YUDIAN

User's Manual
for Ai-8 * 29 Multi-loop Regulator with High Precision
(V 9.35)

Contents

1 Summary

AI-8x29 is a multifunctional 4-loop regulator that can be externally extended with multiple input and output modules. By adding externally extended modules, this regulator can achieve measurement and control up to 96 channels, meeting the needs of various emerging industries for small volume and multi loop control. Under the extension mode, the upper-position computer can control up to 96 test control loops with only a communication instrument. Compared with the mode that needs to access multiple address instruments, the communication efficiency can be greatly improved. Its commonly used parameters allow unlimited number of writes from the upper computer, and the internal memory of the instrument will not be damaged due to frequent writes from the upper computer. The write restriction function of parameters only allows modification of specific or all parameters when Loc is set to a specific value, which reduces the occurrence of abnormal instrument operation caused by communication software writing errors. Compared with similar products on the market, the advantages of this regulator are as follows:

● Highly reliable low-energy design, passed group pulse anti-interference 8KV testing and high-temperature 100 degree Celsius aging testing; The power consumption is less than 0.3W without output conditions.

● Up to 96 control output channels and 256 alarm output channels can be expanded, and up to 96 analog measurement inputs and 16 switch event input channels can be expanded. Each output channel has 4 alarm settings and 5 alarm signals for input error alarms. All alarm signals can be defined as independent outputs or output in a common form to save alarm output ports.

● A brand new multi-channel operation interface with built-in LED digital display, which can quickly view and edit the parameter values of any channel, as well as edit the values of all registers inside the instrument. Even if the upper computer fails, it can work urgently.

● When selecting the number and functions of different control circuits, their usage and register addresses are completely consistent, which means that users only need to learn about the AI-8x29 single model instrument to be able to apply it to other models of instruments in the same series, greatly reducing learning costs.

● With flexible and efficient operation. which are divided into channel parameters, input-output parameters, and common parameters; Channel parameters are independently set parameters for each channel, with 12 parameters per channel, including SV, PID parameters, and alarm parameters; There are four different sets of configuration

parameters for input and output, which are selected and called by each input and output channel; Common parameters are globally used parameters, such as baud rate and communication address. Based on the parameter group definition mode, AI-8 * 29 greatly reduces the overall number of registers while retaining flexibility and powerful functionality, thereby simplifying the operation mode and improving the read and write efficiency of the upper computer. For example, if the 96 input loops of the instrument are standardized, the input parameters can all use the first set of parameters, so only one set of input configuration parameters needs to be set to define the input specifications of all loops. At the same time, different parameter groups can also be selected to define different input specifications. A single instrument can define up to 4 different types of input specifications, which can meet the vast majority of application scenarios.

● The regulator has almost no limit on the number of external input and output modules that can be expanded, and can be quickly customized according to user's requirements. If there is no need to create a new mold, the cycle is only about 2 weeks, and some spare registers can be reserved in the system for users to add new functions.

2 Code Definition

The IO inside the host of this regulator adopts a modular design, allowing for the installation of up to 3 modules, which can be freely combined according to requirements. It consists of the following four parts:

<div align="center">

AI-8529D71J1   G6   G6   G6

①   ②   ③   ④

</div>

This indicates that: ①the basic function is AI-8529 type; Three solid-status relays are installed in ②, ③, and ④ to drive voltage output and regulate output and alarm. The meanings of each part in the instrument model are as follows:

① **basic function**

AI-8529D71J1: Accuracy level 0.2, 4-loop regulator; 4-channel thermocouple input; D71 rail installation, D71 rail mounting dimensions, the width of D71 is only 22.5mm, DIN rail mounting mode, double row LED display, with key operation, the power supply and communication adopt pluggable bus terminals, 4-digit nixie tube display panel. The bottom

terminal is for 24VDC power supply and RS485 communication interface.

AI-8629D71J1: accuracy level 0.15, 4-loop regulator; 4-channel thermocouple input; D71 rail installation, D71 rail mounting dimensions, the width of D71 is only 22.5mm, DIN rail mounting mode, double row LED display, with key operation, the power supply and communication adopt pluggable bus terminals, 4-digit nixie tube display panel. The bottom terminal is for 24VDC power supply and RS485 communication interface.

AI-8629GD71J1: Accuracy level 0.15, input isolated 4-loop regulator; 4-channel thermocouple input; D71 rail installation, D71 rail mounting dimensions, the width of D71 is only 22.5mm, DIN rail mounting mode, double row LED display, with key operation, the power supply and communication adopt pluggable bus terminals, 4-digit nixie tube display panel. The bottom terminal is for 24VDC power supply and RS485 communication interface.

② **Module specifications for the first output (OUTP):** G5, G6, G61, G62, X6, and other modules.

③ **Module specifications for the second output (AUX):** G5, G6, G61, G62, X6, and other modules.

④ **Module specifications for the third output (ALM):** G3, G6, G61, G62,L21,L3, and other modules.

Note 1: The instrument is a maintenance-free type instrument that uses automatic zeroing and digital calibration technology. If it exceeds the tolerance during metrological verification, the problem can usually be solved by cleaning and drying the inside of the instrument. If not, please send the instrument back to the factory for maintenance;

Note 2: The instrument is free of charge during the warranty period. For instruments that need to be repaired, please specify the fault phenomenon and cause to ensure correct and comprehensive repair.

Note 3: The models and functions of commonly used modules are as follows:

Modules	Description
G2	Isolation-free SSR driver voltage output module with two-loop energy-saving function (5V/30mA)
G3	Isolation free SSR driver voltage output module with three-loop energy-saving functions (5V/30mA)
G5	Solid status relay drive voltage output module with two-loop isolation function (12V/30mA, non energy-saving type).

G6	Solid status relay drive voltage output module with three-way isolation function (12V/30mA, non energy-saving type).
G61	NPN output with three-loop isolation function, externally connected 5~24VDC to drive SSR or intermediate relay, with a maximum external voltage of 28VDC and a maximum driving current of 100mA per loop
G62	PNP output with three-loop isolation function, externally connected to 5~24VDC to drive SSR or intermediate relay, with a maximum external voltage of 28VDC and a maximum driving current of 100mA per loop
L21	Small-sized relay contact switch output module (suitable for alarms)
L3	Dual-channel large-sized high-capacity relay contact switch output module
X6	Two-loop linear current output module with high precision (negative output, accuracy level 0.2, 12V internal isolated power supply, maximum output voltage greater than 10.5V), supports definable 0~20mA or 4~20mA output, non energy-saving type
X61	Two-loop linear voltage output module with high precision (negative output, accuracy level 0.2, 12V internal isolated power supply), supporting 0~10V output, low-power energy-saving type

Note: For other modules not listed, please refer to the selection manual or call technical support.

3 Technical Specification

● **Communication:**

The bottom RS485 bus terminal supports MODBUS-RTU protocol; The baud rate is adjustable from 4800 to 115200;

The bottom RS485 bus terminal can be connected to our TCP-MODBUS and EtherCAT communication controllers, supporting relevant communication protocols;

The internal dedicated communication protocol is used between the host, slave, and extended module, with a reliable communication distance of 30m;

Communication delay: Under the serial connection, the communication delay of each entended input or output module is about 10mS (including data transmission time);

● **Input Specification:**

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

Linear voltage: 0~75mV, 0~20mV, 0~50mV

Extended specification: Please refer to the relevant extended input module for details

● **Input range:** K(-200~+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℃)

Linear Input: -9990~+32000 defined by user

● **Measurement accuracy:** level 0.15/0.2

● **Measurement temperature drift:** ≤75PPm/℃

● **Control period:** Under single-loop control, minimum 20mS; Under multi-loop control, each loop 10mS

● **Regulation mode:**

On-off control mode (dead band adjustable)

AI-PID with fuzzy logic PID regulating and auto tuning with advance artificial intelligence algorithm.

