A
Temperature Controller

# AX Series

## Digital temperature controller

- Multi input (K, J and Pt100 Ω are selectable)
- Multi output (Relay and SSR are selectable)
- High speed sampling cycle (0.1 sec)
- Installation depth : 63 mm
- Control loop break alarm (LBA)

## Suffix code

| Model | | Code | | Description | |
|---|---|---|---|---|---|
| AX | □ - | □ | □ | Digital temperature controller | |
| Dimension | 2 | | | AX2 : 48 X 96 ㎜ | |
| | 3 | | | AX3 : 96 X 48 ㎜ | |
| | 4 | | | AX4 : 48 X 48 ㎜ | |
| | 7 | | | AX7 : 72 X 72 ㎜ | |
| | 9 | | | AX9 : 96 X 96 ㎜ | |
| Output selection | | 1 | | SSR + Relay1 + Relay2 | Relay or SSR as control output (selectable in operator setup mode) |
| | | 2 | | SSR + Relay1 + Relay2 + Relay3 | |
| | | 3 | | 4 – 20 ㎃ + Relay2 | Current output as control output |
| | | 4 | | 4 – 20 ㎃ + Relay2 + Relay3 | |
| Power supply voltage | | | A | 100 – 240 V AC 50 / 60 Hz | |

※ Relay output operates as control output, alarm output and LBA output depending on the internal parameter setting.

## Specification

### Input

| | |
|---|---|
| Input selection | Multi input<br>• Thermocouple : K, J, R, T (IEC)<br>• RTD : Pt100 Ω (IEC) |
| Input sampling time | 0.1 s |
| Input impedance | 1 ㏁ max |
| Allowable wiring resistance | 10 Ω / 1wire max(RTD). but resistances among 3 wires should be same |
| Allowable input voltage | 10 V DC max |

### Performance

| | |
|---|---|
| Display accuracy | ±0.3 % of FS ±1 digit<br>(In case of R type, ±1.0 % of ±1 digit in the 0 ~ 600 ℃ range) |
| Insulation resistance | More than 20 ㏁, 500V DC for 1min (Primary terminal-Secondary terminal) |
| Dielectric strength | 2300V AC 50/60Hz, for 1 min (Primary terminal-Secondary terminal) |

## Range and input code

| Classification | Code | Input type | Range | |
|---|---|---|---|---|
| | | | Celsius(℃) | Fahrenheit(℉) |
| 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 | Pt 100 Ω | −100.0 ~ 400.0 ℃ | −148.0 ~ 752.0 ℉ |

## Control function and output

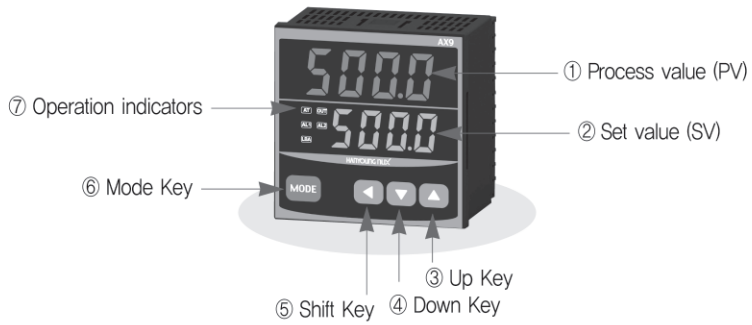
| | | |
|---|---|---|
| Control type | PID control, P control, ON/OFF control | |
| Auto-tuning | PID operation by the auto-tuning | |
| ON/OFF control | When PV 〉 SV, it generates 0 % output. When PV 〈 SV, it generates 100 % output.<br>(Only when control hysteresis is 0) | |
| Manual reset | Users set within the range from 0 % to 100 % | |
| Control output operation | Direct action/Reverse action (selected by the parameter setting) | |
| Control output | Relay output/voltage pulse output (SSR output) * Selected by the parameter setting) | |
| Relay | 1a contact (Resistive load) | |
| | Relay output can be selected maximum 3 and relay control output is displayed as RLY1.<br>Alarm output 2 contacts (AL1, AL2) and LBA output are assigned by the users among RLY1, RLY2 and RLY3 | |
| SSR | CYC | 12 − 15 V DC pulse voltage (Resistive load min 600 Ω) |
| | PHA | |
| 4 − 20 ㎃ | Accuracy : 0.5 % of FS, Ripple Vp-p : 0.3 % of FS, Resistive load : Max 600 Ω | |

