Universal Input Digital Temperature Controller

AX series

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 instruction manual where you can view it any time.

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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 properties damage

⚠ DANGER

- The input/output terminals are subject to electric shock risk. Never let the input/output terminals come in contact with your body or conductive substances.

⚠ WARNING

- When used in equipment with a high risk of personal injury or properties damage (examples: medical devices, nuclear control, ships, aircrafts, vehicles, railways, combustion devices, safety devices, crime/disaster prevention equipment etc.) install double safety devices and prevent accidents. Failure to do so may result in fire, personnel accident or properties damage.
- 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).
- Please supply the rated power voltage, in order to prevent product breakdowns or malfunctions.
- To prevent electric shocks and malfunctions, do not supply power until the wiring is completed.
- The product does not have an explosion-proof structure, so avoid using it in places with flammable or explosive gases.
- Never disassemble, modify, process, improve or repair this product, as it may cause abnormal operations, electric shocks or fires.
- Please disassemble the product after turning OFF the power. Failure to do so may result in electric shocks, product abnormal operations or malfunctions.
- Any use of the product other than those specified by the manufacturer may result in personal injury or properties damage.
- Please use this product after installing it to a panel, because there is a risk of electric shock.

⚠ CAUTION

- The contents of this manual may be changed without prior notification.
- Please make sure that the product specifications are the same as you ordered.
- Please make sure that there are no damages or product abnormalities occurred during shipment.
- Use the product in a temperature range from -5 to 50 °C (max. 40 °C for close installation) / 35 to 85% RH (without condensation)
- Please use the product in places where corrosive gases (especially harmful gases, ammonia, etc.) and flammable gases are not generated.
- Use the product in places where vibrations and impacts are not applied directly to product body.
- Please use the product in places without liquids, oils, chemicals, steam, dust, salt, iron, etc. (pollution degree 1 or 2).
- Please do not wipe the product with organic solvents such as alcohol, benzene, etc. (wipe it with neutral detergents).
- Please avoid places where large inductive interference, static electricity,magnetic noise are generated.
- The display characters may not be visible in external sunlight or heavily illuminated indoor environments.
- Please avoid places with heat accumulation caused by direct sunlight, radiant heat, etc.
- Please use the product in places with elevation below 2000 m.

⚠ CAUTION

- When water enters, short circuit or fire may occur, so please inspect the product carefully.
- For thermocouple input, use the predetermined compensating cable (temperature errors occur when using ordinary cable).
- For RTD input, use a cable with small lead wire resistance and without resistance difference among 3 wires (temperature errors occur if the resistance value among 3 wires is different).
- Use the input signal line away from power line and load line to avoid the influence of inductive noise.
- Input signal line and output signal line should be separated from each other. If separation is not possible, use shield wires for input signal line.
- Use a non-grounded sensor for thermocouple (using a grounded sensor may cause malfunctions to the device due to short circuits).
- 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 terminal as short as possible.
- Tightly twisting the power cables is effective against noise.
- 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 replacing the sensor, be sure to turn off the power.
- Use an extra relay when the frequency of operation (such as proportional operation, etc.) is high, because connecting the load to the output relay rating without any room shortens the service life. In this case, SSR drive output type is recommended.
  * When using electromagnetic switch: set the proportional cycle to at least 20 sec.
  * When using SSR: set the proportional cycle to at least 1 sec.
- Do not wire anything to unused terminals.
- Please wire correctly, after checking the polarity of the terminals.
- When you install this product to a panel, please use switches or circuit breakers compliant with IEC60947-1 or IEC60947-3.
- Please install switches or circuit breakers at close distance for user convenience.
- Please specify on the panel that, since switches or circuit breakers are installed, if the switches or circuit breakers are activated, the power will be cut off.
- 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.
- 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.
- If the user changes the product in case of malfunctions, the operation may be different due to set parameters differences even if the model name is the same. So, please check the compatibility.
- Before using the temperature controller, there may be a temperature deviation between the PV value of the temperature controller and the actual temperature, so please use the product after calibrating the temperature deviation.