Manual regulating

Cascade regulation

● **Output specification (Modularized):**

Linear current output: 0~20mA or 4~20mA customized, with resolution about 20000 words, and maximum load 260 ohms (energy-saving type) or 525 ohms

Linear voltage output: 1-5V; 0~10V, with resolution around 10000~20000 words

SSR Voltage output: 5VDC/30mA(energy-saving) or 12VDC/30mA

NPN or PNP switch output: maximum voltage 28V, maximum current 100mA. When driving the relay coil, a fast recovery diode must be connected in parallel with the relay coil to absorb reverse voltage

When using externally extended output modules, please refer to the module instructions for relevant technical indicators

● **Alarm function:** 4 types of alarm; high limit, low limit, deviation high limit and deviation low limit

● **Electromagnetic compatibility (EMC):** ±6KV/5KHz according to IEC61000-4-4 (Electrical Fast Transient); 6KV according to IEC61000-4-5 (Electrical Surge) and under the interference of 10V/m high-frequency electromagnetic field, the instrument does not crash, the I/O malfunctions will not emerge either, and the fluctuation of the process value does not exceed ±5% of the range.
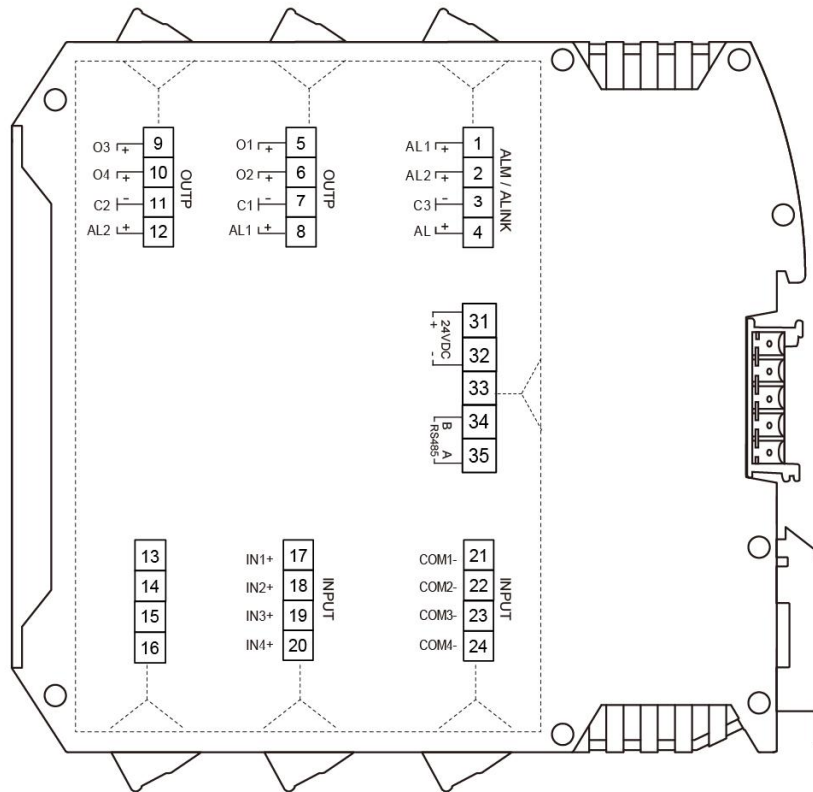
● **Isolation withstanding voltage:** Among power, relay contact or signal terminals ≥2300VDC. Among isolated electroweak terminals ≥600V

● **Power supply:** 24VDC, -15%, +10%

● **Power consumption:** ≤0.3W (excluding any output or external power consumption); The maximum power consumption of the whole instrument ≤ 3W

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

4 Wiring

4.1 Host

Note 1: This wiring diagram is for reference only. Depending on the configuration and version, the random wiring diagram may not match this manual. Please refer to the random wiring diagram for accuracy.

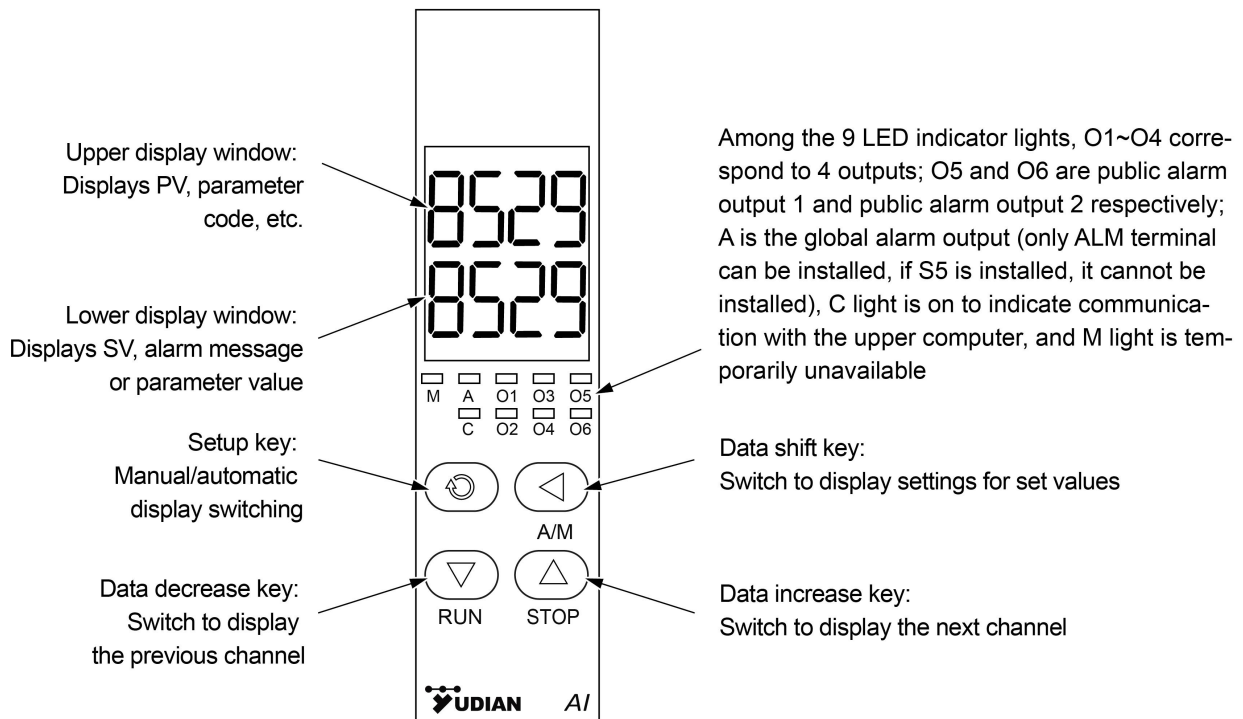**Note 2:** If the two-loop output modules X6 and X61 are installed in the OUTP position, terminals 8 and 12 are empty.

5 Display and Operation

5.1 Panel Description

AI-8*29 comes with a display panel and keyboard, which allows for quick viewing and modification of various parameters with our company's panel mounted instruments, especially when the upper computer malfunctions or is inconvenient to use

After power on, the instrument will automatically display the process values of each channel in a loop. Pressing the up and down keys can quickly switch the display channel and fixedly display the process value of a certain channel. At this time, pressing the setting button can display the set value of the channel for about 2 seconds. After automatic exit, the automatic cycle display status of the process value will be restored. Press the shift key

Upper display window:
Displays PV, parameter code, etc.

Lower display window:
Displays SV, alarm message or parameter value

Setup key:
Manual/automatic display switching

Data decrease key:
Switch to display the previous channel

Among the 9 LED indicator lights, O1~O4 correspond to 4 outputs; O5 and O6 are public alarm output 1 and public alarm output 2 respectively; A is the global alarm output (only ALM terminal can be installed, if S5 is installed, it cannot be installed), C light is on to indicate communication with the upper computer, and M light is temporarily unavailable

Data shift key:
Switch to display settings for set values

Data increase key:
Switch to display the next channel

M   A   O1 O3 O5
C   O2 O4 O6

A/M

RUN   STOP

YUDIAN   AI

to enter the current display channel's setpoint setting status.

