AI-719/719P
Artificial Intelligence Industrial Regulator
User's Manual

(V9.1)

Contents

1 SUMMARY

1.1 Main features

● Supports free selection of thermocouples, thermal resistors, voltage, and current, and can expand input and customize non-linear correction tables, with maximum resolution of 0.01℃.

● Advanced artificial intelligent control algorithm to avoid overshoot. Auto tuning (AT) and fine control provided.

● Innovative modular structure enables abundant output options to adapt different applications. Quick production lead time and convenience in maintenance are benefited.

● Emphasizing energy conservation and environmental protection, using high-quality components to achieve low power consumption and low temperature drift, effectively saving customer energy.

● Measure the sampling rate 12.5 times per second, with a minimum control cycle of 0.24 seconds, which can adapt to the control accuracy of rapidly changing objects.

● 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.

● Anti-interference ability complies with requirement of electromagnetic compatibility under adverse industrial environment

POINTS FOR ATTENTION

● This manual is for Artificial Intelligence Temperature Controller AI-719/719P of V9.1. Some functions

described in this manual may not applicable in other versions. The display will show instrument model and firmware version upon power on. User should pay attention to the difference between different versions. Please read this manual carefully in order to use the instrument correctly and make it to its full use.

● 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 is utilized for AI series instruments. There are maximum 5 module slots: main output (OUTP), alarm (ALM), communication (COMM) and other functions. The input type can be freely set to thermocouple, RTD and linear current/voltage. The ordering code of AI-719/719P series instrument is made up of 9 parts. For example:

AI – 719	A	N	X3	L3	N	S4	– 24VDC	– (F2)
①	②	③	④	⑤	⑥	⑦	⑧	⑨

It shows that the model of this instrument is ①AI-719, ②front panel dimension is A size(96×96mm), ③no module is installed in MIO slot, ④linear current output module is installed in OUTP (main output), ⑤ALM (alarm) is L3 dual relay contact output module, ⑥no module is installed in AUX, ⑦S4 (RS485 communication interface module) is installed at COMM , ⑧and the power supply of the instrument is 24VDC, ⑨an extended input type (F2 radiation type pyrometer) is available. The following is the meanings of the 9 parts:

① Instrument Model

AI-719 (AI artificial intelligence regulator with high resolution of 0.01℃, freely switch between mannual and automatic operation without disturbance, multiple alarm modes and functions such as transmission and communication)

AI-719P (adding 50 time control program based on AI-719)

② **Panel Dimension**

Panel Code	Dimension W* H (mm)	Depth behind mount (mm)	Opening Dimension W* H (mm)	Light Bar	Notes
A	96*96	100	92*92	---	---
A2	96*96	100	92*92	25 segments in 4 levels	---
B	160*80	100	152*76	---	Horizontal
C	80*160	100	76*152	---	Vertical
C3	80*160	100	76*152	50 segments in 2 levels	Vertical
E	48*96	100	45*92	---	---
E2	48*96	100	45*92	25 segments in 4 levels	---
E5	48*96	DIN rail installation, external E8 keyboard and display			
F	96*48	100	92*45	---	---

③ **Modules at auxiliary input (MIO):** I2, I4, K3, V and other modules, N means no modules installed, the same below.

④**Module at main output (OUTP):** L1, L2, L4, L5, W1, W2, G, K1, K3, X3, X5 and other modules

⑤**Modules at alarm (ALM):** L2, L21,L3, L4, W1, W2, G and other modules.

⑥**Modules at auxiliary output (AUX):** L1, L2, L21,L3, L4, W1, W2, G, K1, X3, X5 and other modules.

⑦**Modules at communication (COMM):** S, S4, V and other modules.

⑧**Power supply:**Being blank means 100~240VAC, 24VDC means 20-32VDC.

⑨**Extended graduation specification:** (If there is none, leave it blank). AI-719/719P series instruments input is already universally supporting common thermocouples and resistance inputs (Please refer to the latter part of technical specification). If it is required, an additional specification can be extended.

Note 1: The instrument applies the technology of automatic zero and digital calibration, and is free of maintenance. If the error exceeds certain range, cleaning and drying of the inside parts will improve. If it is not, please send the instrument back to the factory to examine and repair.

Note 2: Instruments are provided with free warranty during the warranty period. For instruments that require repair, please specify the fault and cause to ensure correct and comprehensive repair

1.3 Module use

1.3.1 Slots of modules

There are 5 module slots in AI-719/719P series instruments (3 slots, OUTP, AUX and COMM/ AL1 for D dimension). Different modules installed will provide different functions and output types.

Auxiliary Input (MIO): Install a current input module I4 with 24V power output to directly input 2-wire transmitters or 4~20mA signals; or install the I5 switch input module (event input) to use external switches to switch the set value SP1/SP2 (fixed point control), or to control run/stop; or install K3/K9 module together with OUTP to achieve triggering output of thyristor three-phase zero crossing/phase shifting.

Main output (OUTP): As control output such as on-off control, standard PID control, and AI PID control. It can also be used as retransmission output of process value (PV) or set point (SV). Install L1 or L4 modular to provide relay contact output. Install X3 or X5 module to provide 0~20mA/ 4~20mA/ 0~10mA linear current output. Install G module to provide SSR voltage output. Install W1 or W2 module to provide TRIAC contactless switch output. Install K51 module to achieve triggering output of thyristor phase shifting; Install L5, W5, or G5 to control the forward/reverse rotation of the valve motor.

Alarm (ALM): Installing L0 or L2 will provide 1 normally open + normally close relay output (AL1). Installing L3 module will provide 2 normally open relay outputs (AL1+AL2).

Auxiliary output (AUX): In situations where dual outputs of heating/cooling are used simultaneously, modules such as X3, X5, L1, L4, G, W1, W2 can be installed in the AUX position as the second output of the regulator; In situations where a second output is not required, install L0, L1, L2 or L3 relay module to work as

alarm; or install R module (RS232C interface) to communicate with computer.

Communication Interface (COMM): Install module S or S4 (RS485 communication interface) to communicate with computer; or install I2 switch module for event input; or install voltage output module to provide power supply for external sensor or transmitter.

1.3.2 Commonly used modules

N (Or left blank) No module installed
L1 Relay with large capacity and large size. NO relay output module. (Capacity: 30VDC/1A, 250VAC/2A)
L2/L21 Relay with small capacity and small size. NO+NC relay output module. (Capacity: 30VDC/1A, 250VAC/1A, suitable for alarm)
L3 2-wire relay with large capacity and large size. NO relay output module. (Capacity: 30VDC/2A,250VAC/2A)
L4 Relay with large capacity but small size. NO+NC relay output module. (Capacity: 30VDC/2A, 250VAC/2A)
L5 2-wire relay with large capacity and large size. NO relay output module. (Capacity: 30VDC/2A, 250VAC/2A)
W1/W2 Module with TRIAC contactless NO output (W2 is NC) (Capacity: 100~240VAC/0.2A, burn-proof)
W5 Mmodule with 2-wire TRIAC contactless switch and 5V voltage output, for valve motor control (Capacity: 100~240VAC/ 0.2A, burn-proof)
G Solid-state relay (SSR) voltage output module (12VDC/30mA)
G5 Dual SSR voltage output module
K1/K3 Module with single wire/3-wire burn-proof thyristor zero-crossing triggering output (Each wire triggers one loop of a TRIAC or a pair of inverse parallel SCR with current of 5~500A)
K50/K60 Module with single wire 220VAC/380VAC burn-proof thyristor phase-shift trigger output
K9 Module with 3-wire thyristor phase-shifting triggering output.
X3 Module with photoelectric programmable linear current output
X5 Module with photoelectric programmable linear current output and photoelectric isolated power supply.
S Communication module with photoelectric RS485.
S1 Communication module with photoelectric RS485(Uses internal 24V isolated power)

S4 Communication module with photoelectric RS485.
R Communication/printing module with photoelectric RS232C (please specify if printing is required).
V24/V12/V10 Isolated 24V/12V/10V DC voltage output with maximum current of 50mA for power supply of external transmitter or circuit.
I2/I5 Switch / frequency signal input interface for external switch or frequency signal
I4 An input interface with an analog quantity of 4~20mA/0~20mA, including a 24VDC/25mA power output for the use of a two-wire transmitter.
SL Communication module with dedicated photoelectric isolated RS485 for D6 and a single relay contactless output; internal 12VDC power supply for communication

1.3.3 Installation and replacement

When placing an order, users can request that the module be installed and the corresponding parameters be set before delivery. If the module is damaged or changes functionality, users can replace it themselves. When replacing, please pull out the movement and carefully pry the joint between the original module and the motherboard socket with a small flat screwdriver. Remove the original module and then install a new module according to the instructions. If the type of module changes, it is also necessary to change the settings of the corresponding parameters.

1.3.4 Electric isolation of the modules

There are a group of 24V and a group 12V power supply built in the instrument and isolated to the main circuit. The 24V power commonly supplies voltage output module, such as V24/V12/V10 (24V/12V/10V voltage output), I2 (frequency/on-off input, with 12V isolated voltage output), or I4. The 12V power commonly supplies power for output or communication module. Generally, the relay contact output and TRIAC contact output are self-isolated from the other circuit or does not require isolated power. Therefore, only the electric isolation between the communication interface and the current output should be considered. If the input and output terminals of S(RS485 communication interface), R (RS232 communication interface) and X3 (linear current output) are electrically isolated from the input circuit of the instrument, that is, the main circuit, yet they all draws from the internal 12V power supply. If more than one of the above modules are installed, they will be not electrically isolated because they share the same power supply. To avoid interference, S4 (RS485 communication interface) or X5 (linear current output) is designed. They have their own isolated power supply, without drawing from instrument internal power. For example, if an X3 module is installed in main output (OUTP) slot, S module or X3 module installed in the communication(COMM), the X3 and S modules or X3 module

cannot be isolated, thus S4 or X5 should be installed in communication (COMM) slot. For relay contact point and thyristor contactless point output, they are isolated from other circuits already. Isolation for SSR voltage output (G) generally is not required because solid –state relay itself is isolated.

