2007-05-08

5011633103-TE03

ELC-TC04ANNN

Thermocouple Sensors Module

Instruction Sheet

⚠ WARNING

- This Instruction Sheet only provides descriptions for electrical specifications, general specifications, installation & wiring, troubleshooting and peripherals. For more information about the optional peripherals, please see ELC Application Manual.
- This is an OPEN TYPE Controller. The ELC should be kept in an enclosure away from airborne dust, humidity, electric shock risk and vibration. Also, it is equipped with protective methods such as some special tools or keys to open the enclosure, so as to avoid the hazard to users and the damage to the ELC. Do NOT touch terminals when power on.
- Never connect the AC main circuit power supply to any of the input/output terminals, as it will damage the ELC. Check all the wiring prior to power up. To avoid any electromagnetic noise, make sure the ELC is properly grounded ⏚.
- Warning – Do not disconnect while circuit is live unless area is known to be non-hazardous.
- Power, input and output (I/O) wiring must be in accordance with Class 1, Div. 2 wiring methods - Article 501-10(B)(1) of the National Electrical Code.
- Suitable for use in Class 1, Division 2, Groups A, B, C, D or Non-Hazardous locations only.
- Warning – Explosion hazard - Substitution of components may impair suitability for Class 1, Division 2.
- Warning – Explosion hazard - Do not disconnect equipment unless power has been switched off or the area is known to be Non-Hazardous.

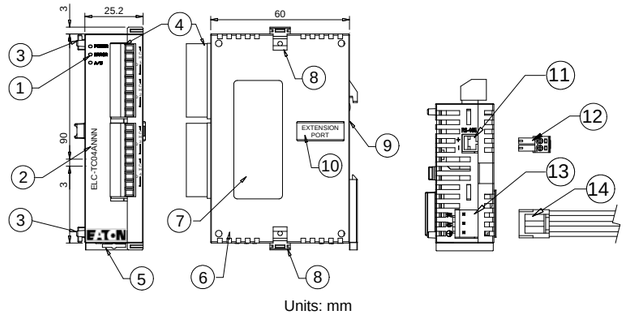
1 INTRODUCTION

1.1 Model Explanation and Peripherals

Thank you for choosing Eaton Logic Controller (ELC) series products. The ELC-TC04ANNN allows the connection of four thermocouple sensors (Type J.K.R.S.T). There are 49 Controlled Registers in each module (each register is 16 bits). The thermocouple sensors Module of ELC-TC04ANNN can read/write the data of analog input module by using commands FROM / TO via ELC program.

The ELC-TC04ANNN works with both Centigrade and Fahrenheit. The input resolution for Centigrade is 0.1 degrees and for Fahrenheit is 0.18 degrees.

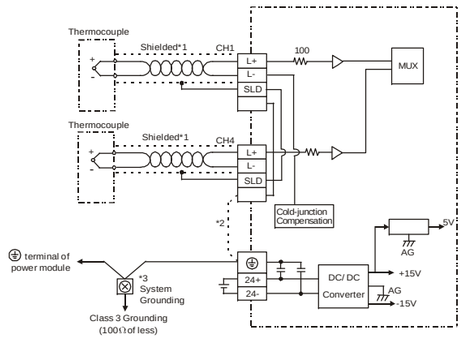
1.2 Product Profile and Outline



Units: mm

1. Status indicator (Power, RUN and ERROR)	2. Model Name
3. Extension unit clip	4. Input/output terminal
5. DIN rail clip	6. Mounting hole of the extension unit
7. Nameplate	8. Extension unit clip
9. DIN rail (35mm)	10. Extension port
11. RS-485 Communication port	12. 2 pin removable terminal (standard accessory)
13. DC power input	14. Power input cable (standard accessory)

1.3 External wiring



Note 1: Use only the wires that are supplied with your thermocouple sensor. ELC terminal screws should be tightened to 1.95 kg-cm (1.7 lb-in).

Note 2: Terminal SLD is a grounding location for noise suppression.

Note 3: Please connect ⏚ terminal of power supply module and ⏚ terminal of ELC-TC04ANNN thermocouple sensors module to system earth ground.

Warning: DO NOT connect wires to the No Connection terminals. Use Copper Conductor Only, 60/75 °C.

