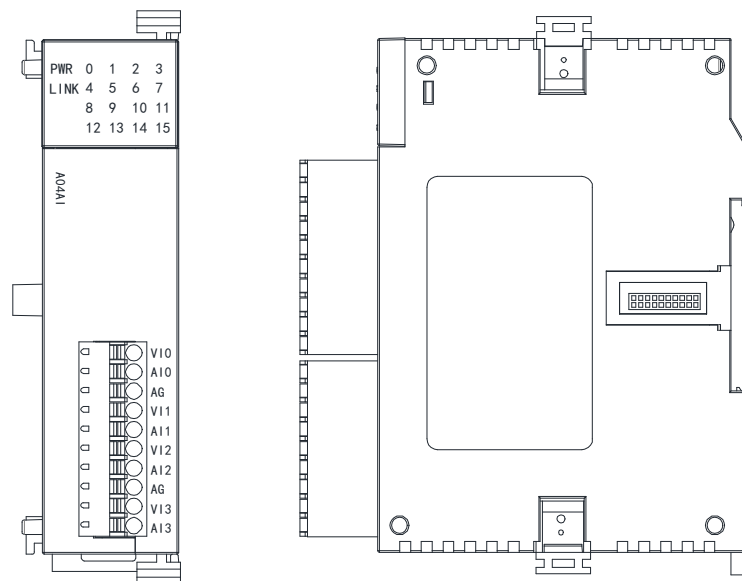


Haiwell PLC User Manual

A Series Card-type PLC

Analog Module User Manual & Application Cases



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Analog Module User Manual

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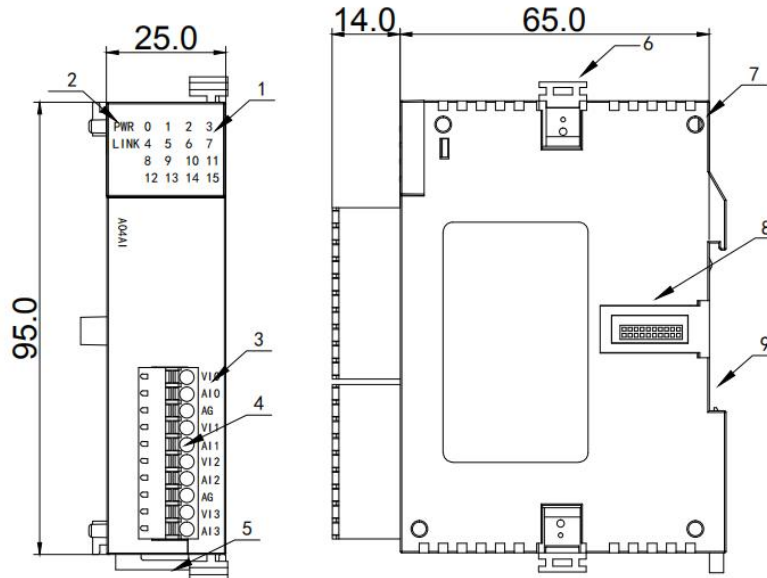
Analog Module Application Case

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Analog Module User Manual

1. Product Model List and Dimension

Model	Power (24V)	Dimension
A04AI	DC24V~0.1A MAX	25*95*65 mm
A04AO	DC24V~0.1A MAX	
A04XA	DC24V~0.1A MAX	
A08AI	DC24V~0.1A MAX	
A08A0	DC24V~0.15A MAX	



1. Indicator	8. Module extension port
2. PWR power indicator, LINK module communication indicator	9. 35mm DIN guide rail track
3. Terminal definition	
4. Removable terminal	
5. Guide rail buckle	
6. Module lock buckle	
7. Module positioning hole	

2. Indicator Description

- ① **PWR**: power indicator. green, constant light -Power normal; Not light - Power abnormal.
- ② **LINK**: multi-status indicator . three colors (Red. Yellow. Green), as follow:

Reference processing mode	Module bus state	LINK indicator state
Normal	No communication of module	No light
	MPU has identified the module but no communication	Constant light in green
	Serial or parallel port in communication	Green jitter: indicator on 30ms and off 30ms
Parallel power supply not enough, must connect to external power supply	Without serial or parallel port in communication	Yellow flicker: indicator on 0.5s and off 0.5s
	With serial or parallel port in communication	Yellow is darkened and jitter alternately: indicator off 0.5s and jitter 0.5s
Firmware upgrade failed, reupgrade the module firmware	Without serial or parallel port in communication	Red flicker: indicator on 0.5s and off 0.5s
	With serial or parallel port in communication	Red is darkened and jitter alternately: indicator off 0.5s and jitter 0.5s
Hardware failure and maintenance	Without serial or parallel port in communication	Constant light in red

