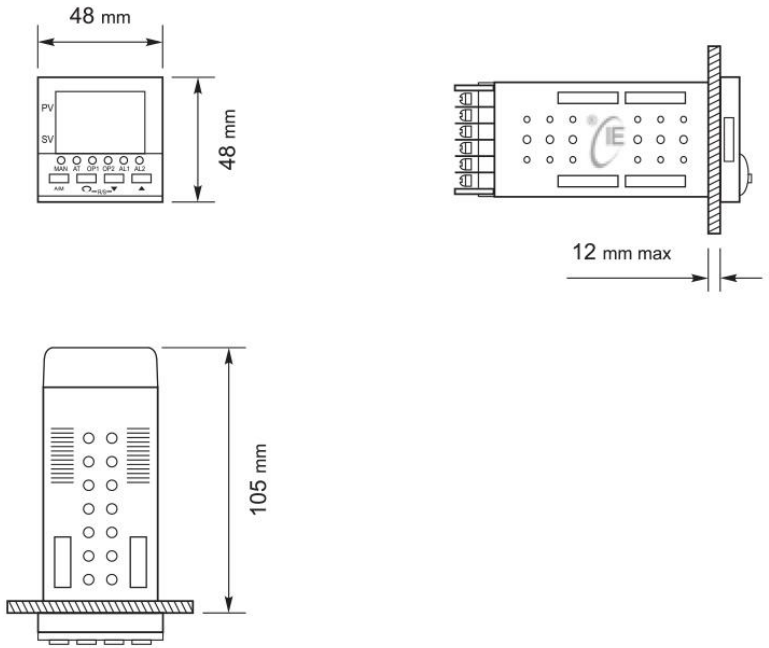
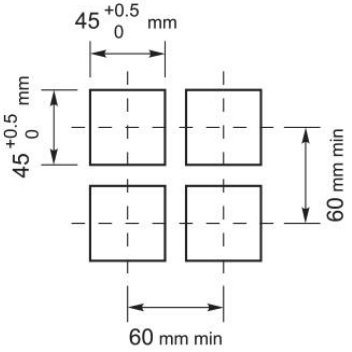
2. Installation

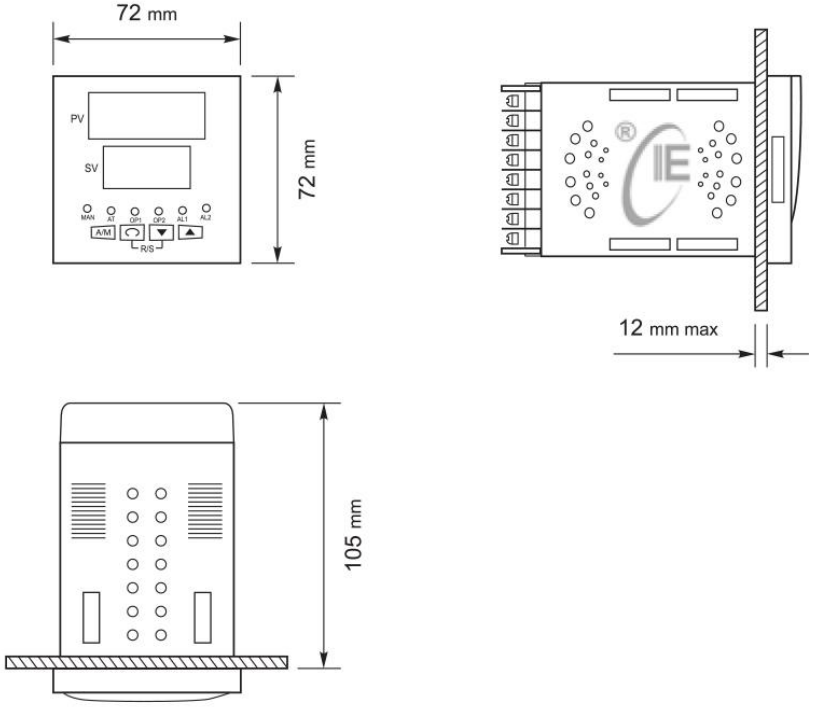
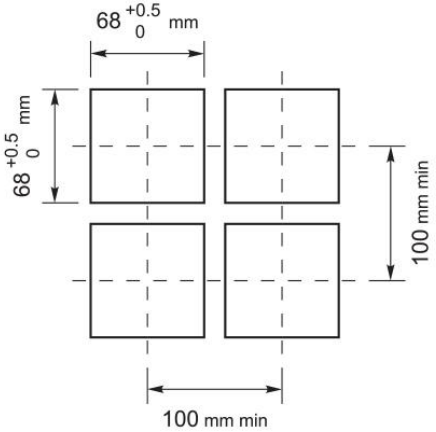
2.1 Installation cautions ⚠

1. This instrument is designed for panel mounting and must be installed in an enclosure.
2. Installation must only be carried out by qualified personnel.
3. This instrument is intended to be used indoors where it is not exposed directly to sunlight.
4. This instrument is intended to be used under the following environmental conditions.
   Temperature 0~50^{o}C Relative humidity 5%~85% (non-condensing) Pollution class 2
5. Do not install this instrument under the following conditions.
   · Rapid changes in ambient temperature which may cause condensation.
   · Corrosive, flammable, or explosive gases.
   · Vibration frequency >50Hz or vibration amplitude >1mm.
   · Water, oil, chemicals, vapour, or steam intrusion.
   · Excessive dust, salt, or iron particles in the atmosphere.
   · Excessive induction noise, static electricity, magnetic fields or noise.
   · Direct air flow from an air conditioning unit.
   · An environment where there is direct radiant heat.

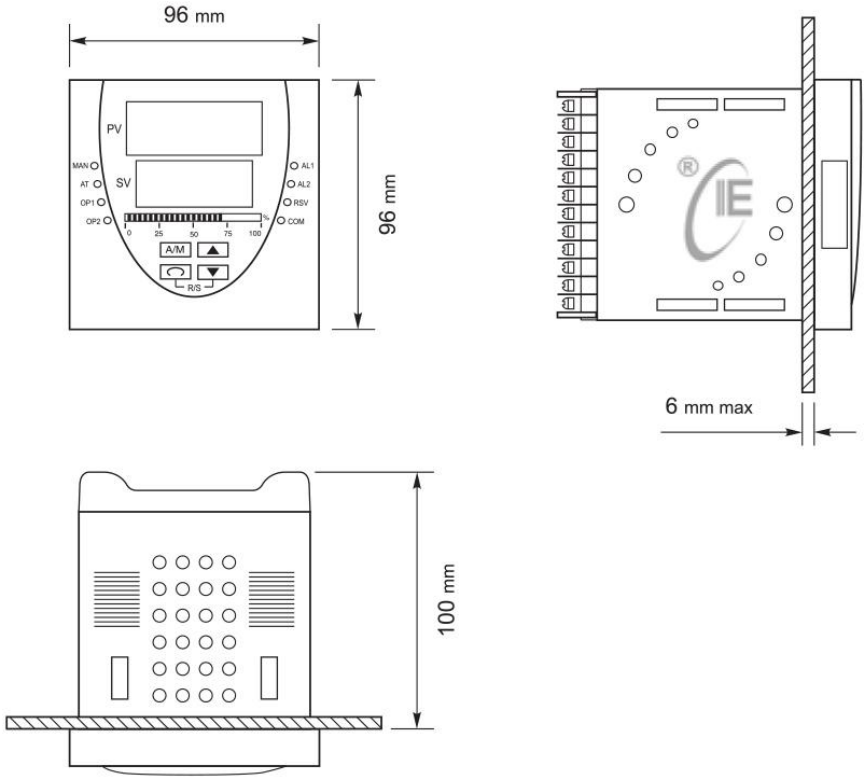
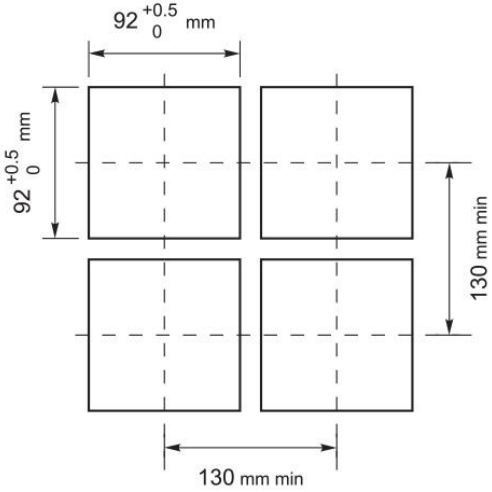
2.2 Dimensions and panel cut-out

	Dimensions	Panel cut-out
Front panel dimensions: 48 mm×48 mm		

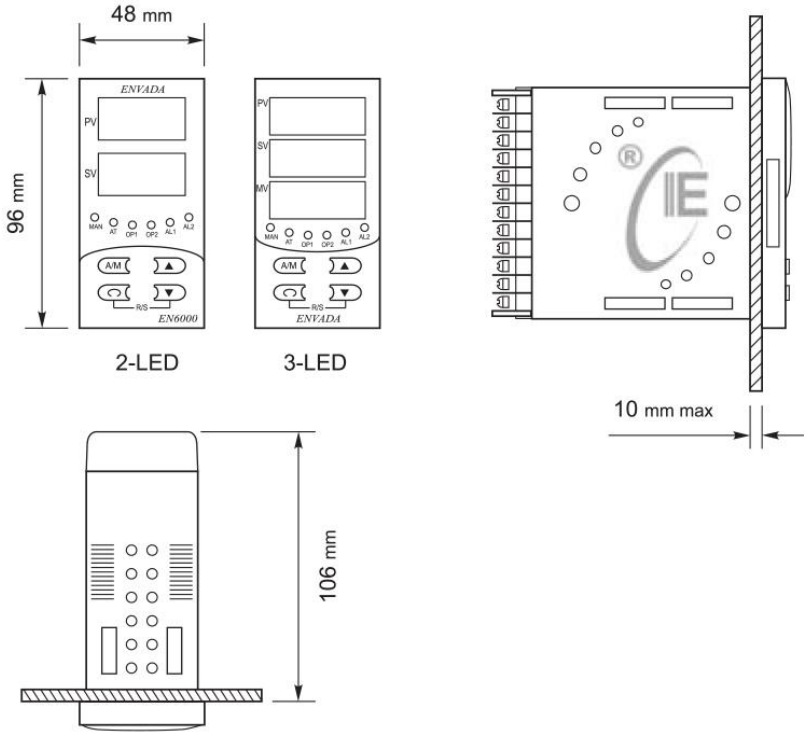
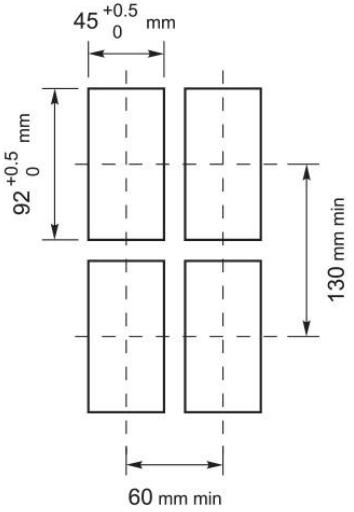
continued **2.2 Dimensions and panel cut-out**

	Dimensions	Panel cut-out
Front panel dimensions: 72 mm×72 mm		

continued **2.2 Dimensions and panel cut-out**

	Dimensions	Panel cut-out
Front panel dimensions: 96 mm×96 mm		

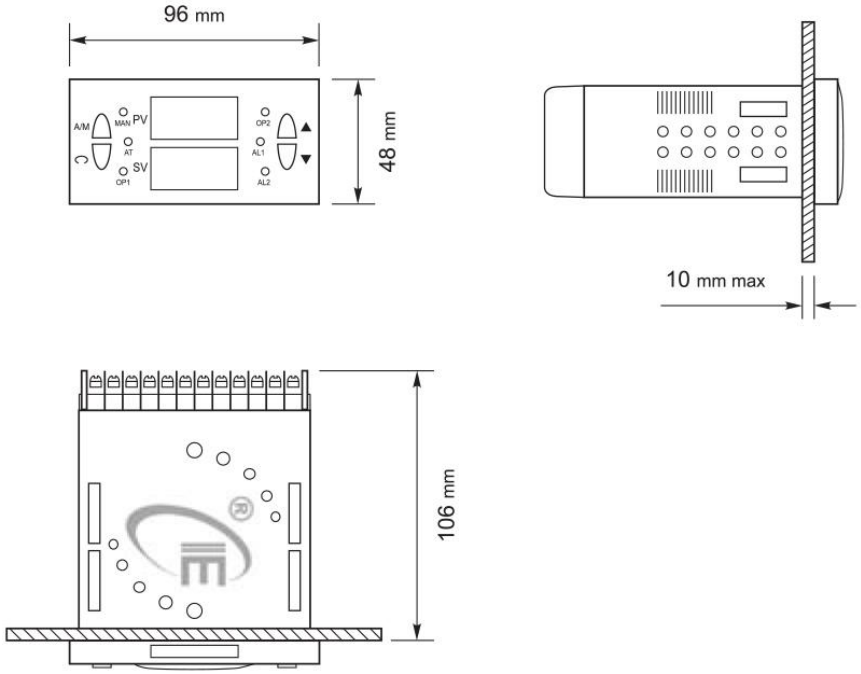
continued **2.2 Dimensions and panel cut-out**

	Dimensions	Panel cut-out
Front panel dimensions: 48 mm×96 mm		

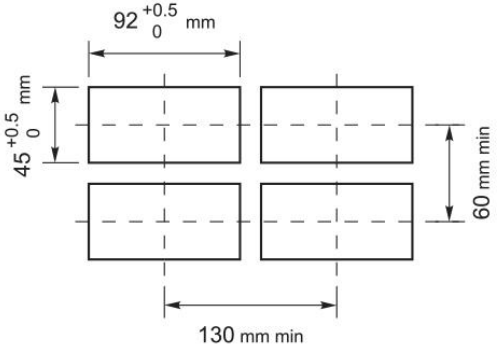
continued **2.2 Dimensions and panel cut-out**

