LX3V-8ITC

User manual

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1. Brief Introduction

Connect LX3V-8iTC to the LX Series Programmable Controller (PLC), then LX3V - 8iTC consumes the 90mA current from LX3V main unit or 5V power slot of the active expansion unit.

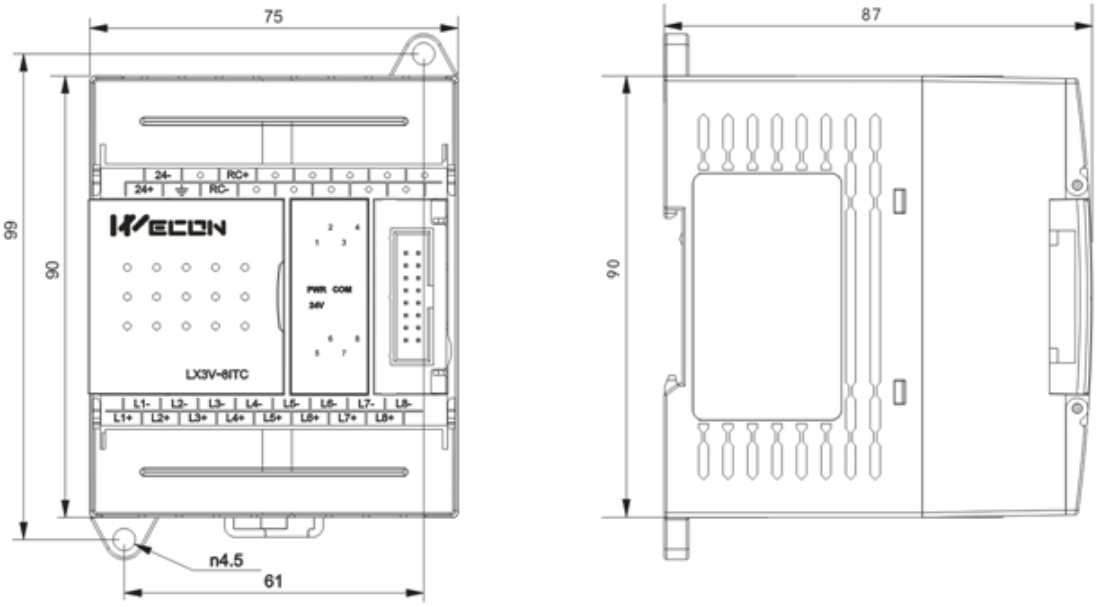
LX3V-8iTC temperature control module amplifies the input signals from eight thermocouple sensors, and converts data into 14-bit readable data to store in the main processing unit (MPU). The temperature is readable in degrees Celsius or Fahrenheit.

All data transfer and parameter settings can be adjusted by WECON PLC Editor software; FROM / TO instruction can be used for reading and writing data.

As input sensor, the eight channels are free to match with any one of the thermocouple K, J, T, E, N, B, R, S type when eight thermocouple input points are in use.

The channels are isolated from one another.

2. Dimension

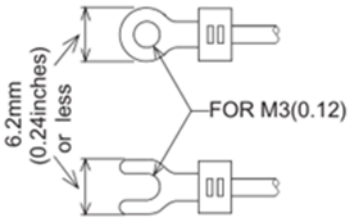


- **POW Lamp:** Module power lamp. Be always on in normal condition; flash in case of hardware

error, communication error or the power supply of acquisition board error; be off when the acquisition board is not calibrated.

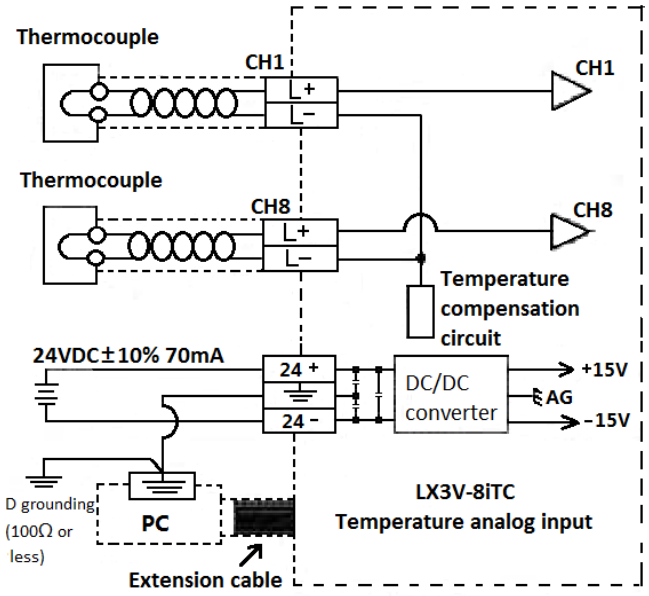
- **COM Lamp:** Be always on when digital transmission is normal; be off when the acquisition board is powered off or fails to communicate with the communication board.
- **24V Lamp:** Be always on when connected to external power supply.
- **Channel Lamp:** Be always on when the temperature is normal; be off when the channel is closed; flash in case of over-limit temperature, hardware error, communication error or power error.

