AI SERIES ARTIFICIAL INTELLIGENCE INDUSTRIAL CONTROLLER

AI-518/518P Operation Instruction

Ver. 7.1

CONTENTS

1.SUMMARY

1.1 Main Features

- Adopt digital calibration technology for input measurement with non-linear calibration tables for standard thermocouples and RTDs are available in the instrument.
- Adopt advanced AI artificial intelligence control algorithm, no overshoot and with the function of auto tuning and self-adaptation.
- Adopt advanced modular structure, with large numbers of output options. Easy installation to shorten the assembly time in manufacturing line. Maintenance of instruments make easy.
- Friendly and customized operating interface leads to easy learning and simple manipulation. Any parameter can be promoted to immediate operator access in Field Parameter Table or password protected in Full Parameter Table.
- With universal power supply of 100-240VAC or 24VDC and various options of installation dimensions.
- ISO9001 (2000Version),high reliability of quality.
- CE certified, complying with EMC requirement, achieving world class level of quality, anti-interference ability and safety.

POINTS FOR ATTENTION

- This manual introduces AI-518/518P model ARTIFICIAL INTELLIGENCE INDUSTRIAL CONTROLLER of Version 7.1. Certain functions may not applicable for other versions. After powering on, the instrument model and software version will be shown. User should pay attention to the version number. Please read this manual carefully to ensure proper and safe operation.
- Please correctly set parameters according to input / output specification and function. Only correctly wired instruments with parameters correctly set should be put into use.
- Compared to Version 6.X or earlier versions, some important changes are: New rear terminal layout,Heating/refrigerating dual output function, and both outputs can be either current or time proportional output. Alarm applies single lateral deadband; Support up to 4 channels of alarm or event outputs; Compared with V7.0, AI-518P has 30segments ramps and soaks with dual editable event output. Adopted advanced X3/X5 high accuracy current output modules instead of X/X4, it makes higher transmittion output accuracy.

1.2 Ordering Code Definition

Advanced modularized hardware design is utilized for AI series instruments. There are maximum five module sockets: multi-function input/output (MIO), main output (OUTP), alarm (ALM), auxiliary output (AUX) and communication (COMM). The input specification can be selected as thermocouple, RTD, or linear current/voltage.

The ordering code of AI-708/708P/808/808P series instrument is made up of 8 parts. For example:

AI-518	**A**	**N**	**X3**	**L5**	**N**	**S4**	—	**F2**	--	**24VDC**
①	②	③	④	⑤	⑥	⑦		⑧		⑨

It shows that the model of this instrument is AI-518, front panel dimension is 96×96mm, no module is installed in MIO (Multi-function I/O) socket, X3 linear current output module is installed in OUTP (main output), ALM (alarm) is L5 (dual relay contact output module), no module is installed in AUX (auxiliary output), a RS485 communication interface with photoelectric isolation is installed. It has external expanded input F2(radiant high thermometer), and the power supply of the instrument is 24VDC.Below is all 10

symbols.

① **Instrument model**

AI-518 High accuracy controller with measurement accuracy 0.3%F.S. It adopts artificial intelligent control technology, and has the functions of control, alarm, retransmission and communication.

AI-518P Add 30 segment program control to AI-518.

② **Front panel dimension**

Model	Front Panel (width x height)	Cut-out (width x height)	Depth Behind Mounting Surface	Remarks
A(A2)	96x96mm	92x92mm	100mm	On A2, there is a light bar with 25 segments and 4 levels of luminosity.
B	160X80mm	152x76mm	100mm	
C(C3)	80x160mm	76x152mm	100mm	On C3, there is a light bar with 50 segments and 2 levels of luminosity
D	72x72mm	68x68mm	95mm	
E	48x96mm	45x92mm	100mm	
D2	48x48x110 (width x height x depth)	45*45mm	95mm	
F	96x48mm	92x45mm	100mm	

③ Stands for function input module slot MIO, K3,V,U,I2,I4 are able to be plugged in MIO.

④ stands for main output (OUTP), can plug in L2,L4,W1,W2,G, K1,K3,X3,X5

⑤ Stands for alarm slot(ALM),can add in L2,L4,W1,W2,G, K1,V,U

⑥ Stands for auxiliary output(AUX),can add L2,L4,W1,W2,G, K1,K3,X3,X5,V,U,I2

⑦stands for communication(COMM), can add S,S4,V,U

⑧ stands for expanded indexing table. AI controllers are defaulted with common used thermocouple,RTD or current input modules, but if other input signals are needed, can use this function.

⑨ stands for power supply. It's default as 100~240VAC ,24VDC is available if wanted.

COMMON USED FUNCTION INPUT AND OUTPUT MODULES AS FOLLOWS:

N no module installed

L2 1 relay contact (NO+NC) output.(small size, 30VDC/1A, 250VAC/1A)

L1/L4 1 relay contact (NO+NC) output.(large size, 30VDC/2A, 250VAC/2A)

L5 2 relay contact (NO) outputs. (30VDC/2A, 250VAC/2A)

W1 "Burn-proof" TRIAC no contact normal open output. (100¯240VAC/0.2A)

W2 "Burn-proof" TRIAC no contact normal closed output. (100¯240VAC/0.2A)

G SSR voltage outputs (12VDC/30mA)

K1 "Burn-proof" single-phase thyristor zero crossing trigger output module (trigger one loop of a TRIAC or a pair of inverse parallel SCR with current of 5~500A)

K3 "Burn-proof" three-phase thyristor zero crossing trigger output module (trigger 3-phase

circuit; each channel can trigger TRIAC or a pair of inverse parallel SCR with current of 5-500A)

K5 "Burn-proof" single-phase thyristor phase-shift trigger output module (trigger one loop of TRIAC or a pair of inverse parallel SCR with current of 5-500A), suitable for 200¯240VAC power supply.

X3 0¯20/4¯20mA linear current output module.(Sharing internal 12VDC power)

X5 0¯20/4¯20mA linear current output module.(With its own isolated power)

S Photoelectric isolated RS485 communication module(sharing internal 12VDC power)

S4 Photoelectric isolated RS485 communication module(with its own isolated power)

V5/V10/V12/V24 Isolated 5V, 10V, 12V or 24V DC output with maximum current 50mA.

U5 Non isolated 5V/25mA voltage output, giving power supply for valve.

I2 on/off switch or frequency signal input, included 12 VDC power for external sensor.

I4 4-20mA/0-20mA analogue input interface, providing a 24VDC/24mA power supply for a two-wire transmitter.

1.3 MODULES

AI-518/518P series instruments have five sockets for modules .By installing different modules, the controller expands its functions and output types.

- **Multiple function Input/Output (MIO):** accepts input signal from 2-wire transmitter or 4-20mA signal by installing I4 (current input) module. If I2 (on-off signal input) module is installed, the instrument can switch between setpoint SV1 and SV2 by external trigger. If add I2 moudle, AI-518P will be albe to on/off control programming.With K3, it's able to give three phase SCR contact zero crossing control output.
- **Main output (OUTP):** commonly used as control output such as on-off control(CtrL=0), if oP1.A=1,2,4, then OUTP will be transmittion output for AI-518, programmalbe given output for AI-518P.
- **Alarm (ALM):** commonly used as alarm output. It supports 1 normal open + normal close relay output (AL1) by installing L1 or L2 module. It supports 2 normal open relay outputs (AL1+AL2) by installing L5 module.
- **Auxiliary output (AUX):** In a heating/refrigerating dual output system, module X3, X5, L1, L4, G, W1, W2 can be installed as the second control output. It can also output alarm by installing L1, L2 or L5 module, or used for communicating with computer by installing R module (RS232C interface).
- **Communication Interface (COMM):** Module S or S4 can be installed in for communicating with computer (RS485 communication interface).
- **Voltage output module:** The voltage output modules like V24, \/10 or V12 are often used for supplying power for external transducer or feedback resistance of transmitter. These modules can be installed in any socket. To standardize the wiring, it is recommended to be installed in the first idle socket in the order of MIO, AUX followed by COMM.
- Modules installation: usually all modules will be plugged in before sending product to customers.But if damage happens, users can plug in or take off or change modules by themselves. Re-setting parameters is needed sometimes, please refer to parameters specially oP,CF.

