LCM-4TC

User manual

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1. Introduction

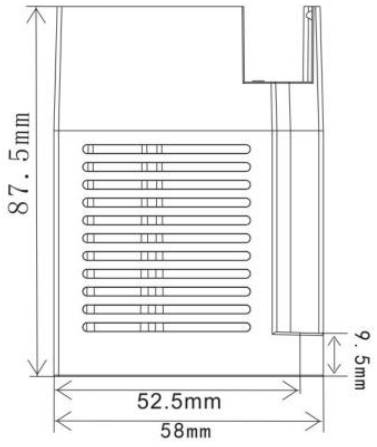
LCM-4TC expansion module amplifies the signal from four thermocouple sensors (Type K or J) and converts the data into 12 bit value stored in the main unit. Both Centigrade (°C) and Fahrenheit (°F) can be read.

Reading resolution is 0.2°C/0.72°F of Type K and 0.3°C/0.54°F of Type J.

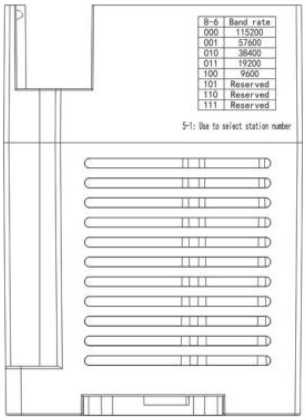
All data transfers and parameter settings are adjusted via modbus. LCM-4TC consumes 35mA current from LX3V main unit or active extension unit's 5V power supply slot. Thermocouples with the following specifications can be used: Type K, Type J.

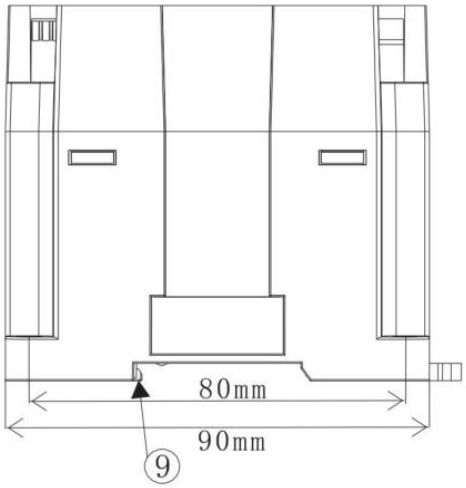
2. Dimensions

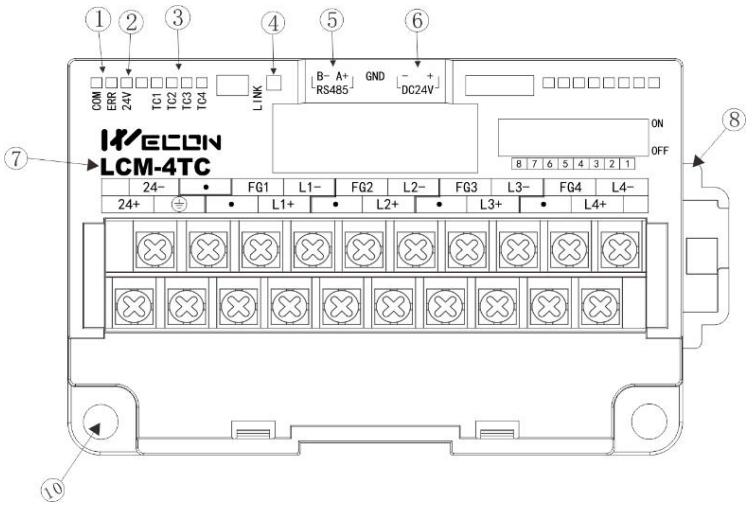
Weight: Approx 0.3kg



Dimensions: mm



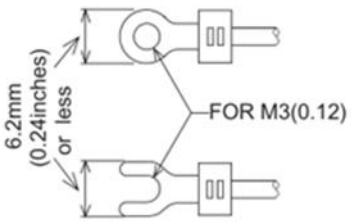




① COM: Communication & acquisition board comm. Indicator
ERR: Channel calibration indicator
② 24V: 24V indicator
③ TC: Four channel input/output indicators
④ LINK: RS485 comm. indicator
⑤ 485 comm. terminal
⑥ DC24V power supply
⑦ Name of extension module
⑧ DIN rail mounting slot
⑨ DIN rail hook
⑩ Mounting holes (ϕ4.5)