## Specification

| Model | AX2 | AX3 | AX4 | AX7 | AX9 |
|---|---|---|---|---|---|
| Power supply voltage | 100 − 240 V AC 50/60 Hz | | | | |
| Voltage fluctuation | ±10 % of power supply voltage | | | | |
| Power consumption | 5.5 VA max | | | | |
| Ambient temperature | −5 ~ 50 ℃ | | | | |
| Ambient humidity | 35 ~ 85 % RH (But without dew condensation) | | | | |
| Vibration (resistance) | 10 − 55 Hz, 0.75 ㎜, X Y Z each in X, Y and Z directions for 2 hour | | | | |
| Shock (resistance) | 300 m/s² to 6 directions each 3 times | | | | |
| Weight | 320 g | 320 g | 180 g | 300 g | 400 g |

※ Weight included the weight of box

## Function and name of each part




| No | Model | | Description |
|---|---|---|---|
| ① | Process value (PV) | | • Display the current temperature in the operation screen |
| ② | Set value (SV) | | • Display the set temperature in the operation screen |
| ③ | ▲ | Up Key | • Change the operation screen, increase the set value, move to the parameter setting mode |
| ④ | ▼ | Down Key | • Decrease the set value, move to the parameter setting mode |
| ⑤ | ◀ | Shift Key | • Shift to the set value digits<br>• Move from operation screen – users<br>• Move from operator – setting mode |
| ⑥ | MODE | Mode Key | • Move from operation screen – users<br>• Move from operator – setting mode |
| ⑦ | AT | Operation indicators | • Light ON with the PID auto tuning |
| | OUT | | • Light ON with the control output operation |
| | AL1 | | • Light ON with the Alarm1 operation |
| | AL2 | | • Light ON with the Alarm2 operation |
| | LBA | | • Light ON with the Loop break alarm operation |

# Important function explanation

## ■ Heating / Cooling output action selection

Able to select the reverse action (heating control) or direct action (cooling control) output by the [trd parameter

## ■ PID auto tuning (A.T) function

Auto tuning function measures, computes and sets the optimum PID or ARW constant automatically. After supplying power in and while temperature is increasing, press the set key MODE and ▲ key synchronously for 2 sec. to begin the auto tuning. When auto tuning is finished, tuning operation will be ended automatically.

## ■ ON/OFF control setting method

Usually temperature controller performs the temperature control by "PID control method" which is done by the PI auto tuning. However, ON/OFF control method is used when controlling the refrigerator, fan, solenoid valve and etc. When users want to set the temperature controller as ON/OFF control mode, set the setting value of proportional band as [trn within the "general setting parameter."
Here, HYS (hysteresis) parameter will be displayed. Prevent such action to occur by setting the desired ON/OFF action range.

## ■ boUt display

When input break (sensor break) occurs or exceeds the maximum temperature range, boUt will be displayed in the measured value displaying unit.

## ■ Output terminal and output signal

• RLY signal allocation

AX Series has maximum 3 relay contact output. These 3 relay contact outputs are called as RLY1 to RLY3. Please refer to the connection diagram for the terminal position. The control signal and alarm signal are generated from the RLY1. Selecting the rLY in the oCtr parameter will yield the control signal in the RLY1. Selecting the SSr in the oCtr parameter will able users to select the alarm signal and make the output. Users can select the alarm signal and make the output in the RLY2 and RLY3.

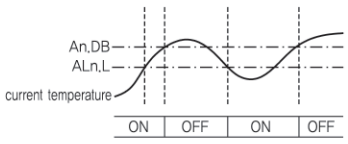
## ■ Alarm

• Using the alarm

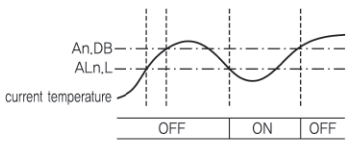
AX Series supports 2 independent alarms (AL1 and AL2). These alarms can allocate AL1 or AL2 signal in the RLY1, RLY2 and RLY3 and be used. If alarm signal is not allocated in the RLY1 to RLY3 then the menu related to the alarm will not be displayed.

