



**XP-BD Manual**  
Operating Manual

WUXI XINJE ELECTRIC CO., LTD.



# Catalog

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## 1. Configure method of BD board

### Configure Method of BD Board:

- 1) Install BD correctly on the main unit;
- 2) Then connect the model online via XCP edit tool, in the “Window” menu, choose “Config. BD Board(C)” as shown in the following graph1.
- 3) Click it, in the “Config. BD Board(C)” dialog box, choose “Other BD” (Just as showed in the graph 2), click “OK” to download the program.

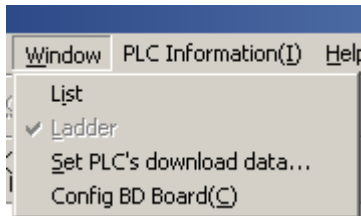


Figure 1

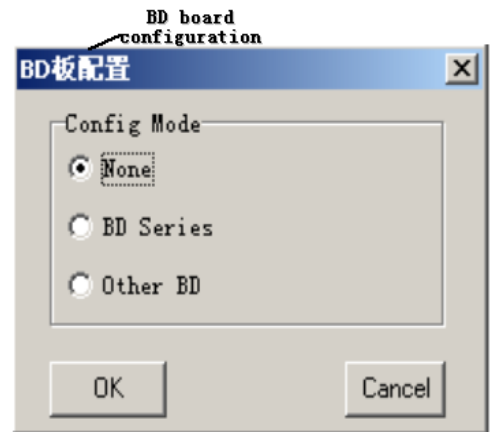
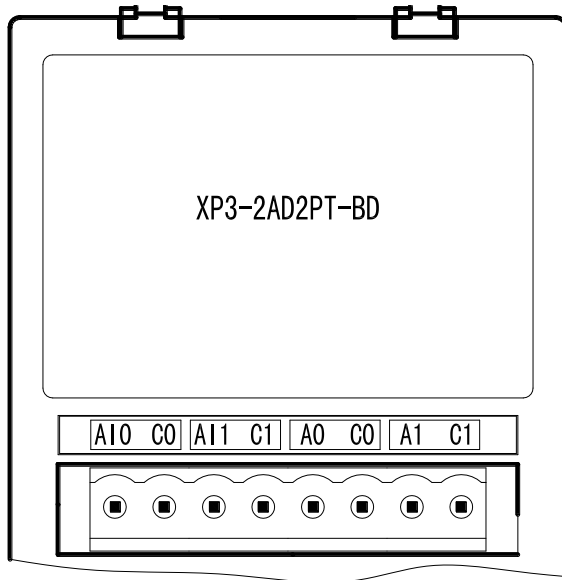


Figure 2

## 2. Analog Input and Temperature Sampling Board XP3-2AD2PT-BD

### 2.1 Specifications



- 14 bits high precision analog input
- 2 channels voltage 0~10V, 0~5V (selectable) analog input
- 2 channels PT temperature testing resistor (PT100 two-line form) temperature sensor

### 2.2 General Specification

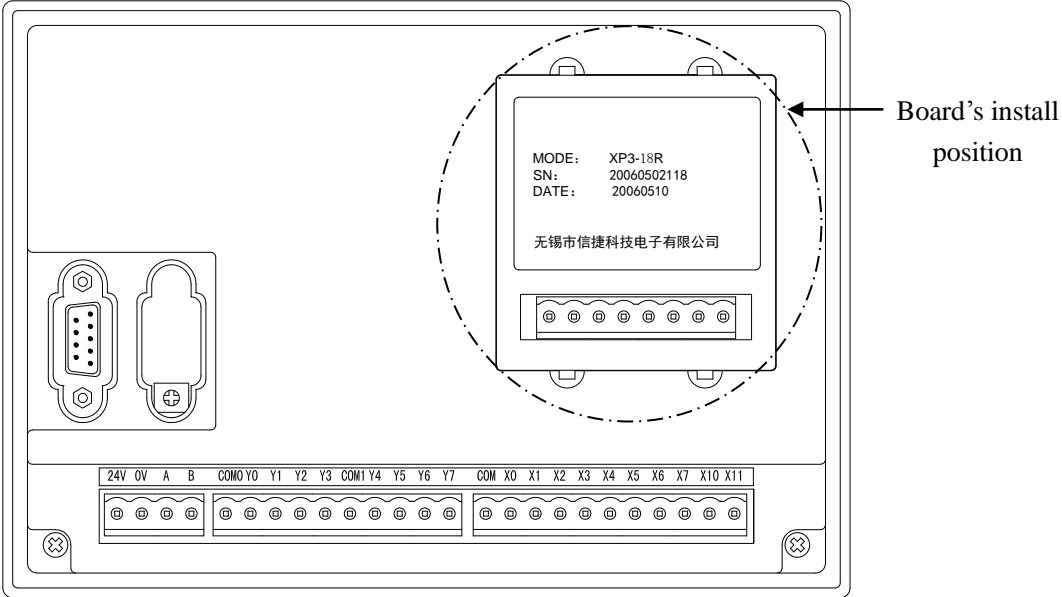
| Item                      | Voltage Input   | Temperature Input   |
|---------------------------|---|---|
| Analog Input Signal       | DC0~5V, 0~10V (Input resistor 300k $\Omega$ )   | Platinum Resistor PT100 (2 lines format)  |
| Temperature Testing Bound | -   | -100~350 $^{\circ}$ C   |
| Distinguish Ratio         | 0.15mV (10/16383)   | 0.1 $^{\circ}$ C  |
| Digital Output Bound      | 0~16383   | -1000~3500  |
| Integrate Precision       | $\pm 0.8\%$ of full scale   |   |
| Convert Time              | 15ms $\times$ 4 channels  |   |
| PID Output Value          | 0~K4095   |   |
| Vacant Defaulted Value    | 0   | 3500  |
| Input Specialty           | <p style="font-size: small; text-align: center;">Analog input <math>\rightarrow</math> 10V/5v</p> | <p style="font-size: small; text-align: center;">Temperature Input <math>\rightarrow</math> 350<math>^{\circ}</math>C</p> |

|                  |  |
|------------------|--|
| Insulation       | No insulation among each channel of PLC  |
| Engrossed points | 0 point (As operated via data register, so the engrossed points are not limited by PLC's max control points) |

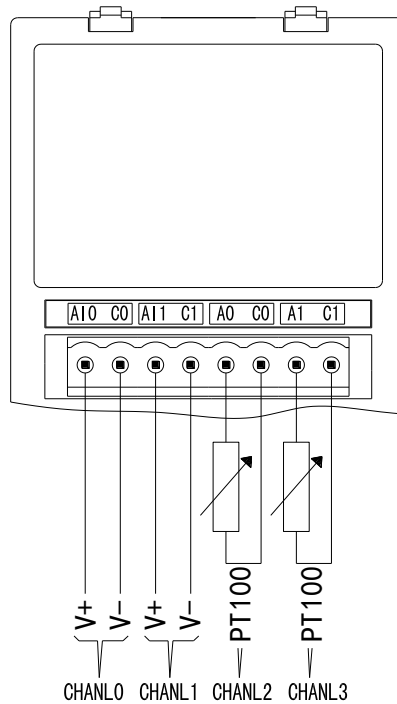
**2.3 External Installation and Connection**

1) The Installation Method of Board:

Open the board's cover at the back of XP3 (As shown in the following graph), install it according to the pin arrangement. Then fix it with screws, close the cover.