Front panel dimensions: 96 mm×48 mm

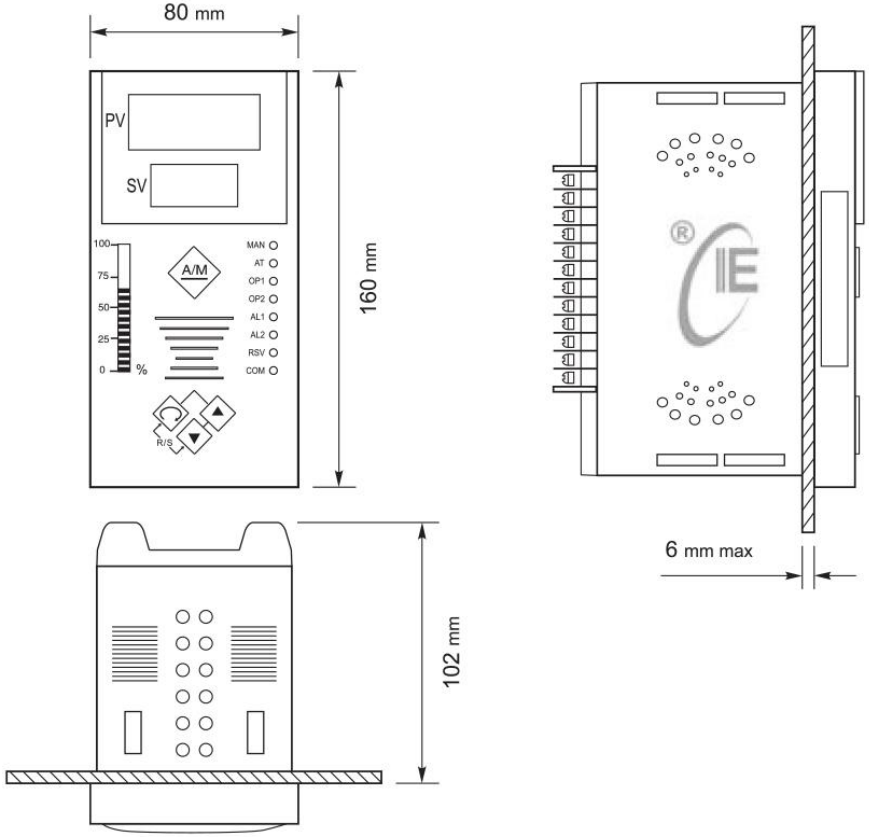
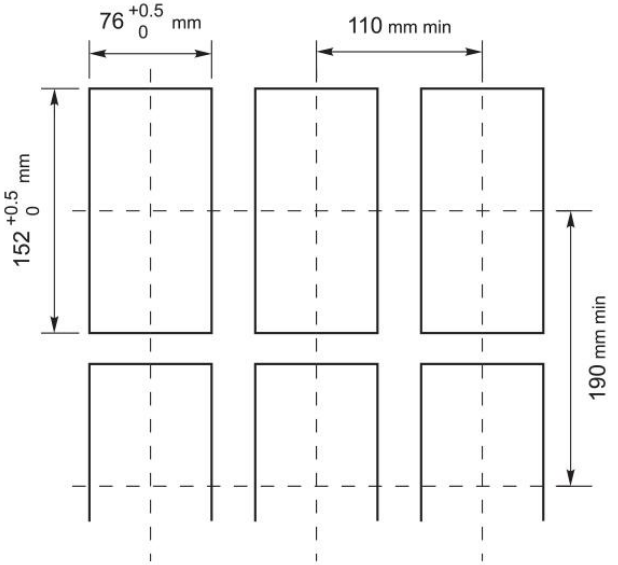
Dimensions



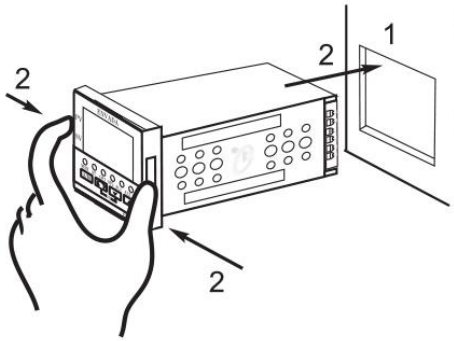
Panel cut-out



continued **2.2 Dimensions and panel cut-out**

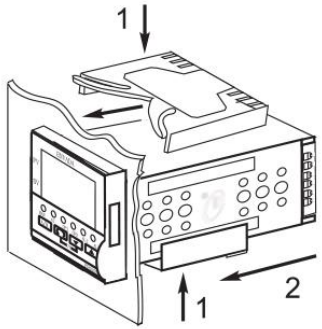
	Dimensions	Panel cut-out
Front panel dimensions: 80 mm×160 mm		

2.3 Installation procedures



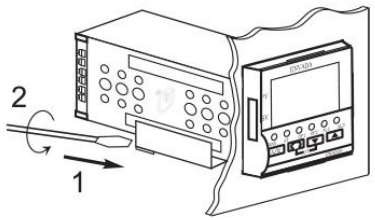
2.3.1 Insert the instrument

1 Prepare panel cut-out.
2 Push the instrument through the cut-out.



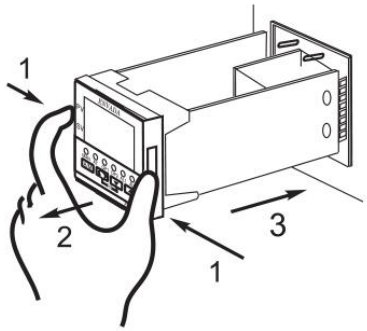
2.3.2 Installation securing

1 Fit the mouting clamps.
2 Push the mouting clamps towards the panel surface to secure the instrument.



2.3.3 Clamps removal

1 Insert a screwdriver in the clips of the clamps.
2 Rotate the screwdriver.



2.3.4 Pull out and insert the internal assembly

1 Push and
2 pull out, or
3 insert the internal assembly.

Notice: ⚠

· IP20 rear termination unit.
· Do not force the clamps when removing to protect the chassis against possible damage.

Warning: ⚠

· To prevent electric shock or malfunction, only qualified personnel should be allowed to access the internal assembly.
· To prevent electric shock or malfunction, always turn off the power supply before accessing the internal assembly.
· To prevent injury or malfunction, do not touch the internal printed circuit board.

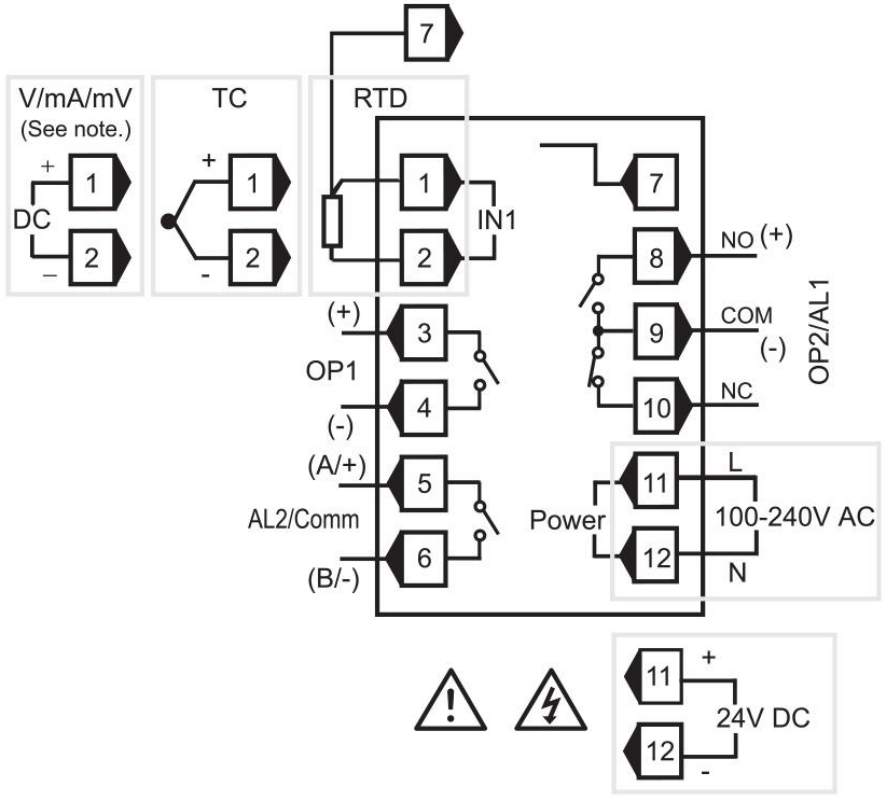
3. Wiring

3.1 Wiring cautions ⚠

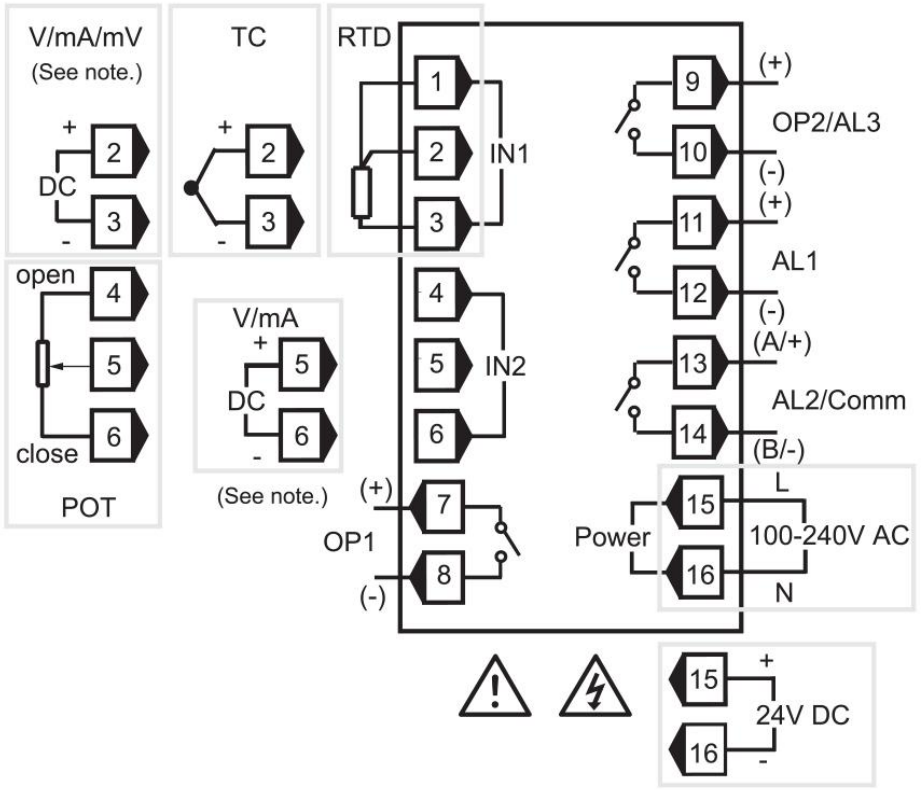
1. Wiring must only be carried out by qualified personnel.
2. Make sure that power supply is not turned on when installing the wiring.
3. Keep the input signal wires away from power supply cables and load cables to avoid noise induction.
4. The input signal wires should be shielded to protect the instrument from the influence of any external interference signal that might be detected at the input terminals.
5. For thermocouple input, use the specified compensation cable.
6. For RTD input, use leads with low resistance (<10Ω per lead). The 3 leads should be of equal resistance.
7. For wiring, use cables conforming to the local standards and regulations.
8. When tightening the terminal screws, use the solderless terminal appropriate to the screw size. (Screw size: M3×6, recommended tightening torque: 0.4N·m [4kgf·cm], recommended terminal: Φ5.5mm fork-shape)
9. Do not connect wires to unused terminals.
10. For relay contact output:
    · Appropriately adjust control cycle time and ON/OFF alarm hysteresis to avoid switching ON/OFF frequently.
    · For inductive loads, externally connect RC snubber or MOV transient/surge absorber.
    · If the signal exceeds the relay contact capacity, use an auxiliary relay to execute ON/OFF control.
11. Make sure that power supply voltage is the same as indicated on the instrument before connecting the instrument to the power supply.