3. Power Supply Specification

Item	DC Power Supply
Power supply voltage	24VDC -15%~+20%
Power supply frequency	—

Instantaneous surge	MAX 20A 1.5ms @24VDC
Power loss time	10ms or less
Fuse	0.3A, 250V
24V Output voltage (for input and expansion)	None
Isolation Type	No Electrical isolation
Power Protection	DC input power polarity reverse, over voltage protection

4. Environmental Specifications for Product

Item	Environment Specification
Temperature/Humidity	Operating temperature:0~+55℃ Storage temperature:-25~+70℃ Humidity: 5~95%RH, No condensation
Vibration Resistance	10~57 HZ, amplitude=0.075mm, 57HZ~150HZ acceleration=1G, 10 times each for X-axis, Y-axis and Z-axis
Impact Resistance	15G, duration=11ms, 6 times each for X-axis, Y-axis and Z-axis
Interference Immunity	DC EFT:±2500V Surge:±1000V
Over Voltage Resistance	1500VAC/1min between AC terminal and PE terminal, 500VAC/1min between DC terminal and PE terminal
Insulation Impedance	between AC terminal and PE terminal @500VDC, >=5MΩ, all input/output points to PE terminal @500VDC
Operating environment	Avoid dust, moisture, corrosion, electric shock and external shocks

5. Analog Input (AI) Specification

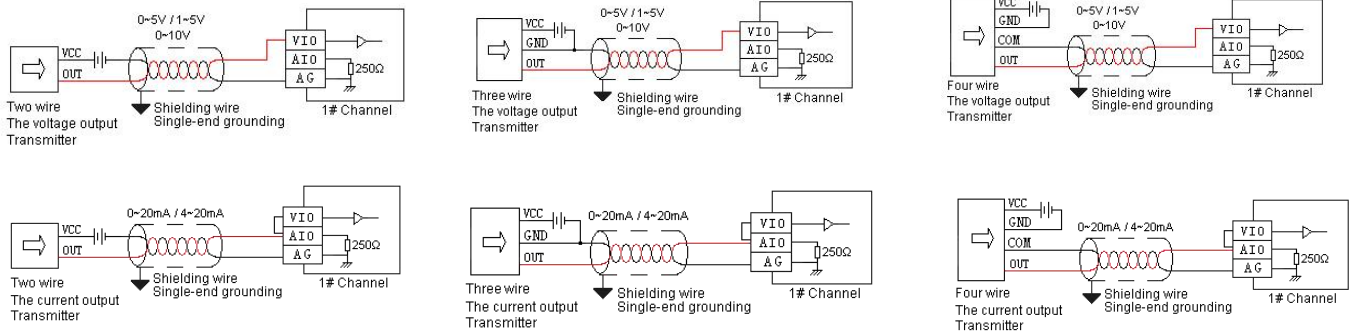
Properties		Voltage input			Current input	
Input range		0V~+10V	0V~+5V	1V~+5V	0~20mA	4~20mA
Max. allowed input		13V			30mA	
Range of digital value		0-32000	0-32000	0-32000	0-32000	0-32000
Input impedance		6MΩ			250Ω	
Response time		2.0ms/ch				
Resolution		16 bits				
Basic error	Room temperature 25±5℃	±0.20%				
	Full temperature range	±0.5%				
Linearity error	Room temperature 25±5℃	±0.10%				
	Full temperature range	±0.10%				
Status display		If the channel is normal, the indicator light will be on.				
Diagnostics function		If disconnection or limit-exceeding (≥110%FS) is detected, the indicator light will be off.				
Isolation		Isolation between an analog circuit and a digital circuit No isolation between channels				
Power supply		24VDC ±20%, 200mA (Max.)				
Notices: 1. If the input signal exceeds the input range, the digital value will be 32000. 2. If the input signal exceeds the maximum allowed voltage or current, the channel might be damaged. 3. It is not allowed to connect the wire inversely.						

