2007-05-08

5011629803-AN03

ELC-AN04ANNN

Instruction Sheet

Analog to Digital Converter Module

⚠ WARNING

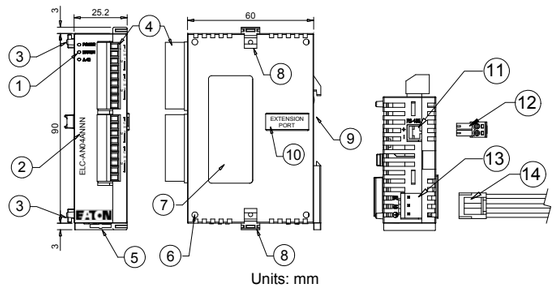
- This Instruction Sheet only provides descriptions for electrical specifications, general specifications, installation & wiring, troubleshooting and peripherals. For more information about the optional peripherals, please see ELC Application Manual.
- This is an OPEN TYPE Controller. The ELC should 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 analog input module receives external 4-point analog signal input (voltage or current) and transforms it into 14 bits digital signal. The analog input module of ELC-AN04ANNN can read/write the data of analog input module by using commands FROM / TO via ELC program. There are 49 CR (Control Register) in each module and there are 16 bits in each register.

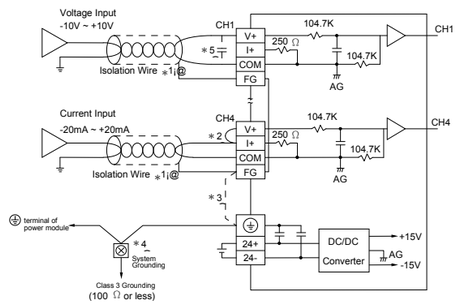
1.2 Product Profile and Outline



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)

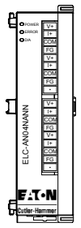
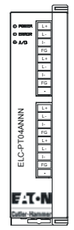
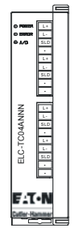
1.3 External wiring



Warning: DO NOT wire to the No function terminal. Use Copper Conductor Only, 60/75 °C.

Note 1: Please isolate analog input and other power wiring.
Note 2: If connect to current signal, please short circuit between V+ and I+ terminals.
Note 3: If noise is too loud, please connect FG to grounding.
Note 4: Please connect ⏚ terminal of power module and ⏚ terminal of analog input module to system earth point and make system earth point be grounding or connects to machine cover.
Note 5: If wave of input terminal of loaded is too big that noise interferes wiring, please connect capacitance with 0.1~0.47uf 25V.

1.4 Terminal of analog module layout

AN04ANNN	AN02NANN	AN04NANN	AN06AANN	PT04ANNN	TC04ANNN
					

2 STANDARD SPECIFICATIONS

2.1 Function Specifications

FOUR CH. A/D MODULE	VOLTAGE INPUT	CURRENT INPUT
Power supply voltage	24 VDC(20.4VDC~28.8VDC) (-15%~+20%)	
Analog input channel	4 channel / each module	
Analog input range	±10V	±20 mA
Digital conversion range	±8,000	±4,000
Resolution	14 bits(1_{LSB}=1.25 mV)	13 bits (1_{LSB}=5 μA)
Input impedance	200 KΩ and above	250Ω
Overall accuracy	±0.5% of full scale at 25℃(77℉) ±1% of full scale during 0~55℃ (32~131℉)	
Response time	3 ms × channels	
Isolation method	It has isolation between digital area and analog area. There is no isolation among channels.	
Isolation	Field to Digital Area: 500V Field to Analog Area: 500V Analog area to Digital Area: 500V Field to 24VDC: 500V	
Absolute input range	±15 V	±32 mA
Digital data format	2's complementary of 16-bit, 13 Significant Bits	
Average function	Yes (CR#2~CR#5 can be set and setting range is K1~K100)	
Self diagnose function	Upper and lower bound detection / channels	
Communication mode (RS-485)	MODBUS ASCII/RTU Mode. Communication baud rate of 4,800 / 9,600 / 19,200 / 38,400 / 57,600 / 115,200 bps. 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-AN04ANNN is connected in series to an ELC.	
Connect to ELC in series	The input point of the first analog extension unit it connects from the near to the distant is from 0 to 7. The Max. is 8 modules and it won't waste digital I/O point.	
Max. rated consuming power	24 VDC(20.4VDC~28.8VDC) (–15%～+20%), 2W, supply from external power	
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 (CONTROL REGISTER)

