AI-733/733P High Precision Intelligent Industrial Controller

(Direct three-phase and three-wire phase-shift trigger)

Operating Instruction

(V8.2)

CONTENTS

1 Overview

1.1 Main characteristics

● Input as thermocouple, thermal resistance, voltage and current can be freely selected, while expanded input and user-defined nonlinear calibration form are permitted, with measuring accuracy of 0.1%

● Advanced AI intelligent PID algorithm eliminates over-adjustment and provids auto tuning (AT) function and brand new fine control mode

● Advanced modular construction and directly three-phase and three-wire phase-shift trigger are adopted, which can widely meet the demands of various electrical heating applications, with quick delivery and convenient maintenance

● Integrating the design of energy saving and environmental protection, high quality components are used to lower power consumption and lower temperature offset and to effectively save energy for customers

● With sampling frequency of 12.5 times per second and the minimum control cycle of 0.24s, control accuracy on fast changing subject can be maintained

● Personalized operation method which is easy to learn and use

● User-defined operation authorization and interface

● Universal 100-240VAC input range for switching power supply or 24VDC power supply. Different panels and dimensions are available

● Emissions of and immunity to electromagnetic interference meets the electromagnetic compatibility (EMC) under severe industrial conditions.

Notice

● This *Operating Instruction* introduces AI-733/733P intelligent PID temperature controller of V8.2, in which part of functions may not suit other instruments. The model and software version of the instrument will be shown on the display when powered on. Users shall pay attention to the difference among various models and instrument versions. Please read the *Operating Instruction* carefully, correctly use and fully play the function of the instrument.

Before the use of AI instrument, please specify appropriate input and output as three-phase and three-wire phase-shift trigger.The instrument should only be put into use with proper parameters.

1.2 Model definition

The hardware of AI series instrument adopts advanced modular design. AI-733/733P instrument can install at most 5 modules, i.e. output, alarm, communication and other modules on demand. Modules can be bought along with the instrument or bought separately for free combination. The input modes of the instrument can be freely set as thermocouple, thermal resistance and linear voltage (current). AI-733/733P instrument totally has 7 parts, for instance:

AI - 733	A	L5	N	S4	-	24VDC	-	(F2)
①	②	③	④	⑤		⑥		⑦

This means that an instrument has the following functions: ① model AI-733; ② Type-A panel size (96 × 96mm); ③ Alarm (ALM) with L5 two-way relay contact output module; ④ Auxiliary output (AUX) without module installation; ⑤ Communication interface (COMM) equipped with optoelectronic isolator RS485 communication interface S4 with its own isolated power supply; ⑥ 24VDC power supply; ⑦ F2 type expanded input specification (radiation-type pyrometer). The following lists out options of the 7 parts

① Instrument model.
AI-733 (high precision AI intelligent regulator with 0.1-level accuracy, three-phase and three-wire phase-shift trigger, multiple alarm modes, communication function and others)
AI-733P (30 sections of time program control function added on the basis of AI-733)

② Size of the instrument panel.
Panel A of 96 × 96mm, opening of 92 × 92mm, and insertion depth of 100mm;

A2 adds 25 sections of 4-level brightness column display function on the basis of A, with panel of 96 × 96mm, opening of 92 × 92mm, and insertion depth of 100mm;
Panel B of 160 × 80mm (W × H), horizontal type, opening of 152 × 76mm, and insertion depth of 100mm;
Panel C of 80 × 160mm (W x H), vertical type, opening of 76 × 152mm, and insertion depth of 100mm;
C3 adds 50 sections of 2-level brightness column display function on the basis of C, with the rest same as panel C;
Panel E of 48 × 96mm (W × H), opening of 45 × 92mm, and insertion depth of 100mm;
E2 adds 25 sections of 4-level brightness column display function on the basis of E, with the rest same as panel E;
E5 of 48 × 96mm (W x H x D), DIN guide installation mode, can be connected to E8 keyboard and display for setup and operation;
Panel F of 96 × 48 × 110mm (W × H), opening of 92 × 45mm, and insertion depth of 100mm;

③ Alarm (ALM) module to be installed: Modules such as L0, L1, L2 and L5 can be installed.

④ Auxiliary output (AUX) module to be installed: Modules such as L0, L1, L2 and L5 can be installed.

⑤ Communication (COMM) module to be installed: Modules such as S, S4 and V can be installed.

⑥ Power supply: 100~240VAC default power supply, while 24VDC represents that 20-32VDC or AC power supply is used.

⑦ Expanded reference table specification of the instrument (Leave blank if there is none). AI-733/733P has stored common thermocouple and thermal resistance input specifications (please see the technical specifications hereinafter for details). However, if input signals beyond the above specifications are used, the user can expand a type of input specification.

Note 1: This instrument is a kind of maintenance-free instrument adopting automatic zero setting and digital calibration technology. If the metrological verification is out of tolerance, the problem can be solved ordinarily by means of cleaning and drying the internal of the instrument. If it fails to recover accuracy after cleaning and drying, the instrument shall be returned to the factory for maintenance as a defective instrument.

Note 2: Customer will be provided 3 years warranty with free maintenance to the instrument. If the instrument must be returned to the factory for maintenance, the failure phenomena and reasons must be clarified, so as to ensure correct and complete recovery.

1.3 Module Selection

1.3.1 Definition of module socket function

AI-733/733P instrument has 3 alternative functional module sockets (i.e. AUX and COMM/AL1). Different output specifications and functional requirements can be met through the installation of different modules.

Auxiliary input (MIO): Installing K9 module along with OUTP provides three-phase and three-wire thyristor phase-shift trigger.

Main output (OUTP): standard PID control, AI intelligent APID controlled output; Installing K9 module along with OUTP provides three-phase and three-wire thyristor phase-shift trigger.

Alarm (ALM): L1 or L2 can be installed as DPDT normally open + normally close relay alarm output (AL1), or L5 can be installed as two-way normally open relay alarm output (AL1+AL2).

Auxiliary Output (AUX): L1, L2 or L5 relay can be installed as alarm output; while R module (RS232C interface) can also be installed to provide the communication with computers.

Communication interface (COMM): S or S4 module (RS485 communication interface) can be installed to communicate with computers, while voltage output modules can also be installed to provide power supply for external sensors.

1.3.2 Common module types

N (or blank)	no module installed;
K9	"burn-proof" directly three-phase and three-wire thyristor phase-shift trigger output module, with trigger current up to 0.5~5A;
L0	Relay contact output module (economical large-sized, high capacity 2A/250VAC, applicable to alarm);
L1	High-capacity and large-sized relay (8A/250VAC) normally open contact output module (capacity: 250VAC/2A);
L2	Low-capacity and small-volume relay normally open + normally close contact output module (capacity: 250VAC/1A, applicable to alarm);
L5	Two-way large-sized relay (Imported brand 5A/250VAC) normally open contact output module (capacity: 30VDC/2A, 250VAC/2A).
S	Optoelectronic isolator RS485 communication interface module;
S4	Optoelectronic isolator RS485 communication interface module with its own isolated power supply;
R	Optoelectronic isolator RS232C communication/printing interface module (printing function must be specified upon order);
V24 / V12 / V10	Isolated 24V/12V/10V DCV output, available for external transmitter or other circuits, with the maximum current of 50mA.

1.3.3 Installation and replacement of modules

Modules can be installed before the delivery of instrument upon users' order demands, while corresponding parameters can also be set correctly beforehand. If a module is damaged or should be replaced, the user can replace it on site. User may pull out the instrument boards from enclosure. removing the original module by small screwdriver, and installing a new module as marked. If the type of the module is changed, corresponding parameters should also be changed.