Suffix code

Model	Code			Content	
AX	□-	□	□	Universal Input Digital Temperature Controller	
Size	2			48(W) × 96(H) × 63(D) ㎜	
	3			96(W) × 48(H) × 63(D) ㎜	
	4			48(W) × 48(H) × 63(D) ㎜	
	7			72(W) × 72(H) × 63(D) ㎜	
	9			96(W) × 96(H) × 63(D) ㎜	
Output selection		1		SSR + Relay 1 + Relay 2	When using relay or SSR output (selection by internal parameter)
		2		SSR + Relay 1 + Relay 2 + Relay 3	
		1B		SSR + Relay 1 (Form c) + Relay 2	Only for AX2, 3, 7, 9
		2B		SSR + Relay 1 (Form c) + Relay 2 + Relay 3	
		3		4 - 20 ㎃ + Relay 2	When using current output
		4		4 - 20 ㎃ + Relay 2 + Relay 3	
Power voltage			A	100 - 240 V a.c. 50/60 Hz	

※ Relay output operates as control output, alarm output and LBA output according to internal parameter setting.

Specifications

Classification		AX2	AX3	AX4	AX7	AX9
Input	Thermocouple	K, J, R, T (selection by internal parameter)				
	RTD	Pt100 Ω (selection by internal parameter)				
	Allowable line resistance	Max. 10 Ω/1 wire (RTD). Resistances among 3 wires should be same				
	Sampling cycle	0.1 sec				
	Impedance	Max. 1 MΩ				
	Input voltage	Max. 10 V d.c.				
	Display accuracy	±0.3 % of F.S ±1 digit (in case of R type, ±1.0 % of ±1 digit in the 0 ~ 600 °C range)				
Control output	Relay output	• 1a contact, 3 A 240 V a.c., 3 A 30 V d.c. (resistive load) • You can select max. 3 relay outputs, and relay control output is output as RLY1. • 2 alarm output contacts (AL1, AL2), loop break alarm (LBA) output assigned by user among RLY1, RLY2, RLY3.				
	SSR output: Time share cycle control (CYC) / Phase control (PHA)	12 - 15 V d.c. pulse voltage (resistive load min. 600 Ω)				
	Current output (SCR)	4 - 20 ㎃ d.c. (resistive load max. 600 Ω)				
Control	Control type	PID control (by auto-tuning), P control, ON/OFF control				
	Auto-tuning	PID operation by auto-tuning				
	ON/OFF control	When PV>SV, 0% output. When PV<SV, 100% output (only when control hysteresis is 0)				
	Manual reset	User set within 0.0% to 100.0% range				
	Control output operation	Direct/reverse actions ※ selection by parameter setting				
	Control output	Relay/voltage pulse (SSR) outputs ※ selection by parameter setting				
Power	Power voltage	100 - 240 V a.c., 50/60 Hz				
	Voltage fluctuation rate	±10 % of power voltage				
	Insulation resistance	Min. 20 MΩ, 500 V d.c. for 1 min (primary terminal - secondary terminal)				
	Dielectric strength	2,300 V a.c. 50/60Hz, for 1 min (primary terminal - secondary terminal)				
	Power consumption	Max. 5.5 VA				
	Ambient temperature & humidity	-5 ~ 50 °C, 35 ~ 85 % RH (without condensation)				
Vibration resistance		10 - 55 Hz, single amplitude 0.75 mm,. 2 hours in each of 3 axis directions				
Shock resistance		300 m/s² to 3 directions each 3 times				
Approval		CE				
Weight (g)		320	320	180	300	400

※ Weight when packed

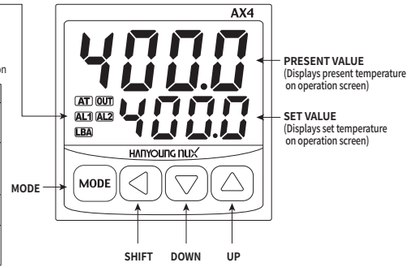
Ranges and input types

Classification	Code	Input type	Range	
			Celsius (°C)	Fahrenheit (°F)
Thermocouple	K1	K	- 100 ~ 1200	-148 ~ 2192
	K2		-100.0 ~ 500.0	-148 ~ 932
	J	J	-100.0 ~ 500.0	-148 ~ 932
	r	R	0 ~ 1700	32 ~ 3092
	t	T	-100.0 ~ 400.0	-148 ~ 752
RTD	Pt	Pt100 Ω	-100.0 ~ 400.0	-148.0 ~ 752.0