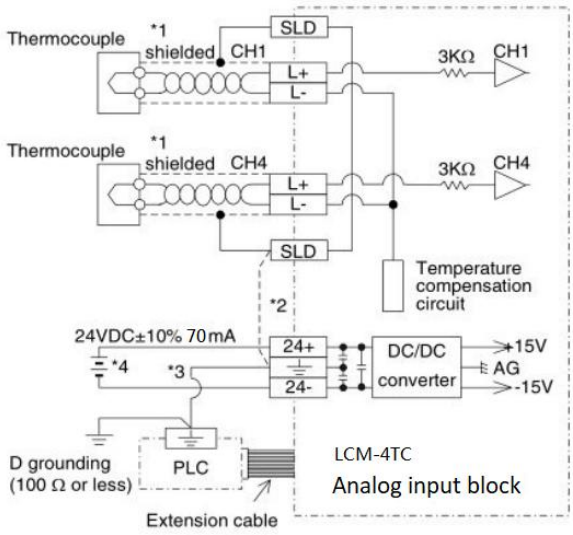
Name	Description	Indicator state	State
LINK indicator	RS485 comm. indicator	Blink	Normal
		OFF	Comm.is abnormal or failed
		ON	Software is running abnormally or hardware failure
COM indicator	Communication & acquisition board comm. indicator	Blink	Normal
		OFF	Data exchanging is abnormal or failed or stop
		ON	Software is running abnormally or hardware failure
TC indicator	Input/output indicators	Blink	Analog input is over range
		OFF	Analog input is in range
		ON	Channel is closed
ERR indicator	Channel calibration indicator	OFF	Calibrate successfully
		ON	Calibration failed or not calibrated

2.1 Terminal



- Be sure to use the terminals that fits the dimensional requirements.
- Apply 0.5 to 0.8 N.m (5 to 8 kgf.cm) torque to tighten the terminals
- Other terminals should be empty but only wiring terminals mention in this manual.

3. Wiring



1) The compensating cables that can be used for connecting with the thermocouple are listed as below:
Type K: KX-G, KX-GS, KX-H, KX-HS, WX-G, WX-H, VX-G
Type J: JX-G, JX-H
For every 1Ω of line resistance, the compensating cable will indicate a temperature 0.12°C higher than actual.
Check the line resistance before using.
Long compensating cables are more prone to noise interference.

Therefore a short (less than 100m) compensating cable is recommended.
Unused channels should have a wire link connected between the + and – terminals to prevent an errors being detected on that channel.

2) If there is excessive electrical noise, connect the FG terminal to the ground terminal on the unit.
3) Connect the ground terminals of the LX3V-4TC module and the PLC.
4) The built-in 24V DC supply of the PLC can be used as the power supply.

4. Installation

4.1 Environmental specification

Item	Specification
Environmental specifications	Same as LX3V plc unit
Insulation withstand voltage	500V AC, 1min (between all terminals and ground)

4.2 Power supply specification

Item	Description
Analog circuits	24V DC±10%, 70mA
Digital circuits	5V DC, 35mA(Main unit internal power supply)