6. Analog Output (AQ) Specification

Properties		Voltage output			Current output	
Output range		0V~ +10V	0V~+5V	1V~+5V	0~20mA	4~20mA
Range of digital value		0-32000	0-32000	0-32000	0-32000	0-32000
Load impedance		1KΩ@10V	≥500Ω@ 10V		≤500Ω	
Response time		3.0ms/ch				
Resolution		12 bits				
Basic error	Room temperature 25±5℃	±0.30%				
	Full temperature range	±0.60%				
Linearity error	Room temperature 25±5℃	±0.20%				
	Full temperature range	±0.20%				
Status display		If the channel is normal, the indicator light will be on.				
Isolation		Isolation between an analog circuit and a digital circuit No isolation between channels				
Power supply		24VDC ±20%, 200mA (Max.)				

Properties	Voltage output	Current output
Notices: 1. If the load doesn't meet the requirement, the accuracy of output might be effected. 2. If there is short-circuit or voltage backflow, the channel might be damaged.		

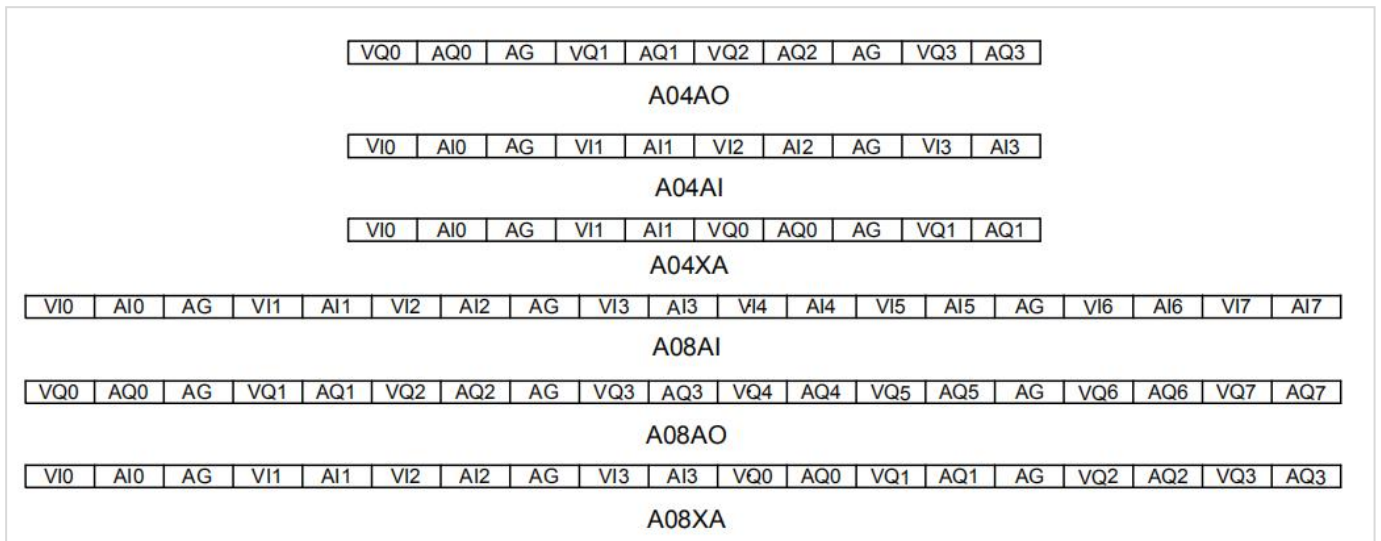
7. Analog Input (AI) Wiring Diagram



7. Analog Output (AQ) Wiring Diagram



8. Terminal Diagram



9. Module Parameter Table

4-channel analog module parameter table

Note: CR code is corresponding to the Modbus register address, the ray parts are read-only ,the white parts are readable and writable.