1.3.5 Further descriptions about module applications

Voltage output module: The voltage output modules like V24, V12, \/10 are often used for supplying power for external transducer or feedback resistance of transmitter. These modules can be installed in any slot. To standardize the wiring, it is recommended to be installed in the first idle slot in the order of MIO, AUX, and COMM.

Contactless switch module: W1/W2 are newly developed non-contact switch module with advanced burn-proof technology and zero-crossing conduction. It can replace the relay contact switch to control AC contactor actuator or electric servo motor. Compared to the relay contact output module, W1/W2 have longer life span and are able to lower the interference spark. This improves the stability and reliability of the system. Since the driving component is thyristor, it is suitable to control 100~240VAC but no DC. Since output terminals are connected in series with protection components, the allowed continuous current for control is up to 0.2A with allowed maximum instantaneous current up to 2A. This driving power can directly control AC contactor of 220VAC with current below 80A. For the load larger than 80A, an intermediate relay is needed. W5 is a 2-way contactless switch designed specifically for position proportional output, with a driving capacity of 1A. It can directly drive servo motors with power below 200W and voltage of 220VAC; At the same time, W5 also has a 5V voltage output for connecting the 1K valve feedback resistor.

Relay switch module: The relay modules are widely used in industrial control. However, they are the only modules with life time limit and size limit and also bringing large amount of electromagnetic interference. It is

important to choose a suitable relay module. To control equipment with 100~220VAC supply, such as AC contactor and electromagnetic valve, W1 module is recommended. To control DC or AC above 50VAC, relay module L1, L4, etc can only be chosen. L2 is a small volume module with normally open and normally closed contacts and can absorb varistor sparks. The contact capacity is small and suitable for alarm output. L1 and L3 are relay modules with large volume and capacity. These modules cannot be installed on the main board or side panel simultaneously in instruments with a width of 48mm (including D2, E, F, E5, etc.), otherwise they will collide. Therefore, when installing L1 or L3 on one side, the output module on the other side cannot be installed with L1 or L3 modules. L3 module 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 driver) with external solid-state relay (SSR) can be used to drive the load instead.

1.4 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, 0~1V, 0~100mV, 0~20mV, -5~+5V, -1V~+1V, -20mV~+20mV etc.

Linear current (external shunt resistor): 0~10mA, 0~20mA, 4~20mA, etc

Extended specification: Apart from the above-mentioned input specification, an additional type can be provided upon request.

● 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℃), WRe3-WRe25(0~2300℃), WRe5-WRe26(0~2300℃)

Cu50(-50~+150℃), Pt100(-200~ +800℃), Pt100(-80.00~+300.00℃)

Linear Input: -9990~+30000 defined by user

● Measurement accuracy : 0.1%FS(Note: When the thermocouple is externally connected to a Cu50 copper resistor for compensation, an additional compensation error of ± 1 ℃ will be added during internal compensation)

● Measurement of temperature drift: ≤ 35PPm/℃ (Note: When the thermocouple is externally connected to a Cu50 copper resistor for compensation, additional temperature drift error will be added during the internal compensation)

● Sampling period: 12.5 times per second. By setting digital filter parameter FILt=0, the response time ≤0.3 second.

● Control period : 0.24~300.0 seconds selectable.

● Regulation mode:

On-off control mode (dead band adjustable)

AI artificially intelligent regulation with fuzzy logic PID regulating and auto tuning with advance artificial intelligence algorithm.

● Output specification (Modularized)

Relay output (NO+NC): 250VAC/1A or 30VDC/1A

TRIAC contactless 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 zero-crossing trigger output: To trigger TRIAC of 5~500A, a pair of inverse paralleled SCRs or SCR power module.

Linear current output: 0~10mA or 4~20mA customized. (X3 module installed, output voltage≥10.5V; X5 module installed, output voltage≥7V)

● Alarm: 4 types of alarm, high limit, low limit, deviation high limit and deviation low limit with alarm blocking at the beginning of power on.

● Electromagnetic compatibility (EMC): ±4KV/5KHz according to IEC61000-4-4 (Electrical Fast Transient); 4KV according to IEC61000-4-5 (Electrical Surge) and under the interference of 10V/m high-frequency electromagnetic field, there will be no crash or I/O misoperation, and the measured value fluctuation will not exceed ± 5% of the range

● 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: ≤5W(When there is no output or alarm action); Maximum power consumption ≤ 4W

● Operating ambient: Temperature -10~60℃; Humidity ≤90%RH

- Dimension of panel: 96*96mm、160*80mm、80*160mm、48*96mm、96*48mm、72*72mm、48*48mm
- Opening Dimension: 92*92mm、152*76mm、76*152mm、45*92mm、92*45mm、68*68mm、45*45mm
- Depth behind: ≤100mm

1.5 Energy-saving and environmental protection design

The AI-719/719P series adopts an energy-saving and environmentally friendly design, which is reflected in its extremely low temperature drift and its own extremely low power consumption. In order to achieve this, high-quality components are used, and low-temperature drift products are selected for key components and have been tested in pairs. The overall typical temperature drift is usually less than 25PPm/℃, which increases costs but brings extensive energy-saving effects. Our company even pays attention to the power consumption of the instrument itself. For example, the use of LED displays with higher luminous efficiency can effectively reduce the driving current under the same brightness; Although the cost has doubled, yet it reduces the power consumption and improve the reliability and performance of the product itself.

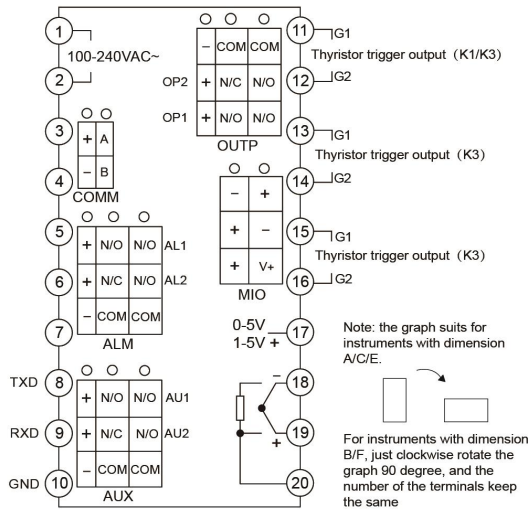
Compared with ordinary temperature control instruments, the low temperature drift instrument has less change in the measured value of temperature due to the influence of ambient temperature. which can not only make the customer's product quality more stable, but also effectively reduce energy consumption. This turns out to make the high-precision instruments more energy-efficient than the instruments with lower precision due to their low temperature drift, for example, assuming that the sintering temperature range of a ceramic material is around 1000~1010℃, and assuming that the temperature drift of an ordinary instrument on the market is about ±5℃ (caused by the change of ambient temperature in winter, summer and morning and evening), therefore, it is necessary to set the instrument at 1005°C (the temperature range is 1000~1010°C) to maintain normal production under different ambient temperature changes. While the temperature drift of AI-719/719P series instruments can be reduced to within ±1°C. In this case, setting the temperature at 1001°C (temperature range of 1000~1002°C) can stabilize production, so that the average temperature of the kiln can be reduced by 4°C, and the lower the average temperature of an industrial furnace, the less power it consumes. In most application scenarios, 0.4%~0.6% energy can be saved by reducing the temperature drift of the instrument and optimizing the debugging, and the product quality can be more stable. This data is consistent with the requirements of

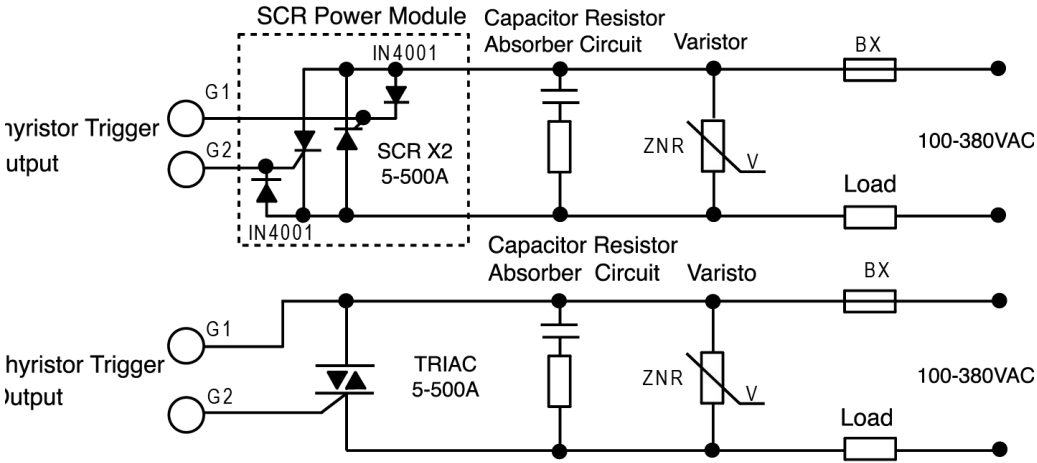
instrument of resolution 0.05℃. In order to save energy and improve product quality, the company adopts components with higher accuracy and smaller temperature drift at the same price, thereby increasing the measurement accuracy of the AI-518/518P/519/519P series instruments from 0.3% to 0.25%, upgrading the accuracy of the AI-708/708P series instruments from 0.2% to 0.15%, and upgrading the measurement accuracy of the AI-719/719P series instruments (upgraded version of AI-808/808P) to 0.1%.

1.6 Wiring

Wiring diagram of rear terminals of standard depth

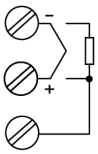
Note: ① Linear voltage ranges below 1V are input from terminals 19+and 18-, while signals 0~5V and 1~5V are input from terminals 17+and 18-; ② The 4~20mA linear current input is converted into a 1~5V voltage signal with a 250 ohm resistor, and then input from the 17+and 18- terminals, or the install I4 module at the MIO and input from the 14+and 15- terminals, or directly connected to a two-wire transmitter from the 16+and 14- terminals; ③ Thermocouples with different graduation numbers use different thermocouple compensation wires; During internal automatic compensation the compensation wire is directly connected to the wiring terminal of the rear cover, and cannot be converted into a regular wire in the middle, otherwise measurement errors may occur; ④ The current and SSR voltage are output from terminals 13+and 11-.