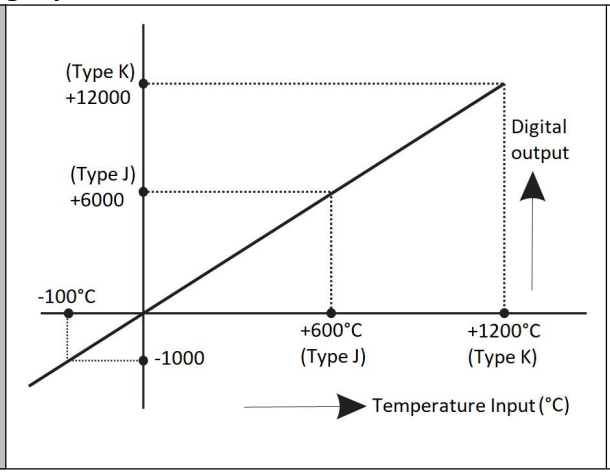
4.3 Performance indicator

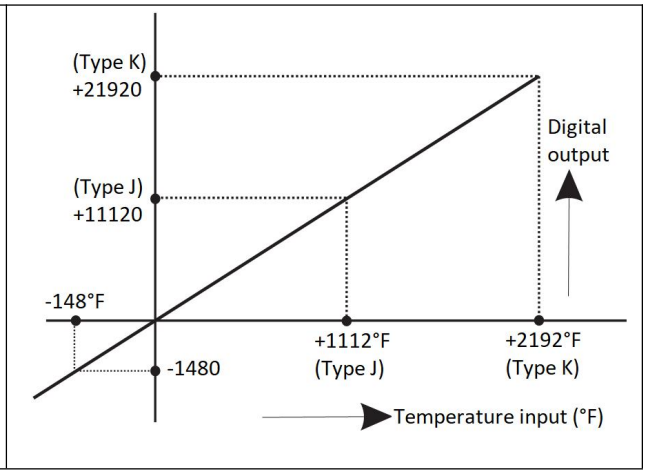
Item	Centigrade		Fahrenheit	
	Both °C and °F readings are available by reading the appropriate buffer memory area.			
Analog input signal	Thermocouple: Type K or J (either can be used for each channel), 4 channels.			
Rated temperature range	Type K	-100°C to 1200°C	Type K	-148°F to +2192°F
	Type J	-100°C to 600°C	Type J	-148°F to +1112°F
Digital output	Type K	-1000 to 12000	Type K	-1480 to 21920
	Type J	-1000 to 6000	Type J	-1480 to 11120
	12-bit conversion ,save as complement of 2 in 16 bits			
Resolution	Type K	0.4°C	Type K	0.72°F
	Type J	0.3°C	Type J	0.54°F
Overall accuracy	±5% full scale + 1°C Freezing point of pure water 0°C / 32°F			
Conversion speed	(240ms ± 2%) × 4 channels (unused channels are not converted)			

Note: Grounded thermocouples are not suitable for this module.

Analog input

Feature Conversion





Other

Item	Description
Isolation	Photo-coupler isolation between analog and digital circuits. DC/DC converter is used to isolate LCM-4TC and the LX3V main unit. No isolation between analog channels.
Occupied I/O points	8 points taken from the LX3V expansion bus (can be either inputs or outputs)

4.4 Buffer memory (BFM)

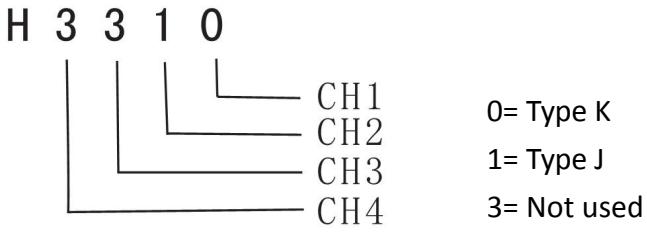
BFM	Description
*#0	Thermocouple Type K or J selection mode. Default value: H0000
*#1→ #4	Number of samples for each channel (1 to 4,096) Default = 8
#5→ #8	CH1 to CH4 Averaged temperature in 0.1°C units
#9→ #12	CH1 to CH4 Present temperature in 0.1°C units
#13→ #16	CH1 to CH4 Averaged temperature in 0.1°F units
#17→ #20	CH1 to CH4 Present temperature in 0.1°F units
#21→ #27	Reserved
#28	Digital range error latch
#29	Error status
#30	Identification code K6030
#31	Software version

- The LCM-4TC module communicates with the PLC via buffer memories.
- BFMs #21 to #27 and #31 are reserved. All non-reserved BFMs can be read by the PLC using the FROM instruction.
- BFMs (buffer memories) marked with an "*" means it can be written with the modbus function code 0x06 or 0x10.

1) Buffer Memory BFM #0: Thermocouple Type K or J selection mode

BFM #0 is used to select Type K or J thermocouples for each channel. Each digit of a 4 digit hexadecimal number corresponds to one channel, the least significant digit corresponds to channel 1.

Example



- A/D conversion time is 240ms per channel. When "3" (unused) is set for a channel, A/D conversion is not executed for that channel, therefore, the total conversion time is decreased. In the above example, the conversion time is as follows:
  240ms (conversion time per channel) × 2channels (number of channels used) = 480ms (total conversion time)

2) Buffer Memory BFMs #1 to #4: Number of samples for each channel

When number of samples for each channel (BFMs #1 to #4) is done, the averaged data is stored

in BFMs #5 to #8 (°C) and #13 to #16 (°F). The range of BFMs #1 to #4 is 1~256. If a value outside of this range is entered, the default value 8 will be used.

3) Buffer Memory BFMs #9 to #12 and #17 to #20: Present temperature

These BFMs store the present value of the input data. This value is stored in units of 0.1°C or 0.1°F, but the resolution is only 0.4°C or 0.72°F for Type K and 0.3°C or 0.54°F for Type J.