New advanced module technology

1.3.1.Electric isolation among modules: There are built-in power supply unit which is a group of 24V and 12V. They are isolated to the main circuit. The 24V power usually supplies voltage output module, such as V24/V12/V10, I4 and I5. The 12V power usually supplies output or communication module. Generally speaking, the relay contact output, TRIAC no contact discrete output and SSR voltage output are self-insulated. Only the electric isolation between the communication interface and the current output needs to be pay attention. Those modules, for example, S (RS485 communication interface), R (RS232 communication interface) and X3 (linear current output) all require 12V power supply. If more than one of the above modules are installed, in order to be electric isolated, only one of them can be module without electric isolation. The other modules must be S4 or X4, which has its own isolated power supply. For example, if an X3 module is installed in OUTP (main output) socket, S4 or X5 module is recommended to be installed in COMM (communication interface) socket, instead of S or X3.

1.3.2.Long life No contact triac switch module : W1 and W2 are new types of no contact switch module which apply the advanced technology of “burn proof” and zero crossing conduction. It can replace the relay contact switch. Compared to the relay contact output module, W1 and W2 have longer life and lower interference. They can largely lower the interference spark of the equipment, and greatly improve the stability and reliability of the system. Since the driver element is TRIAC, it is suitable for controlling 100-240VAC (not for DC power) with current up to 80A. For the current larger than 80A, an intermediate relay is needed.

1.4 Mentinance

Annually there will be one time examination for all AI instruments’s quality. If the control accuracy is too low,usually it’s due to over wet or dust. Clean and clearance is needed. Time won’t influence the accuracy of AI intruments,so don’t try to change parameter by changing Sc parameter. If problem happens, please return to YUDIAN factory.

AI controllers are default with 60 days warranty after the data of departure factory.During this period, free repair is available. Please write down clearly the problem you meet and returns so that can get faster and correct mentinance.

Any question,you can call at 800-858-2033 free for after sales service.

2.TECHNICAL SPECIFICATION

- **Input type:**

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

  Resistance temperature detector: Cu50, Pt100

  Linear voltage: 0～5V, 1～5V, 0～1V, 0～100mV, 0～60mV, 0～20mV, etc.; 0～10V if module I31 is installed on MIO socket.

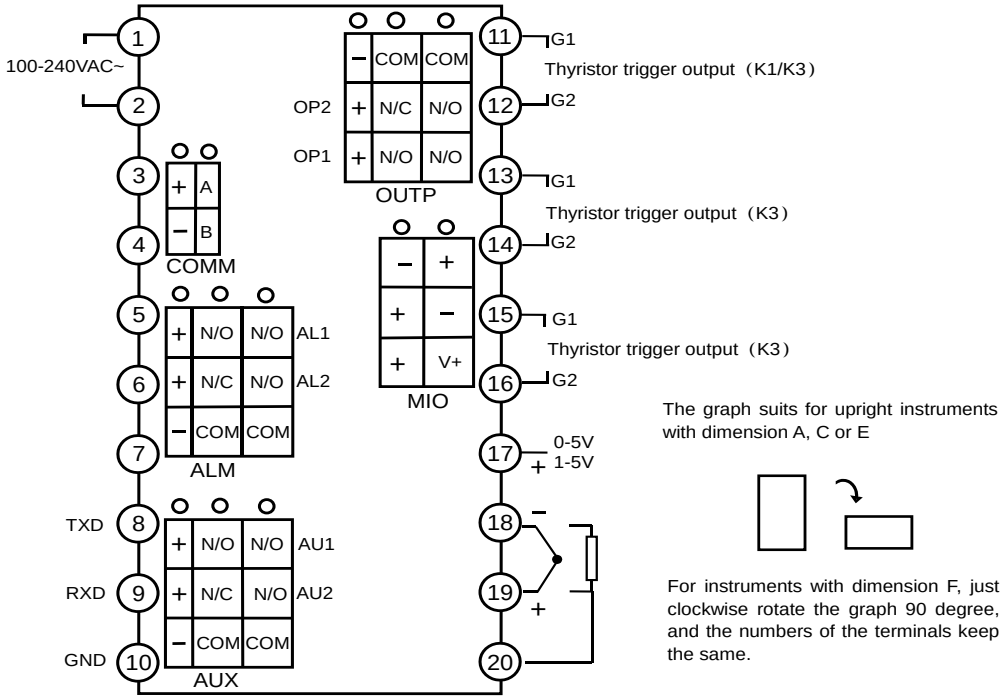
  Linear current (external install I4 module on MIO): 0～20mA, 4～20mA

  Extended input is avaliable

- **Instrument Input range**
  K(-100～1300℃), S(0～1700℃), R(0～1700℃), T(-200～+390℃), E(0～1000℃), J(0～1200℃), B(600～1800℃), N(0～1300℃), WRe3-WRe25(0～2300℃), WRe5-WRe26(0～2300℃)
  Cu50(-50～+150℃), Pt100(-200～+800℃)
  Linear Input: -9990～30000 defined by user.
- **Measurement accuracy :** 0.3%FS ± 0.1℃
- **Resolution :** 0.1℃ (automatically change to 1℃ when the temperature is high than 999.9℃) or 1℃ selectable
- **Temperature drift :** ≤0.01%FS /℃ (typical value is 50ppm/℃)
- **Response time :** ≤0.5s (when digital filter parameter dL=0)
- **Control mode:**
  On-off control mode (deadband adjustable)
  AI MPT with auto tuning, adopting fuzzy logic PID algorithm.
- **Output mode (modularized)**
  Relay output (NO+NC): 250VAC/2A or 30VDC/1A
  TRIAC no contact discrete output (NO or NC): 100～240VAC/0.2A (continuous), 2A (20mS instantaneous, repeat period≥5s)
  SSR Voltage output: 12VDC/30mA (used to drive SSR).
  Thyristor zero crossing trigger output: can trigger TRIAC of 5～500A, a pair of inverse paralleled SCRs or SCR power module.
  Linear current output: 0～20mA, 4～20mA (The output voltage of X module ≥10.5V; and that of X3 module ≥10.5V.)
- **Electromagnetic compatibility (EMC) :** ±4KV/5KHz according to IEC61000-4-4; 4KV according to IEC61000-4-5.
- **Isolation withstanding voltage :** between power, relay contact or signal terminal ≥2300VDC; between isolated electroweak terminals ≥600VDC
- **Power supply :** 100～240VAC, -15%, +10% / 50-60Hz; 120～240VDC; or 24VDC/AC, -15%, +10%.
- **Power consumption:** ≤5W
- **Operating Ambient :** temperature -20～60℃; humidity ≤90%RH
- Stock ambient: temperature -30~+70C
- **Front panel dimension:** 96×96mm, 160×80mm, 80×160mm, 48×96mm, 96×48mm, 48×48mm, 72×72mm
- **Panel cutout dimension:** 92×92mm, 152×76mm, 76×152mm, 45×92mm, 92×45mm, 45×45mm, 68×68mm

3.Rear Terminal Layout and Wiring

Wiring graph for instruments except D and D2 dimension.

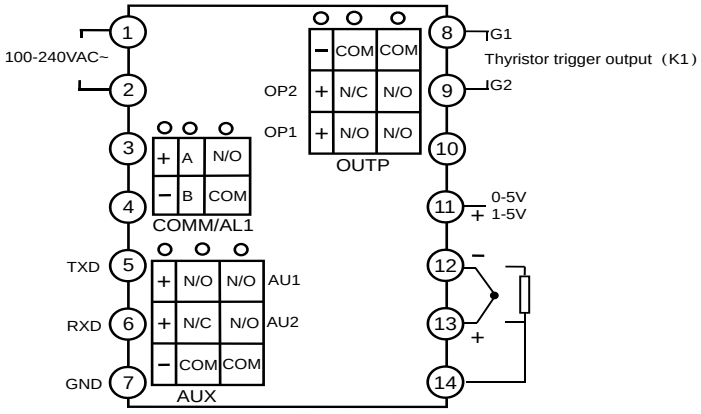


Note 1: For linear voltage input, if the range is below 1V, connect to terminals 19 and 18. 0～5V or 1～5V signal can be inputted from terminals 17 and 18.

Note 2: 4～20mA linear current signal can be transformed to 1～5V voltage signal by connecting a 250 ohm resistor, and then be inputted from terminals 17 and 18. If I4 module is installed in MIO socket, 4～20mA signal can be inputted from terminals 14+ and 15-, and 2-wire transmitter can be inputted from terminals 16+ and 14-.

