AI-519 ARTIFICIAL INTELLIGENCE INDUSTRIAL CONTROLLER

(Applicable for accurate controls of Temperature, Pressure, Flow, Level and Humidity etc.)

Operation Instruction

（ver.9.1）

Content

1. SUMMARY

1.1 Main Features

- Accurate and stable digital calibration technology for wide range of input measurements, such as the thermocouple, thermal resistance, voltage and current.
- Advanced artificial intelligent control algorithm to avoid overshoot. Auto tuning (AT) is provided
- Manual/automatic undisturbed switching and power-on soft start are available.
- The use of current output module X3/X5 with high-precision of 0.2% greatly improves accuracy of the transmission and regulation output.
- Innovative modular structure enables abundant output options to adapt different applications.Quick production lead time and convenience in maintenance are benefited.
- User-friendly operation interface. Customization on operation authorization and interface, as if it is tailor-made.
- Universal power supply 100-240VAC or 24VDC is possible. Different installation dimensions are available. And 50Hz/60Hz power frequency as well as ℃/℉ unit selection is provided.
- With "Fever" grade hardware design. Tantalum capacitors or ceramic capacitors are widely used to replace electrolytic capacitors, which provides lower power consumption, higher reliability, stability and wider temperature range than similar products; Both its power supply and I/O terminals have passed the 4KV/5KHz group pulse anti-interference test.
- With ISO9001 quality certification and CE certification, and international standards in terms of quality, anti-interference ability and safety standards.

POINTS FOR ATTENTION

- Please correctly set parameters according to input / output type and function. Only correctly wired instruments with parameters correctly set can be put into use.

1.2 Ordering Code Definition

Advanced modularized hardware design is utilized for AI series instruments. There are maximum 5 module slots: multi-function input/output (MIO), main output (OUTP), alarm (ALM), auxiliary output (AUX) and communication (COMM). The modules can be purchased together or individual, and can be assembled freely. The input type can be set to thermocouple, RTD, or linear current/voltage.

The ordering code of AI-519 series instrument is made up of 8 parts. For example:

AI – 519	A	N	X3	L3	N	S4	—	24VDC
①	②	③	④	⑤	⑥	⑦		⑧

It shows that the model of this instrument is AI-519, front panel dimension is A size(96 × 96mm), no module is installed in MIO slot, X3 linear current output module is installed in OUTP (main output), ALM (alarm) is L3 (dual relay contact output module), no module is installed in AUX (auxiliary output), S4 (RS485 communication interface module) is installed at COMM , and the power supply of the instrument is 24VDC.

The following is the meanings of the 8 parts:

①Instrument Model

AI-519 Economical artificial intelligent controller with measurement accuracy 0.25%F.S, with artificial intelligent controlling technology and with manual/automatic switching function

②Panel Dimension

	Panel Code	Dimension Width x Height (mm)	Depth behind mount (mm)	Opening Dimension Width x Height (mm)	Light Bar
Standard Depth	A	96×96	100	$92^{+0.5}\times92^{+0.5}$	---
	A2				25 segments in 4 levels of luminosity at 1% resolution
	B	160×80	100	$152^{+0.5}\times76^{+0.5}$	---
	B2				25 segments in 4 levels of luminosity at 1% resolution
	C	80×160	100	$76^{+0.5}\times152^{+0.5}$	---
	C3				50 segments in 2 levels of luminosity at 1% resolution
	E	48×96	100	$45^{+0.5}\times92^{+0.5}$	---
	E2				25 segments in 4 levels of luminosity at 1% resolution
	F	96×48	100	$92^{+0.5}\times45^{+0.5}$	---
	D	72×72	95	$68^{+0.5}\times68^{+0.5}$	---
	D2	48×48	95	$45^{+0.5}\times45^{+0.5}$	---
	D6	48×48	95	$46^{+0.5}\times46^{+0.5}$	---
Short Depth	A1	96×96	70	$92^{+0.5}\times92^{+0.5}$	---
	A21				25 segments in 4 levels of luminosity at 1% resolution
	B1	160×80	70	$152^{+0.5}\times76^{+0.5}$	---
	B21				25 segments in 4 levels of luminosity at 1% resolution
	C1	80×160	70	$76^{+0.5}\times152^{+0.5}$	---

	C31				50 segments in 2 levels of luminosity at 1% resolution
	D1	48×48	80	$45^{+0.5}\times45^{+0.5}$	---
	D61	48×48	80	$46^{+0.5}\times46^{+0.5}$	---
	E1	48×96	70	$45^{+0.5}\times92^{+0.5}$	---
	E21				25 segments in 4 levels of luminosity at 1% resolution
	F1	96×48	70	$92^{+0.5}\times45^{+0.5}$	---
Dail Mount	D5	22.5×100	112	DIN rail mount. Optional external E8 keypad is required to be plugged for parameter setting and operation.	
	D71	22.5×100	112	Power and communication wiring method are grouped in hot-plugged terminals. Others specification are the same as E7.	
	E71	22.5×100	112	DIN rail mount. Specially designed compact dual LED display with operation buttons.	
	E5	48×96	100	DIN rail mount. Optional external E8 keypad is required to be plugged for parameter setting and operation.	

③**Module available in multiple functions I/O (MIO):** N denotes that there is no module installed. Same as below.

I2 single channel switch input module, which can connect a external switch. The set value SV=SP1when the switch is open, while SV=SP2when the switch is closed.

I4 used to expand 0~20mA or 4~20mA current signal input, with built-in 24VDC power output, and enabled to be directly connected to two-wire transmitter

V24/12/V10 represents 24V, 12V and 10VDC output modules respectively, with the maximum output current of 50mA, enabled to be used by external sensors

④Module installed with the main output (OUTP), used to adjust the output or the transmitting output of SV/PV

L1: Large capacity and large volume relay normally open contact switch output module (capacity: 250VAC/2A).

L2: Small capacity small volume relay normally open+normally closed contact switch output module (capacity: 250VAC/1A, suitable for alarm).

L4: Large capacity small volume relay normally open+normally closed contact switch output module(capacity: 250VAC/2A).

K1: single channel and "burn-proof" SCR zero-crossing trigger output module, trigger 5~500A two-way or two anti-parallel one-way SCR.

K3: three-channel "burn-proof" SCR zero-crossing trigger output module, trigger 5~500A two-way or two anti-parallel one-way SCR.

K50: single channel "burn-proof" SCR phase-shift trigger output module, suitable for 200~240VAC power grid

K60: single channel "burn-proof" SCR phase-shift trigger output module, for non standard use at 380VAC

X3: Photoelectrically isolated linear current output module, support 0~20mA and 4~20mA output, with internal 12VDC power supply

X5: Photoelectrically isolated linear current output module with its own isolated power supply, support 0~20mA and 4~20mA output, no need to use internal power

W1: Contactless normally open switch output module, capacity 100~240VAC/ 0.2A, "burn-proof" technology

W2: Contactless normally closed switch output module, capacity 100~240VAC/ 0.2A, "burn-proof" technology

G: Solid state relay(SSR) voltage output module, 12VDC /30mA.

⑤Alarm (ALM) modules (for AL1 and AL2 alarm output)

L0: Large capacity and large volume relay normally open+normally closed contact switch output module (capacity: 250VAC/2A, suitable for alarm).

L0 / L2 / L4 single channel relay output module, supporting AL1 alarm output

L3: Two-way relay normally open contact switch output module, support two-way alarm AL1 and AL2

⑥AUX modules (for AU1 and AU2 alarm)

L0 / L2 / L4 single channel relay output module

L3: Two-way relay normally open contact switch output module, support two-way alarm AL1 and AL2

G: Solid-state relay(SSR) voltage output module (12VDC/30mA).

W1: Contactless normally open switch output module, capacity 100~240VAC/ 0.2A, "burn-proof" technology

W2: Contactless normally closed switch output module, capacity 100~240VAC/ 0.2A, "burn-proof" technology

R: RS232C communication interface module, with internal 12VDC power supply

⑦Communication modules (COMM)

S: RS485 communication interface module with internal 12VDC power supply .

S1: RS485 communication interface module (with internal 24Vpower supply).

S4: RS485 communication interface module with isolated DC/ DC power converter, no need to use internal power

SL: RS485 communication+single channel relay normally open contact switch module with internal 12VDC power supply.(for Dimension D6 only)

⑧Power supply: if not specified, 100~240VAC power supply is used, and 24VDC means 20-32VDC or AC power supply is used.