4.5 States information

1) Buffer memory BFM#28: Digital range error latch

BFM #29 b10 (digital range error) is used to judge whether the measured temperature is within the unit's range or not.

BFM #28 latches the error status of each channel and can be used to check for thermocouple disconnection.

b15 or b8	b7	b6	b5	b4	b3	b2	b1	b0
Not used	High	Low	High	Low	High	Low	High	Low
	CH4		CH3		CH2		CH1	

Low: Turn ON when temperature goes below the lower limit.

High: Turn ON when temperature goes above the upper limit, or when a thermocouple is disconnected.

When an error occurs, the temperature data is latched. If the measured value returns to valid range then the temperature will show as usual. (Note: The error remains latched in (BFM #28))

An error can be cleared by writing K0 to BFM #28 using the TO instruction or turning off the power.

2) Buffer memory BFM#29: Error states

BFM#29 Bit device	ON	OFF
b0: Error	When any of b1 to b3 is ON,A/D conversation is stopped for the error channel	No error
b1: Reserved	Reserved	Reserved
b2: Power error	24V DC power supply failure	Power supply is normal
b3: Hardware error	A/D converter or other hardware failure	Hardware is normal
b4 to b9: Reserved	Reserved	Reserved
b10: Data range error	Digital output/analog input value exceeds the range.	Digital output value is normal
b11: Averaging error	Selected number of averaged results exceeds the available range. See BFM#1 to #4	Averaging is normal (between 1 to 256)
b12 to b15: Reserved	Reserved	Reserved

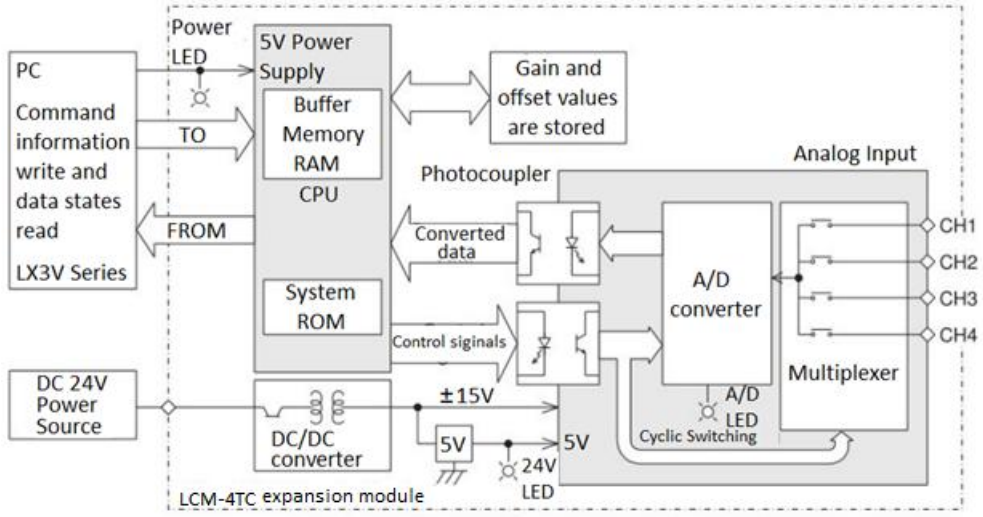
3) identification Code Buffer Memory BFM #30

The identification code or ID number for module is read from buffer memory BFM #30 using the FROM command.

This identification code for the LCM-4TC unit is K6030.

The PLC can use this identification code to identify the expansion module before communicate with the expansion module.

5. System block diagram



6. MODBUS settings

6.1 Com port communication configuration

Com port comm. configuration	
Station No.	1~32 (Adjust by DIP switch)
Baud rate	9600~115200 (Adjust by DIP switch)
Stop bit	1
Data bit	8
parity	even

6.2 Communication

The communication protocol is Modbus, support function codes 03 (read holding register), 06 (write single register), and 16 (write multiple registers).

1) 0x03 function code description

Request (send from master)

Slave address	1 byte	Slave station No.
Function code	1 byte	0x03
Start address	2 bytes	0x0000 to 0xFFFF
Register No.	2 bytes	1 to 125
CRC	2 bytes	CRC of all the above data

Respond (reply from slave)

Slave address	1 byte	Slave station No.
Function code	1 byte	0x03
Byte number	1 byte	2*N
Register value	N*2 bytes	
CRC	2 bytes	CRC of all the above data

Note: N is the number of register.