Terminal	Description	Terminal	Description
24V+	Connect to the positive terminal of 24V power supply	L+	Connect to the positive signal wire of thermocouple
24V-	Connect to the negative terminal of 24V power supply	L-	Connect to the negative signal wire of thermocouple



- Use the crimp terminals that meet the dimensional requirements showed in the left figure.
- Apply 0.5 to 0.8 N.m (5 to 8 kgf.cm) torque to tighten the terminals against disoperation.
- Wire only the module terminals in this manual, keep others blank.

3. Wiring



(1) The temperature compensation cable connected to thermocouple is as follows:

Type K: DX-G, KX-GS, KX-H, KX-HS, WX-G, EX-H, VX-G

Type J: JX-G, JX-H

Type S: SC-G, SC-H

Type N: NC-G,NC-H

Type E: EX-G, EX-H

Type T: TX-G, TX-H

Type B: BC-G, BC-H

Type R: RC-G, RC-H

For line impedance per ohm, the compensation cable indicates that it is 0.12 ° C above the actual value. Check the line impedance before use, and the long compensation cables are susceptible to noise, so compensating cables shorter than 100 meters are recommended.

(2) The ground terminal, which connects LX3V-8iTC and the main unit, uses the 3rd level grounding on the main unit.

(3) The 24V built-in power supply of the programmable controller can be used as the power supply for this unit.

Precautions when wiring:

1) Before installation or wiring, make sure to cut off the external power supply of each phase, for it may cause electric shock or equipment damage if the power supply is not cut off.
2) Make sure to interlock external loads outside PLC and LX3V and through the PLC program, for it may be dangerous when they are connected simultaneously.
3) Connect the LX3V-8iTC and PLC power supply properly according to the instructions in this manual. If the AC power is connected to the DC I / O terminal or the DC power supply terminal, the PLC may be destroyed.
4) Do not connect external wiring to the terminals not used on LX3V-8iTC and PLC, for this connection may damage the device.

4. Installation Instructions

4.1 Environmental indicators

Items	Instructions
Environmental indicators (not including the following intentions)	Same as LX series PLC unit
Isolation Voltage	500VAC for 1 minute (between all terminals and ground)

4.2 Power indicators

Items	Instructions
Analog circuit	24VDC ±10%，50mA
Digital circuit	5V DC, 90mA (From main unit's internal power supply)

