KCM-MX Multi-Loop Controller Instruction Manual

1. Features:

Multichannel temperature controls up to 6 channels in a controller.

Multichannel combinations of temperature set value, PID constant, alarm set value, etc.

1.1.Input Sensor Types

Thermocouple : K, J, T, E, S

Resistance thermometer: Pt100, CU50

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)

c. Current output : 4-20mA or 0-10v

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)

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

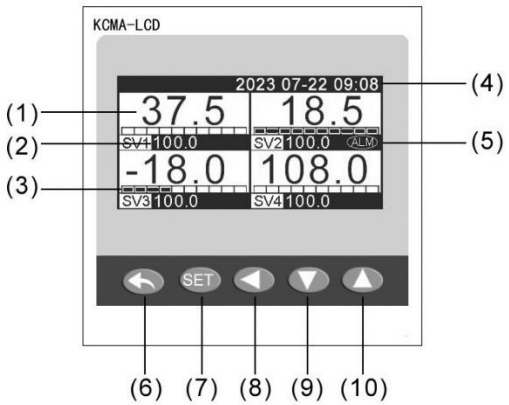
1.5.Use this controller within the following allowable range:

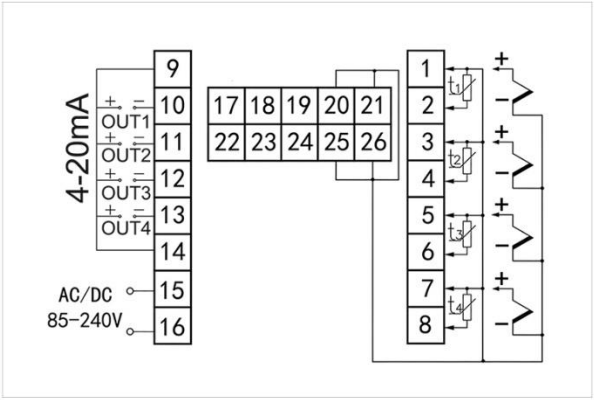
Allowable ambient temperature: −0 to +55 °C

Allowable ambient humidity: 5 to 85 % RH.

1.6. Dimension: 96×96mm panel cutout :92×92mm

2. Parts Description:





This wiring diagram is offered for example purposes only.

Tip: Correct terminal arrangement depend on the actual model.

1 CH1 display: Displays loop 1 Measured value

2 SV1: The set value of channel 1

5 ALM2: "ALM" will be displayed when loop 2 Event occurs

7 Up key: Increase numerals.

Shift key: Shift digits when settings are changed.

3 OUT: The output percentage of channel 3

4 System time: Displayed when recording

6 Exit key: Go back to the previous step.

8 Down key: Decrease numerals

10 Set (SET) key: For setting parameters and saving the parameters value.

3. Parameters

ID	Code	Name	Manual	Setting range	Ex-Factory
The public parameters(Main menu)					
0	LOCK	Set data lock	LOCK=0, parameters can be set. Otherwise parameters cannot be set.	0～50	0
1	SN	Input type	Current：0-mA(0-10mA),4-mA(4-20mA)	-	-