Error (reply from slave)

Slave address	1 byte	Slave station No.
Error code	1 byte	0x83
Exception code	1 byte	01 (not support this function code) 02 (Address over range)
CRC	2 bytes	CRC of all the above data

Example: reading the value of the holding register (0x0000-0x0001) from slave (station No. 0x0f)

Send from master		**Reply from slave**	
Slave address	0x0F	Slave address	0x0F
Function code	0x03	Function code	0x03
Holding register high byte	0x00	Byte number	0x04
Holding register low byte	0x00	High byte of register 0	0x00
High byte of read No.	0x00	low byte of register 0	0x0F
Low byte of read No.	0x02	High byte of register 1	0x00
CRC low byte	0xC5	low byte of register 1	0x01
CRC high byte	0x25	CRC low byte	0xE4
		CRC high byte	0x30

2) 0x06 function code description

Request (send from master)

Slave address	1 byte	Slave station No.
Function code	1 byte	0x06
Start address	2 bytes	0x0000 to 0xFFFF
Register value	2 bytes	0x0000 to 0xFFFF
CRC	2 bytes	CRC of all the above data

Reply (reply from slave)

Slave address	1 byte	Slave station No.
Function code	1 byte	0x06
Register address	2 bytes	0x0000 to 0xFFFF
Register value	2 bytes	0x0000 to 0xFFFF
CRC	2 bytes	CRC of all the above data

Error (reply from slave)

Slave address	1 byte	Slave station No.
Error code	1 byte	0x86
Exception code	1 byte	01 (not support this function code) 02 (Address over range)
CRC	2 bytes	CRC of all the above data

Example: writing 0x001 to address 0x00A from slave(station No. 0x0f)

Send from master		**Reply from slave**	
Slave address	0x0F	Slave address	0x0F
Function code	0x06	Function code	0x06
Holding register high byte	0x00	Register High byte	0x00
Holding register low byte	0x0A	Register low byte	0x0A
High byte of register value	0x00	High byte of register value	0x00
Low byte of register value	0x01	low byte of register value	0x01
CRC low byte	0x69	CRC low byte	0x69
CRC high byte	0x26	CRC high byte	0x26

3) 0X10 Function code description

Request (send from master)

Slave address	1 byte	Slave station No.
Function code	2 bytes	0x10

Start address	2 bytes	0x0000 to 0xFFFF
Register No.	2 bytes	0x0001 to 0x0078
Byte No.	1 byte	2*N
Register value	N*2 bytes	VALUE
CRC	2 bytes	CRC of all the above data

Reply (reply from slave)

Slave address	1 byte	Slave station No.
Function code	1 byte	0x01
Starting address	2 bytes	0x0000 to 0xFFFF
Register No.	2 bytes	1 to 123
CRC	2 bytes	CRC of all the above data

Error (reply from slave)

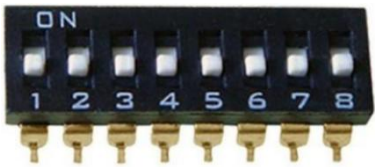
Slave address	1 byte	Slave station No.
Error code	1 byte	0x90
Exception code	1 byte	01 (not support this function code) 02 (Address over range)
CRC	2 bytes	CRC of all the above data

Example: writing 0x001 to address 0x00A from slave (station No. 0x0f)

Send from master		**Reply from slave**	
Slave address	0x0F	Slave address	0x0F
Function code	0x06	Function code	0x06
Start address High byte	0x00	Start address High byte	0x00
Start address low byte	0x0A	Start address low byte	0x0A
High byte of register No.	0x00	High byte of register No.	0x00
low byte of register	0x02	low byte of register	0x02
Byte No.	0x04	CRC low byte	0x29
High byte of register 0	0x00	CRC high byte	0x27
low byte of register 0	0x01		
High byte of register 1	0x00		
low byte of register 1	0x02		
CRC Low byte	0x76		
CRC Low byte	0xB3		

6.3 Introduction of DIP switch

1) DIP switch introduction



8-6	Baud rate
000	115200
001	57600
010	38400
011	19200
100	9600
101	Reserved
110	Reserved
111	Reserved

5-1: Use to select station number

Figure 6- 1 DIP switch

Note:

In practical use, the dial switch is ON (1) downward and OFF (0) upward. As shown in the figure, the status of the DIP switch is downward, all are ON.