1.3.4 Application of K9 module

For direct three-phase phase-shift trigger output instrument, the CPU in instrument directly outputs the PID operands to trigger the three-phase trigger signals, with brand new characteristics and functions as follows:

1. Self-adaptive one-way antiparallel, two-way and one-way thyristor antiparallel diode power module;
2. Automatic identification of phase sequence and synchronizing signals, simple and convenient wiring;
3. "Burn-proof" thyristor trigger technology, no need to worry about wrong wiring or silicon-controlled damage leading to damage of trigger modules;
4. "Strong trigger" type trigger signals, with trigger current up to 0.5~5A and strong trigger ability;
5. Advanced frequency phase lock technology is adopted to automatically balance the three-phase unbalance caused by frequency or component errors, so as to acquire extremely accurate and even three-phase trigger signals and keep steady outputs.
6. S curve correction function will bring linear change of output power and PID operands, which is in favor of promoting control effects, while the trigger line without S curve correction function will lead to the linear relationship between the phase-shift angle and the PID operands, because the wave form is sinusoidal wave, the actually acquired power from PID operands and electric furnace will display S curve type

1.3.5 Model selection and application notice

1. The 2 trigger lines of K9 module have polarity, so please do not get polarity reversed;
2. The thyristor must be in parallel with the resistance and capacitance absorption components and the piezoresistor at the same time, otherwise it may lead to grid peak pulse damages, trigger signals, and lead to output beat, and easily damage the thyristor;
3. Because the neutral is not connected, if the electrical furnace will become aged under three-phase load (such as silicon-carbon rod electrical furnace), the uneven and aging problem will speed up. In such cases, using a standalone YUDIAN thyristor trigger AIJK3 is recommended.

1.4 Technical specifications

● Input specifications (universal input):
  Thermocouple: K, S, R, E, J, T, B, N, WRe3-WRe25, WRe5-WRe26, etc.
  Thermal resistance: Cu50, Pt100
  Linear voltage: 0~5V, 1~5V, 0~1V, 0~100mV, 0~20mV, -5~+5V, -1V~+1V, -20mV~+20mV, etc.
  Linear current (it is required to be connected to shunt resistors): 0~10mA, 0~20mA, 4~20mA, etc.
  Expanded specifications: Users can add an extra input specification on the basis of the above specifications.

● Measuring 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 (-100.00~+300.00℃)
  Linear input: -9990~+30000 user-defined

● Measuring accuracy: 0.1 (note: thermocouple should be connected to Cu50 copper resistor for compensation, while ±1℃ compensation error will be extra added during internal compensation.)

● Measuring temperature drift: ≤ 35PPm/℃ (note: thermocouple should be connected to Cu50 copper resistor for compensation, while temperature drift error will be extra added during internal compensation.)

● Sampling period: 12.5 times per second; when setting digital filtering parameter FILt=0, the response time displayed is ≤ 0.5s.

● Control cycle: 0.24-300.0s adjustable

Control modes:

Position control mode (control hysteresis adjustable)

AI intelligent control, including fuzzy logic PID regulating and parameter self-tuning functions' advanced control algorithm.

● Output specification (modularization):
Directly three-phase and three-wire thyristor phase-shift trigger: trigger current up to 0.5~5A;
5~500A two-way thyristor and 2 one-way thyristor antiparallel connections or thyristor power modules can be triggered.

● Alarm functions: upper, lower, upper deviation, and lower deviation; at most 4 alarms can be output, with alarm exemption when power on.

● Electromagnetic compatibility: IEC61000-4-4 (electrical fast transient) ±4KV/5KHz, IEC61000-4-5 (surge) 4KV and under 10V/m high-frequency electromagnetic interference, no system error or I/O malfunction will occur. The fluctuation of the measured values will not exceed ±5% of the range.

● Isolation withstand voltage: among the power terminals, the relay contact and the signal terminals: ≥2300V; among isolated weak electrical signal terminals: ≥600V

● Power supply: 100~240VAC, -15%, +10% / 50~60Hz; 120-240VDC; or 24VDC/AC, -15%, +10%

● Power consumption: ≤0.5W (without any output or alarm actions); the maximum power consumption ≤4W

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

● Panel size: 96×96mm, 160×80mm, 80×160mm, 48×96mm, 96×48mm

● Opening size: 92×92mm, 152×76mm, 76×152mm, 45×92mm, 92×45mm

● Insertion depth: ≤100mm

1.5 Energy-saving and environment-friendly design

AI-733/733P adopts energy-saving and environment-friendly design, which is reflected in extremely low temperature drift and its own extremely low power consumption. High-quality key components, which pass pair test, with low temperature drift is used. The typical temperature drift on the instrument is less than 25PPm/℃. Extra costs on those components are worthwhile to meet the energy-saving target. We try hard to lower the instrument power consumption, by choosing bright-lit LED displays at the same driving current of usual LED. Despite the cost is almost doubled, reduced power consumption, reliability and performance are lastly improved

Compared with conventional temperature controller, the instrument with low temperature drift has less change in the measured temperature under the influence of ambient temperature, which can provide more stable product quality and less energy consumption. Thanks to low temperature drift, high precision instruments are more energy-saving compared with low precision ones. For instance, provided the sintering temperature range of a ceramic material is 1,000-1,010℃, because the temperature drift of an conventional instrument in the market is about ±5℃ (caused by ambient temperature difference in winter, summer, morning and evening), normal production can only be maintained under different ambient temperatures when the instrument is set at 1,005℃ (range of temperature: 1,000-1,010℃), but the temperature drift of AI-719/719P instrument can be reduced to be within ±1℃, for which stable production can be realized when the temperature is set at 1,001℃ (range of temperature: 1,000-1,002℃), as a result, the average temperature of the furnace can be reduced by 4℃. The lower the average temperature of the industrial furnace has, the less the power consumption will be. 0.4%~0.6% of energy will be saved only relying on reduced temperature shift instrument. And the product quality will become more stable, color aberration will become lower, energy consumption will be further reduced and great contribution will be made to environmental protection. The same result can be obtained from a 0.05-level precision instruments. To realize energy saving and improve product quality, Yudian will adopt components with higher precision and lower temperature drift with prices unchanged, so as to improve the measuring accuracy of AI-518/518P/519/519P series instrument from 0.3% to 0.25%, AI-708/708P series from 0.2% to 0.15%, AI-719/719P series (upgraded AI-808/808P) to 0.1%.

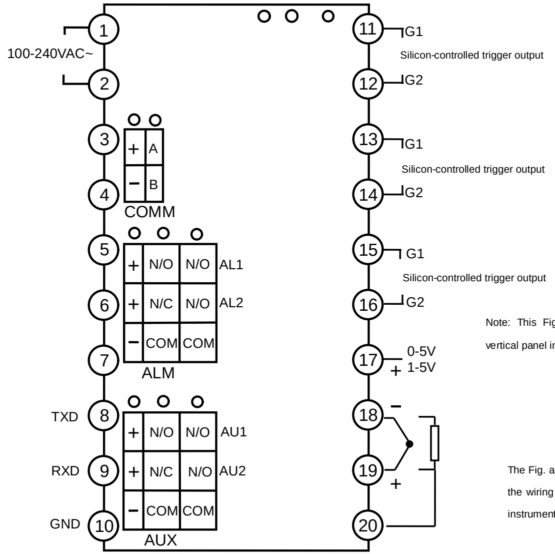
1.6 Wire Connection

Note:

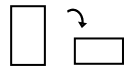
① Linear voltage <1V input to terminal 19, 18 0~5V and 1~5V to terminal 17,18

② Linear current 4~20mA input can be transformed into 1~5V voltage by 250Ω , then input through 17,18

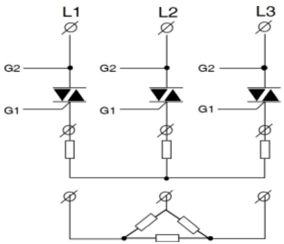
③ Thermocouples with different graduation should use corresponding thermocouple compensating wires. If internal automatic compensation mode is taken place, the compensating wire shall be directly connected to the wiring terminals of the instrument back, no conventional wires should be used to avoid measuring errors.



