

# KCM-XJ4M Multi-Loop Controller Instruction Manual

## 1. Features:

The temperature controller has 4 channels of analog Signal 4-20mA sensors input and 4 channels of temperature controls. 4 kinds of combinations of temperature set value, PID constant, alarm set value, etc.

### 1.1. Input Sensor Types

Thermocouple (temperature input): K, J, T, E, S

Resistance thermometer (temperature input): Pt100, CU50

Or Current input (analog input): 4 ~ 20 mA DC, 0 ~ 10 mA DC depending on the controller model.

### 1.2. Control Outputs

a. Relay output: relay contact: 250 V AC, 3 A (Resistive load)

b. SSR output: DC 0/10V voltage output (for driving SSR)

depending on the controller model.

### 1.3. Adjusting PID Constants

Can be easily set the optimum PID constants by performing AT (auto-tuning) with the limit cycle method.

### 1.4. Standard Alarms (OPTIONAL)

Relay contact: 250 V AC, 3 A (Resistive load).

Can be output an alarm when the deviation, process value, set point, or manipulated value reaches a specified value.

### 1.5 Sampling Time: 2 sec

### 1.6. Use this controller within the following allowable range:

Allowable ambient temperature: -0 to +55 °C

Allowable ambient humidity: 5 to 85 % RH.

## 2. Dimensions:

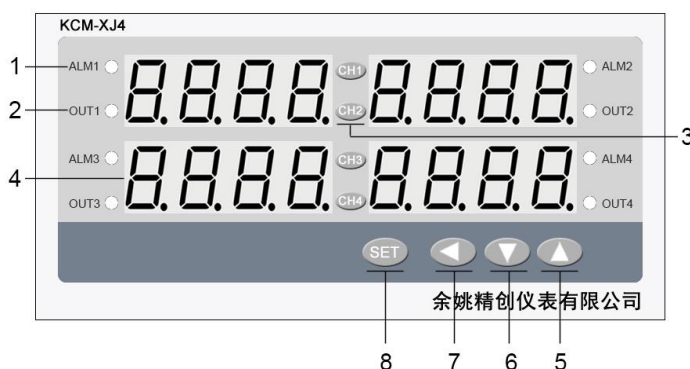
M: 160x80mm panel cutout : 152x76mm (horizontal)

MA: 96x96mm panel cutout : 92x92mm

MD: 72x72mm panel cutout : 68x68mm

MR: 88x107x59mm DIN 35 rail mounting socket

## 3. Parts Description & Terminal Arrangement:



**1 ALM:** lamp Lights when Event occurs

**2 Output lamp:** Lights when output is turned on

**3 Channel key:**

**4 PV display:**

You can press 'CH1~4' for 3 seconds to enter into corresponding channel menu.

Displays Measured value (PV)

**5 Up key:**

**6 Down key:**

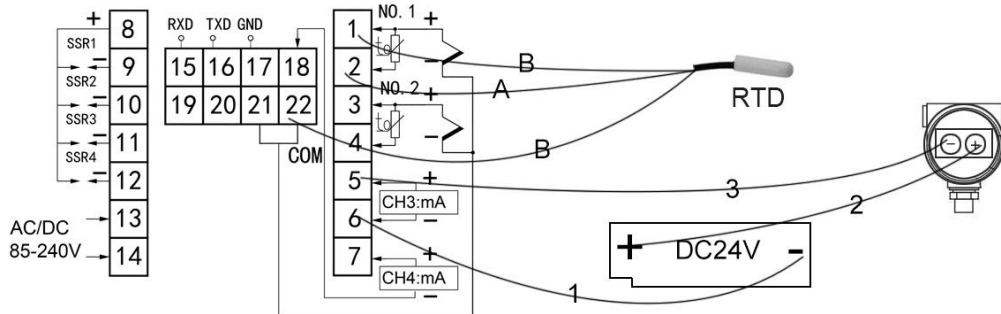
Increase numerals.