CR code	Function Description		
	A04AI	A04AO	A04XA
00H	Low byte for module code, and high byte for module version number.		
01H	Communication address		

CR code	Function Description		
	A04AI	A04AO	A04XA
02H	Communication protocol: The low 4-bit of the low byte: 0 - N,8,2 For RTU, 1 - E,8,1 For RTU, 2 - O,8,1 For RTU, 3 - N,7,2 For ASCII, 4 - E,7,1 For ASCII, 5 - O,7,1 For ASCII, 6 - N,8, 1 For RTU The high 4-bit of the low byte: 0 - 2400, 1 - 4800, 2 - 9600, 3 - 19200, 4 - 38400, 5 - 57600, 6 - 115200		
03H~06H	Module name		
07H~08H	Default IP address: 192.168.1.111		
09~0AH	Reserve		
0BH	High byte subnet mask (b3~b0,1 indicates 255, 0 indicates 0, for example subnet mask 255.255.255.0, b3~b0=1110), low byte reserved		
0CH-0EH	Reserve		
0FH	Error code: 0-Normal, 1-Illegal firmware identity, 2-Incomplete firmware, 3-System data access exception, 4-No external 24V power supply		
10H	channel 1 input value	channel 1 output value	input channel 1 input value
11H	channel 2 input value	channel 2 output value	input channel 2 input value
12H	channel 3 input value	channel 3 output value	input channel 1 signal type, note 2
13H	channel 4 input value	channel 4 output value	input channel 2 signal type, note 2
14H	channel 1 signal type, note 2	channel 1 signal type, note 2	Use the engineering value mark, note 6
15H	channel 2 signal type, note 2	channel 2 signal type, note 2	input channel 1 engineering lower limiting value
16H	channel 3 signal type, note 2	channel 3 signal type, note 2	input channel 2 engineering lower limiting value
17H	channel 4 signal type, note 2	channel 4 signal type, note 2	input channel 1 engineering upper limiting value
18H	Use the engineering value mark, note 6	Use the engineering value mark, note 6	input channel 2 engineering upper limiting value
19H	channel 1 engineering lower limiting value	channel 1 engineering lower limiting value	input channel 1 sampling frequency, note 1
1AH	channel 2 engineering lower limiting value	channel 2 engineering lower limiting value	input channel 2 sampling frequency, note 1
1BH	channel 3 engineering lower limiting value	channel 3 engineering lower limiting value	input channel 1 zero point correction value
1CH	channel 4 engineering lower limiting value	channel 4 engineering lower limiting value	input channel 2 zero point correction value
1DH	channel 1 engineering upper limiting value	channel 1 engineering upper limiting value	Channel 1~2 input disconnection alarm, note 5
1EH	channel 2 engineering upper limiting value	channel 2 engineering upper limiting value	output channel 1 output value
1FH	channel 3 engineering upper limiting value	channel 3 engineering upper limiting value	output channel 2 output value
20H	channel 4 engineering upper limiting value	channel 4 engineering upper limiting value	output channel 1 signal type, note 2
21H	channel 1 sampling frequency, note 1	power-off output mark, note 8	output channel 2 signal type, note 2
22H	channel 2 sampling frequency, note 1	channel 1 power-off output value	Use the engineering value mark, note 6
23H	channel 3 sampling frequency, note 1	channel 2 power-off output value	output channel 1 engineering lower limiting value
24H	Channel 4 sampling frequency, note 1	channel 3 power-off output value	output channel 2 engineering lower limiting value
25H	channel 1 zero point correction value	channel 4 power-off output value	output channel 1 engineering upper limiting value
26H	channel 2 zero point correction value	Channel indicator status, note 7	output channel 2 engineering upper limiting value
27H	channel 3 zero point correction value	Reserve	power-off output mark, note 8
28H	channel 4 zero point correction value		output channel 1 power-off output value
29H	Channel 1~4 input disconnection alarm, note 5		output channel 2 power-off output value
2AH	Reserve		output channel indicator, note 7
2BH~2FH			Reserve

8 channel analog module parameter table

Note: CR code is corresponding to the Modbus register address, the gray parts are read-only, the white parts are readable and writable.

CR code	Function description		
	A08AI	A08AO	A08XA
00H	Low byte for module code, and high byte for module version number.		
01H	Communication address		
02H	Communication protocol: The low 4-bit of the low byte: 0 - N,8,2 For RTU, 1 - E,8,1 For RTU, 2 - O,8,1 For RTU, 3 - N,7,2 For ASCII, 4 - E,7,1 For ASCII, 5 - O,7,1 For ASCII, 6 - N,8, 1 For RTU The high 4-bit of the low byte: 0 - 2400, 1 - 4800, 2 - 9600, 3 - 19200, 4 - 38400, 5 - 57600, 6 - 115200		

