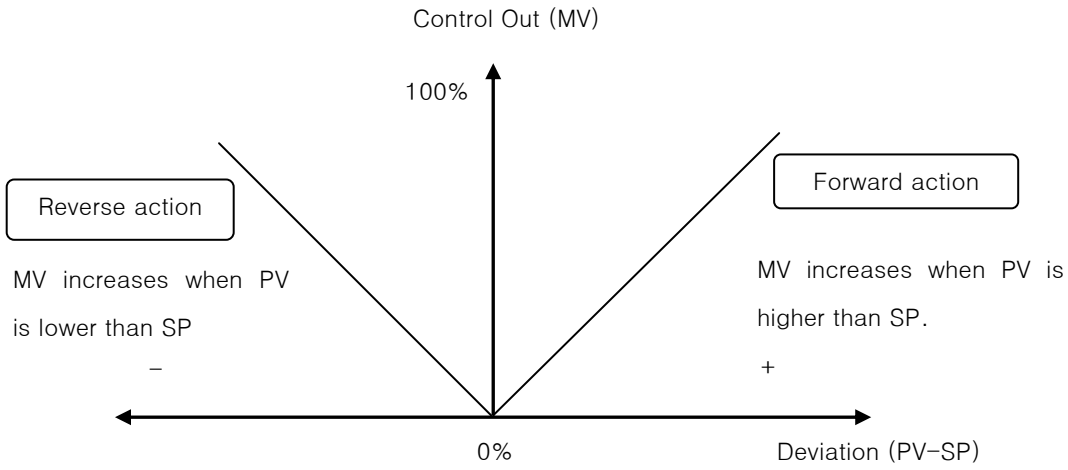
OUTPUT	SSR/SCR/DCV	SSR/SCR	RELAY		
	OUT1	OUT2	EV1	EV2	EV3
CONTROL OUTPUT(HEAT)	◈	◈	◈		
CONTROL OUTPUT(COOL)	◈	◈	◈		
ALARM SIGANL1,2,3			◈	◈	◈
RUN SIGNAL(RUN)			◈	◈	◈
INNER SIGNAL1,2			◈	◈	◈
RETRANSMISSION OUTPUT	◈	◈			

4-2-1 Output Kinds

Symbol	Parameter	Setting range	Display	Unit	default
OUT1	Analog Output 1	HEAT, RET H/C : COOL, HEAT, RET	Always	ABS	HEAT
OUT2	Analog Output 2				RET
HEAT	Heat Output Type	SSR, SCR	OUT1, OUT2 = HEAT		SSR
COOL	Cool Output Type		OUT1, OUT2 = COOL		
EV1	Event Output 1	COOL, HEAT, ALM1, ALM2, ALM3, RUN, IS1, IS2	Always		ALM1
EV2	Event Output 2	ALM1, ALM2, ALM3, RUN IS1, IS2			ALM2
EV3	Event Output 3		Option		ALM3

NOTE

Forward and Reverse Control Action



4-2-2 Output control direction (O.ACT)

- The direction of the control action : Reverse action (REV), Forward action (FWD).
- When O.ACT = REV, and PV < SP, output will be ON for RELAY or will increase for SSR, SCR type. When O.ACT = FWD, the direction of control action is quite the opposite.

Symbol	Parameter	Setting range	Display	Unit	Default
O.ACT	Output Direction	REV, FWD	Always	ABS	REV

4-2-3 Output period (Cycle Time)

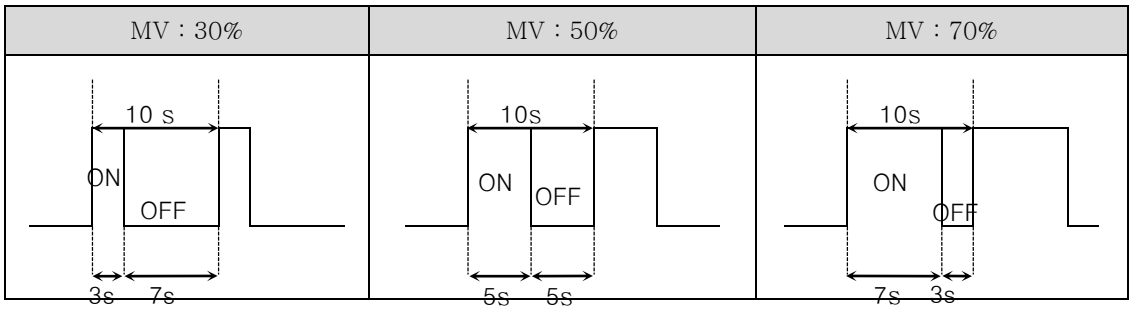
- For Relay or SSR type, cycle time is single ON + OFF time and MV is the ON-time ratio with respect to the cycle time. As cycle time increases, the frequency of On/Off action decreases. Generally, Cycle Time is 30 sec for a relay output, and 2 sec for a SSR considering life time.
- CT is for HEAT and CTc is for COOL output.

Symbol	Parameter	Setting range	Display	Unit	Default
CT	Heat Cycle Time	1 ~ 300 sec	Always	ABS	2 sec
CTc	Cool Cycle Time		H/C Type시		

NOTE

Cycle Time

- Cycle time is valid only when output type is SSR (Solid State Relay) or RELAY.
- Cycle time is 1 period of ON + OFF time.
- In case the cycle time is 10 sec. (CT = 10)



4-2-4 Output limit

- Set the limit of the control output (MV)
- OH is the high limit and OL is the low limit of MV. (-5.0% ≤ OL ≤ MVOUT ≤ OH ≤ 105.0%)
- OH is high limit of HEAT MV and OL is high limit of COOL MV for H/C type controller
  (0.0% ≤ H.OUT ≤ OH, 0.0% ≤ C.OUT ≤ OL)

Symbol	Parameter	Setting range	Display	Unit	Default
OH	Output High Limit H/C:Heat Output Limit	(OL + 1Digit) ~ 105.0% H/C : 0.0 ~ 105.0%	ON.OF = OFF	%	100%
OL	Output Low Limit H/C:Cool Output Limit	-5.0% ~ (OH - 1Digit) H/C : 0.0 ~ 105.0%			0.0% H/C:100.0%

4-2-5 Output change rate

- Set output change rate in the unit of % /sec.

Symbol	Parameter	Setting range	Display	Unit	Default
OPR	Output Process Rate	OFF, 0.1 ~ 100.0%/sec	Always	ABS	OFF

4-2-6 Hysteresis

- When selecting ON-OFF control mode, the range between ON-temperature and OFF-temperature can be set by this parameter.
- Hysteresis is applied in direction of deviation growing.

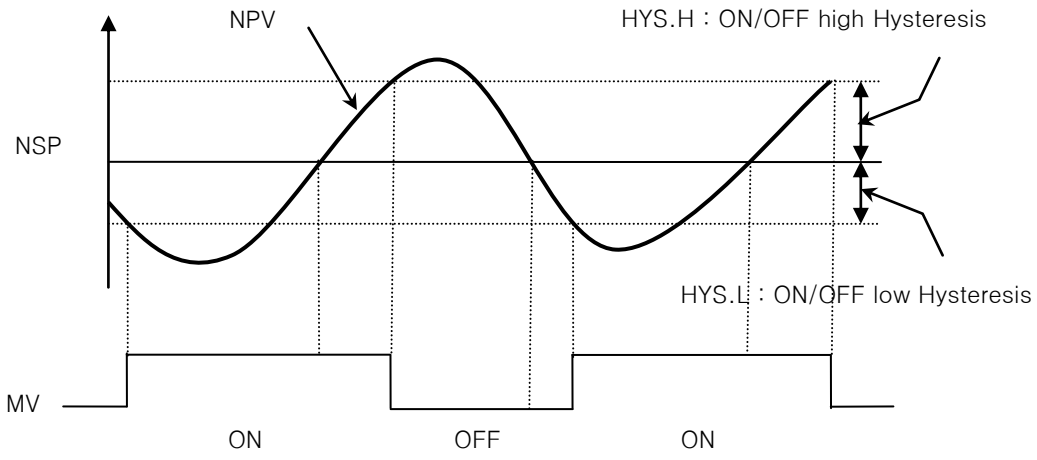
Symbol	Parameter	Setting range	Display	Unit	Default
HYS	ON/OFF Hysteresis	0.0 ~ 10.0%	H/C Type	%	0.5%
HYS.H	ON/OFF High Hysteresis	EUS(0.0 ~ 10.0%)	ON.OF = ON시	EUS	EUS(0.5%)
HYS.L	ON/OFF Low Hysteresis				

4-2-7 ON/OFF mode output

- ON/OFF mode is activated by setting ON.OF = ON in Control Group (G.CTL).
- In ON/OFF mode, EV1 is skipped out, HYS.H and HYS.L appear in G.OUT.
- EV1 is assigned to Relay control output automatically.

NOTE ON/OFF Control

- In ON/OFF control mode, MV is 0% or 100% depending on (NPV – NSP) deviation.
- By setting ON/OFF Hysteresis, time average MV can be controlled.
- ON/OFF mode is valid when output type is RELAY or SSR.



4-2-8 Output in an emergency

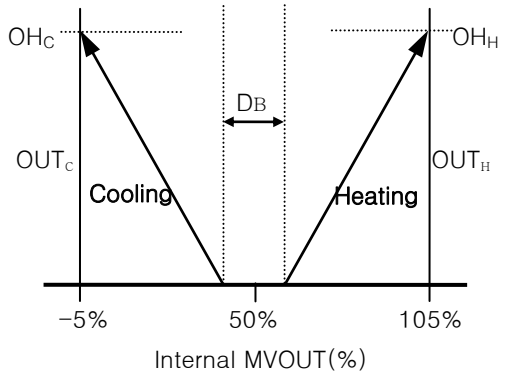
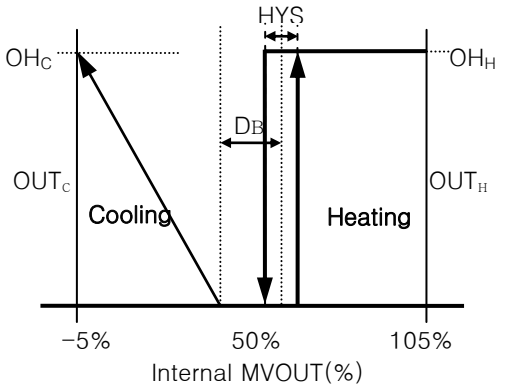
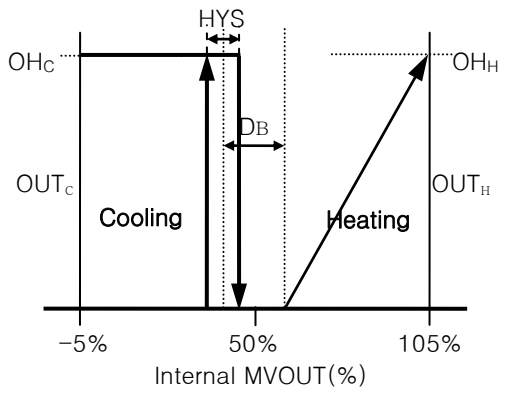
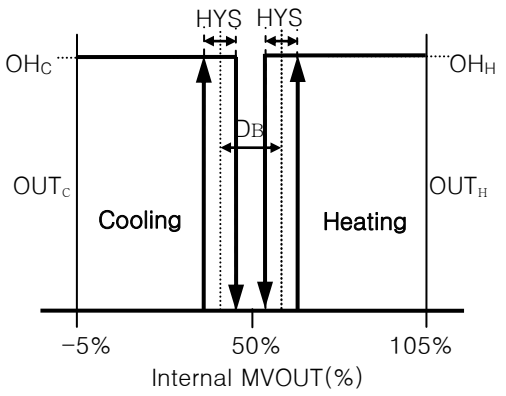
- In case of STOP, A/D ERROR, BURN OUT, the Preset Out value will be set to MV instead of MV calculated by PID algorithm. This function is useful in case warming state should be kept. (if ON.OF = ON, OUT = 0% for PO = 0%, OUT = 100% for PO > 0.1%.)
- If ON.OF = OFF, PRESET OUT will be done with PO value.

▪ When the controller is a H/C type, PO is for HEAT port, POC is for COOL port.

▪ In MAN MODE, the output value by key input will go out regardless of ERROR.

Symbol	Parameter	Setting range	Display	Unit	Default
PO	Heat Preset Output	-5.0 ~ 105.0% H/C : 0.0 ~ 105.0%	Always	%	0.0%
POc	Cool Preset Output	0.0 ~ 105.0%	H/C Type시		

Heating & Cooling Control

① Heating : PID Control, Cooling : PID Control	② Heating : ON/OFF , Cooling : PID Control
	
③ Heating : PID, Cooling : ON/OFF	④ Heating : ON/OFF , Cooling : ON/OFF
	

4-2-9 OUT LED Display

▪ MV OUT LAMP display mode.

SSR : On/Off of MV Out Lamp is synchronized with that of SSR or RELAY output.

SCR : MV Lamp blinks regardless of CT as SCR mode

Symbol	Parameter	Setting range	Display	Unit	Default
O.LED	Output LED	SSR, SCR	Always	ABS	SSR

4-3. Control Functions (G.CTL)

4-3-1 Reservation RUN

▪ Set the standby time to RUN starting

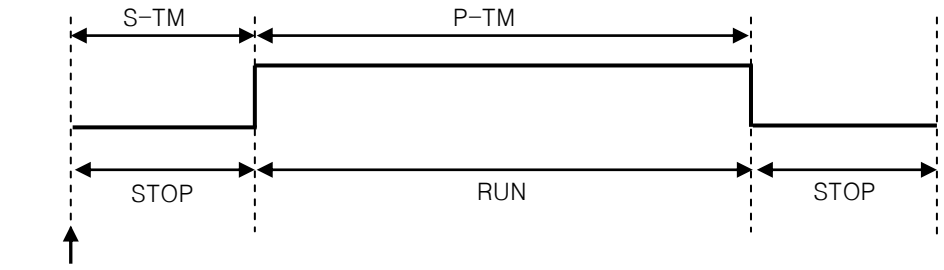
Symbol	Parameter	Setting range	Display	Unit	Default
S-TM	Start Time	OFF, 0.01 ~ 99.59 min	Always	TIME	OFF

4-3-2 Run time setting

▪ Set the process run time.