Part names and functions

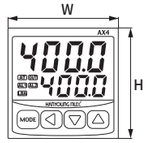
Operation indicator
AT: Turns on during PID auto-tuning
OUT: Turns on during control output operation
AL1: Turns on during alarm 1 operation
AL2: Turns on during alarm 2 operation
LBA: Turns on during loop break alarm operation

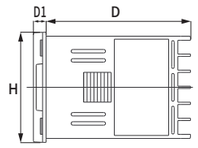
Name		Content
MODE	Mode Key	Move among operation mode, user setup mode and operator setup mode
◀	Shift Key	Move set value row. Move among operation mode, user setup mode and operator setup mode.
▼	Down Key	Decrease set value, move to parameter setting mode.
▲	Up Key	Change operation mode, increase set value, shift parameter setting mode



Dimensions and panel cutout

Dimensions

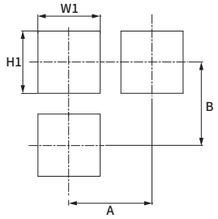




Classification	Type	AX2	AX3	AX4	AX7	AX9
Product dimensions	W	48.0	96.0	48.0	72.0	96.0
	H	96.0	48.0	48.0	72.0	96.0
	D	63.0	63.0	63.0	63.0	63.0
	D1	5.5	5.5	5.5	5.5	5.5
Panel cutout	W1 *	45.0	92.0	45.0	68.0	92.0
	H1 *	92.0	45.0	45.0	68.0	92.0
	A	70.0	122.0	60.0	83.0	117.0
	B	122.0	70.0	60.0	100.0	117.0

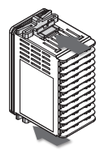
*+0.5 ㎜ tolerance applied

Panel cutout



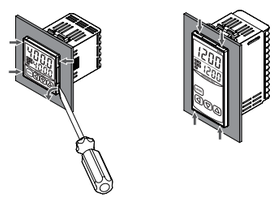
Bracket assembling

● AX2, AX3, AX4, AX7, AX9



Case disassembling

● AX3, AX4, AX7, AX9 ● AX2



Main function description

Auto-tuning (AT)

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. Press and hold MODE and ▲ simultaneously for more than 2 sec. to start the auto-tuning. When auto-tuning is terminated, the control starts automatically.

Alarm

● **Alarm usage**
AX series supports 2 independent alarms (AL1 and AL2). These alarms can assign AL1 or AL2 signal to RLY1~RLY3 outputs and be used. If alarm signal is not assigned to RLY1~RLY3 then the menu related to the alarm will not be displayed.

● **Alarm hold operation**
If the low alarm is turned ON while the power is supplied and the temperature increases, set AnHd (alarm n standby mode) to ON, in order to prevent the low alarm from turning ON while the temperature increases, and you will be able to prevent the low alarm operation from power on until the alarm set value is exited.

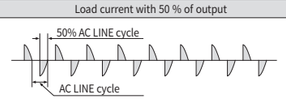
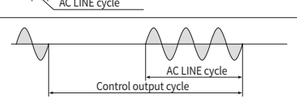
● **Alarm output LOCK**
If the AnoH value is set to ON, alarm output is not cancelled even during alarm cancel condition, after the alarm is output.
Press and hold ▲ for approx 2 sec. to cancel alarm output.

Loop break alarm (LBA)

When the control output value by PID operation is "0"% or "100%" in the control system, it detects heater breaks and sensor break actuator breakdowns by comparing the change amount of measured value at each set time. You can also set the LBA deadband so that it is not affected by normal control loops.
① **When control output value by PID operation is 100%**, if the temperature does not increase more than LbAu value within the LBA set time, LBA output will turn ON.
② **When control output value by PID operation is 0%**, if the temperature does not decrease more than LbAu value within the LBA set time, LBA output will turn ON.

Time share cycle control and phase control of voltage pulse output ※ for SSR output only

When selecting control output type as SSR, you can select the voltage pulse output type. The time share cycle control turns ON/OFF the output by proportioning time to the output amount at regular time cycles. Set in the period CYt parameter of control output. Within half cycle of power wave, the phase control controls the output amount by computing the output ON phase, depending on output amount.
More continuous output than cycle control can be obtained. However, when using the phase control, users must use RANDOM ON/OFF type SSR.

