Board Type Digital Temperature Controller
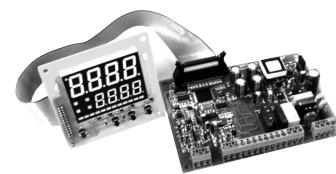
BX8

INSTRUCTION MANUAL

Thank you for purchasing Hanyoung Nux products. Please read the instruction manual carefully before using this product, and use the product correctly. Also, please keep this manual where you can view it any time.

HANYOUNG NUX

Safety information

Please read the safety information carefully before the use, and use the product correctly. The alerts declared in the manual are classified into Danger, Warning and Caution according to their importance

⚠ DANGER	Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury
⚠ WARNING	Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury
⚠ CAUTION	Indicates a potentially hazardous situation which, if not avoided, may result in minor injury or property damage

⚠ WARNING

· The contents of this manual may be changed without prior notification.
· Any use of the product other than those specified by the manufacturer may result in personal injury or property damage.
① Wiring
· If there is a possibility that a malfunction or abnormality of this product may lead to a serious accident, install an appropriate protection circuit on the outside and plan for preventing accidents.
· Since this product is not equipped with a power switch and fuse, install them separately on the outside (fuse rating: 250 V a.c. 0.5 A).
② Power
· Please supply the rated power voltage, in order to prevent product breakdowns or malfunctions.
· To prevent electric shocks and malfunctions, do not supply the power until the wiring is completed.
③ Prohibition of use with gases
The product does not have an explosion–proof structure, so avoid using it in places with flammable or explosive gases.
④ Product handling
· Never disassemble, modify, process, improve or repair this product, as it may cause abnormal operations, electric shocks or fires.
· Do not touch the terminals to avoid electrical shock or malfunction.
⑤ Maintenance
· Please disassemble the product after turning OFF the power. Failure to do so may result in electric shocks, product abnormal operations or malfunctions.
· We recommend regular maintenance for the continuous safe use of this product. Some components of this product may have a lifespan or deteriorate over time.
· The warranty period of this product, is 1 year, including its accessories, under normal conditions of use.

⚠ CAUTION

① Handling (do not install the product under any of the following conditions)
· The ambient temperature exceeds 0 ~ 50 ℃
· The ambient humidity exceeds 20 ~ 90 % RH.
· Places where temperature changes suddenly or condensation occurs.
· Places exposed to corrosive gases (especially harmful gases, ammonia, etc.) or flammable gases.
· Places where vibrations and impacts are applied directly to the product body.
· Places with liquids, oils, chemicals, steams, sunlight.
· Places with a lot of dirt, dust, salt, iron.
· Places where large inductive disturbance, static electricity, magnetic noise can be generated easily.
· Places where heat accumulation occurs due to radiant heat, etc.
② Installation
· This controller does not have outer case and is only composed of PCB (printed circuit board) so you need special attention when you install it to panel. Especially, when insulated against iron plate, and oil or water leak inside the panel, there is danger of fire, so inspection is required.
③ Connections
· Use the predetermined compensating cable with thermocouple.
· For RTD input use a cable with small lead wire resistance and without resistance difference among 3 wires.
· To avoid the inductive noise influence, separate input signal wires from the power and load wires.
· Keep input wires away from output signal wires and be sure to use shielded wires to ground.
· In places with a lot of noise, use the following procedure: connect a surge absorber to the connector coil side if the magnet connectors are connected to the relay contact output load.
· When there is a lot of noise from the power, we recommend to use insulation transformer and noise filter. Please install the noise filter to a grounded panel or structure, etc. and make the wiring of noise filter output and product power supply terminals as short as possible.
· The product power cables are effective when twisted and connected (tightly twisting the power cables is effective against noise)
· For the heater break alarm, the heater power supply and the controller power supply should be connected using the same power cables when a heater break alarm.
· The preparation period of the contact output is required during power supply. If used as a signal to external interlock circuit, etc. please use a delay relay together.
· Be careful during wiring, as this product has a narrower distance among terminals, compared with other products.
· As the connection between the main board and the display board of this product is a signal line, please install after taking into consideration the insulation relationships, so that there is not noise influence.
④ Load circuit connection
· If the operation frequency such as proportional operation is high, connecting the load with the output relay rating without room will shorten the service life, so use an extra relay. In this case, SSR output type is recommended.
 · When using electromagnetic switch: the proportional cycle is at least 30 seconds
 · When using SSR: he proportional cycle is at least 1 second
 · Contact output life : Mechanical: min. 10 million times (no load)
　　　　　　　　　　Electrical: min. 100 thousand times (rated load)
· SSR/current output: not electrically insulated from internal circuit.
⑤ Alarm setting and input disconnection display
· If the alarm function is not set correctly, it will not be output in case of abnormal operation, so please check it before operation.
· When the input (sensor) is disconnected, "b.out" will be displayed on PV display. When replacing the sensor, be sure to turn off the powery.

