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：current output(4-20mA)

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)

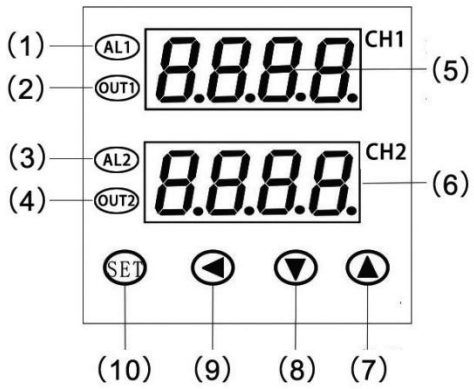
Can be output an alarm when the deviation, process value, set point, or manipulated value reaches a specified value.

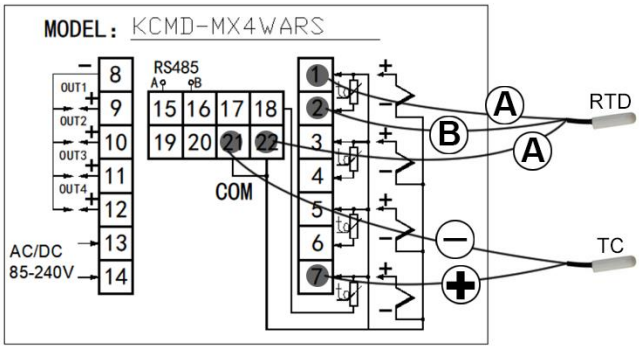
1.5.Use this controller within the following allowable range:

Allowable ambient temperature: −0 to +55 °C

Allowable ambient humidity: 5 to 85 % RH.

2. Parts Description:





This wiring diagram is offered for example purposes only.

Tip: Correct terminal arrangement depend on the actual model.

1 ALM1: lamp Lights when loop 1 Event occurs

2 Out1 lamp: Lights when loop 2 output is turned on

5 CH1 display: Displays loop 1 Measured value (PV1) or various Parameter symbols

7 Up key:

−Ramp/Soak Controller Increase numerals.

9Shift key: Shift digits when settings are changed.

3 ALM2 lamp: Lights when loop 2 Event occurs

4 Out2 lamp: Lights when loop 2 output is turned on

6 CH2 display: Displays loop 2 Measured value (PV2), or various Parameter set values.

8 Down key:

−Decrease numerals

10 Set (SET) key: Used for Parameter calling up and set value registration.

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	oPb	Communication	0:no output; 1:RS232 or RS485 MODBUS-RTU;	0-1	1
3	Addr	Device Address	Device address, can be set from 0 to 255	0～255	1
4	bAud	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	HY	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	HY-	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	Uo	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	PbH	Transmission high	Transmission Output limiter high	0～200	200
19	PbL	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	PSH	Range high	Input range high	P-SL～9999	1300
24	PSL	Range high	Input range low	-1999～P-SH	0
25	dP	Decimal point position	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	UtH	Output limiter high	The min value and max value of output current.	outL～200	200
27	UtL	Output limiter low		0～outH	0

4. Operation

4.1 Menu level switching

Press and hold the “SET” key for 3 seconds to go to the main Parameters (Main menu), the CH1 display shows “ Main ,” and the CH2 display shows “set”.

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

The flashing decimal point which digit can be set. Press ” ◀” key to go to a different digit. Every time the shift key ” ◀” is pressed, the flashing decimal point moves.

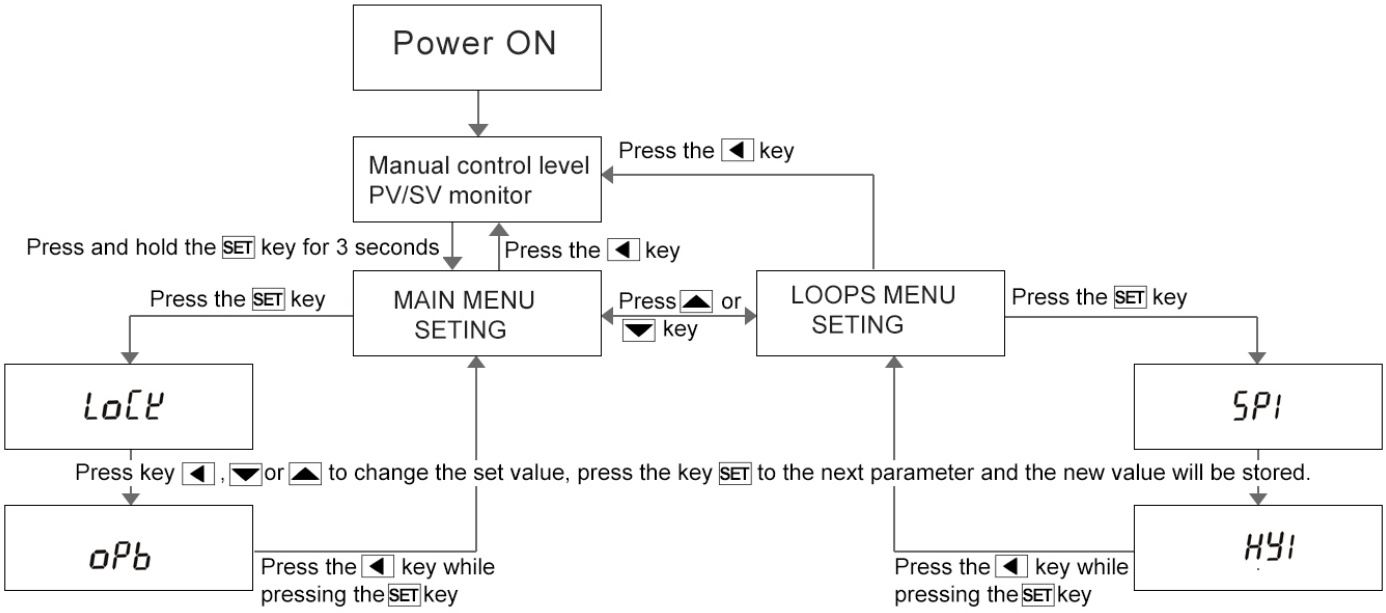
Press the “SET” key , the new value will then be saved and the display will move to the next parameter.