2) Connection: See the following graph



## 2.4 Assignment of Input ID

This BD board does not engross I/O units, the converted data will directly send into PLC register. The channel corresponding PLC register ID is:

| Channel                     | 0CH    | 1CH    | 2CH    | 3CH    |
|-----------------------------|--------|--------|--------|--------|
| AD signal/Temperature value | ID1000 | ID1001 | ID1002 | ID1003 |
| PID output value            | ID1004 | ID1005 | ID1006 | ID1007 |
| Set the target value        | QD1000 | QD1001 | QD1002 | QD1003 |
| Kp                          | QD1004 |        | QD1009 |        |
| Ki                          | QD1005 |        | QD1010 |        |
| -Kd                         | QD1006 |        | QD1011 |        |
| Diff                        | QD1007 |        | QD1012 |        |
| Death                       | QD1008 |        | -      |        |
| Start/Stop                  | Y1000  | Y1001  | Y1002  | Y1003  |

Note:

- 1) Kp: proportion parameter; Ki: Integral parameter; Kd: Differential parameter; Diff: Control proportion band;  
PID value: PID output value (0~4095)
- 2) Control coil's status (Y1000/Y1001) : 0: means close PID control; 1: means start PID control

### Description:

- 1) 0CH, 1CH are AD input channels; 2CH, 3CH are Pt input channels

2) Kp: proportion parameter; Ki: Integral parameter; Kd: Differential parameter; Diff: Control band;

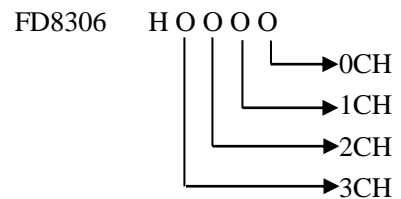
Control Band Diff: Carry on PID control in the assigned bound, beyond the bound, don't carry on PID control

Start Signal (Y): PID control is closed when Y is 0, open PID control when Y is 1

Death Bound "Death": Compare the current PID output value with the preceding PID output value. If their difference is less than the set death bound, the module will abandon the current PID output value, still transfer the preceding PID output value to PLC main unit

### 2.5 Setting of Working Mode

1) Expansion's input has voltage 0~5V、0~10V these two modes and filter form to select. Set via special FLASH data register FD8306 in PLC. Refer to the graph by the right, each register set the 4 channels' mode, each register has 16 bits. From low bit to high bit, each 4 bits set one channel's mode



2) Each channel's working mode is assigned by the four bits of the corresponding register, each bit's definition is shown below:

Register FD8306:

| CH1  |       |       |                   | CH 0   |       |      |                   |
|--|-------|-------|-------------------|--|-------|------|-------------------|
| Bit7   | Bit6  | Bit5  | Bit4              | Bit3   | Bit2  | Bit1 | Bit0              |
| 00: 1/2 filter<br>01: not filter<br>10: 1/3 filter<br>11: 1/4 filter |       | -     | 0:0~10V<br>1:0~5V | 00: 1/2 filter<br>01: not filter<br>10: 1/3 filter<br>11: 1/4 filter |       | -    | 0:0~10V<br>1:0~5V |
| CH3  |       |       |                   | CH 2   |       |      |                   |
| Bit15  | Bit14 | Bit13 | Bit12             | Bit11  | Bit10 | Bit9 | Bit8              |
| 00: 1/2 filter<br>01: not filter<br>10: 1/3 filter<br>11: 1/4 filter |       | -     | -                 | 00: 1/2 filter<br>01: not filter<br>10: 1/3 filter<br>11: 1/4 filter |       | -    | -                 |

3) Usage of four parameters: Proportion parameter (Kp) , integral parameter (Ki), differential parameter (Kd), control proportion band (Diff) .

Parameter P is proportion parameter, mainly reflect system's wrap, when system wrap appears, carry on control immediately to decrease the wrap.

Parameter I is integral parameter, mainly used to remove net difference, improve the system's



no-difference degree

Parameter D is differential parameter, mainly used to control signal's change trend, decrease system's shake.

Temperature control proportion band means: in the assigned bound, carry on PID control, beyond the bound, do not carry on PID control.

## 2.6 Control Specialties

1) Usage of four parameters: Proportion parameter ( $K_p$ )、integral parameter ( $K_i$ )、differential parameter ( $K_d$ )、control proportion band (Diff)

Parameter P is proportion parameter, mainly reflect system's wrap, when system wrap appears, carry on control immediately to decrease the wrap.

Parameter I is integral parameter, mainly used to remove net difference, improve the system's no-difference degree

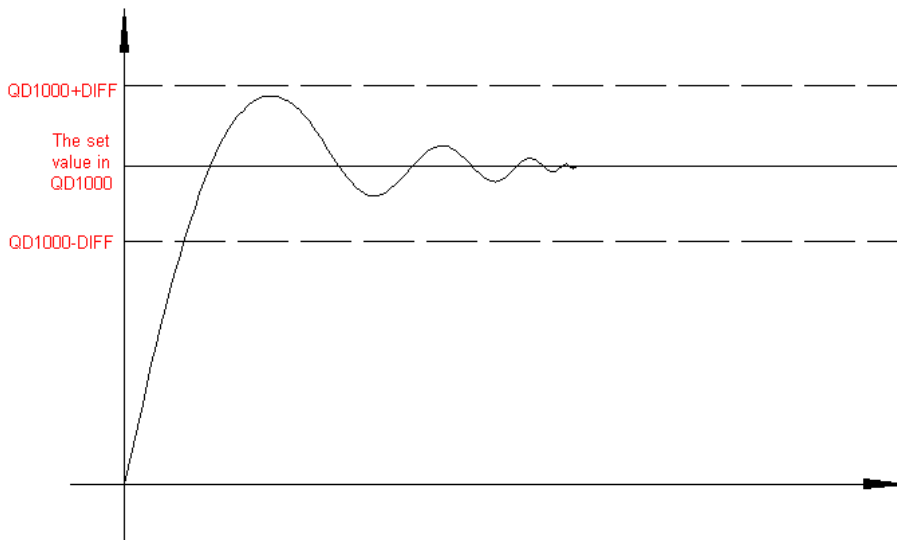
Parameter D is differential parameter, mainly used to control signal's change trend, decrease system's shake.

Temperature Control Band Means: in the assigned bound, carry on PID control, beyond the bound, do not carry on PID control.