Suffix code

Model		Code	Information
BX8–	□ □		48×48 ㎜ Board Type Digital Temperature Controller
Control Type		0	Normal Type
		1	Heating/Cooling
Optional		0	SV2/SV3
		1	HBA
		2	RS485
		3	HBA/RS485

Specification

■ Input

Input	Thermocouple: K, J, E, T, R, B, S, L, N, U, WRe 5–26, PL– II (refer to input signal and measurement range). RTD : Pt100 Ω, KPt100 Ω. Direct voltage : 1 – 5 V, –10 – 20 mV, 0 – 100 mV (free scale)
Sampling cycle	250 ㎳
Input resolution	Below decimal point of measurement range
Input impedance	Thermocouple and mV input: min. 1 MΩ, DC V: 1 MΩ
Allowable signal source resistance	Thermocouple : max. 250 Ω, Voltage : max. 2 kΩ
Lead wire tolerable resistance	RTD: max. 10 Ω / 1 wire (but the conductor resistance among 3 wires should be the same)
Input tolerable voltage	within ±10 V (T/C, RTD, Voltage : mV d.c.), ±20 V (Voltage : V d.c.)
Noise removal rate	NMRR (Normal mode) : min. 40 dB (50/60 Hz ±1 %) CMRR (Common mode) : min. 120 dB (50/60 Hz ±1 %)
Standard	T/C, RTD : KS, IEC, DIN
Standard junction temp. compensation tolerance	±1.5 ℃ (15 ~ 35 ℃), ±2.0 ℃ (0 ~ 50 ℃)
BURN–OUT	T/C: OFF, UP/DOWN scale selectable. RTD : UP Scale (detection current at thermocouple and RTD BURN–OUT: approx. 50 nA)
Accuracy	±0.5 % (FULL SCALE)
Input range	Refer to input signal and measurement range. T/C and RTD are changeable within range of input signal and measurement range. DC voltage: min. voltage and max. voltage are changeable within each measurement range. Scaling available in the measurement range conditions

■ Output

Retransmission output		· Current output range : 4 – 20 ㎃ d.c.　· Resistive load : max. 600 Ω · Resolution : Approx. 3,000　· Sampling cycle : 250 ㎳ · Accuracy : ±0.5 % of max. scale (4 – 20 ㎃ range) · Output ripple : max. 0.3% (P–P) of max. scale (150 Hz)
Alarm output		· Contact capacity: 240 V a.c. 1A, 30 V d.c. 1A (resistive load) · Contact: 1a · Point: 1 point · Output points: Refer to "Terminal Arrangement"
Control output	Relay contact output	· Contact capacity : 240 V a.c. 3 A, 30 V d.c. 3A (resistive load) · Contact : 1 C · Time resolution : 0.1 % or 10 ㎳ (the smaller) · Proportional cycle : 1 ~ 1000 sec. · Output operation : time proportional, ON/OFF · Output limit : 0.0~100.0 % range, high limit(OH) or low limit(OL) (selectable also during AT) · ON/OFF hysteresis : 0 ~ 100 % (Full scale)
	SSR voltage pulse output	· ON voltage: approx. min. 24 V d.c. (resistive load min. 600 Ω, 30 mA limit during short circuit) · Proportional cycle: 1 ~ 1,000 sec. · OFF voltage: max. 0.1 V d.c. · Output operation: time proportional · Time resolution: 0.1 % or 10 ㎳ (the smaller) · Output limit: 0.0~100.0 % range, high limit (OH) low limit(OL) (selectable also during AT)
	Current output (4–20 ㎃)	· Current output range : 4 – 20 ㎃ d.c. · Resistive load : max. 600 Ω · Sampling time : 250 ㎳ · Output operation : PID control · Accuracy : ±0.5 % of full scale (4 – 20 ㎃ range). Resolution : Approx. 3,000I · Output ripple : max. 0.3 % (P–P) of max. scale (150 Hz) · Output limit : –5.0 ~ 105.0 % range, high limit(OH) or low limit(OL) (selectable also during AT)

※ Output type can be selected from relay, current or SSR, and heating/cooling types can be set individually

■ Function

|	
Measurement input	· Input correction (Bias) : −100.0 ∼ 100.0 % for instrument range (desired correction value can be compensated for measured input value) · Scaling : The measurement range can be scaled according to the setting of the maximum measurement range (SL−H) and minimum measurement range (SL−L). Filter : OFF, 1 ∼ 120 sec.
Control	· Number of PIDs per set value (SV): you can set up to 3 types of set values (SV) and select PID constants for each · Auto−tuning : According to set value (Standard type, Low PV type) · Proportional Band : 0.1 ∼ 999.9 % (Max. range), 0.0 ∼ 999.9 % (During heating − cooling control) · Integral Time : OFF, 1 ∼ 6000 sec. · Derivative Time : OFF, 1 ∼ 6000 sec. · ON/OFF control : By selecting output code (OT) "0" · PID selection : Zone PID/Auto 1, 2, 3 selectable · Manual Reset : −5.0 ∼ 105.0 % of output (valid when I=OFF) · Direct / Reverse action : Changeable by parameter · Emergency output value : −5.0 ∼ 105.0 % of output value (normal type), 0.0∼105.0 % (heating/cooling type) · ON/OFF hysteresis (HYS) : 0.0 ∼ 100.0 % of instrument range (valid when ON/OFF control is set) · Heating/cooling dead band: −100.0 to 50.0% about output value · Heating−Cooling hysteresis : −100.0 ∼ 50.0 % of output value · ARW (Anti Reset Wind−up) : AUTO, 50.0 ∼ 200.0 % · Fuzzy : ON/OFF selection by parameter · Ramp: It is possible to set rising temperature and falling temperature gradients in hours or minutes when power is ON.
Retransmission output	· Transmission signal: process value (PV), set value (SV), output value (MV) selectable. Sensor power supply (SPS) 24 V d.c. · Continuous output (However, when retransmission output is used, the sensor power can not be used) · Scaling: Indication value, set value
Alarm output	· Set point: depends on specifications of each model (refer to connection diagram) · Alarm types : High/Low process alarm, High/Low deviation alarm, Hold function of alarm, Heater break alarm (refer to alarm type and code) · Setting range : Process alarm ...... 0 ∼ 100 % of instrument range Deviation alarm ...... −100 ∼ 100 % of instrument range · Alarm hysteresis : 0.0 ∼ 100.0 % of instrument range
HBA	· Current measurement range : 1 − 50 A a.c. (resolution: 0.5 A, ±5 % ±1 digit of FS) · Alarm output : Selectable in alarm output · Dead band: 0 ∼ 100 % of max. range · HBA is available during ON/OFF control or time proportional output (but not during current output or cooling output) · Break detection is not possible below 0.2 sec. during output on.