Note 1: The module K3 needs to use the two positions provided by OUTP and MIO. If the OUTP has already been installed with K3, the MIO cannot be used to install any module. Then if the given value switching function is required, module I2 can be installed at the COMM and set the bAud=1 to replace the MIO to achieve this function.

Note 2: V24, V10 and V12 modules usually provide power for external sensors and transmitter feedback resistors; Except that Dimension D6 cannot be installed with such modules, any other modules can be installed. However, in order to make the wiring standard, it is recommended to install the modules in the MIO, AUX and COMM positions in sequence according to whether the module positions are free.

Replacement of modules: The module can be installed before the instrument is delivered according to the requirements of the user when ordering, and the corresponding parameters can be set correctly. If the module is

damaged or the function needs to be changed, the user can replace the module. When replacing the module, it is necessary to pull out the core, carefully remove the original module, and then install a new module as indicated. If the module type is changed, it is required to reset the corresponding parameter.

Electrical isolation of modules: There are 1 group of 24V and 1 group of 12V power supply isolated from the main line inside the instrument for module use, 24V power supply is usually used for voltage output modules, such as V24/V12/V10 (24V/12V/10V voltage output), I2 (switch input) or module I4. The 12V power supply is used for output and communication modules; the relay and SCR trigger output modules usually have their own isolation or do not need to use an isolated power supply, so the isolation between the communication interface and the current output is mainly considered; S (RS485 communication interface), R (RS232 communication interface)), X3 (linear current output), the input and output terminals of them are electrically isolated from the input circuits, but these modules all need to use the 12V isolation power supply provided by the instrument. If the user installs the above two modules with isolation function at the same time, the two modules cannot be electrically isolated from each other because they share the power supply of the isolated part. For this purpose, new modules such as S4 (RS485 communication interface) and X5 (linear current output) are designed. These modules have their own high-efficiency DC/DC power isolation converters and do not need to use the internal isolation power. For example: if X3 module is installed at the main output (OUTP) position, S or X3 module is installed on the communication interface (COMM),then the X3 and S or X3 modules cannot be isolated, and the S4 or X5 module should be installed.

SCR non-contact switch module: W1/W2 is a new type of non-contact switch module designed with advanced "burn-proof" technology and zero-crossing conduction. It can replace the relay contact switch output to control the AC contactor actuator or electric servo motor. Compared with the relay contact output module, it has longer life and can greatly reduce the risk of interference spark. This improves the stability of the system. Since the driving component is SCR, thus it is suitable to control the 100-240VAC but noDC. Since the output terminal is connected in series with protection components, the maximum continuous current for control is 0.2A with instantaneous current allowed up to 2A. This driving power can directly control AC contactor of 220AC with current below 80A, but for load larger than 80A, an intermediate relay is needed.

Relay switch module: There are four types of modules available: L1, L2, L3 and L4, which are the only modules with life time limit and size limit. For general regulation output, it is recommended to use large volume modules L1 and L4 with large current capacity. Because L4 uses imported relays, although it is small in size and large in capacity, its price is high. Though module L2 is small in size and without size limitation and both of its normal open and normal close terminals have varistor spark absorption, yet its capacity is small too, therefore, it is suitable for alarm output. L1 and L3 are modules with large size and large capacity. But in the Dimension D2 and D6, they can be installed on either the main or the side board. Otherwise the modules will collide to one another. If either main or side board is installed with L1 or L3, another board cannot have L1 or L3 installed at the same time. Module L3 provides dual relay outputs. It can be used to support two loops of alarm, for example, AL1+AL2. If mechanical switch is not preferred, G5 (dual SSR voltage output) with external solid-state relay (SSR) can be used to drive the load instead.

Calibration and maintenance: This instrument is a maintenance-free instrument with automatic zero adjustment and digital calibration technology. If the measurement verification is out of range, the problem can be solved by cleaning and drying the inside of the instrument. In case the accuracy cannot be recovered due to drying and cleaning, please send the instrument back to the factory as a faulty instrument for maintenance.

Instrument maintenance: free maintenance service shall be provided during the warranty period. Any instrument that needs to be repaired must be clear about the fault phenomenon and causes to ensure correct and comprehensive repair.

1.3 Technical Specification

- **Input Specification:** (One instrument is compatible to the following)

  Thermocouple: K, S, R, E, J, T, B, N, WRe3-WRe25, WRe5-WRe26, etc

  Resistance temperature detector: Cu50, Pt100

  Linear voltage: 0~5V, 1~5V, 0~100mV, 0~20mV etc.

  Linear current (module I4 installed in the position of MIO): 0~20mA, 4~20mA or two-wire transmitter, etc.

Extended specification: Apart from the above-mentioned Input specification, an additional type can be provided upon request. (Graduation index may be required to provide by customer)

- **Input range:**
  K(-50~1300℃), S(-50~1700℃), R(-50~1700℃), T(-200~+350℃)
  E(0~800℃), J(0~1000℃), B(200~1800℃), N(0~1300℃)
  Cu50(-50~+150℃), Pt100(-200~+600℃), Ni120 (-50~+270℃)
  Linear Input: -9990~+32000 defined by user
- **Measurement accuracy:** 0.25%FS ± 0.1℃
- **Resolution:** 0.1 ℃ for K, E, J, N, Cu50, Pt100, 1 ℃ for S, R
- **Temperature drift:** ≤ 0.015% FS/℃ (typical value is about 70ppm/℃)
- **Sampling period:** The A/D converter samples 8 times per second; When the digital filtering parameter FILt=1 is set, the response time is ≤ 1s
- **Alarm function:** 4 types of alarm, high limit, low limit, deviation high limit and deviation low limit with alarm blocking at the beginning of power on.
- **Regulation mode:**
  On-off control mode (dead band adjustable)
AI-PID with fuzzy logic PID regulating and auto tuning with advance artificial intelligence algorithm.
- **Control period :** 0.5~120.0 seconds selectable, and it should be integer times of 0.5 second.
- **Output specification (Modularized)**
  Relay output (NO+NC, module L1 or L4): 250VAC/2A or 30VDC/2A
  TRIAC no contact discrete output (NO or NC): 100~240VAC/0.2A (continuous), 2A (20mS instantaneous, repeat period≥5s)

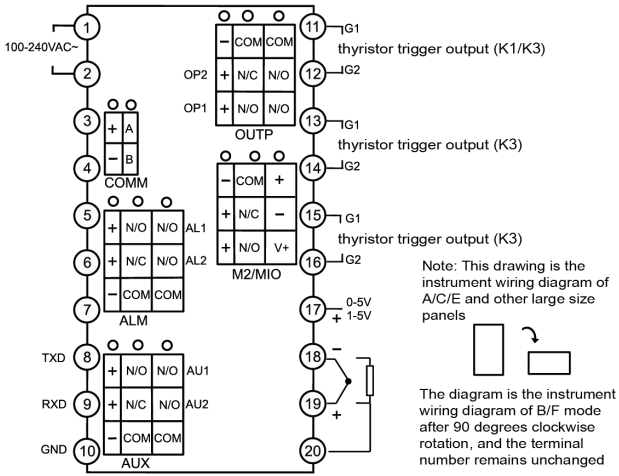
SSR Voltage output: 12VDC/30mA (To drive solid-sate relay SSR).
Thyristor trigger output: To trigger TRIAC of 5~500A, a pair of inverse paralleled SCRs or SCR power module.
Linear current output: 0~20mA or 4~20mA customized, output voltage≥11V, maximum load resistance 500 Ω; output accuracy 0.2% FS

- **Electromagnetic compatibility (EMC):** ±4KV/5KHz according to IEC61000-4-4 (Electrical Fast Transient); 4KV according to IEC61000-4-5 (Electrical Surge).
- **Isolation withstanding voltage:** Among power, relay contact or signal terminals ≥2300VDC. Among isolated electroweak terminals ≥600V
- **Power supply:** 100~240VAC, -15%, +10% / 50~60Hz; 120-240VDC; or 24VDC/AC, -15%, +10%
- **Power consumption:** ≤6W
- **Operating ambient:** Temperature -10~60℃; Humidity ≤90%RH
- **Front panel dimension:** 96×96mm, 160×80mm, 80×160mm, 48×96mm, 96×48mm, 48×48mm, 72×72mm
- **Depth behind mounting surface:** ≤100mm