• Alarm hold action

If there is no standby action function, supply the power in then the LOW alarm will become ON while temperature is increasing.
In order to prevent the low alarm to become ON during temperature is increasing, add the standby action function so from the point when supplying in the power to until the value goes beyond the set value, it can prevent the low alarm to be operated.




Not using the alarm standby mode
(An.HD=OFF)




Using the alarm standby mode
(An.HD=ON)

• Alarm output LOCK

It the AnoH value is ON, Alarm is not cancelled even if it becomes the alarm cancel condition.
If users want to stop the alarm forcedly, please press the ▲ key for approx 2 sec.

## ■ LBA (Loop Break Alarm)

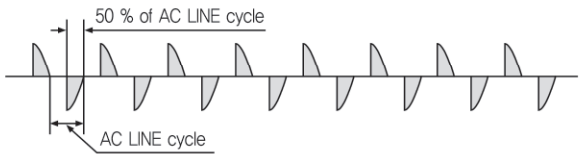
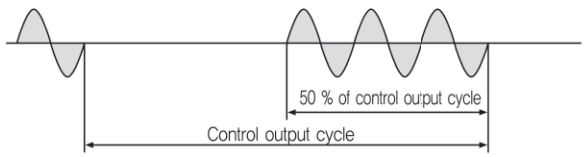
LBA function starts to measure time from the moment when the PID computed value becomes 0 % or 100 %. Also, from this point, this function detects heater break, sensor break manipulator malfunction and etc by comparing the changed amount of measured value in each set time. Also, it can set the LBA dead band in order to prevent any malfunction to happen in the normal control loop.

① **When control output value which obtained by PID operation is 100 %,**
If the temperature does increase more than LbAu value within the LBA set time, LBA output will become ON

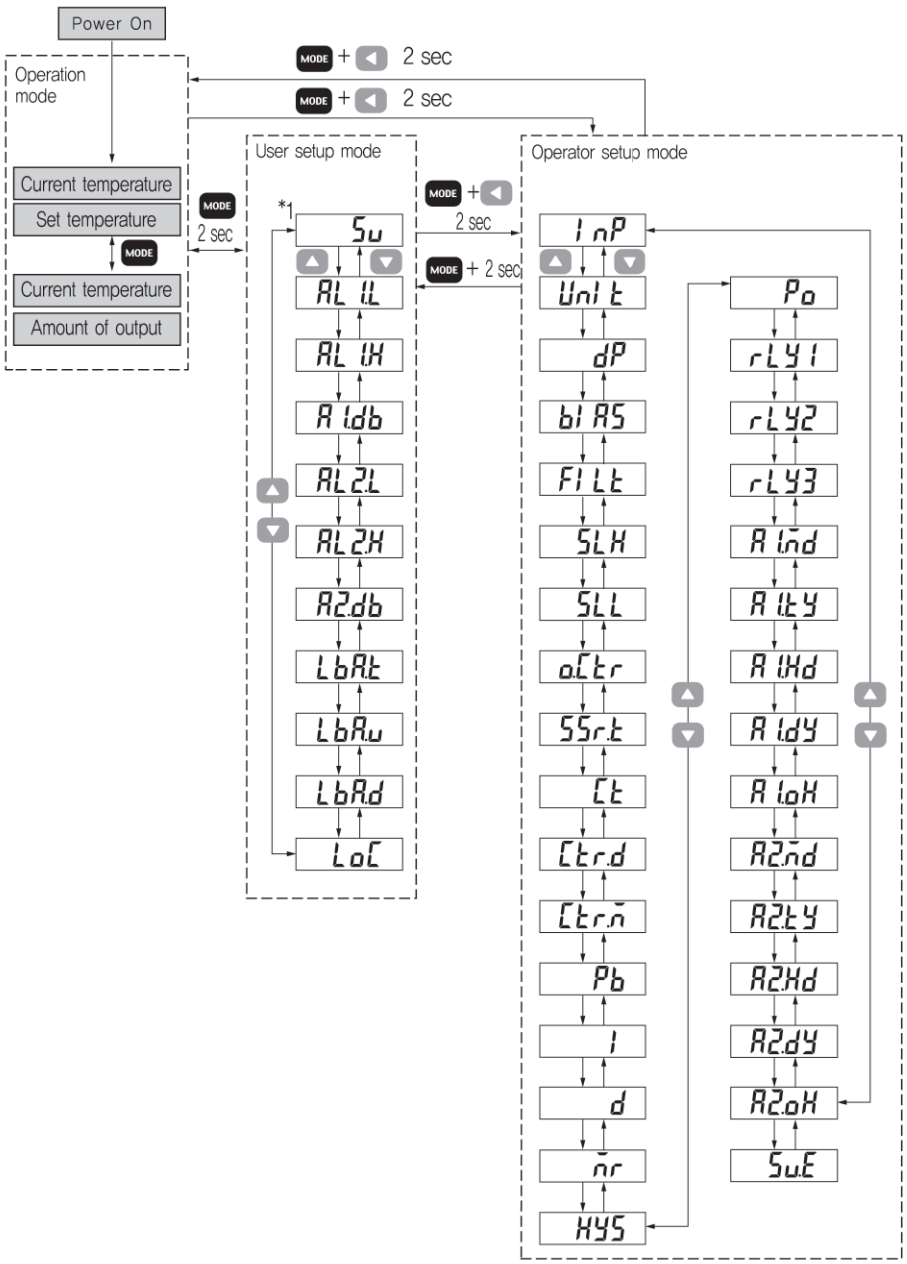
② **When control output value which obtained by PID operation is 0 %,**
If the temperature does decrease more than LbAu value within the LBA set time, LBA output will become ON