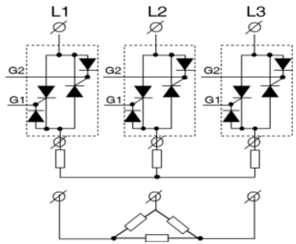
Note: This Fig. is the wiring diagram of A, C, E vertical panel instruments.



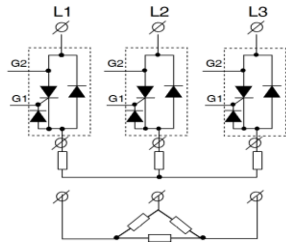
The Fig. after 90° clockwise rotation will become the wiring diagram of B and F transverse panel instruments, with terminal No. unchanged.



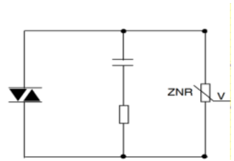
Three-phase and three-wire star and triangle wiring diagram (two-way thyristor)



Three-phase and three-wire fully-controlled power module star and triangle wiring diagram (single-phase thyristor antiparallel)



Three-phase and three-wire half-controlled power module star and triangle wiring diagram (single-phase thyristor + diode)



Note: The two ends of each thyristor or power module must be in parallel with the resistance and capacitance absorption components and the piezoresistor at the same time, otherwise it may lead to grid peak pulse interface, cause abnormal trigger, and even damage the thyristor

Note 1: Select the piezoresistor in accordance with the load voltage and current to protect the thyristor. If there is inductive load or phase-shift trigger, resistance and capacitance absorption must be added.

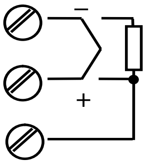
Note 2: It is recommended to use the thyristor power module. A power module includes 2 one-way thyristor, as shown in the dotted part of the figure.

Note 3: The AC range is 380VAC, and the power frequency must be 50Hz.

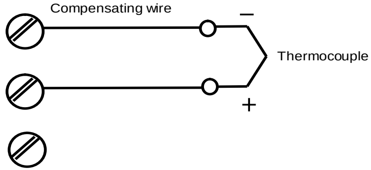
Note 4: The two trigger lines have polarity, so please do not get polarity reversed;

Choosing thermocouple cold junction compensation mode based on wire connection

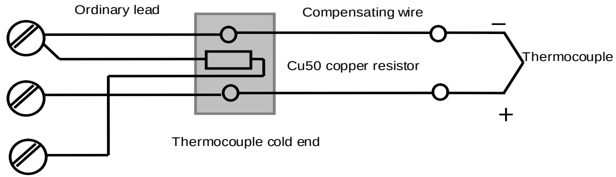
When using thermocouple as the input, cold junction should be applied for temperature compensation based on the thermocouple temperature measuring principles. AI instrument can automatically compensate cold junction referencing the temperature around the wiring terminals. Due to measuring components' errors, instrument's inherent heating and other heat sources nearby, the deviation of automatic compensation modes is comparatively large, for which the worst may exceed 2℃. So if higher accuracy is required, an external junction box can be used. Put Cu50 copper resistor (to be purchased separately) and thermocouple cold junction together, and keep away from the heat sources, thus the measuring inconformity caused by compensation may be less than 0.3℃. Because the inherent errors of Cu50 copper resistor may cause certain errors at room temperature, it can be modified with "Scb" parameter. Change the externally connected copper resistor into precision fixed resistance, which may achieve constant temperature bath compensation. For instance, connect it to constant 60Ω resistor, check the reference table of Cu50 and find the compensation temperature of 46.6℃. At this moment, put the thermocouple cold junction into the constant temperature bath for accurate compensation at the temperature of 46.6℃., its compensation accuracy will be better than that of copper resistor. If the externally connected resistance is changed into short circuit, ice-point compensation may be archieved. At this moment, it is required to place the thermocouple cold junction (the joints of the thermocouple or compensation wires and conventional wires) into the ice-water mixture (0℃), its compensation accuracy may reach above 0.1℃. There are two compensation modes' wiring diagrams as follows:



Instrument's corresponding wiring diagram



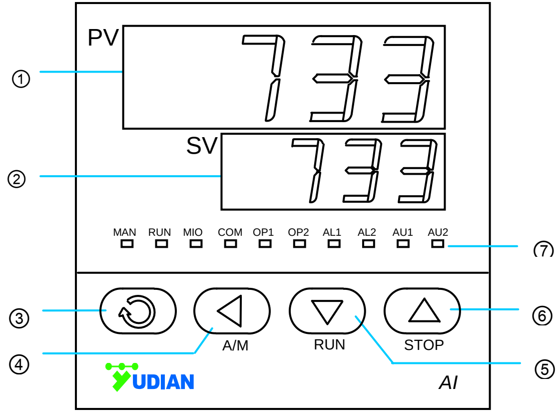
(1) Internal automatic compensation mode
(Compensating wire shall be directly connected to the connection terminals)



(2) Externally connected to copper resistor automatic compensation mode
(Thermocouple cold end terminal box had better keep away from heat sources)

2 Display and operation

2.1 Instruction of panel



① Upper display window, displaying measured value PV and parameter names, etc.

② Lower display window, displaying given value SV, alarm codes, parameters, etc.

③ ENTER, to enter parameter table, confirming parameter change, etc.

④ Digit Shift (Moving pointer)

⑤ Digit Decrease (RUN/HOLD)

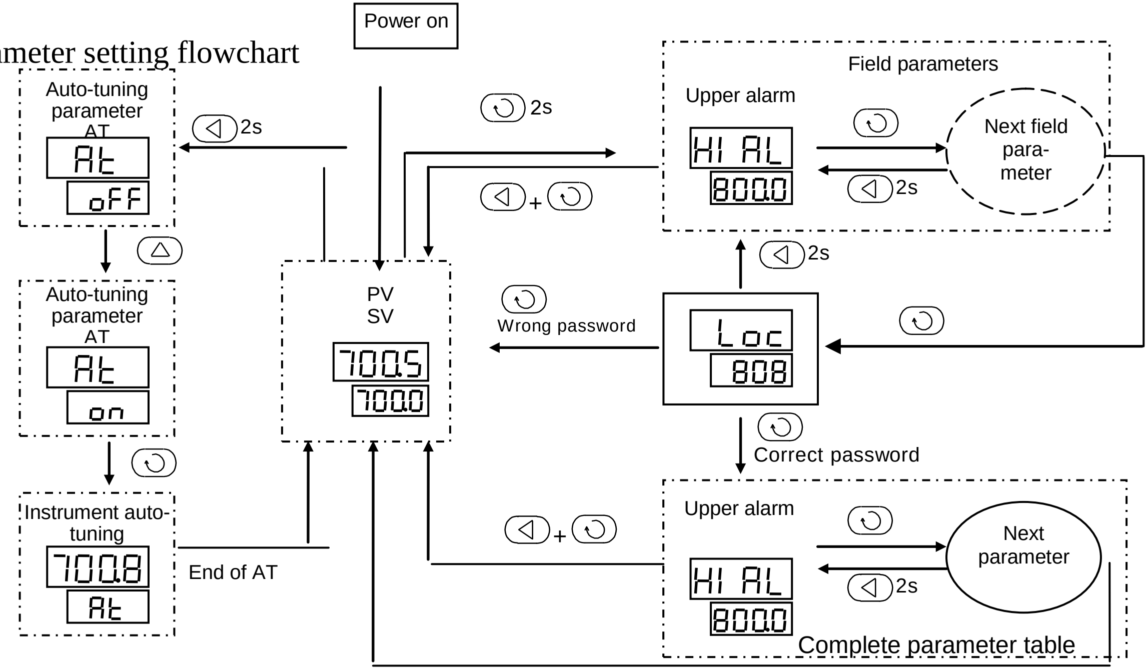
⑥ Digit Increase (STOP)

⑦ 10 LED indicator lamps,
MAN Not applicable
RUN Running Status
MIO Auxiliary Input
OP1 Main Output
OP2 Output 2