Control type	Load current with 50 % of output
Phase control	
Time share cycle control	

Operation mode

Supplying the power after wiring will display the current temperature. Every time you press MODE the set temperature and output amount will be displayed alternatively on the set value (SV) displaying unit.

User setup mode

User setup mode is the mode that sets the set values changed by users frequently such as alarm and loop break alarm (LBA) set values.
The parameters of the operator setup mode are also displayed in the user setup mode, so that they can be easily set.

Symbol (PV)	List	Content	Display condition	Initial value (SV)
Su	Temperature set value (SV)	EU 0 ~ 100 %	Always displayed	EU 0%
AL1L	Alarm 1 low value	EU 0 ~ 100 % or EUS 0 ~ 100 % (temperature unit)	When ALn is set on RLYn	EU 0%
AL1H	Alarm 1 high value			EU 100%
A1db	Alarm 1 deadband			EUS 0%
AL2L	Alarm 2 low value			EU 0%
AL2H	Alarm 2 high value			EU 100%
A2db	Alarm 2 deadband			EUS 0%
LbAt	Loop break alarm time	0 ~ 7200 second	When LBA is set on RLYn	480
LbAu	Loop break alarm temperature	0 ~ 100 °C (°F)		2
LbAd	Loop break alarm deadband	0 ~ 100 °C (°F)		2
LoC	Key lock	0 : No lock function	Always displayed	0
		1 : Operator setup mode lock, auto-tuning inhibited		
		2 : Operator setup mode lock		

Operator setup mode

Operator setup mode is the setting mode that sets the specifications of the temperature controller when the engineer installs it for the first time.
Pressing MODE and ◀ simultaneously for more than 2 sec. in the operation mode or user setup mode will enter to the operator setup mode.
Pressing MODE and ◀ again for more than 2 sec. will return to the operation mode.

Symbol (PV)	List	Content	Display condition	Initial value (SV)
inP	Input type	K1 : K thermocouple (no decimal points) K2 : K thermocouple (decimal points) J : J thermocouple r : R thermocouple t : T thermocouple Pt : Pt100 Ω RTD	Always displayed	K1
Unit	Temperature unit	°C / °F selection	Always displayed	°C
dP	Decimal point display	ON (display), OFF (no display)	When selecting decimal point range	on
biAS	Input bias	-100 ~ 100 (sensor input value + bias)	Always displayed	0
FILt	Input filter time	0 ~ 120 sec.	Always displayed	0
SLH	High set limit	EU 0 ~100 %	Always displayed	1200
SLL	Low set limit	EU 0 ~100 %	Always displayed	-100
oCtr	Control output type	SSr : SSR drive voltage pulse output rLY : Relay output	When output selection is 1 or 2	SSr
SSrt	Voltage pulse output type	CYC : Time share proportional control PHA : SSR phase control (continuous proportion)	When selected SSR control output	CYC
Ct	Control output cycle	0 ~ 1000 sec	When SSrt is CYC or oCtr is RLY	2
Ctrd	Control output operation	rEu : Reverse action (heating control) dir : Direct action (cooling control)	Always displayed	rEu
Ctrl	Control type	PId : PID control P : P (proportional) control onoF : ON/ OFF control	Always displayed	PId
Pb	Proportional band	1 (0.1) ~ EUS 100 %	When it is not ON/OFF control	30
I	Integral time	0 ~ 3600 sec	With PID control	240
d	Derivative time	0 ~ 3600 sec	With PID control	60
nr	Manual reset	0.0 ~ 100.0 %	With P control	500
HYS	Control hysteresis	EUS 0 ~ 100 % (temperature unit)	With ON/OFF control	2
Po	Output amount with input break	0 ~ 100 %	Always displayed	00
rLY1	Relay 1 properties	non : Not using AL1 : Alarm 1 output AL2 : Alarm 2 output LbA : LBA output	When output selection is 1 or 2 and oCtr is not RLY	non
rLY2	Relay 2 properties	non : Not using AL1 : Alarm 1 output AL2 : Alarm 2 output LbA : LBA output	Always displayed	AL1
rLY3	Relay 3 properties	non : Not using AL1 : Alarm 1 output AL2 : Alarm 2 output LbA : LBA output	Always displayed (option)	AL2
A1nd	Alarm 1 mode (Alarm 1 or 2)	non : Not using ---[: High alarm]--- : Low alarm -[]- : Alarm within range]-[: Alarm out range	When AL1 or AL2 is set in RLY 1, 2, 3	---[
A2nd	Alarm 2 mode (Alarm 1 or 2)			]---
A1ty	Alarm 1 type	Abs : ABS (absolute alarm) dEu : DEV (deviation alarm)		Abs
A2ty	Alarm 2 type			
A1Hd	Alarm 1 standby mode	oFF : OFF (not using standby mode) on : ON (using standby mode)		oFF
A2Hd	Alarm 2 standby mode			
A1dy	Alarm 1 delay time	0 ~ 9999 sec		0
A2dy	Alarm 2 delay time			
A1oH	Alarm 1 output lock	oFF : Alarm output return action on : Alarm output maintain action		oFF
A2oH	Alarm 2 output lock			
SuE	Change SV on the operation screen	oFF : No change SV on : Change SV	Always displayed	on