Symbol	Parameter	Setting range	Display	Unit	Default
P-TM	Process Time	OFF, 0.01 ~ 99.59 min	Always	TIME	OFF

NOTE Reservation Function



4-3-3 AUTO/MAN Selection

▪ Set the control state AUTO or MAN.

▪ After setting A/M = MAN, “MAN LED” in front panel is turn on, MV % can be set with keys.

Symbol	Parameter	Setting range	Display	Unit	Default
A/M	AUTO/MAN Control	AUTO, MAN	Always	ABS	AUTO

4-3-4 User screen

▪ The parameter used frequently or to be checked can be displayed in RUN Screen.

Symbol	Parameter	Setting range	Display	Unit	Default
US1	User Screen 1	OFF, D-Register No.(0001～1299)	Always	ABS	OFF
US2	User Screen 2				

4-3-5 User defined key

▪ Pressing ⓤ key for 3 seconds, the function selected in U.KEY will be executed as a user defined function.

Symbol	Parameter	Setting range	Display	Unit	Default
U.KEY	User Define Key	OFF, AT, A/M, R/S	Always	ABS	AT

4-3-6 Key lock

▪ When LOCK = ON, a user cannot edit any parameter value. This function can prevent an accidental trouble due to the wrong parameter setting by a user.

Symbol	Parameter	Setting range	Display	Unit	Default
LOCK	Key Lock	OFF, ON	Always	ABS	OFF

4-3-7 External Contact Input (DI)

▪ Select a Set of DI functions which is predefined for remote controls.

▪ RUN / STOP, HOLD, STEP functions can be executed by DI (external contact).

Table 3. DI Operation

DI.SL	DI1	DI2	ACTION
OFF	–	–	NOT USE
1	OFF	–	STOP
	ON	–	RUN
	–	OFF	SP1
	–	ON	SP2
2	OFF	OFF	SP1
	ON	OFF	SP2
	OFF	ON	SP3
	ON	ON	SP4

※ 'ON' is activated when the contact time is longer than 1 sec

Symbol	Parameter	Setting range	Display	Unit	Default
DI.SL	DI Select	OFF, 1, 2	DI Option	ABS	OFF

4-3-8 Output Status display

▪ When O.STS = ON, The status of OUT1, OUT2, EV1, EV2, EV3 in RUN screen.

Symbol	Parameter	Setting range	Display	Unit	Default
O.STS	Output Status	OFF, ON	Always	ABS	OFF

4-3-9 PV Display High, Low Limit

▪ Set the high and low limits of PV display in the front PV FND.

Symbol	Parameter	Setting range	Display	Unit	Default
DSP.H	Display High Limit	EU(-5.0 ~ 105.0%) (DSP.L < DSP.H)	Always	EU	EU(105.0%)
DSP.L	Display Low Limit				EU(-5.0%)

4-3-10 PASSWORD

▪ Register the PASSWORD.

Symbol	Parameter	Setting range	Display	Unit	Default
U.PWD	User Password	0 ~ 9999	Always	ABS	0

CAUTION Precaution

▪ Be sure not to forget the PASSWORD.

▪ When the PASSWORD is lost. In this case, request a service to Samwontech.

4-3-11 ON/OFF Mode

▪ Set ON/OFF Mode active or disabled

Symbol	Parameter	Setting range	Display	Unit	Default
ON.OF	ON/OFF Mode	OFF, ON	Always	ABS	OFF

4-3-12 Initialization of the controller

▪ Setting INIT = ON will initialize all the parameters except those in G.COM.

Symbol	Parameter	Setting range	Display	Unit	Default
INIT	Parameter Initialization	OFF, ON	Always	ABS	OFF

4-4. Communication (G.COM)

4-4-1 Protocol selection

▪ Select a Protocol to use.

▪ Select PCC0 for PC Link or select PCC1 for PC Link with sum check.

Symbol	Parameter	Setting range	Display	Unit	Default
COM.P	Communication Protocol	PCC0, PCC1, MBS.A, MBS.R, SYN.M, SYN,S	/RS Option	ABS	PCC1

4-4-2 Baud rate

▪ Set the baud rate, communication speed.

Symbol	Parameter	Setting range	Display	Unit	Default
BAUD	Baud Rate	4800, 9600, 19.2K, 38.4K	/RS Option	ABS	9600

4-4-3 Parity

▪ Set the parity.

Symbol	Parameter	Setting range	Display	Unit	Default
PRTY	Parity	NONE, EVEN, ODD	/RS Option	ABS	NONE

4-4-4 Stop Bit

▪ Set the stop bit.

Symbol	Parameter	Setting range	Display	Unit	Default
S.BIT	Stop Bit	1, 2	/RS Option	ABS	1

4-4-5 Data Length

▪ Set the data length.

Symbol	Parameter	Setting range	Display	Unit	Default
D.LEN	Data Length	7, 8	/RS option COM.P = PCC0, PCC1, SYN.M, SYN.S	ABS	8

4-4-6 Communication Address

▪ Set the communication address. Networking is available up to 31 ea max.

Symbol	Parameter	Setting range	Display	Unit	Default
ADDR	Address	1 ~ 99	/RS Option	ABS	1

4-4-7 Response Time

▪ Set the response time.

Symbol	Parameter	Setting range	Display	Unit	Default
RP.TM	Response Time	0 ~ 10 (x10ms)	/RS Option	ABS	0

4-4-8 Remote bias at synchronized run.

▪ Slave add this value to the SP from Master while synchronized RUN.

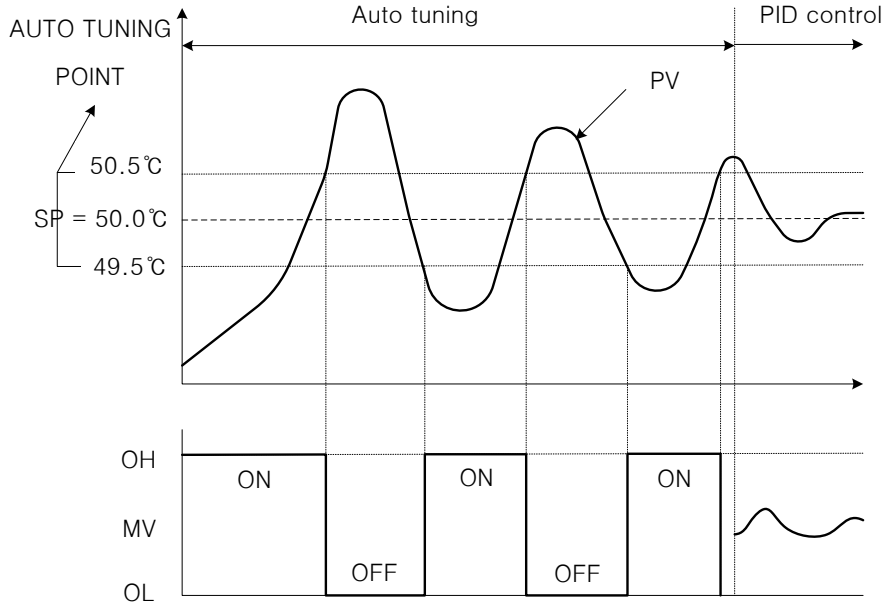
(This parameter will be initialized when the protocol is changed)

Symbol	Parameter	Setting range	Display	Unit	Default
R.BS	Remote SP Bias	EUS(-100.0 ~ 100.0%)	/RS Option COM.P = SYN.S	ABS	EUS(0.0%)

4-5. Auto Tuning (G.AT)

Auto Tuning

- Auto tuning is a strong function that the controller tests the characteristics of the control system, and calculates the optimal values of PID parameters.
- During auto tuning the controller makes ON/OFF control output 2.5 cycles, measure the PV response of the control system with a limit cycle method and calculate the P, I, D value with the oscillation data.
- While a program is running and PV is kept around the SP, Auto tuning can be started. After tuning, the resultant P,I,D parameters of corresponding zone are automatically set.

▪ Auto tuning procedure with a set point	
Parameter Setting	▶ IN-T = PtC (RTD: -50.00℃ ~ 150.00℃) ▶ AUTO TUING POINT = **EUS 0.25%(0.5℃)** ▶ **SP = 50.0℃** ▶ OL = 0.0% ▶ OH = 100.0%
Tuning Procedure	

4-5-1 Auto tuning

- Make auto tuning start by setting AT = ON.
- This parameter is skipped when ON.OF = ON in G.CTL, ON/OFF mode.

Symbol	Parameter	Setting range	Display	Unit	Default
AT	Auto Tuning	OFF, ON	AUTO mode	ABS	OFF

4-5-2 GAIN setting

- A parameter that determines the ratio between PID and MV. A small AT-G value makes the response fast and a large AT-G value is favorable for stable control but it takes long time to reach the target SP.
- This parameter is skipped in ON/OFF Mode.

Symbol	Parameter	Setting range	Display	Unit	Default
AT-G	Auto Tuning Gain	0.1 ~ 10.0	AUTO mode	ABS	1.0

NOTE AT GAIN(Auto Tuning Gain)

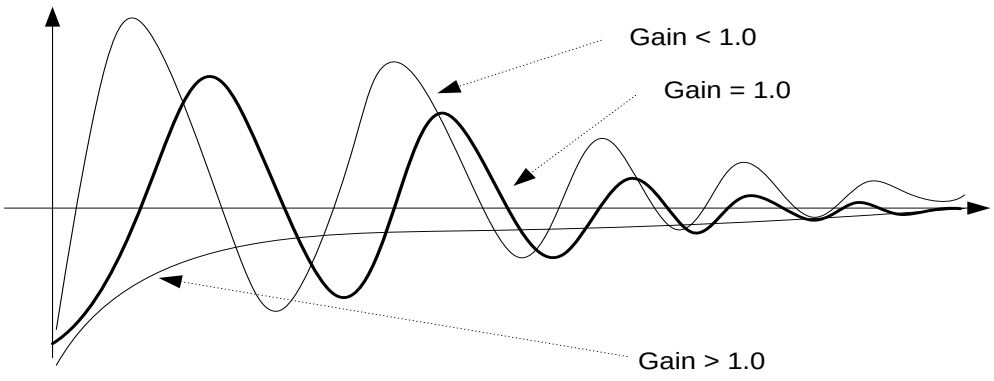
- A parameter to adjust the gain of MV with respect to PID.

  ☞ Generally, use the value obtained after auto tuning.

- To adjust the characteristics of control system, AT GAIN can be set manually.

① If AT GAIN < 1.0, RESPONSE is fast, but PV hunting may occur.

② If AT GAIN > 1.0, OVERSHOOT decreases, RESPONSE becomes slow.



Starting Auto tuning and stopping it

■ Starting

① Check the control system, PV input and heater power.

② Check if 「AT」 lamp = OFF, in RUN mode not in READY mode.

③ Check if 「MAN」 lamp = OFF, in Auto mode.

④ Set the parameter AT ON.

■ Stopping

Auto tuning stops automatically. But by setting AT=OFF or setting Ready mode, AT process will be interrupted. Changing to READY mode or MANUAL mode will stop the AT process.

Cautions

- AT can be done normally under controllable system condition (heater, sensor).
- AT can be started at RUN mode and when PV is in a normal range.
- At an abnormal situations, an Interruption of power or sensor burn-out during AT, AT will stop without changing PID parameters.
- The number of limit cycle or time can be different depending on the control system.
- MV will be ON and OFF for several times for limit cycle operation during AT procedure.
- In a special control system, optimal PID value cannot be obtained with AT. At this time, a user should adjust P, I, D value manually.

4-6. Alarm (G.ALM)