Note 3: The compensation wires for different kinds of thermocouple are different, and should be directly connect to the terminals. When the internal auto compensation mode is used, connecting the common wire between the compensation wire and the terminals will cause measurement error.

Wiring graph of D dimension instruments (72×72mm)



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

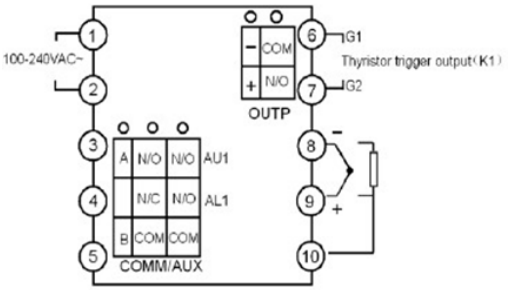
Note 2: 4～20mA linear current signal can be converted to 1 ～ 5V voltage signal by connecting a 250 ohm resistor and inputted from terminals 11 and 12.

Note 3: S or S4 module can be installed in COMM socket for communication. If relay, TRIAC no contact switch, or SSR driver voltage output module is installed in COMM, it can be used as alarm output. If I2

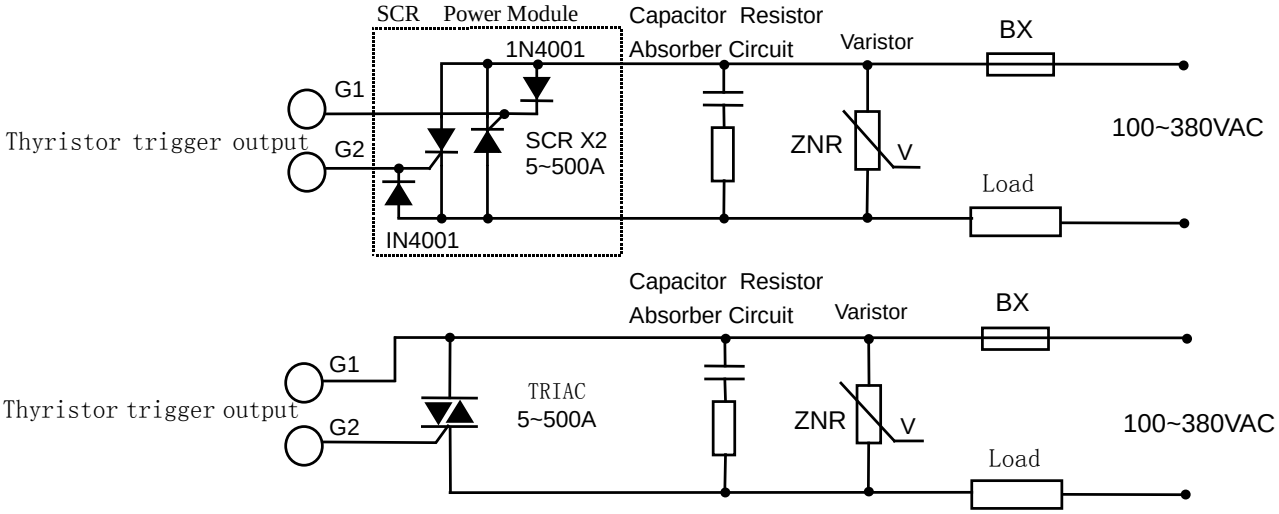
module is installed in COMM and parameter “bAud” is set to 1, then on-off signal can be inputted, and SV1 and SV2 can be switched by connecting a switch between terminals 3 and 4.

Wiring graph of D2 dimension instruments (48*48mm)

P.S.:0-5 1-5 is not available ,transfer to 0-500mV or 100-500mV input. 4-20mA input need add resistant 25ohm so that change to 100-500mV, then connect terminal 9 and 8. Terminal 3.4.5 is for communcation S,S4. L5 is installed then need change bAud as 0.



Wiring graph of thyristor trigger output is as below (suitable for module K1, K3, K5 and K6):



Note 1: According to the voltage and current of load, choose suitable varistor to protect the thyristor. Capacitor resistor absorber is needed for inductance load or phase-shift trigger output.

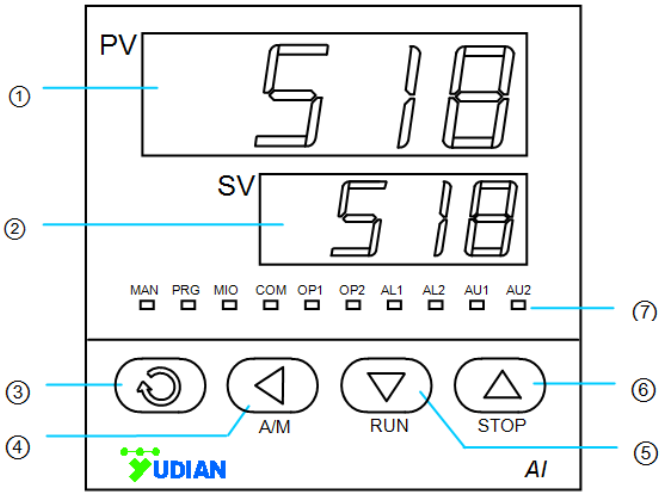
Note 2: SCR power module is recommended. A power module includes two SCRs, is similar to the above dashed square.

Note 3: K1/K3/K5 is burnt free, easy and reliable.

Note 4： Phase-shift trigger module K5 only supports 200～380VAC power, power frequency must be 50Hz.

4.DISPLAYS AND OPERATIONS

Front Panel Description



① Upper display window, displays PV, parameter code, etc.

② Lower display window, displays SV, parameter value, or alarm

③ Setup key, for accessing parameter table and conforming parameter modification.

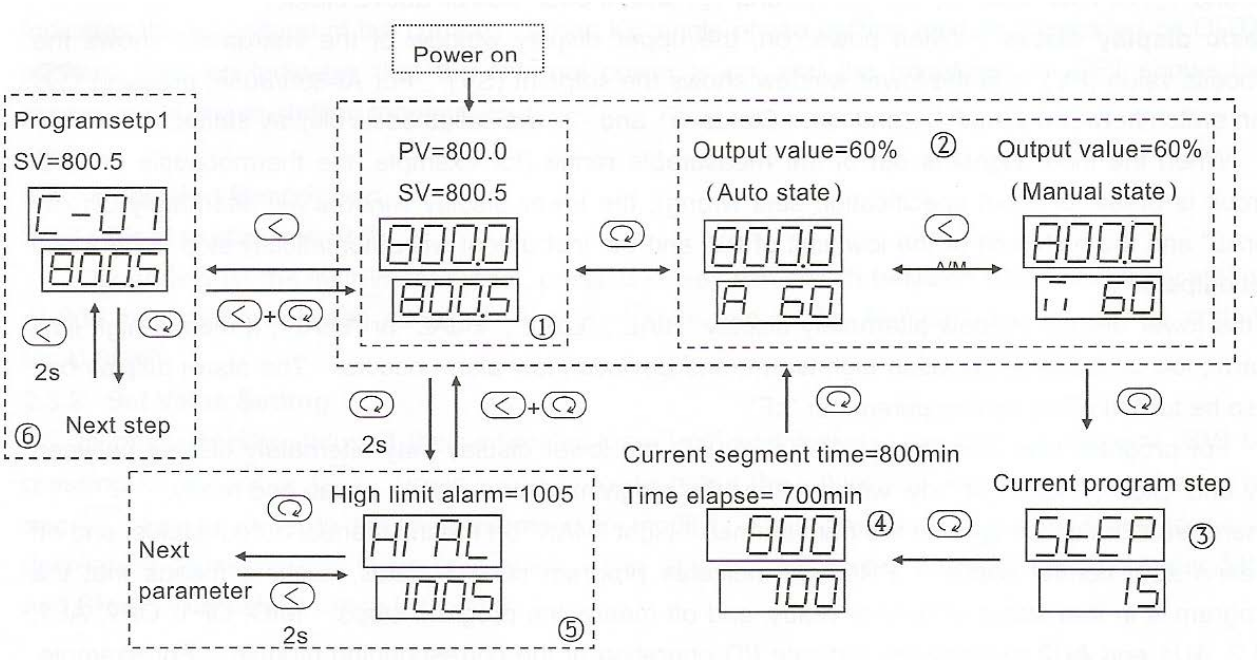
④ Data shift key, and auto/manual control switch.