## ■ Time share cycle control and phase control of Voltage pulse output

When selecting the control output type as SSR, users will be able to select the types for voltage pulse output. The timeshare cycle control turns ON/OFF the output by proportioning the certain time to an output amount in cycle. Set the cycle of control output in the Ct parameter.
Within the half cycle of power wave shape, the phase control (depending on an output amount) controls an output amount by computing the output ON phase. However, when using the phase control, users must use the RANDOM ON/OFF type SSR.

| Control type | Load current with 50 % of output |
|---|---|
| Phase control |  |
| Timeshare cycle control |  |

## Parameter composition



## ■ Operation mode

Supplying in the power after finish wiring will display the current temperature. Pressing the MODE key will display the set temperature and output amount alternatively on the set value (SV) displaying unit.

## ■ User setup mode

User setup mode is the setting mode that sets the set value that is changed by users frequently such as alarm set value and loop break alarm (LBA). It made the parameter of user setup mode to be displayed on the operator setup mode that allows users to set easily (divided the setting level).

## ■ SV setting

① In Operator Setup Mode, When the value of `SuE` parameter is `on`, you can change the value with ◀, ▼, ▲ and press the MODE key to set up.

② In operator Setup Mode, When the value of `SuE` is `oFF`, you can change the value in `Su` parameter with ◀, ▼, ▲ and Press MODE key to set up.

| Symbol (PV) | Lists | Description | Display condition | Default value |
|---|---|---|---|---|
| `Su` | set temperature | EU 0 ~ 100 % | at all times | EU 0 % |
| `AL 1L` | Alarm 1 low value | EU 0 ~ 100 % or<br>EUS 0 ~ 100 %<br>(temperature unit) | When RLYn<br>ALn is set | EU 0 % |
| `AL 1H` | Alarm 1 high value | | | EU 100 % |
| `A 1db` | Alarm 1 dead zone | | | EUS 0 % |
| `AL2L` | Alarm 2 low value | | | EU 0 % |
| `AL2H` | Alarm 2 high value | | | EU 100 % |
| `A2db` | Alarm 2 dead zone | | | EUS 0 % |
| `LbAt` | Loop break alarm time | 0 ~ 7200 sec | When LBA is set in the RLYn | 480 |
| `LbAu` | Loop break alarm temperature | 0 ~ 100 ℃ (℉) | | 2 |
| `LbAd` | Loop break alarm dead zone | 0 ~ 100 ℃ (℉) | | 2 |
| `LoC` | KEY lock | `0` : NO LOCK function | at all times | 0 |
| | | `1` : Operator setup mode LOCK, Auto-tuning prohibited | | |
| | | `2` : Operator and user setup mode LOCK | | |

## ■ Operator setup mode

Operator setup mode is the setting mode that sets the specification of temperature controller when engineer installs it for the first time. Pressing the MODE key and ◀ key synchronously in the operation screen or user setup mode will enter into the operator setup MODE and ◀ keys one more time for 2 sec will return to the operation screen.