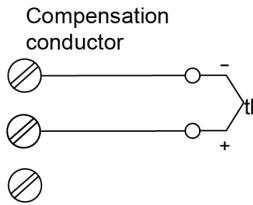


Using the wiring method to select the thermocouple cold junction automatic compensation mode: When a thermocouple is used as the input signal, according to the principle of thermocouple temperature measurement,

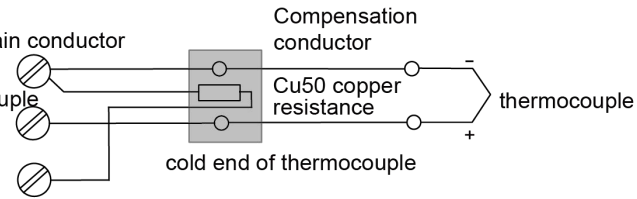
it is necessary to perform temperature compensation on the cold end of the thermocouple. The AI instrument can measure the temperature near the rear terminal of the meter and automatically compensate the cold end of the thermocouple. However, due to the error of the measuring element, the heating of the instrument itself and other heat sources near the instrument, etc., the automatic compensation method often results in a large deviation, which may exceed 2℃ in the worst case. Therefore, when the temperature measurement accuracy is required to be high, an external junction box can be installed, and the Cu50 copper resistor (to be purchased separately) and the cold end of the thermocouple are placed together and kept away from various heating objects, so that the measurement inconsistency due to compensation can thus be less than 0.3℃. because of the error of the Cu50 copper resistor itself, there may be a little error at room temperature, which can be corrected by the Sc parameter. By changing the external copper resistance into a precision fixed resistance, the compensation function of the constant temperature bath can also be realized. For example, an external 60 ohm fixed resistor can be used to check the Cu50 indexing table to obtain a compensation temperature of 46.6℃. At this time, the cold end of the thermocouple can also be accurately compensated by placing it in a constant temperature bath with a control temperature of 46.6℃, and its compensation accuracy is better than that of copper resistors. If the external resistor is changed into a short-circuit line, the freezing point compensation can be achieved. At this time, it is required to place the cold end of the thermocouple (the connection between the thermocouple or the compensation wire and the ordinary wire) in the ice-water mixture (0℃), and the compensation accuracy can be as high as 0.1℃ or more. The wiring diagrams of the two compensation modes are as follows:



wiring



（1）Internal automatic compensation (compensation conductor directly connected to the wiring terminal)

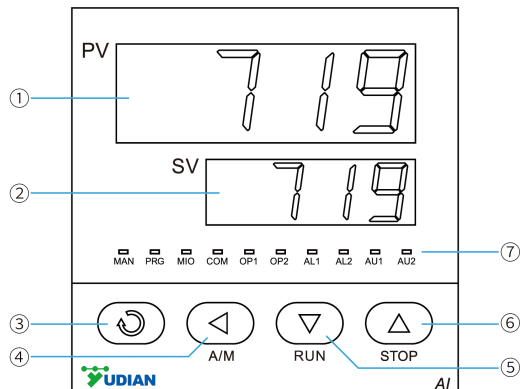


（2）External copper resistance automatic compensation (best to keep the junction box of the thermocouple cold end away from heating objects)

2 Display and operation

2.1 Panel Description

① Upper display window: Displays PV, parameter code, etc.
② Lower display window: Displays SV, parameter value, or alarm message
③ Setup key: Access parameter list and conform parameter modification.
④ Data shift key (cursor pointer)
⑤ Data decrease key (RUN/HOLD)
⑥ Data increase key (STOP)
⑦ 10 LED indicators. MAN turns on when in manual output status; PRG turns on when running. MIO, OP1, OP2, AL1, AL2, AU1 and AU2 turns on when the corresponding modules are giving output. COMM turns on when communicating with upper device.

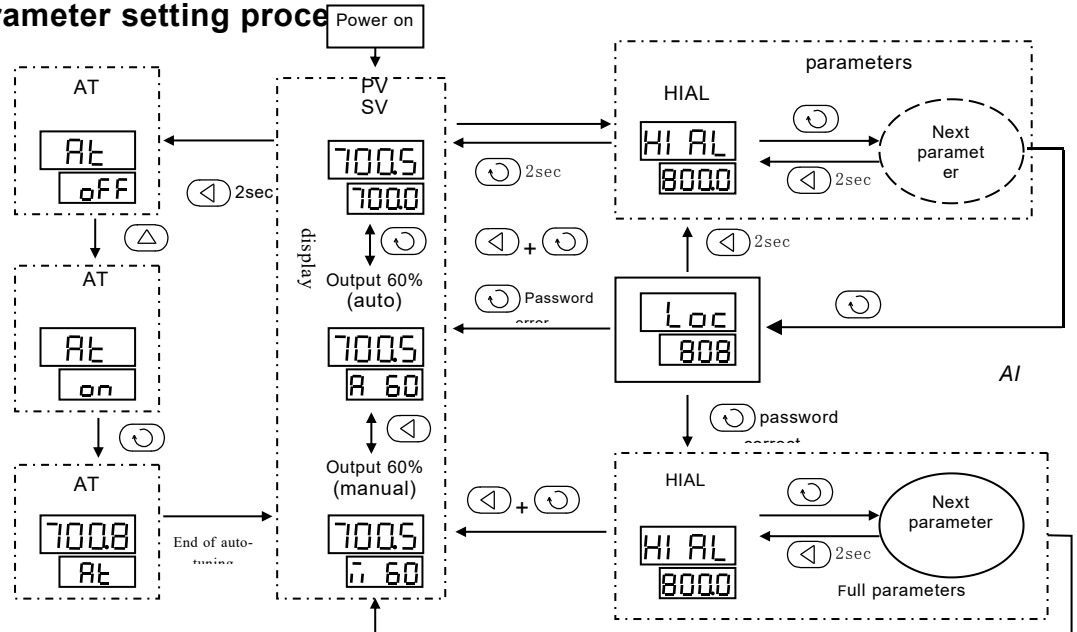


The instrument starts the basic display status upon power on, the upper and lower display windows of the instrument display the process value (PV) and the set value (SV) respectively, and the lower display window can also display the following characters alternately: ① "OrAL", indicating the input signal is out of range; ② EErr

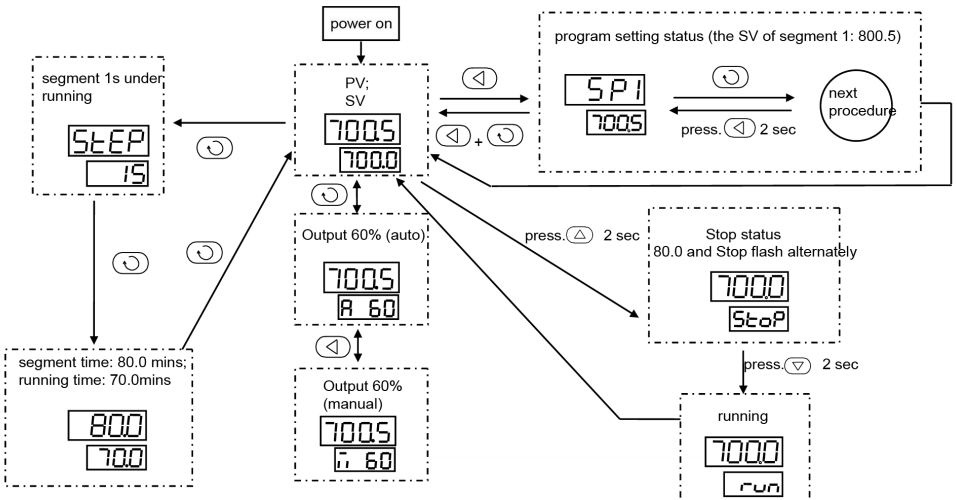
"indicates that an error has been detected within the system, such as parameter loss; FErr "indicates that the valve feedback or external given signal exceeds the range; "HIAL", ③ "LoAL", "HdAL" or "LdAL" indicates that the high limit alarm, low limit alarm, deviation upper limit alarm and deviation lower limit alarm have occurred respectively; ④ "Stop" means it is in the stop status. ⑤ "HoLd" and "rdy" respectively represent the paused state and the prepared state (AI-719P only).

Note: If necessary, turn off the flashing during upper and lower limit and deviation alarms to avoid excessive flashing (set the ADIS=oFF)

2.2 Parameter setting proce



2.3 Procedure setting



Procedure setting for AI-719P only

2.4

Operating Instructions

2.4.1 Parameter setting

In basic display status, press (SET) and hold for about 2 seconds to access Field Parameter List. Press (◁)、(▽) or (△) to modify parameters. Press (▽) to decrease the data, press (△) to increase the data, the decimal point of the modified data will flash (like a cursor). Press and hold the key to quickly increase/decrease the value, and the speed will automatically increase as the decimal point moves to the right. Or press (◁) to directly move the position (cursor) of the modified data, which makes the operation more efficient. Press (SET) to save the modified parameters and display the next parameter, keep pressing (SET) to quickly go down; press and hold (◁) over 2 seconds to return to the previous parameter; press and hold (◁) first and then press (SET) again to exit the parameter setting; if there is no key operation, it will automatically return to the basic display status after about 25 seconds.

2.4.2 Short-cut operation

All function in 719/719P can be accessed through changing parameters. For common operation such as editing set value, changing the status of RUN/STOP/HOLD, short-cut key is provided and set to be prohibited to avoid any incorrect operation.

Set Value Setting: When fixed-point control mode(Pno=0) is adopted, in the basic display status where the lower display window shows the set value (If the lower display window displays the output value, press (SET) to switch to the set value display status, the same below), press (◁) to edit the current set value, and then press (◁), (▽) and (△) to directly edit the set value.