4.3 Performance specification

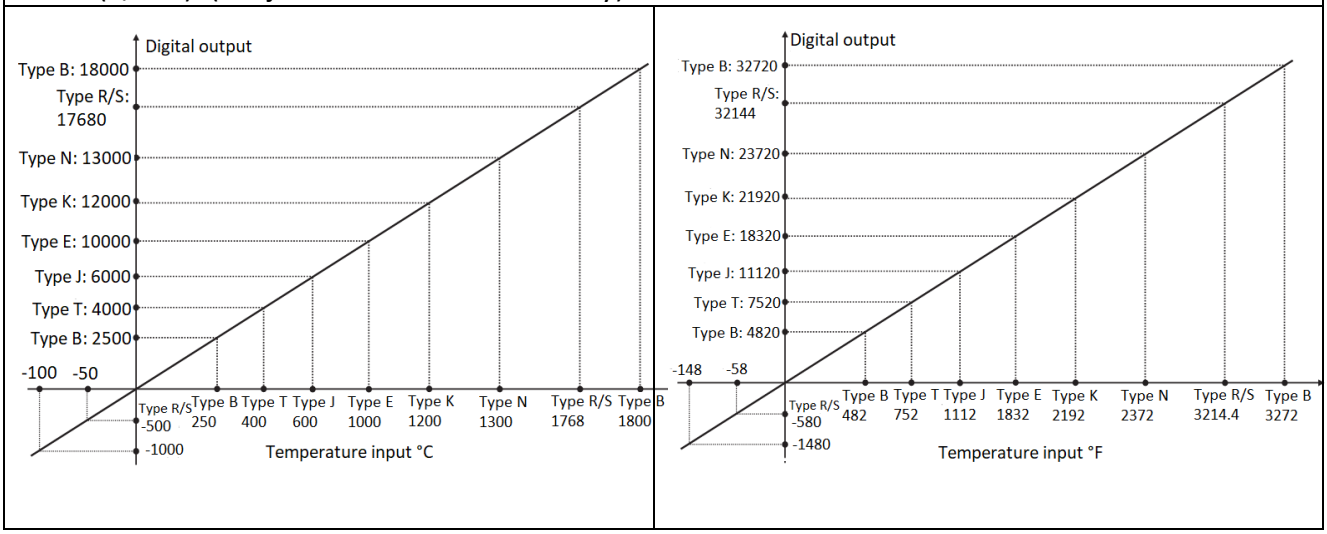
Items	Celsius (°C)		Fahrenheit (°F)	
	Get two kinds of readable data °C and °F by reading appropriate buffer memory.			
Input signal	Thermocouple: Type K, J, T, E, N, B, R, S (use each channel arbitrarily), totally 8 channels as signal input source.			
Rated temperature range	Type K	from -200 °C to 1372 °C	Type K	from -328 °F to 2501 °F
	Type J	from -210 °C to 600 °C	Type J	from -346 °F to 1112 °F
	Type T	from -200 °C to 400 °C	Type T	from -328 °F to 752 °F
	Type E	from -200 °C to 1000 °C	Type E	from -328 °F to 1832 °F
	Type N	from -200 °C to 1300 °C	Type N	from -328 °F to 2372 °F
	Type B	from 250 °C to 1820 °C	Type B	from 482 °F to 3308 °F
	Type R	from -50 °C to 1768 °C	Type R	from -58 °F to 3214.4 °F
	Type S	from -50 °C to 1768 °C	Type S	from -58 °F to 3214.4 °F
Numeric output	Type K	from -2000 to 13720	Type K	from -3280 to 25010
	Type J	from -2100 to 6000	Type J	from -3460 to 11120
	Type T	from -2000 to 4000	Type T	from -3280 to 7520
	Type E	from -2000 to 10000	Type E	from -3280 to 18320
	Type N	from -2000 to 13000	Type N	from -3280 to 23720
	Type B	2500 to 18200	Type B	4820 to 33080
	Type R	from -500 to 17680	Type R	from -580 to 32144
	Type S	from -500 to 17680	Type S	from -580 to 32144
	12-bit conversion, stored as 16-bit binary complement			
Measurement accuracy	Type K	0.4 °C	Type K	0.72 °F
	Type J	0.3 °C	Type J	0.54 °F
	Type T	0.4 °C	Type T	0.72 °F
	Type E	0.25 °C	Type E	0.54 °F
	Type N	0.52 °C	Type N	0.72 °F
	Type B	The average accuracy of B-type: 2.09 °C, The average accuracy for below 1000 °C: 2.97 °C The average accuracy for above 1000 °C: 1.64 °C	Type B	The average accuracy of B-type: 3.762 °F, The average accuracy for below 1832 °C: 5.346 °F The average accuracy for above 1832 °C: 2.952 °F
	Type R	The average accuracy of R-type: 1.53 °C, The average accuracy for below 800 °C: 1.87 °C The average accuracy for above 800 °C: 1.32 °C	Type R	The average accuracy of R-type: 2.754 °F, The average accuracy for below 1472 °C: 3.366 °F The average accuracy for above 1472 °C: 2.376 °F
	Type S	The average accuracy of	Type S	The average accuracy of

		S-type: 1.72 °C, The average accuracy for below 800 °C: 2.01 °C The average accuracy for above 800 °C: 1.53 °C		S-type: 3.096 °F, The average accuracy for below 1472 °C: 3.618 °F The average accuracy for above 1472 °C: 2.754 °F
Total accuracy	±(0.5% of the full range ±1 °C) condensation point of pure water: 0 °C /32 °F			
Conversion speed	(240ms±2%) *4 channel (Unused channels are not converted)			

Note: Grounding thermocouples are not suitable for use with this unit.