3.2 Terminal configuration

For 48×48 dimensions option

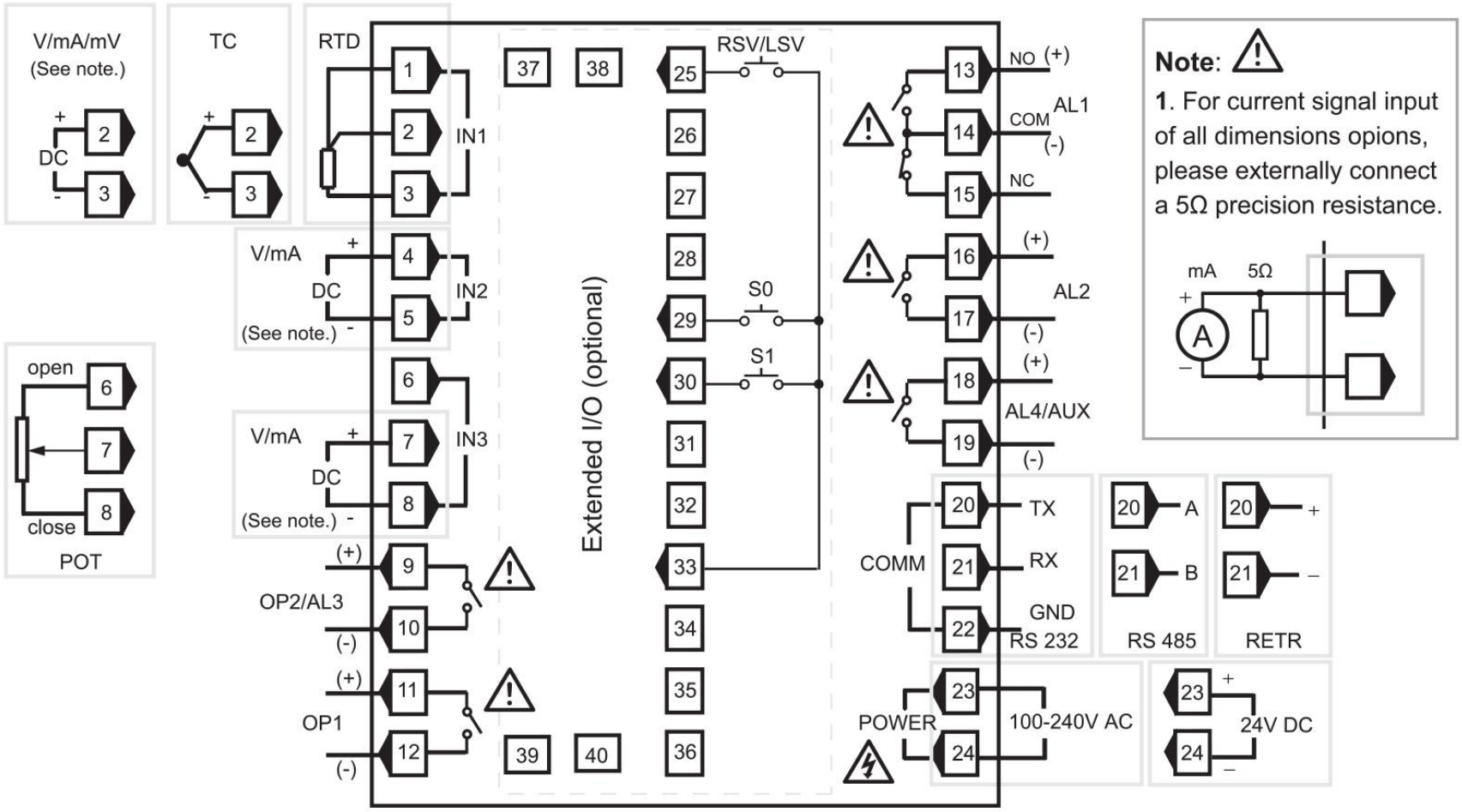


For 72×72 dimensions option



Z90D -Digital Controller (Fixed-value Control)

For 48×96, 96×48, 96×96, 80×160, 160×80 dimensions option



4. Technical specifications

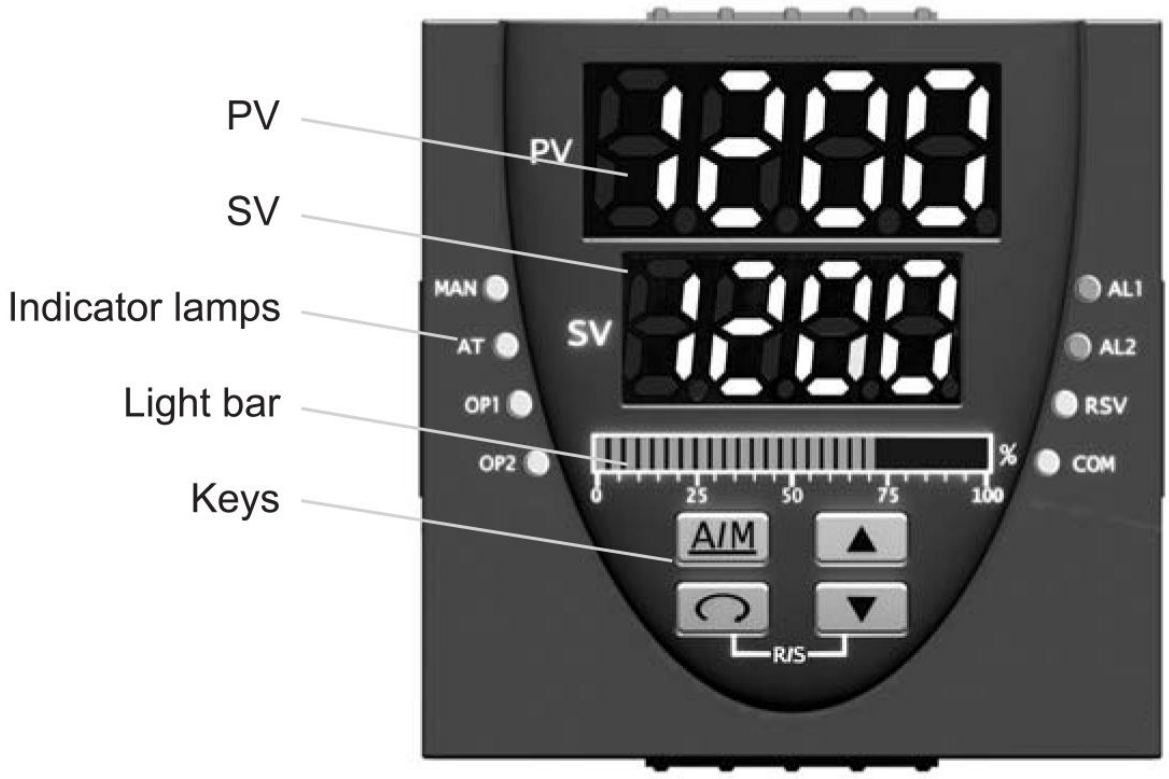
<table>
<tr><td rowspan="6">Input signals</td><td rowspan="3">· Temperature</td><td rowspan="2">Thermocouple</td><td>S,B,T,R,K,E,J,N,W</td><td colspan="2">Input drift: <0.1μV/Ω lead resistance</td></tr>
<tr><td>Sensor break protection</td><td colspan="2">Internal cold junction compensation: 0~50°C</td></tr>
<tr><td rowspan="2">RTD</td><td>Pt-100,Cu-100,Cu-50</td><td colspan="2">Max. lead resistance: 10Ω per lead</td></tr>
<tr><td>Sensor break protection</td><td colspan="2"></td></tr>
<tr><td>· Voltage</td><td colspan="3">-20~20mVDC, -100~100mVDC, 0~100mVDC, 0~500mVDC, 0~1000mVDC, 0~5VDC, 1~5VDC, 0~10VDC</td><td>Max. lead resistance: 100Ω</td></tr>
<tr><td>· Current</td><td colspan="4">0~10mA, 4~20mA, 0~20mA</td></tr>
<tr><td>· Resistance</td><td colspan="4">0.1~3.0KΩ</td></tr>
<tr><td colspan="5">· Input filter time: 0~20 sec · Input impedance for current signals: 5Ω · Input impedance for other signals: >600KΩ</td></tr>
<tr><td rowspan="2">Accuracy</td><td>· for linear input</td><td colspan="4">0.2%FS</td></tr>
<tr><td>· for temperature input</td><td>0.2% FS±2.0°C</td><td>For B type of Thermocouple, maybe more than 0.2%FS in the range of 0~400°C</td><td>Cold junction compensation accuracy: ±2°C</td></tr>
</table>

Z90D-Digital Controller (Fixed-value Control)

Control modes	· ON/OFF control · PID, P, PI, or PD control	· Control cycle time: 1~100sec · Single action, reverse action heat control or direct action cool control	· Double action,heat/cool control · Positive/negative rotation control for position-proportion type of instruments
Output signals	· Linear current	0~20mA, 4~20mA (max. load: 500Ω) 0~10mA (max. load: 1KΩ)	· Accuracy: ±0.3%FS
	· Relay	250V AC/1A or 30V DC/1A for resistive load	
	· SSR driver	Von = 13±2V DC (30mA max.) Voff ≈ 0.1V DC	
	· SCR trigger	Zero-crossing trigger or phase-shifting trigger output for 1-, 2-, or 3-phase SCR	<500A, upper power triac, or 2 inverse-parallel SCR power modules
Event input/ output	· Event input	RSV/LSV selection, A/M switching, SV selection	Passive contact, min. holding time of ON or OFF should be >200ms
	· Event output	PV alarm, A/M state	Relay contact

<table>
<tr><td colspan="2">Power output</td><td colspan="3">Isolated 24V DC/30mA power output</td></tr>
<tr><td colspan="2">Retransmission</td><td colspan="3">· PV, SV, OP1, OP2, or valve position selectable to be transmitted
· Programmable 0~10mA, 4~20mA, 0~20mA retransmission output</td></tr>
<tr><td colspan="2">Communication</td><td>· RS232 (single instrument)</td><td colspan="2">· RS485 (max.99 instruments)</td></tr>
<tr><td rowspan="3">Display</td><td>PV</td><td>4-digit red LED</td><td colspan="2" rowspan="3">· Display resolution: 0.001, 0.01, 0.1, 1
· Display cycle time: 0.5 sec
· Display range: measuring range (-10.0% +10.0%)</td></tr>
<tr><td>SV</td><td>4-digit green LED</td></tr>
<tr><td>Light Bar</td><td>20 segments of red LED</td></tr>
<tr><td rowspan="2">Protection</td><td colspan="2">· Automatic reset when operating abnormally</td><td>· Error code indication</td><td>· Multiple alarm types selectable</td></tr>
<tr><td colspan="2">· Multilevel parameter safety protection</td><td colspan="2">· Parameters are stored for a unlimited time</td></tr>
<tr><td rowspan="2">Operation conditions</td><td colspan="4">· Power supply: 100-240V AC (-15% +10%) 50/60Hz or 24V DC (-15% +25%), 6W max.</td></tr>
<tr><td colspan="2">· Temperture: 0~50°C</td><td colspan="2">· Relative humidity: 5~85%RH (non-condensing)</td></tr>
<tr><td colspan="2">Storage conditions</td><td>· Temperature: -25~70°C</td><td colspan="2">· Relative humidity: 5~95%RH (non-condensing)</td></tr>
</table>