■ Power supply

Power voltage	100 − 240 V a.c. (Voltage fluctuation rate : ±10 %)
Frequency	50/60 Hz
Power consumption	Max. 6.0 W, max. 10 VA
Insulation resistance	Between primary terminal and secondary terminal : min. 500 V d.c., 20 MΩ Between primary terminal and ground : min. 500 V d.c., 20 MΩ Between ground and secondary terminal : min. 500 V d.c., 20 MΩ
Dielectric strength	Between primary terminal and secondary terminal : 2,300 V a.c. 50/60 Hz for 1 min. Between primary terminal and ground : 2,300 V a.c. 50/60 Hz for 1 min. Between F • G and secondary terminal : 1,500 V a.c. 50/60 Hz for 1 min.
Sensor power supply	24 V d.c. 20 mA (but, it is not available in retransmission output)

## ■ Interface

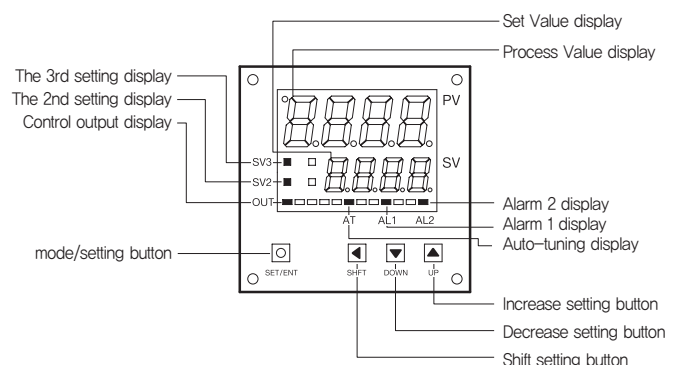|	
Standard	EIA RS485
Max number of connections	31 addresses can be set from 1 to 99
Communication method	2−wire half−duplex
Synchronization	Asynchronous
Communication sequence	None
Communication distance	Within 1.2 km
Communication speed	600, 1200, 2400, 4800, 9600 BPS (Speed is changeable by parameter setting)
START BIT	1 BIT
DATA BIT	7 or 8 BIT
PARITY BIT	None, even numbers, odd numbers
STOP BIT	1 or 2 BIT
PROTOCOL	PC LINK WITHOUT SUM(0), PC LINK WITH SUM(1)
Response time	Reception handling time + (Response time × 10 ms)

Dimension and panel cutout

[Unit : mm]

※Cable length basically 300 mm
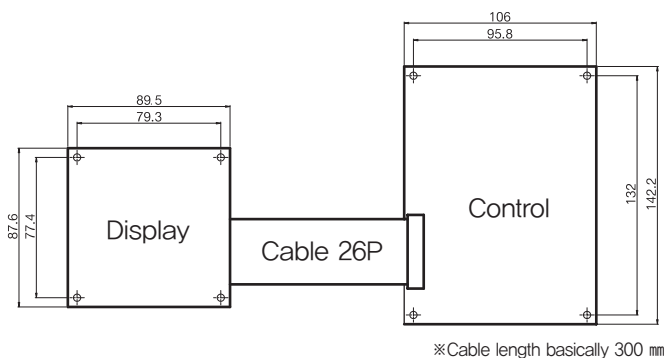
■ Display
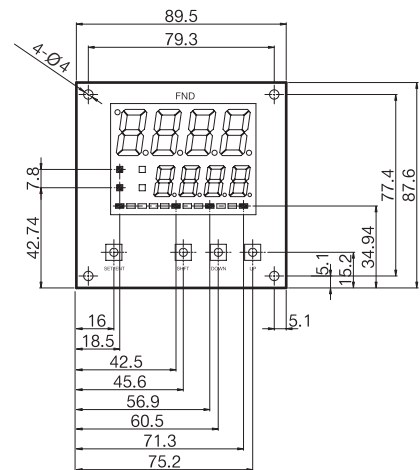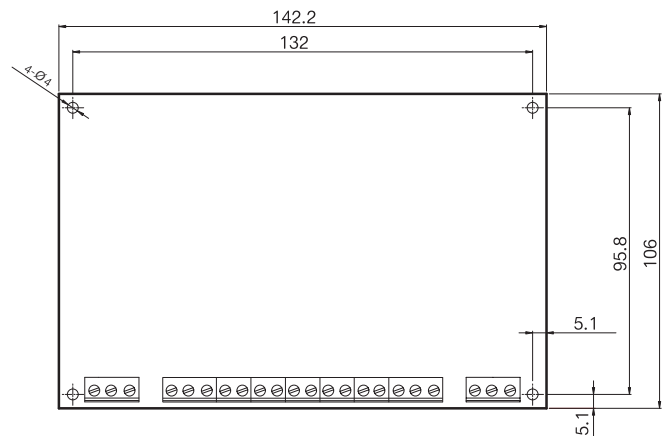
■ Control

Connection diagram
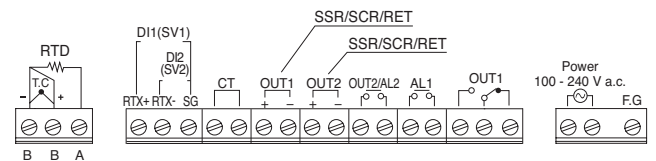
Part name

Parameter configuration

■ Operation ■ Menu

※ Please set in the following order.