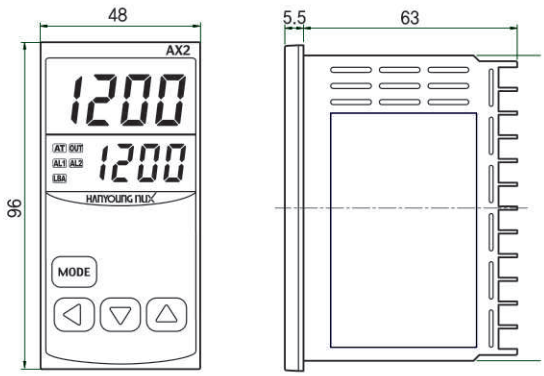
| Symbol (PV) | Lists | Description | Display condition | Default value |
|---|---|---|---|---|
| InP | Input condition | K1 : K thermocouple (Not display the decimal points)<br>K2 : K thermocouple (Displays the decimal points)<br>J : J thermocouple<br>r : R thermocouple<br>t : T thermocouple<br>Pt : RTD Pt 100 Ω | At all times | K1 |
| Unit | Temperature unit | ℃ / ℉ option | At all times | °C |
| dP | Decimal point | ON(YES)<br>OFF(NO) | Select decimal point | on |
| bIAS | Input compensation | -100 ~ 100(sensor input value + BIAS) | At all times | 0 |
| FILt | Input filter time | 0 ~ 120 sec | At all times | 0 |
| SLH | High setting limitation | EU 0 ~ 100 % | At all times | 1200 |
| SLL | Low setting limitation | EU 0 ~ 100 % | At all times | -100 |
| oCtr | Control output type | SSr: SSR operating voltage pulse output<br>rLY: Relay output | When output selection 1 or 2 | SSr |
| SSrt | Voltage pulse output type | CYC: timeshare proportional control<br>PHA: SSR phase control (continuously proportioning) | 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 action | rEu : Reverse action (heating control)<br>dIr : Direct action (cooling control) | At all times | rEu |
| Ctrl | Control type | PId : PID control<br>P : P control (proportional control)<br>onoF: ON/OFF control | At all times | PId |
| Pb | Proportional band | 1 (0.1) ~ EUS 100 % | When it is not ON/OFF | 30 |
| I | Integral time | 0 ~ 3600 sec | Control\With PID control | 240 |
| d | Derivative time | 0 ~ 3600 sec | With PID control | 60 |
| rr | Manual reset | 0.0 ~ 100.0 % | With P control | 50.0 |
| HYS | Control hysteresis | EUS 0 ~ 100 %(Temperature unit) | With ON/OFF control | 2 |
| Po | Output amount with input brea | 0 ~ 100 % | At all times | 0.0 |
| rLY1 | Relay 1 property | non : Not using<br>AL1 : Alarm 1 output<br>AL2 : Alarm 2 output<br>LbA : LBA output | When output selection is 1 or 2 and oCtr is not RLYY | non |

| Symbol (PV) | Lists | Description | Display condition | Default value |
|---|---|---|---|---|
| rLY2 | Relay 2 property | non : Not using<br>AL 1 : Alarm 1 output<br>AL2 : Alarm 2 output<br>LbA : LBA output | At all times | AL 1 |
| rLY3 | Relay 3 property | non : Not using<br>AL 1 : Alarm 1 output<br>AL2 : Alarm 2 output<br>LbA : LBA output | At all times (Option) | AL2 |
| A1md | Alarm 1 mode (Alarm 1 or 2) | non : Not using<br>---[ : High alarm<br>]--- : Low alarm<br>-[]- : Alarm within range<br>]--[ : Alarm not within range | When AL1 or AL2 is set in RLY 1, 2, 3 | ---[ |
| A2md | Alarm 2 mode (Alarm 1 or 2) | | | ]--- |
| A1tY | Alarm 1 type | AbS : ABS(Absolute alarm) | | AbS |
| A2tY | Alarm 2 type | dEu : DEV(Deviation alarm) | | AbS |
| A1Hd | Alarm 1 standby mode | oFF : OFF(not using the standby mode) | | oFF |
| A2Hd | Alarm 2 standby mode | on : ON(using the standby mode) | | oFF |
| A1dY | Alarm 1 delay time | 0 ~ 9999 sec | | 0 |
| A2dY | Alarm 2 delay time | | | 0 |
| A1oH | Alarm 1 output LOCK | oFF : Alarm output return action | | oFF |
| A2oH | Alarm 2 output LOCK | on : Alarm output maintain action | | oFF |
| SuE | Change SV on the operation | oFF : No change SV | At all times | on |
| | | on : Change SV | | |