2 STANDARD SPECIFICATIONS

Function Specifications

Thermocouple sensors Module	Centigrade (˚C)	Fahrenheit (˚F)
Power supply voltage	24 VDC(20.4VDC~28.8VDC) (–15%~+20%)	
Analog input channel	4 channels per module	
Sensors type	J-type, K-type, R-type, S-type and T-type thermocouple	
Temperature input range	J type : -100℃~700℃ K type : -100℃~1,000℃ R type : -10℃~1,700℃ S type : -10℃~1,700℃ T type : -100℃~350℃	J type : -148℉~1,292℉ K type : -148℉~1,832℉ R type : -14℉~3,092℉ S type : -14℉~3,092℉ T type : -148℉~662℉
Digital conversion range	J type : K-1,000~K7,000 K type : K-1,000~K10,000 R type : K-100~K17,000 S type : K-100~K17,000 T type : K-1,000~K3,500	J type : K-1,480~K12,920 K type : K-1,480~K18,320 R type : K-140~K30,920 S type : K-140~K30,920 T type : K-1,480~K6,620
Resolution	14 bits(0.1˚C)	14 bits(0.18˚F)
Overall accuracy	±(1% of full scale+1°C), during 0~55°C (32~131°F)	
Response time	350 ms × channels	
Isolation Method	Isolation between digital and analog circuitry. There is no isolation between channels.	
Isolation	Field to Digital Area: 500V Field to Analog Area: 500V Analog area to Digital Area: 500V Field to 24VDC: 500V	
Digital data format	2's complement of 16-bit, (13 Significant Bits)	
Average function	Yes (CR#2~CR#5 may be set and the range is K1~K100)	
Self diagnostic function	Yes	
Communication mode (RS-485)	MODBUS ASCII/RTU Mode. Communication baud rate of 4,800 / 9,600 / 19,200 / 38,400 / 57,600 / 115,200. For ASCII mode, date format is 7Bits, even, 1 stop bit (7,E,1). For RTU mode, date format is 8Bits, even, 1 stop bit (8,E,1). The RS-485 is disabled when the ELC-TC04ANNN is connected in series to an ELC.	
Connection to a ELC in series	When ELC-TC04ANNN modules are connected to an ELC, the modules are numbered from 0 - 7. 0 is the closest to the ELC and 7 is the furthest. The Maximum number of modules is 8 modules and they do not occupy any digital I/O points of the ELC.	
Maximum power consumption	2W at 24 VDC (20.4VDC~28.8VDC) (-15 % ~ +20 %)	
Noise Immunity	ESD(IEC 61131-2, IEC 61000-4-2): 8KV Air Discharge EFT(IEC 61131-2, IEC 61000-4-4): Power Line: 2KV, Digital I/O: 1KV, Analog & Communication I/O: 1KV RS(IEC 61131-2, IEC 61000-4-3): 26MHz~1GHz, 10V/m	
Grounding	The diameter of the grounding wire cannot be smaller than that of terminals 24V and 0V (if numerous ELCs are used at the same time, make sure that each ELC is grounded respectively to the ground poles)	
Vibration/Shock Immunity	International Standard Regulations: IEC61131-2, IEC 68-2-6 (TEST Fc)/ IEC61131-2 & IEC 68-2-27 (TEST Ea)	
Operation/Storage Environment	Operation: 0℃~55℃(temperature), 50~95% (humidity), pollution degree: 2; Storage: -25℃~70℃(temperature), 5~95% (humidity)	
Agency Approvals	UL508 UL1604, Class1,Div2 Operating temperature code: T5 European community EMC Directive 89/336/EEC and Low Voltage Directive 73/23/EEC	