ELC-AN04ANNN					EXPLANATION
CR No.	Comm. address	Latched		Register name	b15 b14 b13 b12 b11 b10 b9 b8 b7 b6 b5 b4 b3 b2 b1 b0
#0	H 4000	O	R	Model type	System used, data length is 8bits (b7~b0). ELC-AN04ANNN model code =H 88
#1	H 4001	O	R/W	Input mode setting	Reserved | CH4 | CH3 | CH2 | CH1 Input mode setting: factory setting is H0000. Mode 0: input voltage mode (-10V~+10V). Mode 1: input voltage mode (-6V~+10V). Mode 2: input current mode (-12mA~+20mA) Mode 3: input current mode(-20mA~+20mA) Mode 4: Reserved.
#2	H 4002	O	R/W	CH1 average number	Average numbers setting of channel CH1~CH4. Setting range is K1~K100 and factory setting is K10.
#3	H 4003	O	R/W	CH2 average number	
#4	H 4004	O	R/W	CH3 average number	
#5	H 4005	O	R/W	CH4 average number	
#6	H 4006	X	R	Average value of CH1 input signal	Display average value of CH1~CH4 input signal
#7	H 4007	X	R	Average value of CH2 input signal	
#8	H 4008	X	R	Average value of CH3 input signal	
#9	H 4009	X	R	Average value of CH4 input signal	
#10 ~ #11					Reserved
#12	H 400C	X	R	Present value of CH1 input signal	Display present value of CH1~CH4 input signal
#14	H 400E	X	R	Present value of CH3 input signal	
#15	H 400F	X	R	Present value of CH4 input signal	
#16 ~ #17				Reserved	
#18	H 4012	O	R/W	To adjust OFFSET value of CH1	Offset setting of CH1~CH4. Factory setting is K0 and unit is LSB. Voltage input: setting range is K-4,000 ~K4,000 Current input: setting range is K-4,000 ~K4,000
#19	H 4013	O	R/W	To adjust OFFSET value of CH2	
#20	H 4014	O	R/W	To adjust OFFSET value of CH3	
#21	H 4015	O	R/W	To adjust OFFSET value of CH4	
#22 ~ #23				Reserved	
#24	H 4018	O	R/W	To adjust GAIN value of CH1	GAIN setting of CH1~CH4. Factory setting is K4,000 and unit is LSB. Voltage input: setting range is K-3,200 ~K16,000. Current input: setting range is K-3,200 ~K10,400.
#25	H 4019	O	R/W	To adjust GAIN value of CH2	
#26	H 401A	O	R/W	To adjust GAIN value of CH3	
#27	H 401B	O	R/W	To adjust GAIN value of CH4	
#28 ~ #29				Reserved	
#30	H 401E	X	R	Error status	It is the data register to save all error status. Please refer to fault code chart for detail.
#31	H 401F	O	R/W	Communication address setting	Setting RS-485 communication address. Setting range is 01~255 and factory setting is K1
#32	H 4020	O	R/W	Communication baud rate setting	It is used to set communication baud rate (4,800, 9,600, 19,200, 38,400, 57,600, 115,200bps). 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). 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: exchange low and high byte of CRC check code (only for RTU mode) b15: ASCII / RTU mode selection
#33	H 4021	O	R/W	Reset to factory setting and set characteristics adjustable priority	b15 b14 b13 b12 b11 b10 b9 b8 b7 b6 b5 b4 b3 b2 b1 b0 Reserved | CH4 | CH3 | CH2 | CH1 Output latched setting, factory setting H0000 Give CH1 setting for example: 1. When b0=0, user can set OFFSET and GAIN value of CH1 (CR#18, CR#24). When b0=1, inhibit user to adjust OFFSET and GAIN value of CH1 (CR#18, CR#24). 2. b1 means if characteristic register is latched. b1=0 (factory setting, latched), b1=1 (not latched). 3. When b2 is set to 1, all settings will reset to factory setting.

ELC-AN04ANNN					EXPLANATION
#34	H 4022	O	R	System Version	It is hexadecimal to display software version. For example: H 010A means 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.					
LSB (Least Significant Bit): 1. Voltage input: 1_{LSB}=10V/8,000=1.25mV. 2. Current input: 1_{LSB}=20mA/4,000=5μA.					