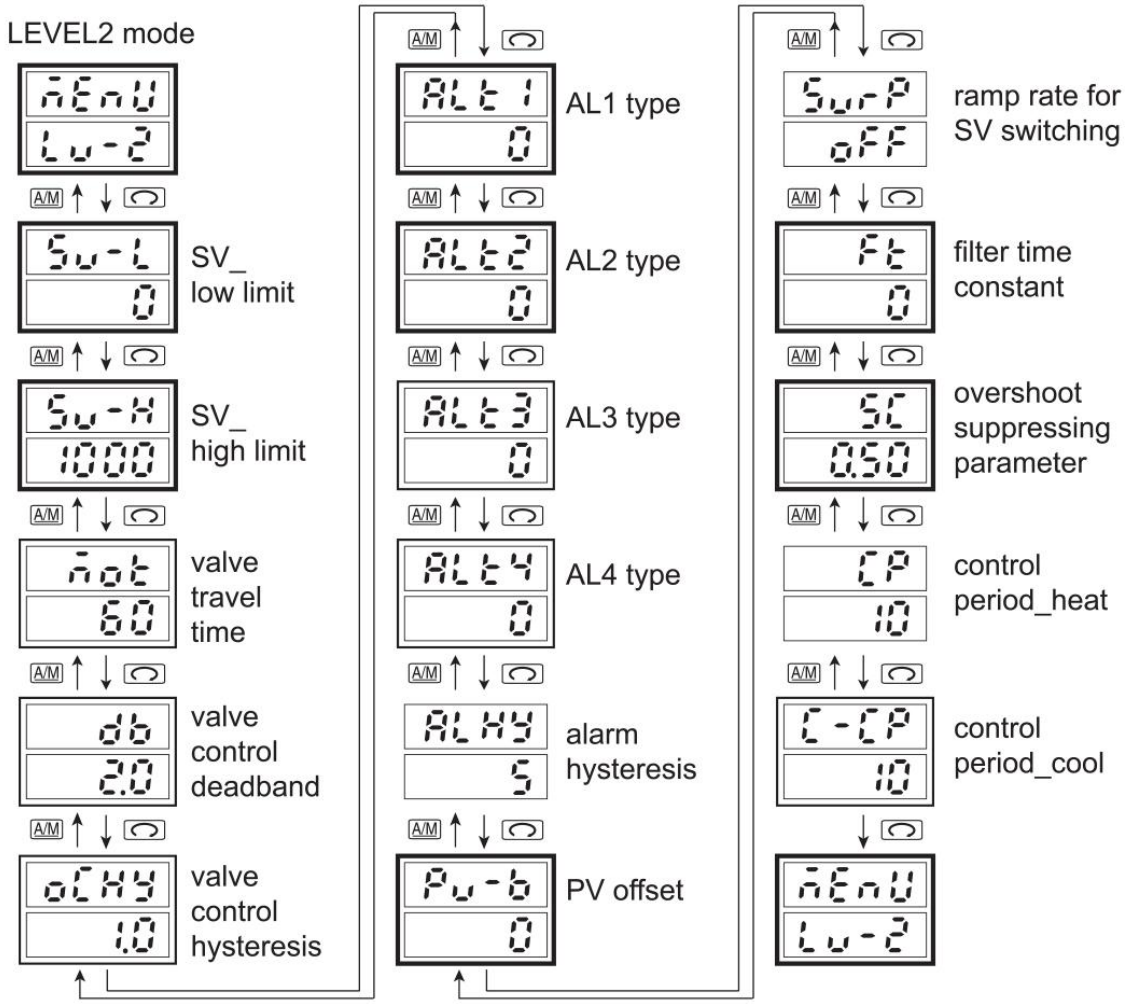
5. Name of parts

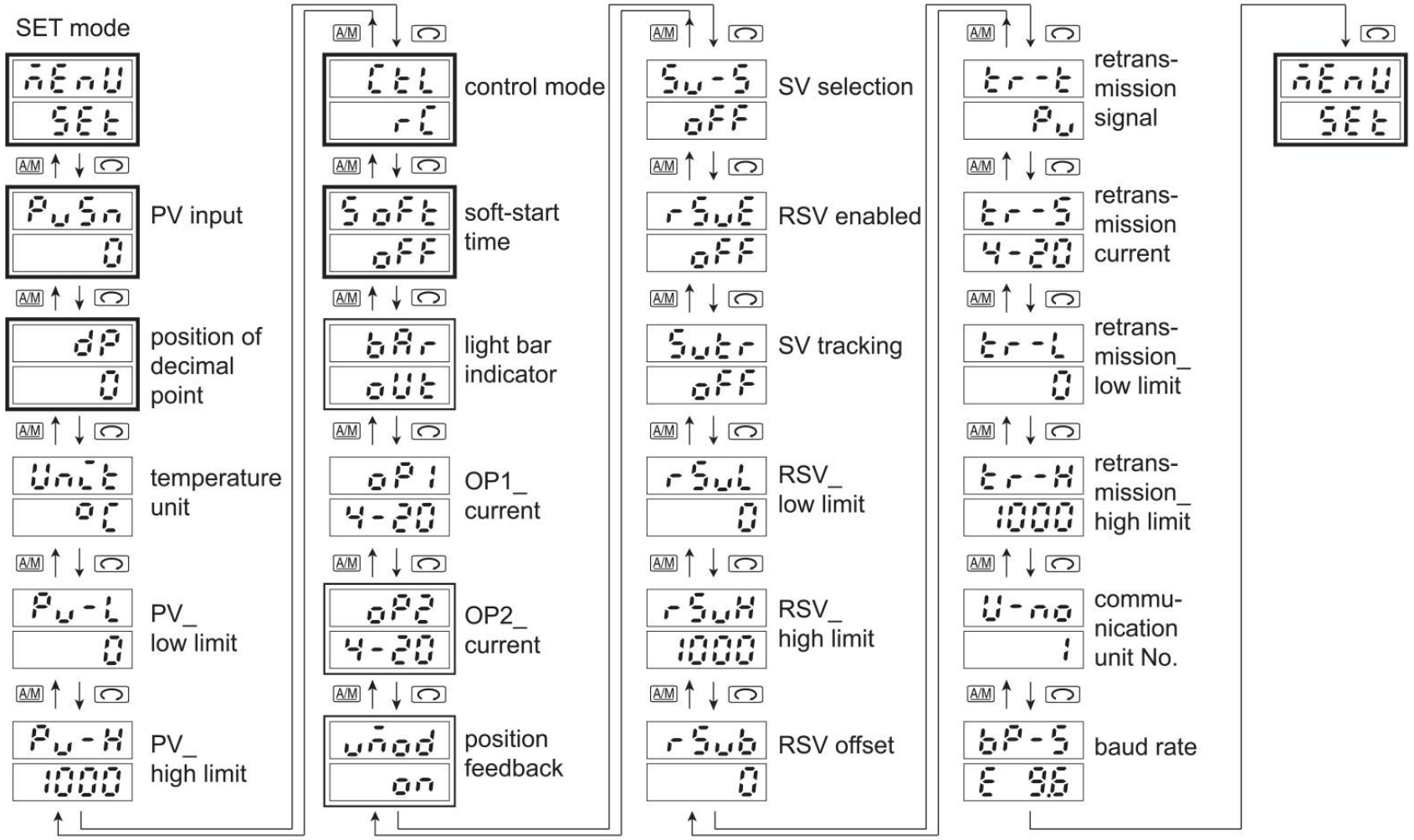


Name	Description	
1. PV	· Indicator for **PV** (**P**rocess **V**alue) measured (red). · Indicator for parameter name (in parameter setup and monitoring state).	
2. SV	· Indicator for **SV** (**S**etting **V**alue) (green). · Indicator for output percentage (in output monitoring state). · Indicator for options or parameter value (in parameter setup and monitoring state).	
3. Indicator lamps	**MAN** (orange):	In manual control mode, the lamp will flash. In auto control mode, the lamp will be off.
	AT (orange):	In **AT** (**A**uto-**T**uning) mode, the lamp will flash. When **AT** ending or disengaged, the lamp will be off.
	OP1, **OP2** (green):	· For contact output or SSR driver, when ouput is ON, the lamp will be on. When output is OFF, the lamp will be off. · For current, voltage, or phase-shifting trigger output, the lamp is always on.
	AL1, **AL2** (red):	When an alarm occurs, the lamp will be on.
	RSV (green):	In remote setting state, the lamp is on. In local setting state, the lamp is off.
	COM (green):	When communicating with the master computer, the lamp will flash.

4. Light bar	Percentage value indicator for measured value, output value, or valve position	
5. Keys	A/M Auto/Manual Key	· In **LEVEL0 mode**, press A/M for 2 sec to swich Auto/Manual. · Together with ⟳, access to parameter safety protection. · In parameter setup state, press A/M to return previous display.
	⟳ Function Key	· In the initial state of **LEVEL0 mode**, press ⟳ for 2 sec to enter the mode selection menu and for another 2 sec to return. · In the mode selection menu, press ⟳ to enter the parameter setup state and press once to move the display a step forward until it returns the mode selection menu. · In the initial state of **LEVEL0 mode**, press ⟳ and A/M together and hold for 2 sec to enter the parameter safety protection mode. Use the same operation to exit from the mode.
	▲ Up Key	· In the mode selection menu, this key is used to select the mode. · In parameter setup state, it is used to increase the value.
	▼ Down Key	· In the mode selection menu, this key is used to select the mode. · In parameter setup state, it is used to decrease the value.

Z90D-Digital Controller (Fixed-value Control)




SET mode
menu
SEt
A/M
PvSn
0
PV input
dP
0
position of decimal point
Unit
°C
temperature unit
Pv-L
0
PV_ low limit
Pv-H
1000
PV_ high limit
CtL
rC
control mode
SoFt
oFF
soft-start time
bAr
out
light bar indicator
oP1
4-20
OP1_ current
oP2
4-20
OP2_ current
uMod
on
position feedback
Sv-S
oFF
SV selection
rSvE
oFF
RSV enabled
Svtr
oFF
SV tracking
rSvL
0
RSV_ low limit
rSvH
1000
RSV_ high limit
rSvb
0
RSV offset
tr-t
Pv
retrans-mission signal
tr-S
4-20
retrans-mission current
tr-L
0
retrans-mission_ low limit
tr-H
1000
retrans-mission_ high limit
U-no
1
commu-nication unit No.
bP-S
E 9.6
baud rate
menu
SEt

6.4 Parameter table

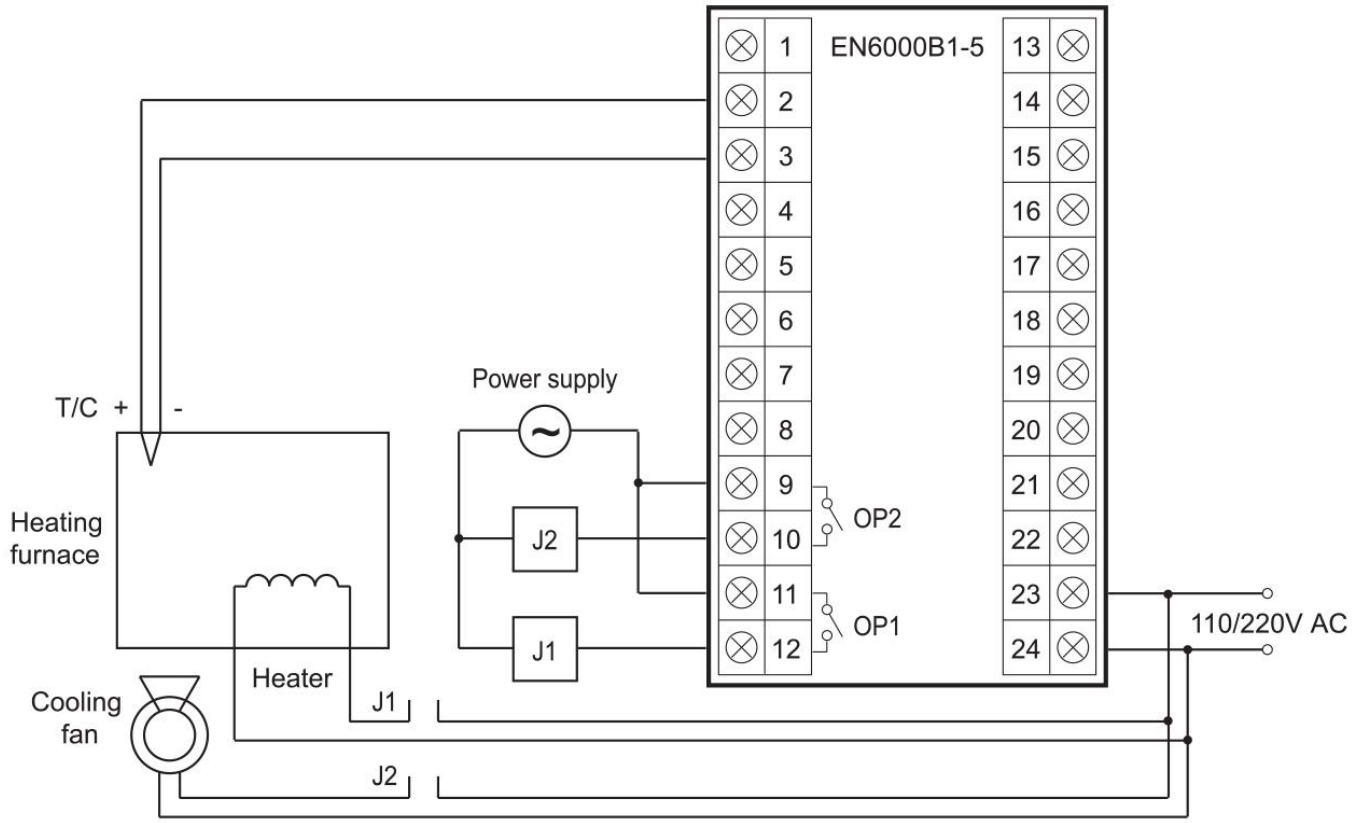
6.4.1 LEVEL0 mode

Code	Name	Descriptions	Range	Default	Units
	Initial state	Initial state of LEVEL0 mode. Monitor PV/SV, and allow to modify SV manually.	SV_L~SV_H	0	EU
	OP1	Output1. Can be modified in the manual state. For a position-proportion type instrument, monitor output1 only when it has valve postion feedback.	0.0~99.9	-	%
	OP2	Output2. Can be modified in the manual state.	0.0~99.9	-	%
AT	AT	Auto-Tuning activated or deactivated. ON: activated. OFF: deactivated.	ON/OFF	OFF	-
rSU	RSV	Remote/local setting selection. ON: remote setting (RSV). OFF: local setting (LSV).	ON/OFF	OFF	-