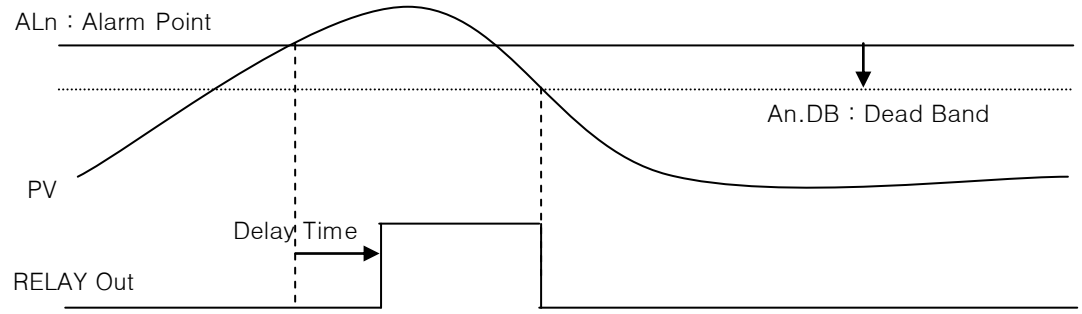
Table 4. Types of Alarm

NO	Display	Type	Direction		Standby		ON Condition	OFF Condition
			Fwd.	Rev.	No	Yes		
1	AH.F	Upper-limit PV	▣		▣		PV ≥ ALn	PV < (ALn – An.DB)
2	AL.F	Lower-limit PV	▣		▣		PV ≤ ALn	PV > (ALn + An.DB)
3	DH.F	Upper-limit Deviation	▣		▣		(PV – SP) ≥ ALn.H	(PV – SP) < (ALn.H – An.DB)
4	DL.F	Lower-limit Deviation	▣		▣		(PV – SP) ≤ –ALn.L	(PV – SP) > (–ALn.H + An.DB)
5	DH.R	Upper-limit Deviation		▣	▣		(PV – SP) ≥ ALn.H	(PV – SP) < (ALn.H – An.DB)
6	DL.R	Lower-limit Deviation		▣	▣		(PV – SP) ≤ –ALn.L	(PV – SP) > (–ALn.H + An.DB)
7	DO.F	Out of Deviation limits	▣		▣		(PV – SP) ≥ ALn.H ∨ (PV – SP) ≤ –ALn.L	(PV – SP) < (ALn.H – An.DB) ∧ (PV – SP) > (–ALn.H + An.DB)
8	DI.F	In band of Deviation limits	▣		▣		(PV – SP) ≤ ALn.H ∧ (PV – SP) ≥ –ALn.L	(PV – SP) > (ALn.H – An.DB) ∨ (PV – SP) < (–ALn.H + An.DB)
9	AH.R	Upper-limit PV		▣	▣		PV ≥ ALn	PV < (ALn – An.DB)
10	AL.R	Lower-limit PV		▣	▣		PV ≤ ALn	PV > (ALn + An.DB)
11	AH.FS	Upper-limit PV	▣			▣	PV ≥ ALn	PV < (ALn – An.DB)
12	AL.FS	Lower-limit PV	▣			▣	PV ≤ ALn	PV > (ALn + An.DB)
13	DH.FS	Upper-limit Deviation	▣			▣	(PV – SP) ≥ ALn.H	(PV – SP) < (ALn.H – An.DB)
14	DL.FS	Lower-limit Deviation	▣			▣	(PV – SP) ≤ –ALn.L	(PV – SP) > (–ALn.H + An.DB)
15	DH.RS	Upper-limit Deviation		▣		▣	(PV – SP) ≥ ALn.H	(PV – SP) < (ALn.H – An.DB)
16	DL.RS	Lower-limit Deviation		▣		▣	(PV – SP) ≤ –ALn.L	(PV – SP) > (–ALn.H + An.DB)
17	DO.FS	Out of Deviation limits	▣			▣	(PV – SP) ≥ ALn.H ∨ (PV – SP) ≤ –ALn.L	(PV – SP) < (ALn.H – An.DB) ∧ (PV – SP) > (–ALn.H + An.DB)
18	DI.FS	In band of Deviation limits	▣			▣	(PV – SP) ≤ ALn.H ∧ (PV – SP) ≥ –ALn.L	(PV – SP) > (ALn.H – An.DB) ∨ (PV – SP) < (–ALn.H + An.DB)
19	AH.RS	Upper-limit PV		▣		▣	PV ≥ ALn	PV < (ALn – An.DB)
20	AL.RS	Lower-limit PV		▣		▣	PV ≤ ALn	PV > (ALn + An.DB)
21	SK.DV	SOAK	▣		▣		※ SOAK Alarm ON, OFF condition	
22	HBA	Heater Break Alarm	▣		▣		HB.CD ≤ HB.CS	HB.CD > (HB.CS + HB.DB)

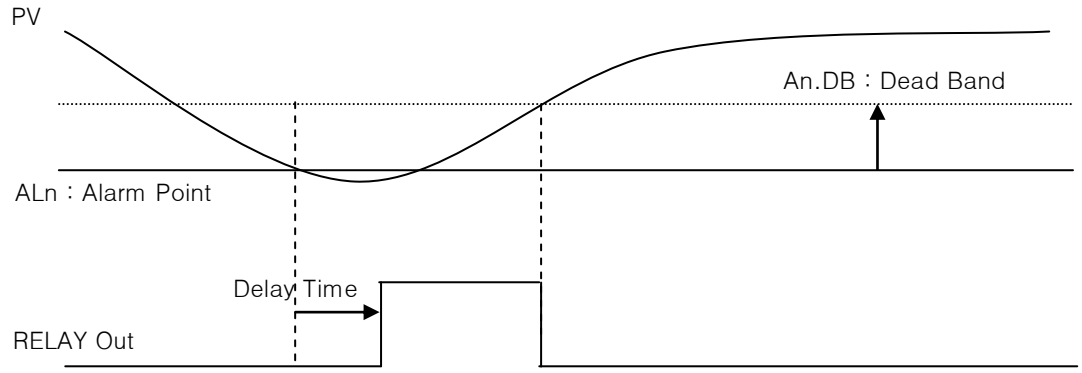
▪ AL : Alarm point, n : Alarm Number, ALn.H : Deviation upper-limit of Alarm n.

Alarm Operation

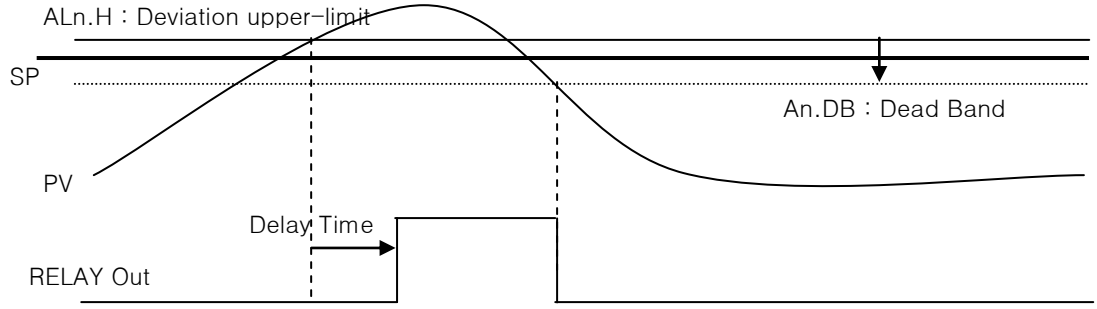
▪ PV Upper-limit Alarm operation (AH.F)



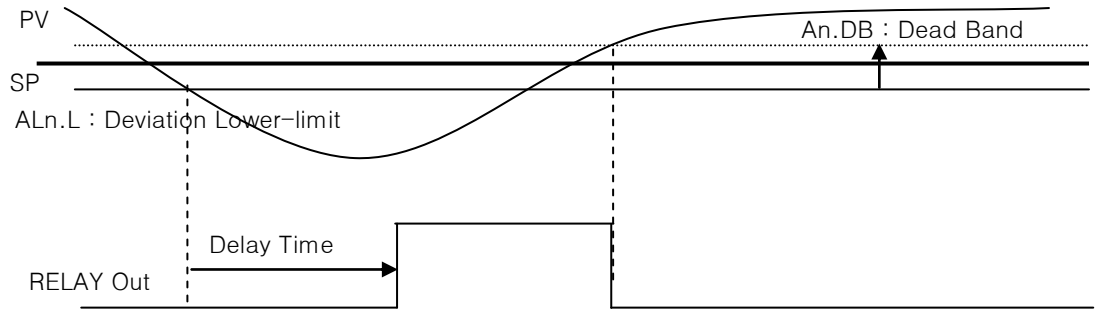
▪ PV Lower-limit Alarm operation (AL.F)



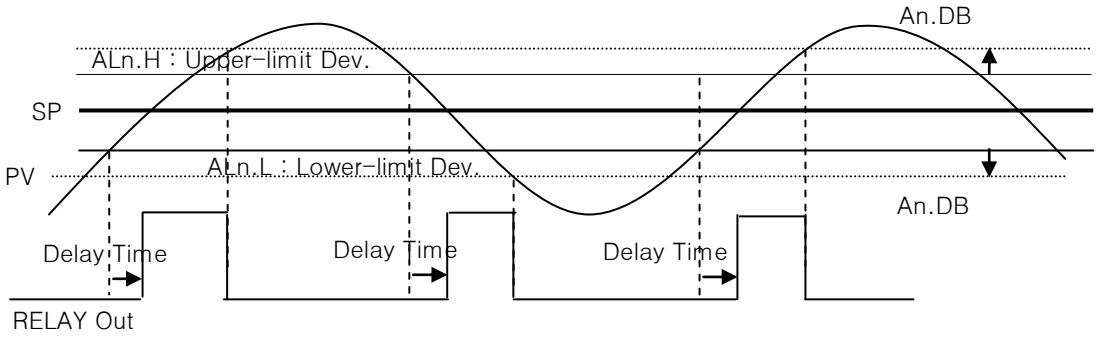
▪ Upper-limit Deviation Alarm operation (DH.F)



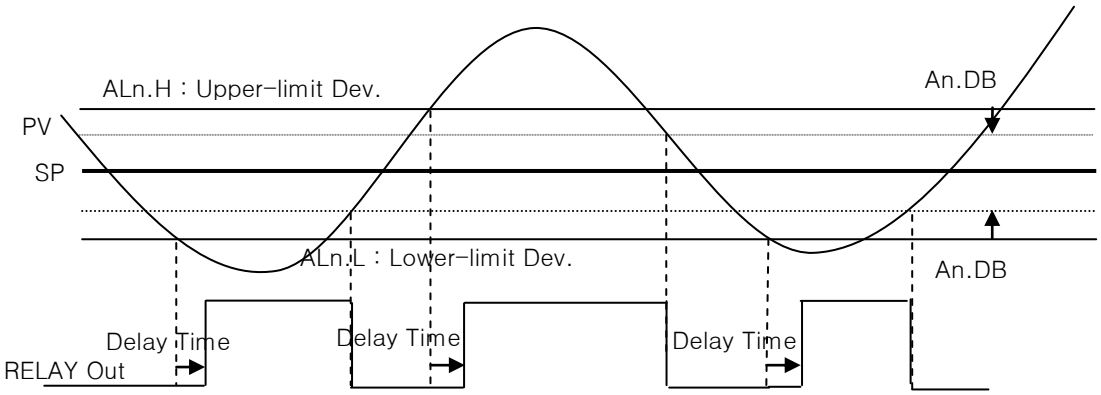
▪ Lower-limit Deviation Alarm operation (DL.F)



▪ In band Deviation limits Alarm operation (DI.F)



▪ Out of Deviation limits Alarm operation (DO.F)



※ Output Direction mode

Forward (FWD) : ON when alarm condition, OFF when alarm off

Reverse (REV) : OFF when alarm condition, ON when alarm off

※ The condition of Standby

Power On

Changing of Alarm Kind

Changing SP

4-6-1 Alarm Kinds

▪ Set the alarm type of Alarm1,2,3.

Symbol	Parameter	Setting range	Display	Unit	Default
ALT1	Alarm 1 Type	Table 4. Types of Alarm	Always	ABS	AH.F
ALT2	Alarm 2 Type				
ALT3	Alarm 3 Type				

4-6-2 Alarm point

▪ Set the alarm point of Alarm1,2,3.

Symbol	Parameter	Setting range	Display	Unit	Default
AL1	Alarm 1 Set Value	EU(-100.0 ~ 100.0%)	Alarm type is not a Dev.	EU	EU(100.0%)
AL2	Alarm 2 Set Value				
AL3	Alarm 3 Set Value				

4-6-3 High/Low Deviation Alarm

▪ Set high and low deviation of Alarm1,2,3.

Symbol	Parameter	Setting range	Display	Unit	Default
AL1.H	Alarm 1 Set High Deviation	EUS(-100.0 ~ 100.0%)	Alarm type is a Dev. Type	EUS	EUS(0.0%)
AL1.L	Alarm 1 Set Low Deviation				
AL2.H	Alarm 2 Set High Deviation				
AL2.L	Alarm 2 Set Low Deviation				
AL3.H	Alarm 3 Set High Deviation				
AL3.L	Alarm 3 Set Low Deviation				

4-6-4 Dead Band

▪ Set the dead band of Alarm1,2,3.

Symbol	Parameter	Setting range	Display	Unit	Default
A1.DB	Alarm 1 Dead Band	EUS(0.0 ~ 100.0%)	Always	EUS	EUS(0.5%)
A2.DB	Alarm 2 Dead Band				
A3.AB	Alarm 3 Dead Band				

4-6-5 Delay Time

▪ Set the delay time of Alarm1,2,3.

Symbol	Parameter	Setting range	Display	Unit	Default
A1.DY	Alarm 1 Delay Time	0.00 ~ 99.59 mm.ss	Always	TIME	0 sec
A2.DY	Alarm 2 Delay Time				
A3.DY	Alarm 3 Delay Time				

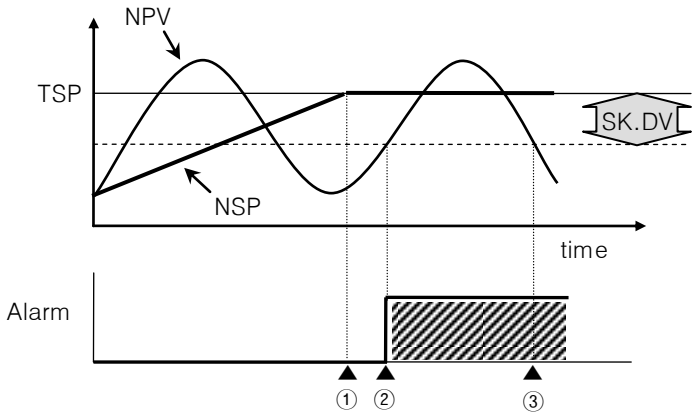
4-6-6 SK.DV Setting

▪ Set the Deviation of Soak Alarm.

Symbol	Parameter	Setting range	Display	Unit	Default
SK.DV	Soak Deviation	EUS(0.0 ~ 10.0%)	SOAK Alarm	EUS	EUS(0.0%)

NOTE **SOAK Alarm ON, OFF Condition**

(가) UP SLOPE(↗ : SP ramping up)

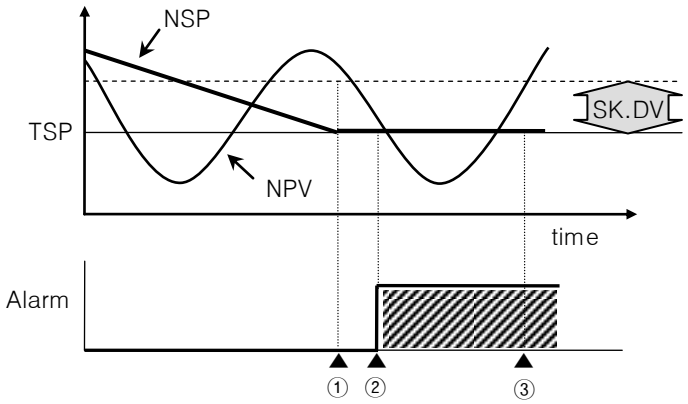


① Check the alarm from the point [TSP = NSP].

② [NPV > TSP - SK.DV] "ON".

③ [NPV < TSP - SK.DV] if "ON" state once, it goes "OFF" when chaning SP.

(나) DOWN SLOPE(↘ : SP ramping down)



① Check the alarm from the point [TSP = NSP].