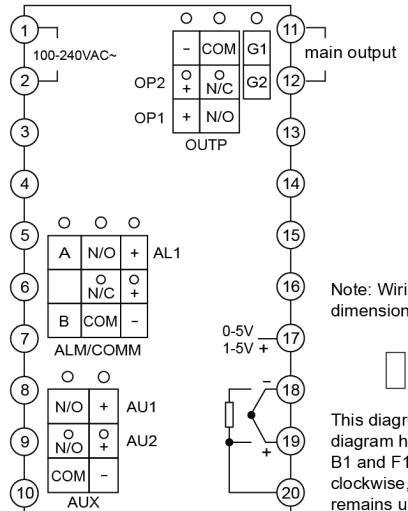
1.4 Wiring Diagram

Wiring diagram of rear terminals

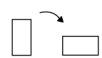
Note 1: For linear voltage input, if the range is below 100mV, connect to terminals 19 and 18. 0~5V or 1~5V signal can be inputted from terminals 17 and 18.
Note 2: 4~20mA linear current signal can change to 1-5V voltage signal by connecting a 250 ohm resistor, and then be inputted from terminals 17 and 18. If I4 module is installed in MIO slot, 4-20mA signal can be inputted from terminals 14+ and 15-, and 2-wire transmitter can be inputted from terminals 16+ and 14-.
Note 3: The compensation wires for different kinds of thermocouple are different, and should be directly connect to the terminals when the internal auto compensation mode is used, connecting the common wire between the compensation wire and the terminals will cause measurement error.
Note 4: When main output selected as linear current or SSR voltage, output form terminal 13+, 11-,
Note 5: When single relay module L1/L0 is installed, OP1, AL1 and AU1 are normally open while OP2, AL2 and AU2 are normally closed.



Wiring diagram of rear terminals of short-depth dimension



Note: Wiring diagram of vertical dimensions A1, C1 and E1



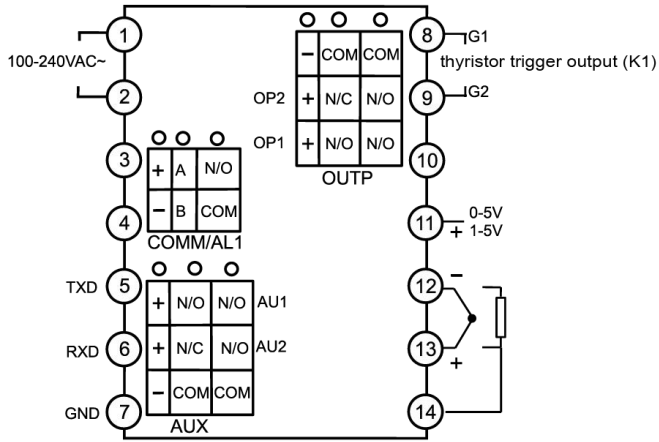
This diagram can be the wiring diagram horizontal dimensions of B1 and F1 after rotated 90 degrees clockwise, but the terminal number remains unchanged

Wiring diagram of Dimension D (72mmX72mm)

Note 1: Linear voltage signal of range below 100mV should be inputted from terminals 13 and 12, and signal of 0~5V and 1~5V should be inputted from terminals 11 and 12.

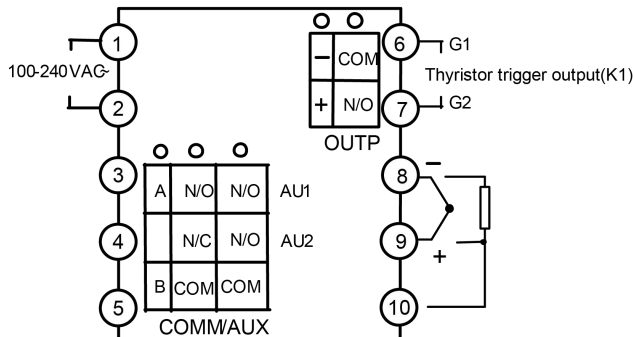
Note 2: 4~20mA linear current signal can be converted to 1~5V voltage signal by connecting a 250 ohm resistor and inputted from terminals 11 and 12.

Note 3: S or S4 module can be installed in COMM slot for communication. If relay, TRIAC no contact switch, or SSR drive voltage output module is installed in COMM, it can be used as alarm output. If I2 module is installed in COMM and parameter “bAud” is set to 1, SV1 and SV2 can be switching by connecting a switch between terminals 3 and 4.



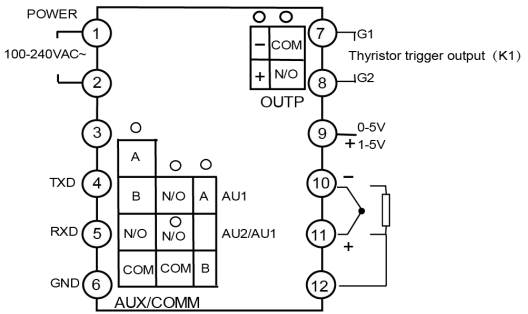
Wiring diagram of dimension D1/ D2 (48x48mm)

Note 1: Dimension D1/ D2 instruments do not support 0~5V nor 1~5V linear voltage input. Instead, 0~5V or 1~5V signal can be converted to 0~100mV or 20~100mV respectively by voltage divider while 4~20mA can be converted to 20~100mV by connecting a 25ohm resistor in parallel, then be inputted from terminals 9 and 8.



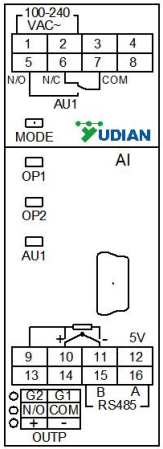
Note 2: In COMM/AUX slot, S or S4 communication module provides communication. If L2 module is installed in, it acts as alarm at AU1. If L3 dual relay module is installed with parameter bAud = 0, it acts as AU1 and AU2 alarm output. If parameter bAud = 2, it acts as alarms at AU1 and AL1. If I2 module is installed with bAud = 1, it simulates MIO slot to read on-off input to switch between SP1/SP2 at terminals 3 and 5.

Wiring diagram of dimension D6 (48×48mm)



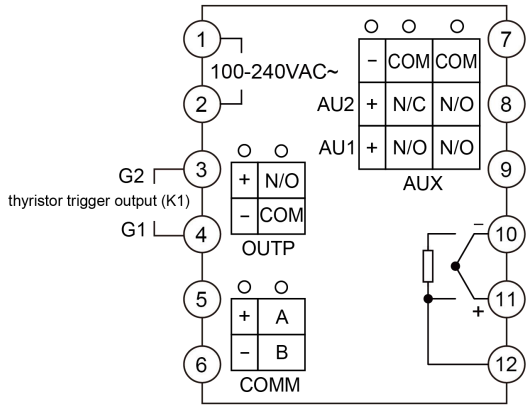
Note 1: Linear voltage signal of range below 100mV should be inputted from terminals 10 and 11, and signal of 0~5V and 1~5V should be inputted from terminals 9 and 10.
Note 2: 4~20mA linear current signal can be converted to 1~5V voltage signal by connecting a 250 ohm resistor and inputted from terminals 9 and 10.
Note 3: In COMM/AUX slot, S or S4 communication module provides RS485 communication(COMM). If L2 module is installed in, it acts as alarm at AU1. If L3 dual relay module is installed with parameter bAud = 0, it acts as AU1 and AU2 alarm output. while installing SL module provides RS485 communication and AU1 alarm output.

Wiring diagram of dimension D5



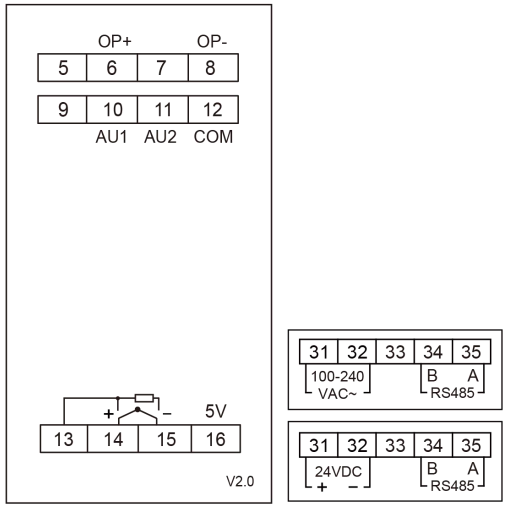
Note: Dimension D5 instruments are fixed with one loop of alarm and communication feature. Available main output module are G, X5, L2, K1, K50, K60 and W1.