**7Shift key:** Shift digits when settings are changed.

Decrease numerals

**8 Set (SET) key:** Used for parameter calling up and set value registration.

#### 4. Terminal Arrangement:



This wiring diagram is offered for example purposes only.

*Tip: Correct terminal arrangement depending on the actual model.*

#### 5. Parameters

Table 5.1

| ID  | Symbol      | Name               | Manual   | Setting range              | Ex-Factory |
|---|-------------|--------------------|--|----------------------------|------------|
| The public parameters(First level)            |             |                    |  |                            |            |
| 0   | <i>Lock</i> | Set data lock      | LOCK=18, Set data unlock<br>LOCK≠18, Set data lock.  | 0~50                       | 18         |
| 1   | <i>t</i>    | PID control cycle. | PID control response time  | 2~120                      | 10         |
| 2   | <i>oPb</i>  | Communication      | 0:no output;<br>1:RS232 or RS485;  | 0-2                        | 1          |
| 3   | <i>Addr</i> | Address            | Communication address can be set from 0 to 255   | 0-255                      | 1          |
| 4   | <i>bAud</i> | Baud Rate          | 1200; 2400; 4800; 9600;  | 0-4                        | 1          |
| The Parameters of each channels(Second level) |             |                    |  |                            |            |
| 5   | <i>Sn</i>   | Input type         | Refer to Table 5.2   | -                          | -          |
| 6   | <i>ALP</i>  | Alarm type         | 0: Alarm function OFF;<br>1:Process high alarm;<br>2:Process low alarm;<br>For more information,<br>Refer to 8. Alarm function | 0~6                        | 1          |
| 7   | <i>SP</i>   | Setting value      | Set the temperature set value (SV) which is the target value for control   | Determined by P-SL<br>P-SH | 100        |
| 8   | <i>AL</i>   | Alarm set value    | For more information,<br>Refer to 8. Alarm function  |                            | 200        |
| 9   | <i>SC</i>   | PV Bias            | The value set in the PV bias is added to the actual input value to correct the input value.                                    | ±20.0                      | 0          |


|    |            |                         |   |            |      |
|----|------------|-------------------------|---|------------|------|
| 10 | <i>P</i>   | Proportional band       | Set when PI or PID control is performance. For heating / cooling PID action.<br>When P=0,the meter is ON/OFF control        | 1~100      | 0    |
| 11 | <i>I</i>   | Integral time           | Eliminates offset occurring in proportional control.  | 0~3000     | 500  |
| 12 | <i>D</i>   | Derivative time         | Prevents overshoot and/or undershoot caused by integral action effect..   | 0~2000S    | 100S |
| 13 | <i>At</i>  | Auto tuning             | 1: AT with learning start<br>0: AT with learning stop   | 0~1        | 0    |
| 14 | <i>HY</i>  | Differential gap        | Output and alarm Hysteresis Value<br>Refer to the next subsection:<br>9. OUT Relay contact On/Off mode<br>8. Alarm function | 0.1~50.0   | 1.0  |
| 15 | <i>CoL</i> | Hot/Cold                | 0:reverse control(heating)<br>1:positive control(cooling)   | 0~1        | 0    |
| 16 | <i>dP</i>  | Decimal point selection | 0: No decimal point<br>1: 1 decimal digit   | 0~3        | 0    |
| 17 | <i>P5H</i> | Range high              | Input range (high)  | P-SL~9999  | -    |
| 18 | <i>P5L</i> | Range low               | Input range (low)   | -1999~P-SH | -    |