Power(ON)

① Normal Type
- Process value — PV
- Set value — SV

⟷ 3 sec

- Process value — PV
- Output value — SV

② Heating/Cooling
- Process value — PV
- Set value — SV

- Process value — PV
- Heat. or cool. output value — SV

Menu diagram:

dISP 3 / PV 1 2 3 / SV

DISP 1 / DISP 2 / DISP 3

1 Control Group G.CtL	2 Set Value Group G.SU	3 Auto-tuning Group G.At	4 PID Group G.PId	5 HBA Group G.HbA	6 Alarm Group G.ALn	7 Retransmission Group G.trn	8 Communication Group G.Con	9 Output Group G.oUt	10 Input Group G.in
EonE	SUno	Atn	ArУ	HbA	AltУ	rEt	P-rS	oUt	inP
FUZУ	SU1	At	PId	Hdb	A2tУ	rEtH	bPS	o.ACt	Unit
UP.rt	SU2		n.P	HCn	Aldb	rEtL	PrI	Ct	Fr-H
dn.rt	SU3		n.I		A2db		StP	CtC	Fr-L
rtnU			n.d		AL-1		dLn	HУS	dP-P
dIS			n.nr		AL-2		Adr	Po	SL-H
			n.PC				rP.t	PoC	SL-L
			n.IC					oL-H	FILt
			h.dC					oL-L	bIAS
			n.db						b.oUt
			IrP						

DISP1 Group setting

■ Control group

- Control zone, fuzzy function, and ramp function are available.
- Fuzzy function is operating in the PID control. (not operating in the ON/OFF control)
- By turning ON / OFF two external contact inputs (SV2, SV3) as shown in Table 1, you can arbitrarily select and control three preset values.

DIS selection	Set value selection by external contact signal		
OFF	No external contact signal		
ON	External signal / Display	SV2	SV3
	SV1 Display	OFF	OFF
	SV2 Display	ON	OFF
	SV3 Display	OFF	ON

⟨Table 1⟩

Symbol	Name	Description	Condition	Initial Value
G.CtL	Control Group	Sets a control mode	–	–
EonE	Zone selection 1	OFF/ON	Always	OFF
FUZУ	Fuzzy function selection	OFF/ON	PID control	OFF
UP.rt	Ramp function (increasing temperature setting)	OFF/EUS (0 ~ 100 %)	Always	OFF
dn.rt	Ramp function (decreasing temperature setting)	OFF/EUS (0 ~ 100 %)	Always	OFF
rtnU	Time unit	HOUR / MIN	Always	HOUR
dIS	External contact input selection	OFF/ON (Refer to Table 1)	Always	OFF

■ Set value group setting

Symbol	Name	Description	Condition	Initial Value
G.SU	Set value group	Sets value setting	–	–
SUno	Select number of set value	1~3 (displays and controls a set value selected among 3 types)	Always	1
SU1	Set SV 1	EU (0.0 ~ 100.0 %)		EU (0.0 %)
SU2	Set SV 2	EU (0.0 ~ 100.0 %)		EU (0.0 %)
SU3	Set SV 3	EU (0.0 ~ 100.0 %)		EU (0.0 %)

In "Set value group", it is possible to select and control each set value with external contact signal (or the key located on the instrument front) after setting 3 types of control setting value (SV1, SV2, SV3). In "Select number of set value", if 1 is selected, the first set value is displayed and controlled by the set value.

DISP2 Group setting

■ Auto-tuning group

Symbol	Name	Description	Condition	Initial Value
G.At	Auto-tuning group	Indicates Auto-tuning	–	–
Atn	Select auto-tuning type	Standard (STD) : Std / Low PV (LOW) : LoУ	ABS	STD
At	Select auto-tuning start	OFF / 1~3 / AUto (AUTO)	ABS	OFF

This digital temperature controller has a standard auto-tuning method (STD: target value) and a low PV auto-tuning method (LOW: SV – 10%) You can select one of the two types of auto-tuning methods. Even if the control stabilization time takes a little longer, the fuzzy function can be used to control the overshoot, and you can get good results.
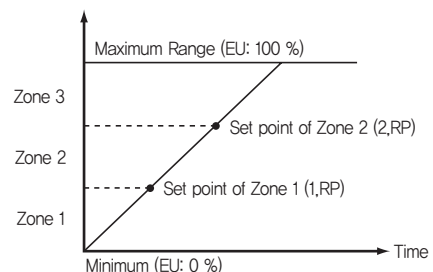
- When "OFF" is selected for auto tuning start selection mode, auto-tuning is not executed. When 1 ~ 3 is selected, the PID value calculated for the corresponding value is saved after the auto-tuning based on the corresponding set value among the three set values (SV1, SV2, SV3) is completed.
- Also, "AUTO" mode is applicable when ZONE is set to ON in the control group. If you set values to 1. rp and 2. rp in PID group, it is divided into 1, 2 and 3 groups, and if AT is executed in Auto mode, it executes the calculation automatically and saves the result in PID 1, 2, 3 groups.