2) Control Specialties

The bound of carry on PID adjustment is: ( $QD-Diff$ ,  $QD+Diff$ ), when temperature is low than  $QD-Diff$ , controller go on heating, when temperature is higher than  $QD+Diff$ , controller stop heating.

PID Temperature Control Curve is Shown Below:



Each parameter's reference value:  $K_p=20\sim100$ ;  $K_i=5\sim20$ ;  $K_d=200\sim500$ ;  $DIFF=100\sim200$ ;

This reference value only for normal condition, according to the locale detail condition, each

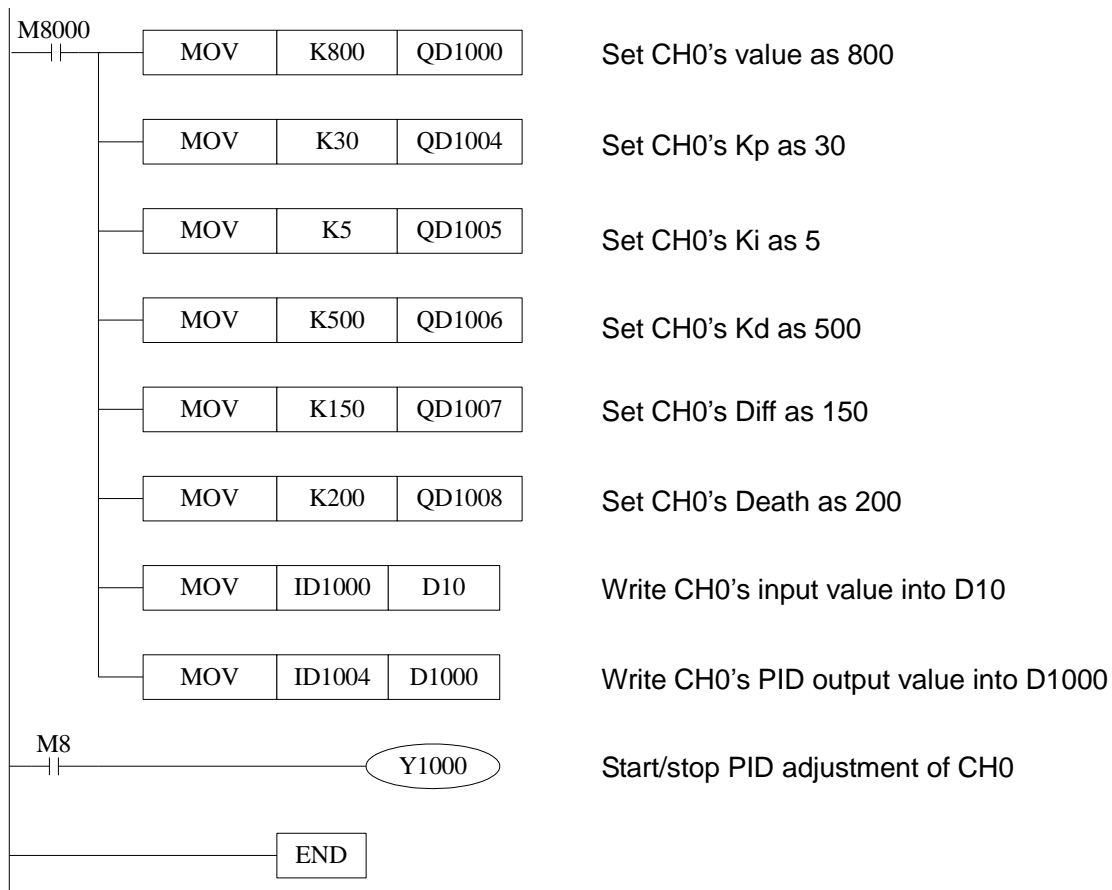
reference value could be beyond the bound.

## 2.7 Application of PID Output Value

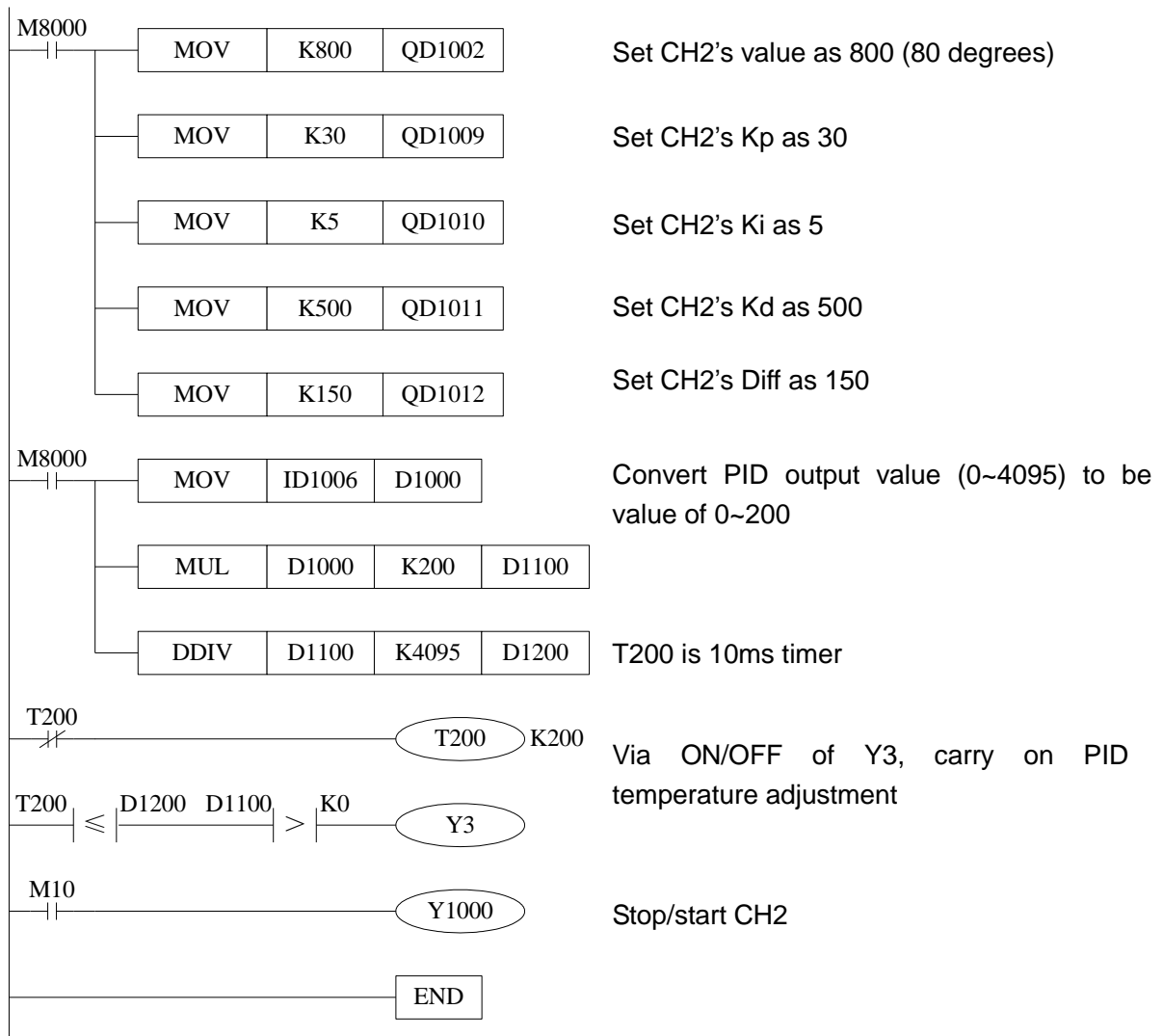
When carry on PID adjustment, this BD board heat with the cycle of 2 second. According to the comparison of PID output value (Channel 1 ID1004、 channel 2 ID1005) and 4095, open and cut of heating form different high-low level ratio. Assume the output value of PID is X ( $0 \leq X \leq 4095$ ). In the heating cycle of 2s, heat at  $2X/4095$  second. Stop heat at  $(2 - 2X/4095)$  second.