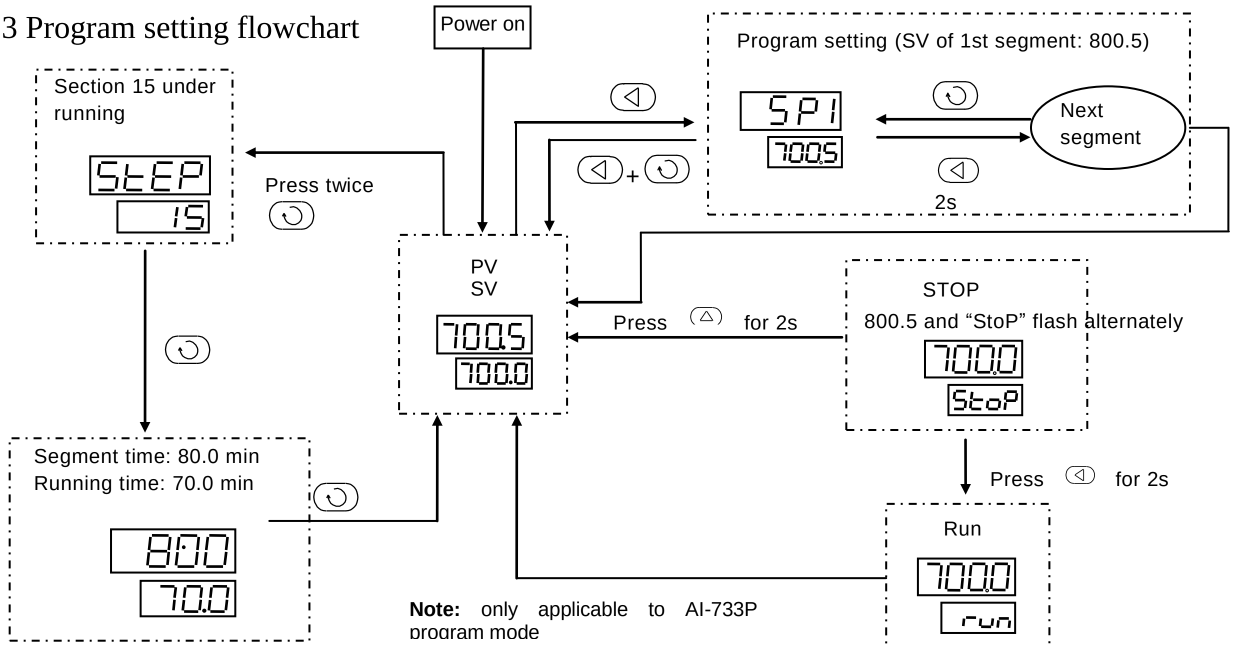
AL1	Alarm 1
AL2	Alarm 2
AU1	Auxiliary Output 1
AU2	Auxiliary Output 1
COM	Communication with computer/PLC

The instrument enters initial status once power on. Upper and lower display respectively show the measured value (PV) and the set value (SV). The display may also alternately show status or warnings
"orAL" means that the input measured signals out of the range;
"HIAL", "LoAL", "HdAL" or "LdAL" respectively represents the High Limit Alarm, Low Limit Alarm, High deviation alarm , or Low deviation alarm ;
"StoP" represents the instrument is in being STOP;
"HoLD" represents the instrument is in being HOLD; (Only AI-733P)
"rdy" represents it is in READY status" (Only AI-733P)

2.2 Parameter setting flowchart



2.3 Program setting flowchart



Note: only applicable to AI-733P program mode

2.4 Operational Method

2.4.1 Parameter setting

Press ↻ for about 2s under initial display to enter user-defined field parameter table. Press keys such as ◁, ▽ and △ to modify parameter values. Press ▽ to reduce number, press △ to increase number, and the decimal points of all modified values will flash (use as pointer). Hold the key will rapidly increase/reduce values. The changing speed will speed up. User can also press ◁ to move the pointer. Press ↻ to save the change and go to the next parameter. Hold ↻ can move down the table quickly. Hold ◁ for 2s will go back to previous parameter. Press and hold ◁ then press ↻ will jump out of the parameter setting. If there is no operation for 25s, it will automatically return to the initial status.

2.4.2 Quick operating functions

All functions of AI-733/733P can be achieved by modifying parameters without any jumpers. We put shortcut on keys for some common functions, such as SV and program RUN/STOP. These shortcuts can be disabled to avoid incorrect operation.

Changing SV: In single set-point control mode (Pno = 0), SV is shown on lower display window. Press ◁ to make it flash, then press ◁, ▽ and △ to change the value.

Program Segment Setting: In program segment control mode (Pno≥1), SV is shown on the lower display. Press ◁ to enter the program segment menu. Current SV comes first, then press ↻ to show the time, The segment SV and time will arrange in “SV-time-SV” sequence. The segment can be modified during the program segment is running.

Program RUN Control: Press ▽ for 2s to RUN. “run” will be shown the lower display. If the parameter PAF.F=1 (AI-733P) and if the program is running, this will enter “HoLD” status. The timer will pause. Press again will resume the program.

STOP control: When the lower display is showing SV, press “△” for 2s to “StoP”, output will be stopped. AI-733P stops program and the segment parameter StEP will become 1
.

Auto-tuning (AT): Press ◁ for about 2s, “At” parameters will appear. Press △ to change “OFF” to “ON”, then press ↻ to start auto-tuning. (If the SPr parameter is effective and in ramp slope limit, auto-tuning will be paused until heating is finished) The lower display will flash “At”. After two oscillating cycles of “ON-OFF” control, it can automatically work out the PID parameters. Press ◁ for 2s to quit auto-tuming. Change the setting from “on” to “OFF” and press ↻ to confirm. If the program steps is running, auto-tuning will pause the program timer, so as to ensure that the SV will not change.

2.4.3 DIN guide installation type instrument

AI-733E5 and AI-733PE5 are DIN rail mounted. E5 series provides no display or keypad 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. E8 provides two-row 4-digit display, without LED indicator lamps. The LED indicator lamp of top 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 (on and off at equal time intervals) at certain frequency. The meaning for lighting signal is explained as below.

Flashing slowly in cycle of 1.6s	- No communication but the instrument works normally with no alarm.
Flashing quickly in cycle of 0.6s	- No communication but there is warnings such as an alarm.
Flashing quickly in cycle of 0.3s	- 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 Functions

3.1 User-defined Parameter Table

AI-733/733P parameter table can program defined functions, which can be defined by users and protect important parameters from changed accidentally. We call those parameters required to be displayed or modified on site as "**field parameters**". Field parameter table is a subset of the complete parameter table and can be defined and modified by users, while the complete table must be entered by passwords. Parameter lock (Loc) offers several authorization levels to several parameters:

Loc=0 Able to modify field parameters and allow all shortcut operations, such as change of set value (SV) and steps value (time and temperature value in program steps);

Loc=1 Able to modify field parameters and use shortcut to change set values and step values, but not allowed to use shortcuts to perform program RUN/HOLD/STOP, set value control and auto-tuning.

Loc=2 Able to modify field parameters, but not allowed to use shortcuts such as changing set value, program steps and auto-tuning, Able to perform shortcuts of program RUN/HOLD/STOP and set value control

Loc=3 Able to modify field parameters, but not allowed for all shortcuts.

Loc=4~255 Not allowed to modify any parameters except for Loc itself. All shortcuts are disabled.

Set Loc= password (the password can be any number between 256 and 9999, and the default password is 808), and press to confirm to enter the display and modify the complete parameter table. Once entering the complete parameter table, except for the read-only parameters, all other parameters can be modified.

Parameters EP1~EP8 allow users to define 1~8 field parameters. If the number of field parameters required is less than eight, the first parameter not used shall be defined as nonE. For instance, the parameter table we need has three parameters HIAL, HdAL and At, the EP parameter can be set as follows: EP1=HIAL, EP2=HdAL, EP3=At and EP4=nonE

3.2 Complete Parameter Table

The complete parameter table can be divided into 8 parts including alarm, regulating control, input, output, and communication, system function, set value/program step, and field parameter.