Program setting: When program control mode(Pno≥1) is adopted, in the basic display status where the lower display window shows the set value, press (◁) to enter the program setting, the set value of the current running segment is displayed first, and press (↻) to display the next data, each program is arranged in the order of set value-time-set value. Programs can be edited even while the program is running.

Run the program: Press and hold (▽) for about 2 seconds until the lower display window shows RUN. AI-719P will start the program from STOP status. If PAF.F =1 and program status is RUN, this operation will HOLD the program. The timer will be paused. Perform RUN again will resume the program.

STOP the program: Press and hold (△) for about 2 seconds until the lower display window shows StOP. The instrument output will be stopped. AI-719P will stop the program and restore the current StEP to 1.

Automatic/manual switching (A/M): When the lower display window shows the output value (if the lower display window shows the set value, press (↻) to switch to the output display status), press the A/M ((◁)) to make the instrument switch between automatic and manual without disturbance. Under the manual status and the output value is showed in the lower display window, press (△) or (▽) to increase and decrease the manual output value. By setting the M-A parameters, the instrument can be fixed in the automatic status and not allowed to be switched to the manual status with the panels, so as to prevent entering the manual status by mistake.

Auto Tuning: Press (◁) for 2 seconds, parameter At will appear. Press (△) to change the value of At from OFF to ON, then press (↻) to activate the auto-tuning process(Note: If the SPr parameter setting is valid and the instrument is in a temperature rise limit state, the self-tuning will be suspended and will automatically start after the temperature rise is completed). During auto tuning, the lower display blinks with At. After two fluctuating cycles by ON-OFF control, the instrument will obtain the optimal PID parameter. If users want to quit auto tuning,

press and hold the ◁ for about 2 seconds until the At parameter appear again. Change At from ON to OFF, press ↺ to confirm. If the instrument is running, the program timer will be paused to avoid changing SV. If the controller was applied on heating/cooling dual output system, two set of PID parameters are required to be calculated separately. When the controller was in cooling status from AUX, enable auto tuning to obtain P2, I2, d2.

Manual auto-tuning: Since positional regulation is adopted for auto-tuning, its output position will be defined by OPL and OPH. In the system difficult to control or in the applications in which some executive bodies such as control valve is used and therefore outputs are not allowed to be greatly changed, traditional auto tuning is not suitable. AI-719/719P instruments have manual auto tuning. To do this, switch the instrument to manual mode. After manual control is basically stable, start up auto tuning at manual mode, and the output will be restricted between +10% and -10% of the current manual output instead of that defined by OPL and OPH. This function can avoid great change of valves and improve the precise of auto-tuning. In addition, when the controlled physical value responds quickly, the manual auto-tuning can obtain more accurate results. Note: before manual auto-tuning, the manual output value should be limited to 10% ~ 90%, and the process value and the set value should be basically consistent and stable, otherwise optimal parameters can not be obtained.

Note 1: The advanced artificial intelligence algorithm APID is employed to avoid overshooting problem over standard PID algorithm and achieve precise control. Both APID and PID can be calculated based on auto-tuning.

Note 2: Different set value will result in different PID values from auto-tuning. Please input the set value SV to an value which is often used or mean value. For those furnaces with good heat preservation, the set value can be set at the highest applicable temperature, it is prohibited to edit SV during auto-tuning. Depending on the

system, the auto-tuning time may vary from seconds to hours.

Note 3: Parameter CHYS has influence on the accuracy of auto-tuning. In general, the smaller the value of CHYS, the higher precision of auto-tuning will be. There is a chance that the CHYS value is too small so as to work as on-off control. Then the resulting PID values will be completely misled. CHYS=2.0 is recommended.

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.

Note 5: In the auto-tuning or manual status, no matter how large the control period (CtI) of the instrument was originally set, it is temporarily limited to no more than 3 seconds to improve the setting accuracy and improve the response speed of the instrument during manual operation.

2.4.3 Instructions for DIN Rail Mounted Instruments

AI-719E5 and AI-719PE5 are DIN rail mounted instruments, and the E5 series instruments themselves do not have a display or keyboard, but it supports RS485 communication with a computer or touch screen to set the parameters and operate. E5 instrument can also connect an optional accessory E8 keypad with display to show and set the parameters. E8 supports hot plug, which is handheld and can also be installed on the DIN rail. The display of E8 can be double row with 4 digits, but there is no LED indicator light, and its operation and display are fully compatible with the instrument panel. The LED indicator of the E5 instrument will flash once during every signal sent between the instrument and computer. If the instrument cannot receive signals from the computer for 6s, the LED will flash at certain frequency. The meaning for lighting signal is explained as below.

Flashing slowly in period of 1.6-No communication but the instrument works normally with no alarm.

Flashing quickly in period of 0.6s-No communication but there is warnings such as an alarm.

Flashing quickly in period of 0.3s-No communication and out of range in input (such as broken thermocouple and thermal resistance RTD) and other severe warnings

No flash for a long time-The instrument is out of power supply or damaged; LED lamps ON continuously (above 8s)-The instrument is connected with power but it has been damaged.

3 Parameter description

3.1 User-defined Parameter List

The parameter table of AI-719/719P can be used to program the parameters of the instrument. To protect important parameters from arbitrary modification, we refer to the parameters that need to be displayed or modified on site as field parameters. The field parameter list is a subset of the full parameter list and can be defined by the user. the full parameter list must be accessible under the condition of entering a password. Parameter lock (Loc) provides different operation privilege and access control to the parameter list. The explanation of Loc function was shown as below:

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

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

Loc=2~3, allowed to edit field parameters, forbidden to directly edit the set value in the basic display status, but allowed short-cut operations such as program run/pause/stop/fixed point control;

Loc=4~255, only Loc allowed to be edited, and all shortcut operations prohibited;

Set Loc=808, and press  to confirm and to access and edit the full parameter list. Once the full parameter list is entered, all parameters except read-only parameters are authorized to be edited.

Parameters EP1~EP8 allow users to define 1~8 field parameters. If the field parameters are less than 8, the

first parameter that is not used should be defined as nonE. For example: there are 3 parameters such as HIAL, HdAL and At in the full parameter list, then the parameter EP can be set as follows: EP1=HIAL, EP2=HdAL, EP3=At, EP4=nonE.

Note: Since version 9.1, communication write restrictions have been set through the Loc parameter. Please refer to the communication protocol for specific details.

3.2 Full Parameter List

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

Code	Name	Description	Setting Range
HIAL	High limit alarm	Alarm on when PV>HIAL; Alarm off when PV<HIAL-AHYS Note: Each type of alarm can be freely defined to control output slots such as AL1, AL2, AU1, AU2, etc., or do nothing at all. Please refer to the alarm output parameter AOP in the following text.	-9990~ +32000 units
LoAL	Low limit alarm	Alarm on when PV<LoAL; Alarm off when PV>LoAL+AHYS Note: If necessary, HIAL and LoAL can also be set as deviation alarms (refer to AF parameters)	
HdAL	Deviation high alarm	Alarm on when PV-SV>HdAL; Alarm off when PV-SV<HdAL-AHYS. When the value set to Max. will disable this function	
LdAL	Deviation low alarm	Alarm on when PV-SV<LdAL; Alarm off when PV-SV>LdAL+AHYS. When the value set to Min, alarm will be disabled. Note: If necessary, HdAL and LdAL can also be set as absolute value alarms (refer to AF parameters)	
AHYS	Alarm	Avoid frequent alarm on-off action because of the fluctuation of PV	0~2000

	hysteresis		units
AdIS	Alarm display	oFF : Will not display alarm message in the lower display window when alarming. on: Alternately display alarm message in the lower display window when alarming, recommended. FOFF, energy saving/confidential display mode; In this mode, the instrument SV window will display the communication address, instead of the process value and the set value	

<table>
<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 (LdAL) 3 (HdAL) 0 (LoAL) 1 (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 take in effect.
Note 2: Installing L3 dual relay output module in ALM or AUX, AL2 or AU2 can be used
</td>
<td>0~6666</td>
</tr>
</table>

nonc	NO/NC	1-way alarm relay can have NO+NC output at the same time, but 2-way alarm module L3 only has NO output which can be defined as NC output through the nonc parameter. When nonc=0, L3 relays installed at AL1, AL2, AU1 and AU2 are NO. When nonc=15, instrument alarms are NC. When some ways are NO and some ways are NC, the nonc value can be calculated according to the following formula. nonc=A*1+B*2+C*4+D*8 In the formula, A, B, C and D respectively represent the NO and NC of AL1, AL2, AU1 and AU2. When nonc=1, NC output, and when nonc=0, NO 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. 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, running status. When the instrument is in an unlimited thermostatic control status(Pno=0), it indicates that the it is in normal operation status. At this time, it is prohibited to run or stop from the panel. When the instrument is under program control (Pno>0), the timing will be suspended. At the same time, the lower display will flash HoLd, so will the indicator PRG. Note: Users can enter the running status by directly editing this parameter or editing program operation, upper computer communication, or event input.	
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) depends on the calculations 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 is off. **on:** Active auto turning of PID and CtI parameter, automatically return to FoFF after auto tuning **FoFF :** Auto tuning is off, cannot activate again by pressing key from panel AAt, fast auto-tuning, automatically returns to OFF after self-tuning. **Note:** If AAt is selected as the AT parameter, the AAt auto-tuning function can be automatically started when the instrument is in the output status of full power heating after power on. PID parameters can be set in advance without traditional periodic oscillation. In most cases, accurate control can be achieved by first heating. If the AAT has not completed the auto-tuning, but the instrument has already exited the full power output status, then the AAT fails and the auto-tuning will be terminated, but the PID parameters will not be modified.	
P	Proportional band	Proportional band in PID and APID control. Instead of percentage of the measurement range, the unit is the same as PV. Note: Generally, optimal P, I, D and CtI can obtained by AT auto tuning. They can also be manually input if users already know the correct values of P, I, D and CtI when batch production of heating equipment is required.	1~32000 units
I	Time of Integral	No integral effect when I=0	1~9999s

d	Time of Derivative	No derivative effect when d=0	0~3200s
Ctl	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. Ctl is recommended to be 1/5 – 1/10 of derivative time. (It should be integer times of 0.5 second.) When the parameter OPt or Aut = rELy, Ctl will be limited to more than 3 seconds. Auto tuning will automatically set Ctl to suitable value considering both control precision and mechanical switch longevity. If the output is a control valve, it is recommended to have Ctl=3~15 seconds to balance response speed and avoid frequent valve operation. When the parameter CtrL = ONOF, Ctl will used as timer to make delay time to avoid the power restart in short period. It suits for compressor protection.	0.2~300.0 s
P2	Proportional band of cold output	Define the cold output proportional band regulated by APID and PID, and the unit is the same as the PV value, rather than the percentage of the range.	1~3200 units