⑤ Data decrease key

⑥ Data increase key

⑦ 10 LED indicators. MAN is not used. PRG is programming condition for AI-518P. MIO,OP1,OP2,AL1,AL2,AU1,AU2 are for input and output.COM is for communication like PC.

4.1 Display Status



Note: Not all models have the above display status.

When powered on, the unit is in above status①, PV is for measuring value, SV is for given value.

4.2.1When the input signal is out of the measurable range (for example, the thermocouple or RTD circuit is break, or input specification sets wrong), the lower display window will alternately display “orAL” and the high limit or the low limit of PV, and the instrument will automatically stop control and set output to 0.

4.2.2 If the lower display window alternately display “HIAL”, “LoAL”, “HdAL” or “LdAL”, it means high limit alarm, low limit alarm, deviation high alarm, and deviation low alarm occurs. The alarm display can also be turned off by setting parameter “cF”.

4.2.3. For program type instruments AI-518P, run is for common status. the lower display may alternately display between SV and “StoP”, “HoLd”, or “rdy” which means the program control is stop, pause and ready.

There are 10 indication lights on the front pannel:
“PRG” on indicates program control status, flashing means that the program is in that status of hold or ready, and off means the program stops.
Light “MAN” on means manual output status, and off means auto control status.
MIO, OP1, OP2, AL1, AL2, AU1 and AU2 respectiviely indicate I/O operation of the corresponding module. For example, That the COMM indicator is lighting means that the instrument is communicating with computer.
When current module X or X4 is installed on OUTP socket, the brightness of OP1 and OP2 indicates the magnitude of the current. When K5 single phase shifting module is installed on OUTP sockets, OP2 on indicates that the external power is on, and the brightness of OP1 shows the magnitude of phase-shifting trigger output.

4.2 Operation Description

4.2.1 Display status switch

Depending on the instrument model, press key can switch between different display status.

AI-518P can switch between 1,2,3while AI-518P can only in 1 ,no need switch.

4.2.2 Set Value Setting

In basic display status, if the parameter lock “Loc” isn't locked, we can set setpoint (SV) by pressing 、 or . Press key to decrease the value, key to increase the value, and key to move to the digit expected to modify. Keep pressing or , the speed of decreasing or inscreasing value gets quick.

4.2.3 Parameter Setting

In basic display status, press and hold for about 2 seconds can access Field Parameter Table. Pressing can go to the next parameter; pressing 、 or can modify a parameter. Press and hold can return to the preceding parameter. Press (don't release) and then press key simultaneously can escape from the parameter table. The instrument will escape auomatically from the parameter table if no key is pressed within 25 seconds, and the change of the last parameter will not be saved. In Field Parameter Table, press till the last field parameter “Loc” appears. Setting Loc=808 and then press can access System Parameter Table.Please refer to the table,specially Loc

description.

4.3 Auto Tuning

When artificial intelligence MPt control or standard PID control is chosen (CtrL=2), the parameter M5, P, and t can be obtained by running auto-tuning. In basic display status, press ⟨ for 2 seconds until “At” flashes in lower window, and the instrument executes on-off control. After 2 cycles of on-off action, the instrument will obtain the values of MPt control parameters. If you want to escape from auto tuning status, press and hold ⟨ for about 2 seconds until the "At" disappears. Change “At” from “on” to “oFF”, press ⟲ to confirm, then the auto tuning process will be cancelled. After the auto tuning is finished, the instrument will set parameter CtrL to 3 (factory default set is 1) or 4, and now it is not allowed to start up auto tuning by pressing ⟨ key on front panel. This will avoid repeat auto tuning by mistake.If you want reset AT, you can set CtrL to be 2 and re do it.

If the setpoint value is different, the parameter obtained from auto tuning will not always the same. So if you want to execute auto tuning, you must adjust setpoint to an often-used value first (For AI-518P, set the value of the current program step to the often-used value), and then start up auto tuning function. Parameter CtI and dF have influence on the accuracy of auto-tuning. Theoretically, the smaller for these two parameters setting value, the higher for the precision of auto tuning. But dF parameter value should be large enough to prevent the instrument from error action around setpoint due to the oscillation of input. Normally, parameters are recommended to be CtI=0-2, dF=2.0.

On the basis of disturbance caused by on-off control, oscillation period, amplitude and waveform are analyzed to calculate optimum control parameters. The auto tuning for AI series instrument will gratify for 90% users. Due to the complexity of the automatic process, parameters calculated by auto tuning are probably not the optimal values on some special occasion (mentioned as follows).

- An electric furnace heated up by stages, and the stages may interact each other, then the value of parameter M5 may on the high side of its optimal value.
- Long lagged process.
- Quick responded physical quantity (flow and certain pressure) controlled by the slow valve, then the value of parameter P, t may on the high side of their optimal value. Manual tuning can get better effect.
- When some mechanical contact such as contactor or solenoid valve are used for control and parameter CtI is set too big.
- It is not easy to get optimal M5 parameter in refrigerating system and non-temperature system such as pressure, flow, etc. So set M5 by its definition that M5 is the change of the measurement value when output change 5%.
- Other special system such as nonlinear system and time varying system.

If optimal parameters can’t obtain by auto tuning, M5, P, t parameters can be manually adjusted. During manual parameter adjustment, response curve of the system should be observed carefully. If it is short period oscillation (oscillation period is similar to the oscillation of auto tuning), you can decrease P (first), or increase the value of parameter M5 and t. If it is long period oscillation (oscillation period is several times of the oscillation of auto tuning), you can increase the value of parameter M5 (first), P and t. None oscillation but too severe steady-state error, you can decrease M5 (first) and increase P. If it must cost a long period of time to obtain stable control, you should decrease t (first), M5 and increase P. Any other questions, welcome to call back to factory.

4.4 Program operation (for AI-518P only)

4.4.1 Setup program

Press the key ⟨ once and release in the display status ①, the instrument will be in the setup program status. The setpoint of the current program StEP will be displayed. Pressing ⟨、⟩ or c can modify the value. Pressing ↺ can go to next parameter. The program parameters will be displayed in the sequence of setpoint1, time1, setpoint2, time 2, etc... Pressing ⟨ and holding for about 2 seconds will return to the previous parameter.

4.4.2 Run/Hold

In display status ①, if the program is in stoP status (“StoP” is alternately displayed on the lower window), press and hold the ⟩ key for about 2 seconds until the lower display window displays the "Run" symbol, the instrument then will start the program. At running status, press and hold the ⟩ key for about 2 seconds until the lower display window displays the "HoLd" symbol, the instrument changes to hold status. At Hold status, the program is still executing, and the process value is control led around the setpoint, but the timer stop working, and the running time and setpoint remains. At Hold status, press and hold the ⟩ key for about 2 seconds until the lower display window displays the "Run" symbol, the instrument then restart.

4.4.3 StoP

Press and hold the ⟩ key for about 2 seconds in the display status ① until the lower display window displays the "stoP" symbol, the stoP operation is executed now. This operation forces the instrument to stop running, and the StEP number is reset to 1, the event output is cleared, the control output is also stopped.

4.4.4 Display and modify the running StEP

Some times it is expected that the program begin with a certain StEP, or jump directly to one StEP and execute from there. For example, when the current program reaches the 4th StEP but the user wants to finish the StEP in advance and execute the 5th StEP, then press ↺ to switch to program step display status (display status ③) and modify the program StEP number. If the StEP number is manually changed, the running time will be cleared to 0 and program will start from the beginning of the new StEP. If the StEP number is not changed, pressing ↺ will escape the program step setting status, and will not affect the program running.