SV change

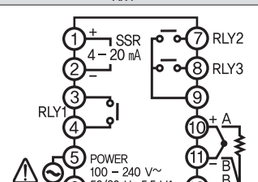
① In operator setup mode, when SuE parameter value is on, you can change value on operation mode with ◀, ▼, ▲ and set with MODE.
② In operator setup mode, when SuE parameter value is oFF, you can change value on user setup mode Su parameter with ◀, ▼, ▲ and set with MODE.

Input error display

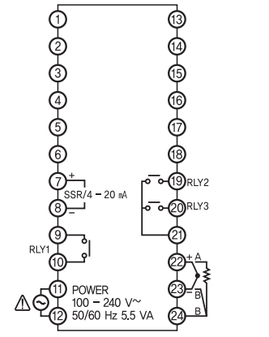
When input break (sensor break) occurs or when the maximum temperature range is exceeded, bolit will be displayed

Connection diagrams

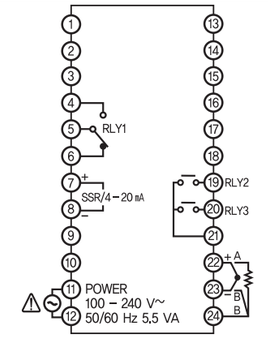
AX4



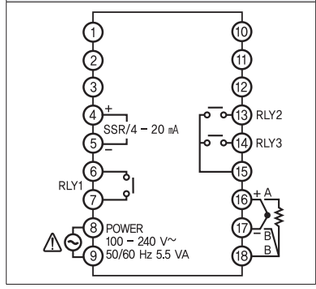
AX2, AX3, AX9



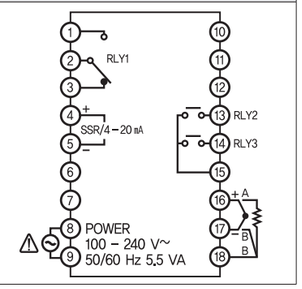
AX2-B, AX3-B, AX9-B



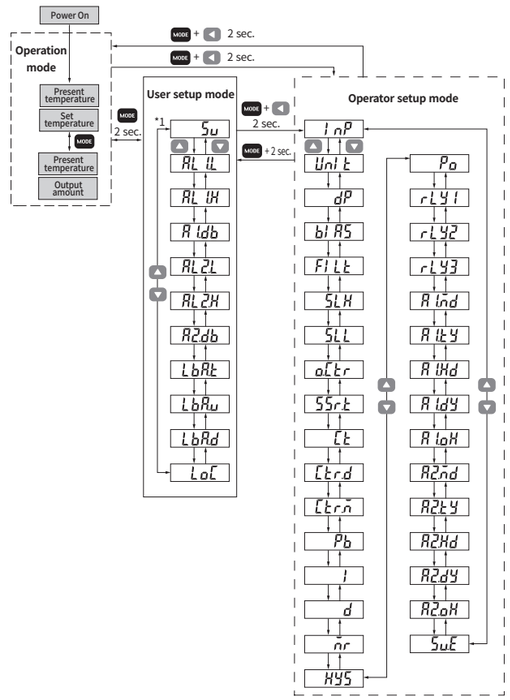
AX7



AX7-B



Parameter configuration



※ For further information, please visit our homepage (www.hanyoungnux.com) and refer to the user's manual in the archive.