2) DIP switch and station setting

In practical use, the # 1 to # 5 of the DIP switch is used for the selection of the module station number, and the relationship between the station number and the 1 # 5 dial number switch is shown in the following table:

#1 DIP switch	#2 DIP switch	#3 DIP switch	#4 DIP switch	#5 DIP switch	Module station
0	0	0	0	0	1
1	0	0	0	0	2
0	1	0	0	0	3
1	1	0	0	0	4
0	0	1	0	0	5
1	0	1	0	0	6
0	1	1	0	0	7
1	1	1	0	0	8
0	0	0	1	0	9
1	0	0	1	0	10
0	1	0	1	0	11
1	1	0	1	0	12
0	0	1	1	0	13
1	0	1	1	0	14

0	1	1	1	0	15
1	1	1	1	0	16
0	0	0	0	1	17
1	0	0	0	1	18
0	1	0	0	1	19
1	1	0	0	1	20
0	0	1	0	1	21
1	0	1	0	1	22
0	1	1	0	1	23
1	1	1	0	1	24
0	0	0	1	1	25
1	0	0	1	1	25
0	1	0	1	1	27
1	1	0	1	1	28
0	0	1	1	1	29
1	0	1	1	1	30
0	1	1	1	1	31
1	1	1	1	1	32

3) DIP switch and baud rate setting

In practical use, the #6 to #8 of the DIP switch are used for the selection of the baud rate, and the relationship between the baud rate and #6-# 8 DIP switch is shown in the following table:

#6 DIP switch	#7 DIP switch	#8 DIP switch	Module baud rate
0	0	0	115200
1	0	0	57600
0	1	0	38400
1	1	0	19200
0	0	1	9600
1	0	1	Reserved for later expansion (Default: 115200)
0	1	1	Reserved for later expansion (Default: 115200)
1	1	1	Reserved for later expansion (Default: 115200)

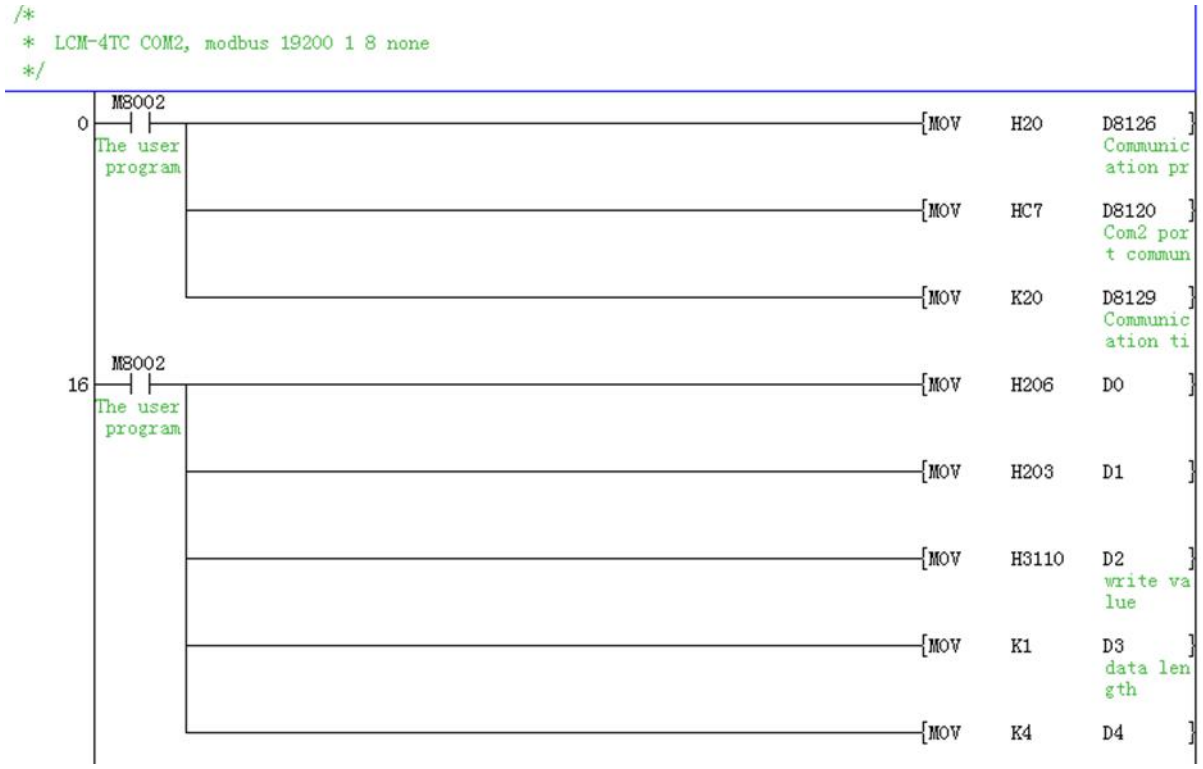
6.4 Note

LCM-4TC and LX3V-4TC differentiate in communication method, but the register functions are the same.