			RTD: Cu (cu50),Pt (pt100) TC: K,E, J,T;		
2	AUX out	Communication	0:no output; RS:RS232 or RS485 MODBUS-RTU; LG: Data Logger	0-1	1
3	Address	Device Address	Device address, can be set from 0 to 255	0～255	1
4	Baud rate	baud rate	1200; 2400; 4800; 9600;	__	9600
5	C-F	Channel1 unit select	C: Celsius F: Fahrenheit	C	C
The Parameters of each channels(loops menu)					
6	SP	Set value	Set the temperature set value (SV) which is the target value for control	Determined by PSL PSH	100
7	SPHY	Differential gap	When P=0,the controller is ON/OFF control ON/OFF action differential gap	0.1～50.0	0.1
8	ALH	Alarm Set value	Refer to 6. Alarm (ALM1) function	Determined by PSL PSH	300
9	AL				300
10	ALMHY	Differential gap	Alarm differential gap		
11	SC	PV Bias	The value set in the PV bias is added to the actual input value to correct the input value.		
12	P	Proportional Band	Set when PI or PID control is performance. For heating / cooling PID action. When P=0,the controller is ON/OFF control	1～100.0	15
13	I	Calculus time	Eliminates offset occurring in proportional control.	0～3000	500
14	D	Differential time	Prevents overshoot and/or undershoot caused by integral action effect..	0～2000S	100S
15	T	PID control period	Control response time	2～120	2S
16	OUT0	Initial value	PID control Initial output value	0～3000	500
17	AT	Auto tuning	1: Auto tuning (AT) with learning start 0: Auto tuning (AT) with learning stop Turns OFF automatically when the AT with learning function is completed.	0～1	0
18	Trans-H	Transmission high	Transmission Output limiter high	0～200	200
19	Trans-L	Transmission low	Transmission Output limiter low	0～200	40
20	OP	Control action	Refer to 7. Main output function	0～5	0
21	ALP	Alarm output Opt.	Refer to 6. Alarm (ALM1) function	0～10	1
22	PF	Digital Filter	This is a 1st-order lay filter by software prepared in order to reduce fluctuations of measured value (PV) by noise.	0～99	20
23	PS-H	Range high	Input range high	P-SL～9999	1300
24	PS-L	Range high	Input range low	-1999～P-SH	0
25	dp	The position of the decimal point	TC/ RTD input: Only 0 or 1 can be set. Voltage (V)/Current (I) input: From 0 to 3 can be set.	0～3	1
26	OUTH	Output limiter high	The min value and max value of output current.	outL～200	200
27	OUTL	Output limiter low		0～outH	0

4. Operation

4.1 Menu level switching

Press and hold the “SET” key for 3 seconds to enter the parameter setting state, “Main menu” and “channels menu” will be displayed on the screen.

Press Key “▲”or”▼” to switch between main menu level and channels menu level

Press the “SET” key to into parameter setting mode of the selected menu level

Press the “↩” key to go back to the PV monitor

Display returns to the PV/SV monitor if no key operation is performed within 4 seconds

4.2 Parameter setting mode:

The parameter value will be changed by using the “▲” key or the “▼” key

One of the digits is flashing which digit can be set. Press ” ◀” key to go to a different digit. Every time the shift key ” ◀” is pressed, the flashing digit will be switched.

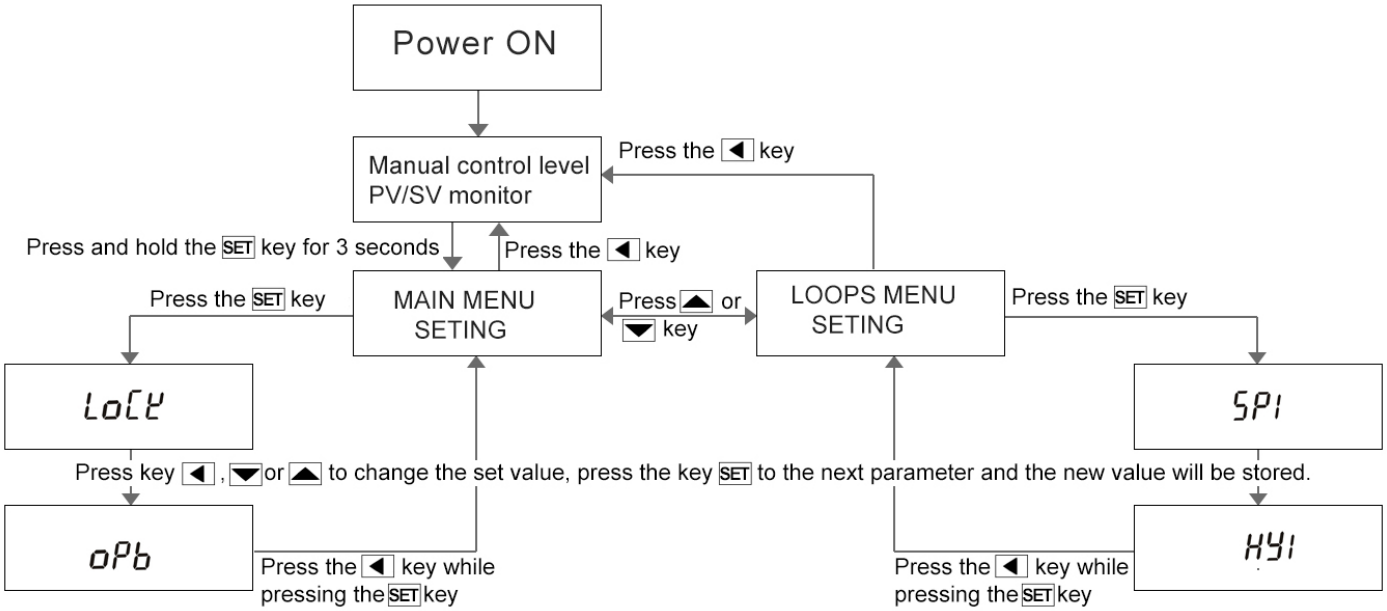
Press the “SET” key , the new value will then be saved.