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:

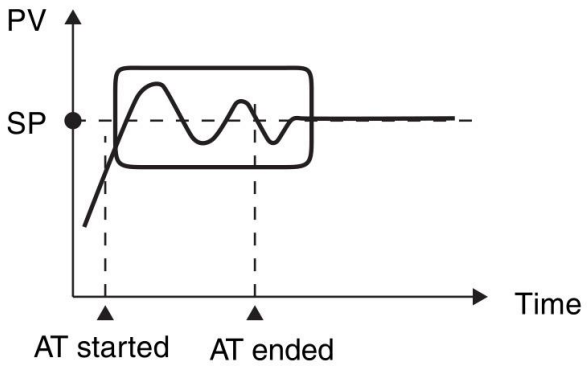
LOCK=0, parameters can be set. Otherwise parameters cannot be set.



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.

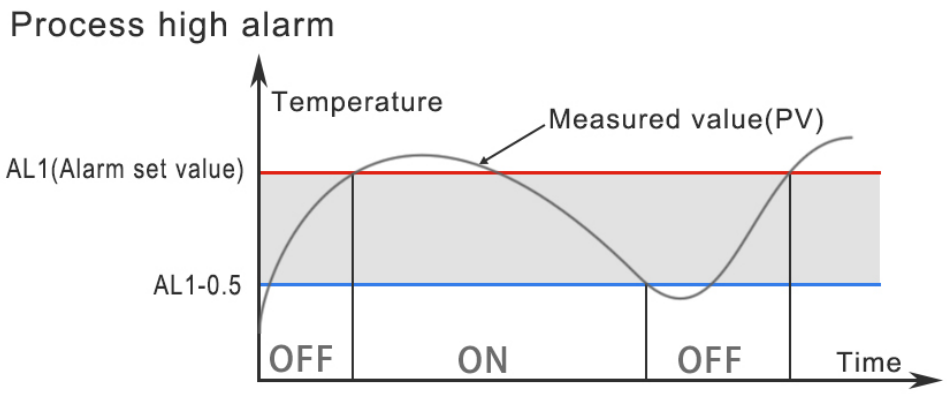
When it need artificially exit during **Auto-tuning**, set the Parameter(AT) to 0 so that can exit， but the setting

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	ALPI =1	PV1 ≥ AL-1	PV1 < AL-1 − HY-1
Process low alarm	ALPI =2	PV1 ≤ AL-1	PV1 > AL-1 + HY-1
Deviation high alarm	ALPI =3	PV1 ≥ SPI + AL-1	PV1 < SPI + AL-1 − HY-1
Deviation low alarm	ALPI =4	PV1 ≤ SPI − AL-1	PV1 > SPI − AL-1 + HY-1
Band alarm	ALPI =5	PV1 ≤ AL-1 or PV1 ≥ ALHI	AL-1 + HY-1 < PV1 < ALHI − HY-1
Out of band alarm	ALPI =6	AL-1 ≤ PV ≤ ALHI	PV1 < AL-1 − HY-1 or PV1 > ALHI + HY-1
difference high alarm	ALPI =7	PV1 − PV2 ≥ AL-1	PV1 − PV2 < AL-1 − HY-1
difference low alarm	ALPI =8	PV1 − PV2 ≤ AL-1	PV1 − PV2 > AL-1 + HY-1
PV1 PV2: measurement values, The parameters of 6: SPI 8: ALHI 9: AL-1 10: HY-1 19: ALPI 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
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,

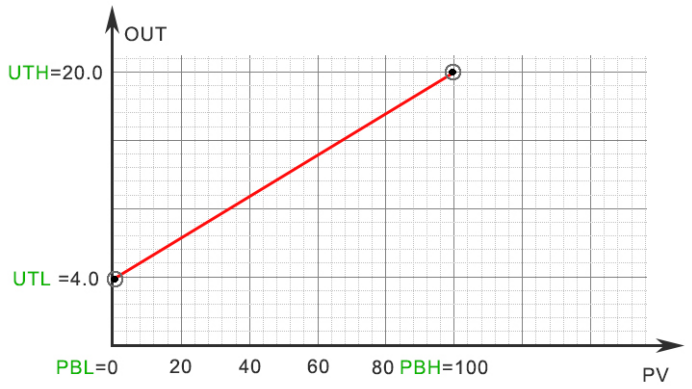
when the measured value of the channel 1 is 0°C, OUT1 output current is 4mA.