Wiring diagram of dimension D61(48X48mm)



Note 1: 4~20mA linear current signal can be converted to 20~100V voltage signal by connecting a 5 ohm resistor and inputted from terminals 10 and 11.

Wiring diagram of dimension D71/E71 (22.5 x 100mm)

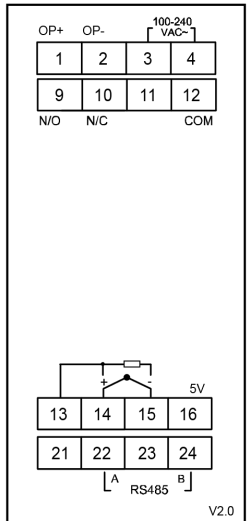


Dimension D71

Note 1:
Input 0~5V/1~5V from 15, 16+. Input 100mV or b elow from 14+, 15-. Input linear current 4~20mA (by 250 ohm resistor converting to 1~5V) from 15-, 16+.

Note 2: The main output module can be selected among G, X3, L2, K1, K50, K60 or W1.Alarm allocation setting is defined as AU1.

Note 3: If the physical wiring diagram received is different from this, please consult the Technical Department

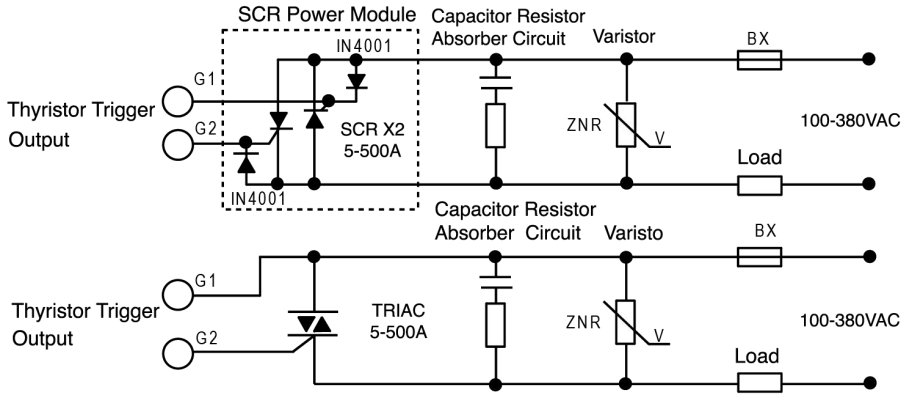


Dimension E71

Note 1:
Input 0~5V/1~5V from 15, 16+. Input 100mV or below from 14+, 15-. Input linear current 4~20mA (by 250 ohm resistor converting to 1~5V) from 15-, 16+.

Note 2:
Fixed with one channel alarm and communication. The main out put module can be selected among G, X3, L2, K1, K50,K60 or W 1. Alarm allocation setting is defined as AU1.

Wiring diagram of SCR(for modules K1, K3, K50, K60)



Note 1: According to the voltage and current of load, choose a suitable varistor to protect the thyristor. A resistor-capacitor circuit (RC circuit) is needed for inductance load or phase-shift trigger output.

Note 2: SCR power module is recommended. A power module includes two SCRs, similar to the above dashed square.

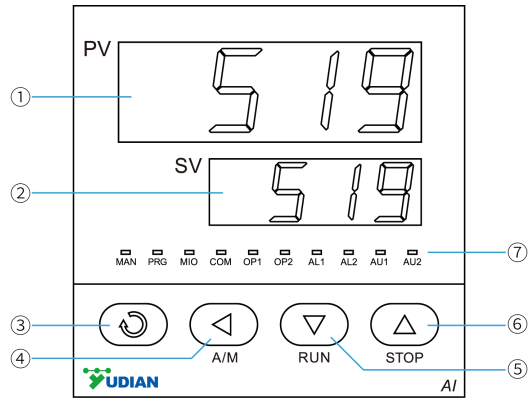
Note 3: Module K60 supports 380VAC; module K50 supports 200~240VAC and 50Hz power.

Note 4: When three-phase three-wire electric furnace is used and the service time exceeds zero trigger control, only two two-channel SCR is required to effectively control the instrument, which not only reduces the cost but also saves

about 0.2% of the power (for three-phase three-channel SCR, about 0.6% of the power consumption is on thyristor). If three-channel thyristor is used for full control without connecting to the neutral line, the instantaneous trigger will be disabled to completely cross zero, which will impact the power grid and trigger module. If the purpose that the furnace wire is not electrified when the thyristor stops triggering is expected, it is recommended to add a leakage switch. If three-channel thyristor is used to fully control, it is recommended to add a zero line to the furnace.

2. DISPLAYS AND OPERATIONS

2.1 Front Panel Description

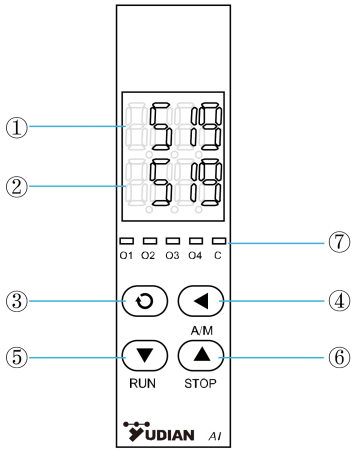


①Upper display window: Displays PV, parameter code, etc.
②Lower display window: Displays SV, parameter value, or alarm message
③Setup key: For accessing parameter table and conforming parameter modification.
④Data shift key(manual/automatic switching)
⑤Data decrease key(RUN/HOLD button)
⑥Data increase key (STOP button)
⑦ 10 LED indicators. Indicator MAN on indicates that it is in the manual output status. PRG is not applicable in this series; MIO, OP1, OP2, AL1, AL2, AU1 and AU2 correspond to module input and output respectively. Indicator COM on indicates that the instrument is communicating with upper device

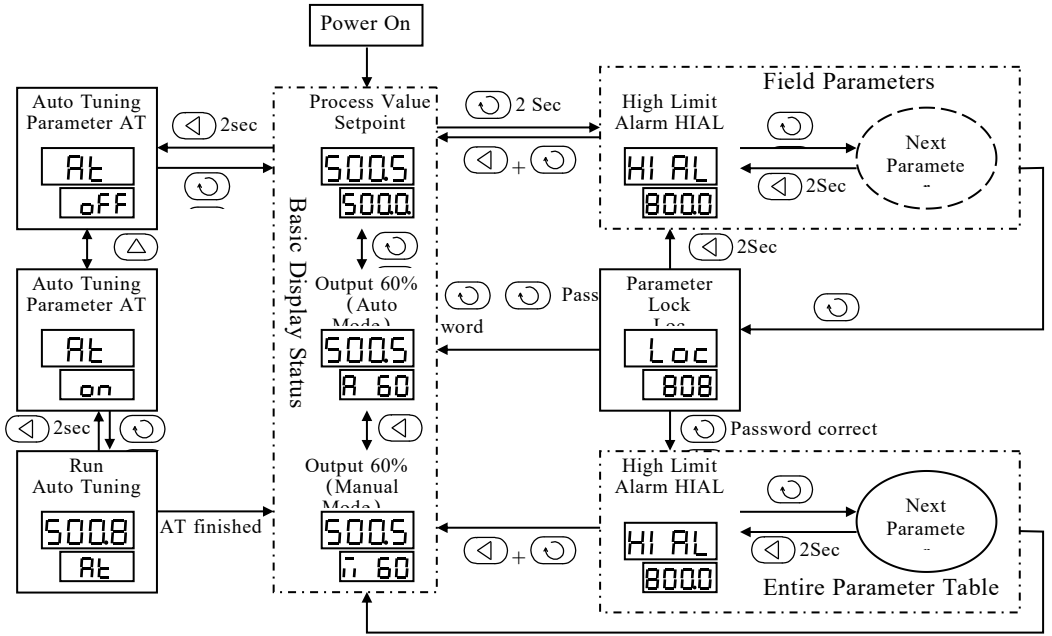
When power on, the upper display window of the instrument shows the process value (PV), and the lower window shows the set value (SV) or output value. When the input signal is out of the measurable range, the upper display window will alternately show orAL. If the lower display window alternately shows HIAL, LoAL, HdAL or LdAL, it means high limit alarm, low limit alarm, deviation high alarm, and deviation low alarm is triggered. This alarm message can be turned off (by setting parameter AdIS to oFF). If EErr is shown, there is an internal self-test error. The instrument should be repaired in the factory.