Analog input

Conversion Characteristics: Readings respectively given at the calibration reference point 0 ° C / 32 ° F (0/320). (Subject to the overall accuracy)



Miscellaneous

Item	Specification
Isolation	It has optical isolation between analog and digital circuits. DC/DC converter is applied to isolate between this device and MPU. It has signal isolation between each analog channel.

5. Buffer Memory

5.1 Allocation of Buffer Memory

BFM		Register	W/R	Latched	Defaults	Contents
CH1->CH4	CH5->CH8					

#0	#40	Channel type selection	W/R	O	H0000	Each HEX bit represents a channel 0：K Type(-200~1372 °C) 1：J Type(-210~600 °C) 2：T Type(-200~400 °C) 3：E Type(-200~1000 °C) 4：N Type(-200~1300 °C) 5：B Type(250~1820 °C) 6：R Type(-50~1768 °C) 7：S Type(-50~1768 °C) 8：Close channel Other: Reserved For example: when # BFM40 is set as H8721, it indicates that CH8 is off, CH7 is S Type, CH6 is T Type, and CH5 is J Type.
#1->#4	#41->#44	Average filter constant	R	O	8	The average number of samples used to calculate. Set to 1 for high-speed sampling. The setting range is 1 ~ 256.
#5->#8	#45->#48	Average temperature °C	R	X	0	The average value of various temperatures in unit of 0.1 degrees Celsius
#9->#12	#49->#52	Current temperature °C	R	X	0	The current value of various temperatures in unit of 0.1 degrees Celsius
#13->#16	#53->#56	Average temperature °F	R	X	0	The average value of various temperatures in unit of 0.1 degrees Fahrenheit
#17->#20	#57->#60	Current temperature °F	R	X	0	The current value of various temperatures in unit of 0.1 degrees Fahrenheit
#21->#25	#61->#65	Cold-end temperature	R	X	0	The cold-end value of various temperatures in unit of 0.1 degrees Fahrenheit
#26	#66	Cold-end mode setting	W/R	O	-	Cold-end mode read setting: Set 1 channel for every 4 bits; 0: Read the internal cold-end temperature 1: Read the external CU50 cold-end temperature Input data must be hexadecimal, only support to input 0 or 1. Other input value is invalid, and the value of BFM26 (BFM66) shows the allowed one by last input. Among which, 26 controls the first 4 channels, and

						66 controls the last 4 channels.
#27	#67	Cold-end mode selection	W/R	O	-	Cold-end mode selection, set 1 channel for every 4 bits; 0: Built-in cold end; 1: external cold end; 2: freezing cold end Input data must be hexadecimal, only support to input 0, 1 or 2. Other input value is invalid, and the value of BFM26 (BFM66) shows the allowed one by last input. Among which, 27 controls the first 4 channels, and 67 controls the last 4 channels. The control of BFM26 (BFM66) and BFM27 (BFM67) do not affect each other.
#28	#68	Error latch	R	X	0	The value range is incorrectly latched
#29	#69	Error code	-	-	0	Error state
#30	#70	Identification code	-	-	-	Identification number(K2038)
#31	#71	Version number	-	-	-	Communication board software version number
#32	#72	Version number	-	-	-	Acquisition board software version number
#33->#39	#73->#79	Reserve	-	-	-	Reserve

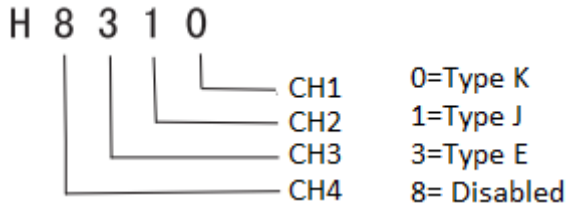
Note: Symbol Description

O represents maintainer line, X represents non-maintainer line, R represents readable data, W represents writable data.