Press the “↩” key while pressing the “SET” key for 1 seconds to go back to the PV/SV monitor

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

Attentions:

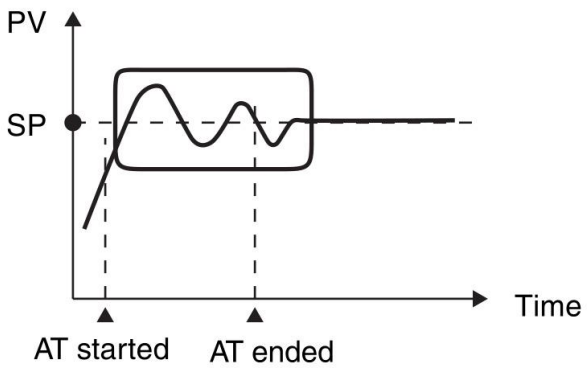
LOCK=0, parameters can be set. Otherwise parameters cannot be set.



5. 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 the set value (Sp) as the actual set value of customers, set the parameter HY as 0.5, then set the AT as on, in this time the controller enter into **Auto-tuning**. the CH2 display shows “AT” and set value, now meter’s control way is on-off mode, after 3 times vibrating(3 control period) automatic save P, I, D parameter, the self-adjusting procession finished. When AT is finished, the controller will restart automatically.



Attentions：

when **Auto-tuning**, the controller should not change the set value.

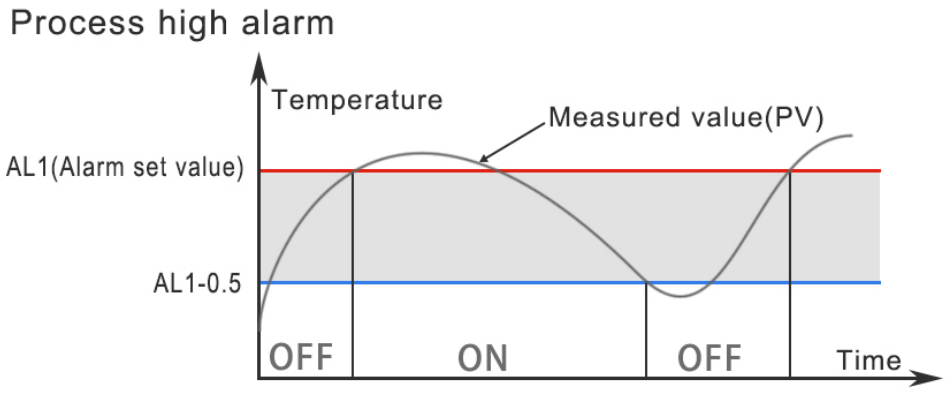
When the power off during **Auto-tuning**, it will restart **Auto-tuning** next time.