2.2 D71/E71Rail Mount Panel Description

①Upper display window, displays PV, parameter code, etc.
②Lower display window, displays SV, parameter value, or alarm code.
③Setup key, for accessing parameter table and conforming parameter modification.
④Data decrease key (RUN/HOLD button)
⑤Data increase key (STOP button)
⑥Data shift key (set point cursor)
⑦Five LED indicators. Indicators O1, O2, O3, O4 correspond to OP1, OP2, AU1, AU2 respectively, indicator C on indicates that the instrument is communicating with upper device



2.3 Parameter Setting Flow Chart



2.4 Operation Description

Parameter Setting: All functions can be achieved through parameter setting. In basic display, press ⟲ and hold for about 2 seconds to access Field Parameter Table. Press ▽ to decrease the value or △ to increase the value. The decimal dot blinks when the value is being editing (as a cursor). Press and hold the buttons will speed up the change of value and going further faster along with the right-shift of cursor. Press ◁ may directly move the cursor. Press ⟲ to proceed to the next parameter. Keep pressing ⟲ will scroll down the parameter table quickly. Press and hold ◁ will return to the preceding parameter. Press ◁ without releasing then press ⟲ simultaneously will escape from the parameter setting. The parameter which is being editing is saved automatically. The setting operation will escape to basic display if no key is pressed within 25 seconds. Any change to that idle parameter will not be saved.

Keep pressing ⟲ will show Loc parameter right after all Field Parameters. Setting Loc with correct password value will access the Full Parameter Table.

Display Mode Switching: In basic display status, press ⟲ to switch the lower display window between set value and output magnitude. If manual mode is activated, even set value display is switched, the lower display will automatically shows output value in a moment.

Set Value (SV) Setting: If the parameter lock Loc isn't locked, press ◁, ▽ or △ in the lower display window to edit the set value (SV).

Auto/ Manual Control Mode Switching (A/M): When output magnitude is displayed in lower display window, pressing AT key (◁) to switch between auto-control and manual control without bumping. If the instrument is in

manual control mode and the lower display window is displaying output magnitude, the output magnitude can be edited by pressing ▽ or △. By setting M-A parameter, the instrument can be locked at automatic mode to avoid entering manual operation by mistake.

Auto Tuning (AT): When APID control or standard PID control is chosen , the PID parameters can be obtained by running auto-tuning. In basic display status, press ◁ for 2 seconds, the At parameter will appear. Press △ to change the value of At from oFF to *on*, then press ↺ to active the auto-tuning process. During auto tuning, At will flash at lower display window and the instrument executes on-off control. After 2 cycles of on-off action, the instrument will obtain the values of PID control parameters. If it is needed to exit from auto tuning status, press and hold ◁ for about 2 seconds until the At parameter appears again. Change At from *on* to oFF, and press ↺ to confirm, then the auto tuning process will be cancelled. After satisfying PID parameters are obtained, At is recommended to be FoFF which prevents auto tuning from being activated((If auto-tuning is needed, enter the parameter table to edit the At parameter)) in basic display status by mistake.

Note 1: The artificial intelligence PID algorithm(APID) is able to avoid overshooting problem of standard PID algorithm and achieve precise control.

Note 2: If the set value is different, the parameters obtained from auto-tuning are possibly different. So it is necessary to make the set value to an often-used value or middle value first, and then start auto-tuning. For the ovens with good heat preservation, the set value can be set to the highest applicable temperature. It is forbidden to change SV during auto tuning. Depending on the system, the auto-tuning time can vary from several seconds to several hours.

Note 3: Parameter CHYS (on-off differential, control hysteresis) has influence on the accuracy of auto-tuning. Generally, the smaller the value of CHYS, the higher is the precision of auto tuning. But the value of CHYS parameter should be large enough to prevent the instrument from error action around set value due to the oscillation of input. CHYS is recommended to be 2.0.

Note 4: The control effect at the first run after auto tuning is probably not perfect, but excellent control result will be obtained after a period of time because of self-adaptation.

3.PARAMETERS AND SETTINGS

3.1 Parameter Lock (Loc) and Field Parameters

The parameters table can be customized. Those parameters required to be edited are grouped as Field Parameter. Field Parameter is a sub-table from the full parameter table. This sub-table can be defined by user. Access to full parameter table requires a password. Parameter lock (Loc) provides different operation privilege and access control to the parameter table. The explanation of Loc function was shown as below:

Loc=0, allowed to edit the field parameters and the set value in the basic display status;

Loc=1, forbidden to edit the field parameters, but allowed to directly edit the set value in the basic display status;

Loc=2~3, allowed to edit the field parameters, but forbidden to directly edit the set value in the basic display status;

Loc=4~255, forbidden to edit any parameters other than Loc, and all shortcut operations forbidden as well;

Set Loc=password (number between 256~9999, initial password is 808), and press  to enter and edit the full parameter list. Once entered, all parameters on the parameter table are authorized to be edited.

The manual/automatic function and the AT function are independently set and controlled.

There are 8 field parameters can be defined by as EP1~EP8. If the quantity of the field parameters is less than 8, the first idle EP parameter should be set to nonE. The initial values of EPs and Loc are EP1=HIAL, EP2=LoAL, EP3=HdAL, EP4=LdAL, EP5=nonE, EP6=nonE, EP7=nonE, EP8=nonE and Loc=0.

Users can redefine field parameters to change operation style. For example, shortcut is prohibited to be used to start auto-tuning, which can only be started from the field parameter table. Three field parameters, HIAL, HdAL, At, can be defined without using LoAL and LdAL alarms. The EP parameter settings are as follows:

EP1=HIAL, EP2=HdAL, EP3=At, EP4=nonE, Loc=0, At=FoFF

Note: Since V9.1, parameter Loc can be limited by setting communication. Please refer to the communication protocol for details.

3.2 Parameter Table

The parameters can be divided into 8 groups, including alarm, control, input, output, communication, system, set point and field parameter:

Parm	Meaning	Description	Rang
HIAL	High limit alarm	Alarm turns on when PV>HIAL; Alarm turns off when PV<HIAL-AHYS Note: Alarm output location can be defined by parameter AOP. All alarms can be assigned to AL1, AL2, AU1, AU2 or none. More alarm allocation is explained in AOP section below.	-9990~ +32000 unit
LoAL	Low limit alarm	Alarm turns on when PV<LoAL; Alarm turns off when PV>LoAL+AHYS	
HdAL	Deviation high alarm	Alarm turns on when PV-SV>HdAL; Alarm turns off when PV-SV<HdAL-AHYS. Set to the maximum value to disable the alarm.	
LdAL	Deviation lower alarm	Alarm turns on when PV-SV<LdAL; Alarm turns off when PV-SV>LdAL+AHYS Set to the minimum value to disable the alarm. Note: HdAL and LdAL can be assigned as absolute high limit and low limit alarms. Details please refer to the description of parameter AF.	
AHYS	Alarm hysteresis	Also known as dead band or lag. To avoid frequent alarm on-off action caused by the fluctuation of PV. Usage of AHYS is shown above.	0~2000 unit

<table>
<tr><td>AdIS</td><td>Alarm display</td><td>OFF: Alarm message is hidden in lower display.
on: Alarm message is shown alternatively in lower display. It is recommended.
FOFF: All alarm message are hidden.
Aon: orAL is hidden when the input measurement is out of range.</td><td></td></tr>
<tr><td>AOP</td><td>Alarm output allocation</td><td>
<table>
<tr><th>Alarm / Output to</th><th>LdAL (x1000)</th><th>HdAL (x100)</th><th>LoAL (x10)</th><th>HIAL (x1)</th></tr>
<tr><td>None</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td>AL1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr>
<tr><td>AL2</td><td>2</td><td>2</td><td>2</td><td>2</td></tr>
<tr><td>AU1</td><td>3</td><td>3</td><td>3</td><td>3</td></tr>
<tr><td>AU2</td><td>4</td><td>4</td><td>4</td><td>4</td></tr>
</table>
Example:
AOP = 3 3 0 1
LdAL HdAL LoAL HIAL
It shows that HdAL and LdAL are sent to AU1, LoAL has no output, HIAL is sent to AL1.
Note 1: When AUX is used as auxiliary output in bidirectional (heating/refrigerating) control, alarms assigned to AU1 and AU2 does not
</td><td>0~4444</td></tr>
</table>

		take in effect. **Note 2:** Installing L3 dual relay output module in ALM or AUX, AL2 or AU2 can be used	
nonc	NO/ NC selection	Single channel alarm relay can have normally open + normally closed output at the same time, but dual channel alarm module L3 only has normally open output. Normally open output can be defined as normally closed output through the nonc parameter. When nonc=0 is set, L3 relays installed at AL1, AL2, AU1 and AU2 are normally open. When nonc=15 is set, alarms are normally closed. When some channels are normally open and some channels are normally closed, the nonc value can be calculated according to the following formula. **nonc=Ax1+Bx2+Cx4+Dx8** In the formula, A, B, C and D respectively represent the normally open and normally closed selection of AL1, AL2, AU1 and AU2. When nonc=1, the corresponding alarm is normally closed output, and when nonc=0, the corresponding alarm is normally open output.	0~15