CR code	Function description		
	A08AI	A08AO	A08XA
03H~06H	Module name		
07H~08H	Default IP address: 192.168.1.111		
09~0AH	Reserve		
0BH	High byte subnet mask (b3~b0, 1 indicates 255, 0 indicates 0, for example subnet mask 255.255.255.0, b3~b0=1110), low byte reserved		
0CH~0EH	Reserve		
0FH	Error code: 0-Normal, 1-Illegal firmware identity, 2-Incomplete firmware, 3-System data access exception, 4-No external 24V power supply		
10H	channel 1 input value	channel 1 output value	input channel 1 input value
11H	channel 2 input value	channel 2 output value	input channel 2 input value
12H	channel 3 input value	channel 3 output value	input channel 3 input value
13H	channel 4 input value	channel 4 output value	input channel 4 input value
14H	channel 5 input value	channel 5 output value	input channel 1 signal type, note 2
15H	channel 6 input value	channel 6 output value	input channel 2 signal type, note 2
16H	channel 7 input value	channel 7 output value	input channel 3 signal type, note 2
17H	channel 8 input value	channel 8 output value	input channel 4 signal type, note 2
18H	channel 1 signal type, note 2	channel 1 signal type, note 2	Use the engineering value mark, note 6
19H	channel 2 signal type, note 2	channel 2 signal type, note 2	input channel 1 engineering lower limiting value
1AH	channel 3 signal type, note 2	channel 3 signal type, note 2	input channel 2 engineering lower limiting value
1BH	channel 4 signal type, note 2	channel 4 signal type, note 2	input channel 3 engineering lower limiting value
1CH	channel 5 signal type, note 2	channel 5 signal type, note 2	input channel 4 engineering lower limiting value
1DH	channel 6 signal type, note 2	channel 6 signal type, note 2	input channel 1 engineering upper limiting value
1EH	channel 7 signal type, note 2	channel 7 signal type, note 2	input channel 2 engineering upper limiting value
1FH	channel 8 signal type, note 2	channel 8 signal type, note 2	input channel 3 engineering upper limiting value
20H	Use the engineering value mark, note 6	Use the engineering value mark, note 6	input channel 4 engineering upper limiting value
21H	channel 1 engineering lower limiting value	channel 1 engineering lower limiting value	input channel 1 sampling frequency, note 1
22H	channel 2 engineering lower limiting value	channel 2 engineering lower limiting value	input channel 2 sampling frequency, note 1
23H	channel 3 engineering lower limiting value	channel 3 engineering lower limiting value	input channel 3 sampling frequency, note 1
24H	channel 4 engineering lower limiting value	channel 4 engineering lower limiting value	input channel 4 sampling frequency, note 1
25H	channel 5 engineering lower limiting value	channel 5 engineering lower limiting value	input channel 1 zero point correction value
26H	channel 6 engineering lower limiting value	channel 6 engineering lower limiting value	input channel 2 zero point correction value
27H	channel 7 engineering lower limiting value	channel 7 engineering lower limiting value	input channel 3 zero point correction value
28H	channel 8 engineering lower limiting value	channel 8 engineering lower limiting value	input channel 4 zero point correction value
29H	channel 1 engineering upper limiting value	channel 1 engineering upper limiting value	Channel 1~4 input disconnection alarm, note 5
2AH	channel 2 engineering upper limiting value	channel 2 engineering upper limiting value	output channel 1 output value
2BH	channel 3 engineering upper limiting value	channel 3 engineering upper limiting value	output channel 2 output value
2CH	channel 4 engineering upper limiting value	channel 4 engineering upper limiting value	output channel 3 output value
2DH	channel 5 engineering upper limiting value	channel 5 engineering upper limiting value	output channel 4 output value
2EH	channel 6 engineering upper limiting value	channel 6 engineering upper limiting value	output channel 1 signal type, note 2
2FH	channel 7 engineering upper limiting value	channel 7 engineering upper limiting value	output channel 2 signal type, note 2
30H	channel 8 engineering upper limiting value	channel 8 engineering upper limiting value	output channel 3 signal type, note 2
31H	channel 1 sampling frequency, note 1	power-off output mark	output channel 4 signal type, note 2
32H	channel 2 sampling frequency, note 1	channel 1 power-off output value	Use the engineering value mark, note 6
33H	channel 3 sampling frequency, note 1	channel 2 power-off output value	output channel 1 engineering lower limiting value
34H	channel 4 sampling frequency, note 1	channel 3 power-off output value	output channel 2 engineering lower limiting value