<table>
<tr><td>I2</td><td>Integral time of cold output</td><td>Define the integral time of cold output regulated by PID, in seconds, and the integral action is disabled when I=0.</td><td>1~9999s</td></tr>
<tr><td>d2</td><td>Differential time of cold output</td><td>Define the differential time of cold output regulated by PID, in 0.1 seconds. When d=0, the differential action is disabled.</td><td>0~3200s</td></tr>
<tr><td>CtI2</td><td>Control circle of cold output</td><td>SSR, thyristor or current output is generally set to 0.5-3.0 seconds. When the output is a relay switch(set OPt/Aut=rELY), the actual CtI will be limited to over 3 seconds, 20~40 seconds is recommended .</td><td>0.2~300.0 s</td></tr>
<tr><td>CHYS</td><td>Control Hysteresis</td><td>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.</td><td>0~2000 units</td></tr>
<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>
</table>
</td><td>0~37</td></tr>
</table>

5	J	27	0~400ohm resistor input		
6	B	28	0~20mV voltage input		
7	N	29	0~100mV voltage input		
8	WRe3-WRe25	30	0~60mV voltage input		
9	WRe5-WRe26	31	0~1V		
10	Extended input specification	32	0.2~1V		
12	F2 radiation type pyrometer	33	1~5V voltage input		
15	Input MIO 1(Install I4 to 4~20mA)	34	0~5V voltage input		
16	Input MIO 2(Install I4 to 4~20mA)	35	-20~+20mV		
17	K (0~300.00℃)	36	-100~+100mV		
18	J (0~300.00℃)	37	-5V~+5V		
19	Ni120	39	20~100mV voltage input		
Note: While InP=10, the non-linear table can be user-defined or input by factory under a paid service.					

dPt	Display Resolution	Four formats (0, 0.0, 0.00, 0.000) are selectable Note 1: For thermocouples or RTD input, only 0 or 0.0 is selectable, and the internal resolution is 0.1℃. When S, R, B type thermocouple is used, dPt is recommended to be 0. If INP= 17,18 or 22, resolution 0.01℃ will support display 0.0 or 0.00. Note 2: When using linear input, if the measured value or other related parameters may exceed 9999, it is recommended to use 0.000 instead of 0, as the display format will change to 00.00 after exceeding 9999.	
SCL	Signal scale low limit	Define scale low limit of input. It is also the low limit of retransmission output and light bar display.	-9990~ +32000 units
SCH	Signal scale high limit	Define scale high limit of input. It is also the high limit of retransmission output and light bar display.	
Scb	Input Shift Adjustment	Scb is used to shift input to compensate the error caused by transducer, input signal, or auto cold junction compensation of thermocouple. Note: It is generally set to 0. The incorrect setting will cause inaccurate measurement.	-1990~ +4000 unist

FILt	PV input filter	The value of FILt will determine the ability of filtering noise. The larger the value is set, the more stable the measurement input is, but the slower the response speed is. If great interference exists, then it is allowable to increase parameter “FILt” gradually to make momentary fluctuation of process value less than 2 to 5. When the instrument is being metrological verified, “FILt” s can be set to 0 or 1 to shorten the response time. The unit of FILt is 0.5 second.	0~40
Fru	Selection of power frequency and temperature scale	50C: Power at 50Hz and maximum anti-interference is achieved ; Display in ℃ 50F: Power at 50Hz and maximum anti-interference is achieved; Display in ℉ 60C: Power at 60Hz and maximum anti-interference is achieved; Display in ℃ 60F: Power at 60Hz and maximum anti-interference is achieved, Display in ℉.	
SPSL	Low limit of SV	Used to define the lower limit of scale of external given input signal when external given function is used; The lower limit of the valve position feedback signal is defined when the position proportional output is used, and the parameter can be automatically set by the valve auto-tuning function.	-9990~+32000 units

SPSH	Upper limit of SV	Used to define the upper limit of external given input signal scale when external given function is used; The upper limit of the valve position feedback signal is defined when the position proportional output is used, and the parameter can be determined by the valve auto-tuning function. Warning: The value of valve position after auto-setting is only for display and reference. Unless professionals, please do not manually modify SPSH and SPSL parameters.	

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 (Ctl) is generally 0.5~4 seconds. rELy: for relay contact output or for execution system with mechanical contact switch. To protect the mechanical switch, the output period (Ctl) 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. K51 module should be installed in OUTP slot. PHA1 is only for 50Hz power supply, and don't support bidirectional control system. nFEd: position proportional output without valve feedback, can directly control valve's direct and inverse rotation. Valve execution time defined by Strt parameter FEd: position proportional output has valve feedback,valve execution time must more than 10s, feedback signal input from 0~5/1~5V terminals.note:in this case forbid useing remote setpoint input function. FEAt: auto-tuning valve position .	

Aut	Auxiliary output type	Define AUX only when AUX is worked as the auxiliary output of a heating/refrigerating bidirectional systerm. SSr: to output SSr driver voltage or thyristor zero crossing trigger signal. G or K1 module should be installed. The output power can be adjusted by adjusting 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. To protect the mechanical switch, the output period (CtI) 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 AUX slot. 4~20: 4~20mA linear current output. X3 or X5 module should be installed in AUX slot. (Not applicable for heating/refrigerating bidirectional control.) Note: In a heating/refrigerating bidirectional control system, if any of OPt or Aut is set to rELy, then CtI is limited to 3~120. If the heating or cooling output signal is 420mA, when the heating has an output, the signal at the cooling output end is 0mA instead of 4mA; When there is an output of refrigeration, the heating output signal is 0mA instead of 4mA.	

OPL	Output low limit	0~100%: OPL is the minimum output of OUTP in single directional control system. -1~-110%: The instrument works for a bidirectional system, and has heating/refrigerating dual output. When ACt=rE or rEbA, OUTP (main output) works for heating, and AUX (Auxiliary output) works for refrigerating. When Act=dr or drbA, OUTP works for refrigerating, and AUX works for heating. In a bidirectional system, OPL for define the limitation of maximum cooling output. So, when the OPL= -100%, means no limitation on cooling output. If set OPL=-110%, it can made current output excess 10% on maximum output. When the output type is SSR output or relay output, maximum of cooling output should not set more than 100%.	-110~ +110%
OPH	Output upper limit	When PV<OEF, limit the maximum output value of the main output OUTP, and when PV>OEF, the system corrects the upper limit of the output to 100%; In the proportional output without feedback position (when OPt=nFEd), if OPH is less than 100, the instrument will automatically set the valve position when powered on; if OPH=100, the instrument will automatically set the valve position when the output is 0% and 100%, which can shorten the power on and startup time. The OPH setting must be greater than OPL.	0~110%

Strt	valve rotation travel time	When the meter is defined as position proportional output, Strt is valve rotation travel time. if there is valve feedback signal, the meter will automatically select the valve control signal based Strt hysteresis setting, the shorter travel time, the hysteres is Large, valve positioning accuracy will be reduced. When Use no valve feedback signal mode or feedback signal over the range.the instrument will use valve rotation travel time comparing the output to determine the valve motor action time.	10~300 s
Ero	Output value at excessive range	When the instrument control mode is PID or APID, Ero defines the output value to be adjusted when the input is over range (usually caused by sensor failure or disconnection). AF2 parameter can define whether the Ero is valid and the setting mode. When the Ero is defined as the automatic setting mode and the deviation is less than 4 measurement units, the instrument automatically stores the integral output value, so the Ero value will automatically change with the system. When the mode is set manually, the Ero value is set manually.	-110 ~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 OUTP output value to rise to 100% is not more than 5 seconds. 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 can be set to 0.5second, and OPrt 5 seconds.	0~3600 s
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%. For example, to avoid that the temperature raises too quickly, under 150℃, a heater can work only under 30% of power, then we can set OEF=150.0 (℃), OPH=30 (%)	-999.0 ~ +3200.0℃
Addr	Communication address	Used to define a communication address, with a valid range of 0-80. Instruments on the same communication line should be set with different Addr values to distinguish them from each other.	0~80

bAud	Baud rate	Define the communication baud rate. The range of baud rate is 0~28800bit/s(28.8K). When COMM slot is not used communication, bAud value defines its function. bAud=0, COMM slot used to retransmit and output process value of 0-20mA; bAud=1, as an external switching input; bAud=4, COMM slot used to retransmit and output the process value of 4~20mA; bAud=8, COMM slot used to retransmit and output the set value of 0~20mA; bAud=12, COMM slot used to retransmit and output the set value of 4~20mA;	0~28.8K

Et	Event input type	**nonE:** Disable event input function. **ruSt:** Run / Stop switching function. Connected in short time, start to running program, keep connect more than 2 sec, program switch to stop. **SP1.2:** Switching set value under set point regulation; when MIO in open status, SV=SP1; when MIO in close status, SV=SP2 **PId2:** When use as single direction control, MIO in open status, P, I, d and Ctl are active, when MIO in close status, P2, I2, d2 and Ctl2 are active **EAct:** External switch to switch the heating/cooling. When MIO turns off, parameters P, I, d and Ctl are used for heating regulation. When MIO turns on, parameters P2, I2, d2 and CtI2 are used for cooling regulation. The OUTP slot starts, and this parameter will automatically edit the value of Act according to the connection/disconnection of MIO. Eman: External switch to switch between manual/automatic. When disconnected, it is in automatic mode, and when connected, it is in manual mode. **Erun:** External switch to RUN/STOP. Instrument stops when switch is off and runs when switch is on.	