5.2 Description of Buffer Memory (BFM)

1) Buffer memory BFM # 0 / BFM # 40: select 8 types of thermocouples

Use to select 8 types of thermocouples for each channel. Each bit of the 4-bit hexadecimal number corresponds to one channel, BFM # 0 sets 1 to 4 channels and BFM # 40 sets 5 to 8 channels. For example, BFM # 0 sets as follows:



The A / D conversion time per channel is 240 ms. When a channel is set to "8" (not used), the corresponding channel does not perform A / D conversion, so the total conversion time is reduced. In the above example, the conversion time is as follows:

240 ms (conversion time per channel) * 3 channels (channels in use) = 720 ms (total usage time)

2) Buffer register BFM # 1-BFM # 4, BFM # 41-BFM # 44: number of the averaged temperature readings

The averaged sample values of the 1st to 4th channels are assigned to BFM # 1 to BFM # 4, and the averaged sample values of the 5th to 8th channels are assigned to BFM # 41 to BFM # 44. Only the range of 1 to 4096 is valid. The overflowed value will be ignored. Use 8 as the default value.

Some of the most recently converted readable values are averaged to give a smoothed readable value. The average Celsius data is stored in BFM # 5 to BFM # 8 and BFM # 45 to BFM # 48. The average Fahrenheit data is stored in BFM # 13 to BFM # 16 and BFM # 53 to BFM # 56.

3) Current temperature

Used to save the current value of input data in the unit of 0.1 ° C or 0.1 ° F. BFM # 9 to BFM # 12 and BFM # 17 to BFM # 20 store the current values of the 1st to 4th input data, and BFM # 49 to # 52 and # 57 to # 60 store the current values of the 5th to 8th input data.

4) Cold-end compensation

BFM # 27 / BFM # 47 sets the thermocouple cold-end compensation mode. Each bit of the 4-bit hexadecimal number corresponds to one channel, BFM#27 sets 1 to 4 channels, and the last bit sets channel 1. BFM # 47 sets 5 to 8 channels, and the last bit sets channel 5.

Built-in cold-end mode: adopt module built-in NTC sensor to collect the indoor temperature for thermocouple cold-end compensation, without additional wiring.

Freezing cold-end mode: place the cold end of TC thermocouple in the ice-water mixture.

5) Buffer memory BFM # 28 / BFM # 68: Digital range error latch

b10 (digital range error) of BFM # 29 / BFM # 69 determines whether the measured temperature is within the unit allowable range.

BFM # 28 latches the error state of each channel and can be used to detect if the thermal resistance is off.

b15-b8	b7	b6	b5	b4	b3	b2	b1	b0
Not used	High	Low	High	Low	High	Low	High	Low
	CH4/CH8		CH3/CH7		CH2/CH6		CH1/CH5	

Low: latch ON when the temperature measurement drops and is below the minimum measurable temperature limit.
High: turn on ON when the temperature measurement rises and is above the maximum temperature limit, or when the thermal resistance is off.

If an error occurs (disconnect the sensor), the temperature data before error is latched. If the measured return value is within valid range, the temperature data returns to normal operation.

6) BFM29 / BFM69: Error state

Bit for error state	ON	OFF
b0: error	If any of b1 to b3 is ON, the error channel A / D stops conversion.	No error
b1: reserve	Reserve	Reserve
b2: power failure	24VDC power failure	Normal power
b3: hardware error	A / D converter or other hardware failure	Normal hardware
b4 to b9: reserve	Reserve	Reserve
b10: data range error	Data output / analog input value is out of specification	Normal data output