5.PARAMETERS AND SETTINGS

5.1 The Full Parameter Table

Code	Name	Description	Setting Range
HIAL	High limit alarm	Alarm is triggered when PV (Process Value) >HIAL; alarm is released when PV<HIAL-dF; To disable high limit alarm, set HIAL=9999 Every alarm can be defined to control AL1,AL2,AU1,AU2	-1999～+9999 units or 1℃
LoAL	Low limit alarm	Alarm triggered when PV<LoAL; alarm released when PV>LoAL+dF Set LoAL =-1999 can disable low limit alarm	
dHAL	Deviation high alarm	Alarm triggered when PV-SV>dHAL; alarm released when PV-SV<dHAL-dF Set HdAL=9999 can disable deviation high alarm. When on/off control mode is used, dHAL and dLAL is for second high alarm and low alarm.	0～9999 units or 0～999.9℃
dLAL	Deviation low alarm	Alarm triggered when SV-PV>dLAL; alarm released when SV-PV<dLAL-dF Set dHAL=9999,when temperature is 999.9C,alarm is cancelled	
dF	Alarm hysteresis	Avoid frequent alarm on-off action because of the fluctuation of PV E.g.: Set HIAL>800C,dF=2.0C 1. in normal status,when HIAL>800C, it alarms 2. in high alarm status, when PV<798C, alarms is cancelled E.g: Set SV=700c,,dF=2.0C for heating 1.in run status,when PV>700C, it breaks 2.in stop status, when PV<698C, it reheats. For on/off control mode,,the hgiher dF, the longer period,the lower accuracy.dF won't influence AI control. But when do AT, not to make too high dF. The adviced dF is 2-3times to PV.	0～2000 units or 0.1℃
CtrL	Control mode	CtrL=0: on-off control. For situation not requiring high precision; CtrL=1: AI MPt control. Allowed to quick activate auto-tuning (pressing ＜ in basic display status.) CtrL=2: AI MPt control. Activate auto-tuning. CtrL=3: After auto-tuning finished, the instrument automatically set CtrL=3, and quick auto-tuning function is disabled. CtrL=4: Comparing with the control mode of CtrL=3, Parameter P is defined as 10 times as its original value. Ex., if set P=5 incase of Ctrl=3 and set P=50 incase of Ctrl=5, then these 2 setting have then same control effect. In the application of rapidly changed temperature (changes by more than 100℃ /second), pressure or flow control, or in the application where inverter is used to control water pressure, P is often very small, even smaller than 1. If CtrL is set to 4, then parameter P can be enlarged 10 times, and so finer control is obtained.	0～4

M5	Hold parameter	Parameter M5, P, t, CtI etc. are only for AI MPt control, and have no effect to on-off control. M5 is defined as measurement variation after output is changed by 5% (0.5mA if OP1=1) and when controlled process is basically stabilized. "5" indicates that output variation is 5 (5% or 0.5mA). Generally M5 parameter of the same system will changes with measurement value, and so M5 parameter should be configured with process value around operating point. Take temperature control of electric furnace as an example, the operating point is 700℃. To find out optimum M5 parameter, assuming that when out remains 50%, the temperature of electric furnace will finally be stabilized at 700℃, and when output changes to 55%, the temperature will final be at 750. Then M5 (optimum parameter)=750-700=50℃. M5 parameter mainly determines the degree of integral function, similar as integral time of PID control. The smaller M5 parameter is, the greater integral function is; where the larger M5 parameter is, the smaller integral function is (integral time is increased). But if M=0, then integral function an artificial intelligence control function will be removed and the instrument is turned to be an PD adjustment that used as a secondary controller during cascade control.	0～9999 units or 0～ 999.9℃
P	rate parameter	P is in reverse proportion to measurement variations caused by output changes by 100% in one second. It is defined as the following: if CtrL=1 or 3, then P=1000/measurement variation per second, the unit is 0.1℃ or 1 defined unit . Ex., instrument use 100% power to heat and there is no heat loss, if temperature in crease 1℃ each second, then P=1000/10=100. If CtrL=4, then P parameter will be configured by increasing 10 times. Ex., P should be set to 1000 in the above example.	1～9999 seconds
t	Lag time parameter	Parameter t is applied as one of the important parameters of AI artificial intelligence control algorithm. "t" is defined as follows: time needed for a electric furnace from the beginning of elevating temperature to get to 63.5% against the final speed of temperature elevating, provided there is no heat loss. The unit of parameter “t” is second. For industrial control, hysteresis effect of the controlled process is an important factor impairing control effect. The longer is system lag time, the more difficult to get ideal control effect. Lag time parameter “t” is a new introduced important parameter for AI artificial intelligence algorithm. AI series instrument can use parameter “t” to do fuzzy calculation, and therefore overshoot and hunting do not easily occurs and the control have the best responsibility at the time. The optimal t equals to derivative time in PID control. Parameter “t” gives effect on proportional, integral and derivative function. If t≤CtI, derivative function of system will be eliminated.	0～2000 seconds
CtI	Control period	The higher CtI,the stronger ratio.Smaller value can improve control accuracy. 1)For SSR, thyristor or linear current output, generally 0.5～3 seconds.For Relay output or in a heating/refrigerating dual output control system, generally 15 to 40 seconds, because small value will cause the frequent on-off action of mechanical switch or frequent heating/refrigerating switch, and shorten its service life. CtI is recommended to be 1/4 – 1/10 of lag time t, and not greater than 60 seconds. 2)For current output, the smaller value can make quicker response,better control result.	0～125 seconds

<table>
<tr>
<td>Sn</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>stock</td><td>22</td><td>0～75mV</td></tr>
<tr><td>3</td><td>T</td><td>26</td><td>0～80ohm resistor input</td></tr>
<tr><td>4</td><td>E</td><td>27</td><td>0～400ohm resistor input</td></tr>
<tr><td>5</td><td>J</td><td>28</td><td>0～20mV voltage input</td></tr>
<tr><td>6</td><td>B</td><td>29</td><td>0～100mV voltage input</td></tr>
<tr><td>7</td><td>N</td><td>30</td><td>0～60mV voltage input</td></tr>
<tr><td>8</td><td>WRe3-WRe25</td><td>31</td><td>0～1V voltage input</td></tr>
<tr><td>9</td><td>WRe5-WRe26</td><td>32</td><td>0.2～1V voltage input</td></tr>
<tr><td>10</td><td>extended input specification</td><td>33</td><td>1～5V voltage input</td></tr>
<tr><td>12</td><td>F2 radiation type pyrometer</td><td>34</td><td>0～5V voltage input</td></tr>
<tr><td>15</td><td>4～20mA (installed I4 in MIO)</td><td>35</td><td>-20～+20mV</td></tr>
<tr><td rowspan="2">16</td><td rowspan="2">0 ～ 20mA (I4 is installed in MIO)
0 ～ 10V (I31 is installed in MIO)</td><td>36</td><td>2～10V</td></tr>
<tr><td>37</td><td>0～20V</td></tr>
</table>
When Sn=10, It means extended input is used. Like R, WRe325,WR3520,BA1,BA2,G,F2,0-5V, 1-5V.
</td>
<td>0～37</td>
</tr>
<tr>
<td>dIP</td>
<td>Radix point position</td>
<td>Four formats (0, 0.0, 0.00, 0.000) are selectable
dIP=0, display format is 0000, no radix point
dIP=1, display format is 000.0
dIP=2, display format is 00.00
dIP=3, display format is 0.000
Note 1: For thermocouples or RTD input, only 0 or 0.0 is selectable, and the internal resolution is 0.1.
dIP only affect the display, and has no affect to the accuracy of measurement or control.</td>
<td>0～3</td>
</tr>
<tr>
<td>dIL</td>
<td>Signal scale low limit</td>
<td>Define scale low limit of input. It is also the low limit of external set value, transmittion output and light bar display.
E.g.:pressure transmitter is used, 1-5v input,as for 1V input is 0,5V is 1MPa, hope to be resolution as 0.001MPa. Then you need to set as follows:
Sn=33(1-5v input)
Dip=3(0.000format)
dIL=0.000(input low limit is 1V)
dIH=1.000(input high limit is 5V)</td>
<td rowspan="2">-1999～ +9999 units or 1℃</td>
</tr>
<tr>
<td>dIH</td>
<td>Signal scale high limit</td>
<td>Define scale high limit of input. It is also the high limit of external set value, retransmission output and light bar display.</td>
</tr>
<tr>
<td>Sc</td>
<td>Input offset</td>
<td>Sc is used to compensate the error caused by transducer, input signal, or auto cold junction compensation of thermocouple.
PV_after_compensation=PV_before_compensation + Scb
E.g.:if input is remaining same, Sc=0.0C, PV=500.0C, when Sc is 10.0, then PV is 510.0C. Sc is usually 0.</td>
<td>-1.99～ +4000 ℃</td>
</tr>
</table>