## 2.8 Program

E.g.1) Real time read the AD value of CH0, then carry on PID parameters setting with CH0, then read the PID output value.

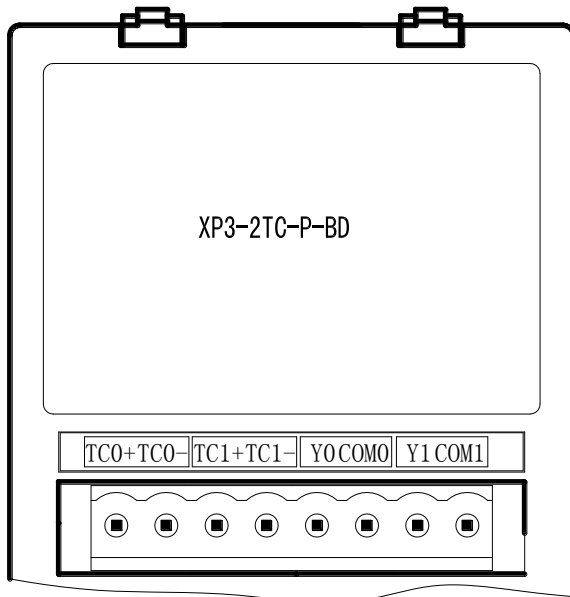


E.g.2) PID temperature control example



### 3. K type thermocouple temperature PID control board XP3-2TC-P-BD

#### 3.1 Specifications



- Analog input used by thermocouple (K type) temperature sensor
- 2 channels input, 2 channels output
- 2 groups PID parameters
- Hide cold terminal compensate circuit inside
- Distinguish ratio precision is 0.1°C

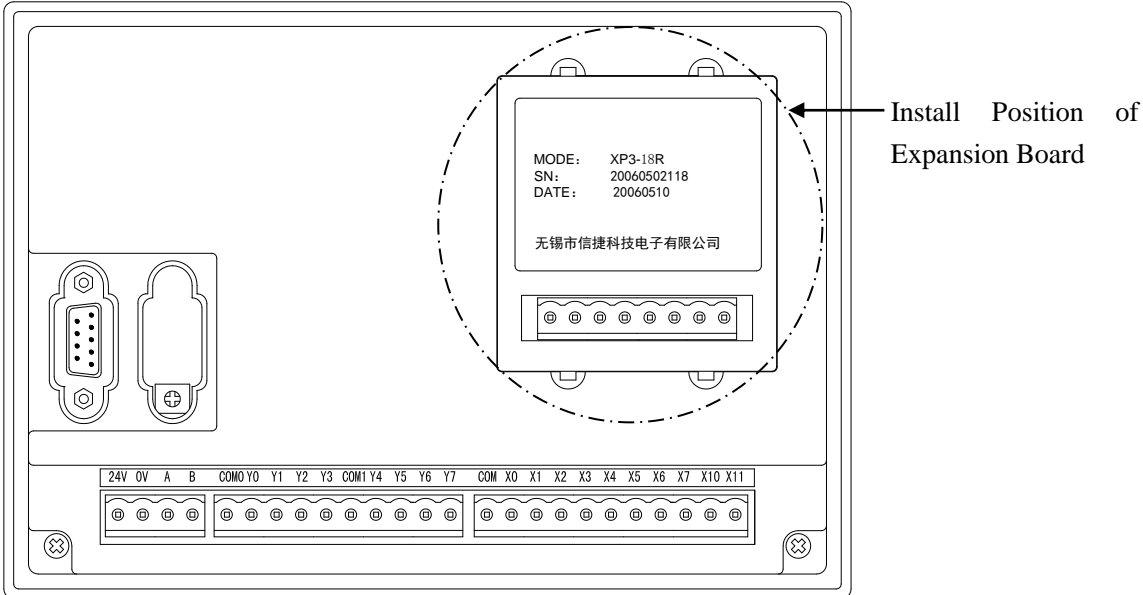
#### 3.2 General Specification

| Item                      | Content                                      |
|---------------------------|--|
| Analog Input Signal       | Thermocouple K type                          |
| Input Points              | 2 points                                     |
| Temperature Testing Bound | 0°C~970°C                                    |
| Digital Output Bound      | 0~9700, 16 bits binary                       |
| Output Points             | 2 points                                     |
| Output Format             | NPN collector open circuit transistor output |
| Control Precision         | 0.4°C  |
| Distinguish Ratio         | 0.1°C  |
| Synthesis Precision       | ±0.8% (Relative max value)                   |
| Convert Speed             | 45ms×2 routes                                |
| Analog Power              | DC24V±10%,50mA                               |

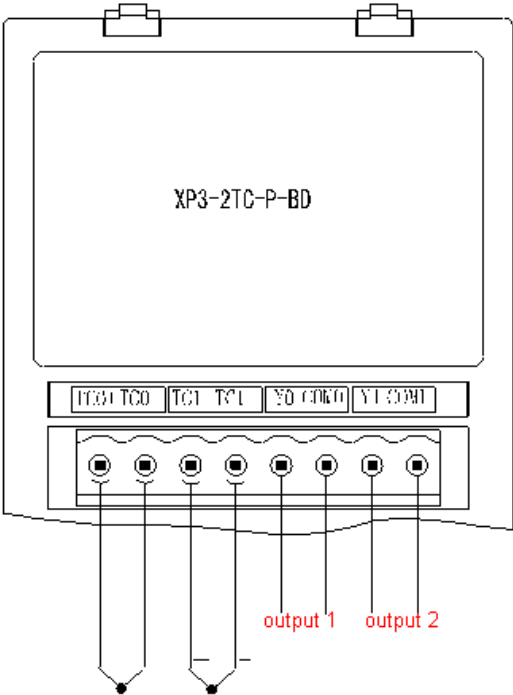
### 3.3 External Installation and Connection

1) Install Method of Expand Board:

Open the expand cover behind XP3 (See the following graph), then install according to the pin and fix with screws. Close the cover to finish.