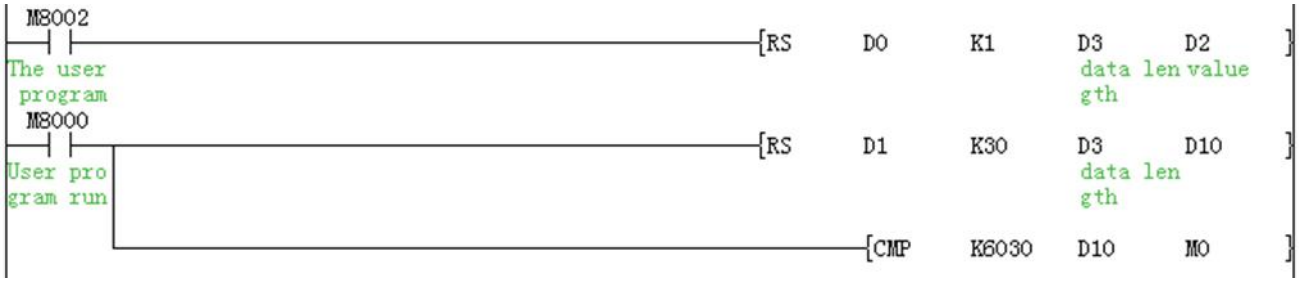
Module	Max. accessible address (BFM address)
4TC	31

7. Exmaple

The following example set the station number as 2, baud rate as 115200 via the DIP switch. Type K thermocouple is used for CH1, Type J thermocouple is used for CH2, CH3 and CH4 are not used. The average number is 4. The average values (°C) of the input channels CH1 to CH4 are stored in the data registers D20 to D23 respectively.



Above demo means plc com2 is Modbus master, communication parameter is 115200, 1, 8, even.

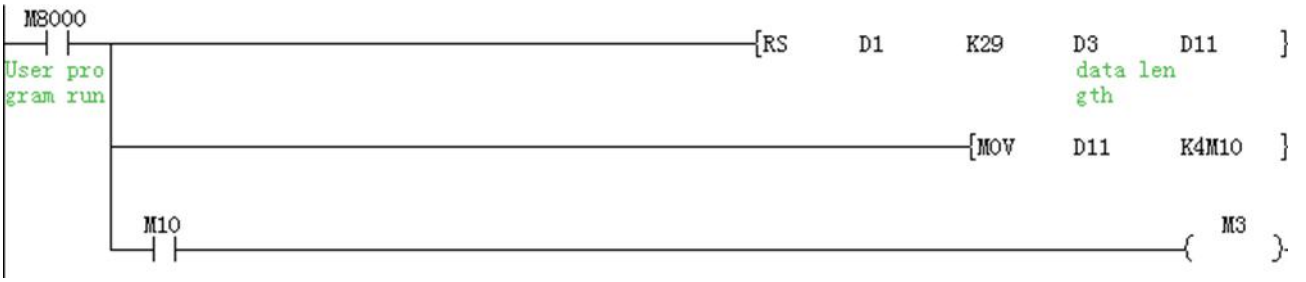


Thermocouple type is definded by BFM0, here is H3310.

CH4: closed (3) , CH3: closed(3), CH2: type J(1), CH1: type K(0)