OP1	output type	OP1 select the control output type: OP1=OP1.A x 1 + OP1.B x 10 OP1.A shows the output type of OUTP. It should be compatible with the module installed in OUTP sockets. **OP1.A=0,** if output modules such as SSR voltage output, relay contact discrete output, thyristor cross zero trigger output, and TRIAC no-contact discrete output are installed in OUTP. **OP1.A=1,** 0～10mA linear current output. Linear current output module should be installed to main output. **OP1.A=2,** 0～20mA linear current output. Linear current output module should be installed to main output. **OP1.A=3,** spare **OP1.A=4,** 4~20mA linear current output. Linear current output module should be installed to main output. **OP1.A=5～7,** is for other models, please not use it for AI-518/518P. **OP1.A=8,** single channel phase-shift output. K5 module should be installed. AUX can not work as refrigerating output. OP1.B shows the AUX output type. It works only when parameter oPL<0. **OP1.B=0**, time proportional output. Output modules such as SSR voltage output, relay contact discrete output, thyristor cross zero trigger output, and TRIAC no-contact discrete output can be installed in OUTP. **OP1.B=1,** 0～10mA linear current output. Linear current output module should be installed to main output. **OP1.B=2,** 0～20mA linear current output. Linear current output module should be installed to main output. **OP1.B=3,** spare **OP1.B=4,** 4～20mA linear current output. Linear current output module should be installed to main output. AUX does not support position proportional output or phase-shift trigger output. For example, OUT and AUX all output 4～20mA linear current, then OP=44.	0～48
OPL	Output low limit	0～110%: OPL is the minimum output of OUTP in single directional control system. -110 ～ -1%: the instrument works for a bidirectional system, and has heating/refrigerating dual output. When CF.A=0, OUTP (main output) works for heating, and AUX (Auxiliary output) works for refrigerating. When CF.A=1, OUTP works for refrigerating, and AUX works for heating. In a bidirectional system, the heating and refrigerating ability are generally different. OPL = -(power when AUX output is maximum /power when OUTP output is maximum) x 100%. For example, for a heating/refrigerating air condition, its maximum power of refrigerating is 4000W, and maximum power of heating is 5000W, and AUX works for refrigerating, then OPL=- (4000/5000)x100% = -80% The range of AUX output can't be freely defined by user. If the internal calculation requires maximum output of AUX (AUX output=OPL), then in 4～20mA output, the AUX output is 20mA, and user can't limit the maximum AUX output to 10mA.	-110～+110%
OPH	Output upper limit	OPL limits the maximum of OUTP (main output). OPH should be greater than OPL.	0～110%

ALP	Alarm output allocation	From right side to left side, the first, second, third and fourth digit of ALP individually indicate the alarm output terminal of HIAL, LoAL, HdAL, and LdAL. 0 shows no output. 1 and 2 are spare for future use. 3,4,5 and 6 respectively indicate alarms outputted to AL1, AL2, AU1 or AU2. For example, ALP = 5 (LoAL) 5 (HdAL) 0 (LoAL) 3 (HIAL) It shows that HIAL is sent to AL1, LoAL has no output, HdAL and LdAL are sent to AU1. Note 1: When AUX is used as auxiliary output in bidirectional (heating/refrigerating) control, alarm to AU1 and Au2 won't work. Note 2: Installing L5 dual relay output module in ALM or AUX can implement AL2 or AU2 alarm.	0～5555
CF	System function selection	CF is used to select some system function. The value of CF is calculated as below: **CF=A×1+B×2+C×4+D×8+E×16+F×32+G×64+H×128** **A=0**, reverse action control mode. When this mode is selected, an increase in PV results in a decrease in the control output. Ex, heating control. **A=1,** direct action control mode. When this mode is selected, an increase in PV results in an increase in the control output. Ex, cooling control. **B=0,** without the function of alarm suppressing at power on or setpoint changing. **C=0,** When the instrument work as a program generator, the upper window displays the program step; **C=1**, it displays PV (measurement value).(only for AI-518P) **C=0,** When the instrument work within HIAL & LoAL,**C=1**,SV is not litmited(only for AI-518,not for AI-518P) **D=0,** no remote setpoint input function; **D=1**,allow remote setpoint input. (only for AI-518P) **D=0,** works as transmittion PV value; **D=1**,give SV output. (only for AI-518) **E=0,** disable the function of sectional power restriction **E=1,** enable the function of sectional power restriction **F=0,** light bar indicates output value.**F=1,** light bar indicates measurement value **G=0,** When alarm is triggered, the alarm symbol is alternatively displayed on the lower window. It is helpful for user to know the cause of the alarm.**G=1,** disable alarm symbol display. **H=0,** unilateral hysteresis is applied; **H=1,** bilateral hysteresis is applied (in order to compatible with old version V6.X). **For example:** if it is expected that the instrument service as reverse action control; has the function of alarm suppressing at power on; no restriction on the range of setpoint; no sectional power restriction; no light bar; alternatively display alarm symbol when alarming, then we get A=0, B=1, C=1, D=0, E=0, F=0, G=0,H=0. And so parameter "CF" should be set as follows: **CF=0×1 + 1×2 + 0×4 + 0×8 + 0×16 + 0×32 + 0×64 = 2**	0～127
Addr	communication address	In the same communication line, different instrument should be set to different address.	0～100
bAud	Communication baud rate	The range of communication baud rate is 1200～19200bit/s.	0～19200

dL	PV input filter	The value of dL will determine the ability of filtering noise. There is one intermediate-value filter system and one second order integral digital filter system in AI series instrument. Intermediate value filter takes intermediate value among three continuous values, while integral filter has the same effect as resistance-capacity integral filter. If measurement input fluctuates due to noise, then digital filter can be used to smooth the input. Parameter “dL” may be configured in the range of 0 to 20, among which, 0 means no filter, 1 means intermediate-value filter and 2～20 means that intermediate-value filter and integral filter can be selected simultaneously. If great interference exists, then you can increase parameter “dF” gradually to make momentary fluctuation of measured value less than 2 to 5. When the instrument is being metrological verified, “dF” s can be set to 0 or 1 to shorten the response time.	0～20
run	System running mode	**For AI-518P running mode is :** **Run=A×1+D×8** Among which: A is used to select 5 kinds of power-cut event handling modes; D is used to select 4 kinds of run /modify event-handling modes; **A=0,** start to run the program from step 1 unless the instrument was in “stop” state before power cut. **A=1,** if these is deviation alarm after power resume, then stop the program, otherwise, continue to run the program from the original break point. **A=2,** continue to run the program from the original break point.. **A=3,** stop the program. **A=4,** go into HOLD state after power on. If it is in StoP state before power cut, then keep in StoP State after power on. **D=0,** neither PV startup nor PV preparation function. Program is executed as planed. This mode guarantees constant running time of the program, but it can’t guarantee the integrity of the whole curve. **D=1,** With the function of PV startup and without the function of preparation. **D=2** With the function of preparation and without the function of measurement value startup. **D=3** With the function of measurement value startup and preparation. For details about PV startup function and PV preparation function, see program instruction later chapter. **For example:** for one AI-518P, can set A=2,D=3, then we get parameter: **Run=2×1+3×8+0×32=26**	