② [NPV < TSP + SK.DV] “ON”.

③ [NPV > TSP + SK.DV] if “ON” once, it goes “OFF” when changing SP.

4-7. SP group (G.SP)

4-7-1 Run/Stop Selection

▪ Select Run/Stop operation.

Symbol	Parameter	Setting range	Display	Unit	Default
R-S	RUN/STOP Operation	RUN, STOP	Always	ABS	RUN

4-7-2 SP Kind

▪ Select SP Kind.

Symbol	Parameter	Setting range	Display	Unit	Default
SP.SL	SP Select	R.SP, SP1, SP2, SP3, SP4	Always	ABS	SP1

4-7-3 SP Setting

▪ Set SP values, SP1, SP2, SP3, SP4.

Symbol	Parameter	Setting range	Display	Unit	Default
SP1	Setting Point 1	EU(0.0 ~ 100.0%)	Always	EU	EU(0.0%)
SP2	Setting Point 2				
SP3	Setting Point 3				
SP4	Setting Point 4				

4-7-4 High/Low Limit

▪ Set High/Low limit of SP.

Symbol	Parameter	Setting range	Display	Unit	Default
SP.RH	SP Range High	EU(0.0 ~ 100.0%)	Always	EU	EU(100.0%)
SP.RL	SP Range Low				EU(0.0%)

4-7-5 Time Unit

▪ Select the Time Unit.

Symbol	Parameter	Setting range	Display	Unit	Default
TM.U	Time Unit	HH.MM, MM.SS	Always	ABS	HH.MM

4-7-6 Slope of ramping up/down

▪ Set the ramping rate (EUS/min).

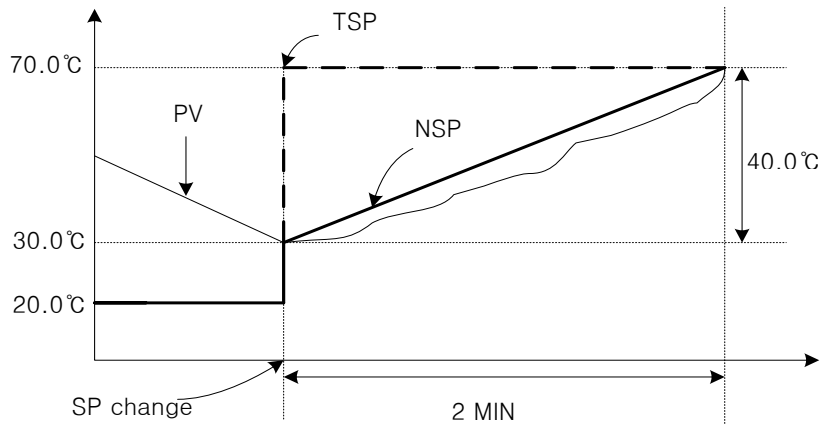
Symbol	Parameter	Setting range	Display	Unit	Default
U.SLP	Up Slope	OFF, EUS(0.0%+1digit ~ 100.0%)/min	Always	EUS	OFF
D.SLP	Down Slope				

NOTE **Operation of Slope**

▪ When changing TSP, the ramping rate is given from NPV to TSP by gradually changing NSP.

▪ Operation of SLOPE

▶ SLOPE : 20.0 ℃/MIN



Amount of change to TSP = [SP(TSP) – NPV] and Slope = 20.0℃/min.

→ (70.0 – 30.0)℃ = 40.0℃, it will take 2 min to ramp up to TSP.

☞ **For 2 minutes, NSP will be changed from 30.0℃ to 70.0℃ at a constant rate of 20℃/min.**

4-8. PID Group (G.PID)

▪ When On/Off mode, it is skipped. ON.OF = ON in G.CTL.

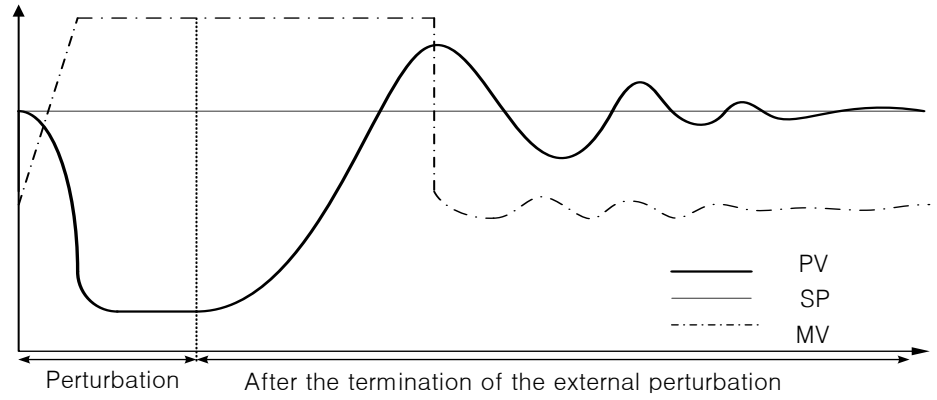
Anti reset wind-up (ARW)

▪ ARW is an effective function to minimize the influence of an external perturbation or disturbance.

▪ When I=0 in PID parameter, ARW will not work.

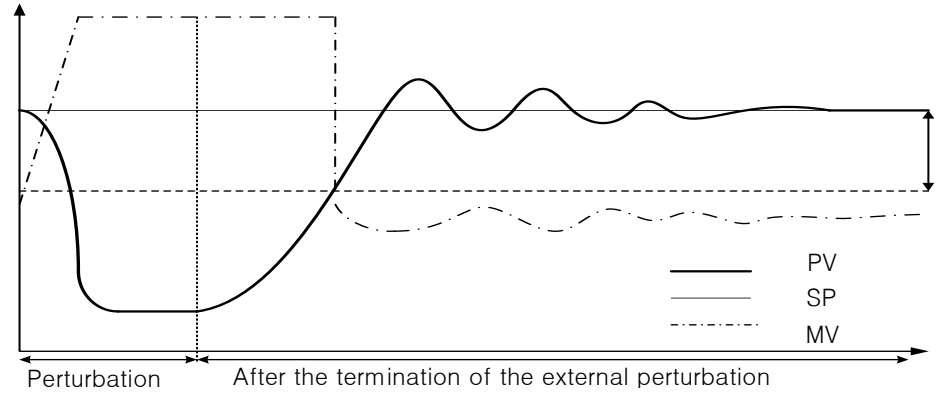
▪ MV estimation in PID control : MV = P (proportional) + I (integration term) + D (derivative term)

과적분방지 기능이 없는 경우



When a perturbation occurs (ex. door open) PV decreases, and MV increases to fit PV to SP. If the deviation keeps high for a long time, the integration value in I term remains for long time after the termination of the perturbation. Consequently, a large overshoot may occur and it takes a long time to get stable PV.

과적분방지 기능이 있는 경우



When current NPV approaches **±P BAND** , the integration value in I term vanishes by the operation of Anti-Reset-Windup. Therefore, overshooting is minimized and PV gets stable quickly.

▶ **P BAND** setting example

→ input range : 0.0~100.0℃ , P:10.0% , ARW : 200%

P BAND = 200% of P = 20.0%(P*2) = 20.0℃ (input range * 0.2)

4-8-1 ARW (Anti Reset Wind-up)

▪ Set the deviation band to prevent over-integration.

Symbol	Parameter	Setting range	Display	Unit	Default
ARW	Anti-Reset Wind-Up	AUTO(0.0) ~ 200.0%	Always	%	100.0%

4-8-2 Control Mode

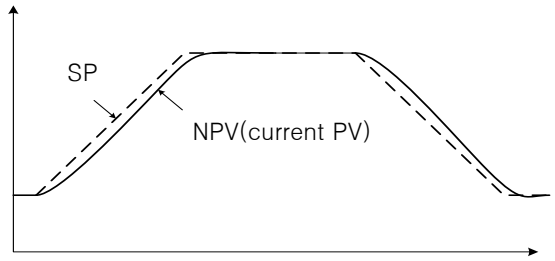
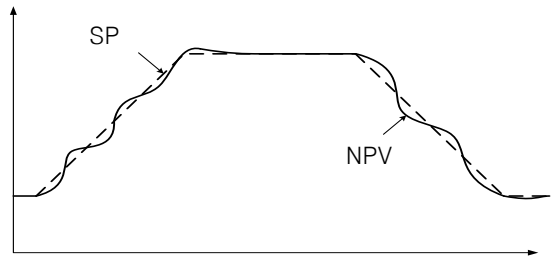
▪ Select a mode of PID control.

D.DV : MV change rate is small. Overshoot is small but it takes a bit long time to reach a TSP.

D.PV : MV change rate is large. Overshoot may be large and PV approaches TSP shortly.

Symbol	Parameter	Setting range	Display	Unit	Default
C.MOD	Control Mode	D.PV, D.DV	Always	ABS	D.PV

NOTE Control Mode

D.DV mode	Description
	▶ In D.DV mode, MV changes slowly. Overshoot is small but the delay may appear to reach SP. ▶ It is suitable for a system which shows sensitive response to MV.
D.PV mode	**Description**
	▶ In D.PV mode, MV changes quickly. Overshoot may occur but the time to reach the TSP is shorter. ▶ It is suitable for a system which shows slow response to MV.

4-8-3 Fuzzy Function

▪ Set Fuzzy Function active or disabled.

Symbol	Parameter	Setting range	Display	Unit	Default
FUZY	Fuzzy Select	OFF, ON	Always	ABS	OFF

Fuzzy Operation

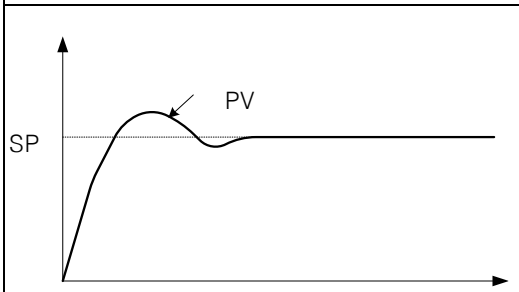
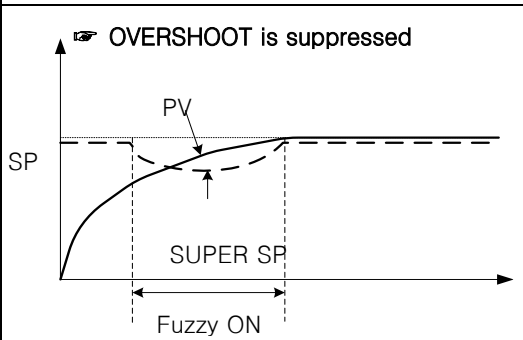
▪ When the variation of load power is great, or SP is changed frequently, overshooting appears generally. The Fuzzy function is effective to suppress the overshooting.

▪ Internal working sequence of FUZZY function

① When PV approaches SP, The calculation of SUPER SP is carried out.

② Assuming this Super SP as SP, MV is estimated.

☞ **Overshooting is suppressed by FUZZY function.**

The effect of FUZZY function	
Fuzzy OFF	Fuzzy ON
	

4-8-4 PID Number

▪ Select the PID number to use.

Symbol	Parameter	Setting range	Display	Unit	Default
PID	PID Number	MENU, 1 ~ 4	Always	ABS	MENU

4-8-5 Proportional band

▪ Set the Proportional band of PID.

Symbol	Parameter	Setting range	Display	Unit	Default
n.P	Heat Proportional Band	0.1 ~ 1000.0% H/C : 0.0 ~ 1000.0%	Always	%	10.0%

4-8-6 Integration time

▪ Set the Integration time of PID.

Symbol	Parameter	Setting range	Display	Unit	Default
n.I	Heat Integral Time	OFF, 1 ~ 6000 sec	Always	ABS	120 sec

4-8-7 Derivation time

▪ Set the Derivation time of PID.

Symbol	Parameter	Setting range	Display	Unit	Default
n.D	Heat Derivative Time	OFF, 1 ~ 6000 sec	Always	ABS	30 sec

4-8-8 Manual set value of Integration time

▪ If the Integration time (I) is “OFF”, the setting value will be assigned to the I term in PID.

Symbol	Parameter	Setting range	Display	Unit	Default
n.MR	Manual Reset	-5.0 ~ 105.0%	I = 0 H/C Type시	%	50.0%

4-8-9 Proportional band (cooling control)

▪ Set cooling proportional band in H/C Type

Symbol	Parameter	Setting range	Display	Unit	Default
n.Pc	Cool Proportional Band	0.0 ~ 1000.0%	Always	%	10.0%

4-8-10 Integration time (cooling control)

▪ Set cooling integration time in H/C Type

Symbol	Parameter	Setting range	Display	Unit	Default
n.Ic	Cool Integral Time	OFF, 1 ~ 6000 sec	Always	ABS	120 sec

4-8-11 Derivation time (cooling control)

▪ Set cooling derivation time in H/C Type

Symbol	Parameter	Setting range	Display	Unit	Default
n.Dc	Cool Derivative Time	OFF, 1 ~ 6000 sec	Always	ABS	30 sec

4-8-12 DEAD BAND

▪ Set Dead band of Heating/Cooling control in H/C Type

Symbol	Parameter	Setting range	Display	Unit	Default
n.DB	Dead Band	-100.0 ~ 15.0%	H/C Type	%	3.0%

4-8-13 PID zone setting

▪ Set the boundaries of 3 zone of PID.

Symbol	Parameter	Setting range	Display	Unit	Default

1.RP	Reference Point 1	EU(0.0%) ≤ 1.RP ≤ 2.RP	PID = 1	EU	EU(33.3%)
2.RP	Reference Point 2	1.RP ≤ 2. RP ≤ EU(100.0%)	PID = 2		EU(66.7%)

4-8-14 PID DEAD BAND

- When using Zone PID, set the hysteresis at the zone boundary.
- The hysteresis works when moving from zone 3 to zone 2 or from zone 2 to zone 1.