CR code	Function description		
	A08AI	A08AO	A08XA
35H	channel 5 sampling frequency, note 1	channel 4 power-off output value	output channel 3 engineering lower limiting value
36H	channel 6 sampling frequency, note 1	channel 5 power-off output value	output channel 4 engineering lower limiting value
37H	channel 7 sampling frequency, note 1	channel 6 power-off output value	output channel 1 engineering upper limiting value
38H	channel 8 sampling frequency, note 1	channel 7 power-off output value	output channel 2 engineering upper limiting value
39H	channel 1 zero point correction value	channel 8 power-off output value	output channel 3 engineering upper limiting value
3AH	channel 2 zero point correction value	Channel indicator status	output channel 4 engineering upper limiting value
3BH	channel 3 zero point correction value	Reserve	power-off output mark
3CH	channel 4 zero point correction value		output channel 1 power-off output value
3DH	channel 5 zero point correction value		output channel 2 power-off output value
3EH	channel 6 zero point correction value		output channel 3 power-off output value
3FH	channel 7 zero point correction value		output channel 4 power-off output value
40H	channel 8 zero point correction value		output channel indicator
41H	Channel 1~8 input disconnection alarm, note 5		Reserve
42H~4FH	Reserve		

Note:

- Sampling frequency: 0 - 2 times, 1 - 4 times, 2 - 8 times, 3 - 16 times, 4 - 32 times, 5 - 64 times, 6 - 128 times, 7 - 256 times
- Signal type: 0 - [4,20]mA, 1 - [0,20]mA, 2 - [1,5]V, 3 - [0,5]V, 4 - [0,10]V
- Disconnection alarm: Each bit indicates 1 channel, 0-normal, 1-disconnection
- Use the engineering value mark: Each bit indicates 1 channel, 0-No, 1-Yes
- Channel indicator status: Each bit indicates 1 channel, 0-off, 1-on
- Power-off output mark: Each bit indicates 1 channel, 0-No, 1-Yes

10. Mounting and installation

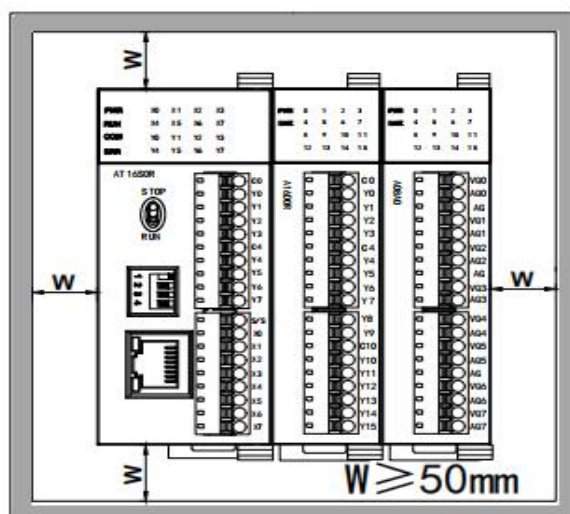
The PLC should be secured to an enclosed cabinet while mounting. For heat dissipation, make sure to provide a minimum clearance of 50mm between the unit and all sides of the cabinet. (See the figure.)

Rail Mounting: Use standard 35 mm rail.

Connecting Extended Module

Join lower right parallel interface of Last module (Host or Extension Module) to the lower right of the parallel interface of next module, then tight with two buckles on top and bottom.

The interface of the right side module is left for extension interface for next extension module.



Analog Module Application Case

1. Expand module through the host PLC parallel port

1.1. Module power supply

- ① Analog module can be the expansion module for A series PLC; When the module is directly connect to the host PLC, no need to take external power supply, the module is powered by host PLC.