3 CR (CONTROLLED REGISTER)

ELC-TC04ANNN					EXPLANATION
CR No.	Parameter Comm. address	Latched		Register name	b15 b14 b13 b12 b11 b10 b9 b8 b7 b6 b5 b4 b3 b2 b1 b0
#0	H 4096	O	R	Model type	System used, data length is 8bits (b7~b0). ELC-TC04ANNN model code = H 8B
#1	H 4097	O	R/W	Thermocouple type	Reserved | CH4 | CH3 | CH2 | CH1 Example: Setting of CH1 1. (b2~b0) set(0,0,0) to use J type. 2. (b2~b0) set(0,0,1) to use K type. 3. (b2~b0) set(0,1,0) to use R type. 4. (b2~b0) set(0,1,1) to use S type. 5. (b2~b0) set(1,0,0) to use T type.
#2	H 4098	O	R/W	CH1 average number	The number of readings used for "average" temperature on channels CH1~CH4. Setting range is K1~K100 and factory setting is K10.
#3	H 4099	O	R/W	CH2 average number	
#4	H 409A	O	R/W	CH3 average number	
#5	H 409B	O	R/W	CH4 average number	
#6	H 409C	X	R	CH1 average degrees(˚C)	Average degrees for channels CH1~CH4. (unit: 0.1 degrees C)
#7	H 409D	X	R	CH2 average degrees(˚C)	
#8	H 409E	X	R	CH3 average degrees(˚C)	
#9	H 409F	X	R	CH4 average degrees(˚C)	
#10	H 40A0	X	R	CH1 average degrees(˚F)	Average degrees for channels CH1~CH4. (unit: 0.1 degrees F)
#11	H 40A1	X	R	CH2 average degrees(˚F)	
#12	H 40A2	X	R	CH3 average degrees(˚F)	
#13	H 40A3	X	R	CH4 average degrees(˚F)	
#14	H 40A4	X	R	Present temp. of CH1 (˚C)	Present temperature of channels CH1~CH4. (unit: 0.1 degrees C)
#15	H 40A5	X	R	Present temp. of CH2 (˚C)	
#16	H 40A6	X	R	Present temp. of CH3 (˚C)	
#17	H 40A7	X	R	Present temp. of CH4 (˚C)	
#18				Reserved	
#19	H 40A9	X	R	Present temp. of CH1 (˚F)	Present temperature of channels CH1~CH4. (unit: 0.1degrees F)
#20	H 40AA	X	R	Present temp. of CH2 (˚F)	
#21	H 40BB	X	R	Present temp. of CH3 (˚F)	
#22	H 40BC	X	R	Present temp. of CH4 (˚F)	
#23				Reserved	
#24	H 40AE	O	R/W	CH1 OFFSET Value	Adjust offset value of channels CH1~CH4. The range is -1,000~+1,000 and factory setting is K0. (unit: 0.1 degrees C)
#25	H 40AF	O	R/W	CH2 OFFSET Value	
#26	H 40B0	O	R/W	CH3 OFFSET Value	
#27	H 40B1	O	R/W	CH4 OFFSET Value	
#28~ #29				Reserved	
#30	H 40B4	X	R	Error status	Data register stores the error status; refer to fault code chart for details.
#31	H 40B5	O	R/W	Communication address setting	RS-485 communication address. Setting range is 01~255 and factory setting is K1
#32	H 40B6	O	R/W	Communication baud rate setting	Communication baud rate (4,800, 9,600, 19,200, 38,400, 57,600 and 115,200 bps). b0: 4,800 bps (bit/sec). b1: 9,600 bps (bit/sec). (factory setting) b2: 19,200 bps (bit/sec). b3: 38,400 bps (bit/sec). b4: 57,600 bps (bit/sec). b5: 115,200 bps (bit/sec). b6~b13: Reserved. b14: switch between low bit and high bit of CRC code (only for RTU mode) b15: RTU mode.
#33	H 4085	O	R/W	Reset to factory setting	b15 b14 b13 b12 b11 b10 b9 b8 b7 b6 b5 b4 b3 b2 b1 b0 Def. of ERR LED | CH4 | CH3 | CH2 | CH1

ELC-TC04ANNN					EXPLANATION															
CR No.	Parameter Comm. address	Latched		Register name	b15	b14	B13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
					Example: Setting of CH1 1. b0 Reserved 2. b1 Reserved 3. b2: Set to 1 and ELC will be reset to factory settings. Definition of ERR LED: b12~b15=1111(factory settings) 1. b12 corresponds to CH1: when b12=1, scale exceeds the range, ERR LED flashes. 2. b13 corresponds to CH2: when b13=1, scale exceeds the range, ERR LED flashes. 3. b14 corresponds to CH3: when b14=1, scale exceeds the range, ERR LED flashes. 4. b15 corresponds to CH4: when b15=1, scale exceeds the range, ERR LED flashes.															
#34	H 40B8	O	R	System version	Display software version in hexadecimal. Example: H 010A = version 1.0A.															
#35~#48				System used																
O means latched. X means not latched. R means can read data by using FROM command or RS-485. W means can write data by using TO command or RS-485.																				