Symbol	Parameter	Setting range	Display	Unit	Default
RP.HY	Reference Hysteresis	EUS(0.0 ~ 10.0%)	PID = 3	EUS	EUS(0.3%)

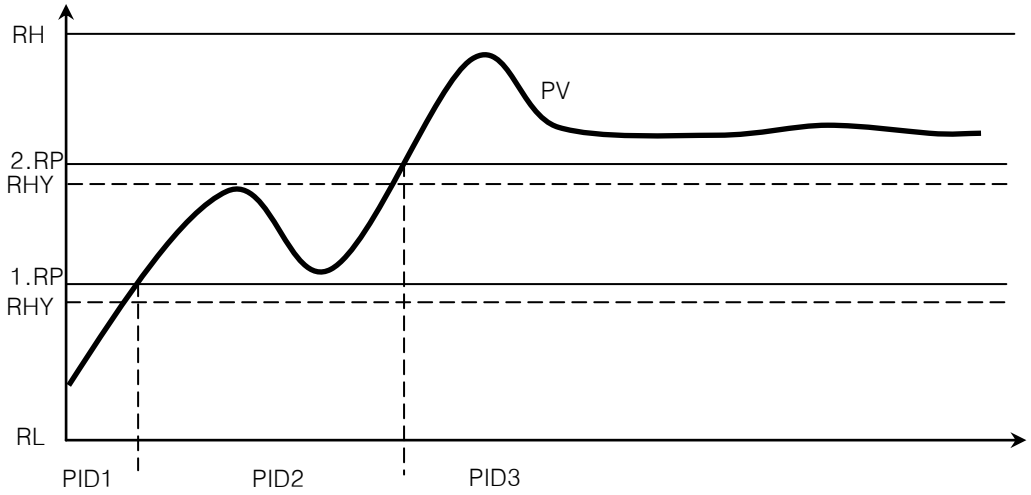
4-8-15 Deviation value used in deviation PID

- Set the deviation value when using Deviation PID.

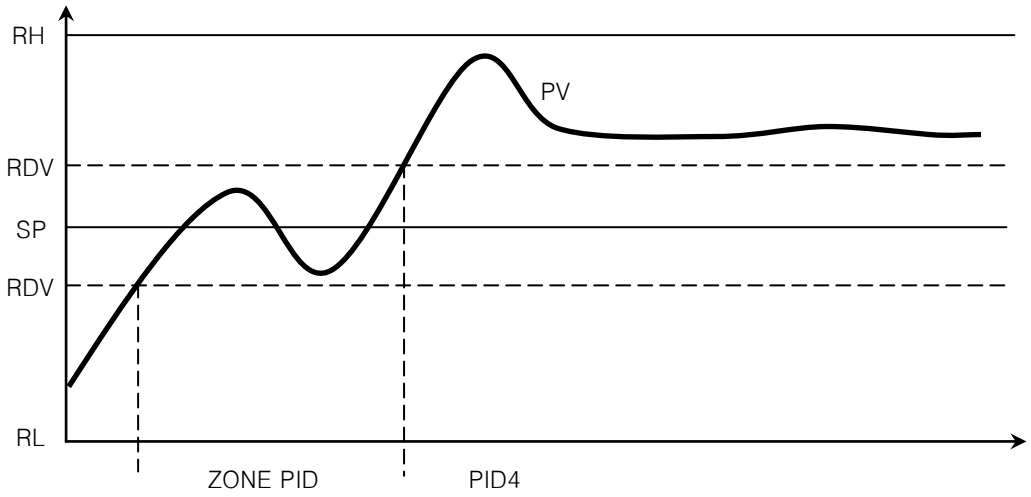
Symbol	Parameter	Setting range	Display	Unit	Default
RDV	Reference Deviation	EUS(0.0 ~ 100.0%)	PID = 4	EUS	EUS(0.0%)

PID Group

- PID Zone is determined by NPV. When PV oscillates around the zone boundaries 1.RP, 2.RP, PID set changes correspondingly. To prevent frequent change of PID set, the RP.HY can be set.



▪ Deviation PID (4.PID) may be used by setting RDV value. When |PV-SP| >RDV, 4.PID set is applied.



4-9. Inner Signal Group (G.IS)

4-9-1 Type to be referenced (.IST)

▪ Set the reference parameter of Inner signal action.

Symbol	Parameter	Setting range	Display	Unit	Default
1.IST	Inner Signal Type 1	NSP, NPV, TSP	Always	ABS	NPV
2.IST	Inner Signal Type 2				

4-9-2 Out or In band (.ISB)

▪ Select the domain of a band of IS operation, in-band (I.BD) or out-of-band (O.BD).

Symbol	Parameter	Setting range	Display	Unit	Default
1.ISB	Inner Signal Band 1	I.BD, O.BD	Always	ABS	I.BD
2.ISB	Inner Signal Band 2				

4-9-3 High/Low limits of band (.ISH, .ISL)

▪ Set the high limit (.ISH) and low limit (.ISL) of the IS band

Symbol	Parameter	Setting range	Display	Unit	Default
1.ISH	Inner Signal Range High 1	EU(0.0 ~ 100.0%)	Always	EU	EU(0.0%)
1.ISL	Inner Signal Range Low 1	(1.ISL ≤ 1.ISH)			
2.ISH	Inner Signal Range High 2	EU(0.0 ~ 100.0%)			
2.ISL	Inner Signal Range Low 2	(2.ISL ≤ 2.ISH)			

4-9-4 Delay Time (.ISD)

▪ Set the delay time for IS output

Symbol	Parameter	Setting range	Display	Unit	Default
1.ISD	Inner Signal Delay 1	OFF, 0.01 ~ 99.59 Min	Always	Time	OFF
2.ISD	Inner Signal Delay 2				

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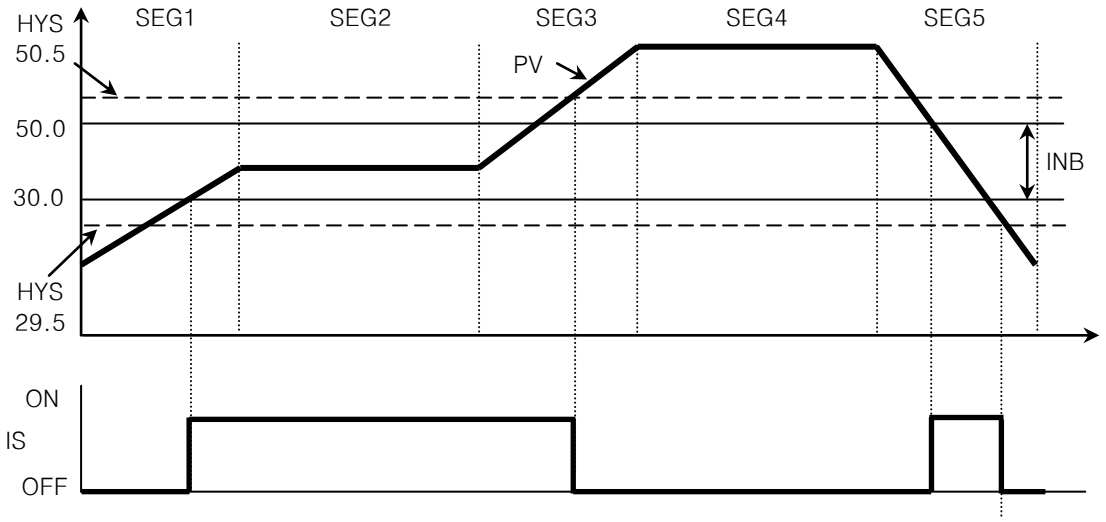
[Example 1]

▪ INPUT = 0.0 ~ 100.0 → EUS 0.5% = 0.5

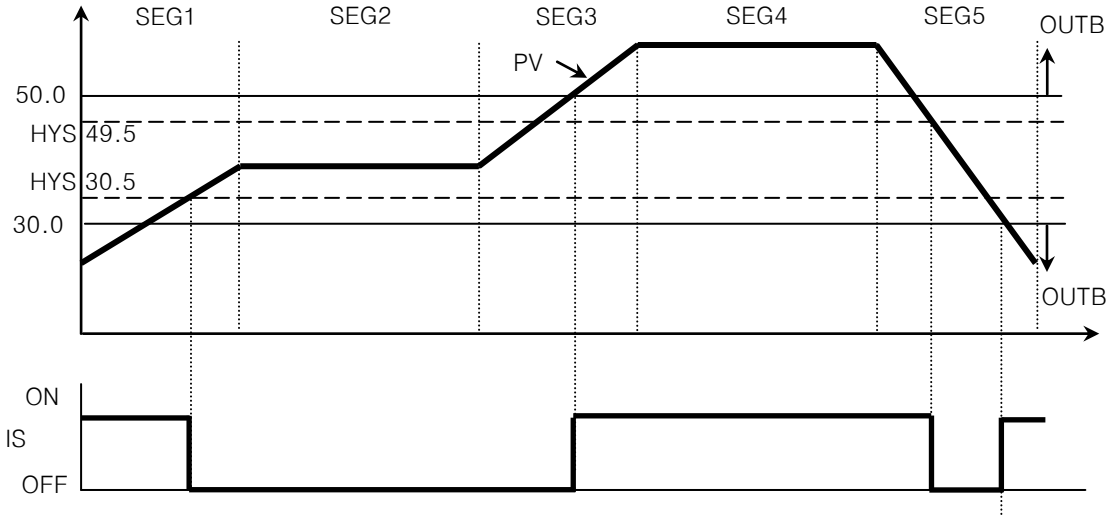
TYPE	RANGE LOW	RANGE HIGH	DIRECT	DELAY TIME
PV	30.0℃	50.0℃	IN BAND	00.00



[Example 2]

▪ INPUT = 0.0 ~ 100.0 → EUS 0.5% = 0.5

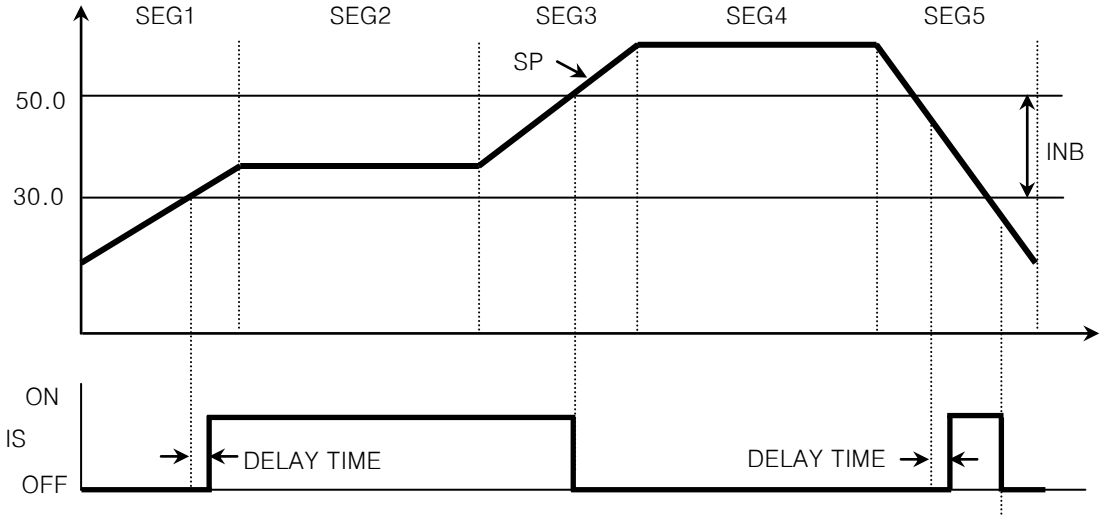
TYPE	RANGE LOW	RANGE HIGH	DIRECT	DELAY TIME
PV	30.0℃	50.0℃	OUT BAND	00.00



[Example 3]

▪ INPUT = 0.0 ~ 100.0

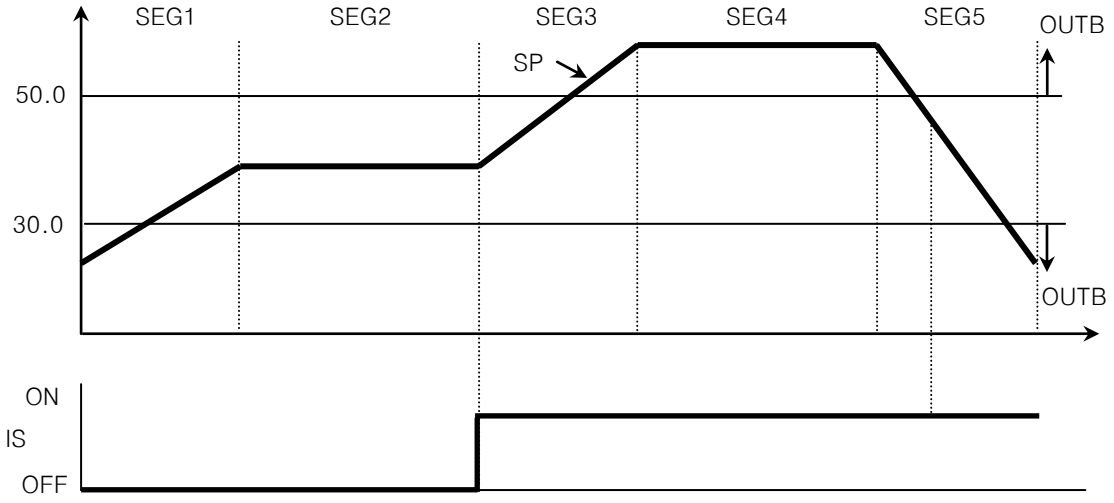
TYPE	RANGE LOW	RANGE HIGH	DIRECT	DELAY TIME
SP	30.0℃	50.0℃	IN BAND	00.10



[Example 4]

▪ INPUT = 0.0 ~ 100.0 → EUS 0.5% = 0.5

TYPE	RANGE LOW	RANGE HIGH	DIRECT	DELAY TIME
TSP	30.0℃	50.0℃	OUT BAND	00.00



4-10. Retransmission Group (G.RET)

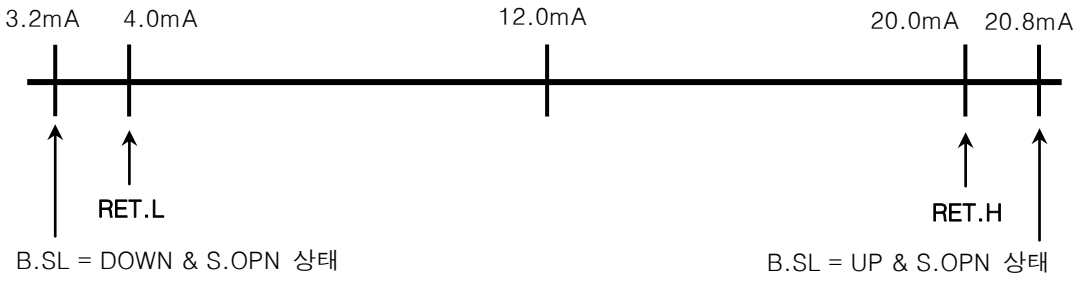
4-10-1 Type of retransmission (RET)

▪ Set the type of retransmission signal.