5.2 Global and Group Parameter Setting

Long press the setting button to set group parameters and global parameters. The shortcut parameters defined by EP parameters will be displayed first. Continuing to press the setting button will display LOC parameters. After unlocking, 4 sets of preset input/output configuration parameters and global parameters can be displayed and set (to enter the hidden LOC mode, long press the setting button to enter the group parameters first, and then long press the shift button to enter the LOC interface). In the parameter setting status, long press the shift key to exit to display the previous parameter. If the setting key is pressed at the same time, the instrument can immediately exit the parameter setting status.
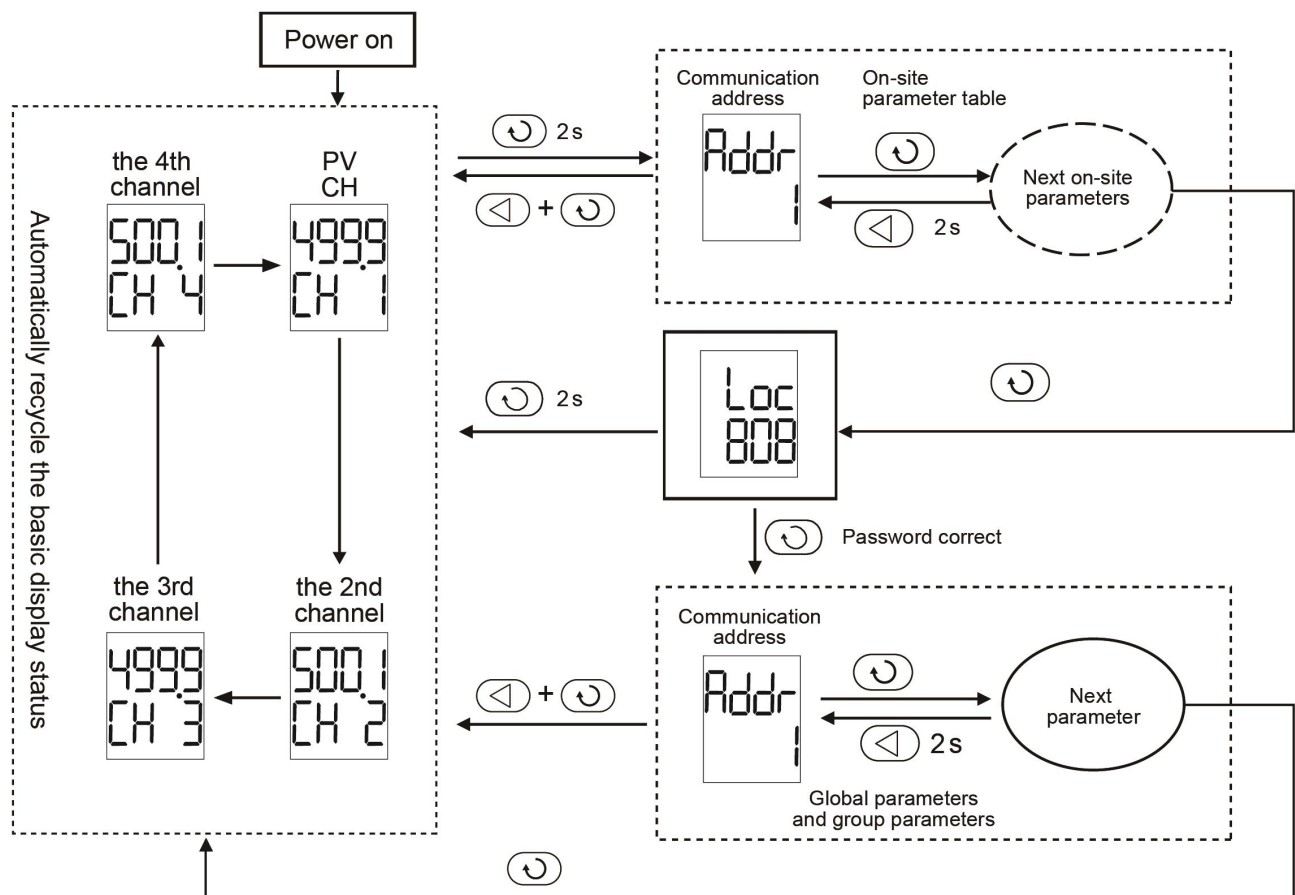
5.3 Channel Parameter Setting

Long press the shift key to display and edit the set value and PID parameters of the current channel. If the parameter lock Loc is unlocked, it can be edited. In the parameter setting status, long press the shift key to exit to display the previous parameter. If the setting key is pressed at the same time, the instrument can immediately exit the parameter setting status.
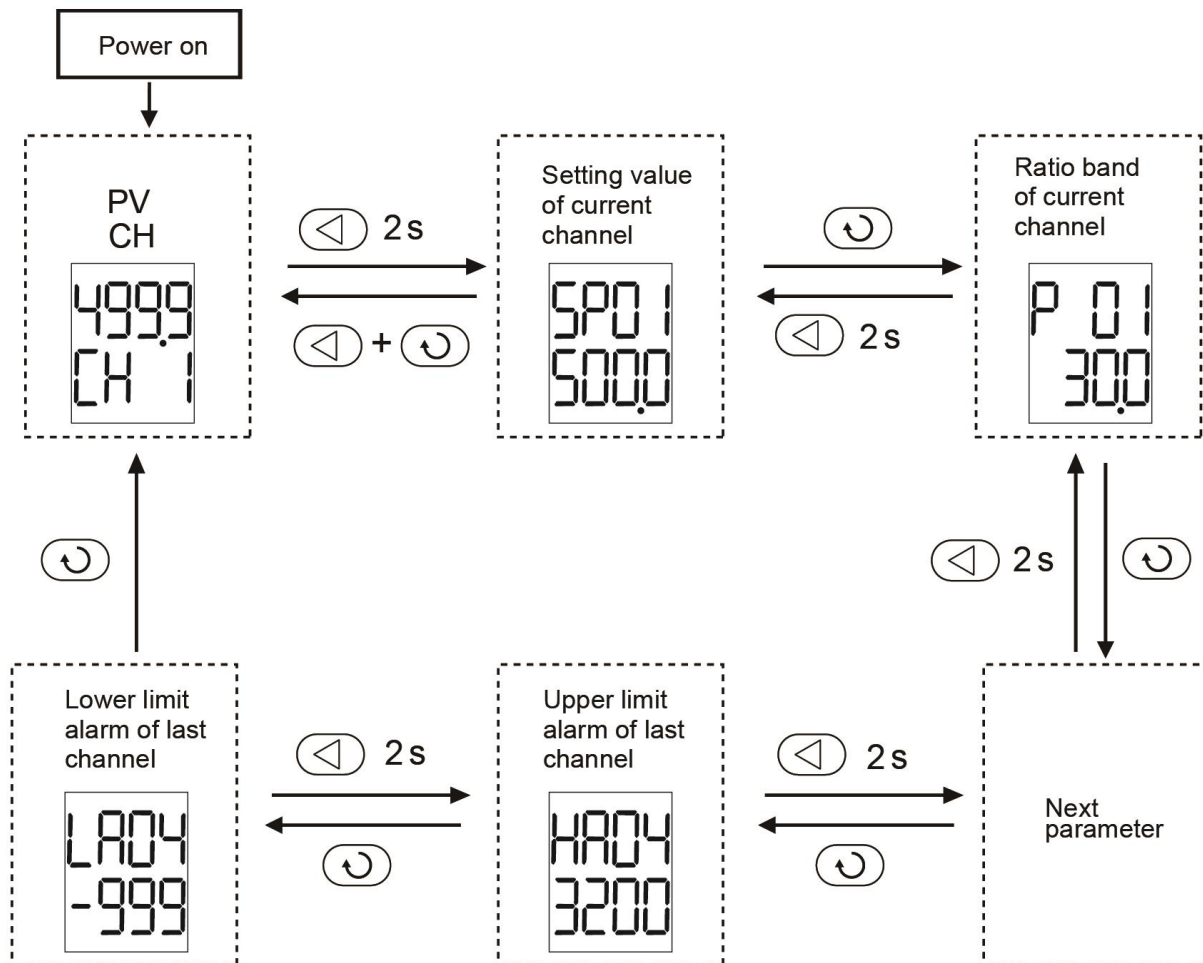
6 Description of Communication Protocol and Parameter Register

Connect the AI-8*29 instrument to the upper computer using RS485 serial port, or through our company's TCP modbus or EtherCAT communication controller. AI-8*29 adopts asynchronous serial communication interface, and the interface level complies with the provisions of RS485 standard. The data format consists of 1 starting bit, 8 data bits, no parity or even parity bits, and 1 stop bit. The baud rate of communication transmission data can be adjusted to 4800~115200 bps. When the communication baud rate exceeds 28800 bps, a high-speed optocoupler communication module should be used. When the communication distance is long, 4800 bps can be selected.

AI-8*29 supports the instructions 03H (read parameters and data), 06H (write a single parameter), and 10H (write multiple parameters) under the MODBUS-RTU protocol. The AI instrument can communicate with other MODBUS devices and adopts RTU (binary) mode to ensure speed. The communication interface can select 1-2 stop bits, without parity or even parity.