AF	Advanced function	AF is used to select advanced function. The value of AF is calculated as below: **AF=A*1 + B*2 + C*4 + D*8 + E*16 + F*32 + G*64 + H*128** 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, displayed in the third row with a decimal point; C=1, displayed in the third row without a decimal point(Only three rows of display are available). D=0, Loc=808 to access the parameter list; D=1, Loc=PASd to access the parameter list. 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, then there are four deviation alarms. F=0, Fine control, internal control resolution was demonstration's 10 times. When on linear input mode, biggest 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.	0~255

		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 15s delay to trigger in normal usage. H=0, HIAL and LOAL can alarm independently; H=1, HIAL and LOAL become interval alarm, and will alarm only when LOAL>PV>HIAL is met. The alarm code is HIAL, and HIAL is also used for output. Note: AF=32 is recommended for ordinary usage.	
AF2	Advanced function 2	AF2 is used to select the second group of advanced function codes, and its calculation method is as follows: **AF2=A×1+B×2 +C×4 +D×8+E×16+F×32+G×64** A=0, the given value is internally given; A=1, the given value is external given, and the external given signal is input from the 5V input terminal. B = 0, the external given signal is 1~5V; B = 1, the external given signal is 0~5V. C=0, normal input mode; C=1, the linear input signal is squared. D=0, the transmitting output uses SCH SCL to define the scale; D=1,	0~255

		the transmission output uses SPSL SPSH to define the scale (Note: Do not use the valve feedback signal input). E=0, output 0 when sensor is disconnected, E=1, the Ero parameter is output when the sensor is disconnected. F=0, the system automatically sets Ero, F=1, set Ero manually. Automatic definition of Ero is one of the contents of AI auto-learning control, that is, the instrument will automatically memorize the average output value when the measured value is consistent with the given value, which can be used for PID adjustment operation as a reference to improve the control effect. For safety, the maximum learning value of Ero is 70% of the output power. If a higher value of Ero is required, it should be set as the safest common output when Ero parameters can be manually set. G=0, standby.	

AFC	Communication mode	Select communication mode, its calculation method is as follow: **AFC=A*1+D*8** 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.	
PASd	Password	When PASd=0~255 or AF.D=0, set Loc=808 can enter the full parameter list. When PASd=256~9999 and AF.D=1, only Loc=PASd can access the full parameter list. Note: Please setting PASd cautiously, if the password is lost, you cannot access the parameter list again.	0~9999
SPL	Low limit of SV	Minimum value that SV is allowed to be.	-9990~ +30000 units
SPH	Upper limit of SV	Maximum value that SV is allowed to be.	
SP1	Setpoint 1	For AI-719/719P, when Pno=0 or 1, normally SV=SP1	SPL~SPH

SP2	Setpoint 2	For AI-719/719P, when Pno=0 or 1 and I2 is installed at the MIO and Et=SP1.2, to switch SP1/SP2 with an external switch; when the switch turns off, SV=SP1; when the switch turns on, SV=SP2.	
SPr	Temperature -rising rate limit	When SPr is set as valid, the program runs or the set value is changed, and the measured value is lower than the set value, the instrument will rise to the set value at the temperature rise rate limit defined by SPr. The PRG light will flash under the temperature rise rate limit state. SPR is valid for fixed point control (Pno=0) and program platform mode, but not for slope mode. When item C of PAF=1, the units of SPR and SPRL become ℃/hour.	0~3200 ℃/ min
Pno	Numbers of program steps	Define the number of effective program steps from 0 to 50. When Pno=0 is set, the instrument is in constant temperature mode; When Pno=1 is set, it is a single program mode. Only one set value and one holding time need to be set, and the holding time will end and enter the stop status; When Pno=2~50 is set, normal program is adopted for operation.	0~50

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. Run 1, Continue to stop if it is stopped before power failure, otherwise, it will automatically start running from the first step after power on. 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. HoLd, If the instrument is powered off during operation, the instrument will enter the suspend status no matter what happens after power on. However, if the instrument is stopped before power failure, it will remain stopped after power on.	
PAF	Program operation mode	PAF is used to select program control, and its calculation method is as follows: **PAF=A*1+B*2+C*4+D*8+E*16+F*32+G*64+H*128** A=0, the preparation function (rdy) is disabled; A=1, the preparation function is enabled. B=0, ramp mode; B=1, soak mode (constant temperature mode), each step of the program defines the set value and holding time, rdy function	0~255

		is used to limit the conditions to enter the next step, and SPr/SPrL parameter is used to regulate the rising/cooling rate; in addition, even if B=0 is set, if the command in the last step of the program is not STOP, the constant temperature mode will still be executed, and it will automatically end when the time is up. C=0, in minutes; C=1, in hours. D=0, without PV startup function; D=1, with PV startup function. E=0, PV showed in the upper display window when it works as program generator; E=1, StEP number showed in the upper display window when it works as program generator. F=0, standard operation mode; F=1, HoLd status when the program RUN. G=0, in minutes; G=1, in seconds. H=0, standard operation mode; H=1, each step has preparation function (rdy) in ramp mode.	
EP1~EP8		Define 1~8 field parameters for those common used parameters when the Loc lock is applied. If there is none or less than 8 field parameters, please set as nonE.	

3.3 Additional Explanation On Special Functions

3.3.1 Single-phase phase-shift trigger output

When OPt is set to PHA1, installing a K50/K60 module in OUTP slot can single-phase phase-shift trigger a TRIAC or 2 inverse parallel SCRs. It can continuously adjust heating power by control the conduction angle of thyristor. With non-linear power adjustment according to the characters of sine wave, it can get ideal control.The trigger adopts self-synchronizing technology, so it can also work even when the power supplies of the instrument and the heater are different. Phase-shift trigger has high interference to the electric power, so user should pay attention to the anti-interference ability of other machines in the system. Now the K50 or K60 module can be only used in 50Hz power grid.

3.3.2 position proportion output

AI-719/719P can direct drive the motor to control the valve and supports two modes: valve position feedback signal and no valve position feedback signal. In the proportional output of the no-feedback position (OPt=nFEd), if OPH is less than 100, the valve position will be set automatically when the instrument is powered on, that is, the valve will be closed automatically when the instrument is powered on. The time is the valve stroke time. In this case, the maximum valve opening can be limited via the OPH parameter when the measured valve PV is less than the parameter OEF. If OPH is set as 0, the instrument will automatically set the valve position when the output is 0% and 100%. The valve position will not be set after powering-on, thereby shorting the start-up time. In the proportional output of the feedback position, OPt is set to be equal to FEAt, the instrument will automatically close and then fully open the valve, and the feedback signal is measured to set the

valve position. In addition, the valve position will be saved. After automatic setting of the valve position, the instrument will automatically set the parameter OPt as FEd for normal control. If the feedback signal is 2% more than the range, the feedback signal will be considered abnormal, the mode of no valve feedback signal will be automatically enabled for control, and the lower display window will display “FErr” as the error prompt. The feedback signal can be 1K resistance (requiring the module W5 or U5) or 0-5V/1-5V signal (the current 0-20mA/4-20mA can be converted in parallel to the resistance). When the instrument adopts the position proportion in the output, it is recommended to use the instrument panel with the light pillar indicator, such as A2 and E2. The light pillar can indicate the valve opening instead of the output value which is not calculated by the instrument.

3.3.3 Setpoints switch/ External program control

If an I2 module is installed in MIO slot (or bAud=1 installed in COMM slot). User can connect external on off switch to realize some control function. Set Et = ruSt and press the switch to run the program or to stop the operation by pressing and holding the button for more than 2 seconds. For AI-719(Pno=0 for AI-719P), set Et = SP1.2 to switch between SP1/SP2.

3.3.4 Alarm blocking at the beginning of power on

Sometimes the fault alarm may occur at the beginning of power on. In a heating system, at the beginning of power on, its temperature is much lower than the set point. If low limit and deviation low limit are set and the alarm conditions are satisfied, the instrument should alarm, but there is no problem in the system. Contrarily, in an refrigerating system, the unnecessary high limit or deviation high limit alarm may occur at the beginning of

power on. Therefore, AI instruments offer the function of alarm blocking at the beginning of power on. When Act is set to rEbA or drbA, the corresponding low or high alarms are blocked until the alarm condition first clears. If the alarm condition is satisfied again, the alarm will work.

3.3.5 Communication Function

AI series instruments can be installed with S or S4 and other communication modules at the COMM position, and can be connected with computers to realize various operations and functions of the instrument. For the computer without RS485 interface, one RS232C/RS485 converter or USB/RS485 converter can be added. Each communication port can directly connect 1-60 instruments. With RS485 repeater, up to 80 instruments can be connected. One computer can support multiple communication ports. Please note that each instrument shall be set with a different address. When there are more than one instrument, two or more computers can be used, and a local network can be formed between the computers. The manufacturer can provide AIDCS application software, which can run under the Chinese WINDOWS operating system, realize centralized monitoring and management of 1~200 AI series instruments of various models, and automatically record and print measurement data. If users want to develop their own configuration software, they can ask the instrument seller for free when obtaining the communication protocol. A variety of configuration software can support AI instrument communication.

3.3.6 Temperature re-transmitter/ Program Generator

Apart from APID/PID control and ON-OFF control, the instrument can retransmit PV (processed value) or SV (set value) from OUTP terminals. When the output is defined as current output, AI-719 becomes a

temperature re-transmitter. The precision of 4~20mA current output is 0.3%FS. The corresponding parameters are set as below:

CtrL=PoP, PV is retransmitted. When CtrL=SOP, SV is retransmitted.

OPt, OPL and OPH defines the specification of output, generally it is 4~20mA or 0~20mA.

InP, SCH, SCL and Scb define the input specification of thermocouple or thermal resistance and retransmit low limit or high limit of PV and doing adjustment.