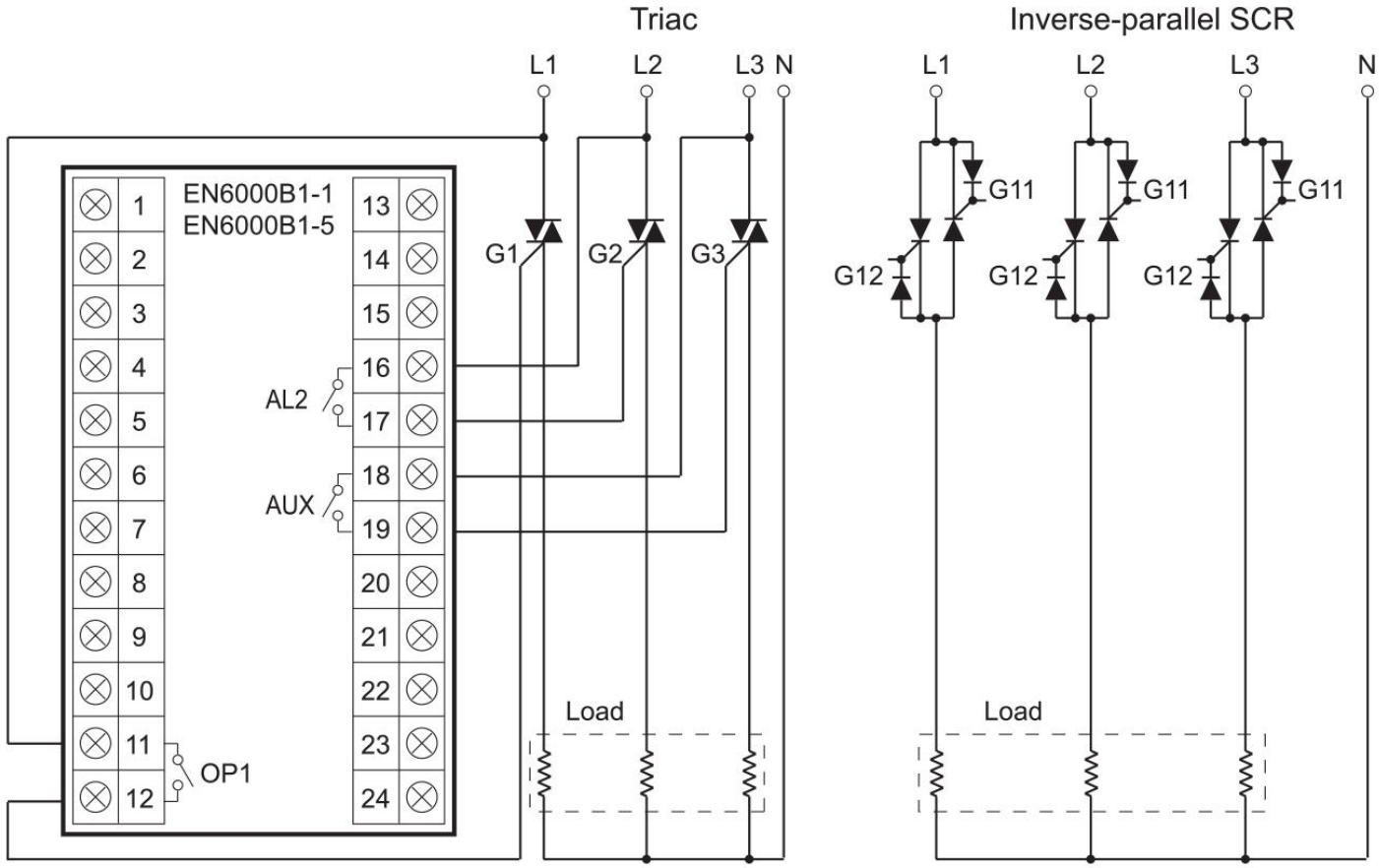
8. Examples of application

8.1 Double output temperature control system

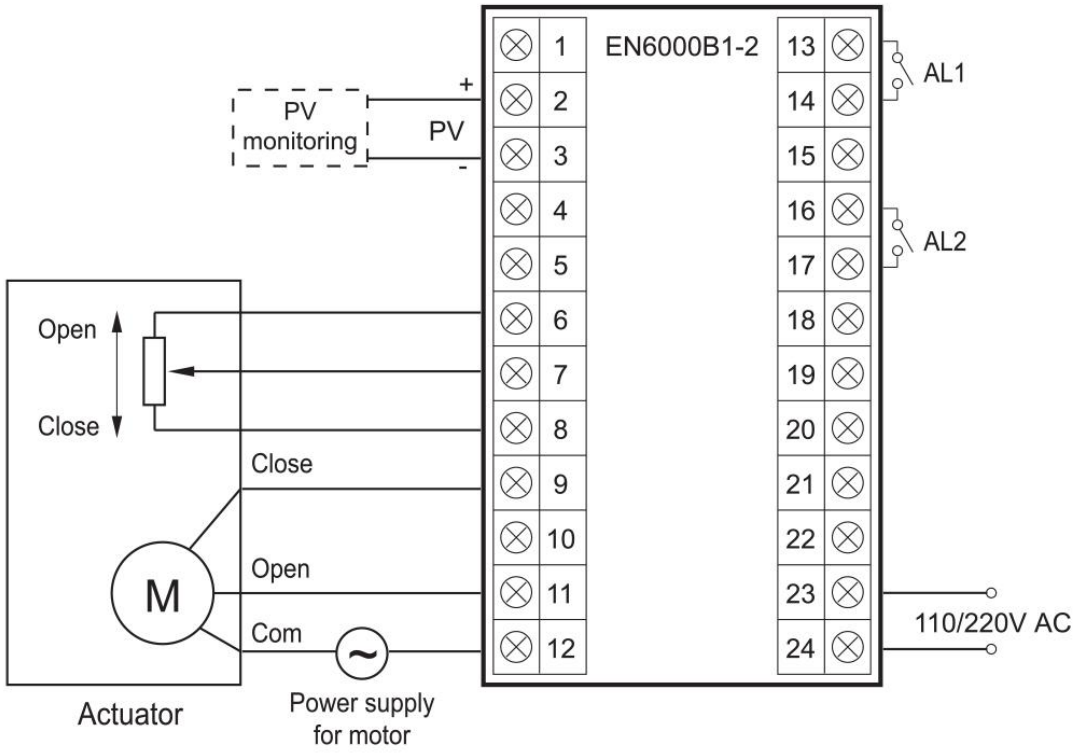
OP1 is used to control heater and OP2 is used to control cooling fan.



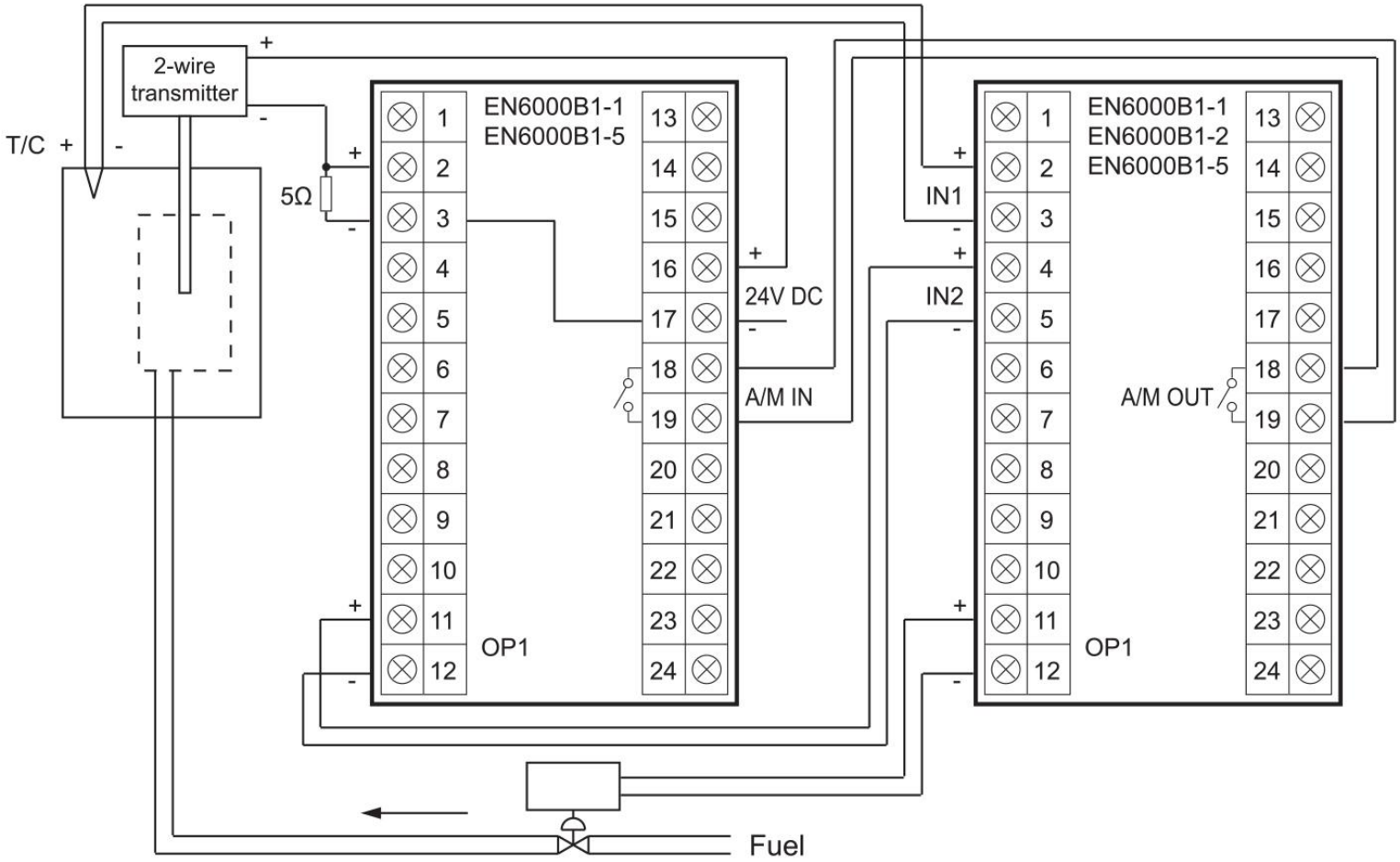
8.2 3-phase SCR zero-crossing/phase-shifting control system



8.3 Position-proportion control system

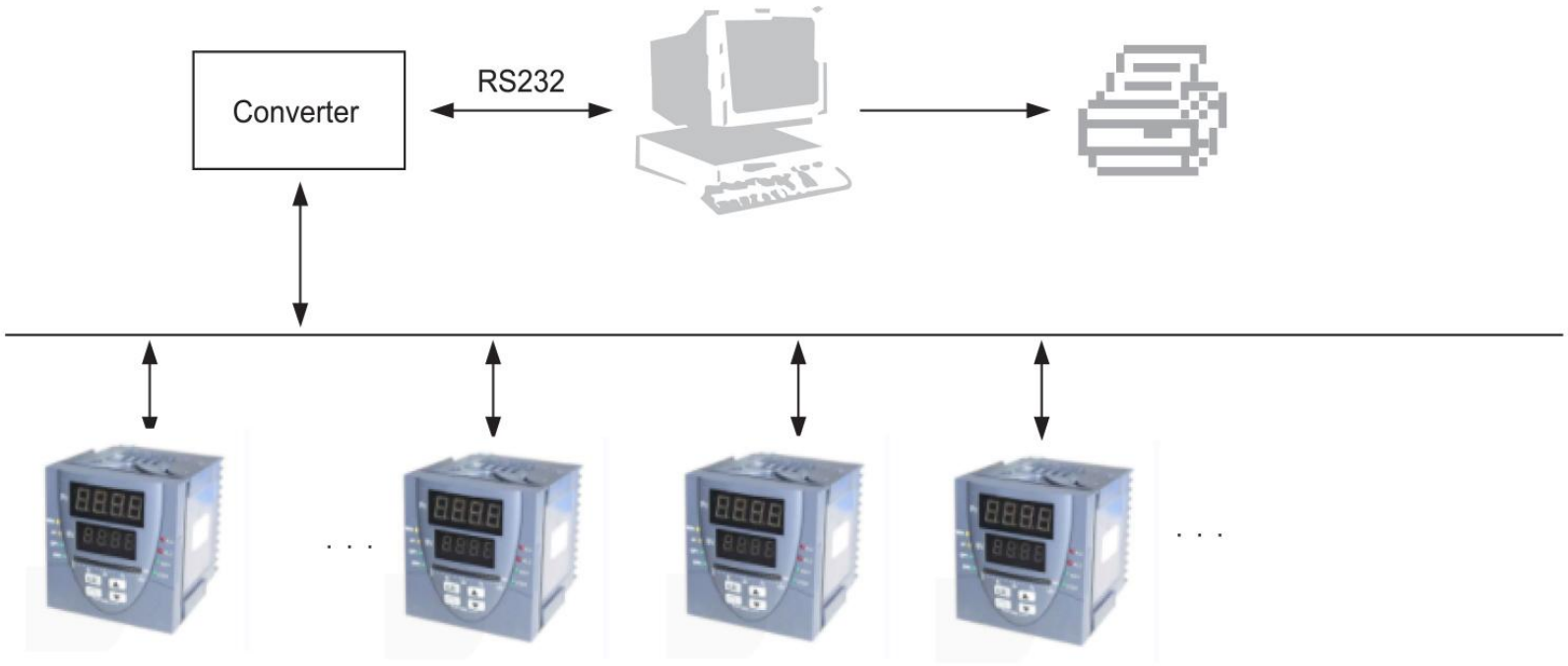


8.4 Cascade control system



8.5 Small DCS system

EN6000B1 instruments can form a small DCS (Distributed Control System), together with other ENVADA industrial instruments. The software of master computer can be ENVADA special software and other industrial configuration software as well, such as Kingview, MCGS, Fix, and Intouch.



9. Maintenance and troubleshooting

9.1 Maintenance

This instrument does not need special maintenance, if used within the specifications described in this manual.
Measurement errors will not increase even after extensive use.
The calibration parameters of this instrument have been encoded within the internal memory and it is unnecessary to recalibrate (except valve position feedback adjustment).
Appropriately adjust the relay contact output control cycle time and ON/OFF alarm hysteresis to avoid switching ON/OFF frequently. If signal exceeds the relay contact capacity, use an auxiliary relay to execute ON/OFF control.
For inductive load, externally connect a RC snubber or MOV transient/surge absorber.

9.2 General troubleshooting

Trouble	Cause	Solution
PV display is wrong	· The ordered product model is not the one the user needs. · The input signal code doesn't match actual input signal. · The wiring of the input signal is incorrect.	· Check model code. · Check input parameter setting. · Correct the wrong wiring.
No display	· Power supply has failed. · The instrument is damaged.	· Check power supply wiring. · Replace the instrument.
The keys are disabled.	· The keys are locked. · The keys are damaged.	· Unlock the keys. · Check or replace the instrument.
Error code indication		See section 9.3-**Error code.**