03H can read up to 32 data at a time, with 2 bytes per data. For example, the instruction to read **2 data is as follows:**

Address	Read	Address Code	Length	Check Code
XXH	03H	00H 01H	00H 02H	CRC

06H writes 1 data each time, the instruction sent is:

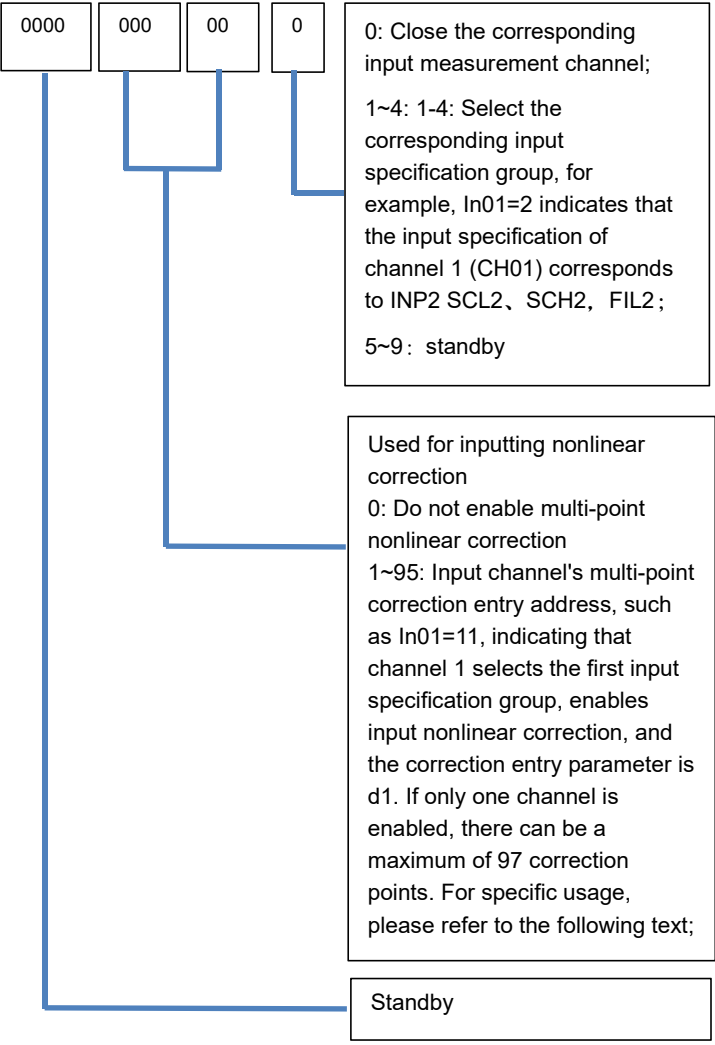| Address	Write	Address Code	Data	Check Code
XXH	06H	00H 01H	03H E8H	CRC

10H can write up to 16 data at a time, which is a length of 32 bytes. For example, the instruction to write a single data is:
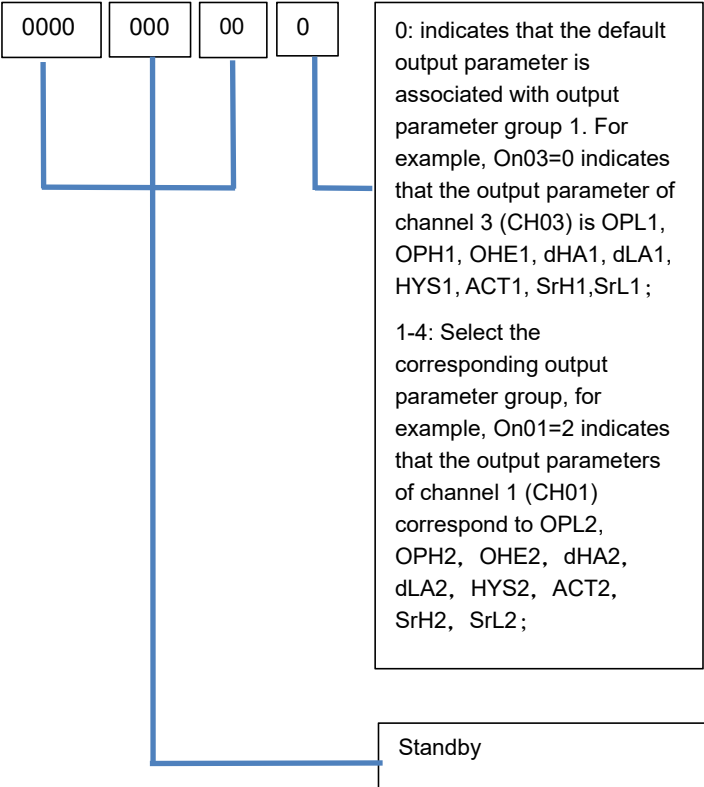
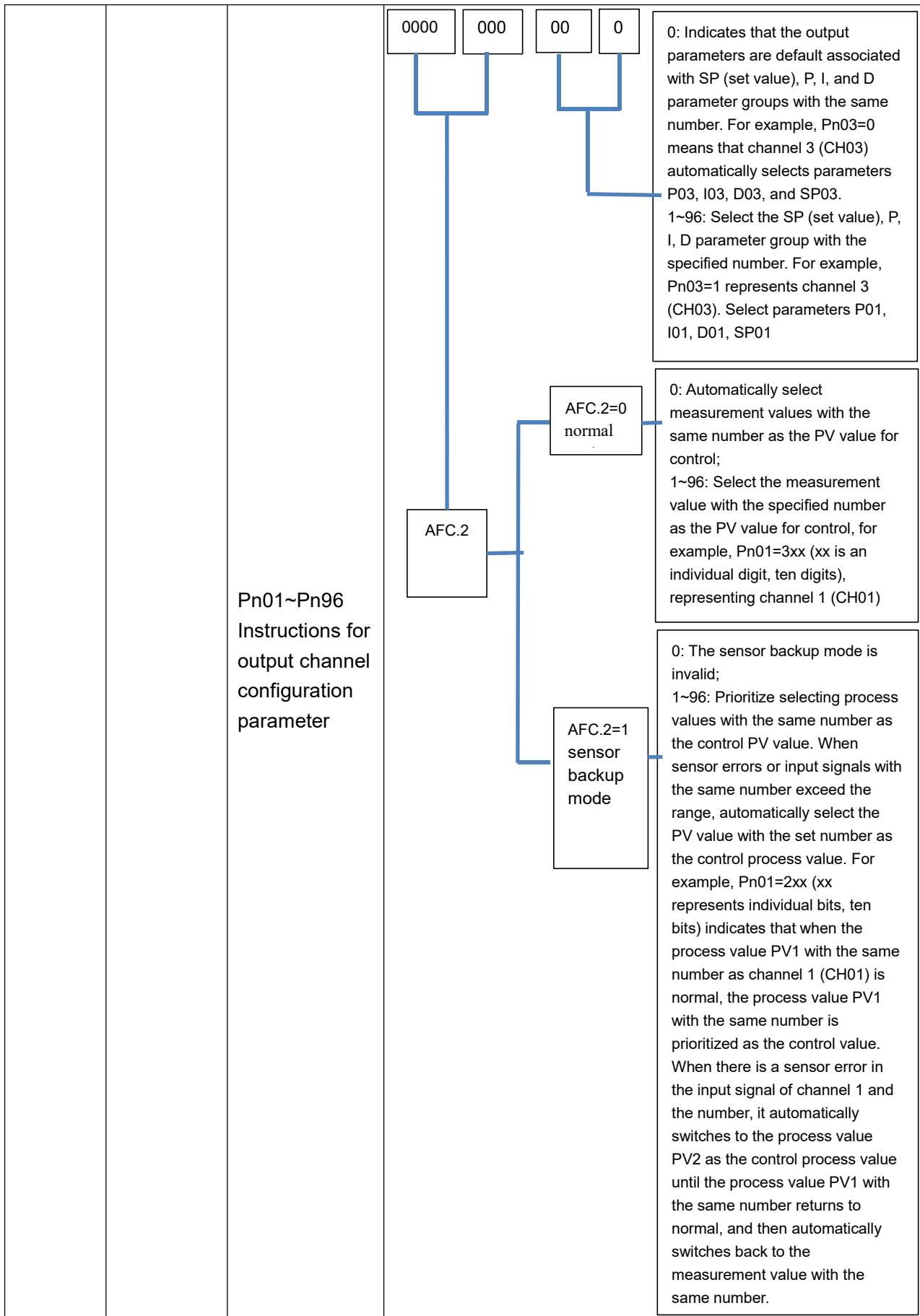| Address	Read	Address Code	Quantity	Byte	Data	Check Code
XXH	10H	00H 01H	00H 01H	02H	03H E8H	CRC

AI-8*29 has 96 sets of independent channel parameters, each containing 12 parameters, including SV, proportional band, integration time, differentiation time, control mode, output value (with setting to write manual value), control output parameter group number and table programming entry address, input channel and SV and PID parameter

group allocation, input specification group and input table correction entry address, input translation correction amount, upper limit alarm and lower limit alarm. The configuration group parameters include 4 sets of input configurations and 4 sets of output configurations (including alarm configurations); Measure input group parameters including input specifications, filtering strength, lower and upper scale limits, etc; The output group parameters include output limits, positive and negative deviation alarms, hysteresis, and functional configuration parameters; Configuring group parameters is only valid for channels that select that group parameter. In addition, there are global parameters such as communication address and baud rate, which are valid for all channels. The addresses of each parameter are shown in the table below (note: depending on the functional model, some products do not have all parameters).