Explanation:

1. CR#1: CR#1 is used to set 4 inner channels working mode of analog input module. Every channel has four modes to set and can be set individually. For example: if setting CH1 to mode 0 (b2~b0=000), CH2 to mode 1(b5~b3=001), CH3: mode2 (b8~b6=010), CH4: mode 3(b11~b9=011). It needs to set CR#1 to H0688 and the upper bit (b12~b15) will reserved. The factory setting of CR#1 is H0000.
2. CR#2 ~ CR#5: it is used to set average times of CH1~CH4. Setting range is K1~K100 and factory setting is K10.
3. CR#6 to CR#9 are the average value that calculates according to the value that is set in CR#2~CR#5 (average time of CH1~CH4 input signal). For example, if CR#2 (the average times of CH1) is 10, it will calculate the average of CH1 input signal every 10 times.
4. CR#12 ~ CR#15: display present value of CH1~CH4 input signal.
5. CR #18~ CR #21: the content is the value of adjusting OFFSET value of CH1~CH4 if analog input voltage or current is 0 after it transfers from analog to digital. Voltage setting range: -5V~+5V(-4,000$_{LSB}$~+4,000$_{LSB}$). Current setting range: -20mA~+20mA (-4,000$_{LSB}$~+4,000$_{LSB}$).
6. CR #24~ CR #27: means analog input voltage or current when conversion value from analog signal to digital is 4000. Voltage setting range: -4V~+20V(-3,200$_{LSB}$~+16,000$_{LSB}$). Current setting range: -16mA~+52mA(-3,200$_{LSB}$ ~+10,400$_{LSB}$). But it needs to notice that GAIN VALUE – OFFSET VALUE = +800$_{LSB}$~+12,000$_{LSB}$ (voltage) or +800$_{LSB}$~+6,400$_{LSB}$ (current). When this value under this range, the resolution of the input signal will be thin and the variation of value will be larger. When this value exceeds this range, the resolution of input signal will be thick and the variation of value will be smaller.
7. CR#30 is fault code. Please refer to the following chart.

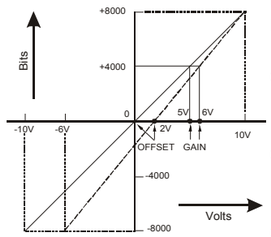
Fault description	Content	b15~b8	b7	b6	b5	b4	b3	b2	b1	b0
Power source abnormal	K1(H1)	Reserved	0	0	0	0	0	0	0	1
Analog input value error	K2(H2)		0	0	0	0	0	0	1	0
Setting mode error	K4(H4)		0	0	0	0	0	1	0	0
Offset/Gain error	K8(H8)		0	0	0	0	1	0	0	0
Hardware malfunction	K16(H10)		0	0	0	1	0	0	0	0
Digital range 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.										

8. CR#31: it is used to set RS-485 communication address. Setting range is 01~255 and factory setting is K1.
9. CR#32 is used to set RS-485 communication baud rate: 4,800, 9,600, 19,200, 38,400, 57,600, 115,200 bps. 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: exchange low and high byte of CRC check code. (only for RTU mode) b15=0: ASCII mode. b15=1: RTU mode. 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).
10. CR#33 is used to set the inner function priority. For example: characteristic register. Output latched function will save output setting in the inner memory before power loss.
11. CR#35~ CR#48: system used.
12. The corresponding parameters address H4000~H4022 of CR#0~CR#34 can provide user to read/write data by RS-485.
    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 ADJUST A/D CONVERSION CHARACTERISTIC CURVE

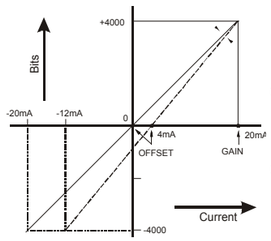
4.1 Adjust A/D Conversion Characteristic Curve

Voltage input mode:



Mode 0 of CR#1 GAIN=5V (4,000$_{LSB}$), OFFSET=0V (0$_{LSB}$)
Mode 1 of CR#1 GAIN=6V (4,800$_{LSB}$), OFFSET=2V (1,600$_{LSB}$)
GAIN: Voltage input value when digital output is 4000. Setting range is -4V~+20V(-3,200$_{LSB}$~+16,000$_{LSB}$)
OFFSET: Voltage input value when digital output is 0. Setting range: -5V~+5V (-4,000$_{LSB}$ ~ +4,000$_{LSB}$)
GAIN－OFFSET：Setting range is +1V~+15V (+800$_{LSB}$~+12,000$_{LSB}$)

Current input mode:



Mode 2 of CR#1: GAIN = 20mA (4,000$_{LSB}$), OFFSET=4mA (800$_{LSB}$).
Mode 3 of CR#1: GAIN = 20mA (4,000$_{LSB}$), OFFSET=0mA (0$_{LSB}$).
GAIN: Current input value when digital output is +4000. Setting range is-16 mA ~+52 mA (-3,200$_{LSB}$ ~ +10,400$_{LSB}$)
OFFSET: Current input value when digital output value is 0. Setting range is-20mA ~+20mA (-4,000$_{LSB}$ ~ +4,000$_{LSB}$)
GAIN－OFFSET: Setting range is +4mA ~ +32mA (800$_{LSB}$~+6,400$_{LSB}$)

The chart above is to adjust A/D conversion characteristic curve of voltage input mode and current input mode. Users can adjust conversion characteristic curve by changing OFFSET values (CR#18~CR#21) and GAIN values (CR#24~CR#27) depend on application.