CtrL	Control mode	onoF: on-off control(ON-OFF), for situation not requiring high precision APId: advanced artificial intelligence PID control. (Recommended) nPId: standard PID algorithm with anti integral-saturation function (no integral when PV-SV > proportional band) POP: Direct PV retransmission, working as a temperature re-transmitter. SOP: Direct SV retransmission, working as a program generator.	
Srun	Running status	run, running status, indicator PRG turns on. Stop, stop status, the lower display flashes Stop, and the indicator PRG turns off. HoLd, keep running status. If the instrument is thermostatically controlled for unlimited time (Pno=0), this status can be defined as normal status, but it is prohibited to run or stop from the panel. If the instrument is under program control (Pno>0), the instrument will control the output, but the timing will be suspended. At the same time, the lower display will flash HoLd, so will the indicator PRG. The keys on the panel can be used to control or stop to release the running status. Note: It is impossible to enter the running status only by using the panel, and only by directly editing this parameter or programming the running program can enter this status.	

Act	Acting method	rE: Reverse acting. Increase in measured variable causes a decrease in the output, such as heating control. dr: Direct acting. Increase in measured variable causes an increase in the output, such as refrigerating control. rEbA: Reverse acting with low limit alarm and deviation low alarm blocking at the beginning of power on. drbA: Direct acting with high limit alarm and deviation high alarm blocking at the beginning of power on.	
A-M	Automatic/ Manual Control Switch	MAn: Manual Control. User manually adjusts the output (OUTP). Auto: Automatic Control. Output (OUTP) magnitude depends on the calculations on mode set by CtrL. FSv: compatible with manual/automatic function, prohibited from entering manual/automatic switching interface FAut: Fixed Automatic Control. This mode forbids front panel short-cut key switching back to manual control.	
At	Auto tuning	oFF: Auto tuning function was off. on: Active auto turning function to calculate the values, automatically return to FoFF after self tuning FoFF : Auto tuning function was off, cannot activate again by pressing key from panel	
P	Proportional band	Proportional band in PID and APID control. Instead of percentage of the measurement range, the unit is the same as PV. Generally, optimal P, I, D and CtI can obtained by auto tuning. Those values can be manually entered if they are known already.	10~9999 unit

I	Time of Integral	Used to define the integral time of PID regulation, in seconds, no integral effect when I=0	0~9999 s
d	Time of Derivative	Used to define the derivative time of PID regulation, in 0.1 second, no derivative effect when d=0	0~999.9 s
CtI	Control period	For SSR, thyristor or linear current output, it is generally 0.5~3 sec. For Relay output or in a heating/refrigerating dual output control system, generally 15~40 sec, because small value will cause the frequent on-off action of mechanical switch or frequent heating/refrigerating switch, and shorten its service life. CtI is recommended to be 1/4 – 1/10 of derivative time. (It should be integer times.) When the parameter OPt or Aut = rELy, CtI will be limited to more than 3 seconds. Auto tuning will automatically set CtI to suitable value considering both control precision and mechanical switch longevity.	0.5~120.0s
CHYS	Control Hysteresis	CHYS is used for on-off control to avoid frequent on-off action of relay. For a reverse acting (heating) system, when PV>SV, output turns off; when PV<SV-CHYS, output turns on. For a direct acting (cooling) system, when PV<SV, output turns off; when PV>SV+CHYS, output turns on.	0~2000 unit

<table>
<tr>
<td>InP</td>
<td>Input specification Code</td>
<td>
<table>
<tr><th>InP</th><th>Input spec.</th><th>InP</th><th>Input spec.</th></tr>
<tr><td>0</td><td>K</td><td>20</td><td>Cu50</td></tr>
<tr><td>1</td><td>S</td><td>21</td><td>Pt100</td></tr>
<tr><td>2</td><td>R</td><td>22</td><td>Pt100 (-80~+300.00℃)</td></tr>
<tr><td>3</td><td>T</td><td>25</td><td>0~75mV voltage input</td></tr>
<tr><td>4</td><td>E</td><td>26</td><td>0~80ohm resistor input</td></tr>
<tr><td>5</td><td>J</td><td>27</td><td>0~400ohm resistor input</td></tr>
<tr><td>6</td><td>B</td><td>28</td><td>0~20mV voltage input</td></tr>
<tr><td>7</td><td>N</td><td>29</td><td>0~100mV voltage input</td></tr>
<tr><td>8</td><td>WRe3-WRe25</td><td>30</td><td>0~60mV voltage input</td></tr>
<tr><td>9</td><td>WRe5-WRe26</td><td>31</td><td>0~1V</td></tr>
<tr><td>10</td><td>Extended input specification</td><td>32</td><td>0.2~1V</td></tr>
<tr><td>12</td><td>F2 radiation type pyromter</td><td>33</td><td>1~5V voltage input</td></tr>
<tr><td>15</td><td>4~20mA (installed I4 module in MIO)</td><td>34</td><td>0~5V voltage input</td></tr>
<tr><td>16</td><td>0~20mA (installedI4 module in MIO)</td><td>35</td><td>-20~+20mV</td></tr>
<tr><td>17</td><td>K (0~300.00℃)</td><td>36</td><td>-100~+100mV</td></tr>
<tr><td>18</td><td>J (0~300.00℃)</td><td>37</td><td>-5V~+5V</td></tr>
<tr><td>19</td><td>Ni120</td><td>39</td><td>20~100mV voltage input</td></tr>
</table>
Note : While InP=10, the non-linear table can be self-defined or input by factory under a paid service.
</td>
<td>0~106</td>
</tr>
</table>

dPt	Display Resolution	Four formats are selectable: 0, 0.0, 0.00 and 0.000. **Note 1:** For thermocouple or RTD input, only 0 or 0.0 are selectable. When format 0 is selected, the internal resolution still remains 0.1 ℃ to control calculation. When S, R and B are used, dPt is recommended to be 0; When InP=17, 18, 22, the internal resolution=0.01 ℃, formats, 0.0 or 0.00 can be selected. **Note 2:** When linear input is used, PV or other relevant parameter values are greater than 9999, it is recommended not to use format 0 but format 0.000, it's because the display format will change to 00.00 after the values are greater than 9999.	
ScL	Signal scale low limit	Define scale low limit of input. It is also the low limit of retransmission output (CtrL=POP or SOP) and light bar display.	-9999 ~+30000 unit
ScH	Signal scale high limit	Define scale high limit of input. It is also the high limit of retransmission output (CtrL=POP or SOP) and light bar display.	
Scb	Input Shift Adjustment	It is used to shift input to compensate the error caused by transducer, input signal, or auto cold junction compensation of thermocouple. PV after compensation=PV before compensation + Scb **Note**: generally set to 0; incorrect setting will cause measurement inaccurate	-1999 ~4000 unit
FILt	PV input filter	The value of FILt will determine the ability of filtering noise. When a large value is set, the measurement input is stabilized but the response speed is slow. If high interference exists, parameter FILt can be increased to gradually make momentary fluctuation of measured value less than 2 to 5 digits. When the instrument is being	0~40

		metrological verified, FILt can be set as 0 or 1 to shorten the response time.	
Fru	Selection of power frequency and temperature scale	50C: 50Hz,display ℃. ; 50F: 50Hz, display ℉ 60C: 60Hz,display ℃. ; 60F: 60Hz, display ℉. Input has max. anti-interference ability to 50Hz or 60Hz frequency when parameter set;	
OPt	Main output type	SSr: Output SSr drive voltage or thyristor zero crossing trigger signal. G, K1 or K3 module should be installed. The output power can be adjusted by the on-off time proportion. The period (CtI) is generally 0.5~4 seconds. rELy: For relay contact output or for execution system with mechanical contact switch (such as contactor or compressor). To protect the mechanical switch, the output period is limited to 3~120 seconds, and generally is 1/5 to 1/10 of derivative time. 0-20: 0~20mA linear current output. X3 or X5 module should be installed in OUTP slot. 4-20: 4~20mA linear current output. X3 or X5 module should be installed in OUTP slot. PHA1: Single-phase phase-shift output. K50/K60 phase-shift trigger output module shall be installed to realize phase-shift trigger output. PHA1 is only for 50Hz power supply.	
OPL	Output low limit	0~100%: OPL is the minimum output of OUTP in single directional control system	0~110%