Hexadecimal	Decimal	Parameter	Description
0000H~005FH	0000~0095	SP01~SP96 Preset values for groups 1 to 96	Range -9990~32000; The set value and four parameters including PID form a parameter group, The output channel can select different groups as set values and PID parameters through the PnXX parameter. Usually, the output channel number and PID parameter group number are the same, but the output channel can also switch to different numbered set values and PID parameter groups, and different output channels can share the same PID and set value parameter groups.
0060H~00BFH	0096~0191	P01~P 96 Proportional band	Range 0~32000, with the same unit as set value.
00C0H~011FH	0192~0287	I 01~I 96 integration time	Unit 0.1 seconds, with a range of 0.0~3200.0 seconds.
0120H~017FH	0288~0383	d 01~d96 differentiation time	Unit 0.01 seconds, with a range of -327.60~+327.60 seconds. (The maximum automatic result is+327.60. If a larger value is required, the value can be written in unsigned 16 bit format, and the corresponding 16 bit signed value will be displayed on the instrument.)

0180H~ 01DFH	0384~ 0479	In01~In96 Selection of input channel configuration parameter group	Range 0~9999, single digits 1~4 are the input specification group for selecting the measurement channel configuration. Setting it to 0 means turning off the measurement channel; Ten hundred digits are used to configure the correction address for the multi segment curve of the measurement channel. Setting it to 0 indicates no correction; For example, setting In01=112 means selecting the second set of input configuration parameters for channel 1, and the multi segment curve correction entry address for this channel is d11.
		In01~In96 Instructions for input channel configuration parameter groups	0: Close the corresponding input measurement channel; 1~4: 1-4: Select the corresponding input specification group, for example, In01=2 indicates that the input specification of channel 1 (CH01) corresponds to INP2 SCL2、SCH2, FIL2; 5~9：standby Used for inputting nonlinear correction 0: Do not enable multi-point nonlinear correction 1~95: Input channel's multi-point correction entry address, such as In01=11, indicating that channel 1 selects the first input specification group, enables input nonlinear correction, and the correction entry parameter is d1. If only one channel is enabled, there can be a maximum of 97 correction points. For specific usage, please refer to the following text; Standby
01E0H~ 023FH	0480~ 0575	Sc01~Sc96 Translation of the process values of the input channel	Range -9990~32000, used for translating and correcting process values. Specifically, if the process value of the input channel is turned off, the physical process value is 0. Writing this value can be equivalent to assigning a value to the channel process value by the upper computer or program.

0240H~ 029FH	0576~0671	On01~On96 Output channel configuration parameters	Range 0~9999, and the single digit set is 1~4 to select the configuration parameter group for the output channel; Ten hundred thousand reserved functions. When set to 0 by default, it indicates the associated output parameter group 1.
		On01~On96 Instructions for output channel configuration parameter groups	0: indicates that the default output parameter is associated with output parameter group 1. For example, On03=0 indicates that the output parameter of channel 3 (CH03) is OPL1, OPH1, OHE1, dHA1, dLA1, HYS1, ACT1, SrH1,SrL1; 1-4: Select the corresponding output parameter group, for example, On01=2 indicates that the output parameters of channel 1 (CH01) correspond to OPL2, OPH2, OHE2, dHA2, dLA2, HYS2, ACT2, SrH2, SrL2;
029FH~ 02FFH	0672~0767	Pn01~ Pn96 Selection of PID configuration parameter group and process value channel for output channel	Range 0~9999. If the single digit and ten digit are set to 1~96, the PID and SP parameter groups with set values can be selected (a total of 96 groups). If set to 0, the same numbered PID and SP parameter groups with set values will be automatically selected; In normal mode (AFC.2=0), If the hundred and thousand digits are set to 1~96, the input channel of PV can be selected. If set to 0, the same numbered process value will be automatically selected as PV value for control; In sensor backup mode (AFC.2=1), the same numbered process value is prioritized as the PV value. However, if the same numbered PV exceeds the range or is abnormal, the numbered channel process value defined by the Pn parameter hundreds and thousands will be automatically selected as the PV value for this channel.

		Pn01~Pn96 Instructions for output channel configuration parameter		0000	000	00	0

[Box: 0 0000 000 00 — rightmost "0"]

0: Indicates that the output parameters are default associated with SP (set value), P, I, and D parameter groups with the same number. For example, Pn03=0 means that channel 3 (CH03) automatically selects parameters P03, I03, D03, and SP03.

1~96: Select the SP (set value), P, I, D parameter group with the specified number. For example, Pn03=1 represents channel 3 (CH03). Select parameters P01, I01, D01, SP01

AFC.2 → AFC.2=0 normal

0: Automatically select measurement values with the same number as the PV value for control;

1~96: Select the measurement value with the specified number as the PV value for control, for example, Pn01=3xx (xx is an individual digit, ten digits), representing channel 1 (CH01)

AFC.2=1 sensor backup mode

0: The sensor backup mode is invalid;

1~96: Prioritize selecting process values with the same number as the control PV value. When sensor errors or input signals with the same number exceed the range, automatically select the PV value with the set number as the control process value. For example, Pn01=2xx (xx represents individual bits, ten bits) indicates that when the process value PV1 with the same number as channel 1 (CH01) is normal, the process value PV1 with the same number is prioritized as the control value. When there is a sensor error in the input signal of channel 1 and the number, it automatically switches to the process value PV2 as the control process value until the process value PV1 with the same number returns to normal, and then automatically switches back to the measurement value with the same number.

0300H~ 035FH	0768~0863	At01~At96 Output channel in working mode	0 represents the execution of APID, which is a PID control algorithm with AI functionality; 1 indicates the activation of At; 2 represents the execution of ONOFF control mode; 3 represents the execution of manual control mode; 4 means stop control, turn off output; 1XX is defined as a cascade sub control (inner loop) mode, and the set value of this channel will be set by parameters LA and SP as the lower and upper limit calibration respectively, For example, At10=101, which means that the set value of the 10th channel is LA10+(SP10-LA10)*OP01/25600. It is worth noting that if the process value PV10 is lower than LA10, the lower limit alarm will still be triggered. If SP10 is less than LA10, the cascade control function will not be executed; 2XX means not implementing PID control, and the output of this channel follows the output of XX channel proportionally. The proportional band parameter can be set to 0~3200.0% to adjust the relative output ratio. For example, At10=206, which means that the output value of channel 10 OP10=OP6*P10*0.1%, that is, OP10 follows the output of OP6, and the unit of P10 value is 0.1%. The effective range of this function XX is 1~16. 3X (X ranges from 1 to 9, representing channel number), indicating intelligent calibration cascade control mode.