2) Connection Method



- Output terminals

Transistor output terminals, please choose DC5V~30V smooth power.

- Circuit insulation

Between programmable controller's interior circuit and output transistor, use optical coupling device to insulate. Each public module is divided separately

- Response time

The time from PLC drive optical coupling device to transistor ON/OFF is not more than 0.2ms.

- Output current

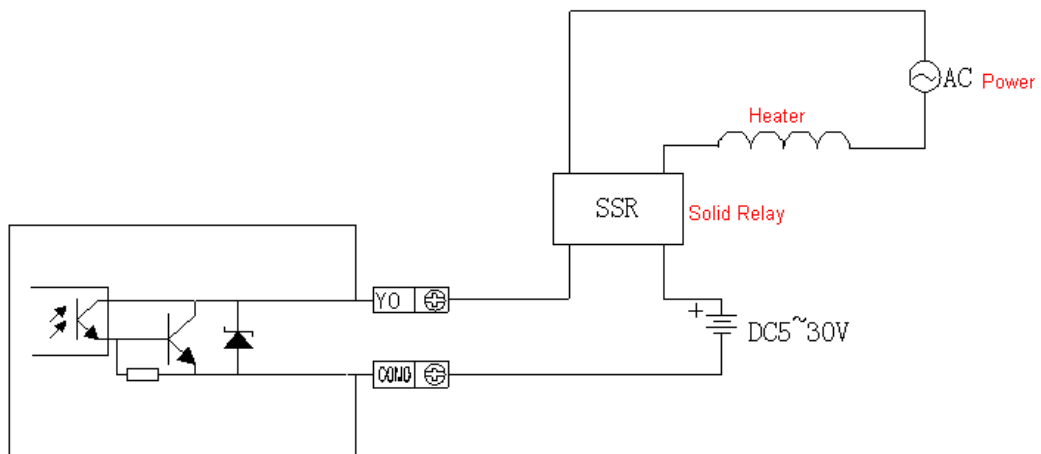
Each point's current could be 0.8A, but to restrict temperature increasing, please use as 1.2A per 4 points or 2.0A per 8 points.

- Open circuit leak current

Below 0.1mA.

The output current is the following:

The Output Current is Shown Below:



### 3.4 The Assignment of I/O ID

This BD expansion does not engross I/O unit, the converted data is directly sent into PLC register, also add two extra output points. Extra outputs do not conclude normal system's I/O output. Channel's correspond PLC register ID is:

| Channel | Current Temperature | Set Temperature | Kp     | Ki     | Kd     | Diff   | Start/stop |
|---------|---------------------|-----------------|--------|--------|--------|--------|------------|
| 0CH     | ID1000              | QD1000          | QD1001 | QD1002 | QD1003 | QD1004 | Y1000      |
| 1CH     | ID1001              | QD1005          | QD1006 | QD1007 | QD1008 | QD1009 | Y1001      |

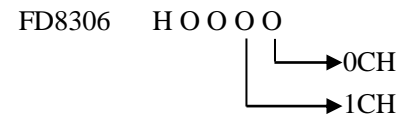
#### Note:

- 1) Kp: proportion parameter; Ki: integral parameter; Kd: differential parameter; Diff: control proportion band.
- 2) Control coil's status (Y1000/Y1001): 0: means close PID control; 1: means start PID control.

- 3) Expansion input has voltage 0~5V/0~10V these two modes and filter form to select. Set via set the 4 channels' mode, each register has 16 bits. From low bit to high bit, each 4 bits set one channel's mode

### 3.5 Setting of the Working Mode

- 1) Set the expansion's working mode via special FLASH data register FD8306 in PLC. Refer to the graph by the right, each register has 16 bits, from low bit to high bit, every 4 bits confirm 1 channel's mode



- 2) Temperature Control Cycle

Temperature Control Cycle: When carry on PID adjustment, the output terminals carry on heating according to the duty cycle got by PID output value, this period is called Temperature Control Cycle

| CH1  |      |      |           | CH0  |      |      |           |
|------|------|------|-----------|------|------|------|-----------|
| Bit7 | Bit6 | Bit5 | Bit4      | Bit3 | Bit2 | Bit1 | Bit0      |
| -    | -    | -    | 0:2 Sec.  | -    | -    | -    | 0:2 Sec.  |
| -    | -    | -    | 1:20 Sec. | -    | -    | -    | 1:20 Sec. |

- 3) Control Specialty

Usage of Four Parameters: Proportion parameter (Kp)、integral parameter (Ki)、differential parameter (Kd)、control proportion band (Diff)

Parameter P is proportion parameter, mainly reflect system's wrap, when system wrap appears, carry on control immediately to decrease the wrap.

Parameter I is integral parameter, mainly used to remove net difference, improve the system's no-difference degree

Parameter D is differential parameter, mainly used to control signal's change trend, decrease system's shake.

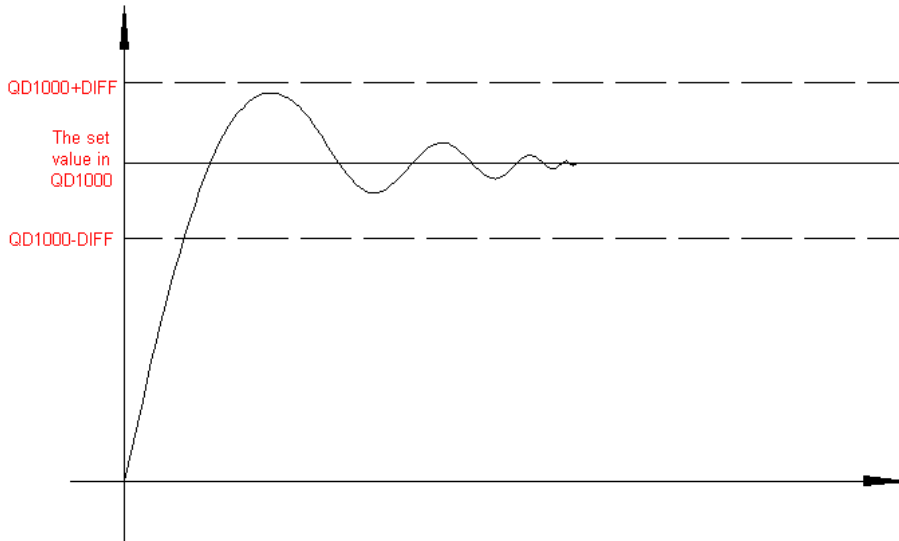
Temperature Control Band Means: in the assigned bound, carry on PID control, beyond the bound, do not carry on PID control.