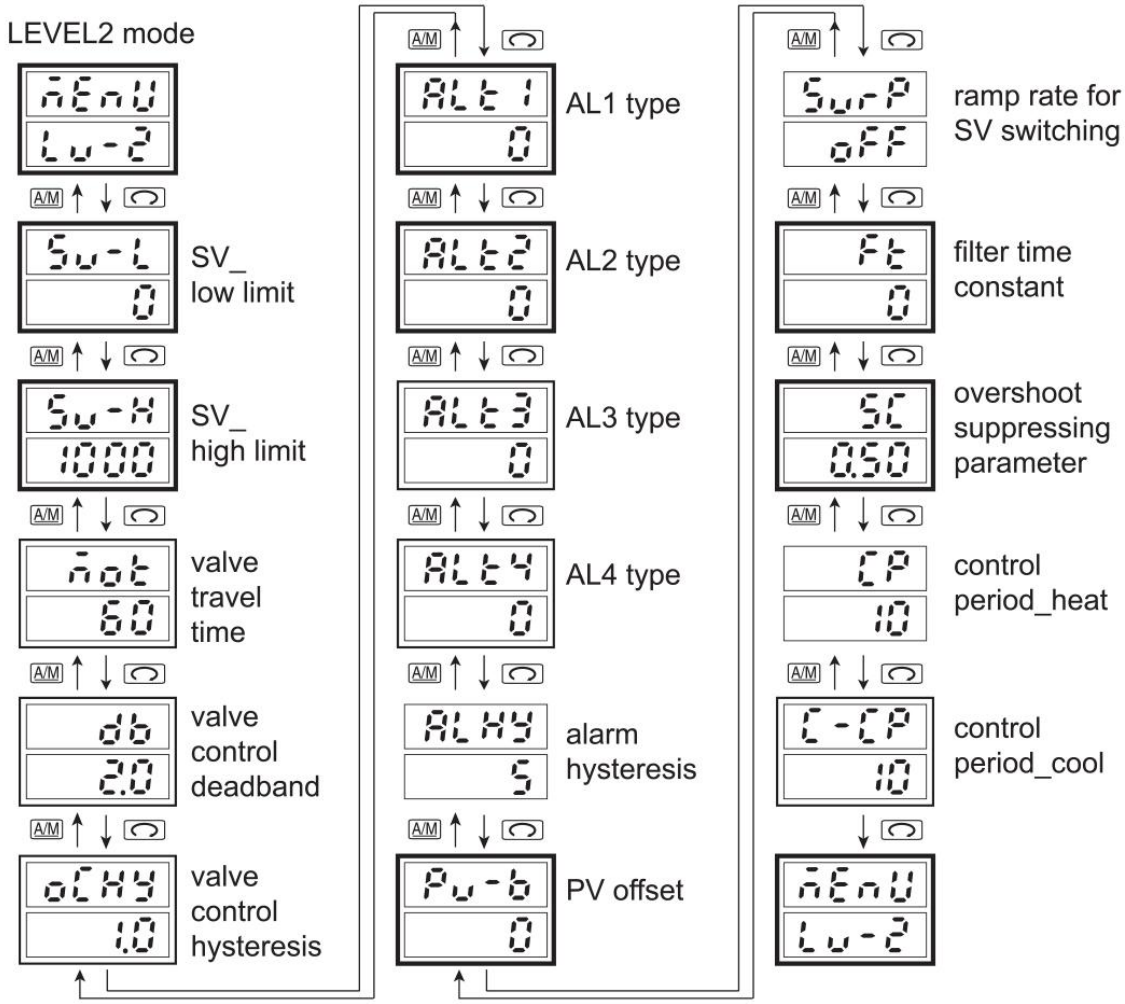
9.3 Error code

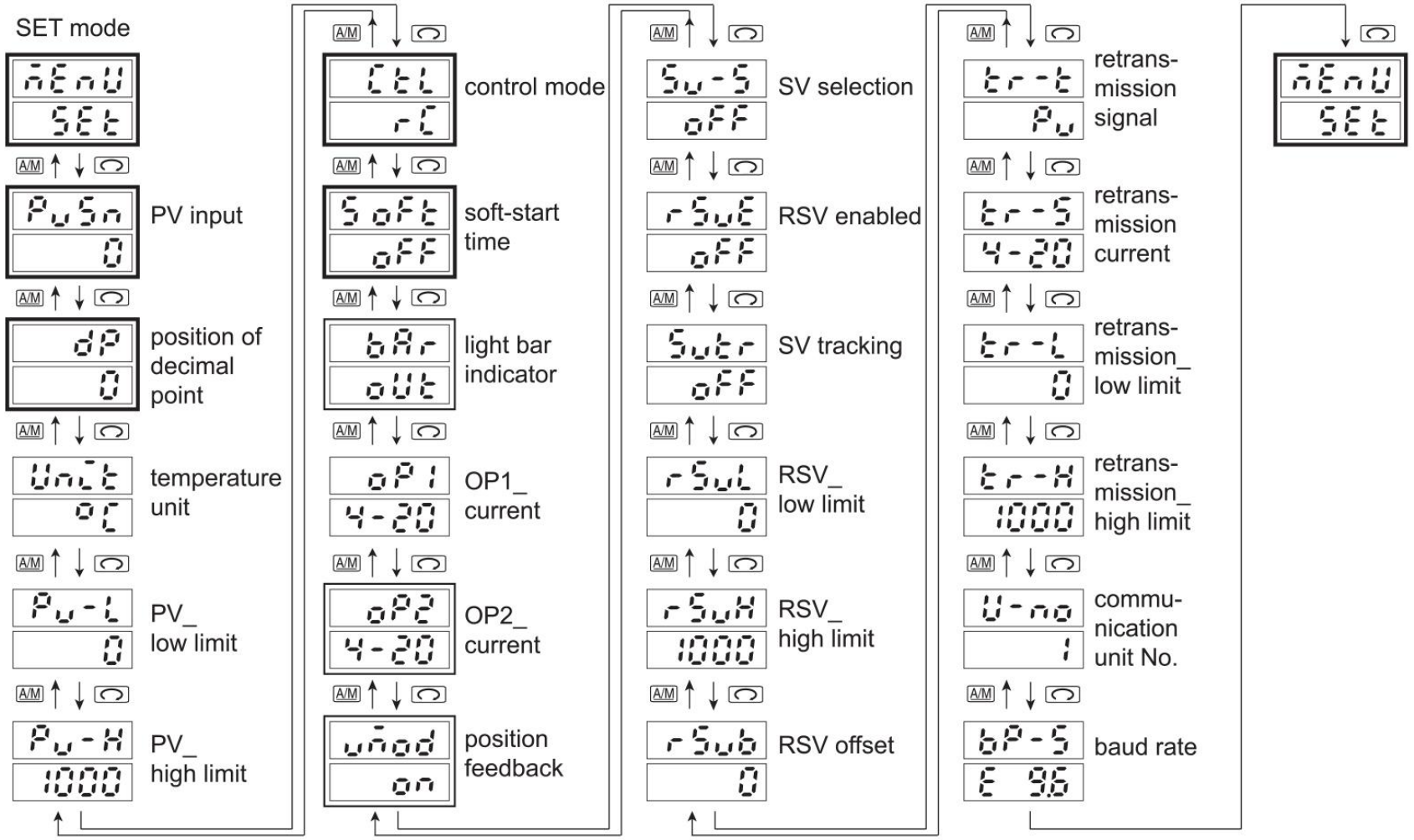
Error code	Trouble	Cause	Solution
cHHa	Over the high range	· The input signal has exceeded the input high range by 10%. · Wrong input connection.	· Check input signal and its parameter setting. · Check input connection.
cLLa	Under the low range	· The input signal is less than the input low range by 10%. · Wrong input connection.	· Check input signal and its parameter setting. · Check input connection.
oPEn	Sensor break/open	· Thermocouple input break. · RTD input break. · Wrong signal parameter setting.	· Check thermocouple connection. · Check RTD connection. · Check signal parameter setting.

9.3 Error code

Error code	Trouble	Cause	Solution
cHHa	Over the high range	· The input signal has exceeded the input high range by 10%. · Wrong input connection.	· Check input signal and its parameter setting. · Check input connection.
cLLa	Under the low range	· The input signal is less than the input low range by 10%. · Wrong input connection.	· Check input signal and its parameter setting. · Check input connection.
oPEn	Sensor break/open	· Thermocouple input break. · RTD input break. · Wrong signal parameter setting.	· Check thermocouple connection. · Check RTD connection. · Check signal parameter setting.

Z90D-Digital Controller (Fixed-value Control)




SET mode
menu
SEt
A/M
PvSn
0
PV input
dP
0
position of decimal point
Unit
°C
temperature unit
Pv-L
0
PV_ low limit
Pv-H
1000
PV_ high limit
CtL
rC
control mode
SoFt
oFF
soft-start time
bAr
out
light bar indicator
oP1
4-20
OP1_ current
oP2
4-20
OP2_ current
uMod
on
position feedback
Sv-S
oFF
SV selection
rSvE
oFF
RSV enabled
Svtr
oFF
SV tracking
rSvL
0
RSV_ low limit
rSvH
1000
RSV_ high limit
rSvb
0
RSV offset
tr-t
Pv
retrans-mission signal
tr-S
4-20
retrans-mission current
tr-L
0
retrans-mission_ low limit
tr-H
1000
retrans-mission_ high limit
U-no
1
commu-nication unit No.
bP-S
E 9.6
baud rate
menu
SEt

6.4 Parameter table

6.4.1 LEVEL0 mode

Code	Name	Descriptions	Range	Default	Units
	Initial state	Initial state of LEVEL0 mode. Monitor PV/SV, and allow to modify SV manually.	SV_L~SV_H	0	EU
	OP1	Output1. Can be modified in the manual state. For a position-proportion type instrument, monitor output1 only when it has valve postion feedback.	0.0~99.9	-	%
	OP2	Output2. Can be modified in the manual state.	0.0~99.9	-	%
AT	AT	Auto-Tuning activated or deactivated. ON: activated. OFF: deactivated.	ON/OFF	OFF	-
rSU	RSV	Remote/local setting selection. ON: remote setting (RSV). OFF: local setting (LSV).	ON/OFF	OFF	-

continued **6.4.1 LEVEL0 mode**

Code	Name	Descriptions	Range	Default	Units
uAL	potentiometer	Feedback potentiometer resistance for position-proportion control (VAL).	0.1~3.0	1.0	KΩ
u--L	valve position adjustment _low	Press ▼ to close valve to minimum.	-	-	-
u--H	valve position adjustment _high	Press ▲ to open valve to maximum.	-	-	-

6.4.2 LEVEL1 mode

Code	Name	Descriptions	Range	Default	Units
P	proportional band	Used in PID control mode. It is the proportional band of heat control when it is used in PID heat/cool control. OFF: setting to ON/OFF control. (for phase-shifting control and positive/ negative rotation control, no OFF option)	OFF, 0.1~999.9	10.0	%FS
I	integral time	Integral parameter, used to eliminate deviation in the proportional control.	OFF, 1~3600	120	sec
d	derivative time	Derivative parameter, used to suppress overshoot and improve control stability.	OFF, 1~900	30	sec
CCS	cool proportion coefficient	In heat/cool double action control, this is used to calculate the proportional band of cool control as P×CCS. When CCS=1.0, the proportional band of heat control is equal to that of cool control. When P=OFF, this option is disabled.	0.01~99.99	1.00	-

continued **6.4.2 LEVEL1 mode**

Code	Name	Descriptions	Range	Default	Units
HY	heat control hysteresis	ON/OFF control hysteresis (HY). In heat/cool double action control, it sets the heat control hysteresis .	1~999	10	EU
CHY	cool control hysteresis	ON/OFF control hysteresis (CHY). In heat/cool double action control, it sets the cool control hysteresis.	1~999	10	EU
Cdb	heat/cool control deadband	See section 7.7. In heat/cool control, it defines heat/cool control band (CDB).	-1999~9999	0	EU
o1L	OP1_low limit	The low limit of output1 (O1L).	0.0~99.9	0.0	%
o1H	OP1_high limit	The high limit of output1 (O1H).	O1L+0.1~100.0	100.0	%
o2L	OP2_low limit	The low limit of output2 (O2L).	0.0~99.9	0.0	%
o2H	OP2_high limit	The high limit of output2 (O2H).	O2L+0.1~100.0	100.0	%
AL1	AL1 threshold	Sets threshold value for alarm1.	-1999~9999	0	EU
AL2	AL2 threshold	Sets threshold value for alarm2.			
AL3	AL3 threshold	Sets threshold value for alarm3.			
AL4	AL4 threshold	Sets threshold value for alarm4.			

6.4.3 LEVEL2 mode

Code	Name	Descriptions	Range	Default	Units
SV-L	SV_low limit	Limit SV in a safe range.	PV_L~SV_H-1	0	EU
SV-H	SV_high limit	Limit SV in a safe range.	SV_L+1~PV_H	1000	EU
not	valve travel time	Continuous run time of valve movement from fully closed to fully open, only for the position-proportion type of instrument.	5~250	60	sec
db	valve control deadband	The insensitive band for valve ON/OFF switching, only for the position-proportion type of instrument.	0.1~10.0	2.0	%
oCHY	valve control hysteresis	Sets hysteresis (OCHY) to avoid frequent motor startup, for the position-proportion type of instrument.	0.1~20.0	1.0	%
ALt1	AL1 type	See section 7.6. Select alarm type for alarm1~alarm4.	0~13	0	-
ALt2	AL2 type				
ALt3	AL3 type				
ALt4	AL4 type				
ALHY	alarm hysteresis	Sets ON/OFF alarm hysteresis (ALHY).	1~999	5	EU

continued **6.4.3 LEVEL2 mode**

Code	Name	Descriptions	Range	Default	Units
Pv-b	PV offset	This offset value is used to modify the actual measured PV value. Actual PV + offset value = modified PV The initial offset value has been set to 0, but the user can adjust it.	-1999~9999	0	EU
SvrP	ramp rate for SV switching	When switching RSV/LSV, or switching between multi-SVs, setting this parameter (SVRP) can ensure smooth switching of SV and avoids large transient of SV. OFF: cancels the smoothening function.	OFF, 1~9999	OFF	/min
Ft	filter time constant	Low-pass filter time constant (FT). If the control variable is a slow-changing physical variable, such as temperature, water level, etc, the filter effect is significant. The greater the value of FT, the more significant the filter effect will be, but the slower will be the response speed of PV. Setting FT=0 cancels the filter effect.	0~20	0	sec

continued **6.4.3 LEVEL2 mode**

Code	Name	Descriptions	Range	Default	Units
SC	overshoot suppressing constant	Used to suppress overshoot and improve control stability. If SC=1.00, the suppression effect is the most significant, but the response speed is slow. If SC=OFF, the normal PID control mode is undertaken.	OFF, 0.01~1.00	0.5	-
CP	control period_heat	Defines the cycle time of output pulse, when a time-proportion output is selected.	1~100	10	sec
C-CP	control period_cool				

6.4.4 SET mode

Code	Name	Descriptions	Range	Default	Units
PvSn	PV input	Select the input signal type for PV. See section 6.5-Table for input signals.	0~27	0	-
dP	position of decimal point	For linear inputs, the parameter defines the position of decimal point (DP). For thermocouple or RTD input, DP=0 means display resolution is 1°C. DP=0.0 means display resolution is 0.1°C when sampling temperature is below 1000°C and 1°C when over 1000°C.	0 0.0 0.00 0.000	0	-
Unit	temperature unit	Sets the unit of temperature, only for temperature sensor input.	°C / °F	°C	-
Pv-L	PV_low limit	Defines the low limit of input range, when main input is linear input.	-1999~PV_H-1	0	EU
Pv-H	PV_high limit	Defines the high limit of input range, when main input is linear input.	PV_L+1~9999	1000	EU

continued **6.4.4 SET mode**

<table>
<tr><th>Code</th><th>Name</th><th>Descriptions</th><th>Range</th><th>Default</th><th>Units</th></tr>
<tr><td>CtL</td><td>control mode</td><td>Setting Direct/Reverse Control mode:
<table>
<tr><th>Output</th><th>Mode</th><th>OP1</th><th>OP2</th></tr>
<tr><td rowspan="2">Single</td><td>RC</td><td>Heat</td><td>-</td></tr>
<tr><td>DC</td><td>Cool</td><td>-</td></tr>
<tr><td rowspan="2">Double</td><td>RC</td><td>Heat</td><td>Cool</td></tr>
<tr><td>DC</td><td>Heat</td><td>Heat</td></tr>
</table></td><td>RC/DC</td><td>RC</td><td>-</td></tr>
<tr><td>SoFt</td><td>soft-start time</td><td>Soft-start time of output when power-on.
OFF: no soft-start.</td><td>OFF,
1~100</td><td>OFF</td><td>sec</td></tr>
<tr><td>bAr</td><td>light bar indicator</td><td>Sets whether the light bar indicates.
OUT: indicates the output variable
(for position-proportion type of instrument,
indicating valve position).
PV: indicates the process variable.</td><td>OUT/ PV</td><td>OUT</td><td>-</td></tr>
<tr><td>oP-1</td><td>OP1 current</td><td rowspan="2">Defines the current range of OP1 and OP2, corresponding to low limit and high limit of output1 and output2 (O1L, O1H, O2L, O2H, on page 35).</td><td rowspan="2">0~10,
4~20
0~20</td><td rowspan="2">4~20</td><td rowspan="2">mA</td></tr>
<tr><td>oP-2</td><td>OP2 current</td></tr>
</table>