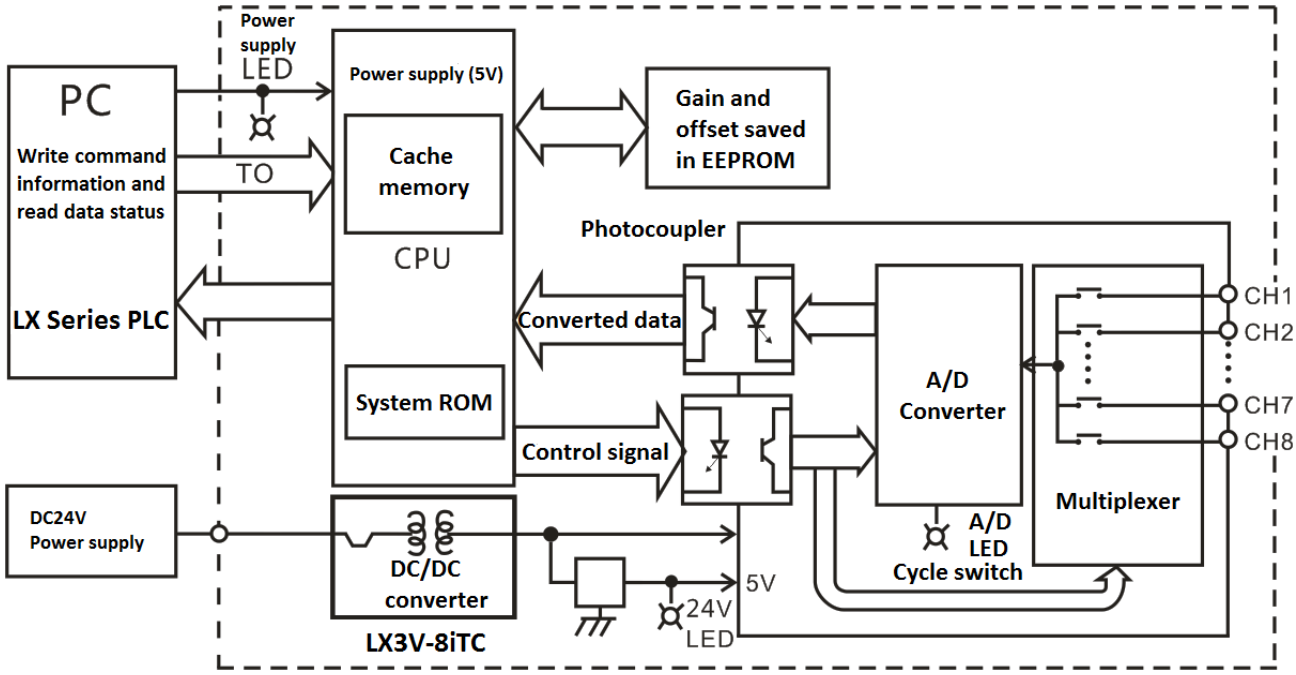
b10: average error	The value of selected average result is out of the available range, refer to BFM # 1 to # 4	Average normal (within 1 to 4096)
b12 to b15: reserve	Reserve	Reserve

7) ID buffer memory BFM # 30 / BFM # 70

Use FROM instruction to read the ID code or ID number of special function module from the buffer memory BFM # 30 or BFM # 70. The ID code of LX3V-8iTC unit is K2038.

Use this ID code in the user program of programmable controller to confirm this special function module before transmitting / receiving data.

6. System Block Diagram

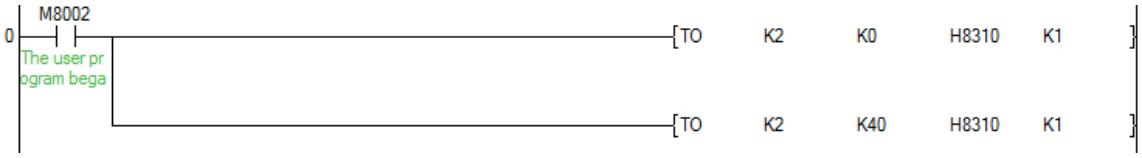


7. Sample Program

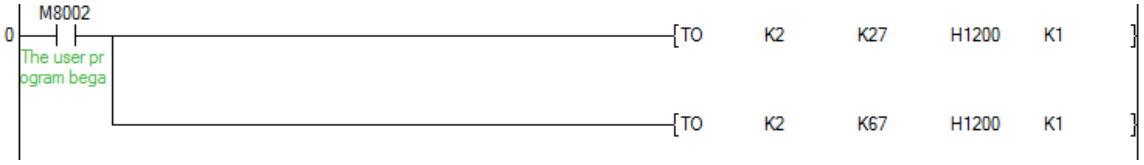
In the program shown below, the LX3V - 8iTC module occupies the location of special module 2 (this

is the third closest to the programmable control unit). The average number is 4. The average values of input channels CH1 to CH4 in °C are respectively stored in data registers D0 to D3. The average value of input channels CH5 to CH8 in °C is respectively stored in data registers D4 to D7.