Explanation:

1. CR#0: The ELC model type.
2. CR#1: Used to set the working mode of four channels (CH1~CH4). There are 2 modes (J-type and K-type) for each channel and allow to set separately. For example, If you want to set CH1~CH4 as CH1: mode 0 (b2~b0=000), CH2: mode 1(b5~b3=001), CH3: mode 0(b8~b6=000) and CH4: mode 1(b11~b9=001), you should set CR#1 to H0208. The higher bits (b12~b15) will be reserved and the factory setting is H0000.
3. CR#2 ~ CR#5: Used to set the number of input readings used for the average temperature calculation. The available range is K1~K100 and factory setting is K10. (Note: When PLC sets average times via TO/DTO instructions, please use rising-edge/falling-edge detection instruction (such as LDP and LDF) to get correct average times.)
4. CR#6 ~ CR#9: The average temperature (˚C). The average temperature is calculated using multiple temperature readings. Example: If CR#2 is 10, the temperature in CR#6 will be the average of the last 10 readings on CH1.
5. CR#10 ~ CR#13: The average temperature (˚C). The average temperature is calculated using multiple temperature readings. Example: If CR#2 is 10, the temperature in CR#12 will be the average of the last 10 readings on CH1.
6. CR#14 ~ CR#17: display present temperature (˚C) of CH1~CH4 input signal.
7. CR#18, CR#23, CR#28, CR#29 are reserved.
8. CR#19 ~ CR#22: display present temperature (˚F) of CH1~CH4 input signal.
9. CR #24 ~ CR #27: display offset value of channels CH1~CH4. The range is -1,000~+1,000 and unit is 0.1 degrees C. The definition of OFFSET is Actual temperature = temperature measured by ELC-TC04ANNN – OFFSET value.
10. CR#30 is a fault code register. Refer to the following chart.

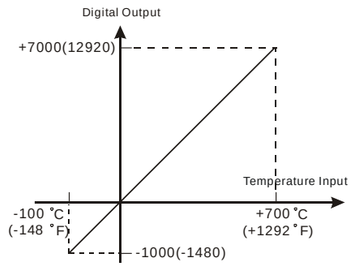
Fault description	Content	b15~b8	b7	b6	b5	b4	b3	b2	b1	b0
Power source abnormal	K1(H1)	Reserved	0	0	0	0	0	0	0	1
Analog input value error	K2(H2)		0	0	0	0	0	0	1	0
Setting mode error	K4(H4)		0	0	0	0	0	1	0	0
Offset/Gain error	K8(H8)		0	0	0	0	1	0	0	0
Hardware malfunction	K16(H10)		0	0	0	1	0	0	0	0
Digital range error	K32(H20)		0	0	1	0	0	0	0	0
Average times setting error	K64(H40)		0	1	0	0	0	0	0	0
Command error	K128(H80)		1	0	0	0	0	0	0	0
Note: Each fault code will have corresponding bit (b0~b7). Two or more faults may happen at the same time. 0 means normal and 1 means having fault.										

11. CR#31: RS-485 communication address. Setting range is 01~255 and factory setting is K1.
12. CR#32: RS-485 communication baud rate: 4,800, 9,600, 19,200, 38,400, 57,600 and 115,200. b0:4,800bps, b1:9,600bps (factory setting), b2:19,200bps, b3:38,400 bps, b4:57,600 bps, b5:115,200 bps, b6~b13: Reserved, b14: switch between low bit and high bit of CRC code (only for RTU mode) b15: ASCII / RTU mode. For ASCII mode, date format is 7Bits, even, 1 stop bit (7,E,1). For RTU mode, date format is 8Bits, even, 1 stop bit (8,E,1).
13. CR#33: Used to reset the settings of CR registers to factory defaults.
14. CR#34: software version.
15. CR#35~ CR#48: Reserved for internal system use.
16. The corresponding parameters address H 4096~H 40B8 of CR#0~CR#34 may provide users to read/write data via RS-485 communication.
    a) Communication baud rate: 4,800, 9,600, 19,200, 38,400, 57,600, 115,200 bps.
    b) Communication format: ASCII mode is 7Bit, even bit, 1 stop bit (7,E,1). Communication format of RTU mode is 8Bit, even bit, 1 stop bit (8,E,1).
    c) Function code: 03H—read data from register. 06H—write a WORD into register. 10H—write many WORDs into register.