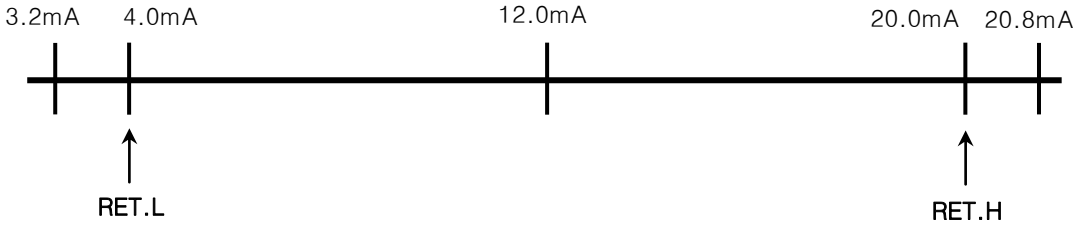
Symbol	Parameter	Setting range	Display	Unit	Default
RET	Retransmission Type	LPS, PV, SP, MV	Always	ABS	PV

NOTE Retransmission Output

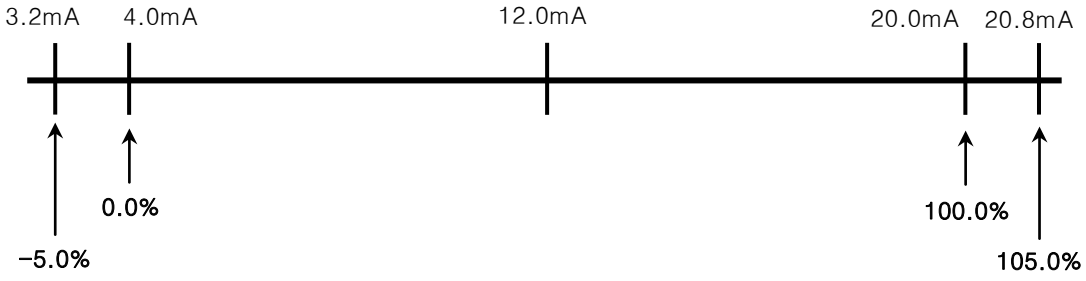
1) PV : 3.2mA ~ 20.8mA



2) SP : 4.0mA ~ 20.0mA



3) MV : 3.2mA ~ 20.8mA



4-10-2 High and low limits (RETH, RETL)

▪ Set high and low limits of retransmission

Symbol	Parameter	Setting range	Display	Unit	Default
RET.H	Retransmission High Limit	TC, RTD : IN.RL ~ IN.RH DCV : IN.SL ~ IN.SH (RET.L < RET.H)	RET.T = PV or SP시	EU	IN.RH(TC,RTD) IN.SH(DCV)
RET.L	Retransmission Low Limit				IN.RL(TC,RTD) IN.SL(DCV)

Setting Example

PV = -100~200℃, output : 4~20mA,

RET = PV ☞ PV is retransmitted.

RET.H= 200.0

RET.L= -100.0

4-11. Heater Break Alarm (HBA)

4-11-1 Heater Current Display

▪ Display the current of the heater.

Symbol	Parameter	Setting range	Display	Unit	Default
HB.CD	Heater Break Current Display	Display only	HBA option시	ABS	-

4-11-2 Heater Current Alarm Point

▪ Set the alarm point of heater current.

Symbol	Parameter	Setting range	Display	Unit	Default
HB.CS	Heater Break Alarm Current	OFF, 1 ~ 50A	HBA option	ABS	OFF

4-11-3 Dead band

▪ Set dead band of heater break alarm.

Symbol	Parameter	Setting range	Display	Unit	Default
HB.DB	Heater Break Alarm Dead Band	0 ~ 10A	HBA option	ABS	0

HBA(Heater Break Alarm)

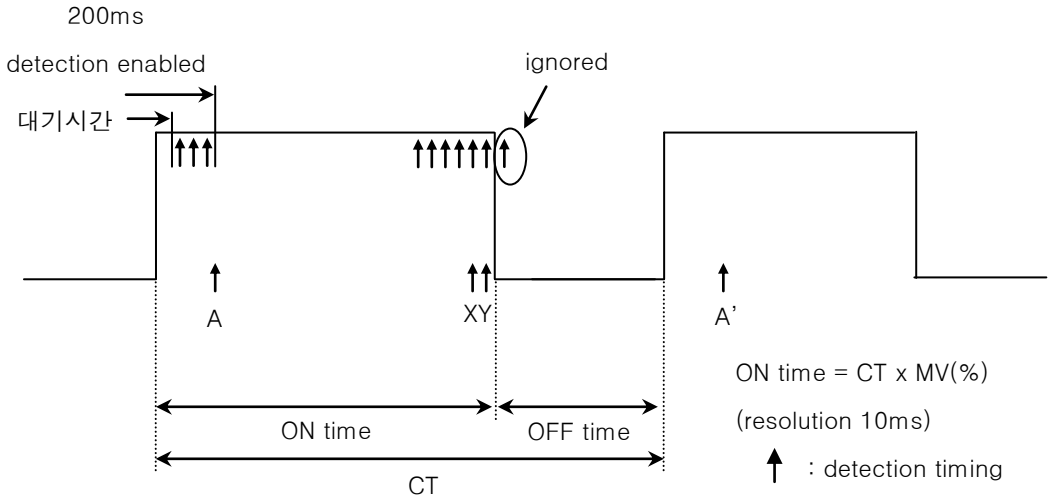
▪ HBA can work only when control output type is “SSR(Solid State Relay)” or “RELAY”.

▪ CT sensor should have the turn ratio of 800:1.

▪ Detection condition : MV output pulse width should be greater than 200ms. If the cycle time is set to 2 sec, MV should be greater than 10 % (200 ms duty ON).

▪ Accuracy of Measurement : ±3% of F.S. ±1 Digit

▪ Resolution : 0.5A (MAX)



▶ While ON time, detection is done repeatedly and the final value Y is kept while OFF time and until A’ position the first measurement in the next ON time. The measurement is refreshed at A’.

Error Display and Correction

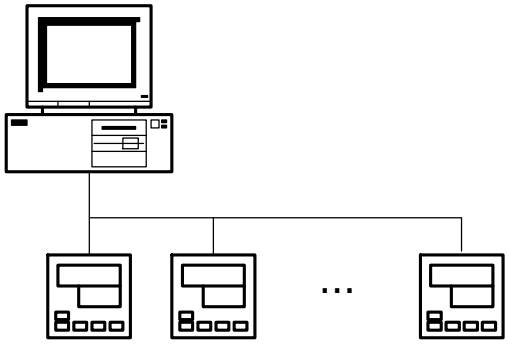
NO.	Time	Display	Cause of Error	Correction
1	Power ON	E.SYS	Incomplete inspection	Ask for repairs.
2	Operating	E.RJC	Abnormal temperature of terminal	Check the ambient temperature and make it suitable for operation condition.
3		PV Blinking	Incomplete inspection	Ask for repairs.
4		SP decimal point blinking	Communication error	Check the parameters in G.COM. Check the communication line.
5		S.OPN	Sensor burn-out, Wiring error, Wrong parameter set	Check the SENSOR. Check the wiring. Check input parameter setting.
6		E.AT	Auto tuning time out (over 27 hours)	Check the control system.
7		All blackout	Hardware damage ROM memory fail	Check the power supply. Ask for repairs.

5. Communication

5-1. Outline of communication

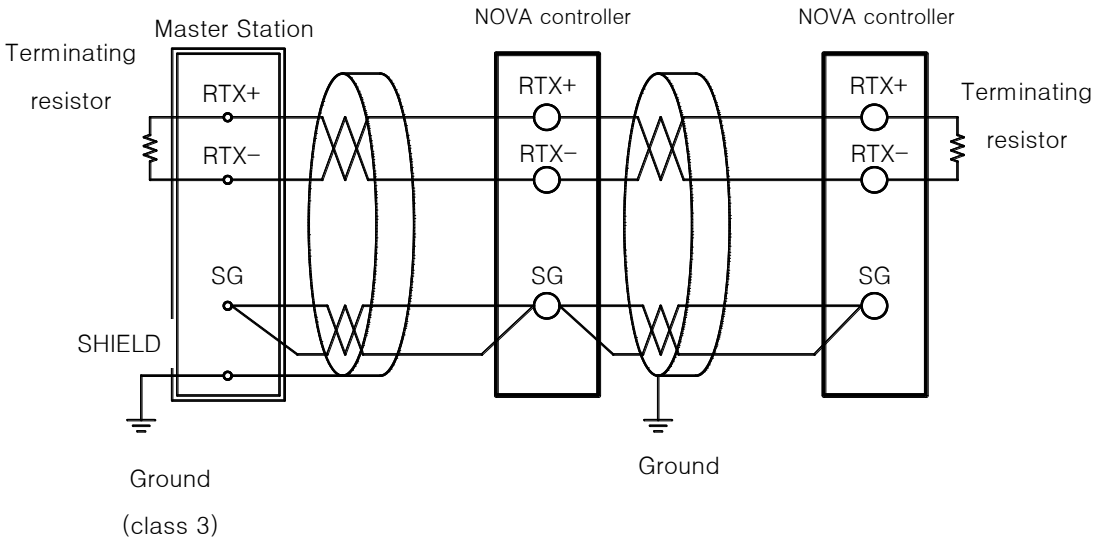
▪ NOVA series adopt RS485 communication method, Half-Duplex, 2 wire communication.

▪ A host computer can communicate with the controllers (up to 31 ea) through RS485 multi-drop network and using a protocol provided.



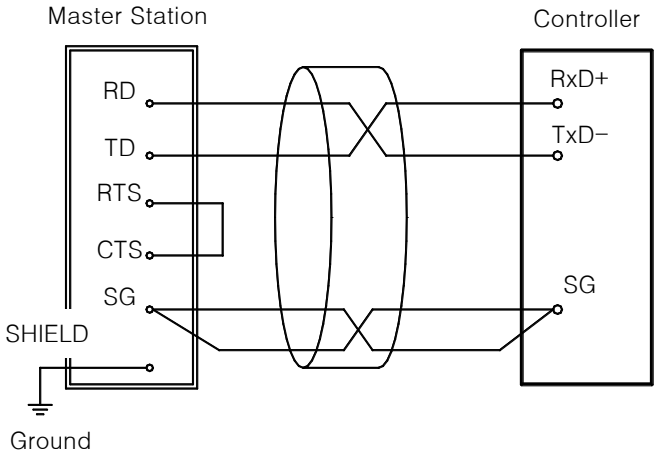
5-2. Wiring of communication

▪ RS485 : The wiring of NOVA Series and Master station is as following figure.



- Slave controllers can be connected to a master device by multi-drop networking.
- Be sure to connect two termination resistors (200Ω 1/4W) to both ends of the network.

▪ RS232 : The wiring between the controller and a host device.



5-3. Communication parameters

▪ The parameters of communication setup.

Display	Parameter	Set value	Description	Default
COM.P	Protocol	0	Standard protocol	X
		1	Standard protocol + Check Sum	O
		2	MODBUS ASCII	X
		3	MODBUS RTU	X
		4	SYNC-Master	X
		5	SYNC-Slave	X
BAUD	Baud Rates	3	38400	X
		2	19200	X
		1	9600	O
		0	4800	X
PTRY	Parity	NONE	No parity	O
		EVEN	Even parity	X
		ODD	Odd parity	X
SBIT	Stop Bit	1	1 bit	O
		2	2 bit	X
DLEN	Data Length	7	7 bit	X
		8	8 bit	O
ADDR	Address	1~99	Address	1
RPTM	Response time	0~10	= Processing time + RPTM * 10msec	0

※ Data Length(D.LEN) : When the protocol is MODBUS, this is skipped.

5-4. Standard Protocol

- The standard protocol of NOVA series is composed of ASCII string. A user can read or write the contents of D-Register.
- There are two kinds of protocols which can be selected by COM.P parameter.
- The frame of standard protocol starts with STX and ends with CR LF.
- 'SUM' protocol (COM.P = 1) is a more sophisticated one which includes Check Sum as an error check.

① The Frame structure of standard protocol

STX	Address	Command	Data	CR	LF
0x02	1~99	Refer to each command		0x0D	0x0A

② The Frame structure of the SUM protocol

STX	Address	Command	Data	SUM	CR	LF
0x02	1~99	Refer to each command		Check Sum	0x0D	0x0A

- Check Sum is calculated as following.

1) Add the ASCII code of characters from the character next to STX one by one up to the character prior to SUM.

2) Represent the lowest one byte of the sum as a hexadecimal notation (2 characters).

5-4-1 Communication command

- There are several kinds of commands, general commands for read/write of D-register, information command for checking the controller version, and check command for inspection procedure.

① General Command

Command	Function
RSD	D-Register Sequential Read
RRD	D-Register Random Read
WSD	D-Register Sequential Write
WRD	D-Register Random Write
STD	D-Register Monitoring Set
CLD	D-Register Monitoring Call

② Information Command

Command	Function
AMI	Model, Version Information of the controller

③ Error Response

▪ When an Error occurs during communication, NOVA sends a frame as following.

Bytes	1	2	2	2	2	1	1
Frame	STX	Address	NG	Error Code	SUM	CR	LF

▪ SUM is used only when COM.P = “1”

(refer to Error Code : 5-4-4)

5-4-2 General command

5-4-2-1 Read Command

① RSD Command

▪ RSD Command is used to read a part of D-Register sequentially. It is necessary to set the number of registers to read and starting address.