Parameter	Meaning	Description	Set range
HIAL	High Limit Alarm	High Limit Alarm will occur when PV is larger than HIAL; High Limit Alarm will reset when PV is lower than HIAL-AHYS. Note: Each kind of alarm can be freely defined to control AL1, AL2, AU1, AU2 output actions, and do not take any actions, please see the instruction on the alarm output defined parameter AOP hereinafter.	-9990~ +32000 unit
LoAL	Low Limit Alarm	Low Limit Alarm will occur when PV is lower than LoAL; Low Limit Alarm will reset when PV is larger than LoAL + AHYS. Note: When necessary, HIAL and LoAL can also be set as deviation alarms (please see AF parameter instructions)	
HdAL	High deviation alarm	High deviation alarm will occur when the deviation (PV-SV) is larger than HdAL; High deviation alarm will reset when the deviation is lower than HdAL-AHYS. When HdAL is set as the maximum value, the alarm function will be cancelled.	
LdAL	Low deviation alarm	Low deviation alarm will occur when the deviation (PV-SV) is lower than LdAL; Low deviation alarm will reset when the deviation is larger than LdAL+AHYS. When HdAL is set as the minimum value, the alarm function will be cancelled. Note: When necessary, HdAL and LdAL can also be set as absolute value alarm (please see AF parameter instruction).	

AHYS	Alarm hysteresis	Also called alarm deadband. It is used to avoid frequent action of alarm critical position caused by alarm relay, with functions as above mentioned.	0~2000 unit
AOP	Alarm output allocation	The unit, decade, hundred and thousand of the 4 digits of AOP are respectively used to define the output positions of HIAL, LoAL, HdAL and LdAL, as follows: AOP = 3 3 0 1 ; LdAL HdAL LoAL HIAL The number range is 0-4, of which 0 means that no alarm output from any ports; while 1, 2, 3, 4 means that alarms will respectively be output from AL1, AL2, AU1, and AU2. For instance, AOP=3301 means that High Limit Alarm HIAL will be output from AL1, Low Limit Alarm LoAL without output, HdAL and LdAL from AU1, i.e. HdAL and LdAL alarms will both lead to AU1 actions. Note 1: If AL2 or AU2 is needed, L5 two-way relay module can be installed at the position of ALM or AUX.	0~4444
CtrL	Control mode	OnoF: ON-OFF regulation, only applicable to undemanding occasions. APID: advanced AI intelligent PID regulating algorithm, recommended. nPID: standard PID regulating algorithm, with anti-integral functions.	

Srun	Running status	Run: operation control status, RUN lamp on. StoP: stop status, the lower display will flash “StoP”, RUN lamp off. HoLd: maintening operation control status. If the instrument adopts fixed temperature control without time limit (AI-719 or AI-719P, Pno=0), this status is treated as normal status. But it is forbidden to carry out operation or stop operation from the panel. If the instrument is program step control (Pno>0), under such status the instrument will keep control output but pause timer, at the same time, the lower display will flash “HoLd”, and RUN lamp flashes. Panel keys can be used to carry out operation control or stop operation to relieve “HoLd” status. Note: “HoLd” status cannot be achieved only with panel operation, which can only be reached by directly modifying parameters or by means of programming, communication with computer or event input.	
Act	Direct action/ Reverse action	rE, Reverse action regulating method, when the input increases, the output will decrease, such as heating control. dr, Direct action regulating method, when the input increases, the output will increase, such as cooling control. rEbA, Reverse action regulation, with alarm exemption when power on and Low deviation alarm functions. drbA, Direct action regulating method, with alarm exemption when power on and High deviation alarm functions.	

At	Auto-tuning	OFF: auto-tuning At function is off. on: PID and Ctl parameter auto-tuning function is on, which will automatically return to OFF after auto-tuning is completed. FOFF: auto-tuning function is off, and it is forbidden to start auto-tuning from panel operation.	
P	Proportional band	Define the proportional bands of APID and PID regulation, with unit the same as PV rather than measuring range's percentage. Note: Generally, it can adopt At function to define P, I, D and CtI parameters, but for known systems, such as mass production heating equipment, known P, I, D, CtI parameters can be directly input.	1~32000 unit
I	Integral time	Define the integral time of PID regulating, with unit of second. Integral functions shall be cancelled when I=0.	0~9999s
D	Derivative time	Define the derivative time of PID regulating, with unit of 0.1 second. Derivative functions shall be cancelled when d=0.	0~3200s
CtI	Control Period	The conventional control period or time is set to 0.5-3.0s.	0.2~300.0s
CHYS	Control hysteresis (Deadband)	It is used to avoid frequent action of ON-OFF regulating output relay. When PV is larger than SV and the relay is turned off, and when PV is lower than SV-CHYS and output is reconnected, it will be used to reverse action (heating) control. When PV is lower than SV and the output is turned off, and when PV is larger than SV-CHYS and output is reconnected, it will be used to direct action (cooling) control.	0~2000 unit

<table>
<tr>
<td>InP</td>
<td>Input specification code</td>
<td>InP is used to select input specifications. The input specifications corresponding to its values are as follows:
<table>
<tr><td>0 K</td><td>21 Pt100</td></tr>
<tr><td>1 S</td><td>22 Pt100（-100~+300.00℃）</td></tr>
<tr><td>2 R</td><td>25 0~75mV voltage input</td></tr>
<tr><td>3 T</td><td>26 0~80Ω resistance input</td></tr>
<tr><td>4 E</td><td>27 0~400Ω resistance input</td></tr>
<tr><td>5 J</td><td>28 0~20mV voltage input</td></tr>
<tr><td>6 B</td><td>29 0~100mV voltage input</td></tr>
<tr><td>7 N</td><td>30 0~60mV voltage input</td></tr>
<tr><td>8 WRe3-WRe25</td><td>31 0~1V</td></tr>
<tr><td>9 WRe5-WRe26</td><td>32 0.2~1V</td></tr>
<tr><td>10 User-defined</td><td>33 1~5V voltage input</td></tr>
<tr><td>12 F2 radiation-pyrometer</td><td>34 0~5V voltage input</td></tr>
<tr><td>17 K（0~300.00℃）</td><td>35 -20~+20mV</td></tr>
<tr><td>18 J（0~300.00℃）</td><td>36 -100~+100mV</td></tr>
</table>
Note: When InP=10, the non-linear table can be either input by users or by factory upon extra charges.</td>
<td>0~37</td>
</tr>
</table>

dPt	Position of decimal points	0, 0.0, 0.00 and 0.000 four display forms are available. Note 1: For conventional thermocouple or thermal resistance inputs, 0 or 0.0 can be selected. Even if the form of 0 is selected, the internal should still maintain 0.1℃ resolution for control algorithm, when S, R or B type thermocouple is used, the form of 0 is recommended. When INP=17, 18, or 22, the internal of the instrument should maintain 0.01℃ resolution, for which 0.0 or 0.00 can be used. Note 2: When linear input is used, if the process values (PV) or other relevant parameters are larger than 9,999, the form of 0.000 is recommended rather than the form of 0, become the display form will turn into 00.00 if larger than 9,999.	
SCL	Low input scale	Define the low scale of linear input signals. Also define retransmission scale or light bar display.	-9990~ +32000 unit
SCH	High input scale	Define the high scale of linear input signals. . Also define retransmission scale or light bar display.	
Scb	Input shift compensation	Scb parameters are used to input shift compensation, so as to compensate for the sensors, input signals or thermocouple cold junction automatic compensated errors. Note: The default setting is 0. Incorrect setup may lead to measuring errors.	-9990~ +4000 unit