Code	Name	Descriptions	Range	Default	Units
uñod	position feedback	For position-proportion type of instrument, ON: yes. OFF: no feedback.	ON,OFF	ON	-
Su-S	SV selection	ON: max.4 SVs from external input. OFF: only 1 SV, no external input SV.	ON,OFF	OFF	-
rSuE	RSV enabled	ON: RSV enabled. OFF: RSV disabled.	ON,OFF	OFF	-
Sutr	SV tracking	ON: SV tracking enabled. When switching from RSV to LSV, SV here is the RSV just before switching. OFF: SV tracking disabled. When switching from RSV to LSV, SV here is equal to the previous LSV.	ON,OFF	OFF	-
rSuL	RSV_low limit	Defines the low limit and high limit of the linear input range when RSV has been set. When the low or high limit of SV changes, that of RSVL will be forced to change.	SV_L~SV_H	0	EU
rSuH	RSV_high limit		SV_L~SV_H	1000	EU
rSub	RSV offset	This offset value is used to modify RSV. Actual RSV + offset value = modified SV The initial offset value has been set to 0, but the user can adjust it.	-1999~9999	0	EU

continued **6.4.4 SET mode**

Code	Name	Descriptions	Range	Default	Units
tr-t	retransmission signal	Select the signal to be transmitted. PV: main input PV retransmission. SV: SV retransmission. OP1: output1 (heat side) retransmission. OP2: output2 (cool side) retransmission. POST: valve position retransmission (only for position-proportion type of instrument)	PV, SV, OP1, OP2, POST	PV	-
tr-S	retransmission current	Sets the retransmission current range .	0~10, 4~20, 0~20	4~20	mA
tr-L	retransmission low range	Defines the low and high range of the signal transmitted, corresponding to the retransmission current above. For PV retransmission, if input from a temperature sensor, the retransmission range is limited within measuring range of sensor and if it is linear input, the range is PV_L~PV_H. For SV retransmission, the range is SV_L~SV_H. For OP1, OP2, POST retransmission, the range is 0~100%. In addition, if retransmission high range is set below low range, transmission will be in the reverse direction.		0	-
tr-H	retransmission high range			1000	-

Code	Name	Descriptions	Range	Default	Units
U-no	communication unit No.	Defines the communication address of this instrument in the communication network.	1~99	1	-
bP-5	baud rate	Sets the communication rate. For ENVADA protocol, E2.4 (2400bps), E4.8 (4800bps), E9.6(9600bps), E19.2 (19200bps). For MODBUS protocol, M2.4(2400bps), M4.8 (4800bps), M9.6(9600bps), M19.2 (19200bps).	E2.4,E4.8, E9.6,E19.2, M2.4,M4.8, M9.6,M19.2	E9.6	Kbps

6.5 Table for input signals

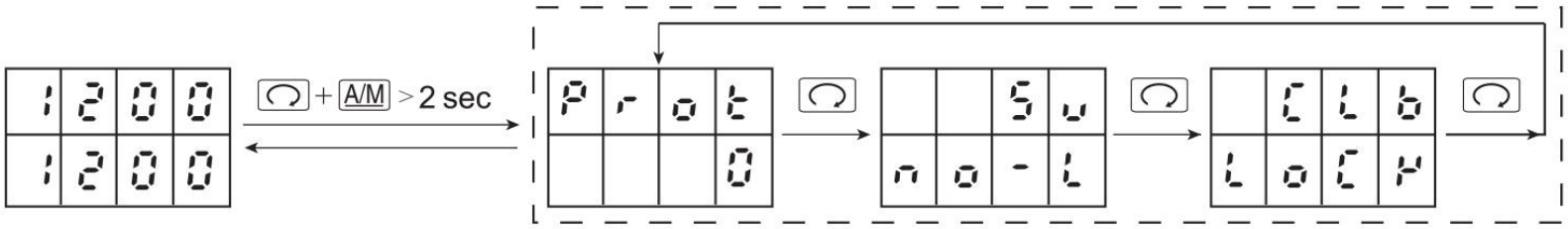
Code	Input signal type	Range	Code	Input signal type	Range
0	S	0~1700°C	**14**		
1	B	0~1800°C	**15**	0~100Ω	-1999~9999
2	R	0~1700°C	**16**	30~350Ω	-1999~9999
3	T	-199.9~400°C	**17**	-20~20mV	-1999~9999
4	K	-199.9~1300°C	**18**	-100~100mV	-1999~9999
5	E	0~900°C	**19**	0~20mA	-1999~9999
6	J	0~1200°C	**20**	0~5V	-1999~9999
7	N	0~1300°C	**21**	1~5V	-1999~9999
8	Wre5~26	0~2300°C	**22**	0~10V	-1999~9999
9			**23**	0~10mA	-1999~9999
10			**24**	4~20mA	-1999~9999
11	Pt100	-199.9~600°C	**25**	0~100mV	-1999~9999
12	Cu50	-50~150°C	**26**	0~500mV	-1999~9999
13	Cu100	-50~150°C	**27**	0~1V	-1999~9999

7. Detail of functions and operations

7.1 Parameter safety protection

7.1.1 Setting method

In the initial state of LEVEL0 mode, press ⟳ and A/M together and hold 2 sec, then enter the setup mode for parameter safety protection. Repeating the same operation will return LEVEL0 mode.



7.1.2 Setting option

1. Prot : parameter protection
   - 0 : no protection
   - 1 : parameter protection for SET mode
   - 2 : parameter protection for SET mode, LEVEL2 mode
   - 3 : parameter protection for SET mode, LEVEL2 mode, LEVEL1 mode
   - 4 : parameter protection for SET mode, LEVEL2 mode, LEVEL1 mode, LEVEL0 mode

Note: **1**. If parameter protection for LEVEL0 mode is set, A/M switching is disabled in LEVEL0 mode.

2. SV : SV protection

no-L : press [▲] or [▼] to modify SV, in the initial state of LEVEL0 mode.

LoCK : modifying SV disabled.

3. CLb : valve position adjustment protection

no-L : allow to enter valve position adjustment in LEVEL0 mode.

LoCK : not allow valve position adjustment.

4. AT : AT operation protection

no-L : AT operation enabled.

LoCK : AT operation disabled.

7.2 Setting SV

1. In the initial state of LEVEL0 mode, press [▲] or [▼] to set SV. Continued pressing of [▲] or [▼] brings a rapid increase or decrease of the value, and the numeric digit modified will have decimal point flashing. After releasing the key, the decimal point continues flashing for 0.5 sec so as to modify the numeric digit further.
2. Setting SV operation is disabled when AT function is activated or SV protection has been set.
3. After finishing setting SV, this instrument will automatically keep a memory of the setting internally.

7.3 Manual state

1. In LEVEL0 mode, press [A/M] for 2 sec to switch from auto to manual state and MAN indicator lamp flashes. Press [A/M] for 2 sec again to switch back auto state and MAN indicator lamp is off.
2. In manual state, press [▲] or [▼] to modify the output value at the parameter OP1/OP2 of LEVEL0 mode until the

measured value reashes SV.

3. In position-proporation control mode, when set in state of no feedback, there is no monitor display.

4. When output reaches 100%, the display is 99.9 flashes.

5. The instrument cannot enter manual mode when parameter protection for LEVEL0 Mode is set or the AT function is activated.

6. When switching from auto to manual output, the output value increases or decreases manually on the basis of the value used just before switching, allowing switching without disturbance. When switching from manual to auto output, switching is also without disturbance, unless the measured PV value exceeds the range of proporational band.

7. When the instrument is pawered-on again after a power-off, the control outputs retains the auto or manual state registered just before power-off.

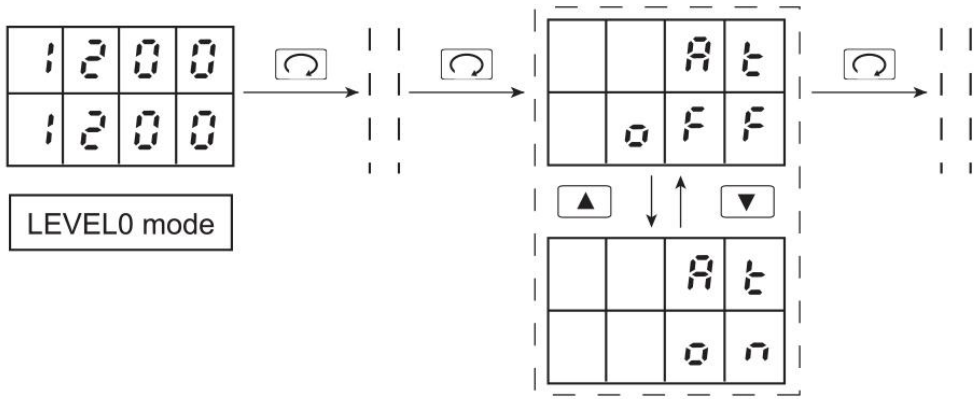
Note: In the manual state, allow time for the display screen to switch or modify the parameter value during which time the MAN indicator lamp will flash. The control output will also be in a manual state.

7.4 Auto-Tuning (AT)

The AT function adjusts and automatically determines PID parameters. The time needed by tuning process depends on the control object.

7.4.1 AT activated (see the diagram on page 48)

In the AT display screen of LEVEL0 mode, press ▲ or ▼ to switch from OFF to ON, then press ↺ to activate AT and the AT indicator lamp flashes. When executing AT, the control output of the instrument is in ON/OFF operation. Repeat the operation until tuning finishes. At that time, the AT indicator lamp will be off and the instrument will start to control the output according to new PID parameter.



7.4.2 AT disengaged

During executing AT, in the AT display screen, press ▲ or ▼ to switch from ON to OFF, then press ↻ to disengage AT. The AT indicator lamp will be off. The PID parameter retains the previous value.

7.4.3 AT is unable to be executed under following conditions.

1. The control output is in manual state.
2. The measured value PV exceeds its measurement range.
3. The proportional band parameter P is set to OFF.
4. AT operation protection has been set.

7.4.4 AT is terminated under following conditions.

1. The measured value PV exceeds its measuring range.
2. AT is terminated by keys or communication.

7.4.5 AT operation when double output.

1. RC: Both of OP1 and OP2 execute AT operation.

2. DC: AT operation is only for OP1. The output of OP2 is 0% or equal to the low limit of OP2.

7.5 PID control

7.5.1 PID parameter

1. Proportional band (P)

Proportional band is a range that is set to the percentage of the PV measurement range for control output. The value of control output increases or decreases in proportion to the difference between PV and SV. The wider proportional band is, the smaller the proportion effect on the change of output. Correspondingly, the narrower proportional band is, the greater the proportion effect on the change of output. When proportional band is too narrow, the control will close to ON/OFF control.

2. Integral time (I)

Integral is used to eliminate the deviation. The longer the integral time, the smaller the effect on elimination of the deviation. Correspondingly, the shorter the integral time, the greater the effect on elimination of the deviation. Too short an integral time could cause output oscillation.

3. Derivative time (d)

Derivative is used to predict the trend of error and set the value of control variable in advance to improve control stability. The longer the derivative time, the faster the response speed of system. Too long a derivative time could cause output oscillation.

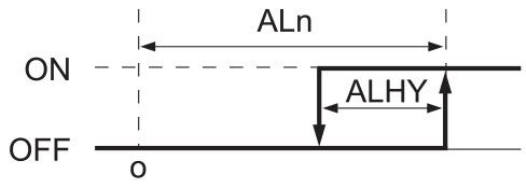
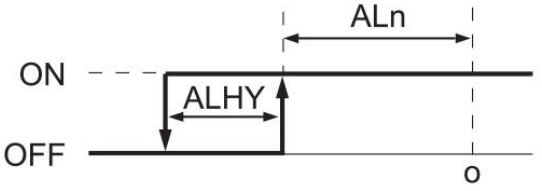
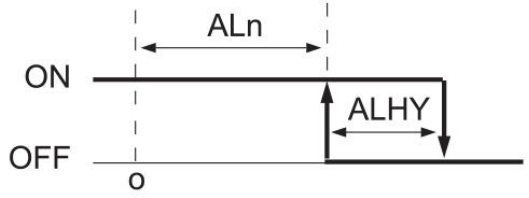
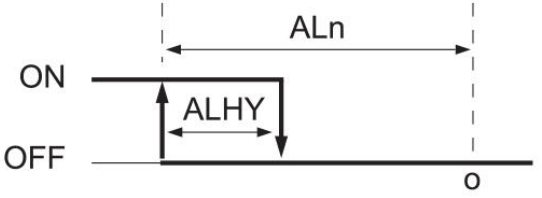
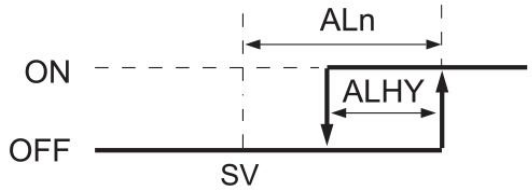
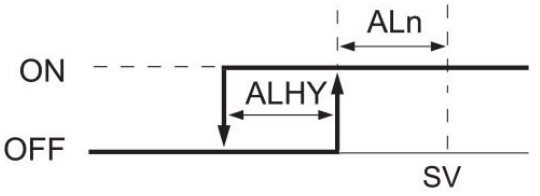
7.5.2 PID mode

1. Continued PID

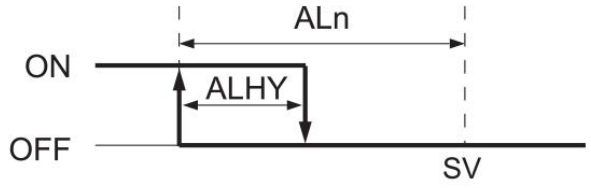
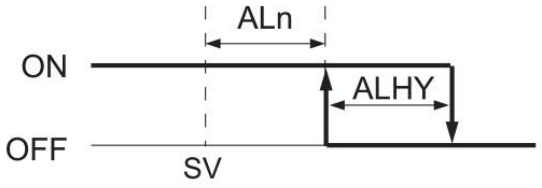
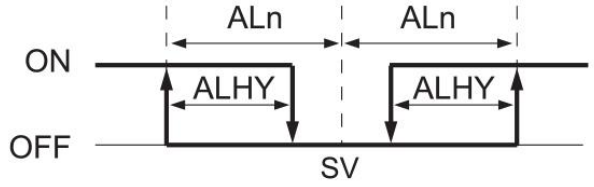
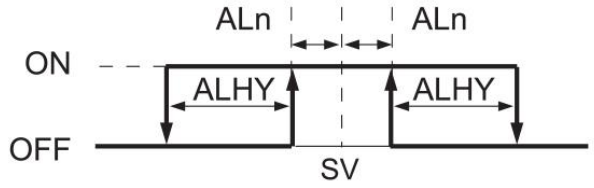
The result of PID operation is outputed in proportion to analog signals (current, voltage) or SCR conduction angle.