For example, in order to retransmit temperature reading from a K-type thermocouple, ranging 0~400℃, output as current 4~20mA, the parameters are set as below: InP=0, ScL=0.0, ScH=400.0, OPt=4~20, OPL=0, OPH=100. X3 or X5 linear current module installed in OUTP slot is 4mA. When the temperature is lower than or equal to 0℃, the output is 4mA. When the temperature equals to 400℃, the output is 20mA. When the temperature reading is in between 0~400℃, the output will sit between 4~20mA.

3.3.7 Fine Control

Under fine control, the PID operation resolution is 10 times higher than the display resolution. For example, the temperature signal of the instrument is displayed at 1 ℃, but the internal PID is still operated and controlled according to the resolution of 0.1 ℃, which can achieve a much higher control accuracy than the display resolution. The previous AI series instruments only used fine control for temperature signals. When the new version of the instrument was in linear input, as long as the displayed value was less than 3000 words (most industrial applications were no more than 3000 words), the fine mode was defaulted to obtain higher control

accuracy and more stable output. When the displayed value was greater than 3000, AF.F=1 can be set.

3.3.8 **User-defined Input Specifications**

When the parameter InP=10 is set, the instrument input specification is a user-defined input type, and non-linear tables can be edited. Setting method: Set Loc=3698 to enter the table setting status. The parameter A 00 definition table is used for: 0 for input nonlinear measurement or multi segment linear correction of input signal, 1 for nonlinear power control of high temperature furnace; Parameters include A01~A04 and d00~d59 (the values of A02~A04 and d00~d59 have decimal places. If dPt is set to 0.0, the values of A02~d59 should be divided by 10), respectively set as follows:

A 00: 0

A 01: Define the input type, whose values are defined as follows:

A 01=A*1+E*16+G*64

A indicates input signal range: 0, 0~20mV (0-80 Ω); 1, 0~60mV (0-240 Ω); 2, 0~100mV (0-400 Ω); 4，0~5V；10, 0~20mA or 0~10V (I4 or I31 module is installed at MIO position).

E indicates input signal display: 0, indicating that the table output value needs to be calibrated again by the ScH/ScL parameter when the linear input signal is used. 1, indicating that the table output value is the display value.

G indicates the type of input signal (determine whether the input signal is temperature type or non temperature type): 0, thermocouple; 1. Thermal resistance; 2. Linear voltage (current); 3. Linear resistance.

For example, if the signal is 1~5V voltage input and not temperature type, set A01=4*1+0*16+2*64=132

A 02: Define the lower limit of the input signal, equal to the lower limit of the signal*K/range, for example, 1~5V signal input, A02=1*25000/5=5000 can be set.

K is the signal coefficient, where the coefficient is 20000 when A01.A is 0, 25000 when A01.A is 2, 4 and

10, and 30000 when A01.A is 1.

A 03: Define the input signal range, equal to the signal range*K/range, for example, in 1~5V input, if the range is 5-1V=4V, A03=4*25000/5=20000 should be set.

A 04: Define the table spacing of input signals, A04=A03/number of curve segments. If there is only one segment, A04=A03; If it is divided into two sections, A04=A03/2.

d 00: represents the starting point value of the curve table, which corresponds to the output value when the input signal is A02. for example, set d 00=0

d 01: represents the value of the first segment of the curve table, which corresponds to the output value when the input signal is A02+A04, for example, it can be set as 20000 in 1~5V input (full scale).

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

3.3.9 Multi-step Linear Correction to Input Signal

When the input specification InP is set to plus 64, the instrument has the input multi segment linear correction function. Setting method: Set Loc=3698 to enter the table setting status (if Loc=808, set Loc to 0 first, exit the parameter setting status, and then enter the parameter status again to set Loc=3698). The settings are as follows:

A00：0；

A01: Input signal and display setting:

A 01=A*1+E*16+G*64

A indicates signal range: A=0, 0~20mV (0~80 Ω); A=1, 0~60mV (0~240 Ω); A=2, 0~100mV (0~400 Ω).

E indicates signal display: E=0, no effect; E=1, the values set in the table d00~d59 are the displayed values.

G indicates signal type: G=0, thermocouple; G=1, thermal resistance.

For example, if the signal is thermocouple input and temperature type, set A01=2*1+1*16+0*64=18

A02: Starting temperature

A03: measuring range=highest value measured - A02

A04: Temperature interval of each section=A03/number of sections

d00~d59: temperature setting value of each section

For example, the input range of K thermocouple is 0 to 300 degrees, one decimal place, correction every 100 degrees. 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. Just set the corresponding temperature point slightly higher or lower than the value displayed on the instrument, for example, the instrument shows 200.0 degrees, and the calibration device measures 202.0, then change d02=200.0 to d02=202.0.

Note: The corrected value is the value of each point, and the point-to-point transition is automatic and linear. When this function is enabled, the instrument can only be displayed within the temperature range set by the table. When the actual temperature exceeds the table range, the instrument will display the orAL overrun alarm.

3.3.10 Nonlinear Power Control to High Temperature Furnace

For high-temperature furnaces with non-linear load, the resistance will change dramatically with the temperature change. Take the silicon-molybdenum bar furnace as an example, its room temperature is about 6% when the resistance is only 1600 degrees. If the output power of the instrument is not limited and transformed, it will lead to two problems. First, when the instrument starts at low temperature, the current of the electric furnace is too large and exceeds the maximum allowable load of the power grid, thyristor and transformer, which causes damage to thyristor, electric furnace and transformer or even causes power grid tripping. In addition, when the instrument has the same output, the power of the electric furnace in the low temperature zone and the high temperature zone will differ by more than 10 times at most, which means that the proportional band P in the PID

parameter needs to change by more than 10 times at different temperatures to enable accurate temperature control in the low temperature and high temperature zones. However, the method of limiting 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 use, but also ineffective.

The user-defined output limit transformation function simultaneously solves the function of limiting output and transforming the proportional band P. This function limits and transforms the instrument output according to the measured temperature. It not only limits the power in the low temperature zone, but also automatically corrects the parameters of the proportional band at different temperatures. The power limit and the change of the proportional band are both continuous broken line mode, which is better than the grouping mode. The power limit only reduces the actual output of the instrument proportionally, while the display range of the instrument output is still 0~100%. For example, when it is used for silicon molybdenum bar furnace, it can be set as follows (customers can also edit the data according to their own needs):

A00=1, A 01=1050, A02=100.0; A03=1500; A04=750.0, d00=120.0; d01=1100, d02=2000

When parameter A00=1 and A01=1050 are set, the instrument enables the user-defined output limit transformation function. A02 represents the initial temperature of the output limit, A03 represents the temperature range of the output limit(A03=max-A02), and A04 represents the segment length of the nonlinear data temperature segment. In this example, 1500/750.0=2 represents two segments. The more segments, the more complex and refined the curve can be. d00 represents the maximum output power when it is lower than A02, and its unit is 100%*(1/2000), d00=120.0 means 6%, d01 means 55%, and d02 means 100%.

The meaning of this curve is that when the temperature is below 100 ℃, the output limit is 6%; when the temperature is between 100 ℃ and 850 ℃, the power limit is 6% and smoothly transits to 55%; when the

temperature is between 850 ℃ and 1600 ℃, the power limit is 55% and 100%; when the temperature is above 1600 ℃, the power limit is not limited to 100%.

Note: This function cannot be used with the input multi segment linear correction function at the same time. If it is used at the same time, special specification input is required. Please contact the seller to negotiate the solidification into the instrument, but there may be a one-time additional payment.

4 Program Control(AI–719P only)

The AI-719P program type instrument is used in situations where it is needed to automatically change the set value to control according to a certain time rule. It not only has the function of 50 steps programming, which can set the rise and fall slope of any set value, but also has programmable/operable commands such as jump, run, pause and stop, which can edit the program during controlling; in addition, it has functions like power failure processing, process value startup and preparation, which makes program more efficient and perfect.

4.1 Functions and Concepts

Program step: The number of the program Step can be defined from 1 to 50. The current Step is the program Step being executing.

Program time: refers to the total running time set for the program step, in minute or hour, with effective values ranging from 0.1 to 3200.

Running time: refers to the running time of the current step. When the running time reaches the set period, the program automatically moves to the next period.

Jump: the program step can be programmed to automatically jump to any step to achieve circle-control. Or it can also be achieved by editing the value of StEP.

Run (run/HoLd): When the program is in the running status, the time shall be timed, and the changes of the set value follow the prearranged program curve. When it is changed to suspend status (suspended), the timing function stops and the set value remains unchanged. The suspend operation (HoLd) can be programmed in the program step.

StoP: it will stop the program running. Here the running time is cleared and the timing as well as the output is stopped. In this situation, if the instrument is required to run, start the step number set by StEP. Autostop is

allowed to be programmed into steps and the StEP value of the run step is set. Or stop the operation artificially at any time (StEP is set to 1, which can be modified by the user). If the program step has run through the last step defined in the Pno parameter, it stops automatically.

Power cut/ resume event handling: it refers to the power on or the accidental power failure during operation. A variety of solutions can be found by setting PonP parameters.

PV preparation function (rdy): When the program is running and the power is cut off/started unexpectedly but the operation needs to continue, if the process value is different from the set value (if the program allows starting with the process value, start with the process value; and if the process value works well, the preparation function is unnecessary, and only when the process value does not meet the requirements for starting can the preparation function be used for processing), and when PV-SV>deviation alarm value (HdAL and LdAL), the instrument will not immediately give a positive (or negative) deviation alarm. On the contrary, it will adjust the process value until its error is less than the deviation alarm value. Here the timing will be suspended, and the deviation alarm signal will not be output. The program will not be started again until the positive and negative deviations meet the requirements. The preparation function can also be used to set the program step with unpredictable rise/drop time, which can be achieved by setting PAF parameters; It can ensure the integrity of the whole program curve, but it is possible to increase the total running time due to the preparation time. The preparation function and process value startup can be used to solve the uncertainty of program operation caused by the inconsistency between the process value and the set value during startup, so as to obtain efficient, complete and satisfactory results.