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.

6. Alarm (ALM1) function[optional]：

Take example for channel 1 alarm			
Alarm function		Alarm status[ON]	Alarm status[OFF]
Process high alarm	ALP=1	PV1 ≥AL	PV1< AL − ALMHY
Process low alarm	ALP =2	PV1 ≤AL	PV1> AL + ALMHY
Deviation high alarm	ALP =3	PV1 ≥SP + AL	PV1<SP + AL − ALMHY
Deviation low alarm	ALP =4	PV1 ≤SP − AL	PV1>SP − AL + ALMHY
Band alarm	ALP =5	PV1 ≤AL or PV1 ≥AL	AL + ALMHY< PV1<ALH − ALMHY
Out of band alarm	ALP =6	AL≤PV≤ALH	PV1< AL1 − ALMHY or PV1>ALH + ALMHY
difference high alarm	ALP =7	PV1 − PV2≥AL	PV1 − PV2<AL − ALMHY
difference low alarm	ALP =8	PV1 − PV2≤AL	PV1 − PV2>AL + ALMHY
PV1 PV2: measurement values, The parameters of 6: SP 8: ALH 9: AL 10: ALMHY 19: ALP refer to 3.Parameters			

[Example: Process high alarm]



7. Main output function：

Control action	Value	Description
PID control	OP=0	Heat PID control: direct action
PID control	OP=1	Cool PID control: reverse action
The following definitions(op>=2) only applicable for analog(4-20mA/0-10V) output.		
Transmission output	OP=2	-Analog signal of varying state of the Measured value (PV) is produced. -Determined by PBH and PBL
Example : Use 4 to 20 mA DC Current output for input range from 0 to 100 °C where output port is out1. 4 mA[Set the parameter of UtL as 4.0] is produced at 0 °C [Set the parameter of UtL as 0.0] 20 mA[Set the parameter of UtH as 20.0] is produced at 100 °C [set the parameter of PbH as 100.0] Setting parameters: OP1=2, PBL1=0, PBH1=100, UTH1=20.0, UTL1=4.0 Tip: -If the parameters OP1=2, PBL1=0, PBH1=100,UTH1=20.0,UTL=4.0,		

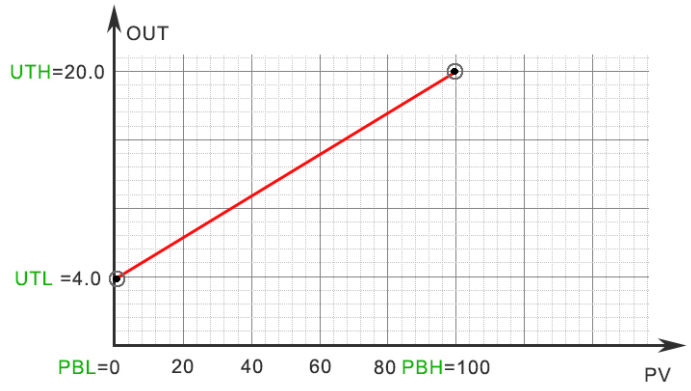
when the measured value of the channel 1 is 0°C, OUT1 output current is 4mA.

-If instead the parameters OP1=2, PBL1=100, PBH1=0, UTH1=20.0,UTL1=4.0,

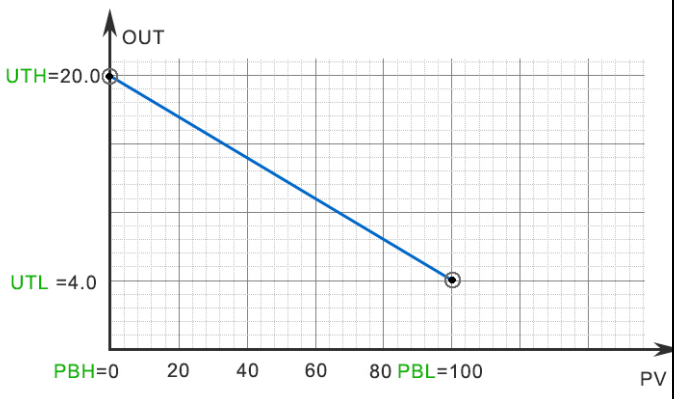
when the measured value of the channel 1 is 0°C , OUT1 output current is 20mA .