Temperature Control Cycle: When carry on PID adjustment, the output terminals carry on heating according to the duty cycle got by PID output value, this period is called Temperature Control Cycle

- 4) Control Specialties

The bound of carry on PID adjustment is: (QD-Diff, QD+Diff), when temperature is low than QD-Diff, controller go on heating, when temperature is higher than QD+Diff, controller stop heating.

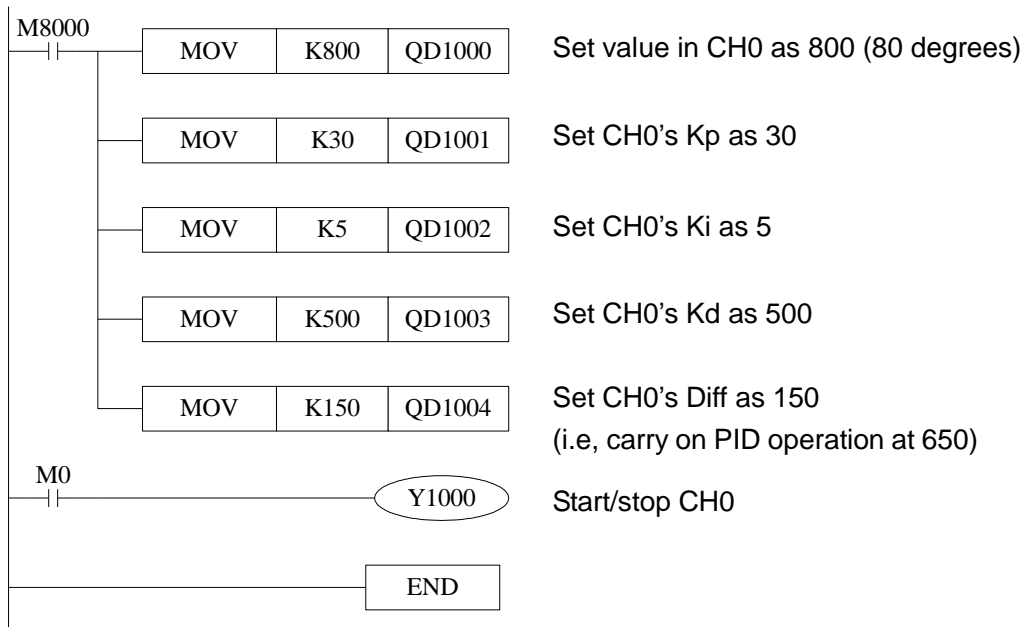
The Control Curve of PID is Shown Below:



Each parameter's reference value:  $K_p=20\sim100$ ;  $K_i=5\sim20$ ;  $K_d=200\sim500$ ;  $DIFF=100\sim200$ ;  
 This reference value only for normal condition, according to the locale detail condition, each reference value could be beyond the bound.

### 3.6 Program

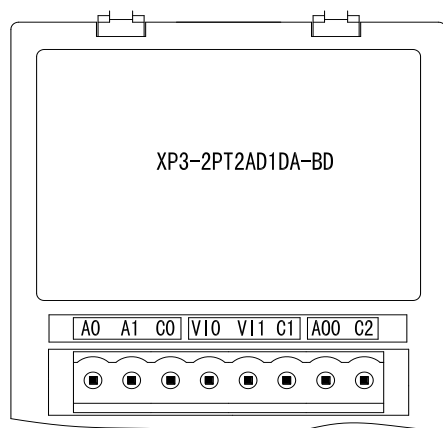
Program with CH0





## 4. Analog and Temperature Sampling Board XP3-2PT2AD1DA-BD

### 4.1 Specifications



- 14 bits high precision analog input
- 10 bits high precision analog output
- 2 channels voltage 0~10V、0~5V (selectable) analog input
- 2 channels PT temperature testing resistor (Pt100 2-line format) temperature sensor

### 4.2 General Specification

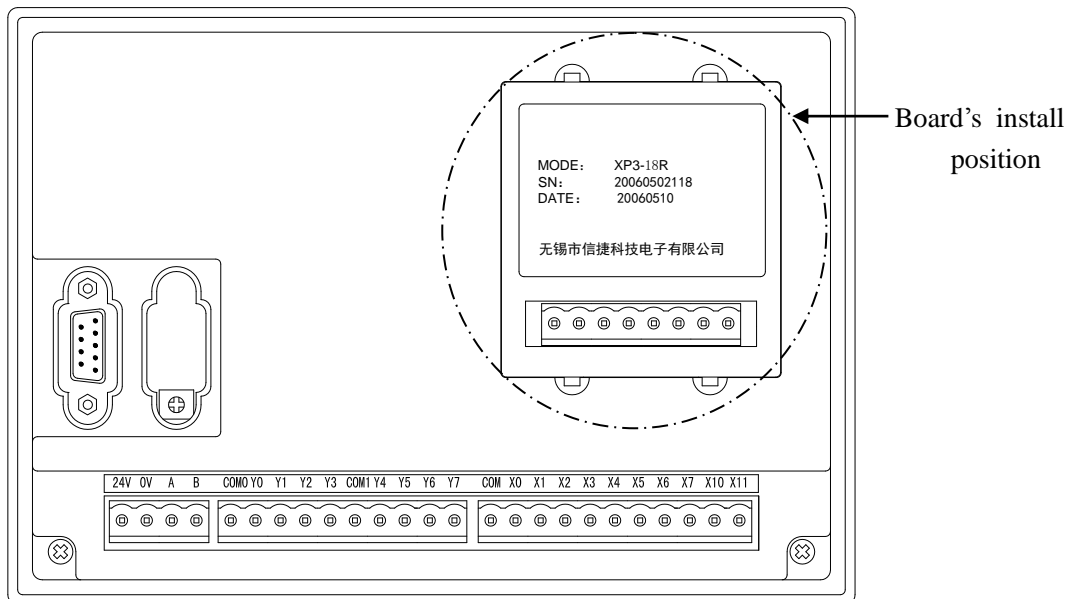
| Item                      | Voltage Input                                | Temperature Input                     | D/A output              |
|---------------------------|--|---------------------------------------|-------------------------|
| Analog Input Signal       | DC0~5V、0~10V (Input Resistor 300k $\Omega$ ) | Platinum resistor Pt100 (2 line from) | —                       |
| Digital Input Bound       | —  | —                                     | 10 bits Binary (0~1023) |
| Analog Output Bound       | —  | —                                     | 0~20mA、4~20mA           |
| Temperature Testing Bound | —  | -100~350 $^{\circ}$ C                 | —                       |
| Distinguish Ratio         | 0.15mV (10/16383)                            | 0.1 $^{\circ}$ C                      | 1/1023                  |
| Digital Output Bound      | 0~16383                                      | -1000~3500                            | —                       |
| Integrate Precision       | $\pm 0.8\%$ of the full scale                |                                       |                         |
| Convert Time              | 15ms $\times$ 4 channels                     |                                       |                         |
| PID output value          | 0~K4095                                      |                                       |                         |

|                        |  |      |   |
|------------------------|--|------|---|
| Vacant defaulted value | 0  | 3500 | — |
| Input/Output Specialty |  |      |   |
| Insulation             | No insulation among PLC's each channel   |      |   |
| Engrossed I/O          | 0 point (because it is operated via data register, so it is not limited by master PLC's standard I/O control points) |      |   |