Table 5.2

| MODEL                   | Input type list  |                             |                                       |
|-------------------------|--|-----------------------------|---------------------------------------|
| Temperature sensor      | Cu50( <i>LU50</i> )<br>-50.0~150.0°C                     |                             | Pt100( <i>Pt2</i> )<br>-199.9~600.0°C |
|                         | K( <i>K</i> ) -30.0~1300°C                               | E( <i>E</i> ) -30.0~700.0°C | J ( <i>J</i> )-30.0~900.0°C           |
|                         | T( <i>T</i> ) -199.9~400.0°C                             | S( <i>S</i> ) -30~1600°C    |                                       |
| Analog input (Optional) | 0~50mV( <i>0_50</i> );<br>1~5V/4~20mA( <i>I_50</i> )     | 10~50mV( <i>R_50</i> )      | 0~5V/0~10mA( <i>0_50</i> )            |
|                         | DC input is single-option, depending on the actual mode. |                             |                                       |

## 6. Operation

### 6.1 First level menu setting

Press and hold the  key for 3 seconds to go to the first level menu, the controller will display the parameter symbols (0~4) on the first LED display, and display the parameter value on the second LED display.

### 6.2 Second level menu setting.

Press and hold the CH1/ CH2/ CH3 /CH4 key for 3 seconds to go to one of the channel menu level.

The controller will display the parameter symbols (5~18) on the first LED display, and display the parameter value on the second LED display.

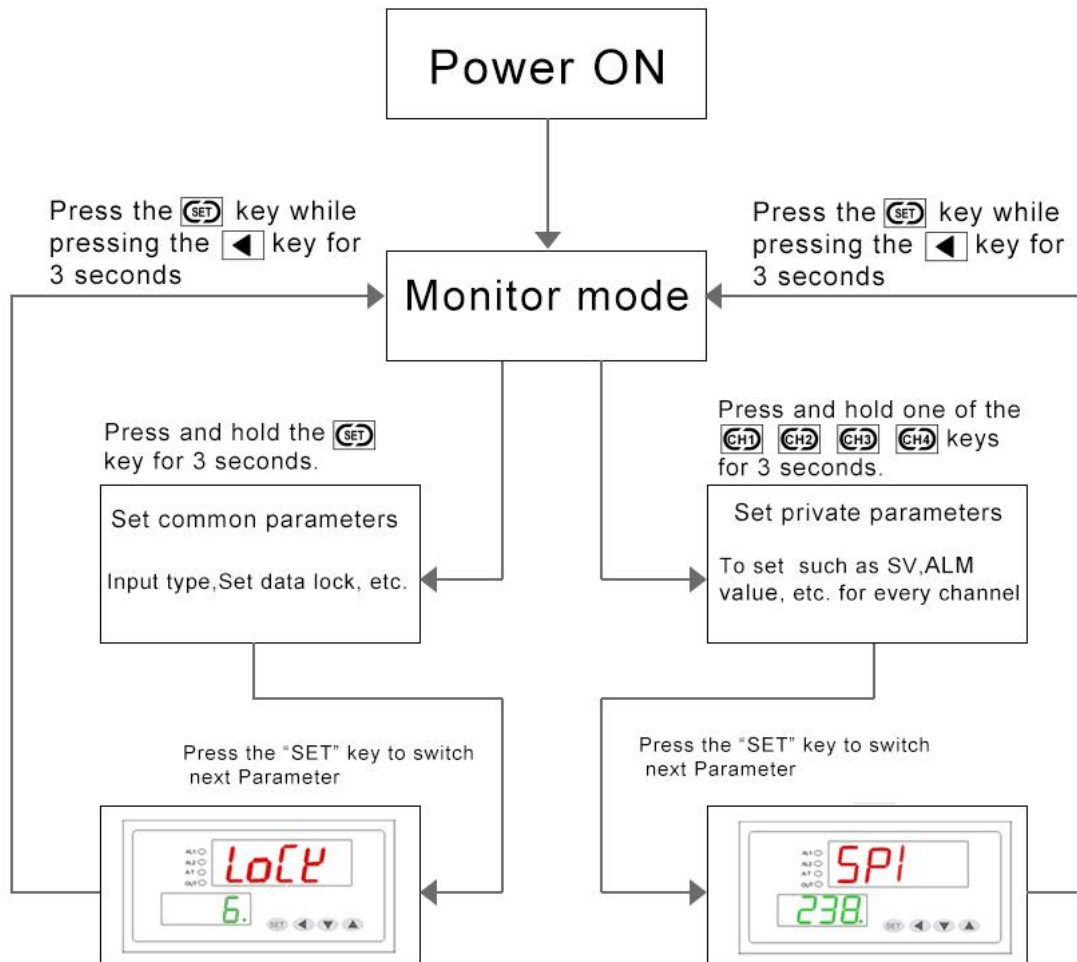
### 6.3 Parameter value setting

Press ◀ key to go to a different digit.