AT01~ AT96	Function	Description
0	APID adjustment	Indicates the execution of APID, which is a PID control algorithm with AI functionality
2	Positional control	Operates ONOFF positional control mode
3	manual output	Switch the channel to manual mode and change the output size of the channel by modifying OPxx
4	STOP	Stop controlling this channel and turn off the output
1xx	cascade regulation	1XX (XX represents channel number) is the cascade control sub control (inner loop) mode. The set value of this channel will be set by parameters LA and SP as the lower and upper limits respectively. For example, At10=101, which means that the set value of the 10th channel is LA10+(SP10-LA10)*OP01/25600. It is worth noting that if the process value PV10 is lower than LA10, the lower limit alarm will still be triggered. If SP10 is less than LA10, the cascade control function will not be executed
2xx	Follow output	2XX means not implementing PID control, and the output of this channel follows the output of XX channel proportionally. The proportional band parameter can be set to 0~3200.0% to adjust the relative output ratio. For example, At10=206, which means that the output value of channel 10 OP10=OP6*P10*0.1%, that is, OP10 follows the output of OP6, and the unit of P10 value is 0.1%. The effective range of this function XX is 1~16.
3X	Intelligent calibration cascade regulation	3X (X range 1~9, representing channel number) is the intelligent calibration cascade control mode (only supports heating effect); In this mode, the sub control ratio band represents the strength of cascade control, with a unit of 0.1%. If the proportion of the sub control is set to 0, it means that the cascade control effect will be cancelled (at this time, the sub control output is equal to the main control output), and the maximum setting is 120.0%; The SP and integral parameters of the sub control are auto-learning parameters (which will automatically change during use). For first-time use, they can be directly input with reference to similar devices, which can accelerate the adaptation process of the control system. The differential parameter of the sub control can define the learning style of the sub control, usually recommended to be 50.00. Increasing the setting of this parameter can reduce overshoot, and reducing this value can shorten the heating time, but there may be some overshoot.

| 0360H~ 03BFH | 0864~0959 | OP01~OP96 Output value of output channel | In automatic mode, this channel is read-only and is the output value of PID control (when ONOFF control is used, 0 indicates disconnection, 25650 indicates connection); In manual mode, this channel can read and write, and writing can be used as a manual output value for control. 25600 represents 100% output. |

03C0H~ 041FH	0960~1055	HA01 ~HA96 Multi functional parameter 1	Range -9990~32000, multifunctional parameter, default to the upper limit alarm value of the process value selected for the first output channel, or as a positive deviation alarm, or as a transmission output scale definition, etc.
0420H~ 047FH	1056~1151	LA01~LA96 Multi functional parameter 2	Range -9990~32000, multifunctional parameter, default to the lower limit alarm value of the process value selected for the first output channel, or as a negative deviation alarm, etc.
0480H~ 04DFH	1152~1247	SV1~SV96 PID Actual set value	In the normal fixed-point temperature control mode, it is equal to SP1~SP96; But in the sub control mode of rise/fall slope control or cascade control, it is not equal to SP1~SP96. When there is a temperature rise and fall slope limit function, this parameter can be written to define the initial setting value, and multi-channel data can be written to achieve synchronous curve heating and cooling functions for multiple channels.
04E0H~ 05FFH	1248~1535	Backup address	For future version upgrades, please do not use temporarily
0600H ~065FH	1536~1631	Process value of Channel 1~96	Read only; If it is necessary to download process values from the upper computer, the channel can be closed and the Sc parameter can be written to achieve this, and the system will automatically refresh this parameter.
0660H ~066FH	1632~1647	Process value of Channel 1~8 32bit	Read only; Provide high-resolution data of 32bit (positive only) for channels 1~8, used in situations where high-resolution display is required. This process value can be subjected to secondary filtering defined by FL32.
0680H~ 06AFH	1664~1711	Alarm status, 48 parameters	Each parameter contains alarm statuss for two channels, with the high byte representing odd channels and the low byte representing even channels. BIT0~BIT4 correspond to input errors, HA, LA, dHA, and dLA alarms respectively. When selecting alarm lock, this parameter can be written to unlock it.

		Alarm Status		Description （x or xx represents channel number）
		Even channels eg:CH02	Bit0	0: The sensor input signal is normal 1: Sensor input error or input signal out of range or oral
			Bit1	0: The input signal does not exceed the set upper limit HAxx value 1: An HA alarm is triggered when the input signal exceeds the set upper limit HAxx value
			Bit2	0: The input signal does not exceed the set lower limit LAxx value 1: An LA alarm is triggered when the input signal exceeds the set lower limit LAxx value
			Bit3	0: The input signal does not exceed the set upper limit deviation dHALx value 1: DHA alarm generated when the input signal exceeds the set upper limit deviation dHAx value
			Bit4	0: The input signal does not exceed the set lower limit deviation dLAx value 1: dLA alarm generated when input signal exceeding the set lower limit deviation dLAx value.
			Bit5~bit7	Standby
		Odd channels eg:CH01	Bit8	0: The sensor input signal is normal 1: Sensor input error or input signal out of range or oral
			Bit9	0: The input signal does not exceed the set upper limit HAxx value 1: An HA alarm is triggered when the input signal exceeds the set upper limit HAxx value
			Bit10	0: The input signal does not exceed the set lower limit LAxx value 1: An LA alarm is triggered when the input signal exceeds the set lower limit LAxx value
			Bit11	0: The input signal does not exceed the set upper limit deviation dHALx value 1: DHA alarm generated when the input signal exceeds the set upper limit deviation dHAx value
			Bit12	0: The input signal does not exceed the set lower limit deviation dLAx value 1: dLA alarm generated when input signal exceeding the set lower limit deviation dLAx value.
			Bit13~bit15	Standby
06C0H~ 06EFH	1728~1775	Control status, 48 parameters		Read only, each parameter contains the control status of 2 channels, BIT0 is 0 for auto-tuning status and 1 for non auto-tuning status; BIT1 is 0, indicating normal control, and 1 indicates a stopped control status; Please note that this parameter should not be written. If it is necessary to change the relevant control status, writing the relevant parameters will be necessary to achieve it, and the system will automatically refresh this parameter.

Control status		Description(read only)
Even channels eg: CH02	Bit0	0: auto-tuning 1: Non auto-tuning
	Bit1	0: Normal control 1: Currently in stop control mode, STOP mode
	Bit2~bit7	Standby
Odd channels eg: CH01	Bit8	0: auto-tuning 1: Non auto-tuning
	Bit9	0: Normal control 1: Currently in stop control mode, STOP mode
	Bit10~bit15	Standby

-06F0H~ 07FFH	1776~2047	Backup address	For future version upgrades, please do not use temporarily
0800~ 0803H	2048~2051	InP1~4 ; Input specification	This parameter is one of the input group parameters and can be selected as an input specification. It needs to be matched with the corresponding module. For example, the thermocouple input module must set a thermocouple as the input specification. There are four sets of input

0 K	13 T (0~300.00℃)
1 S	17 K (0~300.00℃)
2 R	18 J (0~300.00℃)
3 T	25 0~75mV voltage input
4 E	28 0~20mV voltage input
5 J	29 0~50mV voltage input or 0~20mA current input
6 B	30 0~60mV voltage input
7 N	35 -10~+10mV
8 WRe3-WRe25	36 -37.5~+37.5mV voltage input
9 WRe5-WRe26	38 10~50mV voltage input or 4~20mA current input
12 F2 Radiation high-temperature thermometer	39 15~75mV voltage input

parameters, each consisting of four parameters: InP, ScL, ScH, and FIL. InP is used to select input specifications, shown as below:

0804H~ 0807H	2052~2055	ScL1~4 Linear input calibration lower limit value	Define the lower limit of linear input time, with units equal to the processs value.
0808H~	2056~2059	ScH1~4	Define the upper limit of linear input time, with units equal

080BH		Scale upper limit value	to the process value.
080CH~ 080FH	2060~2063	FIL1~4 Digital filtering	Define the strength of input digital filtering, with 0 indicating no filtering, 1 indicating filtering with intermediate values, and 2 to 999 indicating integral filtering, with the unit being the sampling period.
0810H~ 0813H	2064~2067	dHA1~4 Alarm parameters	Works as the default positive deviation alarm, or as an upper limit alarm, and is one of the output group parameters. The output parameter group can be selected with the same number as the input parameter group, or different parameter groups can be selected separately. The instrument has 4 sets of output parameters.
0814H~ 0817H	2068~2071	dLA1~4 Alarm parameters	Works as default negative deviation alarm, or as a lower limit alarm.
0818H~ 081BH	2072~2075	AAF1~4 Alarm selection	AAF. 0~AAF. 4 respectively select input fault, HA alarm, LA alarm, dHA and dLA alarm to automatically reset or not reset. If set to 1, it means that the alarm is not automatically reset. The user needs to issue a write command to clear the corresponding alarm status before the register can release the alarm action.

