2007-05-08

5011632203-A403

ELC-AN04NANN

Digital to Analog Converter Module

Instruction Sheet

⚠ WARNING

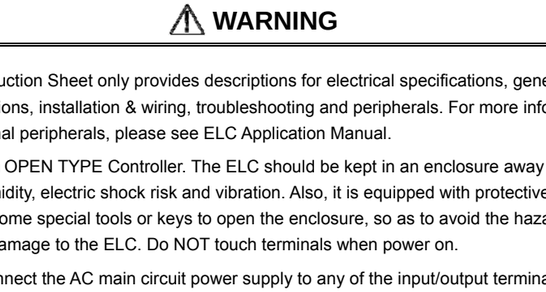
- This Instruction Sheet only provides descriptions for electrical specifications, general specifications, installation & wiring, troubleshooting and peripherals. For more information about the optional peripherals, please see ELC Application Manual.
- This is an OPEN TYPE Controller. The ELC should 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 analog output module ELC-AN04NANN can read and write analog output data by using the FROM / TO commands via ELC controllers. The analog output module receives 12-bit digital data of 4 groups from ELC and transforms it into 4 points of an analog output signal (voltage or current).

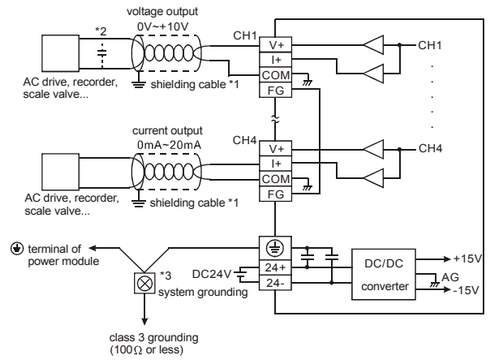
1.2 Product Profile and Outline



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: Please isolate analog output and other power wiring.

Note 2: If noise interference from loaded input terminal wiring is significant, please connect capacitor with 0.1~0.47μF 25V for noise filtering.

Note 3: Please connect ⏚ power module terminal and ⏚ analog output module terminal to system earth point and make system earth point be grounded or connects to machine cover.