FILt	Input digital filtering	FILt decides digital filtering strength, the higher the setup is, the stronger the filtering is, but the response speed of measured data may also be slow. When measuring meets large interface, FILt can be gradually increased to make the measured value beat less than 2-5 characters. When the instrument executes measuring verification, FILt shall be set as 0 or 1, so as to improve the response speed. The unit of FILt is 0.5s.	0~40
OPH	Upper output limit	When PV is lower than OEF, it is required to limit the maximum output of OUTP; but when PV is larger than OEF, the modification output upper limit of the system is 100%. The instrument will automatically tune the position of valves when power on if OPH is lower than 100 when the non-feedback positions output in proportion (Opt = nFEd); if OPH=100, the instrument will automatically tune the position of valves when the output is 0% and 100%, which can reduce the starting time when power on. The setup of OPH must be larger than OPL.	0~110%

OPrt	Input soft starting time when power on	If PV is lower than OEF when getting power on, the maximum allowable output of OUTP will rise to 100% after OPrt time. If PV is larger than OEF when getting power on, the rising time for input will be limited within 5s. This function is only applicable to customers with special requirements. During manual output or auto-tuning, the maximum output will not be limited by soft starting. If soft starting function is required to reduce the impact current of inductive load, Ctl shall be equal to 0.5s, while OPrt shall be equal to 5s.	0~3600s
OEF	OPH effective range	When PV is lower than OEF, the upper output limit OUTP should be OPH; but when PV is larger than OEF, the output of regulator will not be limited, equal to 100%. Note: This function is applicable to some occasions when low temperature cannot allow full-power heating. For example, if the dryer is required to contain moisture or quick temperature rise is forbidden, some heater can only allow at most 30% heating power when the temperature is lower than 150℃, the setup may be: OEF=150.0℃, OPH=30%.	-999.0~ +3200.0℃ or linear unit
Addr	Communication address	Addr parameters are used to define the communication address, with effective range of 0~80. The instrument on the same communication line shall set up different Addr values to distinguish from each other.	0~100

bAud	Baud rate	bAud parameters are used to define baud rate, with definable range of 1200~19200bit/s (19.2K); when the position of COM is not used for communication, it can used for other functions through bAud parameter setup.	0~19.2K

AF	Advanced function code	AF parameters are used to select advanced functions, whose calculation method is as follows: AF=A×1+B×2 +C×4 +D×8+E×16+F×32+G×64+H×128 If A=0, HdAL and LdAL are deviation alarms; if A=1, HdAL and LdAL become absolute value alarms, thus the instrument can have two High Limit Alarms and two Low Limit Alarms. If B=0, alarm and ON/OFF regulating hysteresis is unilateral hysteresis; if B=1, it is bilateral hysteresis. If C=0, the light bar will indicate output value; if C=1, the light bar will indicate process value (PV, only applicable to the light bar panels) D should be set as 0. If E=0, HIAL and LOAL will respectively serve as absolute value High Limit Alarm and absolute value Low Limit Alarm; if E=1, HIAL and LOAL will respectively serve as High deviation alarm and Low deviation alarm , thus there are four deviation alarms. If F=0, fine control mode is used, the internal control resolution is 10 times as much as that of display, but the maximum display value during linear input is 3,200 unit. If F=1, wide range display mode is used, which is selected when the required display value is larger than 3,200.	0~255

		If G=0, the process value increase caused by sensor disconnection allows High Limit Alarm (the High Limit Alarm set value should be less than the upper signal range); if G=1, the process value PV increase caused by sensor disconnection will not allow High Limit Alarm, attention should be paid to that even normal High Limit Alarm (HIAL) in this mode will delay about 30s. If H=0, the communication protocol is AIBUS; if H=1, the communication protocol is MODBUS compatible mode. Note: For non-expert users, the parameter can be set as 0.	
Loc	Password	Setup Loc=808 can enter the complete parameter table.	0-9999
SPL	SV lower limit	Allowed minimum set value.	-9990~ +32000 unit
SPH	SV upper limit	Allowed maximum set value	
SPr	Ramp Slope Limit (only for AI-733P)	If SPr is set as effective, when the program starts, if the process value PV is lower than the set value SV, the ramp slop limit SPr will rise to be the first set value SV. RUN lamp will flash. In ramp mode, SPr is only effective to the first step. In soak mode, SPr will be effective to all steps.	0~3200 ℃/min.

Pno	Number of program steps (only for AI-733P)	Define effective program steps (0~30) which can reduce unnecessary steps for easy setup. Setting Pno=0, AI-733P become normal fixed set value mode and is fully compatible with AI-733 operation. At the same time, SPr parameters can also be set to limit the ramp slope rate Setting Pno=1, there is only one single program step. A set value SV and a holding time is used for simple setup. Setting Pno=2~30, AI-733P will enter normal program control panel operation mode	0~30
PonP	Program run mode after power restart (only for AI-733P)	Cont: Continue to run at the original break point. It will STOP only if the status is STOP during power goes off StoP: STOP program after power restart. run1: Run step 1 after power restart it is in STOP state before power goes off dASt: Continue to run programs if there is no deviation alarm after power restart. STOP if there is deviation alarm. HoLd (only for AI-733P): if power failure occurs during program running, it will go HOLD state. If the instrument is in stop status before power failure, it shall still keep stop status after power on.	

PAF	Program running modes (only for AI-733P)	PAF parameters are used to select program control functions. The calculation method is as follows: $PAF = A\times1 + B\times2 + C\times4 + D\times8 + E\times16 + F\times32$ A=0, Deactivate ready function (rdy). A=1, Activate ready function B=0, Ramp mode. When there is temperature difference during programs, broken line transition shall be adopted. Different ramp slope modes can be set. This is also valid for cooling B=1, Soak mode (fixed temperature mode). Each step is provided with set values SV and temperature holding time, the temperature rising rate between steps can be limited by SPr. The condition before reaching next steps can be limited by rdy parameter. Note: when B=0, if the last steps of the program is not an ending command, soak mode will override to end the program the time is up C=0, Time unit as minute C=1, Time unit as hour. D=0, Deactivate PV start function. D=1, Activate PV start function. F=0, Standard operating mode, without HoLD function F=1, There is RUN/HoLd switching function.	
EP1-EP8	Definition of field used parameters	1~8 field parameters can be defined as commonly used Loc parameters required for field operation after lock; Set nonE to hide the EP.	

3.3 Additional instruction of special functions

3.3.1 Alarm exemption function when power on

The instrument will have some unnecessary alarms when newly getting power on, for instance, when an electric stove is connected with power for temperature control (heating control), the actual temperature is far below the given temperature. If users set Low Limit Alarms or Low deviation alarm s, the instrument will meet the alarm conditions when immediately getting power on, but in fact, the actual system may have no problems. On the contrary, in the process of cooling control (direct action control), it may have High Limit Alarms or High deviation alarm s when newly getting power on. So AI instrument is provided with alarm exemption characteristics when power on, when Act parameter is set as rEVA or dIrA, the instrument will meet the alarm conditions when immediately getting power on, it will not deliver alarms immediately and wait till the alarm conditions are cancelled, which will deliver corresponding alarms if any by then.

3.3.2 Communication functions

AI series instrument can install S or S4 type RS485 communication interface modules at the position of COMM, which is connected to several computers, and thus realize instrument's each operation and function through computers. As for the computer without RS485 interface, a RS232C/RS485 converter or USB/RS485 converter can be added. Each communication port can be directly connected to 1-60 sets of instruments, after RS485 repeater is added, it can be connected to at most 80 sets of instruments. A computer can support several communication interfaces. Each instrument shall set different addresses. When there are a large number of instruments, two and more computers can be used. Local network will form among computes. The manufacturer can provide AIDCS application software, which can operate in Chinese WINDOWS operating systems, realize centralized monitoring and management of 1-200 sets of AV series instruments, and automatically record measuring data and printing. If the users want to independently develop configuration software, they can submit the application for the communication protocol to the salespersons of the instrument for free. There are several types of configuration software supporting AI instrument communication.