The graphic below shows the example above:

PBH>PBL: Forward transmission output



PBH<PBL: Reverse transmission output



Transmission output	OP=3	- Analog signal of varying state which is the maximum measured value in all the channels is produced. -Determined by PBH and PBL.

Example: The maximum measured value of all the channels is produced as 4-20mA on out1 whose range is 0 to 100 °C.

Setting parameters:

OP1=3, PBL1=0, PBH1=100, UTH1=20.0, UTL1=4.0

Tip:

when the maximum measured value of all channels is 50 °C ,

OUT1 output current is 12mA : (16mA/100)*50+4mA=12mA

Transmission output	OP=4	- Analog signal of varying state which is the minimum measured value in all the channels is produced -Determined by PBH and PBL
Transmission output	OP=5	-Analog signal of varying state which is the average measured value of all the channels is produced. -Determined by PBH and PBL
Transmission output	OP=6	-Voltage/Current signal of varying state which is the difference value between the channel 1 measured value and the channel 2 measured value is produce. -Determined by PBH and PBL.

Example: The difference value between the CH1 measured value and the CH2 measured value is produced as 4-20mA on out1 whose range is 0 to 100 °C.

Setting parameters:

OP1=6, PBL1=0, PBH1=100, UTH1=20.0, UTL1=4.0

Tip:

If OP1=6, PBL1=0, PBH1=100, UTH1=20.0,UTL1=4.0,

when CH1 measured value is 0 °C , CH2 measured value is 50 °C,

OUT1 output current is 4mA ,because PV1-PV2: 0-50=-50,-50 less than 0.

Transmission output	OP=7	-Voltage/Current signal of varying state which is absolute value of difference value between the channel 1 measured value and the channel 2 measured value is produce. -Determined by PBH and PBL.

Example: The absolute value of the difference value between the CH1 measured value and the CH2 measured value is produced

as 4-20mA on out1 whose range is 0 to 100 °C

Setting parameters:

OP1=7, PBL1=0, PBH1=100, UTH1=20.0, UTL1=4.0

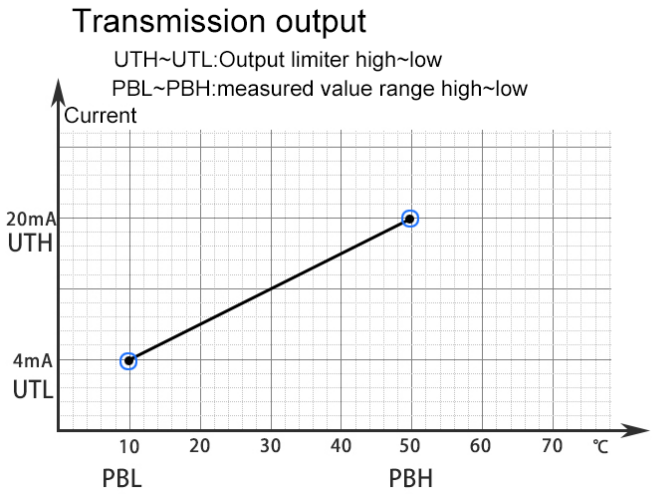
Tip:

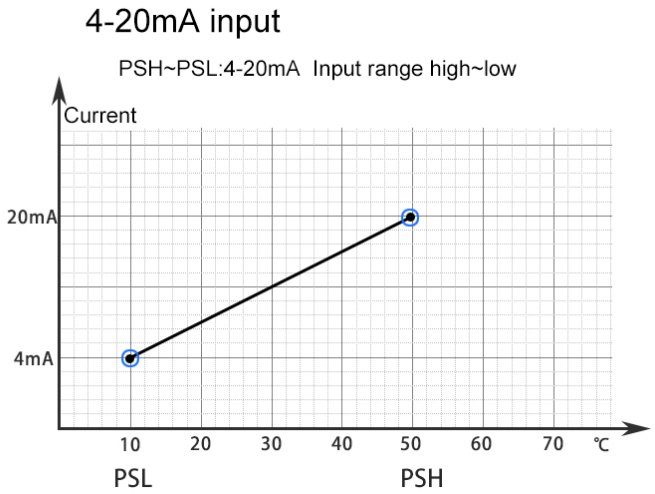
If OP1=7, PBL1=0, PBH1=100, UTH1=20.0,UTL1=4.0,

when CH1 measured value is 0 °C , CH2 measured value is 50 °C,

OUT1 output current is 12mA ,because absolute value of difference value between the CH 1 measured value and the CH 2 measured value is 50.

8. Transmission outputs and analogue inputs：





10. Host communication based on MODBUS-RTU protocol [OPTIONAL]

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 (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 **2. Message length of each function**

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 03H	Register address	Quantity The setting must be 1	CRC16
Example: The contents of the holding register 1001H are the read out from slave address 1. Query message: 01 03 10 01 00 01 D1 0A Response message: 01 03 02 **00 FD** 79 C5 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. Query message: 01 06 00 04 FF 38 88 29 Response message: 01 06 00 04 FF 38 88 29 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	PV1:1001H~PV4:1004H	44098~44101
Manipulated output (MV):	NO	PV1:1101H~ PV4:1104H	44354~44357
Alarm output	NO	PV1:1201H~ PV4:1204H	44610~44613
The first public parameters *(Refer to 5. Parameters)*			
LocK	NO	0000H	40001
SN	NO	0001H	40002
OPB	NO	0002H	40003
Addr	NO	0003H	40004
Baud	NO	0004H	40005
C F	NO	0005H	40006
The Parameters of channel 1 *(Refer to 3. Parameters)*			
SP1~ UTL1	-	0006H~001BH	40007~40028
The Parameters of channel 2 *(Refer to 3. Parameters)*			
SP2~ UTL2	-	001CH~0031H	40029~40050
The Parameters of channel 3 *(Refer to 3. Parameters)*			

SP3~ UTL3	-	0032H~0047H	40051~40072
The Parameters of channel 4 *(Refer to 3. Parameters)*			
SP4~ UTL4	-	0048H~005DH	40073~40094

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.

A	B	C	D	E	F	G	H	I	J	K	L	M
A	b	C	d	E	F	G	H	I	J	K	L	n
N	**O**	**P**	**Q**	**R**	**S**	**T**	**U**	**Y**				
n	o	P	q	r	S	t	u	y				

11. Model and Suffix Code

Specifications	Model and Suffix Code							
Model	KC	□	□	□	□	□	□	
SIZE	96×96mm panel cutout :92×92mm	MA						
Number of channel	4 channels input		LCD4					
Number alarm	No alarm			□				
	1 Alarm relay out for each channel			1				
Input Type	Thermocouple: K, E,J, R, S, T,RTD : Pt100, Cu50				W			
	DC voltage : 0 to 5V, 1 to 5V or Current 0 to 10 mA DC, 4 to 20 mA DC				A			
	Thermocouple, RTD, DC voltage or Current Fixed input type per channel				M			
Control output	Analog output (DC current:4-20mA DC) for PID or transfer output.					A		
	Relay output					R		
	Voltage pulse(for driving SSR)					G		
Power supply voltage	100 to 240V AC						□	
Communications	RS-485(2-wire system: MODBUS-RTU)							RS
	RS-232(3-wire system: MODBUS-RTU)							RX
	Measured value Data Logger							LG