	AAF	Description
	Bit0	0: Automatic reset of alarm status after input signal error is resolved 1: After the input signal is cleared of the error, the alarm status does not automatically reset. To manually clear the alarm status, the corresponding bit of the channel corresponding to the alarm status parameter needs to be written as 0. write bit8=0 for odd channels, and write bit0=0 for even channels;
	Bit1	0: After the HA alarm is cleared, the alarm status will automatically reset 1: After the HA alarm is released, the alarm status will not automatically reset. To manually release the alarm status parameter, write 0 to the corresponding bit of the channel. Write bit9=0 for odd channels and bit1=0 for even channels;
	Bit2	After the LA alarm is cleared, the alarm status will automatically reset 1: After the LA alarm is released, the alarm status does not automatically reset. To manually release the alarm status parameter, write 0 to the corresponding bit of the channel. Write bit10=0 for odd channels and bit2=0 for even channels;
	Bit3	0: The alarm status will automatically reset after the dHA alarm is cleared 1: After the dHA alarm is cleared, the alarm status does not automatically reset. To manually clear the alarm status parameter, write 0 to the corresponding bit of the channel. Write bit11=0 for odd channels and bit3=0 for even channels;
	Bit4	After the 0: dLA alarm is cleared, the alarm status will automatically reset 1: After the dLA alarm is cleared, the alarm status does not automatically reset. To manually clear the alarm status parameter, write 0 to the corresponding bit of the channel. Write bit10=0 for odd channels, and write bit4=0 for even channels;
	Bit5~bit7	Standby

081CH~ 081FH	2076~2079	HYS1~4 hysteresis	The same unit as the process value, used as the hysteresis for alarm, ON/OFF control, and PID auto-tuning, but auto-tuning can also be selected to use EHYS as the hysteresis through Act. 1.

0820H~ 0823H	2080~2083	OPL1~4 Output lower limit	Range 0~100, default as output lower limit, or output value when entering fault/over range.
0824H~ 0827H	2084~2087	OPH1~4 Output upper limit	Range 0~105, as the output upper limit.
0828H~ 082BH	2088~2091	OHE1~4 Segmented power limit setting	The effective range of OPH, The same unit as the process value, used to implement the restriction function for segmented output; When PV<OHEF, the output is limited by OPH; When PV>OHEF, there is no limit to the output, which is 100%.
082CH~ 082FH	2092~2095	Act1~4 Selection for control	If Act.0=0, reverse effect (heating); =1, positive effect (cooling). If Act.1=0, the HYS value of the auto-tuning and ON/OFF parameter group will be used as the hysteresis; =1, use the global parameter EHYS as the hysteresis. If Act.2=0, it means that when an input fault occurs in this channel, the forced output is 0; =1, it means that when an input fault occurs, the forced output is OPL. If Act.3=0, it means that the output lower limit is defined by OPL; =1, it means that the output lower limit is fixed at 0. If Act.4=1, the HA alarm will also force the output to be the same as the input fault state.

ACT	Description
Bit0	0: Reaction (heating control) 1: Positive effect (cooling control);
Bit1	0: At auto-tuning and (ON/OFF) positional control use the HYS value of this parameter group as the hysteresis value. For example, if On01=2, then the hysteresis value of channel 2 is HYS2; 1: At auto-tuning and (ON/OFF) positional control adopt the global parameter EHYS as the hysteresis
Bit2	0: Indicates that when an input fault occurs in this channel, the forced output is 0 1: Force output is OPL when input fault occurs
Bit3	0: Indicates that when there is an input fault, the forced output is OPL 1: Indicates that the output lower limit is fixed at 0
Bit4	0: Output not affected when HA alarm occurs 1: When the HA alarm occurs, it will force the output to be equivalent to the state when the input fault occurred;
Bit5~bit7	Standby

0830H~ 0833H	2096~2099	Srh1~4 Limit value of heating slope	Indicates the heating rate value per minute, with 0 indicating no limit. If the SP value changes, its rate of change will be limited. When powering on or starting control for the first time, the current PV value will be automatically used as the initial setpoint. In addition, if AFC.3=1, when the setpoint SPXX is edited, the current PV value will also be automatically used as the initial setpoint. Note that this function does not work on the cascade sub control channel; In addition, the value of the control cycle CTI should be divisible by 60.0, such as 0.5, 0.8, 1.0, 1.2, 1.5, 2.0 seconds, etc. If set to other values such as 0.9, 1.1 seconds, etc., there may be calculation errors in the heating slope value.
0834H~ 0837H	2100~2103	SrL1~4 Limit value of cooling slope	Indicates the cooling rate value per minute, with 0 indicating no limit. The usage is the same as the Srh parameter.
0838H~ 083FH	2104~2111	Backup address, please do not use	
0840H	2112	Communication address	Define the local communication address, range 0~88.
0841H	2113	bAud	Baud rate, unit is 0.1K, range: 9.6K~115.2K.
0842H	2114	Adn extended input loops	If the communication input interface of the local extended module cannot receive sufficient process values of input module defined by Adn, a corresponding input fault alarm signal will be generated. If the actual input exceeds the set value, it is meaningless. This parameter is only used to define the prompt range for communication input alarms and will not be used to close the measurement channel. If the user needs to close the measurement channel, the In parameter can be set.
0843H	2115	Func Working mode	This feature is currently unavailable in this version.
0844H	2116	Ctn Control loops	Indicates the quantity of enabled control loops; Each control loop will take up 10mS of processing time. If set to 96, the actual control cycle will be at least 0.96 seconds.

0845H	2117	Srun Running / STOP	Normally, instruments are in automatic control mode, but each channel can independently set the At parameter to turn off. If Srun=9655, all PID channels will stop outputting to implement the shutdown command. If Srun=15, it is in a running state. If it is powered off and restarted, it will automatically enter the 9655 global stop state.
0846H	2118	Ctl	Control cycle, up to 0.1-5.0 seconds, the minimum cycle that the system can achieve is 0.1
0847H	2119	ALAL Alarm public output (requires externally extended alarm module)	ALAL. 0~4 respectively define whether the input ORAL fault, HA alarm, LA alarm, dHA and dLA alarms are common outputs; Set to 0, no output; Set to 1, output. Any alarm will cause the global public alarm output AL, and the alarm output terminal needs to be installed on the host when outputting the global public alarm.
0848H	2120	ALCH Alarm independent output range (requires externally extended alarm module)	Define the starting and ending numbers of output channels for extended independent alarms; Although up to 5 * 97 alarm signals can be generated, it is possible to expand up to 256 alarm output channels. For example, if each channel needs to output 4 independent alarms, then when setting the ending and starting numbers for the output channels, the difference between these two values should not be greater than 64.
0849H	2121	ALbt Alarm independent output content	ALbt.0~4 respectively define whether input faults (including over range, open circuit, and communication disconnection), HA alarms, LA alarms, dHA and dLA alarms are output; Set to 0, no output; Set to 1, output. For example, if ALAL=7, ALBt=3, ALCH=16, Then output 3 common alarm signals and 32 independent alarm signals to the extended alarm output module, where the output terminal numbers 1~3 are common input alarm, upper limit alarm, and lower limit alarm, respectively; The sequence of terminals numbered 4~7 is input error alarm for channel 1, HA alarm for channel 1, input error alarm for channel 2, and HA alarm for channel 2, arranged in reverse order based on these numbers. For example, setting ALAL to 0, ALbt=31，ALCH=616，The system will output 55 alarm signals, with 5 alarm outputs per channel for channels 6~16.

084AH	2122	AFA Function Parameter A	AFA.0=0, HA as the default upper limit alarm; = 1, as a positive deviation alarm. AFA.1=0, LA as the default lower limit alarm; =1, as a negative deviation alarm. AFA.2=0, dHA as the default positive deviation alarm; =1, as the upper limit alarm. AFA.3=0, dLA as the default negative deviation alarm; =1, as the lower limit alarm. AFA. 4=0, LA as the default lower limit alarm; =1, as an upper limit alarm, there is an additional upper limit alarm. AFA.5=0, corresponding input channels for HA and LA alarms; =1, Corresponding output channel (note: HA and LA should not be selected as deviation alarms in this mode); AFA.6=0, define AL1 according to ALAL; =1, AL1 is a global alarm AFA.7=0, define AL2 according to ALAL; =1, AL2 is a global alarm
084BH	2123	AFB Function Parameter B	Standby
084CH	2124	AFC Function Parameter C	AFC.0 displays 0 as no checksum and 1 as even checksum when selecting a communication checksum. AFC.1=0, 4~20mA or 2~10V for linear output; AFC.1=1, 0~20mA or 0~10V for current output is. AFC.2=0, no sensor backup; AFC.2=1, sensor backup available. AFC.3=0, during slope control, the PV START function is not executed when the set value changes; AFC.3=1, during slope control, the PV START function is executed when the set value changes. Attention: When using this function, the maximum number of control channels cannot exceed 4 temporarily. AFC. 4=0, AD converter has better anti-interference performance for 50Hz power grid; AFC. 4=1, the AD converter has better anti-interference performance for 60Hz frequency and is only suitable for use in countries with 60Hz grid frequency. AFC.5=0, host status BIT0~BIT7 ports for address 0851H, where 1 indicates output action and 0 indicates no action; When AFC.5=1, host status BIT0~BIT7 port for address 0851H, where 0 indicates action and 1 indicates no action;