Parameters value can be changed by pressing the ▼ key or the ▲ key.

Press the **SET** key. The display changes to the next parameter and the new value will be stored. All the Parameters can be modified when *LoLk*=18.

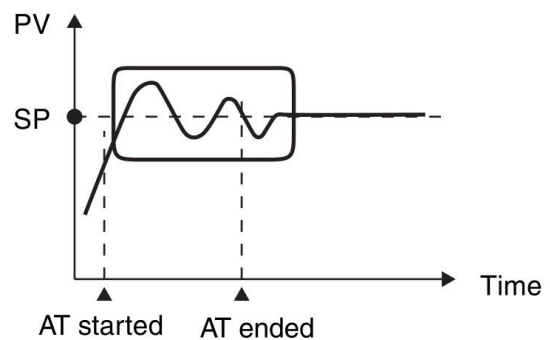
Display returns to the PV monitor if no key operation is performed within 10 seconds, and the set value will be saved.



### 7. Determining PID Constants (Auto-tuning)

When AT is executed, the optimum PID constants for the set point at that time are set automatically. A method (called the limit cycle method) for forcibly changing the manipulated variable and finding the characteristics of the control object is employed.

Set parameter *HY* as 0.5, if the output is relay set the *t* as 10, then set the *RL* as 1, in this time the controller enter into **Auto-tuning**. PV window will alternately Display "AT" and PV value, control mode is on-off mode, after 3 times vibrating (3 control period) automatic save P, I, D parameter, the self-adjusting procession finished.



**Attentions:**

- The parameters of 14:  $HY$  ,1:  $t$  ,13:  $RL$  refer to 5.Parameters
- when **Auto-tuning**, the controller should not change the set value.
- When the power off during **Auto-tuning**, it will restart **Auto-tuning** next time.
- When it need artificially exit during **Auto-tuning**, set the Parameter(AT) to 0 so that can exit, but the setting result will not be valid.

## 8. Alarm function[OPTIONAL]

| Take example for channel 1 alarm  |                    |   |
|---|--------------------|---|
| Alarm function  | Alarm status[ON]   | Alarm status[OFF]                                   |
| $RLP=1$   | $PV1 \geq RL$      | $PV1 < RL - HY$                                     |
| $RLP=2$   | $PV1 \leq RL$      | $PV1 > RL + HY$                                     |
| $RLP=3$   | $PV1 \geq SP + RL$ | $PV1 < SP + RL - HY$                                |
| $RLP=4$   | $PV1 \leq SP - RL$ | $PV1 > SP - RL + HY$                                |
| $RLP=5$   | Alarm status[ON]   | $PV1 \leq SP - RL \text{ OR } PV1 \geq SP + RL$     |
|   | Alarm status[OFF]  | $SP - RL + HY < PV1 < SP + RL - HY$                 |
| $RLP=6$   | Alarm status[ON]   | $SP - RL \leq PV1 \leq SP + RL$                     |
|   | Alarm status[OFF]  | $PV1 < SP - RL - HY \text{ OR } PV1 > SP + RL + HY$ |
| The parameters of 7: $SP$ , 8: $RL$ , 14: $HY$ , 6: $RLP$ refer to 5.Parameters |                    |   |

## 9. OUT Relay contact On/Off mode

Set the parameter of P (Proportional Band)=1, When P=0,the controller is ON/OFF control.