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

2 STANDARD SPECIFICATIONS

2.1 Specifications

FOUR CH. D/A MODULE	VOLTAGE OUTPUT	CURRENT OUTPUT
Power Supply Voltage	24 VDC (20.4VDC~28.8VDC) (–15%~+20%)	
Analog Output Channel	4 channels / each module	
Analog Output Range	0~10V	0~20mA
Digital Data Range	0~4,000	0~4,000
Resolution	12 bits (1_{LSB}=2.5 mV)	12 bits (1_{LSB}=5 μA)
Output Impedance	0.5Ω or lower	
Overall Accuracy	±0.5% of full scale at 25℃(77°F). ±1% of full scale during 0~55℃ (32~131°F).	
Response Time	3 ms × channels	
Max. Output Current	10mA (1KΩ~2MΩ)	—
Tolerance Carried Impedance	—	0~500Ω
Digital Data Format	2's complementary of 16-bit, 11 Significant Bits	
Isolation Method	Isolation between digital area and analog area. But 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	
Protection	Voltage output has short circuit protection but a long period short circuit may cause internal wire damage and open circuit protection.	
Communication Mode (RS-485)	Yes, communication formats are (4,800 / 9,600 / 19,200 / 38,400 / 57,600 / 115,200 bps) 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). When connecting to ELC MPU in series, RS-485 can't be used.	
Connect to ELC MPU in Series	If AN04NANN modules are connected to MPU, the modules are numbered from 0 – 7. 0 is the closest and 7 is the furthest to the MPU. 8 modules is the max and they do not occupy any digital I/O points of the MPU.	
Max. Rated Consuming Power	24 VDC (20.4VDC~28.8VDC) (-15%~+20%), 4.5W, 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-AN04NANN					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 4032	O	R	Model type	System used, data length is 8 bits (b7~b0). ELC-AN04NANN model code=H 89
#1	H 4033	O	R/W	Output mode setting	Reserved | CH4 | CH3 | CH2 | CH1 Output mode setting: factory setting is H0000. Mode 0: output voltage mode (0V~10V). Mode 1: output voltage mode (2V~10V). Mode 2: output current mode (4mA~20mA). Mode 3: output current mode (0mA~20mA). Mode 4: Reserved
#2 ~ #5					Reserved
#6	H 4038	X	R/W	CH1 out value	The output setting range of channel CH1~CH4 is K0~K4,000. Factory setting is K0 and unit is LSB.
#7	H 4039	X	R/W	CH2 out value	
#8	H 403A	X	R/W	CH3 out value	
#9	H 403B	X	R/W	CH4 out value	
CR No	Parameter Comm. Address	Latched		Register Name	b15 b14 b13 b12 b11 b10 b9 b8 b7 b6 b5 b4 b3 b2 b1 b0
#10 ~ #17					Reserved
#18	H 4044	O	R/W	To adj. OFFSET value of CH1	It is used to set the OFFSET value of CH1~CH4. The setting range is K-2,000~K2,000. The factory setting is K0 and unit is LSB.
#19	H 4045	O	R/W	To adj. OFFSET value of CH2	
#20	H 4046	O	R/W	To adj. OFFSET value of CH3	
#21	H 4047	O	R/W	To adj. OFFSET value of CH4	
#22 ~ #23					Reserved
#24	H 404A	O	R/W	To adj. GAIN value of CH1	It is used to set the GAIN value of CH~CH4. The setting range is K-1,600~K8,000. The factory setting is K2,000 and unit is LSB.
#25	H 404B	O	R/W	To adj. GAIN value of CH2	
#26	H 404C	O	R/W	To adj. GAIN value of CH3	
#27	H 404D	O	R/W	To adj. GAIN value of CH4	
#28 ~ #29					Reserved
#30	H 4050	X	R	Error status	Data register to save all error status. Please refer to fault code chart for detail.
#31	H 4051	O	R/W	Communication address setting	Used to set RS-485 communication address. The setting range is from 01 to 255 and the factory setting is K1.
#32	H 4052	O	R/W	Communication Baud Rate setting	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 (RTU mode only) b15: ASCII / RTU mode selection
#33	H 4053	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 is used to check if characteristic register is latched. b1=0 latched (factory setting), b1=1 not latched. 3. When b2 is set to 1, all settings are reset to factory setting.
#34	H 4054	O	R	Software version	Show software version in hexadecimal. 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 output: 1_{LSB}=10V/4,000=2.5mV. 2. Current output: 1_{LSB}=20mA/4,000=5μA.

Explanation:

1. The content of CR#0 is model type, user can read the data from program to check if there is expansion module.
2. CR#1 is used to set two internal channels working mode of analog output module. Every channel has four modes that can be set individually. For example: if setting CH1 to mode 2 (b2~b0=010), CH2 to mode 1(b5~b3=001). It needs to set CR#1 to H000A. The factory setting of CR#1 is H0000.
3. CR#2 ~ CR#5, CR#10 ~ CR#17, CR#22, CR#23, CR#28, CR#29 Reserved.
4. CR #6 ~ CR#9 display CH1 ~ CH4 output signals. The setting range is K0~K4,000. Factory setting is K0 and unit is LSB.
5. CR#18 ~ CR#21 are used to adjust the OFFSET value of CH1 and CH4. The factory setting is

K0 and unit is LSB. If output value equal to 0 after calculation, the adjustable range of analog output voltage or current is -2,000~+2,000.
Voltage adjustable range: -5V~+5V(-2,000$_{LSB}$~+2,000$_{LSB}$).
Current adjustable range: -10mA~+10mA (-2,000$_{LSB}$~+2,000$_{LSB}$).

6. CR#24 ~ CR#27 are used to adjust the GAIN value of CH1 and CH4. The factory setting is K2000 and unit is LSB. If output value equal to 2000 after calculation, the adjustable range of analog output voltage or current is -1,600~+8,000.
Voltage adjustable range: -4V~+20V(-1,600$_{LSB}$~+8,000$_{LSB}$).
Current adjustable range: -8mA ~+40mA (-1,600$_{LSB}$~+8,000$_{LSB}$).

   Please be noticed that GAIN VALUE – OFFSET VALUE = +400$_{LSB}$ ~+6,000$_{LSB}$ (voltage or current). If the value difference comes up small (within range), the output signal resolution is then slim and the variation is definitely larger. On the contrast, if the value difference exceeds the range, the output signal resolution becomes larger and the variation is definitely 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 output 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 is used to set RS-485 communication address. The setting range is from 01 to 255. The 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. (RTU mode only) b15=0: ASCII mode, b15=1: RTU mode. Communication format: ASCII mode is 7Bit, even bit, 1 stop bit (7,E,1), while RTU mode is 8Bit, even bit, 1 stop bit (8,E,1).