3.3.3 Fine control

Fine control means that the PID operating resolution is ten times as high as the display resolution. For example, the temperature signal of the instrument displays 1℃, but the internal PID still operate and control as per 0.1℃ resolution, thus can realize the control accuracy much higher than the display resolution. In former AI series instruments, only temperature signal adopts fine control mode. The new edition approves default fine control mode when the displayed value range is below 3,000 characters (on most of industrial application occasions, the value should not exceed 3,000 characters) during linear input, so as to get higher control accuracy and more stable output. When the required display value range is larger than 3,000, AF.F = 1.

3.3.4 User-defined input specifications

When INP=10, the input specification of the instrument is a kind of user-defined input type, and linear table can be edited, the setup method is as follows: set Loc parameter as 3698, and then enter the table setup status (if the original Loc=719, the Loc shall be zeroed, exit the parameter setting status, and then reenter the parameter setting status and set Loc as 3698). Of which the parameter A 00 defines the use of the table, 0 is used to input non-linear measuring, 1 is used to high temperature furnace non-linear control, with parameters of A01~A04 and d00~d60 respectively set as follows:

A 00=0

A 01 defines input type (when the table is used to build special input specifications), with values defined as follows:

A 01=A×1+E×16+G×64

A stands for instrument range: 0, 0~20mV (0-80Ω); 1, 0~60mV (0-240Ω); 2, 0~100mV (0-400Ω); 3, 0~1V; 4, 0~5V, 10, 0~20mA or 0~10V (MIO position installed with I4 or I31 module)

When E=0, it means that that output value still should be determined as per ScH/ScL parameters during linear input of signals. When E=1, the table output value is the display value.

G represents resistance or voltage (current) type input signals or temperature or non-temperature type input signals, with definition as follows:

G=0, thermocouple; G=1, thermal resistance; G=2, linear voltage (current); G=3, linear resistance

For instance: if signals are 1-5V voltage inputs, they are non-temperature type, and the setup A01=4×1+0×8+0×16+2×64=132

A 02 is used to define lower input signals, lower signals x 2000/range, for instance, as for 1-5V signal inputs, the setup A02=1×2000/5=400.0

A 03 stands for the range of input signals, for instance, among 1-5V inputs, the range is 5-1V=4V, and the setup A03=4×20000/5=1600

A 04 represents the spacing of the input signal table, A04=A03/curve section No., if only one section, A04=A03=1600

d 00 stands for the starting value of the curve table, corresponding to the output value when the input signal is A02. For instance, it can be set as 0.

d 01 represents the value of the first section of the curve table, corresponding to the output value when the input signal is A02+A04. For instance, it can be set as 2,000 (full range).

d 02-d60 stands for the values of sections 2-60 of the curve table, if all applications can modify the very completed curve, such as extracting, logarithm and exponent curves.

3.3.5 User-defined transformation of output limits and control of silicon molybdenum furnace

As for non-linear high temperature furnace, the resistance will change with the temperature. Taking silicon molybdenum furnace for an example, its room temperature to resistance occupies only 6% or so of that at 1,600 degrees. If there is no limit or transformation of output power, it will lead to another problem. First of all, the current of the electric furnace will be too large for starting at a low temperature, beyond the maximum allowable load of the grid, the silicon controlled and the transformer, which may damage the silicon controlled, the electric furnace and the transformer or cause trip. Besides, because the maximum power difference between the low temperature zone and the high temperature zone of the furnace at the same instrument output is as much as ten times, the proportional band P in the PID parameters will suffer more than ten times' variation at different temperatures to realize accurate temperature control in the high and low temperature zones. The approach to limit the parameters OPH can only limit the output power rather than the transformation of the proportional band, in order to reach accurate temperature control in the high and low temperature zones, several groups of PID must be set, which will be very complicated and low efficient.

User-defined output limit and transformation function solves the limit output and the transformation of the proportional band P at the same time, which carry out limit and transformation on the basis of measured temperatures, which not only limit the power of the low temperature zone but also automatically modify the parameters of the proportional band at different temperatures. And the limit of power and transformation of the proportional band are continuous fold line method. The following setup can be adopted in case of silicon molybdenum furnace (the customers can also change the data as required):

A00=1, A 01=1050, A 02=100.0; A03=1500; A04=750.0, d 00=120.0; d 01=1100, d02=2000

When A 00=1 and A 01=1050, the instrument starts user-defined output limit switching function, A 02 stands for the starting temperature of the output limit, A 03 stands for the highest temperature of the output limit, A 04 stands for the sectional length of the non-linear data temperature section. In this example, 1500/750.0=2, the more sections, the more complicated and finer the curve is. d 00 stands for the maximum output power for less than A 02, with unit of 100%× (1/2000), d 00=120.0 represents 6%, d 01 represents 55%, and d 02 represents 100%.

This curve means that the output limit is 6% under 100℃, 6%-55% between 100 and 850℃, 55%~100% between 850 and 1600℃, and not 100% above 1600℃.

Note: This function cannot be used along with user-defined input functions at the same time. If special specification inputs are required at the same time, please contact the salespersons to insert them into the internal of the instrument, but a disposable additional payment may be demanded.

4. Program control (only for AI-733P type)

AI-733P procedure type instrument is used on occasions that set value. Equipped with 30-step programming, it is able to set arbitrarily sized rising and dropping slopes of set value, programmable and operable commands including jump, run, hold and stop, and to modify procedure during procedure control; it is also provided functions including power-outage processing mode, process value boot and ready, which helps to implement the procedure in a higher efficient and perfect manner.

4.1 Functions and concepts

Procedure StEP: the StEP number is from 1 to 30, and current StEP indicates the step in process.

Set time: it is the total time set for procedure step running, in the unit of minute or second, and valid numerical value ranges from 1 to 9,999.

Run time: it refers to the time that has been running for current step. Process will shift automatically to the next step when the run time reaches the set step time.

Jump: The procedure step may be programmed as shift jump to any step to realize cycle control. Jump is also achieved by modifying the value of StEP.

Run/HoLd: When the procedure is running and starts the time, the set value is in a curved variation according to pre-programmed procedure. In continuous running (HoLd), the time stops and the set value remain unchanged. HoLd could be programmed into the procedure StEP.

StoP: the execution of StoP will stop the running of procedure, when the run time is cleared to zero, timing stops, and control output suspends. The instrument will start the procedure running from the StEP number sett by StEP when running starts in StoP state. Automatic StoP can be programmed into the procedure StEP, and the StEP value of the running StEP number will be set at the same time. StoP may also be executed artificially at any time (StEP is set to 1 after execution, but users can modify it as well). Automatic StoP will occur if the procedure StEP number has run the final StEP defined in Pno parameters.

Power outage/start event: the instrument is plugged in power or experiences an accidental power outage when running. Various processing schemes may be selected through setting PonP parameters.

Rdy: to continue running the procedure after staring and unexpected power outage/start, if the process value is different from the set value (the system will handle with process value boot first if permitted; if process value boot is effective, rdy will not be needed, and rdy will be used only when the conditions of process value boot are not met), and the D-value exceeds the deviation alarm value (HdAL and LdAL), the instrument will not give a immediate alarm of positive (or minus) deviation, but to adjust the process value till the deviation is smaller than the deviation alarm value, and the procedure will also stop timing or outputting deviation alarm signals, and will not start again until positive (or minus) deviation meets the requirement. Rdy is also useful in setting StEP when the time of temperature rising/dropping is unpredictable. Allow or cancel rdy in setting PAF parameters. Rdy can assure the completeness of running procedure curve, but the running time may be added due to setup time. Rdy and process value boot are both used for dealing with the uncertainty in procedure running when the process value is different from the set value, thus obtaining outcomes of higher efficiency and completeness to users' requirements.