Frame Format

Bytes	Frame
1	STX
2	Address
3	RSD
1	,
2	개수
1	,
4	D-Register
2	SUM
1	CR
1	LF

1~32

starting D-Register address

Normal Response Format

Bytes	Frame
1	STX
2	Address
3	RSD
1	,
2	OK
1	,
4	Data – 1
1	,
…	…
1	,
4	Data – n
2	SUM
1	CR
1	LF

Hexadecimal 16bit Word (4 character)

ex) Reading PV(D0001), SP(D0002) D-Register

- Sending Frame : [stx]01RSD,02,0001[cr][lf]
- Sending Frame (Check Sum) : [stx]01RSD,02,0001C5[cr][lf]

If PV, SP are 50.0, 30.0 respectively,

- Receiving Frame : [stx]01RSD,OK,01F4,012C[cr][lf]
- Receiving Frame(Check Sum) : [stx]01RSD,OK,01F4,012C19[cr][lf]

※ Converting 4digit hexadecimal number to decimal number

① Radix conversion : 01F4 (hexadecimal) ➔ 500(decimal)

② Multiply factor (decimal point) : 500*0.1 ➔ 50.

② RRD Command

▪ RRD Command is used to read D-Registers in randomly. It is necessary to set the number of registers to read and the addresses of the registers.

Frame Format

Bytes	Frame
1	STX
2	Address
3	RRD
1	,
2	개수
1	,
4	D-Register - 1
1	,
...	...
1	,
4	D-Register - n
2	SUM
1	CR
1	LF

1~32

First D-Register address

Normal Response Format

Bytes	Frame
1	STX
2	Address
3	RRD
1	,
2	OK
1	,
4	Data - 1
1	,
...	...
1	,
4	Data - n
2	SUM
1	CR
1	LF

16bit Word (16 character)

hexadecimal notation

ex) Reading PV(D0001), SP(D0002) D-Registers

- Sending Frame : [stx]01RRD,02,0001,0002[cr][lf]
- Sending Frame (Check Sum) : [stx]01RRD,02,0001,0002B2[cr][lf]

If D0001 = 50.0 and D0002 = 30.0

- Receiving Frame : [stx]01RRD,OK,01F4,012C[cr][lf]
- Receiving Frame (Check Sum) : [stx]01RRD,OK,01F4,012C18[cr][lf]

5-4-2-2 Write Command

① WSD Command

▪ WSD Command is used to write data to successive D-Registers. It is necessary to set the number of register, starting address, and array of data.

Frame Format

Bytes	Frame
1	STX
2	Address
3	WSD
1	,
2	개수
1	,
4	D-Register
1	,
4	Data - 1
1	,
...	...
1	,
4	Data - n
2	SUM
1	CR
1	LF

1~32

First D-Register address

16bit Word (4 character)

Normal Response Format

Bytes	Frame
1	STX
2	Address
3	WSD
1	,
2	OK
2	SUM
1	CR
1	LF

ex) Writing to D-Registers from ALT1(D0401) to ALT3(D0403)

- Sending Frame : [stx]01WSD,03,0401,0000,0000,0000[cr][lf]
- Sending Frame (Check Sum) : [stx]01WSD,03,0401,0000,0000,000093[cr][lf]

② WRD Command

▪ WRD Command is used to write data to D-Registers randomly. It is necessary to set the number of registers and the pairs of address and data.

Frame Format

Bytes	Frame
1	STX
2	Address
3	WRD
1	,
2	개수
1	,
4	D-Register - 1
1	,
4	Data - 1
1	,
...	...
1	,
4	D-Register - n
1	,
4	Data - n
2	SUM
1	CR
1	LF

1~32

D-Register address

16bit Word (4 character)

Normal Response Format

Bytes	Frame
1	STX
2	Address
3	WRD
1	,
2	OK
2	SUM
1	CR
1	LF

ex) Writing data to ALT1 (D0401) and ALT3 (D0403)

- Sending Frame : [stx]01WRD,02,0401,0001,0403,0001[cr][lf]
- Sending Frame (Check Sum) : [stx]01WRD,02,0401,0001,0403,00019A[cr][lf]

5-4-2-3 Monitoring Command

① STD Command

▪ STD Command is used to set the addresses of the D-Registers to monitor. It is necessary to set

the number of registers, and array of addresses.

▪ To read data of the registers set by STD command, CLD command is used.

※ The register list set by STD vanishes when the controller power is OFF. It is necessary to use STD command to use CLD command after power recovery.

Frame Format

Bytes	Frame
1	STX
2	Address
3	STD
1	,
2	개수
1	,
4	D-Register - 1
1	,
...	...
1	,
4	D-Register - n
2	SUM
1	CR
1	LF

1~32

D-Register

Normal Response Format

Bytes	Frame
1	STX
2	Address
3	STD
1	,
2	OK
2	SUM
1	CR
1	LF

ex) Setting PV(D0001) and SP(D0002) to monitor

- Sending Frame : [stx]01STD,02,0001,0002[cr][lf]
- Sending Frame (Check Sum) : [stx]01STD,02,0001,0002B5[cr][lf]

② CLD Command

▪ CLD Command is used to read the D-Registers which had been set by STD command.

ex) Reading D-Registers which had been set by STD Command

- Sending Frame : [stx]01CLD[cr][lf]
- Sending Frame (Check Sum) : [stx]01CLD34[cr][lf]

Frame Format

Bytes	Frame
1	STX
2	Address
3	CLD
2	SUM
1	CR
1	LF

Normal Response Format

Bytes	Frame
1	STX
2	Address
3	CLD
1	,
2	OK
1	,
4	Data – 1
1	,
…	…
1	,
4	Data – n
2	SUM
1	CR
1	LF

16bit Word (4 character)

5-4-3 Information Command

▪ Information Command is used to get the controller information.

Frame Format

Bytes	Frame
1	STX
2	Address
3	AMI
2	SUM
1	CR
1	LF

Normal Response Format

Bytes	Frame
1	STX
2	Address
3	AMI
1	,
2	OK
1	,
10	모델명(Size)
1	SPACE
7	Version-Revision
2	SUM
1	CR
1	LF

ex) Getting the controller information, Model, size, version.

- Sending Frame : [stx]01AMI[cr][lf]
- Sending Frame (Check Sum) : [stx]01AMI38[cr][lf]

- Receiving Frame : [stx]01AMI,OK,SP541:4848[sp]V00-R00[cr][lf]
- Receiving Frame (Check Sum) : [stx]01AMI,OK,SP541:4848[sp]V00-R002E[cr][lf]

5-4-4 Error Code

▪ On Error while communicating, NOVA Series sends a frame as following.

Error Response Frame

Bytes	1	2	2	2	2	1	1
Frame	STX	Address	NG	Error Code	SUM	CR	LF

Error Code	Description	Remark
01	Invalid Command	
	Invalid Register address	
	Data Error	Invalid character in Data string (0~9, A~F hexadecimal digit)
	Error in Format	- Mismatching Command and Format - Number, Number of Data
	Monitoring Command Error	No Monitoring Command
	Time Out Error	Timeout : no termination character for 30 sec after [stx].
11	Check Sum Error	
00	Other Error	

ex) When using an invalid command

- Sending Frame : [stx]01RSF,03,0001[cr][lf]
- Sending Frame (Check Sum) : [stx]01RSF,03,0001C8[cr][lf]

- Receiving Frame : [stx]01NG01[cr][lf]
- Receiving Frame (Check Sum) : [stx]01NG0157[cr][lf]

5-5. MODBUS Protocol

▪ NOVA의 MODBUS communication has two modes, ASCII(COM.P = '2') and RTU(COM.P = '3').

① Factors of MODBUS

Item	ASCII	RTU
Start of text	: (colon)	none
End of text	CR+LF	None
Data length	7-bit (fixed)	8-bit (fixed)
Data Type	ASCII	Binary
Error Detection	LRC (Longitudinal Redundancy Check)	CRC-16 (Cyclic Redundancy Check)
Data Interval	Less than 1 second	Max. 24-bit time

② Frame Structure

▪ MODBUS ASCII

Start character	Comm. address	Function code	Data	CRC Check	End character
1 char.	2 char.	2 char.	n char.	2 char.	2 char. (CR+LF)

▪ MODBUS RTU

Start character	Comm. address	Function code	Data	CRC Check	End character
none	8-bit	8-bit	N*8-bit	16-bit	None

5-5-1 Function Code

▪ NOVA provides MODBUS function codes to read/write D-Register and to detect Loop-Back.

Function code	Function
03	D-Register sequential Read
06	Single D-Register Write
08	Diagnostics(Loop-Back Test)
16	D-Register sequential Write

5-5-1-1 Function code - 03

▪ To read the data of successive D-Register block up to 32 registers.

▪ Frame Format

Factor	ASCII	RTU
Start character	: (colon)	None
Communication address	2 characters	8-bit

Function code – 03	'03' 2 characters	8-bit
D-Register Hi	2 characters	8-bit
D-Register Lo	2 characters	8-bit
Number of reg. Hi	2 characters	8-bit
Number of reg. Lo	2 characters	8-bit
Error detection	2 characters	16-bit
End character	2 characters (CR+LF)	none

▪ Response Format

Factor	ASCII	RTU
Start character	: (colon)	none
Communication address	2 characters	8-bit
Function code – 03	'03' 2 characters	8-bit
Byte Count	2 characters	8-bit
Data-1 Hi	2 characters	8-bit
Data -1 Lo	2 characters	8-bit
...	...	...
Data -n Hi	2 characters	8-bit
Data -n Lo	2 characters	8-bit
Error Detection	2 characters	16-bit
End character	2 characters (CR+LF)	none

5-5-1-2 Function code – 06

▪ To write to single D-Register.

▪ Frame Format

Factor	ASCII	RTU
Start character	: (colon)	None
Communication address	2 characters	8-bit
Function code – 06	'06' 2 characters	8-bit
D-Register Hi	2 characters	8-bit
D-Register Lo	2 characters	8-bit
Write Data Hi	2 characters	8-bit
Write Data Lo	2 characters	8-bit
Error Detection	2 characters	16-bit
End character	2 characters (CR+LF)	None

▪ Response Format

Factor	ASCII	RTU
Start character	: (colon)	none
Communication address	2 characters	8-bit
Function code – 06	'06' 2 characters	8-bit
D-Register Hi	2 characters	8-bit
D-Register Lo	2 characters	8-bit
Write Data Hi	2 characters	8-bit
Write Data Lo	2 characters	8-bit
Error Detection	2 characters	16-bit
End character	2 characters (CR+LF)	none

5-5-1-3 Function code – 08

▪ Function code – 08 is used for self-diagnosis.

▪ Frame Format

Factor	ASCII	RTU
Start character	: (colon)	None
Communication address	2 characters	8-bit
Function code – 08	2 characters	8-bit
Diagnosis code Hi	2 characters	8-bit
Diagnosis code Lo	2 characters	8-bit
Data Hi	2 characters	8-bit
Data Lo	2 characters	8-bit
Error Detection	2 characters	16-bit
End character	2 characters (CR+LF)	None

▪ Response Format

Factor	ASCII	RTU
Start character	: (colon)	None
Communication address	2 characters	8-bit
Function code – 08	2 characters	8-bit
Diagnosis code Hi	2 characters	8-bit
Diagnosis code Lo	2 characters	8-bit
Data Hi	2 characters	8-bit

Data Lo	2 characters	8-bit
Error Detection	2 characters	16-bit
End character	2 characters (CR+LF)	None

※ 진단코드와 내용

Code	Description
:	Loop-Back Test : Received Frame Return

5-5-1-4 Function code - 16

▪ To write data to successive D-Register block up to 16 registers

▪ Frame Format

Factor	ASCII	RTU
Start character	: (colon)	None
Communication address	2 characters	8-bit
Function code - 16	'10' 2 characters	8-bit
D-Register Hi	2 characters	8-bit
D-Register Lo	2 characters	8-bit
Number of reg. Hi	2 characters	8-bit
Number of reg. Lo	2 characters	8-bit
Data Bytes	2 characters	8-bit
Data-1 Hi	2 characters	8-bit
Data-1 Lo	2 characters	8-bit
...	...	...
Data-n Hi	2 characters	8-bit
Data-n Lo	2 characters	8-bit
Error Detection	2 characters	16-bit
End character	2 characters (CR+LF)	None

▪ Response Format

Factor	ASCII	RTU
Start character	: (colon)	None
Communication address	2 characters	8-bit
Function code - 16	2 characters	8-bit
D-Register Hi	2 characters	8-bit
D-Register Lo	2 characters	8-bit

Number of data Hi	2 characters	8-bit
Number of data Lo	2 characters	8-bit
Error Detection	2 characters	16-bit
End character	2 characters (CR+LF)	None

5-5-2 Error Code

▪ Error code is returned when an error is in the Frame.

▪ Frame Format

Factor	ASCII	RTU
Start character	: (colon)	None
Communication address	2 characters	8-bit
Function code	2 characters	8-bit
Error code	2 characters	8-bit
Error Detection	2 characters	16-bit
End character	2 characters (CR+LF)	None

※ Error codes

Error codes	Description
01	Invalid Function code
02	Invalid D-Register address
08	Data number error

※ The causes of No Response

- Overrun, Framing Error, Parity Error, LRC Error, CRC Error
- Wrong communication address
- The time between adjacent characters is longer than 1 sec.
- Broadcast communication mode

5-6. SYNC communication

▪ A master controller (COM.P='4') sends its operation parameters (Run/Stop, SP) to slave controllers (COM.P='5') periodically and the operation of slaves are synchronized with that of the master controller. Maximum 31 controllers can be networked.

5-6-1 SYNC-Master

① SYNC-Master Model

- SP and ST Models can be set to SYNC-Master.

② Transmission Frame

SYNC, a, b, c[CR][LF]

Factor	Description
A	STOP(0)/RUN(1)
B	Current SP value including decimal point if any.
c	Check Sum

5-6-2 SYNC-Slave

① SYNC-Slave Model

- ST series can be set to SYNC-Master.