10. CR#33 is used to set the internal function priority. For example: characteristic register. Output latched function will save output setting to the internal memory before power loss.

11. CR#34 is software version of model type.

12. CR#35~ CR#48 are used for system.

13. The corresponding parameters address H4032~H4054 of CR#0~CR#34 are provided for user to read/write data via RS-485.

    a) Communication baud rate: 4,800, 9,600, 19,200, 38,400, 57,600, 115,200 bps.

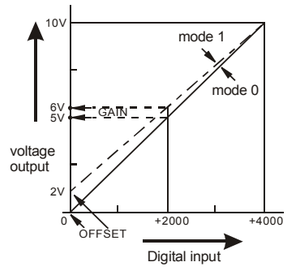
    b) Communication format: ASCII mode is 7Bit, even bit, 1 stop bit (7,E,1). Communication format of RTU mode is 8Bit, even bit, 1 stop bit (8,E,1).

    c) Function code: 03H - read data from register. 06H - write one WORD to register. 10H - write multiple WORD to register.

4 ADJUST D/A CONVERSION CHARACTERISTIC CURVE

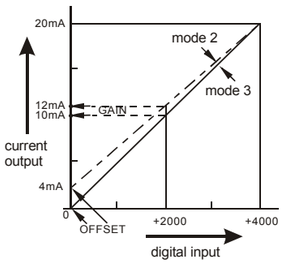
4.1 Adjust D/A Conversion Characteristic Curve

Voltage output mode:



Mode 0 of CR#1: GAIN = 5V(2,000$_{LSB}$), OFFSET=0V (0$_{LSB}$)
Mode 1 of CR#1: GAIN = 6V(2,400$_{LSB}$), OFFSET=2V (800$_{LSB}$).
GAIN: The setting range of voltage output value when digital input value is K2,000 should be -4V~+20V(-1,600$_{LSB}$ ~+8,000 $_{LSB}$).
OFFSET: The setting range of voltage output value when digital input value is K0 should be -5V~+5V(-2,000$_{LSB}$ ~ +2,000 $_{LSB}$).
GAIN - OFFSET: Setting range: +1V~+15V (+400$_{LSB}$ ~ +6,000 $_{LSB}$).

Current output mode:



Mode 2 of CR#1: GAIN = 12mA (2,400$_{LSB}$), OFFSET=4mA (800$_{LSB}$).
Mode 3 of CR#1: GAIN = 10mA (2,000$_{LSB}$), OFFSET=0mA (0$_{LSB}$).
GAIN: The setting range of current output when digital input value is K2,000 should be -8mA~+40mA (-1,600$_{LSB}$ ~+8,000$_{LSB}$).
OFFSET: The setting range of current output when digital input value is K0 should be -10mA ~+10mA (-2,000$_{LSB}$ ~+2,000$_{LSB}$).
GAIN - OFFSET: Setting range: +2mA~+30mA (+400$_{LSB}$ ~+6,000$_{LSB}$).

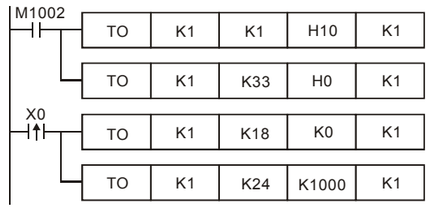
The charts above are D/A conversion characteristic curve of voltage input mode and current input mode. Users can adjust conversion characteristic curve by changing OFFSET values (CR#18~CR#21) and GAIN values (CR#24~CR#27) depend on application.

LSB(Least Significant Bit):

1. Voltage output: 1$_{LSB}$=10V/4,000=2.5mV.
2. Current output: 1$_{LSB}$=20mA/4,000=5μA.

4.2 Program Example for Adjusting D/A Conversion Characteristics Curve

Setting OFFSET value of CH1 to 0V(=K0$_{LSB}$) and GAIN value is 2.5V(=K1,000$_{LSB}$).



Writing H10 to CR#1 of analog output module#0. Setting CH1 to mode 0 (voltage output 0V~ +10V) and CH2 to mode 2 (current output 4mA~ +20mA).