■ PID group

Symbol	Name	Description	Condition	Initial Values
G.PId	PID group	Sets PID mode	–	–
ArУ	ANTI RESET WIND-UP	Auto / 50.0 ~ 200.0 %	PID control	Auto
PId	PID group selection	0 / 1~3	Always	0
n.P	n. Proportional band (P)	0.1 (H/C TYPE:0.0) ~ 999.9 %	PID group	5.0 %
n.I	n. Integal time (I)	OFF / 1 ~ 6000 s	Always	240 s
n.d	n. Derivative time (D)	OFF / 1 ~ 6000 s	Always	60 s
n.nr	n. Manual reset	−5.0 ~ 105.0 %	Integral time : OFF	50.0 %
n.PC	n. Cooling proportional band (P)	0.0 (ON/OFF control) / 0.1 ~ 999.9 %	Heating/Cooling	5.0 %
n.IC	n. Cooling integral time (I)	OFF / 1 ~ 6000 s	Heating/Cooling	240 s
n.dC	n. Cooling derivative time (D)	OFF / 1 ~ 6000 s	Heating/Cooling	60 s
n.db	n. Heating dead band	−100.0 ~ 50.0 %	Heating/Cooling	3.0 %
IrP	n. Zone point	EU (0) ⟨1.RP ⟨ 2.RP ⟨ EU (100.0 %)	ZONE=ON	EU (100.0 %)

In the PID group, it is used to check the auto-tuned PID and ARW values in the auto-tuning group or to change the set value manually.
- Press 🔲 to set the ANTI RESET WIND-UP value automatically or manually. If you press 🔲 again, the PID mode will be displayed. In this mode, you can view and select 3 group PID values, from 0 to 3. For example, if "0" is set to PID mode, the PID value is not displayed. If you press 🔲 after setting "1" using △ or ▽ ,each PID value of group 1 is displayed one by one. Also, if you set 2 or 3, group 2 and group 3 values are displayed respectively.
- The manual reset mode display also displays the manual reset mode when the integral value (I) is "0" in the PID group selection and you can set the manual reset value to remove the off set (deviation between target value and measured value). Setting range: −5.0% ~ 105.0% of proportional band
- When the control group control zone selection mode is "ON", 3 zones can be formed by setting two existing position settings.
※ From the table above ("Symbol" and "Description" columns) "n" can be set from 1 to 3. Only with the heating / cooling type, the cooling proportional band, cooling integral time, cooling derivative time heating/cooling dead band are displayed. And the picture below shows the zone setting when controlling PID group.

Maximum Range (EU: 100 %)

Zone 3
Zone 2 — Set point of Zone 2 (2.RP)
Zone 1 — Set point of Zone 1 (1.RP)

Minimum (EU: 0 %) — Time

■ Heater break alarm group

Symbol	Name	Description	Condition	Initial Value
G.HbA	Heater break alarm group	Sets HBA mode	–	–
HbA	Current setting mode of HBA output	OFF / 1 ~ 50 A	Optional	OFF
Hdb	Hysteresis setting mode HBA	EUS (0.0 ~ 100.0 %)		EUS (0.5 %)
HCm	Current measurement value of HBA	Only display (0 ~ 50 A)		

In the heater break alarm group setting mode, it is possible to detect the current of one place and output each alarm, and it consists of output dead band setting mode and current detection display mode (to be ordered separately: current transformer model CTL–6–S, Measuring range: 1 – 5 A)

■ Alarm group setting

Symbol	Name	Description	Condition	Initial Value
G.CtL	Alarm group	Sets alarm mode	–	–
ZonE	Type of Alarm 1	OFF / 1 ~ 22	Always	1
FUZY	Type of Alarm 2	Refer to alarm type and code		2
UP.rt	Dead band of Alarm 1	EUS (0.0 ~ 100.0 %)		EUS (0.5 %)
dn.rt	Dead band of Alarm 2			
rtmU	Set value of Alarm 1	PV alarm, Deviation alarm EU (−100.0 ~ 100.0%)		EU (100.0 %)
dIS	Set value of Alarm 2			EU (0.0 %)

※ Note: when inverted alarm type is selected in alarm type and code, the indicator lamp will be OFF when contact output is ON.

※ It is not displayed when output selection No. 10, 11, 12 is selected in heating / cooling type (refer to output type)

Code No.	Alarm type	Function
1	High absolute value	
2	Low absolute value	
3	High deviation value	
4	Low deviation value	
5	High deviation value (inverted)	
6	Low deviation value (inverted)	
7	High · Low deviation	
8	High · Low range	
9	High absolute (inverted)	
10	Low absolute (inverted)	
11	High absolute with hold function	
12	Low absolute with hold function	
13	High deviation with hold function	
14	Low deviation with hold function	
15	High deviation with hold function (inverted)	
16	Low deviation with hold function (inverted)	
17	High · Low deviation with hold function	
18	High · Low range with hold function	
19	High absolute value with hold function (inverted)	
20	Low absolute value with hold function (inverted)	
21	Heater break alarm 1 (HBA 1)	

* In case of reverse selection, the output will be OFF when the indicator lamp is ON.

Hysteresis (△ : Set value, −▲: Minus alarm set value, ▲ : Alarm set value)

■ Retransmission group

Symbol	Name	Discription	Condition	Initial Value
G.trn	Retransmission group	Sets retransmission mode	※ Note	–
rEt	Retransmission type or sensor power supply	PV / SV / Output value (MV) / Sensor power supply (SPS)	Optional	PV
rEtH	Retransmission high limit	Thermocouple / RTD: FR −H ~ FR− L DC voltage: SL −H ~ SL− L but, RET. H 〉RET.L	PV / SV	
rEtL	Retransmission low limit			

In retransmission output mode, process value (PV), set value (SV), output value (MV) or sensor power supply (SPS) can be selected, maximum value and minimum value of retransmission output can be set.