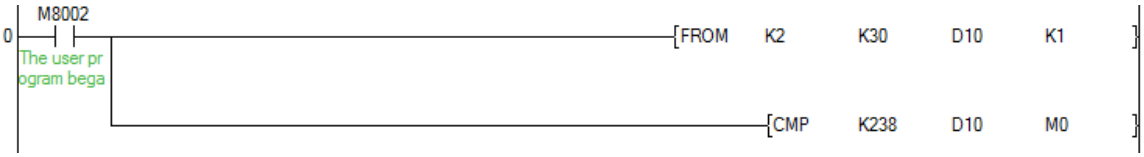
1) Set the thermocouple type and write H8310 into BFM#0 and BFM#40 of N0.2 module. CH1: K type; CH2: J type; CH3: E type; CH4: not used; CH5: K type; CH6: J type; CH7: E type; CH8: not used.



2) Set the thermocouple cold-end compensation mode and write H1200 into BFM # 27 and BFM # 67 of the N0.2 module. CH1: built-in cold-end mode; CH2: built-in cold-end mode; CH3: freezing cold-end mode; CH4: external cold-end mode. CH5: built-in cold-end mode; CH6: built-in cold-end mode; CH7: freezing cold-end mode; CH8: external cold-end mode.

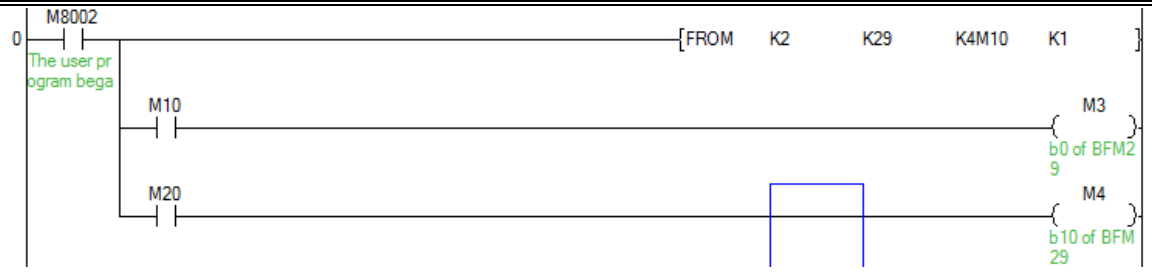


3) BFM # 30 -> (D10) of the module NO.2, When (K2038) = (D10), M1 = ON, that is, when the ID code is K2038, M1 = ON.

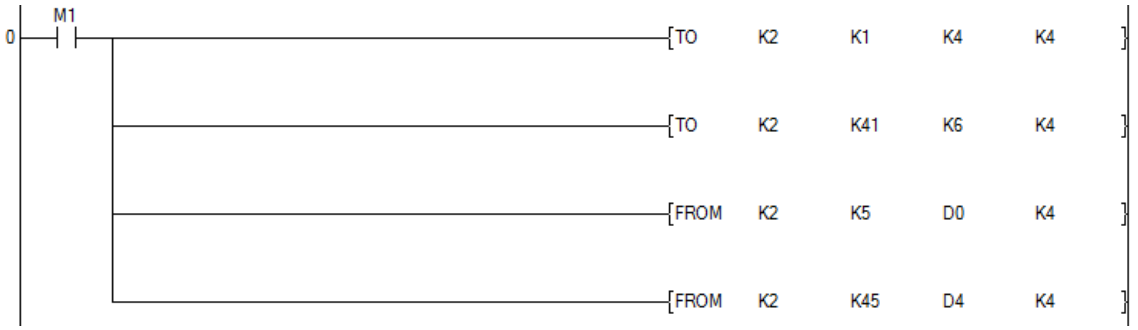


The initialization step checks if the special function module in position 2 is LX3V - 8iTC, that is, if its unit ID code is K2038 (BFM # 30 / BFM # 70). This step is optional, but it provides a way for software to check if the system is properly configured.

4) This step provides optional monitoring of the error buffer memory (# 29) of the LX3V - 8iTC. If there is an error in LX3V-8iTC, b0 of BFM # 29 will be set to ON. This can be read out by this program step and output as a device in LX3V programmable controller (M3 in this case). Additional error devices can be output in the same way, such as b10 of BFM # 29.



5) This step sets the average number of samples in LX3V - 8iTC and reads back the average Fahrenheit value of samples. For example, "TO" instruction sets the average number of samples and "FROM" instruction reads the data in LX3V - 8iTC buffer memory. The average number of samples from CH1 to CH4 is set to 4, and the average number of samples from CH5 to CH8 is set to 6. The data of BFMs # 5 to # 8 and BFMs # 45 to # 48 are then respectively stored into the PLC data registers D0 to D3 and D4 to D8.