OPH	Output upper limit	OPL limits the maximum of OUTP (main output) when PV<OEF. OPH should be greater than OPL.	0~110%
OPrt	Soft start time	At the beginning of power on, if PV<OEF, it takes OPrt for the output value of OUTP to rise to OPH; if PV>OEF, then the time for output value of OUTP to rise to 100% is not more than 5s. This function is only needed by special requirement. Soft start function doesn't affect the maximum output at auto tuning or manual control. If it is needed to lower the impulse current of induction load, CtI=0.5, and OPrt=5s.	0~3600s
OEF	Work range of OPH	When PV<OEF, the upper limit of OUTP is OPH; when PV>OEF, the upper limit of OUTP is 100%. If the output soft start is used at power on for a long time, the OEF should be set less than the set value SV by about ten ℃, otherwise, OPrt limiting the output may cause abnormal increase of PID regulation integral.	-9999~+30000 unit
Addr	Communication address	In the same communication line, different instrument should be set to different address. S or S4 type RS485 communication interface module is installed at the COMM position, which can enable multiple instruments to connect with the computer to read and write the measured values and parameters, and realize various operations and functions of the instrument. The computer without RS485 interface can be added with an RS232C/RS485 converter or USB/RS485 converter. Each communication slot can directly connect 1~60 instruments. After connecting the RS485 converter, up to 80 instruments can be connected. One computer can use two communication slots to connect 80 instruments respectively. If users want to develop their own configuration	0~80

		software, please ask the salesperson for the communication protocol for free. A variety of configuration software can support AI instrument communication.	
bAud	Baud rate	Defines the communication baud rate, ranging 0~28800bit/s (28.8K); When COM slot is not used for communication, COM slot can be used as other function by setting bAud: bAud=1, as an external switching input, same function as MIO slot. When the MIO slot is used, the I2 module can be installed in the COMM slot. bAud=3, COMM slot used to transmit and output the process value of 0~20mA; bAud=4, COMM slot used to transmit and output the process value of 4~20mA; bAud=8, COMM slot used to transmit and output the set value of 0~20mA; bAud=12, COMM slot used to transmit and output the set value of 4~20mA;	0~28.8K
Et	Event input type	nonE: Disable event input function ruSt: RUN/STOP switch. With MIO connected in a short moment, RUN mode is activated. Press and hold for more than 2s, the program STOP. SP1.2: During fixed point control, this switches between set point 1 and set point 2. When MIO is open, SV=SP1. When MIO is closed, SV=SP2. EMAn: External switch switches between manual and automatic function, switch on for manual output status. Erun: External switch switches RUN/STOP. When MIO is open, the instrument STOP. When MIO is closed, the instrument RUN.	

AF	Advanced function	AF is used to select advanced function. The value of AF is calculated as below: AF=Ax1+Bx2+Cx4+Dx8+Ex16+Fx32+Gx64 A=0, HdAL and LdAL work as deviation high and low limit alarms; A=1, HdAL and LdAL work as high and low limit alarms, and the instrument can have two groups of high and low limit alarms. B=0, Alarm and control hysteresis work as unilateral hysteresis; B=1, As bilateral hysteresis. C=0, The light bar indicates the output value; C=1, The light bar indicates the process value (for instruments with light bar only). D=0, Loc=808 can access the parameter table; D=1, Loc=PASd can access the parameter table. E=0, HIAL and LoAL work as high and low limit alarms respectively; E=1, HIAL and LoAL work as deviation high and low limit alarms respectively; and the instrument can have two groups of high and low limit alarms. F=0, Fine control mode, internal control resolution is 10 times of the display. When on linear input mode, maximum display value is 3200 units, F=1, Wide range display mode, when the value is required to be larger than 3200, it is recommended to choose this mode. G=0, When the thermocouple or RTD input is burnt out, PV value will increase and trigger the high limit alarm(set value of the upper limit alarm should be less than the upper limit of signal range). G=1, When the thermocouple or RTD input is burnt out, PV value will increase and NOT trigger the high limit alarm. After it was set, high limit alarm(HIAL) will have	0~255

		16s delay to trigger in normal usage. Note: For non-professional users, it is recommended to set AF=32.	
AFC	Communication mode	Used to select communication mode, its calculation method is as follow: AFC=Ax1+Dx8 A=0, standard MODBUS; A=1, AIBUS; A=2, MODBUS compatible mode; A=4, compatible with S6 module. D=0, no calibration; D=1, even calibration. Note: AFC supports 03H (read parameters and data) and 06H (write a single parameter) under MODBUS. When AFC=0 or 4, the 03H can read up to 20 words at a time; When AFC=2, 03H reads 4 words. For more details, Please refer to the communication protocol description.	0~12
PASd	Password	When PASd=0~255 or AF.D=0, set Loc=808 can enter the full parameter table. When PASd=256~9999 and AF.D=1, only Loc=PASd can access the full parameter table. Note: Please setting PASd cautiously, if the password is lost, users can't access the parameter table again.	0~9999
SPL	Low limit of SV	Minimum value allowed to be set by SP1, SP2.	-9990~ +30000 unit
SPH	Upper limit of SV	Maximum value allowed to be set by SP1, SP2.	

PonP	automatic operation after power restarts	Cont, continue to stop if it is stopped before power failure; otherwise, continue to execute at the original termination after power restarts. Stop, enter the stop status no matter what happens after power restarts. dASt, if there is no deviation alarm after power restarts, the program continues to run; If there are any deviation alarm, it will stop the program.	PonP
SP1	Set point 1	Generally, SV=SP1	SPL~SPH
SP2	Set point 2	When I2 module installed in MIO slot, an external switch can switch the SV between SP1 and SP2. When MIO is open, SV=SP1. When MIO is closed, SV=SP2.	
EP1~EP8	Field parameter definition	0~8 field parameters can be defined and edited by field operators. Other parameters can only be set by inputting 808 or the password set in PASd.	nonE and all parameter codes

Note 1: The units of measured values and parameters are 0.1 ℃ or 0.1 ℉ (depending on the setting of Fru) during temperature measurement. For example, the range of - 9990~+30000 means the setting range is - 999.0 ℃~+3000.0 ℃ or - 999.0 ℉~+3000.0 ℉. The decimal places will be automatically removed for the numbers exceeding 999.9. The decimal point position of the linear unit is used for display, and does not affect the internal calculation resolution and range.

Note 2: When the instrument is powered on, it will generate unnecessary alarms. For example, when the electric furnace temperature is controlled (heating control), its actual temperature is far lower than the given temperature. Yet if the user has already set the lower limit alarm or deviation lower limit alarm, it will generate an alarm once the

instrument is powered on. In fact, the control system may not have problems. On the contrary, in the cooling control (positive action control), power on may also cause upper limit alarm or deviation upper limit alarm. When the Act parameter is set to rEbA or drbA, the instrument will not give an alarm immediately even if it meets the alarm conditions after power on. Only after the alarm conditions are canceled and there are conditions that meet the alarm requirements again will the instrument give an alarm.

The output of OUTP terminal enables AI-519 to be used as a temperature transmitter. Its current output accuracy is 0.2% FS, and the overall retransmission accuracy is equivalent to a 0.5-grade transmitter. For example, the temperature range transmitted by K-type thermocouple is 0~400 ℃, and the output is 4~20mA. Then set the following parameters: CtrL=POP, InP=0, SCL=0.0, SCH=400.0, OPt=4-20.