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

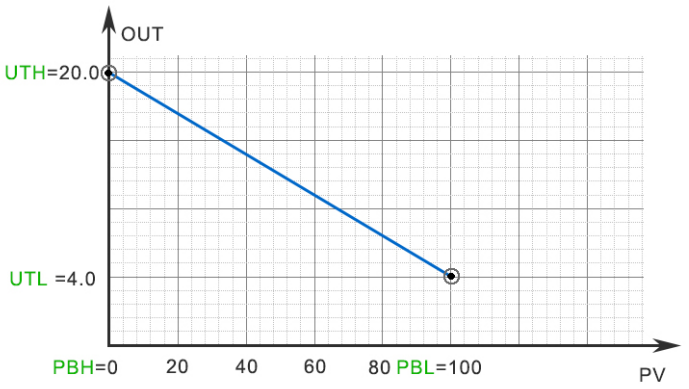
when the measured value of the channel 1 is 0°C , OUT1 output current is 20mA .

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 of the maximum measured value of 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 of the minimum measured value of all the channels is produced. -Determined by PBH and PBL
Transmission output	OP=5	-Analog signal of varying state of 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 of 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 of 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:

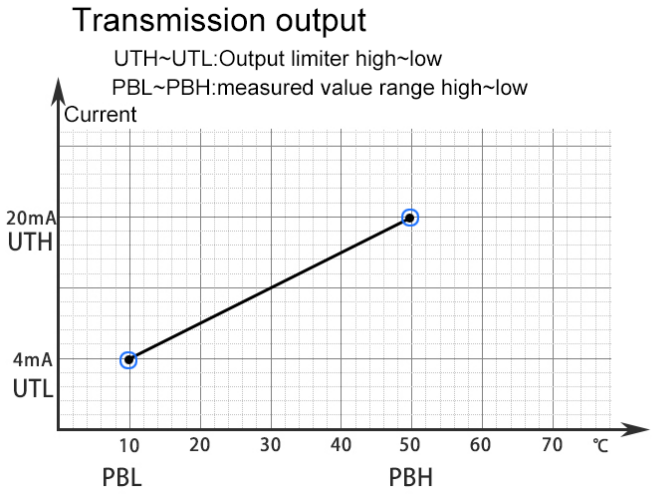
OP1=7, PBL1=0, PBH1=100, UTH1=20.0, UTL1=4.0

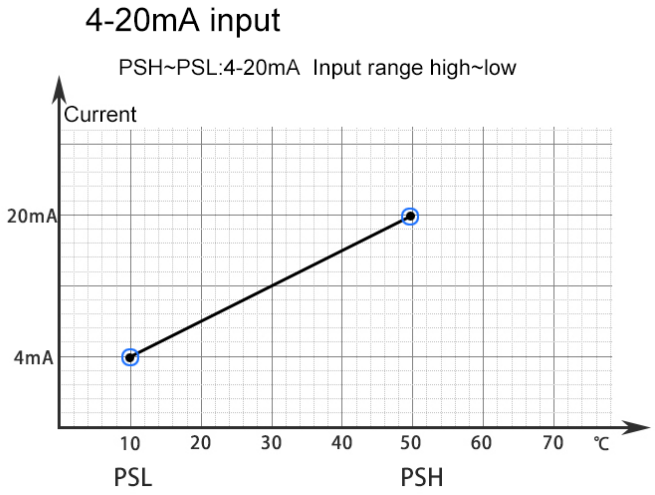
Tip:

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	160×80mm panel cutout :152×76mm	M						
	96×96mm panel cutout :92×92mm	MA						
	72×72mm panel cutout :68×68mm	MD						
	48×48mm panel cutout :44×44mm	MG						
	96×48mm panel cutout :92×44mm	MF						
	88×107×59mm DIN 35 rail mounting socket	MR						
Number of channel	2 channels input		MX2					
	4 channels input		MX4					
	5 channels input (size: 160×80mm)		MX5					
	6 channels input (size: 160×80mm)		MX6					
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		
Power supply voltage	100 to 240V AC						□	
	24V DC						1	
Communications	RS-485(2-wire system: MODBUS-RTU)							RS
	RS-232(3-wire system: MODBUS-RTU)							RX
	Measured value Data Logger							LG