### 4.3 External Installation and Connection

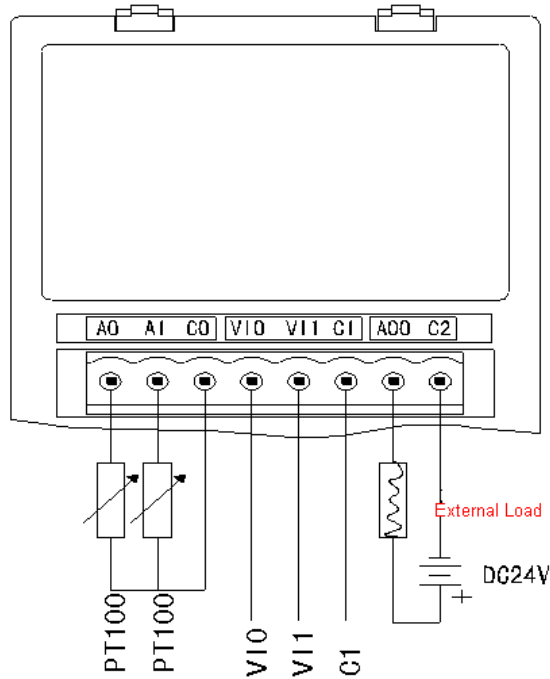
1) Installation method of the expansion board:

Open the board's cover at the back of XP3 (As shown in the following graph), then install it according to the pin arrangement. Then fix it with screws, close the cover.



2) Connection format: As showed in the following graph:

Note: Module's 0~20mA or 4~20mA output need 24V power supplier from outside. According to the QD value, the module adjusts the signal's current. However, the model itself doesn't generate current.



#### 4.4 Assignment of input ID

This BD board does not engross I/O units, the converted data will directly send into PLC register. The channel's correspond PLC register ID is:

| Channel                     | 0CH    | 1CH    | 2CH    | 3CH    |
|-----------------------------|--------|--------|--------|--------|
| AD signal/Temperature value | ID1000 | ID1001 | ID1002 | ID1003 |
| PID output value            | ID1004 | ID1005 | ID1006 | ID1007 |
| Set the target value        | QD1001 | QD1002 | QD1003 | QD1004 |
| D/A Output Value            | QD1000 |        |        |        |
| Kp                          | QD1005 |        | QD1009 |        |
| Ki                          | QD1006 |        | QD1010 |        |
| -Kd                         | QD1007 |        | QD1011 |        |
| Diff                        | QD1008 |        | QD1012 |        |
| Death                       | --     |        | QD1013 |        |
| Start/Stop                  | Y1000  | Y1001  | Y1002  | Y1003  |

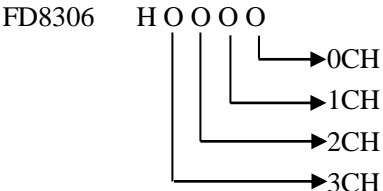
**Note:**

- 1) Both 0CH and 1CH are Pt input channels; 2CH、3CH are AD input channels
- 2) Kp: proportion parameter; Ki: Integral parameter; Kd: Differential parameter; Diff: Control bound  
Control bound (Diff): carry on PID control in the assigned bound; beyond the bound, don't carry on PID control  
Start Signal (Y): Close PID control when Y is 0, open PID control when Y is 1

Death Bound (Death): Compare the current PID output value with the preceding PID output value. If their difference is less than the set death bound, the module will abandon the current PID output value, still transfer the preceding PID output value to PLC main unit.

**4.5 Setting of Working Mode**

1) Expansion's input has voltage 0~5V、0~10V these two modes and filter form to select. Set via special FLASH data register FD8306 in PLC. Refer to the graph by the right, each register set the 4 channels' mode, each register has 16 bits. From low bit to high bit, each 4 bits set one channel's mode



Register FD8306:

| CH 1           |       |       |                   | CH 0           |       |      |                   |
|----------------|-------|-------|-------------------|----------------|-------|------|-------------------|
| Bit7           | Bit6  | Bit5  | Bit4              | Bit3           | Bit2  | Bit1 | Bit0              |
| 00: 1/2 filter |       | -     | -                 | 00: 1/2 filter |       | -    | -                 |
| 01: not filter |       |       |                   | 01: not filter |       |      |                   |
| 10: 1/3 filter |       |       |                   | 10: 1/3 filter |       |      |                   |
| 11: 1/4 filter |       |       |                   | 11: 1/4 filter |       |      |                   |
| CH 3           |       |       |                   | CH 2           |       |      |                   |
| Bit15          | Bit14 | Bit13 | Bit12             | Bit11          | Bit10 | Bit9 | Bit8              |
| 00: 1/2 filter |       | -     | 0:0~10V<br>1:0~5V | 00: 1/2 filter |       | -    | 0:0~10V<br>1:0~5V |
| 01: not filter |       |       |                   | 01: not filter |       |      |                   |
| 10: 1/3 filter |       |       |                   | 10: 1/3 filter |       |      |                   |
| 11: 1/4 filter |       |       |                   | 11: 1/4 filter |       |      |                   |

2) Output channel's mode setting value is stored in register FD8307 (Low bit), it's definition is shown below:

Register FD8307:

| -  |       |       |       | D/A channel  |       |      |                        |
|--|-------|-------|-------|--|-------|------|------------------------|
| Bit7   | Bit6  | Bit5  | Bit4  | Bit3   | Bit2  | Bit1 | Bit0                   |
| 00: 1/2 filter<br>01: not filter<br>10: 1/3 filter<br>11: 1/4 filter |       | -     | -     | 00: 1/2 filter<br>01: not filter<br>10: 1/3 filter<br>11: 1/4 filter |       | -    | 0: 0~20mA<br>1: 4~20mA |
| -  |       |       |       | -  |       |      |                        |
| Bit15  | Bit14 | Bit13 | Bit12 | Bit11  | Bit10 | Bit9 | Bit8                   |
| -  |       | -     | -     | -  |       | -    | -                      |

Parameter D is differential parameter, mainly used to control signal's change trend, decrease system's shake.

Temperature control proportion band means: in the assigned bound, carry on PID control, beyond the bound, do not carry on PID control.

### 3) Control features

The bound of carry on PID adjustment is: (QD-Diff, QD+Diff), when temperature is low than QD-Diff, controller go on heating, when temperature is higher than QD+Diff, controller stop heating.

## 4.6 Control Specialties

- 1) Usage of four parameters: Proportion parameter (Kp)、integral parameter (Ki)、differential parameter (Kd)、control proportion band (Diff)

Parameter P is proportion parameter, mainly reflect system's wrap, when system wrap appears, carry on control immediately to decrease the wrap.