1.2. The analog need't be written any conversion program, read the analog register value directly.

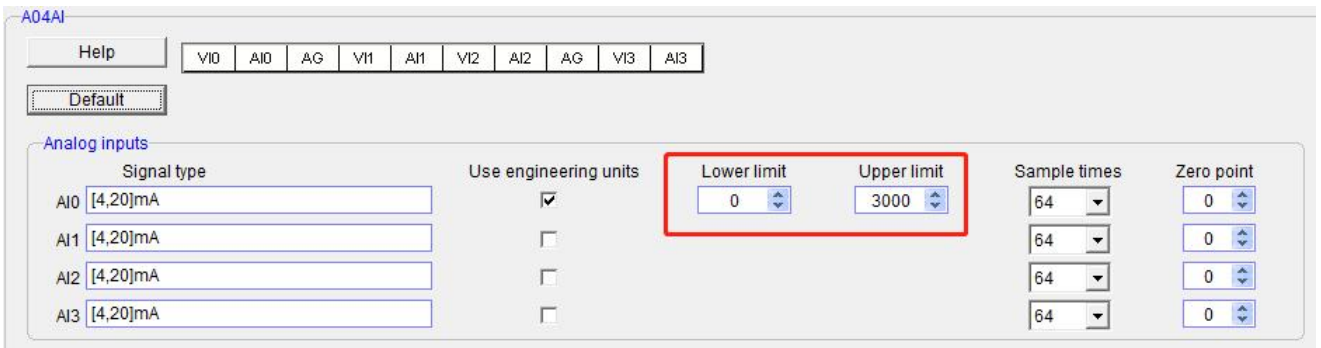
For example, the host PLC AT16S0R, respectively, is expanded with three modules of A16DI, A16XDR, A04AI and A04AO from left to right, assuming the scene:

- Analog module A04AI input channel 1, signal type is 4-20mA, used to measure the pressure, the pressure range of 0.0~3.0Mpa;
- Analog module A04AO input channel 1, signal type is 0-10V, used to control the inverter frequency of 0.0~50.0Hz;

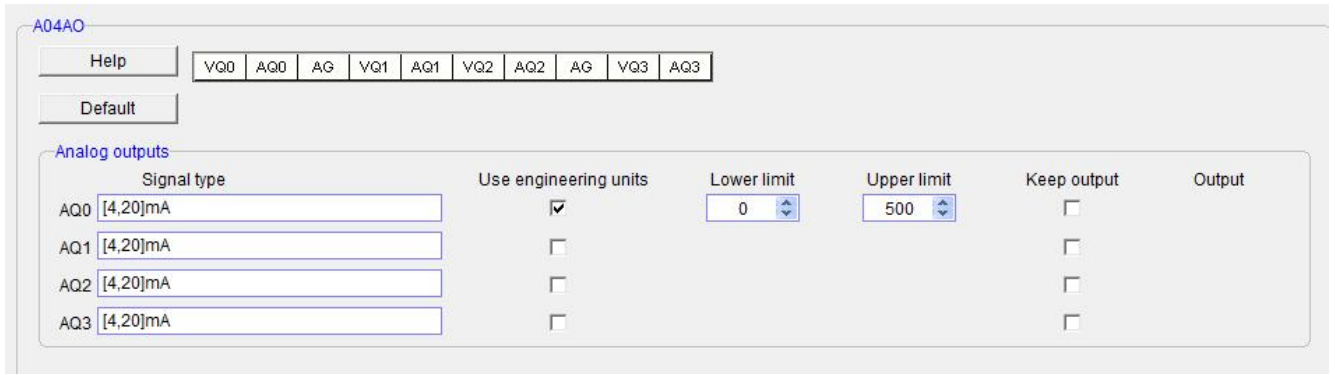
First enter the PLC programming software menu bar - view - hardware configuration, in accordance with the external order of actual modules to add the module models, after added, the analog address will be automatically arranged, as shown below:

Index	Module type	X Component	Y Component	AI Component	AQ Component	Other	Description
0	AT16S0R	X0 - X7	Y0 - Y7			COM1-2 HSC0-1	CPU module 8*DI 8*DO relay
1	A16DI	X8 - X23					Digital input module 16*DI
2	A16XDR	X24 - X31	Y8 - Y15				Digital I/O module 8*DI 8*DO
3	A04AI			AI0 - AI3			Analog input module 4*AI
4	A04AO				AQ0 - AQ3		Analog output module 4*AO

Haiwell analog module need't be written any conversion program, as for above pressure measurement, we only need to check the use of engineering value, set the lower limit value of 0 corresponding 0.0Mpa, set the upper limit value of 3000 indicating 3.000Mpa, the upper limit value 3000 hidden three decimal places can achieve magnification times and improve accuracy. Then we read the value of the analog input register AI0, if AI0 = 1234, then the actual value is 1.234Mpa.