※ Note: retransmission group will be displayed only when selecting retransmission in output group output selection mode. If selecting output code 4,5,7,8 in output group, retransmisson will not be indicated.

■ Communication group

Symbol	Name	Description	Condition	Initial Value
G.Con	Communication group	Sets communication mode	–	–
P–rS	RS485/RS422 Protocol	PC.LINK (Set value : 0) / PC.LINK SUM (Set value :1)	Optional	0
bPS	Communication speed (BPS)	600 (SV: 0) / 1200 (SV: 1) / 2400 (SV: 2) / 4800 (SV: 3) / 9600 (SV: 4)		4
Prl	Parity check	NONE (SV: 0) / EVEN (SV: 1) / ODD (SV: 2)		0
StP	Stop bit	1 bit (SV: 1) / 2 bit (SV: 2)		1
dLn	Data length	7 bit (SV: 7) / 8 bit (SV: 8) (SV except PC LINK: 8)		8
Adr	Address	1 ~ 99 , maximum 31 devices		1
rP.t	Response time	0 ~ 10. response time = (handling time + response time) X 10ms		0

BX8 series are equipped with 2–wire half–duplex by RS485 communication interfaces. You can connect up to 31 devices with the computer. The communication mode of the communication group is for setting the communication conditions as follows.

DISP3 Group setting

■ Input group

⚠ Caution

When setting, the input type number must be selected in input type selection mode of input group. Also, output type number must be selected in output type selection mode of output group before setting other modes. If you change input type number or output type number after setting other group modes, other group data already set will be changed to initial values.

Signal	Name	Description	Condition	Initial Value
G.In	Input group	Sets Input type and mode	–	–
InP	Input signal selection	Selects input signal and measurement range	Always	Selection NO.1
Unit	Input range unit	℃ / ℉	Thermocouple or RTD	℃
Fr-H	High limit	Within range (refer to input signal and range) (Note: FR–H 〉FR–L)	Always	1370
Fr-L	Low limit			−200
dP-P	Decimal point (on voltage input)	Thermocouple or RTD fixed / DC Voltage : position selection by setting 0 ~ 3	On voltage input (mV,V)	1
SL-H	Maximum on scale (on voltage input)	−1999~9999 Note: SL–H 〉SL–L Decimal point : according to DP–P	On voltage input (mV,V)	100.0
SL-L	Minimum on scale (on voltage input)			0.0
FILt	PV filter	OFF / 1 ~ 120 sec	Always	OFF
bIAS	PV bias	EUS (−100.0 ~ 100.0 %)	Always	EUS (0.0 %)
b.oUt	Burn-out	OFF / UP / DOWN	Always	UP

■ Input signal and Measurement range

Input signal	Input code	Input type	Range (℃)	Accuracy	Remarks
Thermocouple (TC)	1	K ∗2	−200 ~ 1370	±0.5 % of FS ± 1digit	• FS ranges from the minimum value to the maximum value of each measurable range. • Digit is the minimum display value ∗1: 0~400 ℃ : ±10 % of FS ±1 digit ∗2: 0 ℃ and below : ±1.0% of FS ±1 digit ∗3: −150.0 ~ 150.0 ℃ : ±1.0 % of FS ±1 digit ※ 20 → KPt100 ※ 21 → DPt100
	2	K ∗2	−199.9 ~ 999.9		
	3	J ∗2	−199.9 ~ 999.9		
	4	E ∗2	−199.9 ~ 999.9		
	5	T ∗2	−199.9 ~ 400.0		
	6	R ∗2	0 ~ 1700		
	7	B ∗1	0 ~ 1800	±0.5 % of FS ± 1digit	
	8	S	0 ~ 1700		
	9	L ∗2	−199.9 ~ 900.0	±0.5 % of FS ±1digit	
	10	N	−200 ~ 1300	±1.0 % of FS ±1digit	
	11	U ∗2	−199.9 ~ 400.0		
	12	W	0 ~ 2300		
	13	Platinel II	0 ~ 1390		
RTD	20	KSPt100 Ω ∗3	−199.9 ~ 500.0		
	21	Pt100 Ω ∗3	−199.9 ~ 640.0	±0.5 % of FS ± 1digit	
DC voltage (V d.c. / mV d.c.)	30	1 – 5 V d.c.	1 – 5 V d.c.		
	32	−10 – 20 mV d.c.	−10 – 20 mV d.c.		
	33	0 – 100 mV d.c.	0 ~ 100 mV d.c.		
DC current	30	4 – 20 mA d.c.	※ When using current input, use the resistor 250 Ω 0.1 % on input signal terminal.		

■ Output group setting

Symbol	Name	Description	Condition	Initial Value
ɢoUt	Output group	Selects output type and mode	–	–
oUt	Output signal	Refer to control output configuration	Always	(0 / 3)
o.ACt	Output action	REV: Reverse DIR: Direct action	Output code 0~3	REV
Ct	Cycle time	1 ~ 1000 s	Relay / SSR	30 s
CtC	Cycle time of cooling output	1 ~ 1000 s	Output code 4 ~ 12	30 s
HYS	Hysteresis of normal type	EUS (0.0 ~ 100.0 %)	ON/OFF Control	EUS (0.5%)
	Hysteresis of Heating/ Cooling type	0.0 ~ 10.0 %	Heating/Cooling	0.5 %
Po	Output value during input disconnection Output 1 (Out1)	Normal: −5.0 ~ 105.0 % Heating / Cooling: 0.0 ~ 105.0 %	Always	0.0 %
PoC	Output value during input disconnection Output 2 (Out2)	0.0 ~ 105.0 %	Heating/Cooling	0.0 %
oL-H	Maximum value of output	Normal: OL−L+1Digit ~ 105.0 % Heating / Cooling : 0.0 ~ 105.0 %	PID Control	100.0%
oL-L	Minimum value of output	Normal: −0.5% ~ OL−H−1Digit Heating / Cooling : 0.0 ~ 105.0 %	PID Control	0.0 % / 100.0%