Parameter I is integral parameter, mainly used to remove net difference, improve the system's no-difference degree

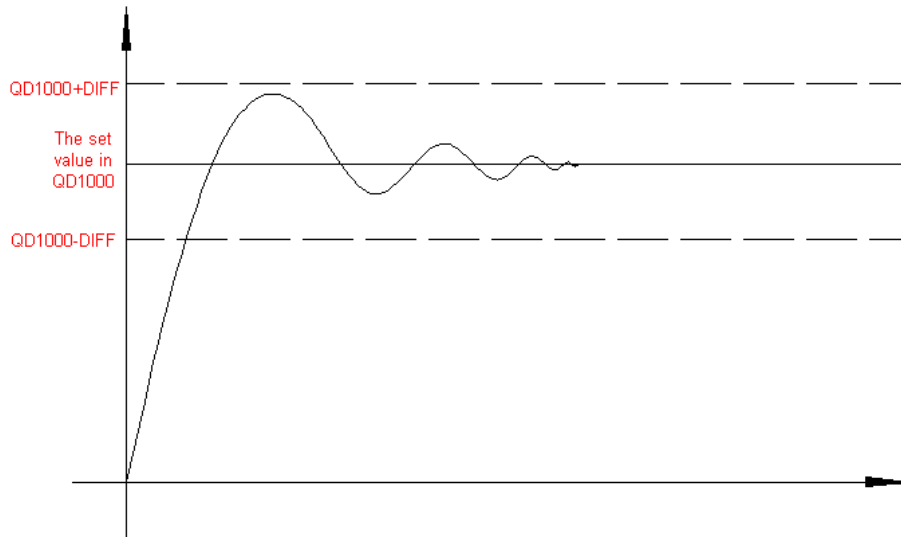
Parameter D is differential parameter, mainly used to control signal's change trend, decrease system's shake.

Temperature control band means: in the assigned bound, carry on PID control, beyond the bound, do not carry on PID control.

- 2) Control Specialties

The bound of carry on PID adjustment is: (QD-Diff, QD+Diff), when temperature is low than QD-Diff, controller go on heating, when temperature is higher than QD+Diff, controller stop heating.

PID temperature control curve is shown below:

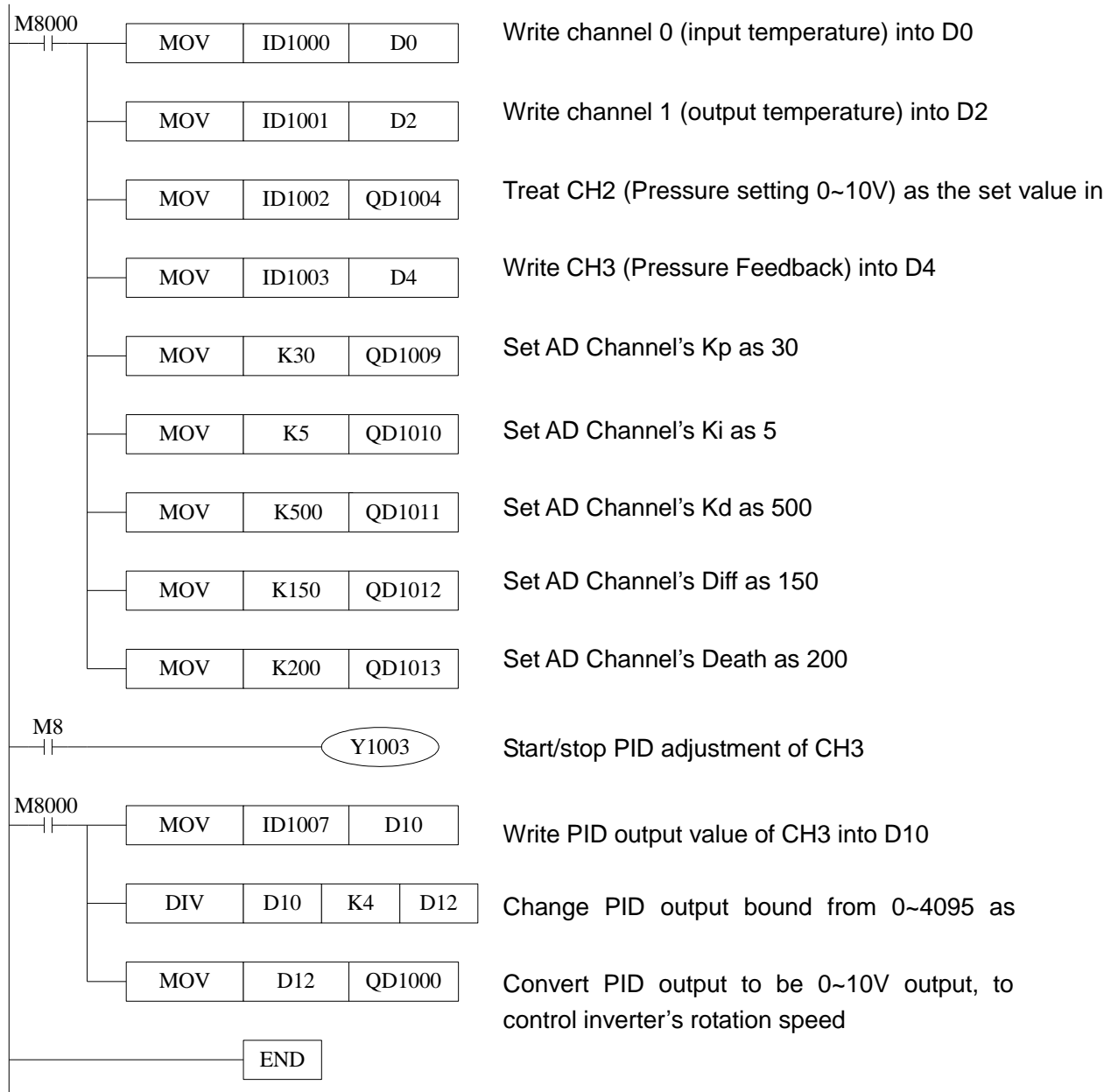


Each parameter's reference value:  $K_p=20\sim100$ ;  $K_i=5\sim20$ ;  $K_d=200\sim500$ ;  $DIFF=100\sim200$ ;  
 This reference value only for normal condition, according to the locale detail condition, each reference value could be beyond the bound.

#### 4.7 Program

E.G.: Use the water pump's rotation speed to control the pipe's water pressure. 2 channels temperature input (ID1000、ID1001). Via a potentiometer, set a pressure value (ID1002). From the pipe, test a pressure feedback value (ID1003). According to the pressure setting value and the pipe's feedback pressure value, via PID operation, output an analog signal (QD1000). Use this analog signal to control the inverter's speed, then realize controlling the pipe's pressure. In this way, it will form a closed loop of control system.

Program& correspond description:





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