2. Time-proportion PID

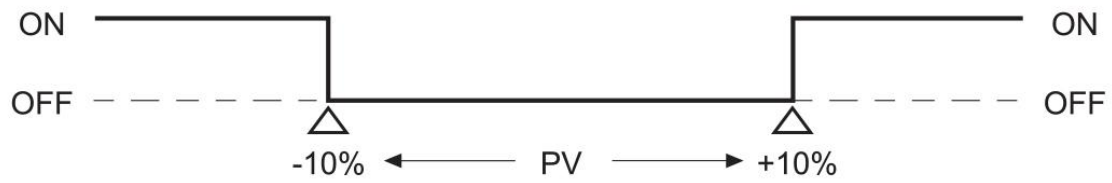
Table of alarm types

<table>
<tr><th colspan="2" rowspan="2">Alarm types</th><th colspan="2">Diagrams of alarm output</th></tr>
<tr><th>ALn>0</th><th>ALn<0</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">High limit alarm</td><td> 
</td><td> 
</td></tr>
<tr><td colspan="2">ON: at PV>ALn; OFF: at PV<ALn-ALHY</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Low limit alarm</td><td> 
</td><td> 
</td></tr>
<tr><td colspan="2">ON: at PV<ALn; OFF: at PV>ALn+ALHY</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">High deviation alarm</td><td> 
</td><td> 
</td></tr>
<tr><td colspan="2">ON: at PV-SV>ALn; OFF: at PV-SV<ALn-ALHY</td></tr>
</table>

(continued)

<table>
<tr><th colspan="2" rowspan="2">Alarm types</th><th colspan="2">Diagrams of alarm output</th></tr>
<tr><th>ALn>0</th><th>ALn<0</th></tr>
<tr><td rowspan="2">4</td><td rowspan="2">Low deviation alarm</td><td> 
</td><td> 
</td></tr>
<tr><td colspan="2">ON: at SV-PV>ALn; OFF: at SV-PV<ALn-ALHY</td></tr>
<tr><td rowspan="2">5</td><td rowspan="2">Outer deviation alarm</td><td> 
</td><td>Alarm is always ON.</td></tr>
<tr><td colspan="2">ON: at |PV-SV|>ALn; OFF: at |PV-SV|<ALn-ALHY</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Inner deviation alarm</td><td> 
</td><td>Alarm is always ON.</td></tr>
<tr><td colspan="2">ON: at |PV-SV|<ALn; OFF: at |PV-SV|>ALn+ALHY</td></tr>
</table>

(continued)

Alarm types		Diagrams of alarm output	
		ALn>0	ALn<0
7	High limit standby alarm	High limit alarm + standby function	
8	Low limit standby alarm	Low limit alarm + standby function	
9	High deviation standby alarm	High deviation alarm + standby function	
10	Low deviation standby alarm	Low deviation alarm + standby function	
11	Outer deviation standby alarm	Outer deviation alarm + standby function	
12	Inner deviation standby alarm	Inner deviation alarm + standby function	
13	Overrange alarm		
		ON: at sensor break, PV>PV_H+1PV_H-PV_L1x10%,or PV<PV_L-1PV_H-PV_L1x10%	

7.7 Output mode

7.7.1 Single output

For heat control or the control in which output decreases as positive deviation of PV and SV increases, the control mode parameter CtL should be set to RC (Reverse Control).

For cool control or the control in which output increases as positive deviation of PV and SV increases, the control mode parameter CtL should be set to DC (Direct Control).

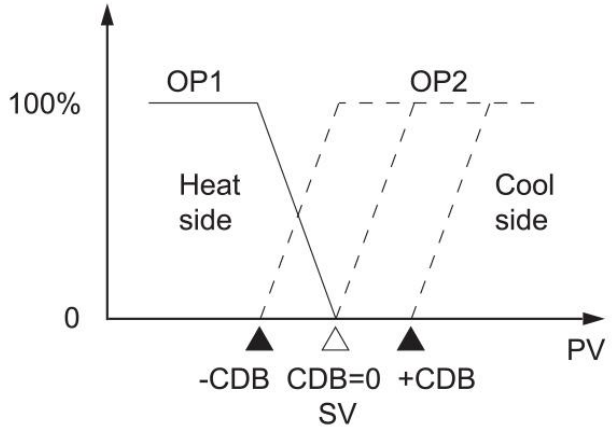
7.7.2 Double output

· When CtL is set to RC (Reverse Control), OP1 is heat control output and OP2 is cool control output.

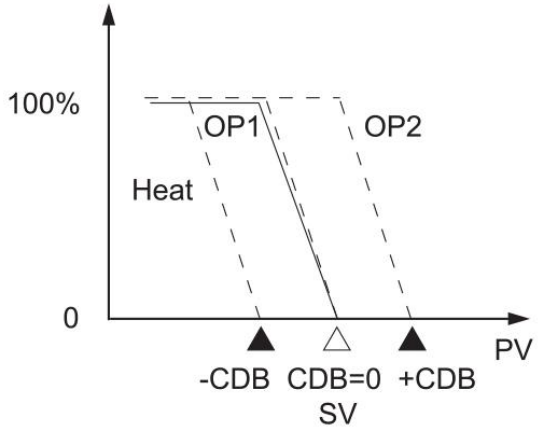
· When CtL is set to DC (Direct Control), both of OP1 and OP2 are heat control output.

7.7.3 Diagram of control output

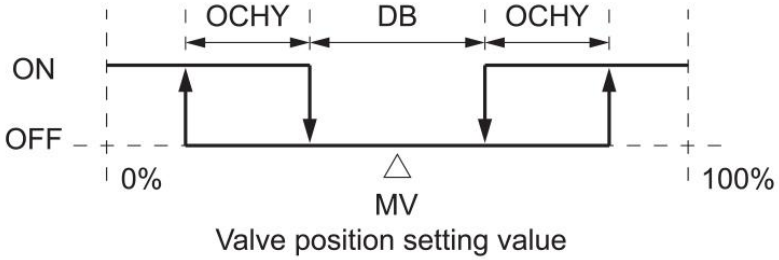
1. Heat/cool control



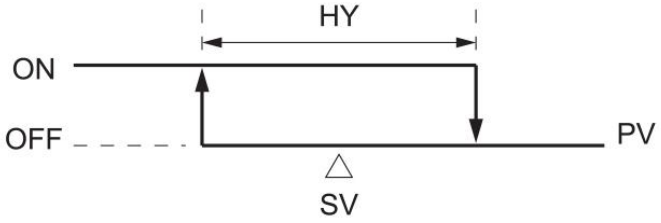
2. Double heat control



3. Position-proportion control



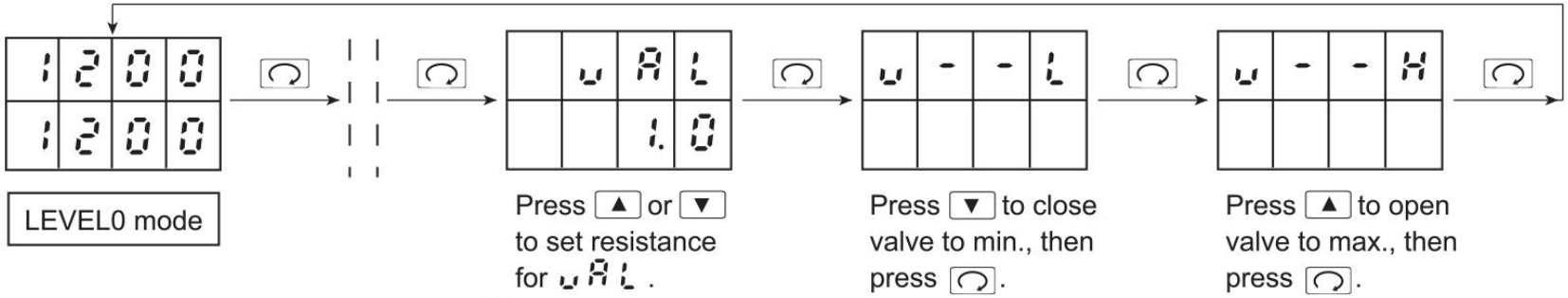
4. ON/OFF control



7.8 Valve position feedback adjustment

In the position-proportion control mode, this allow the user to execute valve postion adjustment.

7.8.1 Method of adjustment



In LEVEL0 mode, press ⟳ until uAL (feedback potentiometer) display screen appears, then press ▲ or ▼ to set uAL (resistance of feedback potentiometer).

Note: **1**. If the feedback signal is not potentiometer, but standard signal (current, voltage), then uAL display screen does not appear.

7.8.2 Valve position adjustment is disabled under following conditions.

· Valve position adjustment protection is set to LoCH. See section 7.1.2.

· The instrument has finished adjusting. The second adjustment is disabled.

7.8.3 Why the instrument cannot exit from adjustment process?

· Potentiometer resistance is not properly set. · Valve does not move.

· The connection is not made between the feedback signal and the instrument.

To solve the problem, press [⟲] for 2 sec to return the initial state of LEVEL0 mode, then eliminate malfunction and execute adjustment again.

7.9 Output reset

In auto control state, if PV exceeds measuring range because an input break, short, or improper parameter setup, the valve position output is limited to the value of parameter o1L or o2L.

For position-proportion control output, the instrument is in HOLD state when reset.

7.10 Event input/output

7.10.1 A/M input/output

The auxiliary output AUX can select either of A/M control input or A/M state output, but not both of them.

1. A/M control input

When contact is ON, the instrument switches to manual control. MAN indicator lamp flashes. It is not possible to switch A/M state by keys or communication.

When contact is OFF, the instrument switches to auto control. MAN indicator lamp is OFF.

2. A/M state output

When the instrument is in manual state, the output contact is ON. When in auto state, the output contact is OFF.

7.10.2 Selection of RSV/LSV and SV (Only in fixed-value control mode and when extended I/O is chosen)

1. RSV/LSV

When contact is ON, the instrument SV inputs from external equipment via IN2. RSV indicator lamp is ON. It is unable to switch RSV/LSV state by keys or communication.

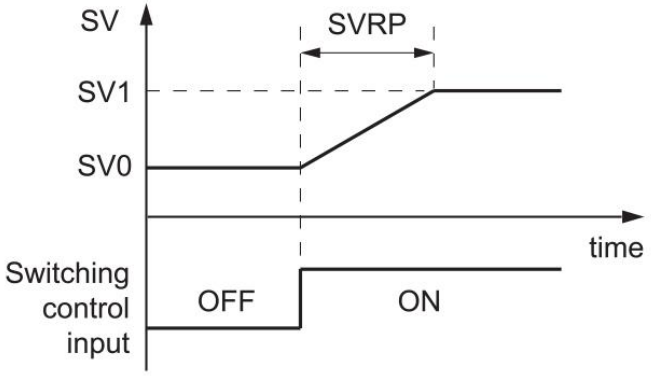
When contact is OFF, the instrument SV is internally set. RSV indicator lamp is OFF.

2. SV selection:

S1	OFF	OFF	ON	ON
S0	OFF	ON	OFF	ON
SV	SV0	SV1	SV2	SV3

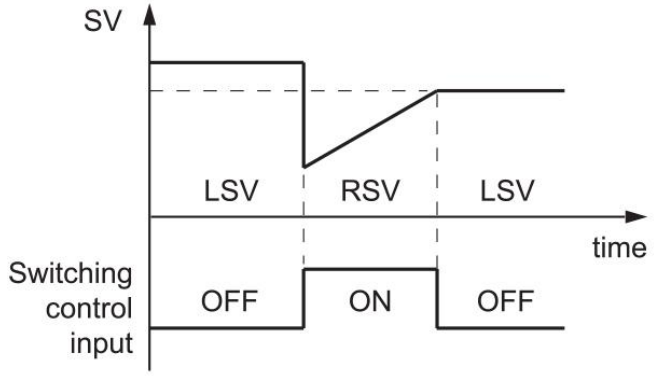
3. SV switching

When switching between multi-SVs, setting this ramp rate parameter (SVRP) avoids large transient of control process. See the following diagram.



4. SV tracking

When switching from RSV to LSV, if it has set SV tracking to ON, SV here is the RSV just before switching. See the following diagram.



7.10.3 PV events

PV events are those alarm operations relevant to PV measured value. See section 7.6.

9.3 Error code

Error code	Trouble	Cause	Solution
cHHa	Over the high range	· The input signal has exceeded the input high range by 10%. · Wrong input connection.	· Check input signal and its parameter setting. · Check input connection.
cLLa	Under the low range	· The input signal is less than the input low range by 10%. · Wrong input connection.	· Check input signal and its parameter setting. · Check input connection.
oPEn	Sensor break/open	· Thermocouple input break. · RTD input break. · Wrong signal parameter setting.	· Check thermocouple connection. · Check RTD connection. · Check signal parameter setting.