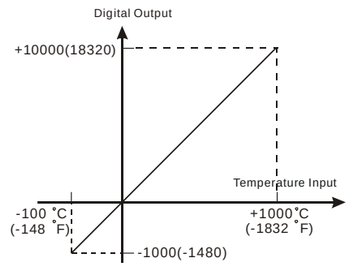
4 TEMPERATURE/DIGITAL CHARACTERISTIC CURVE

Temperature mode: (Centigrade/Fahrenheit)

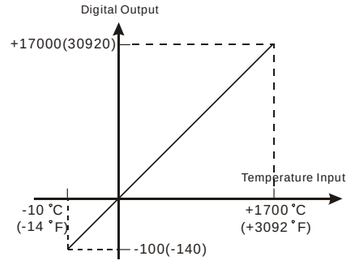
J-type thermocouple sensors



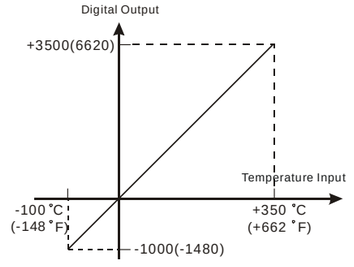
K-type thermocouple sensors



R/S-type thermocouple sensors



T-type thermocouple sensors

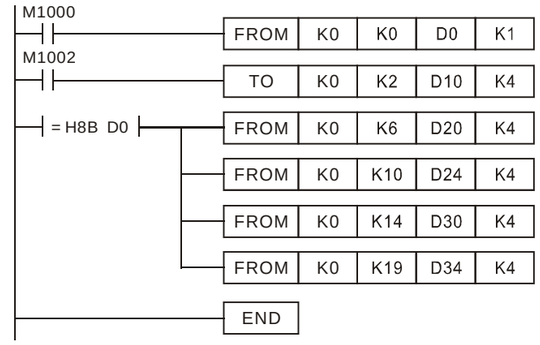


5 INITIAL ELC START-UP

LED display:

1. Upon power-up, the ERROR LED will light for 0.5 seconds the POWER LED will light continuously.
2. No errors= POWER LED on and ERROR LED off.
3. Low Voltage error (lower than 19.5V), ERROR LED will blink continuously till the power supply rises above 19.5V.
4. ELC-TC04ANNN connected to ELC in series = RUN LED on ELC will be lit and A/D LED or D/A LED should blink.
5. After receiving the first RS-485 command the A/D LED or D/A LED will blink.
6. If the input or output exceeds the upper or lower bounds, then the ERROR LED will blink.

Example:



Explanation:

1. Reading the model type of extension module K0 (should be H8B for ELC-TC04ANNN model type).
2. The averaging number for CH1~CH4 will be D10~D13.
3. If the model type is ELC-TC04ANNN. Reading the average temperature (°C) of CH1~CH4 (4 data) from CR#6~CR#9 and save them into D20~D23.
4. Reading the average temperature (°F) of CH1~CH4 (4 data) from CR#10~CR#13 and save them into D24~D27.
5. Reading the present temperature (°C) of CH1~CH4 (4 data) from CR#14~CR#17 and save them into D30~D33.
6. Reading the present temperature (°F) of CH1~CH4 (4 data) from CR#19~CR#22 and save them into D34~D37.

6 RELATED INSTRUCTIONS EXPLANATION

API	Mnemonic			Operands				Function	Controllers			
78	D	FROM	P	m_1	m_2	D	n	Read CR from Module	PB	PC	PA	PH

Type / OP	Bit Devices				Word devices										Program Steps
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	E	F	
m_1					*	*										FROM, FROMP: 9 steps DFROM, DFROMP: 17 steps
m_2					*	*										
D								*	*	*	*	*	*	*	*	
n					*	*										

PULSE				16-bit				32-bit			
PB	PC	PA	PH	PB	PC	PA	PH	PB	PC	PA	PH

Operands:

m_1: Number for special module (**m_1**=0~7) **m_2**: Number of CR (Control Register) of special module (**m_2**=0~48) that will be read **D**: Location to save read data **n**: Data words to read at one time (**n** =1~(49- **m_2**))

Explanations:

ELC uses this instruction to read CR data of special modules.

API	Mnemonic			Operands				Function	Controllers			
79	D	TO	P	m_1	m_2	S	n	Write CR to Module	PB	PC	PA	PH

Type / OP	Bit Devices				Word devices										Program Steps
	X	Y	M	S	K	H	KnX	KnY	KnM	KnS	T	C	D	E	F	
m_1					*	*										TO, TOP: 9 steps DTO, DTOP: 17 steps
m_2					*	*										
S					*	*	*	*	*	*	*	*	*	*	*	
n					*	*										

PULSE				16-bit				32-bit			
PB	PC	PA	PH	PB	PC	PA	PH	PB	PC	PA	PH

Operands:

m_1: Number of special module (m_1=0~7) **m_2**: Number of CR (Control Register) of special module that will be written to (**m_2**=0~48) **S**: Data to write in CR **n**: number of words to write one time (**n** =1~(49- **m_2**))

Explanations:

ELC uses this instruction to write CR data of special modules.