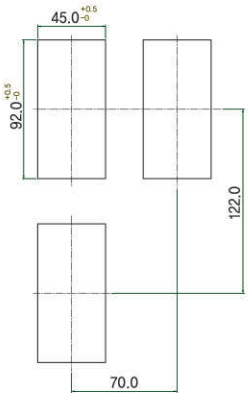
## Dimension and panel cutout

### AX2

● Dimension

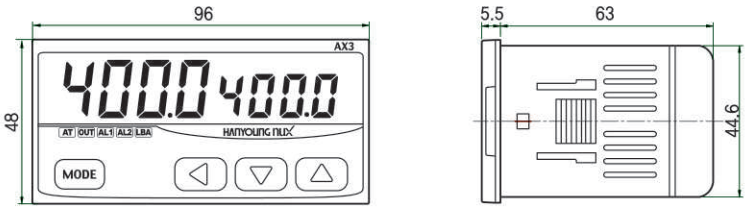



● Panel cutout

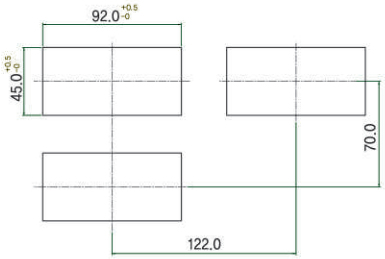



### AX3

● Dimension

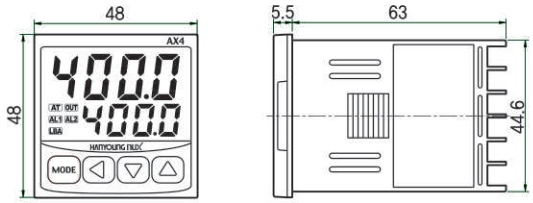



● Panel cutout



## AX4

● Dimension

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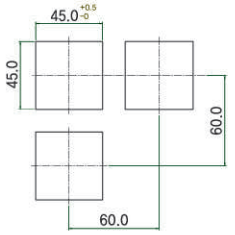
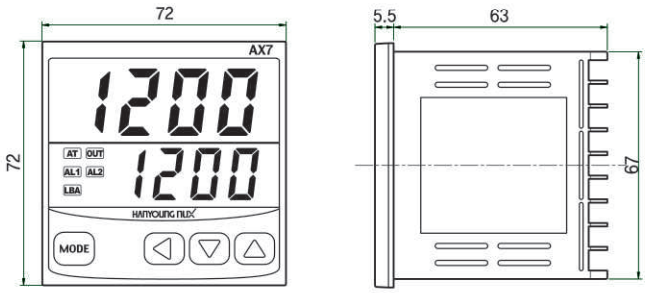