Writing H0 to CR#33 and allow CH1 ~ CH4 to adjust characteristic.

When X0 switches from Off to On, K0$_{LSB}$ of OFFSET value will be written to CR#18 and K1,000$_{LSB}$ of GAIN value will be written to CR#24.

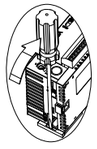
5 INSTALLATION & WIRING

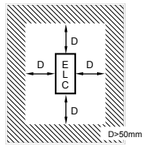
1. Installation of the DIN rail

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.

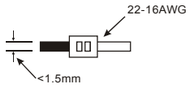
To remove it, pull down the retaining clip and gently pull the ELC away from the DIN rail. As shown on the right:

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:

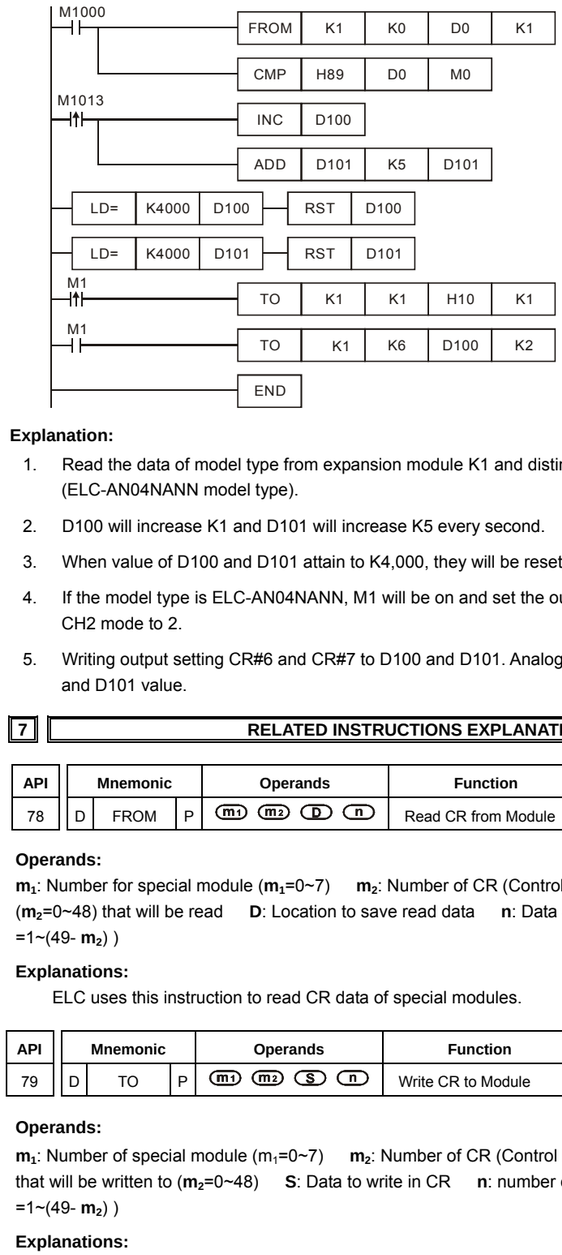
1. Please use 22-16AWG (1.5mm) wiring (either single or multiple core) for I/O wiring terminals. The specification for the terminals is as shown on the left. ELC terminal screws should be tightened to 1.95 kg-cm (1.7 lb-in). Use Copper Conductor Only, 60/75 °C.
2. I/O signal wires or power supply should 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. 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 voltage is higher than 19.5V.
3. When it connects to ELC MPU in series, RUN LED on MPU will be lit and A/D LED or D/A LED should blink.
4. After receiving the first RS-485 command during controlling via RS-485, A/D LED or D/A LED should blink.
5. After converting, ERROR LED should blink if input or output exceeds the upper bound or below the lower bound.

Program example:



Explanation:

1. Read the data of model type from expansion module K1 and distinguish if the data is H89 (ELC-AN04NANN model type).
2. D100 will increase K1 and D101 will increase K5 every second.
3. When value of D100 and D101 attain to K4,000, they will be reset to 0.
4. If the model type is ELC-AN04NANN, M1 will be on and set the output mode: CH1 mode to 0, CH2 mode to 2.
5. Writing output setting CR#6 and CR#7 to D100 and D101. Analog output will vary with D100 and D101 value.

7 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.