Similarly, for the analog output, check the use of engineering value, set the lower limit value of 0 indicating 0.0Hz, set the upper limit value of 500 indicating 50.0Hz, if you want the inverter frequency output is 25.6Hz, as long as force the AQ0 value as 256 or through other logic instructions to output the AQ0 value of 256. As shown below:



1.3. Programming skills

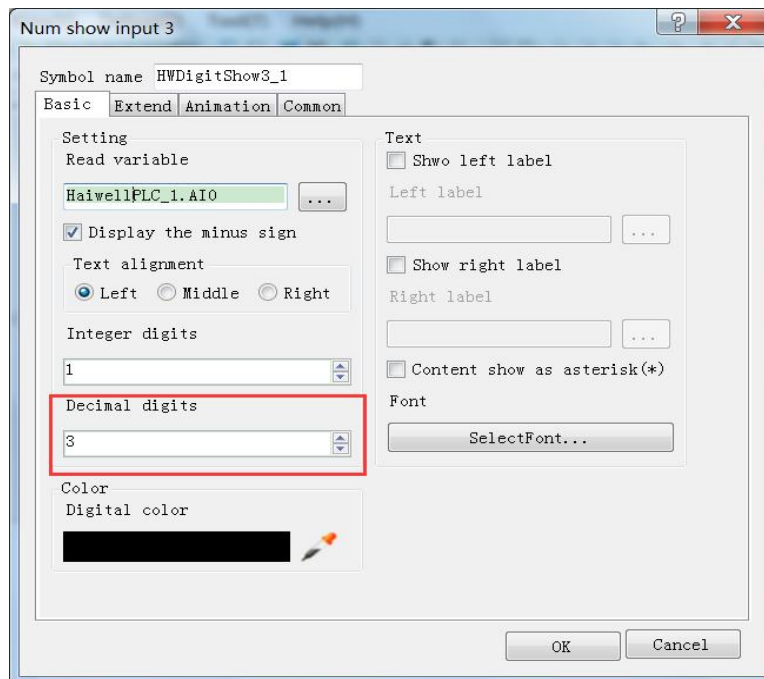
If you want to write the alarm program that pressure exceeds the setting value, for example, when the pressure is more than 1.25Mpa, it will alarm, the program of PLC can be written as follows:

```
//Network 1 When the liquid level is higher than the setting value 1.25Mpa, the alarm output
```



1.4. Display analog value on SCADA, HMI

If the SCADA, touch screen, text and other PC software want to display the current pressure, only need to set three decimal digits on the numerical display primitive, then the read value will be automatically reduced 1000 times in the configuration, that is the actual temperature value, for example, you can set 3 on decimal digits of Haiwell Cloud SCADA settings.



So that when the PLC read AI0 value, AI0=1234, that is the actual value of 1.234Mpa, there is no need to have data processing in PLC and configuration, only set the 3 decimal places on the numerical display primitive, then it will be automatically reduced by 1000 times, displaying value of 1.234, that is the actual value of 1.234Mpa.

1.5. When the engineering value is not used, the default code value is 0 ~ 32000

When using the engineering value, the linear transformation is specified by the lower limit and the upper limit value, and the program is automatically transformed. When the engineering value is not used, all types are unified to correspond with 0 ~ 32000 code value. The same case of pressure measurement, this time can according to the linear transformation formula: $Out = (In - InDw) * (OutUp - OutDw) / (InUp - InDw) + OutDw$ to write the conversion program, or use the SC linear transformation instructions to calculate directly.

Haiwell analog used easily, it is recommended to check the use of engineering value, so that the analog will be very convenient without writing any program.

1.6. Module CR code application example: Read the module channel disconnection alarm

In this example, in order to read the external sensor disconnection information of A08XA module, the disconnection alarm data of A08XA module input channel 1-4 is stored in CR29, that is, 29H (hexadecimal), decimal 41. (More CR contents can be found in the software online help - hardware manual - expansion module parameters within the corresponding model). This program is as follows:

- **Slot:** Position number, A08XA is the third module, so fill in 3;
- **CR:** Module disconnection alarm CR41, that is, 29H (hexadecimal) = 41 (decimal), it can be directly input 41 or 0x29 into the instruction CR terminal;
- **N:** Number for readings, 1 register for 16 bits, low 4 bits corresponding channel 1-4, disconnection for 1 (ON), normal for 0 (OFF).