Loc	Parameter lock	If parameter Loc is set to other values than 808, then only field parameters in the range of 0 to 8 and parameter Loc itself can be set. When parameter Loc is set to 808, user can set all parameters. Parameter Loc provides several operation privileges. When user has completed setting some important parameters such as input and output, parameter Loc can be set to other values than 808 in order to avoid field operators' accidental modification of some important operation parameters. See the following: **1. for AI-518 series instrument** **Loc=0,** allowed to modify field parameters and setpoint. **Loc=1,** allowed to view field parameters, and to set setpoint. But the modification of field parameters (except parameter Loc itself) is not allowed. **Loc=2,** allowed to display and view field parameters, but the modification of field parameters and setpoint (except parameter Loc itself) is not allowed. **Loc=808,** configuration of all parameters and setpoint is allowed. **2. For AI-518P series instrument** **Loc=0,** allowed to modify field parameters, program value (time and temperature value) and program segment number StEP. **Loc=1,** allowed to modify field parameters and StEP value, but the modification of program is not allowed. **Loc=2,** allowed to modify field parameters, but not allowed to modify StEP value and program. **Loc=3,** only allowed to modify parameter Loc itself, all other parameters, program and StEP value can not be modified. **Loc=808,** allowed to set all parameters, program and StEP value. **Note:** that 808 is the password of all AI series instrument. In application the instrument should be set to other values to protect from modifications of parameters. Meanwhile the management of production should be enforced to avoid arbitrary operation. If Loc is set to other values than the above mentioned, the result may be one of those above mentioned, and most of them are the same as when loc=1 is set. If you Set Loc to be 808 during field parameter setting, parameter Loc will automatically turned to be 0 when you finished setting field parameter. If you set Loc to be 808 after the parameters are unlocked, parameter Loc will be saved as 808 permanently.	0～9999
EP1～EP8	Field parameter definition	When parameters are all set, most are not needed to changed and there maybe damage if wrong parameters are set. Therefore, there is lock function added. As for AI-518P,you may need to change parts of ramps values or times,like HIAL,LoAL etc. 1 to 8 field parameters can be defined by parameters EP1to EP8. If the number of the field parameters is less than 8, the first idle EP parameter should be set to "nonE". Loc=0.EP2=LoAL, EP3=HdAL,	nonE ~run

5.2 Additional Remarks of Special Functions

5.2.1 Time proportional output(oP1=0)

Usually it's by relay or SSR output voltage high and low proportion to realise the output change. CtL is like control period. Output is 0%~100%. As for relay output, it's better set in 20~40seconds, so as to protect relay life. As for ssr output, it's better set 0.5~1second so as to achieve best control result. E.g: if want to make output 20% ~60%, you can set oPL=20,oPH=60. Usually the output is default as oPL=0,oPH=100. No output limit.

5.2.2 Single phase contact output (oP1-8)

Phase-shifting output is usually realised by TRIAC.but it will has influence on heater, so please make sure of the anti-interference of other equipments when use it.

5.2.3 SV limit setting (only for AI-518,and CF.C=0)

SV is usually between HIAL and LoAL. So that to make sure SV is not too high nor too low. If no auto-alarm is installed, it maybe burnt, in order to cancel it, you can set CF.C=1. AI-518P programmable given SV is not limited.

5.2.4 Alarm blocking at the beginning of power on(CF.B=1).

Some unnecessary alarms often occur at the beginning of power on or when the setpoint is modified. For example, in a heating system, at the beginning of powers on, its temperature is much lower than the setpoint. If low limit and deviation low limit are set and the alarm condition 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. Alarm blocking function is correlative to direct/reverse action control. In a reverse action control system (refer to CF), the corresponding absolute and deviation low limit alarms are blocked until the alarm condition first clears. If the alarm condition is satisfied again, the alarm will work. Similarly, in a direct action control system, the absolute and deviation high limit alarms are blocked.

5.2.5 Sectional power restriction(CF.E=1).

With regards to some high temperature electric resistance furnace whose heating materials is silicon-molybdenum bar or tungsten filament, the resistance of there heater in cold condition is much lower than that in hot condition, so the furnace current will exceed its rated current greatly in cold condition. If the instrument works in automatic control mode, full power output in cold condition will lead to power switch trip and shorten the heating materials service life to a large extent.

The function of sectional power restriction will be executed if CF.E=1. Then the instrument output lower limit will be fixed on 0, while oPL is the output upper limit when the temperature is lower than the value of lower limit alarm. If the temperature is higher than the lower limit alarm value, oPH is the upper limit of output. In this way, the instrument can work with 2 optional power according to the measurement in order to restrict the oversized current in cold condition. Lower limit alarm function will be canceled when sectional power restriction function is active.

For example: If it is needed that output power should be restricted to 20% when the furnace temperature is lower than 600℃ and 100% when the temperature is higher than 600℃. Parameters is as follows:

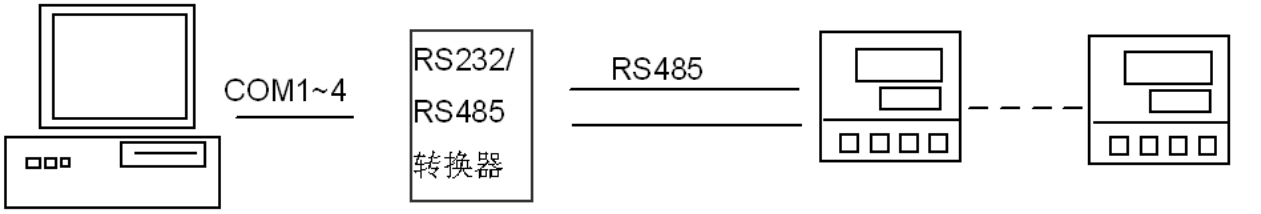
LoAL=600, oPL=20, oPH=100, CF.E=1 (see parameter CF for details).

5.2.6 Dual given value switch/ external programmable control button

If I2 is installed in MIO, then you can connect a switch between 14 and 16. As for AI-518, SV1/SV2 can be changed. As for AI-518P, press for 0.3~1 second for run/Hold function. If press over 4 seconds, then it stops working.

5.2.7 Working with computer

AI controller are able to work with computer if S, S4 is installed. AIDCS is developed specially for AI controller to be used and controlled on computer. Both Chinese and English version are available. 1~200 units controllers are workable. RS232/RS485 changable. One computer with two communication interfaces are workable with 100 units controllers. Diffferent communication addresses are needed. AI-485 AIBUS is advised to be used with AI series instruments.



Computer AI series intruments upto 100units

6.Widely used control mode

6.1 on/off control/ alarming instruments

On/off control mode is the simpest way of control, used in low requirement cases or alarms.
If want regulation function, AI-518 is adviced. Install W1 OR L2,L4 in OUTP. So that to achieve the best control result.
On/off control can be decided by dF parameter. AI controllers are needed to be set as: CtrL=0,oP1=0, CF.A can be used for positive/negtive regulation.CF.A=0, OUT is heating function or low alarm. CF.A=1, OUT is for cooling or high alarm. SV is for set point.
Sometimes it may need more than 2 alarms, there are high limit alarm,low limit alarm. Parameters are HIAL,LoAL,dHAL,dLAL. Respectively there are AL1,AL2,AU1,AU2 lights on controller panel.By correctly setting these parameters, you can reduce comsumption and save energy,raise the control accuracy.

6.2 Temperature tramsmission/ program give gernator

AI-518 can give any range current outputs, the transmission accuracy is 0.5. Thermocouple or RTD inputs, and any current output,accuracy is 0.2. The parameter setting is as belows:
If CtrL=0(on/off control mode),oP1=1,2 or 4(current output), main output is current transmission output. Then this unit is without regulation function, but with alarm and communication function.
Sn, choose thermocouple RTD input
dIL, transmittion high limit,unit is C

dIH,transmittion low limit, unit is C
oP1, 1,2or 4,namely,0-10mA,0-20mA or 4-20mA
oPL,low PV,1%
opH,high PV,1%.
For example, if K thermocouple is required to give transmission output, temeprature range is 0-400C, output is 4-20mA, then you can set as belows: Sn=0, dIL=0,dIH=400,oPL=0,oPH=100. OUTP install X3 or X5.When temperature is over 400C, then give 20mA output, when temperature is with 0 to 400C, then the output is within 4~20mA.

6.3 AI artificial intelligent regulator

AI series controllers are developed with advanced AI artificial intelligent fuzzy logic control mode, high accuracy. Advanced Auto turning function can help users to set parameters. AI-518P has the programmable control function. When CtrL is 1-4, then the unit is able to regulate other functions.
SSR voltage output(time proportion): if OUTP install G module, it can drive the external SSR.
Single/three-phase TRIAC output(time proportion): OUT is installed with K1,or K3 ,it can drive the external single/three phase TRIAC.
Relay output(time proportion):if OUTP is installed L2/L4, can drive middle relay.But the disavantage is that the relay maybe burnt.
Users must choose the right output according to his application, and must undstand the output parameter oP1,oPL,oPH , CtrL,M5,P,t,Ctl and so on.

7.Further description for the operation of AI-518P series instrument

AI-518P program type temperature controller is used in the application where the setpoint should be changed automatically with the time. It provides 30 segment program control which can be set in any slope and the function of jump, run, hold and stop can also be set in the program.