② SYNC-Slave Setting

- COM.P = '5' in G.COM and SPSL = 'RSP' in G.SP.

※ There is no response frame. Slaves do not send response frame.

5-7. D-Register Map

▪ D-Registers are provided for checking status of the controller. Basically, they are grouped by 100 addresses.

D-Register	Group name	Description	Read	Write
D0000~D0099	PROCESS	Basic parameters	○	○
D0100~D0199	FUNCTION	Operation and functions	○	○
D0200~D0299	SET POINT	SP setting	○	○
D0300~D0399	SIGNAL	Inner Signal	○	○
D0400~D0499	ALARM	Alarm setting	○	○
D0500~D0599	PID	P.I.D	○	○
D0600~D0699	IN/OUT	Input and Output	○	△
D0700~D0799	RESERVED	Reserved	X	X
D0800~D0899	RESERVED	Reserved	X	X
D0900~D0999	RESERVED	Reserved	X	X
D1000~D1099	RESERVED	Reserved	X	X
D1100~D1199	RESERVED	Reserved	X	X
D1200~D1299	RESERVED	Reserved	X	X
D1300~D1399	RESERVED	Reserved	X	X

5-7-1 Process

▪ Process Group includes the basic information of operating. The detailed Bit-Map information of status registers is described at the end of this manual.

D-Register	Symbol	Description
D0001	NPV	Current PV
D0002	NSP	Current SP
D0003	TSP	Target Set Point
D0005	SPSL	Current SP No.
D0006	MVOUT	Control output
D0007	HOUT	Heating output
D0008	COUT	Cooling output
D0009	PIDNO	P.I.D Number being used
D0010	NOWSTS	Current operation status
D0014	ALSTS	Current alarm status
D0015	EVSTS	Current event status

D0017	SIGNAL.STS	Current signal status
D0019	ERROR	Current error status
D0020	PROC_TIME	Time to run
D0030	HB.CD	Heater current

5-7-2 Function

▪ Function Group is related with operation and settings.

D-Register	Symbol	Description
D0101	R-S, RUN/STOP	Operation state = 'RUN' or 'STOP'
D0105	A/M	Control state = Auto or Manual
D0106	H.OUT(MVOUT)	Heating output in Manual mode
D0107	C.OUT($MVOUT_C$)	Cooling output in Manual mode
D0121	AT	Auto Tuning On/Off
D0122	AT-G	PID gain
D0131	S-TM	Standby time to RUN in reservation
D0132	P-TM	RUN time in reservation
D0134	ON/OFF	ON/OFF Mode
D0135	US1	User screen 1
D0136	US2	User screen 2
D0137	LOCK	If Lock on, parameter setting is blocked.
D0138	DI.SL	Select mapping mode of DI and operation
D0140	DSP.H	High limit of PV display
D0141	DSP.L	Low limit of PV display
D0143	U.KEY	User defined Key

5-7-3 Set Point

▪ Set Point group is related with SP setting.

D-Register	기 호	내 용
D0200	SPSL	Select a SP to RUN of SP1,2,3,4
D0201	SP1	SP1 value
D0202	SP2	SP2 value
D0203	SP3	SP3 value
D0204	SP4	SP4 value
D0211	SPRH	High limit of SP
D0212	SPRL	Low limit of SP

D0214	TM.U	Time unit
D0216	U.SLP	Ramping up slope
D0217	D.SLP	Ramping down slope

5-7-4 Signal

▪ Signal Group is related with Inner Signal.

D-Register	Symbol	Description
D0301	1.IST	Type of Inner Signal1
D0302	1.ISB	Inner Signal1 direction (in-band, out-of-band)
D0303	1.ISH	High limit of the Inner Signal1 band
D0304	1.ISL	Low limit of the Inner Signal1 band
D0305	1.ISD	Delay time of Inner Signal1 output
D0306	2.IST	Type of Inner Signal2
D0307	2.ISB	Inner Signal2 direction (in-band, out-of-band)
D0308	2.ISH	High limit of the Inner Signal2 band
D0309	2.ISL	Low limit of the Inner Signal2 band
D0310	2.ISD	Delay time of Inner Signal2 output

5-7-5 Alarm

▪ Alarm group is related with alarm setting.

D-Register	Symbol	Description
D0401	ALT1	Type of Alarm-1
D0402	ALT2	Type of Alarm-2
D0403	ALT3	Type of Alarm-3
D0406	AL-1	Alarm point of Alarm-1
D0407	AL-2	Alarm point of Alarm-2
D0408	AL-3	Alarm point of Alarm-3
D0411	A1.DB	Dead Band of Alarm-1
D0412	A2.DB	Dead Band of Alarm-2
D0413	A3.DB	Dead Band of Alarm-3
D0416	A1.DY	Delay time of Alarm-1 output
D0417	A2.DY	Delay time of Alarm-2 output
D0418	A3.DY	Delay time of Alarm-3 output
D0421	AL1.H	High limit of deviation (Alarm-1)
D0422	AL2.H	High limit of deviation (Alarm-2)

D0423	AL3.H	High limit of deviation (Alarm-3)
D0426	AL1.L	Low limit of deviation (Alarm-1)
D0427	AL2.L	Low limit of deviation (Alarm-2)
D0428	AL3.L	Low limit of deviation (Alarm-3)
D0430	SK.DV	Deviation of Soak Alarm
D0432	HB.CS	Heater break current setting
D0433	HB.DB	Dead band of Heater break alarm

5-7-6 PID

▪ PID group is related with PID setting.

D-Register	Symbol	Description
D0501	ARW	Deviation band for ARW function
D0502	FUZZY	FUZZY function on/off
D0503	C.MOD	PID control mode (D.DV, D.PV)
D0511	1.P	Proportional band of PID1 set
D0512	1.I	Integration time of PID1 set
D0513	1.D	Derivation time of PID1 set
D0514	1.MR	Manual reset value of integration time when 1.I = 0
D0515	1.Pc	Zone boundary between PID1 and PID2
D0516	1.Ic	Proportional band of PID2 set
D0517	1.Dc	Integration time of PID2 set
D0518	1.DB	Derivation time of PID2 set
D0519	1.RP	Deviation band for ARW function
D0521	2.P	FUZZY function on/off
D0522	2.I	PID control mode (D.DV, D.PV)
D0523	2.D	Proportional band of PID1 set
D0524	2.MR	Manual reset value of integration time when 2.I = 0
D0525	2.Pc	Zone boundary between PID2 and PID3
D0526	2.Ic	Proportional band of PID3 set
D0527	2.Dc	Integration time of PID3 set
D0528	2.DB	Derivation time of PID3 set
D0529	2.RP	Manual reset value of integration time when 2.I = 0
D0531	3.P	Zone boundary between PID2 and PID3
D0532	3.I	Proportional band of PID3 set
D0533	3.D	Integration time of PID3 set

D0534	3.MR	Manual reset value of integration time when 3.I = 0
D0535	3.Pc	Proportional band of PID3 set for cooling
D0536	3.Ic	Integration time of PID3 set for cooling
D0537	3.Dc	Derivation time of PID3 set for cooling
D0538	3.DB	Dead Band for PID3 for Heating/Cooling
D0539	RP.HY	Hysteresis at PID Zone boundary
D0541	4.P	Proportional band of PID4 set
D0542	4.I	Integration time of PID4 set
D0543	4.D	Derivation time of PID4 set
D0544	4.MR	Manual reset value of integration time when 4.I = 0
D0545	4.Pc	Proportional band of PID4 set for cooling
D0546	4.Ic	Integration time of PID4 set for cooling
D0547	4.Dc	Derivation time of PID4 set for cooling
D0548	4.DB	Dead Band for PID4 for Heating/Cooling
D0549	RDV	Deviation when using deviation PID

5-7-7 IN/OUT

▪ IN/OUT group is related with input and control output.

D-Register	Symbol	Description
D0601	IN-T	Sensor Input type
D0602	IN-U	Temperature unit of '℃' and '°F'
D0603	IN.RH	High limit of sensor input
D0604	IN.RL	Low limit of sensor input
D0605	IN.DP	Decimal point of PV
D0606	IN.SH	Input scale high limit
D0607	IN.SL	Input scale low limit
D0608	IN.FL	PV Filter
D0609	B.SL	Burn-out mode selection
D0610	R.SL	RJC selection
D0611	BSP1	PV Bias point 1
D0612	BSP2	PV Bias point 2
D0613	BSP3	PV Bias point 3
D0615	BS0	PV Bias at IN.RL
D0616	BS1	PV Bias at BSP1
D0617	BS2	PV Bias at BSP2

D0618	BS3	PV Bias at BSP3
D0619	BS4	PV Bias at IN.RH
D0621	AL.BS	PV display offset value in all range
D0622	D.FL	PV display filter
D0624	OUT1	OUT1 type (4~20mA, PULSE) of HEAT, RET
D0625	OUT2	OUT2 type (4~20mA, PULSE) of HEAT, RET
D0627	EV1	EVENT1 Output
D0628	EV2	EVENT2 Output
D0629	EV3	EVENT3 Output
D0631	HEAT1	OUT1(Heating) type of SSR, SCR
D0632	COOL1	OUT1(Cooling) type of SSR, SCR
D0633	HEAT2	OUT2(Heating) type of SSR, SCR
D0634	COOL2	OUT2(Cooling) type of SSR, SCR
D0637	O.ACT	Control Direction (Forward, Reverse)
D0638	CT	The cycle time of SSR or Relay control
D0639	CTc	The cycle time of SSR or Relay control for cooling
D0641	OH	High limit of MV output
D0642	OL	Low limit of MV output
D0644	HYS	Hysteresis for Heating/Cooling control output
D0646	PO	Preset Output
D0647	POc	Preset Output for cooling
D0648	HYS.H	ON-OFF High hysteresis
D0649	HYS.L	ON-OFF Low hysteresis
D0651	RET	Retransmission type of PV, SP, MV
D0652	RETH	High limit of retransmission
D0653	RETL	Low limit of retransmission
D0655	OPR	MV change rate %/sec
D0657	O.LED	MV out lamp display type of SSR, SCR
D0661	COM.P	Communication Protocol
D0662	BAUD	Baud Rate
D0663	PRTY	Parity
D0664	SBIT	Stop Bit
D0665	DLEN	Data Length
D0666	ADDR	Address
D0667	RP.TM	Response Time

D0668	RBS	Bias to be added to Remote SP at SYNC operation

※ D-Register 0000~0499

NO	PROCESS	FUNCTION	SET POINT	SIGNAL	ALARM
	0	100	200	300	400
0			SPSL		
1	NPV	R-S, RUN/STOP	SP1	1.IST	ALT1
2	NSP		SP2	1.ISB	ALT2
3	TSP		SP3	1.ISH	ALT3
4			SP4	1.ISL	
5	SPSL	A/M		1.ISD	
6	MVOUT	H.OUT(MVOUT)		2.IST	AL-1
7	HOUT	C.OUT(MVOUTc)		2.ISB	AL-2
8	COUT			2.ISH	AL-3
9	PIDNO			2.ISL	
10	NOWSTS			2.ISD	
11			SPRH		A1DB
12			SPRL		A2DB
13					A3DB
14	ALSTS		TM.U		
15	EVSTS				
16			U.SLP		A1DY
17	SIG.STS		D.SLP		A2DY
18					A3DY
19	ERROR				
20	PROC_TIME				
21		AT			AL1.H
22		AT-G			AL2.H
23					AL3.H
24					
25					
26					AL1.L
27					AL2.L
28					AL3.L
29					
30	HB.CD				SK.DV
31		S-TM			
32		P-TM			HB.CS
33					HB.DB
34		ON/OFF			
35		US1			
36		US2			
37		LOCK			
38		DI.SL			
39		DSP.H			
40		DSP.L			
41					
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43		U.KEY			
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50	User Area				
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※ D-Register 0500~0999

NO	PID	IN/OUT	RESERVED	RESERVED	RESERVED
	500	600	700	800	900
0					
1	ARW	IN-T			
2	FUZZY	IN-U			
3	C.MOD	IN.RH			
4		IN.RL			
5		IN.DP			
6		IN.SH			
7		IN.SL			
8		IN.FL			
9		B.SL			
10		R.SL			
11	1.P	BSP1			
12	1.I	BSP2			
13	1.D	BSP3			
14	1.MR				
15	1.Pc	BS0			
16	1.Ic	BS1			
17	1.Dc	BS2			
18	1.DB	BS3			
19	1.RP	BS4			
20					
21	2.P	AL.BS			
22	2.I	D.FL			
23	2.D				
24	2.MR	OUT1			
25	2.Pc	OUT2			
26	2.Ic				
27	2.Dc	EV1			
28	2.DB	EV2			
29	2.RP	EV3			
30					
31	3.P	HEAT1			
32	3.I	COOL1			
33	3.D	HEAT2			
34	3.MR	COOL2			
35	3.Pc				
36	3.Ic				
37	3.Dc	O.ACT			
38	3.DB	CT			
39	RP.HY	CTc			
40					
41	4.P	OH			
42	4.I	OL			
43	4.D				
44	4.MR	HYS			
45	4.Pc				
46	4.Ic	PO			
47	4.Dc	POc			
48	4.DB	HYS.H			
49	RDV	HYS.L			
50					
51		RET			
52		RETH			

53		RETL			
54					
55		OPR			
56					
57		O.LED			
58					
59					
60					
61		COM.P			
62		BAUD			
63		PRTY			
64		SBIT			
65		DLEN			
66		ADDR			
67		RP.TM			
68		RBS			
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※ D-Register 1000~1399

NO	PT INFO	PT1	PT2	RESERVED
	1000	1100	1200	1300
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※ BIT-MAP 정보

NO	NOW STATUS	ALARM STATUS	SIGNAL STATUS	ERROR STATUS
	(D0010)	(D0014)	(D0017)	(D0019)
0	RUN/STOP	ALARM1	IS1	SYS.ERR
1		ALARM2	IS2	
2		ALARM3		
3				
4		EVENT1		AD.ERR
5		EVENT2		
6		EVENT3		
7				
8				+OVER
9				-OVER
10				S.OPN
11				
12	AT			
13	AUTO/MAN			
14				
15				

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