## AX7

● Dimension

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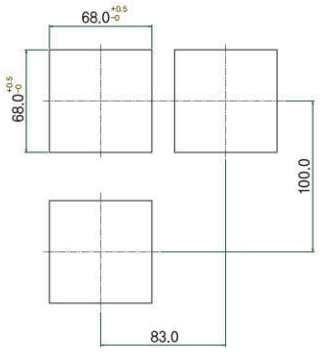
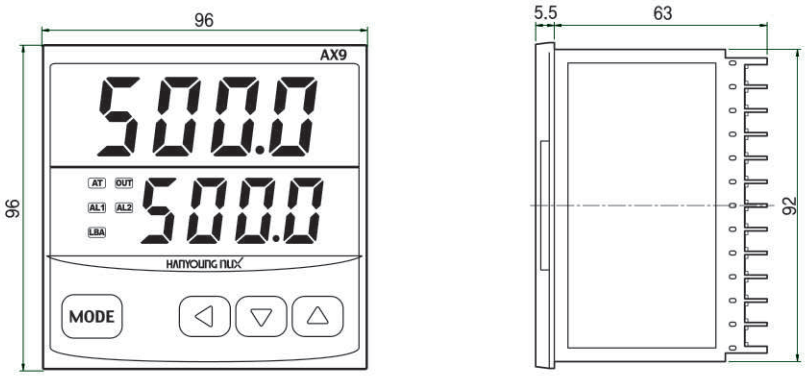


## AX9

● Dimension

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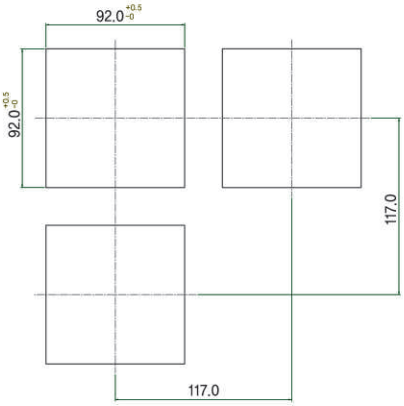
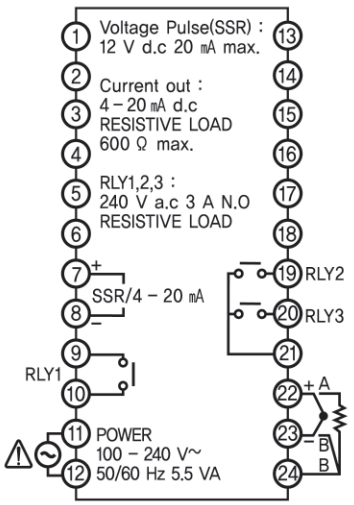
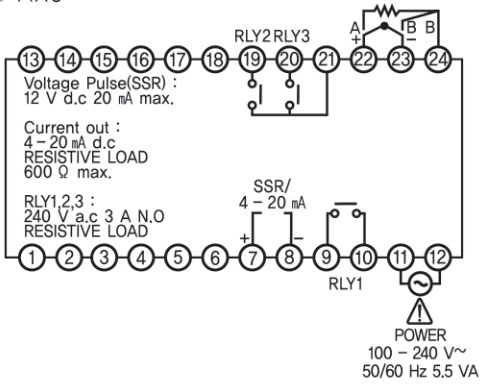


## Connection diagram (unit : ㎜)

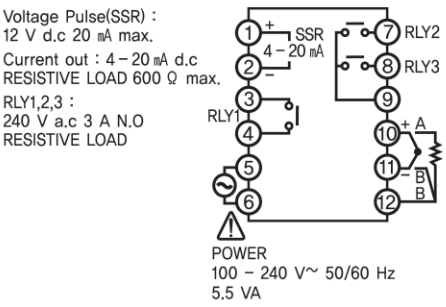
● AX2




● AX3




● AX4

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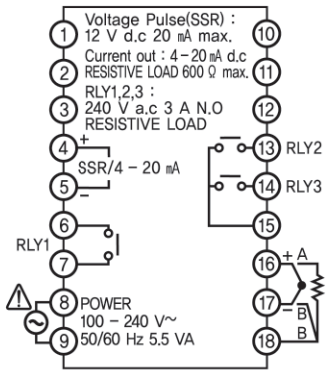

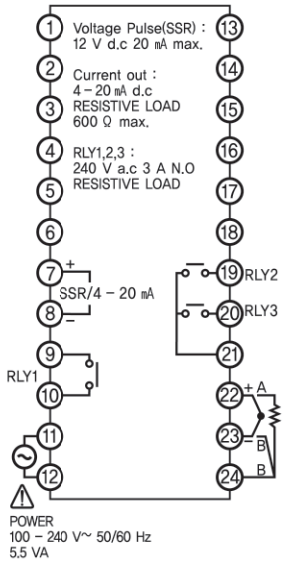
● AX9