PV Startup: When the program is started and the power is cut off/started unexpectedly but the operation needs to continue, the actual process value is often different from the set value set by the computer, which is sometimes unexpected and unpredictable. For example, set a heating section from 25 ℃ to 625 ℃ after 600 minutes, and the temperature will rise by 1 ℃ every minute. It is assumed that when starting from the starting

position of this program step, if the process value is just 25 ℃, the program can run successfully as originally planned, but if the system temperature has not been reduced at the time of starting, for example, 100 ℃, then the program cannot run successfully as originally planned. Thus the startup function of the process value can be realized by automatically adjusting the running time of the instrument to make them consistent; In the above case, if the measuring temperature is 100 ℃ when starting the operation, the instrument will automatically set the running time to 75 minutes, so that the program can be started directly from the position of 100 ℃.

Curve fitting: it is a controlling technology adopted by the instrument. Because the control objects usually lag behind time, the instrument automatically smoothes the linear rise, drop and constant temperature curves at the break point. The smoothness is related to the system's lag time t (t=differential time d+control period CtI). The greater t is, the greater the smoothness is, and vice versa. The smaller the lag time (such as thermal inertia) of the control object, the better the control effect. The overshoot can be avoided by processing the program curve according to the way of the curve fitting.

Note: The characteristic of curve fitting makes the program control generate a fixed negative deviation during linear temperature rise and a fixed positive deviation during linear temperature drop. The value of the deviation is proportional to the lag time (t) and the rate of temperature rise (fall). It is a normal phenomenon.

4.2 Program Arrangement

4.2.1 Ramp Mode

When the parameter PAF.B=0, the program arrangement is set in the format of temperature-time-temperature, which means temperature “A”(SP 1), passed Time “A”(t01), then reached Temperature “B”(SP 2). The unit of temperature is the same as PV (processed value). The unit of time can be minute or hour. In ramp mode, when the program pointer reaches the last step number defined in Pno parameter, the instrument will hold the time (t) at the temperature (SPx) then ends the program, unless the SPx value is a command for stop or jump. The following example includes 5 steps, which is linear temperature heating up, constant temperature, linear temperature cooling down, jump cycling, ready, Hold.

Step 1: SP 1=100 , t 1=30.0; Start linear temperature heating up from 100℃. Time required is 30 minutes. Rate of temperature increase is 10℃/minute.

Step 2: SP 2=400 , t 2=60.0; Temperature 400℃ is kept for 60 minutes.

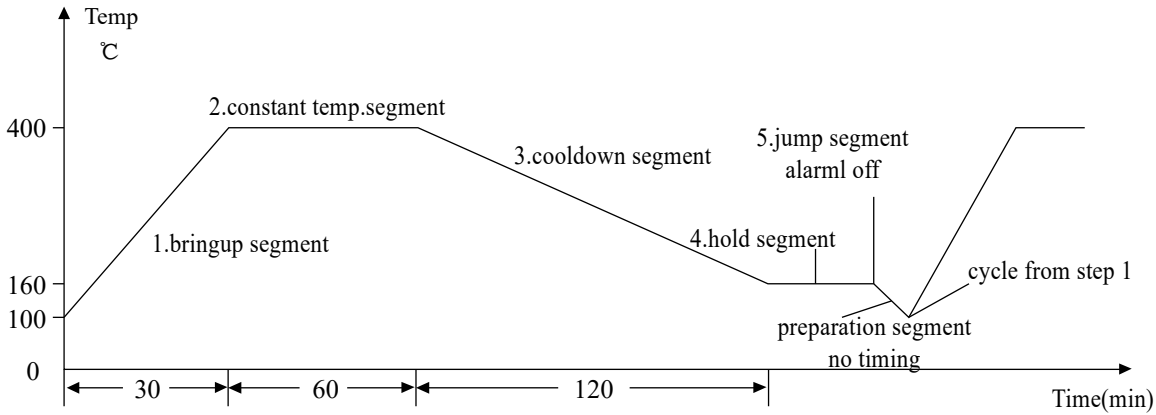
Step 3: SP 3=400 , t 3=120.0; Temperature cooling at a rate of cooling is 2℃/minute. Time needed is 120 minutes to reach SP4

Step 4: SP 4=160 , t 4=0.0; When temperature reached 160 degree, the program paused (HoLd status). User has to execute “run” to proceed to next steps.

Step 5: SP 5=160 , t 5=-1.0; Jump to Step 1 to start from beginning in a loop.

In the example above, When the program jump from step 5 to step 1, the temperature is 160℃ which is not equal to the value of step 1 as 100℃. The step 5 is a command step as well. Assuming that the deviation high

alarm is set to 5℃, before the program jumping from step 5 to step 1, it will activate PV Preparation/Ready function (if PV Preparation/Ready “rdy” was enabled) to regulate the temperature until the deviation between PV and SV is less than deviation high alarm value, i.e. 105℃. Then the program will be started from Step 1 again. The temperature control curve is illustrated below.



The advantage of applying “temperature-time-temperature” arrangement is to provide a wide window of setting rate of increasing and decreasing temperature. The format of increasing and decreasing temperature steps keep the same format, for easy to learn. There is a high flexibly to set the curve, enabling possibility to input continuous increasing curves (e.g. using different rate of increasing curve to achieve functional heating) or continuous temperature-holding steps

4.2.2 Soak Mode

When the parameter PAF.B=1, soak mode is selected. This is suitable for the process which does not need to establish the temperature slope, simplifying the programming and using the quantity of steps more effectively. Each step contain the meaning of “temperature ~ holding time at that temperature”. Parameter “SPr” defines the rate of temperature change among steps. If “SPr=0”, the rate will set to maximum. Since the time of temperature increasing and it occupies the holding time, PV preparation/Ready function “rdy” is advised to be used to ensure to obtain the correct soak time (holding time).

4.2.3 Time Setting

Each step of program includes set value and time. The range of the set value is limited by SPL and SPH, which is - 999~+3200 ℃, indicating the temperature (℃) or linear unit to be controlled; In addition to the running time, time has special significance, as follows:

Set “t-xx” = 0.1~3200 (min)

Set the time of Step xx. (Time unit can be change to hour by parameter “PAF”.)

Set “t-xx” = 0.0

The program pauses (HoLd) on Step xx. The program will be paused and timer pauses counting.

Set “t-xx” = -121.0

The program stops(StoP), and go into stop status.

Set “t-xx” = -0.1~-122.0

Negative value in time value represents a command (a jump operation + event output). The integral part “-1~-120” refers to the step number to jumped to. Step number greater than Pno (Number of program step) with non-zero decimal space does nothing but proceed to next step. Decimal place refers to programming of event output at AL1 and AL2. –XXX.0 indicates the event is none but step jumping only. Please note that if parameter AOP assigns alarm action at AL1 or AL2, no matter event outputs or ordinary alarms will cause alarms from AL1 and AL2. The definition of -XXX.1 ~ -XXX.4 are as below

-XXX.1, AL1 activated, AL2 released

-XXX.2, AL1 released, AL2 activated

-XXX.3, AL1 activated, AL2 activated

-XXX.4, AL1 released, AL2 release

Example 1: t- 5 = -1.1; When the program pointer arrives step 5, AL1 is activated. AL2 is released. The program jumps to step 1 to keep running.

Example 2: t- 6 = -0.3; When the program arrives step 6, AL1 and AL2 are activated. The program proceeds to the next step (Step 7).

Note: Only when the “run” operation is executed or jumping during the power is just on, the program will continues to jump. If the program jump to a step setting itself is a jump step as well, the program will be paused (HoLd status. The system will automatically insert HoLd between two jump step). External run/Hold operation is

needed to release this HoLd status. Please be reminded if the jumping destination is the step number itself(i.e. t-6= -6), the HoLd status is not able to be released. This is a meaningless step.

4.2.4 Program arrangement of multi-curve operation

AI-719P has the advanced function of flexible program arrangement. Normally, when the program stops (StoP), the StEP will be automatically set to 1. If multiple curves are defined in all the steps available, the control method can be done by setting different jump steps in step 1, as a starting point. For example, there are three curves with the length of 3 steps represent three groups of process parameter. They are separately arranged on Step 2~Step 4, Step 5 ~ Step 7 and Step 8 ~ Step 10. By changing the step number:

t- 1=-2.0 Execute the program of curve 1 (Step 2 ~ Step 4)

t- 1=-5.0 Execute the program of curve 2 (Step 5 ~ Step 7)

t- 1=-8.0 Execute the program of curve 3 (Step 8 ~ Step 10)

When the manufacturing methodology is required to be changed, the curves can be loaded by setting the “t-1“ as -2.0, -5.0 or -8.0. This jump selection step can also be omitted. The corresponding StEP number can be chosen before the program starts.

5. FAQs

5.1 How to set self-tuning?

When the process 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.

5.2 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 LOC and set LOC=808, then press ↺ briefly to refer to all the parameters.

5.3 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, then check whether the instrument parameters are set correctly; If it is on, it indicates that the instrument output status is normal. A multi-meter 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.

5.4 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.

5.5 How to set program segments?

After the instrument turns on, press ◁ on the initial interface to enter the program section menu, and then press ↻ to display the next data. Each program section is arranged in the order of "set value---time---set value". Please refer to the program control of this manual for details.

5.6 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).

5.7 How to set dual output for heating and cooling?

Find the OPL parameter (lower output limit) in the internal parameter list, change the OPL to -1%~-110%, and the instrument will change to a bidirectional PID output. The main output OUTP is used to control heating, and the auxiliary output AUX is used to control cooling.

5.8 How to set external settings?

Find the AF2 parameter in the internal parameter list of the instrument and set AF2=1 (enable external setting function), then set the lower limit parameter SPSL and upper limit parameter SPSH of the external setting scale, so that these two parameters correspond to the set value range. The external given signal is input from terminals 17+and 18- (0~5V/1~5V DC signal), and the external given function can be used normally after connecting the wires.

5.8 How to switch between manual/automatic output?

Press once on the initial interface, and the SV window will switch from the set value to the output value status. Press again to switch the instrument between automatic and manual without disturbance. A is in the automatic status and M is in the manual status.