3.3 Additional Explanation on Special Functions

3.3.1 User-defined Input Specifications

When the parameter InP=10 is set, input specification works as user-defined input type and editable non-linear tables. Setting method: Set Loc=3698 to enter the table setting status. Parameter A 00 defines the usage of the table: 0 for nonlinear measurement input or multi segmented linear correction, 1 for non-linear power control in high temperature furnace; available parameters are A01~A04 and d00~d59 (A02~A04 and d00~d59 have decimal places. If dPt=0.0, the values of A02~d59 should be divided by 10), respectively set as follows:

A 00=0

A 01: Input specification and display setting

A 01=Ax1+Ex16+Gx64

A refers to the range of signal.

A=0: 0~20mV (0~80 ohm); A=1: 0~60mV (0~240 ohm);

A=2: 0~100mV (0~400 ohm); A=4: 0~5V;

A=10, 0~20mA or 0~10V(I4 or I31 module installed at MIO slot).

E refers to the signal display.

E=0: the output value needs to be calibrated again by the SCH/SCL parameter under the linear input

E=1: Values set in table d00~d59 are the display value.

G refers to the type of signal(to determine whether the input signal is temperature type or non temperature type).

G=0: Thermocouple;

G=1: RTD;

G=2: Linear voltage (current);

G=3: Linear resistance.

For example: 1~5V voltage input, non temperature type, set A01 = 4*1+0*16 +2*64 = 132

A 02 refers to the lower limit of the input signal, A 02=the lower limit of the signal*K/range, for example, 1-5V input, then A 02=1×25000/5=5000.

K refers to signal coefficient;

A01.A=0, K=20000;

A01.A=2 or 4 or 10, K=25000;

A01.A=1, K=30000.

A 03 refers to the input signal range, A 03=the signal range × K/range, for example, 1-5V input and range is 5-1V=4V, then A03=4*25000/5=20000.

A 04 refers to the spacing of input signals, A04=A03/number of curve segments. If there is only one segment, A04=A03; if there are two sections, A04=A03/2.

d 00 refers to the starting point value of the curve table, which is the output value when the input signal is A02.

d 01 refers to the value of the first segment of the curve table, which is the output value when the input signal is A02+A04, for example, d 01=20000 when input is 1-5V(full scale).

d 02~d59 refers to the values from 2nd to 59th segments of the curve table. All applications can correct very complex curves, such as square root, logarithmic and exponential curves.

3.3.2 Multiple Segmented Linear Correction of Input Signal

Add the input specification value InP by 64 will activate the multiple segmented linear correction of the input signal. Set parameter Loc = 3698 and press confirm button to enter the particular settings. (If originally Loc = 808, it is required to firstly set Loc = 0 to exit parameter setting, then set back Loc = 3698). Respectively set as follows:

A00: 0;

A01: Input specification and display setting

A 01=Ax1+Ex16+Gx64

A refers to the range of signal.

A=0: 0~20mV (0~80 ohm);

A=1: 0~60mV (0~240 ohm);

A=2: 0~100mV (0~400 ohm);

E refers to the signal display.

E=0: Null;

E=1: Values set in table d00~d59 are the display value.

G refers to the type of signal.

G=0: Thermocouple;

G=1: RTD;

For example, thermocouple input, type of temperature, then set A01=2*1+1*16+0*64=18.

A02: Initial temperature;

A03: Measurement range = maximum value of the measurement – A02;

A04: Temperature interval = A03/number of interval

d00~d59: set value of each temperature section

For example, when the operation range of the K-type thermocouple is 0~300℃ with a decimal place with a correction of 100℃ for each section. Then set parameters A00=0, A01=18, A02=0.0, A03=300.0, A04=100.0, d00=0.0, d01=100.0, d02=200.0, d03=300.0. Directly adjust the corresponding temperature point slightly higher or lower than the value displayed. For example, if instrument shows 200.0℃ and the calibration shows 202.0, set d02 = 200.0 to d02 = 202.0.

Note: The adjustment is on the value of each point; between points, it is an automatic linear transition. When this function is enabled, the temperature value can only be displayed within the temperature range set by the table. When the actual temperature exceeds the range, the instrument will flash orAL and output alarm.

3.3.3 Non-linear Power Control of High Temperature Furnace

For high-temperature furnaces with non-linear load, the resistance will change dramatically with the temperature change. Take the silicon-molybdenum furnace as an example, its resistance at room temperature is only about 6% of that at 1600 degree Celsius. If there is no restriction and change on the power output from the controller, two problems will be occurred. Firstly, the furnace current will be too large at the start up at low temperature. The power grid, thyristor and transformer would be overloaded and damaged. If the power output of a controller is kept constant, the furnace power rating in low temperature zone and high temperature zone can be deviated by over 10 times. In such situation, proportional band P among the PID parameters is required to change over 10 times to achieve accurate control. However, the method of applying parameter OPH can only limit the output power and cannot achieve proportional band transformation. If accurate temperature control is required in high and low temperature areas, multiple sets of PIDs need to be set, which is not only complex to handle, but also undesirable. Customized power output restriction here is able to both limits the output and changes P value. This function changes and applies restriction based on the measured temperature. Apart from limiting power in low temperature zone, it automatically adjusts P values in various temperatures. Both the power limit and adjustment of P are changed in way of continuous line. Thus the control performance is better than using sets of PID. This power limit lowers the actual output of the controller while the display of power output is still 0~100%. Here is a suggested configuration for of a silicon-molybdenum furnace(customers can also modify the data according to their own needs):

A00=1; A01=1050; A02=100.0; A03＝1500; A04=750.0; d00=120.0; d01=1100; d02=2000

When A00=1 and A01=1050, the customized power output restriction is activated. A02 refers to initial temperature when the power limit starts. A03 refers to the temperature interval of the limit. A04 refers to the length

of interval of non-linear temperature. In this example, there are two temperature segments (1500/750.0 = 2). The more the number of segments are divided, the more concise the curve can be drawn. d00 refers to the maximum output power below A02. Its unit is 100% * (1/2000). d00 = 120 refers to 6%. d01 is set as 55%. d02 is set as 100%.

The purpose of this curve is to limit the output to 6% when the temperature is below 100 °C. The limit smoothly transits from 6% to 55% when the temperature sits between 100~850°C. The limit smoothly transits from 55% to 100% when the temperature sits between 850~1600°C. The limit is not applicable when the temperature is higher than 1600°C.

Note: The available range of d values is 0~59 which is 60 intervals of power limit. This function cannot be used at the same time with the “Multiple segmented linear correction of input signal” mentioned in the previous section of this manual. If special input specification is required, contact the sales representative to burn the code into the controller. Additional service charge shall be required.

4. FAQs

4.1 How to set self-tuning?

When the measured value PV is room temperature, set the set value SV to about 60% of the common temperature(directly set signals like pressure or flow to commonly-used set values), then press ◁ and hold for two seconds to call up the parameter At, change the parameter value from OFF to ON, and click ↻ to start self-tuning. After the self-tuning signal At automatically stops flashing, it can work normally.

4.2 How to enter the internal parameter list?

Press ↻ and hold for two seconds to enter the parameter list, and then press ↻ briefly to refer to the next parameter. If the parameters are locked, please find the password lock LOC and set it to 808, then press ↻ briefly to see all the parameters.

4.3 How to judge whether the instrument has output?

First, check whether the panel indicator light OP1 is on, If it is not on, check whether the instrument operates normally, and then check whether the instrument parameters are set correctly; If it is on, it indicates that the instrument output status is normal. A multimeter can be used to check whether the output signal is normal. If it is normal but the back-end actuator does not work, it is necessary to check other equipment or line faults along the output line. If there is no output signal, it can be judged that the output module is abnormal.

4.4 Panel flashes orAL?

When the panel flashes orAL, it indicates that there is no input signal. First, check whether the sensor model corresponds to the input specification parameter InP, and then check whether the input terminal wiring is correct. If there is no problem for the above mentioned, judge whether the input signal of the sensor is correct, otherwise, the sensor may be damaged.

4.5 How to set alarm parameters?

First, set the alarm parameters to the required values (for example, if 200 degrees is set for the upper limit alarm, change the HIAL value to 200), then enter the internal parameters to find the parameters AOP to define the alarm output terminals(for example, If the upper limit alarm outputs from AL1, set the digit of AOP to 1. For specific definitions, please refer to the AOP parameter introduction in the manual).

4.6 How to switch manual/ automatic output?

Click once on the initial interface, and the SV will switch from the set value to the output value state. Click  again to make the instrument switch between automatic and manual without disturbance. A is the automatic state, and M is the manual state.