084DH	2125	Nonc	Nonc.0~5 respectively define the normally open and normally closed outputs corresponding to input faults, HA alarms, LA alarms, dHA alarms, dLA alarms, and public alarms. Setting 0 means normally open (closed when an alarm occurs), and setting 1 means normally closed. Attention: If the system loses power, the relay will disconnect regardless of the settings.
084EH	2126	EAF Host sampling parameters; Only valid for the host sampling rate, as for extended input module, it is configured by the extended module itself.	EAF=0, Automatically set the refresh rate of the main input based on the CTI control cycle parameters, with a maximum of 20mS per channel for thermocouples and voltage/current; EAF=1, Fixed at 20mS per channel. EAF.AB=2, Fixed at 40mS per route. EAF.AB=3, Fixed at 80mS per route.
084FH	2127	EHYS Extra hysteresis	If it is required that the self-tuning and ON/OFF hysteresis values are different from the HYS alarm hysteresis value, EHYS can be selected as the self-tuning and ON/OFF hysteresis value through Act. 1.
0850H	2128	dPt	Range 0~3, set the position of the decimal point display on the host operation panel. This setting is only for the display of numerical values on the simple operation panel. The decimal point position does not affect the data read by the upper computer, and the upper computer program can handle the decimal point display on its own.
0851H	2129	host status	Read only, BIT0~5 respectively represent the status of the host's O1~O4 and AL1, AL2, a total of 6 IO ports. Setting it to 1 indicates output (can be defined by AFC. 5). BIT8=1 indicates the presence of system faults, such as memory data errors, etc; BIT9=1 indicates the presence of a global alarm.

0852H	2130	Loc	Set Loc.5=0 to allow writing of all parameters; When Loc.5=1, it is not allowed to write parameters within the range of 0800H~08FFH; Loc.6=0/1 respectively indicates allowing/not allowing single byte write instructions; Loc.7=0/1 respectively indicates allowing/not allowing multi byte write instructions. When writing is not allowed, the instrument can still exit, but the parameters will not be substantially edited.
0853H	2131	Characteristic words for instrument model	Read only, indicating instrument model, reading 8629
0854H	2132	High position	Read only, indicating that the instrument number is 4 digits high.
0855H	2133	Low position	Read only, indicating that the instrument number is 4 digits low.
0856H	2134	OPCH Output starting channel	Set OPCH to 1, outputs channel 1 corresponding to channel 1; If set to 5, outputs OP5 of channel 5 corresponding to 1. This function is used when channels 1-4 are only used for calculation and not directly output.
0857H	2135	FL32 Filter constant for high-resolution process values	Same unit as the sampling period, range 0~999. High-resolution secondary filtering is applied to 32BIT data from 8 channels to improve the stability of display data; This filter will not be used for PID regulation; Usually, due to the larger mass and volume of the heated workpiece compared to temperature sensors, temperature conduction lags behind stable sensors. If the filtering parameters can be set reasonably, a more realistic internal actual temperature of the heated workpiece can be obtained.
0861H~ 088FH	2145~2191	Standby	
0898H~ 08FBH	2200~2099	Input data from the non-linear correction table	Including 100 data points such as input calibration curve and high-temperature furnace output limit curve.
0900H~	2305~	Temporarily prohibit reading and writing	

Notice：

1. When writing upper computer software, it is important to note that for each valid instruction, the instrument should respond within 0-5mS(Note: This time is calculated based on different baud rates and data lengths, excluding data transmission time and interval time required by the MODBUS protocol), And the upper computer must wait for the instrument to transmit data before issuing new instructions, otherwise it will cause errors. If the instrument still does not respond after exceeding the maximum response time, the reasons may include invalid commands, invalid instrument addresses or parameter addresses, communication line faults, instrument not turning on, communication address mismatch, etc. At this time, the upper computer should resend the command or skip the instrument where the address is located.

2. Except for input errors, all other alarms on the instrument are generated based on the input channel values selected for the control channel. Usually, the numbers of input channels and control channels are the same. If they are not the same, for example, If control channel 2 selects input channel 1 as the PV and inputs it, The alarms for channel 2 are generated based on the absolute value and channel control deviation of input channel 1, and are unrelated to input channel 2. Specifically, if two control channels select the same input channel as the process value, the process of that channel can have a maximum of 8 alarm settings. In addition, for input channels that have not been selected, they are usually closed, otherwise the measurement behavior of that channel will affect the input error flag of the input channel selected by the output channel with the same number.

3. If any alarm condition is met, an additional global public alarm signal will be generated, but this alarm will not be output from the extended alarm module. Instead, it will cause the host's own alarm indicator light to light up, which will then be read out by BIT9 of 0851H; Bur if the host has an optional alarm output module, the alarm can be output by the host.

4. The instrument will limit the writing range of parameter values between addresses 0800H and 088FH. Although erroneous data written beyond the range will still be executed, the system will limit its range to avoid system failures caused by writing out of range data.

5. AFB. 1=0, PID group in normal mode; AFB.1=1，Preset 5 sets of PID automatic switching modes; In this mode, the maximum number of channels effectively controlled by independent PID is 16. The instrument divides the SV and PID parameter groups into 16*6

groups, where groups 1~16 are the PID parameters currently used in channels 1~16. The remaining 80 sets of PID will be arranged in the order of using 5 sets for each channel, meaning that each channel can automatically switch up to 5 preset PID sets based on the current SP value. For example, if SP1<SP17, P1, I1, and d1 are automatically set to P17, I17, and d17; if SP17<SP1<SP18, P1, I1, and d1 are automatically set to P18, I18, and d18; if SP18<SP1<SP19, P1, I1, and d1 are automatically set to P19, I19, and d19, and so on. This function needs to be combined with APLC to achieve.

6. Alarm description

How to set up to drive AL1 and AL2, and the parameters related to alarms are as follows:

HA01~HA96, Default as upper limit absolute value alarm, can be changed to upper deviation alarm by editing configuration

LA01~LA96, Default as lower limit absolute value alarm, can be changed to lower deviation alarm by editing configuration

dHA1~dHA4, Default as upper limit deviation alarm, can be changed to upper absolute value alarm by editing configuration

dLA1~dLA4, Default as lower limit deviation alarm, can be changed to lower absolute value alarm by editing configuration

AAF1~4, Alarm function, whether the output and status are reset after the set alarm is automatically released.

HYS1~4, hysteresis, the hysteresis after the alarm is cleared.

ALAL, Define whether each alarm is output

ALCH, Used when expanding the outbound alarm output module

ALbt, Used when expanding the outbound alarm output module

How to operate AL AL1 AL2 is shown in the table below

ALAL parameter, public alarm parameter,

Bit 0 Abnormal input	Bit 1 HA	Bit 2 LA	Bit 3 dHA	Bit 4 dLA	AL1	AL2	AL
1	0	0	0	0	When an abnormal input alarm is triggered, ON	Always OFF	Any alarm ON
0	1	0	0	0	When an HA alarm is generated, ON	Always OFF	Any alarm ON
1	1	0	0	0	When an abnormal input alarm is triggered, ON	When an HA alarm is generated, ON	Any alarm ON
0	0	1	0	0	When an LA alarm is generated, ON	Always OFF	Any alarm ON
1	0	1	0	0	When an abnormal input alarm is triggered, ON	When an LA alarm is generated, ON	Any alarm ON
0	1	1	0	0	When an HA alarm is generated, ON	When an LA alarm is generated, ON	Any alarm ON
1	1	1	0	0	When an abnormal input alarm is triggered, ON	When an HA alarm is generated, ON	Any alarm ON
0	0	0	1	0	When an dHA alarm is generated, ON	Always OFF	Any alarm ON
…	…	…	…	…	…	…	Any alarm ON
…	…	…	…	…	…	…	Any alarm ON
1	1	1	1	1	When an abnormal input alarm is triggered, ON	When an HA alarm is generated, ON	Any alarm ON

The first 5 bits of NONC correspond to the first 5 bits of ALAL. As long as the corresponding alarm bit in the NONC parameter is set to 1, the alarm and action will be reversed.

If NONC=2 is set to reverse the upper limit alarm and ALAL=2, then AL1 will take action under normal conditions until the upper limit alarm of a certain channel is generated, and then AL1 will disconnect the action.

This product is restriction of use in the industrial environment

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