This Digital temperature controller is divided into 2 types : normal type and heating/cooling type.
Output can be selected from Relay, SSR (voltage pulse) and Current (4 − 20 mA d.c.)
Output type range (output code) is ⓪ ~ ③ for normal type and ④ ~ ⑫ for heating /cooling type.
Sometimes retransmission output and alarm output are not available by control output.
※ Control output configuration (HBA can not be used when control output is SCR)

● Normal type

Normal type	Output code (OT)	OUT1		OUT2	
		Relay	SSR/SCR (Current)	Relay	SSR/SCR (Current)
BX8 − 0▢	0	Relay (ON/OFF control)		AL2	RET
	1		SSR	AL2	RET
	2		SCR	AL2	RET
	3	Relay		AL2	RET

● Heating / Cooling type

Heating / Cooling type	Output code (OT)	OUT1		OUT2	
		Relay	SSR/SCR (Current)	Relay	SSR/SCR (Current)
BX8 − 1▢	4		SSR	AL2	SSR
	5		SCR	AL2	SSR
	6	Relay	RET	AL2	SSR
	7		SSR	AL2	SCR
	8		SCR	AL2	SCR
	9	Relay	RET	AL2	SCR
	10		SSR	Relay	RET
	11		SCR	Relay	RET
	12	Relay		Relay	RET

Example: if the control output of the normal type is selected as current output, the output selection number (OT) will be 2. In this case, transmission output and alarm output are available. However, with the heating / cooling control type, only the transmission output can be used and the alarm output can not be used when the heating output is voltage pulse and the cooling side output is a relay (output selection No. ⑩~⑫).

Function

■ Auto−tuning

The auto−tuning function automatically measures, computes the control system characteristics, and automatically sets the optimum proportional band (P), integral time (I),and derivative time(D) constants. When auto−tuning starts, the control output is changed temporarily to ON/OFF control and the optimum PID constants are computed and set from those response data. This method is called limit cycle. BX8 controller have two types of Auto−tuning as below.
① Standard type auto−tuning : auto−tuning based on set value (SV)
② Low PV type auto−tuning : auto−tuning based on a value 10 % lower than the set value (SV)
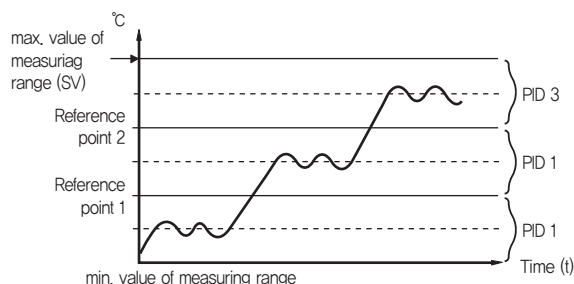
● Standard type auto−tuning
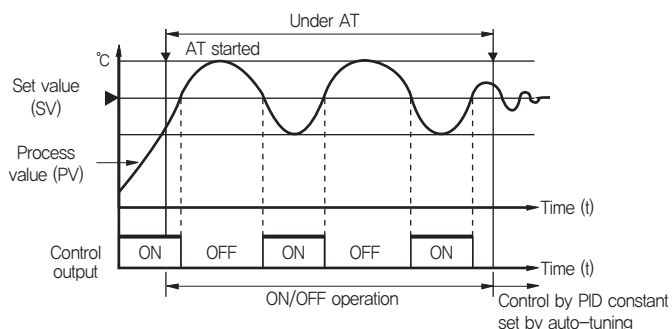

● Low PV type auto−tuning
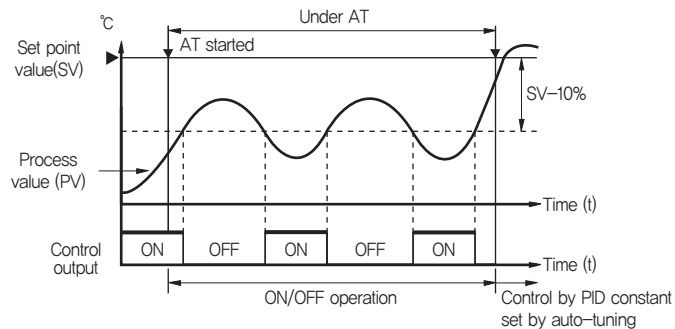
■ PID auto−tuning in zone selection

It divides into 3 zones in the input range and applies different PID groups to each zone.
Since the optimal PID value varies depending on the temperature area in a control process with wide temperature range, it is a function to apply the PID data according to the area.