7.1 Concepts and functions

Program StEP: The NO. Of the program StEP can be defined from 1 to 10, and the current StEP is the program StEP being executing.
StEP time: the total running time of the program StEP. The unit is minute and the available value range from 1 to 9999.
Running time: time that the current StEP has run. As the running time reaches the StEP time, the program will jump to the next StEP automatically.
Jump: the program can jump to any other steps in the range of 1 to 30 automatically as you programmed in the program StEP, and realize cycle control. If the StEP No. Is modified, the program also will jump.
Run/Hold: when program is in the running status, timer works, and setpoint value changes according to the preset curve. When Program is in the holding status, timer stops, and setpoint remains.
The holding operation can be programmed into the program StEP. When the program meets with the StEP, the StEP time of that is set to zero, or when a jumping StEP jumps to another jumping StEP, the program will get in Hold status. Hold/Run operation can also be performed manually at any time.
Stop: when the stoP operation is activated, the program will stop, the running time will be clear and timer will stop, event output switch is reset and the output control is stopped. If run operation is activated when

instrument is in the stoP status, the program will start-up and run from the StEP NO. set.

The stoP function can be programmed into the program StEP. The running StEP NO. Can be set at the same time. The stoP operation can also be performed manually at any time. (After stoP operation is done, the StEP NO. Will be set to 1, but user can modify it again).

Power cut /resume event handling: There are four event handling method selectable for power resume after power cut.

PV startup and PV preparation function: At the beginning of starting a program, resuming a program after power cut or continuing to run a program after it is just modified, the PV (process value) are often quite different from the setpoint. PV startup function and PV preparation function can make PV and setpoint consistent, and avoid unexpected result.

When PV startup function is enable, the instrument will adjust the running time automatically to make the expected setpoint is the same as the current PV.

For example, the program is set that the temperature will be raised form 25℃ to 625℃ in 600 minutes. But the current PV is 100℃, then the instrument will automatically adjust the running time to 75 minutes, and then run the program.

Preparation function(rdy): when start program control, when all setting is correct, then the preparation work will be avoided, otherwise, the function will be started to correct unnormal parameters. You can set in run parameter so as to make sure of high accuracy.

Curve fitting: curve fitting is adopted as a kind of control technology for AI-518P series instrument. As controlled process often has lag time in system response, by the way of curve fitting the instrument will smooth the turning point of the linear heating-up, cooling-down and constant temperature curves automatically. The degree of the smooth is relevant with the system's lag time, the longer of the lag time, the deeper of the smooth degree. On the opposite the smooth function will be weaker. Generally the shorter of the process lag time (such as temperature inertia), the better of the program control on effect. By the way of the curve fitting to deal with the program curves, will avoid overshoot. Note: The characteristic of the curve fitting will force the program control to generate fixed negative deviation during the linear heating-up and fixed positive deviation during the linear cooling-down, the deviation is direct proportional to the lag time (t) and the speed of heating-up (cooling-down). This phenomenon is normal.

7.2 Programming and operation editting

Programming of AI series instrument has uniform format of temperature-time-temperature, which means that temperature set for current StEP will change to temperature set for next StEP after the time set for the current StEP. The unit of temperature set is ℃ and the unit of time set is minute. The following example includes 6 steps, which is linear temperature heating up, constant temperature, linear temperature cooling down, jump cycling, ready, Hold and event output.

StEP1: **C01=100 , t01=30** Start linear temperature heating up from 100℃, and the time needed is 30 minutes.

StEP2: **C02=400 , t02=60** Raise temperature to 400℃, slope of raising curve is 10℃/minute, and the time for temperature to remain constant is 60 minutes.

StEP3: **C03=400 , t03=120** The StEP for temperature cooling down, slope of cooling curve is 2℃ /minute, and the time needed is 120 minutes.

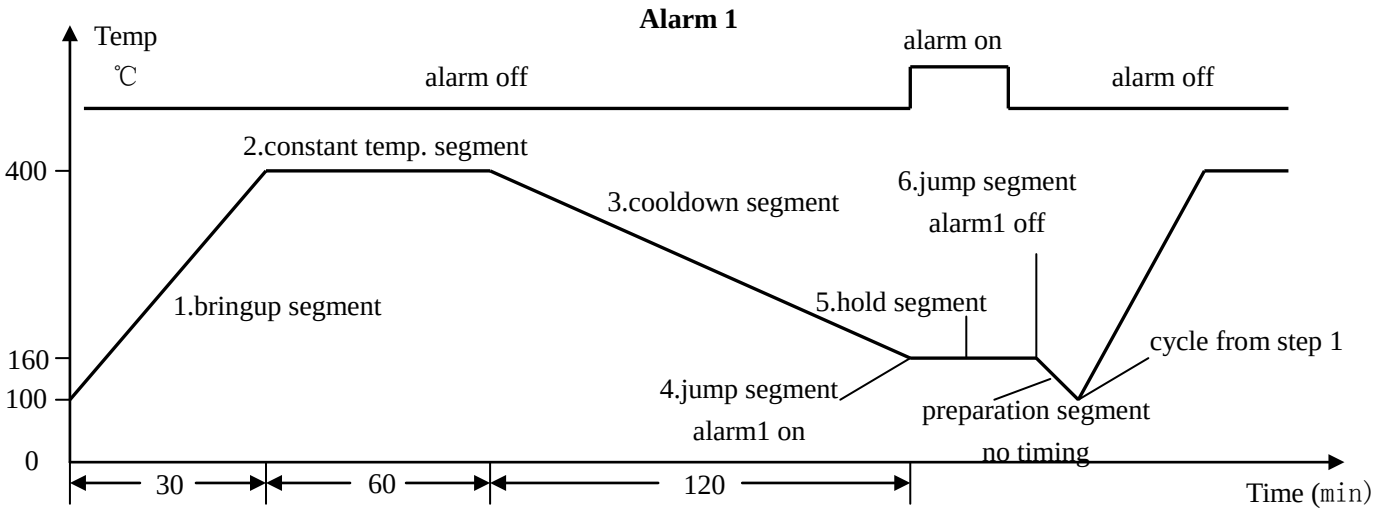
StEP4: **C04=160 , t04=-35** Temperature cool down to 160℃, then alarm 1 is triggered, and the program

jump to StEP5.

StEP5: **C05=160 , t05=0** The program get in Hold state, and run operation executed by operator is needed for the program to continue running to StEP 6.

StEP6: **C06=100 , t06=-151** Alarm 1 is switch off, and jump to StEP1 to start from beginning.

In this example, it is assumed that the positive deviation alarm is set to 5℃. Because the temperature of StEP 6 is 160℃, and the temperature of StEP1 is 100℃, when program jumps from StEP 6 to StEP 1, the program will change to preparation state at first, i.e., Control the temperature until the deviation between setpoint and PV is less than positive deviation alarm value. After temperature is controlled to 105℃, the program will be started from StEP 1, and run the above steps again. The temperature control block is shown below.



7.2.1 Time setup

txx = 1—9999 (min) setting time of No. xx StEP

txx = 0 the program is hold on StEP xx

txx = -1—-30 negative value of time represents an operation command such as: run, Hold, stoP, jump and even output, the signification is as follows:

txx=-121 Program is stopped.

Note: The program will be held if it jump from a control segment to another control segment (an Hold action will be inserted between two control sections), external run/Hold operation is needed to release the Hold status. It is not allowed that the jump section jump to itself (for example: t 06= -6), otherwise, the Hold status can not be released.

7.2.2 Setpoint setup

Cxx = ~199.9～++3000.0C or 999-1999～+9999 (units or ℃)

7.2.3 Program arrangement of multi-curve operation

AI-518P has the advanced function of flexible program arrangement. Normally, when the program stops, the StEP will be automatically set to1. Thus if StEP is not change to other value, a program will start from step1. If multiple curves are defined, the control can jump to different curve by setting step 1 as jump segment.

For example: There are three curves with the length of 3 steps represent three groups of process parameter, they are separately arranged on StEP2-StEP4, StEP5-StEP7, StEP8-StEP10. Settings are as follows:

T 1=-2 Execute the program of curve 1 (StEP2-StEP4)

T 1=-5 Execute the program of curve 2 (StEP5-StEP7)

T 1=-8 Execute the program of curve 3 (StEP8-StEP10)

Note: t 1 setup can be omitted, if you choose the curves by setting the value of StEP before the program startup.