8. Diagnosis

8.1 Initial Check

1) Check if the input / output wiring and / or extension cable are connected to the LX3V-8iTC analog special function module.
2) Check does not violate the system configuration rules of LX3V, for example: the number of special function modules cannot exceed 8, and the total number of system I / O points cannot exceed 256.
3) Make sure the correct operating range is selected for the application.
4) Check if there is power overload in the 5V or 24V power supply. Remember: the load change of the LX3V unit or active expansion unit varies depending on the number of expansion modules or special function modules connected.
5) Set the LX3V main unit MPU to RUN state.

8.2 Error Check

If the special function module LX3V - 8iTC does not operate normally, check the following items.

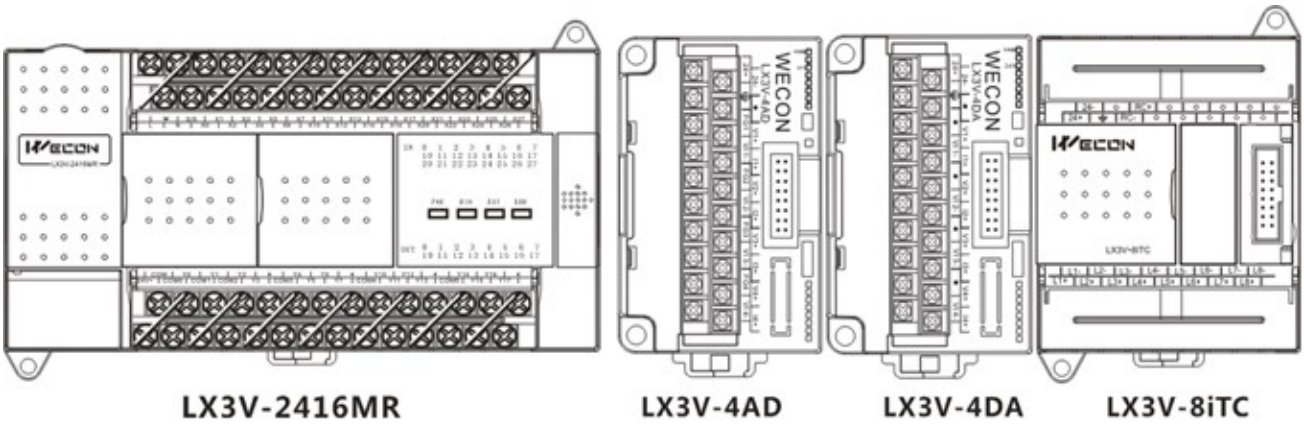
1) Check the state of power LED lamp:
   On: Expansion cable is properly connected;
   Off: Check the connection of expansion cable;
   Flash: check the external 24V connection.

2) Check the external wiring
   Check the state of "24V" LED lamp.
   On: LX3V - 8iTC is normal, 24V DC power supply is normal;
   Otherwise: Possible 24V DC power failure, LX3V - 8iTC failure if power supply is normal.

3) Check the state of "A / D" LED lamp (COM lamp)
   On: A / D conversion is operating normally
   Otherwise: Check buffer memory BFM # 29 (error state). If any bit (b2 and b3) is in ON state, that is why the A / D LED lamp goes out.

8.3 Check the Number of Special Function Modules

Other special modules that use FROM / TO instruction, such as analog input modules, analog output modules, and high-speed counting modules, can be directly connected to the main unit of LX3V programmable controller or to the right of other expansion modules or units. Depending on the close extent to the main unit, each special module is numbered from 0 to 15. Up to 16 special modules can be connected.



9. EMC Measures

Electromagnetic compatibility or EMC must be considered before using LX3V - 8iTC.

If some form of cable protection is used, "shield 

" must be connected to the ground terminal, as shown in section 3.

Due to the very weak analogue signal, it will lead to EMC noise error if EMC precautions are not taken seriously, with error value up to ± 10% of actual value. This situation is very bad. Users can get the desired operation in normal allowable range only by taking good precautions.

EMC measures should include the selection of high quality cables that are well wired to avoid potential sources of noise.

In addition, signal averaging is recommended to reduce the "puncture" effect of random noise.

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