| OUT function  |                          | OUT status[ON]    | OUT status[OFF]   |
|---|--------------------------|-------------------|-------------------|
| positive control  | $P = 0; \text{CoL} = 1;$ | $PV \geq SP + HY$ | $PV \leq SP - HY$ |
| reverse control   | $P = 0; \text{CoL} = 0$  | $PV \leq SP - HY$ | $PV \geq SP + HY$ |
| The parameters of 7: $SP$ , 10: $P$ , 14: $HY$ , 15: $\text{CoL}$ refer to 5.Parameters |                          |                   |                   |

## 10. Host communication based on MODBUS-RTU protocol

The master controls communication between master and slave. A typical message consists of a request (query message) sent from the master followed by an answer (response message) from the slave. When master begins data transmission, a set of data is sent to the slave in a fixed sequence. When it is received, the slave decodes it, takes the necessary action, and returns data to the master.

### 10.1 Communication Mode:

| Data bit length | Stop bits | Parity bit | Communication time interval |
|-----------------|-----------|------------|-----------------------------|
| 8-bit (Binary)  | 1,2       | NONE       | 300ms                       |

### 10.2 Message length of each function (Unit: byte):

| Function code<br>(Hexadecimal) | Function               | Query message |     | Response message |     |
|--------------------------------|------------------------|---------------|-----|------------------|-----|
|                                |                        | Min           | Max | Min              | Max |
| 03H                            | Read holding registers | 8             | 8   | 7                | 7   |
| 06H                            | Preset single register | 8             | 8   | 8                | 8   |

### 10.3 Message format

|               |  |
|---------------|--|
| Slave address | The slave address is a number from 1 to 255 manually set at the front key panel of the controller.   |
| Function code | Refer to <b>2. Message length of each function</b>   |
| Data          | The data to execute the function specified by the function code is sent to the slave and corresponding data returned to the master from the slave. |
| CRC-16        | CRC-16: Cyclic Redundancy Check)   |

### 10.4 Read holding registers [03H]

The query message specifies the starting register address and quantity of registers to be read.

| Slave address  | Function code | Register address | Quantity              | CRC16 |
|--|---------------|------------------|-----------------------|-------|
|  | 03H           |                  | The setting must be 1 |       |
| Example: The contents of the holding register 1001H are the read out from slave address 1.<br>Query message: 01 03 10 01 00 01 D1 0A<br>Response message: 01 03 02 <b>00 FD</b> 79 C5<br>Explain: 00FD=253, is processed as 25.3 |               |                  |                       |       |

### 10.5 Preset single register [06H]

The query message specifies data to be written into the designated holding register. Only R/W holding registers can be specified. The controller EEPROM had a life span of data written to the EEPROM less than 1000,000 times

| Slave address  | Function code | Register address | Write data | CRC16 |
|--|---------------|------------------|------------|-------|
| Example: Data is written into the holding register 0004H of slave address 1.<br>Query message: 01 06 00 04 FF 38 88 29<br>Response message: 01 06 00 04 FF 38 88 29<br>When input set value(SV) is -20.0, -20.0 is processed as -200, -200=0000H-00C8H=FF38H |               |                  |            |       |

### 10.6 No response

The slave ignores the query message and does not respond when:

- The slave address in the query message does not coincide with any slave address settings.
- The CRC code of the master does not coincide with that of the slave.
- Transmission error such as overrun, framing, parity and etc., is found in the query message.
- Set the Response Timeout >200ms and Delay between polls >200ms.