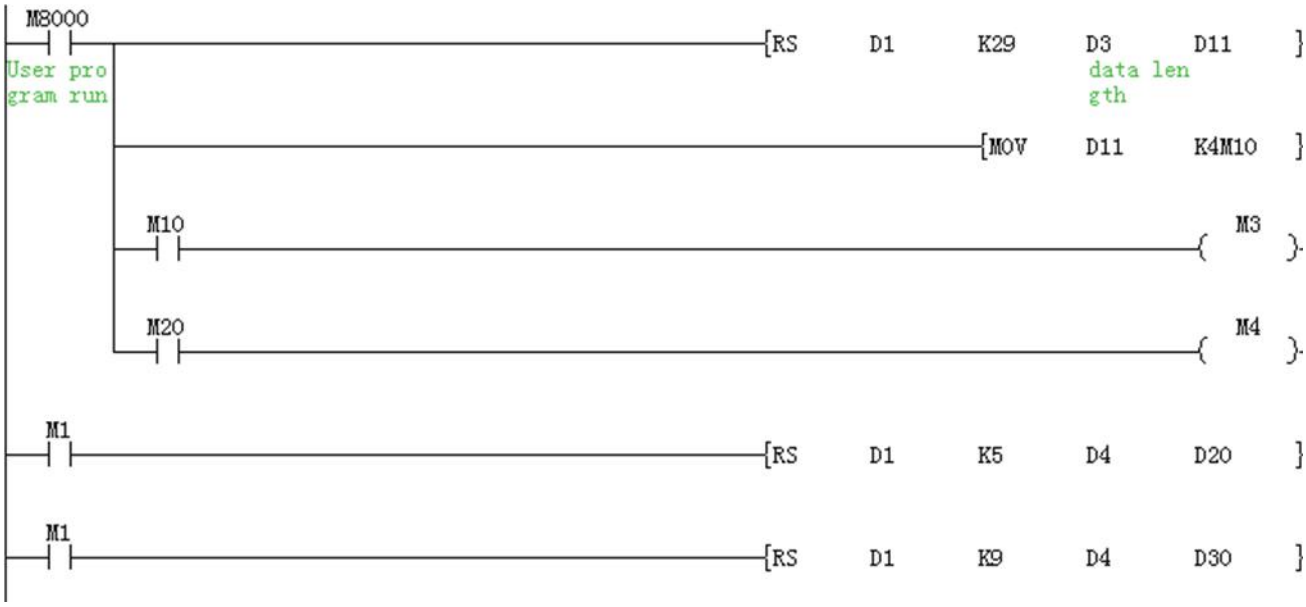
D10 reads from the BFM30, when D10=K6030, then m1=ON. It is not compulsory to check BFM30 in the program.

If the module with checkpoint number 2 is LCM-4TC in the initialization step, that is, if its unit identification code is K6030 (BFM#30). This step is optional, but it provides a way for software to check that the system is configured correctly.



BFM29 (K4M10) assign value to m25~m10. When there is an error, m10=1. M10 is the bit0 of BFM 29.

This step provides optional monitoring of the error buffer memory (#29) of LCM-4TC. If there is an error in LCM-4TC, bit0 of BFM#29 will be set to ON. This can be read by this program step and output as a bit device in an LX3V programmable controller (M3 in this case). Additional error devices can be output in the same way, such as b10 for BFM#29. (see below)



M3 is the b0 of BFM#29, M4 is the b10 of BFM#29.

BFM#5 to BFM#8 is stored in D0 to D3 in the unit of ℃ as an average temperature.

The last line is for reading the average temperature and stored in D30~D33.

8. Diagnosis

8.1 Preliminary examination

1) Check if the input/output wiring and/or extension cable are connected to the LCM-4TC module.
2) Check if the number of special functions modules exceeds 16, and the total number of system I/O points cannot exceed 256 points.
3) Ensure that the correct operating range is selected in the program.
4) Check that there is no power overload in the 5V or 24V power supply.
5) The LX3V main unit is at the RUN state.

8.2 check error

If LCM-4TC does not work properly, please check the following items.

- Check the status of the power LED
  ON: the extension cable is properly connected
  Otherwise: Check the connection of the extension cable.
- Check external wiring
- Check the status of the "24V" LED (upper right corner of the LCM-4TC)
  ON: The LCM-4TC is normal and the 24VDC power supply is normal.
  Otherwise: The 24V DC power supply may be faulty. If the power supply is normal, the LCM-4LTC is faulty.
- Check the status of the “A/D” LED (upper right corner of LCM-4TC)
  Lit: A/D conversion works normally.
  Otherwise: Check buffer memory #29 (error status). If any of the bits (b2 and b3) are in the ON state, which is why the A/D indicator is off.

9. EMC

- Electromagnetic compatibility or EMC must be considered before using the LCM-4TC.
- WECON recommends that the thermocouple sensors used, should be fitted with a form of seild or screening as protection against EMC noise.
- If some form of cable protection is used, the “Shield” must be terminated at the terminals as shown in chapter 3.

- Because of the delicate nature of all analog signals, failure to take good EMC precautions could lead to EMC noise induced errors; up to ±10% of actual values. This is an absolute worst case figure, users who do take good precautions can expect operation within normal tolerances. EMC considerations should include selection of good quality cables, good routing of those cables away from potential noise sources.
- Additionally it is recommended that signal averaging is used as this will reduce the effects of random noise “spikes”

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