■ Ramp function

It is the gradient of the set value that reaches the set value (SV). The setting method is to set the initial rising (falling) temperature according to the temperature value set in the initial rising temperature setting and initial falling temperature setting mode and the time (minute) selected in the unit time selection mode. It has a slope that reaches the set value (SV).
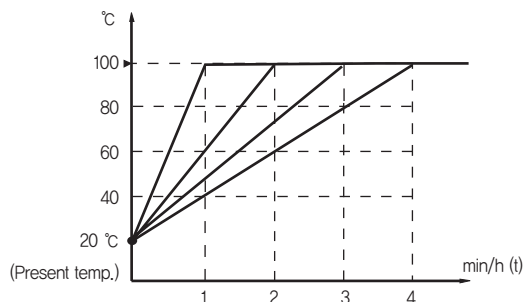
## ■ External contact input

Optional SV will be selected among preset SV1, SV2, and SV3 by external contact input.
It can be used as step control.
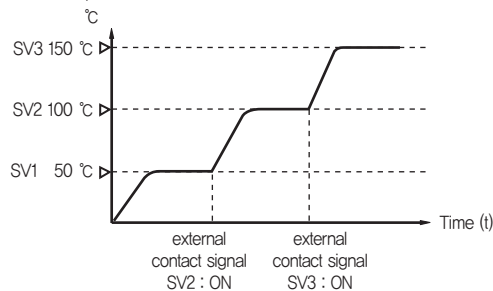
■ Fuzzy control

The fuzzy calculation function can do an effective control in the following cases, as an overshoot suppression function using fuzzy logic (inference), that can be used in combination with the auto-tuning function.

① If the operation start position starts the control at the position where it shows large deviation between target set value and PV
② If you want to shorten the operation warming-up time
③ If the load fluctuation is severe during normal operation
④ When the set value is changed frequently, if the fuzzy function is ON, the deviation is monitored, the danger of overshoot is detected, and the control continues by automatically changing the target set value to a virtual lower subsidiary target value. Thereafter, when you enter to range without overshoot risk, you gradually return to the original target set value. However, the fuzzy function operates in PID operation.
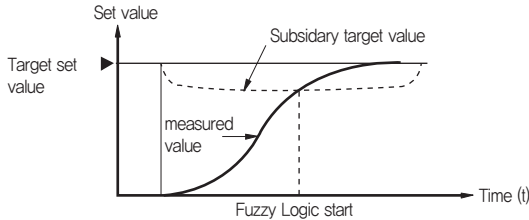
■ Output limit

You can set to high limit and low limit by control output operating range.
The output limit can be set from −5 to 105% of the output volume for the high limit value and the low limit value.
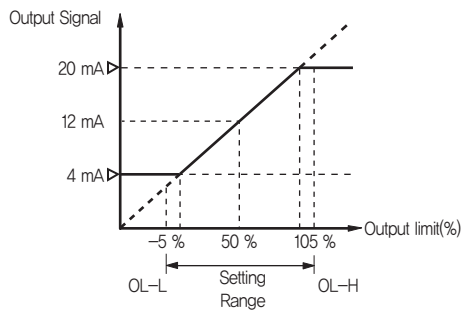

■ Heater break alarm (HBA)

① Detects the heater disconnection and starts the alarm operation immediately.
② Please use our original current detector (CT).
③ Set the operating voltage and alarm operating point with the front key.
④ It can not be used when controlling by phase angle control method using thyristor (SCR output)
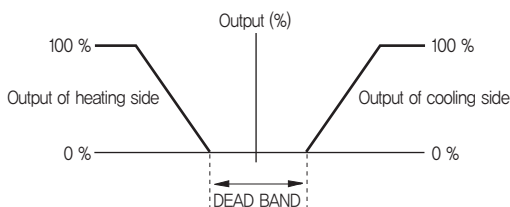
■ Heating / Cooling control

The heating / cooling control divides the PID operation result into two signals for heating and cooling. It is possible to select and output the heating side and cooling side by PID control or ON / OFF control respectively. It is also possible to select one of the relay output, SSR (voltage pulse output) and current output (4 − 20 ㎃ d.c.) for the heating output and the cooling output respectively.

● When heating and cooling side are ON / OFF control, dead band will be shown as below.
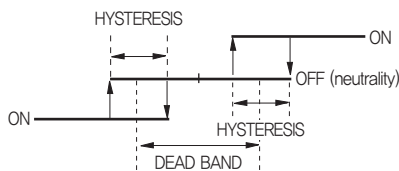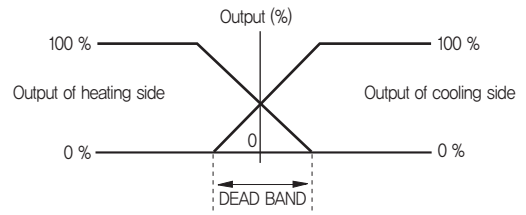

〈ON / OFF control for both heating/cooling sides〉

● When heating and cooling side are PID control, dead band will be shown as below.

〈 PID control for both heating/cooling sides "+" set value dead band〉

Also, "−" indicates the dead band of the set value and the dead band during PID control for both heating/cooling sides, as shown below. At this time, output overlaps of both sides occur.

〈 PID control for both heating/cooling sides " − "set value dead band〉
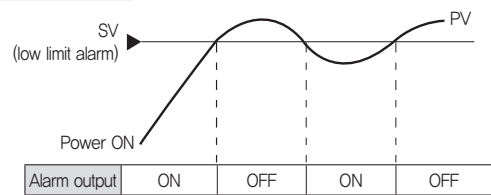
■ Emergency output

When A/D error or input disconnection occur in auto mode, PID output is cut and pre-set output is operated (PO output).
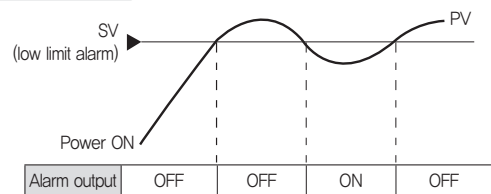
■ Hold function

If there is no hold function, the low limit alarm turns on while the power is turned on and the temperature rises (refer to Picture 1). In order to prevent the low limit alarm from turning on during the temperature rise, by selecting the hold function, you can disable the low limit alarm from the power on until the alarm set value is exited.

(Picture 1)

(Picture 2)