Process value boot: to continue running the procedure after staring and unexpected power outage/start, the actual process value usually differs from the set value of the procedure calculation, which is sometime undesired and hard to predict for the users. For example: in a rising temperature StEP, the instrument is set as rising to 625℃ from 25℃ by 600 minutes, 1℃ per minute. Assume that the process value is just 25℃ when the procedure starts form the home position of the StEP, the procedure will proceed smoothly with the initial plan. However, if the system temperature has not fallen at starting, and the process value is 100℃, then it will be difficult for the procedure to carry on the original plan. Process value boot will enable the instrument automatically adjust the run time to make the two values stay the same. As in the above example, if the process temperature is 100℃ at starting, the instrument will set the run time to 75 minutes automatically, and the procedure will start running from 100℃.

Curve fitting: it is a control technique adopted by instrument of Type AI-733P. As the controlled subject is generally characterized with time lag, the instrument will automatically smooth linear curves of rising, dropping and constant temperature at turning points. The smoothness is in relation to the lag time of the system (t = d (derivative time) + CtI (control cycle)), and the degree of smooth is greater with a larger t; otherwise smaller. The procedure control will have a better effect with smaller lag time (e.g. thermal inertia) of the controlled subject. Process the procedure curve in curve fitting can avoid the overshoot. Note that because of the characteristic of curve fitting, procedure control produces a constant minus deviation at rising temperature of the linear procedure, and a constant positive deviation at dropping temperature, which is a normal occurrence and the value of deviation is proportional to the lag time (t) and the rate of temperature rising (dropping).

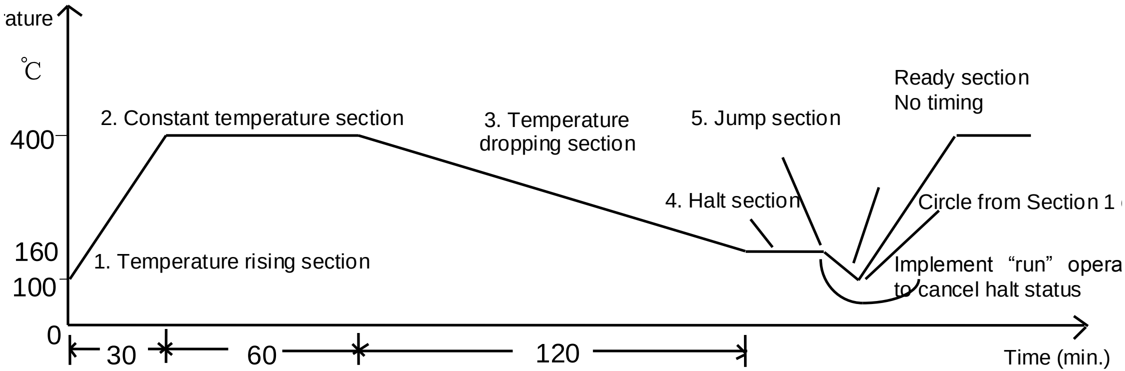
4.2 Programming

4.2.1 Slope mode

When PAF.B=0, procedure programming uniformly adopts temperature-time-temperature form, with definition as follows: when set the temperature from the current section, through the time set in this section, to the next temperature. The unit of the set temperature value is the same as that of PV, while the unit of time value is minute or hour. In slope mode, if the last section of procedure is not stop order or jump order (hereinafter time setting is editable), it will automatically end at the temperature after a temperature holding period. The following is an instance of a five-section procedure including linear temperature rise, constant temperature, linear temperature dropping, jump cycling, preparation and halt.

Section 1 SP 1=100.0 t 1=30.0; linear temperature rise to SP2 from 100℃ on, with rising time of 30 minutes and rising slope of 10℃/minute.
Section 2 SP 2=400.0 t 2=60.0; insulating operation at 400℃, with time of 60 minutes.
Section 3 SP 3=400.0 t 3=120.0; temperature drop to SP4, with dropping time of 120 minutes and dropping slope of 2℃/minute.
Section 4 SP 4=160.0 t 4=0.0; temperature drop to 160℃ and then enter halt status; it is required to implement “run” before operating the next section.
Section 5 SP 5=160.0 t 5=-1.0; jump to the implementation of Section 1, and circulate operation from the very beginning on.

In this instance, after Section 5 jumps to Section 1, because its temperature is 160℃, but C 01 is 100℃, obviously unequal, and Section 5 is a jump section, provided that the High deviation alarm set is 5℃, the procedure will firstly enter ready status after jumping from Section 5 to Section 1 (namely control the temperature below the High deviation alarm , i.e. 105℃), and then carry out the temperature rising procedure of Section 1. The temperature control procedure is as shown in the Fig.:



The merit of temperature-time programming method is wide temperature rise, drop and slope setting range. The temperature rising section and the constant temperature section has a unified set form for convenient learning. The setup curve is flexible and can set continuous temperature rising sections (if temperature rising sections with different slopes are used to approximately achieve functional temperature rising) or continuous constant temperature sections.

4.2.2 Platform mode

Set parameter PAF.B=1, the platform mode can be selected, suitable for applications requiring no independent setting of temperature rising or dropping slopes, which can simplify programming and effectively utilize sections. The definition of each section of procedures is temperature ~ the constant temperature time. SPr parameters can also be used to define a temperature rising rate limit among sections. If SPr set is 0, it indicates full-rate temperature rising. Because the time for temperature rising cannot be determined and it will occupy temperature holding time, “rdy” can be set as effective to ensure correct constant temperature time.

4.2.3 Program set value and time setting

Each section of procedure includes set values and time. The range of set value can be set is limited by -999~+3200℃, indicating temperature value required to be controlled or linear definition unit. The time expresses the running time as well as the following special control functions:

t-XX = 0.1~3200 (min.) indicating the set time value of Section XX (note: the unit of time can also be changed into hour with PAF parameters).

t-XX = 0.0 means that the instrument enters HoLD status in Section XX, the procedure halts operation and stops timing at the moment.

t-XX = -121.0, the procedure executes StoP operation and enter stop status.

t-XX = -0.1~-122.0 the negative time value means that this is a jump + event output order, the integer part 1~120 shows the jump sections, but the sections beyond Pno definition will be invalid; the integer 0 (decimal will not be 0) represents operation to the next section. The decimal part is the event output programming, AL1 and AL2 can be programmed during operation. -XXX.0 represents that the procedure event status will not be influenced; only jumping. If alarm output definition AOP defines that alarm is output by AL1 or AL2, both the procedure events and the alarms may lead to AL1 or AL2 actions. The definition of -XXX.1~-XXX.4 is as follows:

-XXX.1, AL1 action; AL2 reset;
-XXX.2, AL1 reset, AL2 action;
-XXX.3, both AL1 and AL2 action;
-XXX.4, both AL2 and AL2 reset;

For instance: set t- 5=-1.1, indicating that AL1 action and AL2 reset and jump to Section 1 when operating to Section 5.

For another instance: set t- 6=-0.3, indicating that both AL1 and AL2 actions and progress to the next section (Section 7) when operating to Section 6.

Note: Except that jump operation can proceed when jump sections are met for implementing operation or connecting power, the procedure will halt implementation in the operating process from a jump section to another jump section (i.e. operation halt between two continuous jumps), external operation is required to cancel the halt status. If the jump section jumps to its own section (such as t- 6=-6), the halt status cannot be removed, because it is meaningless.

4.2.4 Program layout method when several curves run

AI-733P is provided with advanced and flexible program layout method. As the StEP is automatically set to 1 after AI instrument executes StoP, if the value of StEP is not modified again before running starts, the procedure will generally rerun from the first StEP. Users who have programmed multiple temperature control curves may execute different curves respectively by setting the first StEP as jump StEP. For example, the users may marshal the procedure at 2~4, 5~7, 8~10 if having three curves in length of three StEPs. To execute different curve after starting, the first StEP may be set as the following:

t- 1= -2.0, to execute the first curve after Run (2~4);
t- 1=-5.0, to execute the second curve after Run (5~7);
t- 1=-8.0, to execute the third curve after Run (8~10);

Set t- 1 as -2.0,-5.0 or -8.0 to run respective curve when changing production process is necessary.

The jump StEP may also be omitted, but the StEP should be set as the home StEP that needs to run curves before each running starts