### 10.7 Register address list:

| Symbol             | Decimal point | Real Register | Holding Register |
|--------------------|---------------|---------------|------------------|
| Measured value(PV) | YES           | 1001H~1004H   | 44098~44101      |

|  |    |             |             |
|--|----|-------------|-------------|
| The first public parameters (Refer to 5. Parameters) |    |             |             |
| Lock   | NO | 0000H       | 40001       |
| ... And so on  |    |             |             |
| Baud   | NO | 0004H       | 40005       |
| The Parameters of channel 1 (Refer to 5. Parameters) |    |             |             |
| sn1~ PSL 1   | -  | 0005H~0012H | 40006~40019 |
| The Parameters of channel 2 (Refer to 5. Parameters) |    |             |             |
| sn2~ PSL 2   | -  | 0013H~0020H | 40020~40033 |
| The Parameters of channel 3 (Refer to 5. Parameters) |    |             |             |
| sn3~ PSL 3   | -  | 0021H~002EH | 40034~40047 |
| The Parameters of channel 4 (Refer to 5. Parameters) |    |             |             |
| sn4~ PSL 4   | -  | 002FH~003CH | 40048~40061 |

Refer to this link for more information on MODBUS-RTU Communication Protocol:

<http://www.kcmeter.com/servicesread.asp?id=4>

Or scan QR code for more information:



**Character Symbols :** This manual indicates 9-segment display characters as shown below.

|          |          |          |          |          |          |          |          |          |          |          |          |          |
|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|----------|
| <b>A</b> | <b>B</b> | <b>C</b> | <b>D</b> | <b>E</b> | <b>F</b> | <b>G</b> | <b>H</b> | <b>I</b> | <b>J</b> | <b>K</b> | <b>L</b> | <b>M</b> |
| <i>A</i> | <i>b</i> | <i>[</i> | <i>d</i> | <i>E</i> | <i>F</i> | <i>G</i> | <i>H</i> | <i>I</i> | <i>J</i> | <i>K</i> | <i>L</i> | <i>n</i> |
| <b>N</b> | <b>O</b> | <b>P</b> | <b>Q</b> | <b>R</b> | <b>S</b> | <b>T</b> | <b>U</b> | <b>Y</b> |          |          |          |          |
| <i>n</i> | <i>o</i> | <i>P</i> | <i>q</i> | <i>r</i> | <i>S</i> | <i>t</i> | <i>u</i> | <i>y</i> |          |          |          |          |

## 11. Model and Suffix Code

|                      |   |                             |                          |                          |                          |                          |                          |    |
|----------------------|---|-----------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|----|
| Specifications       | Model and Suffix Code   |                             |                          |                          |                          |                          |                          |    |
| Model                | KC  | <input type="checkbox"/>    | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |    |
| SIZE                 | 160×80mm  | panel cutout :152×76mm      | M                        |                          |                          |                          |                          |    |
|                      | 96×96mm   | panel cutout :92×92mm       | MA                       |                          |                          |                          |                          |    |
|                      | 72×72mm   | panel cutout :68×68mm       | MD                       |                          |                          |                          |                          |    |
|                      | 88×107×59mm   | DIN 35 rail mounting socket | MR                       |                          |                          |                          |                          |    |
| Number of channel    | 4 channels  |                             |                          | XJ4                      |                          |                          |                          |    |
| Number alarm         | No alarm  |                             |                          |                          | <input type="checkbox"/> |                          |                          |    |
|                      | 1 Alarm relay out for each channel                                    |                             |                          |                          | 1                        |                          |                          |    |
| Input Type           | Thermocouple, RTD, DC voltage or Current Fixed input type per channel |                             |                          |                          |                          | M                        |                          |    |
| Control output       | Relay output  |                             |                          |                          |                          | <input type="checkbox"/> |                          |    |
|                      | Voltage pulse(for driving SSR)  |                             |                          |                          |                          | G                        |                          |    |
| Power supply voltage | 100 to 240V AC  |                             |                          |                          |                          |                          | <input type="checkbox"/> |    |
|                      | 24V DC  |                             |                          |                          |                          |                          | 1                        |    |
| Communications       | RS-485(2-wire system: MODBUS-RTU)                                     |                             |                          |                          |                          |                          |                          | RS |
|                      | RS-232(3-wire system: MODBUS-RTU)                                     |                             |                          |                          |                          |                          |                          | RX |