LSB(Least Significant Bit): 1. voltage input: 1_{LSB}=10V/8,000=1.25mV.

2. current input: 1_{LSB}=20mA/4,000=5μA.

4.2 Program Example for Adjusting A/D Conversion Characteristics Curve

Setting OFFSET value of CH1 to 0V(=K0$_{LSB}$) and GAIN value of CH1 to 2.5V(=K2,000$_{LSB}$).

1. Writing H0 to CR#1 of analog input module no. 0 and set CH1 to mode 0 (voltage input -10V~+10V)
2. Writing H1 to CR#33 and allow to adjust characters of CH1.
3. When X0 switches from Off to On, K0$_{LSB}$ of OFFSET value will be wrote in CR#18 and K2,000$_{LSB}$ of GAIN value will be wrote in CR#24.

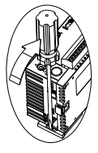
5 INSTALLATION & WIRING

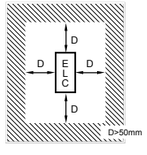
1. Installation of the DIN rail

The ELC can be secured to a cabinet by using the DIN rail that is 35mm high with a depth of 7.5mm. When mounting the ELC on the DIN rail, be sure to use the end bracket to stop any side-to-side motion of the ELC, thus to reduce the chance of the wires being pulled loose. At the bottom of the ELC is a small retaining clip. To secure the ELC to the DIN rail, place it onto the rail and gently push up the clip.

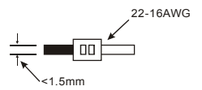
To remove it, pull down the retaining clip and gently pull the ELC away from the DIN rail. As shown on the right:

When installing the ELC, make sure that it is installed in an enclosure with sufficient space (as shown on the right) to its surroundings so as to allow heat dissipation.





2. Wiring



Notes:

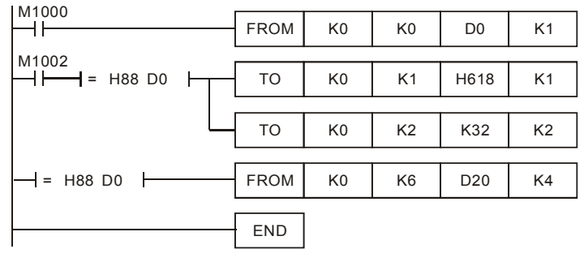
1. Please use 22-16AWG (1.5mm) wiring (either single or multiple core) for I/O wiring terminals. The specification for the terminals is as shown on the left. ELC terminal screws should be tightened to 1.95 kg-cm (1.7 lb-in). Use Copper Conductor Only, 60/75 °C.
2. I/O signal wires or power supply should not run through the same multi-wire cable or conduit.

6 INITIAL ELC START-UP

Lamp display:

1. When power is on, POWER LED will be lit and ERROR LED will be lit for 0.5 second.
2. When it is normal that POWER LED should be lit and ERROR LED should turn off. When power supply is lower than 19.5V, ERROR LED will blink continuously till the power supply is higher than 19.5V.
3. When it connected to ELC in series, RUN LED on ELC will be lit and A/D LED or D/A LED should blink.
4. After receiving the first RS-485 command during controlling by RS-485, A/D LED or D/A LED should blink.
5. After converting, ERROR LED should blink if input or output exceeds upper bound or lower than lower bound.

Example:



1. Reading the data of model type from extension module K0 and distinguish if the data is H88 (ELC-AN04ANNN model type).
2. If the model type is ELC-AN04ANNN, the setting input mode is (CH1, CH3) = mode 0, (CH2, CH4) = mode 3.
3. Setting the average times of CH1 and CH2 are K32.
4. Reading the input signal average value of CH1~CH4 (4 data) saving in D20~D23.

6 RELATED INSTRUCTIONS EXPLANATION

API	Mnemonic			Operands	Function	Controllers			
						PB	PC	PA	PH
78	D	FROM	P	(m1) (m2) (D) (n)	Read CR from Module				

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			
						PB	PC	PA	PH
79	D	TO	P	(m1) (m2) (S) (n)	Write CR to Module				

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.