Eaton Logic Controller

Effective December 2010
Supersedes February 2008

Operation Manual

Powering Business Worldwide™

ELC Series

Operation Manual

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Safety Instructions

For the best results with the Eaton Logic Controller (ELC), carefully read this manual and all of the warning labels regarding the ELC before installing and operating it. Follow all instructions exactly and keep this manual handy for quick reference.

Safety notices are highlighted in this manual by a warning triangle and are marked as depending on the level of danger.

HIGH VOLTAGE: This symbol indicates high voltage. It calls your attention to items or operations that could be dangerous to you and other persons operating this equipment. Read the message and follow the instructions carefully.

WARNING: Indicates a potentially hazardous situation which, if not avoided, can result in serious injury or death.

- 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.
- 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 ⏚.
- DO NOT touch terminals when power on.

CAUTION: Indicates a potentially hazardous situation which, if not avoided, can result in minor to moderate injury, or serious damage to the product. The situation described in the CAUTION may, if not avoided, lead to serious results. Important safety measures are described in CAUTION (as well as **WARNING**).

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ELC Controllers

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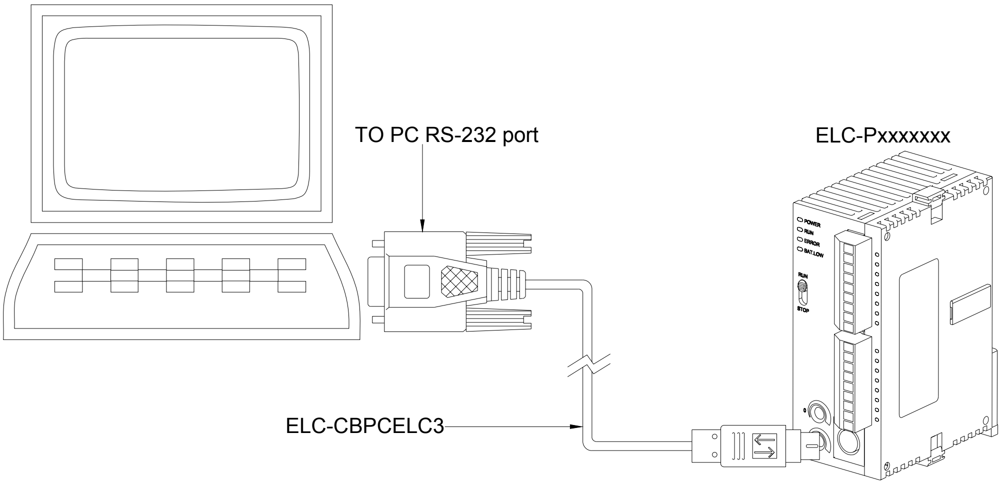
1.1 Connecting an ELC controller to a PC

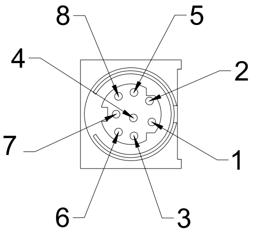
Connect a PC to an ELC controller via the ELC-CBPCELC3 programming cable. This cable is for a 9-pin RS-232 serial port on a PC (Communication port). If you do not have an RS232 port on your computer, any commercially available USB/RS232 device will work.



ELC communications - factory default settings (FOR ASCII):

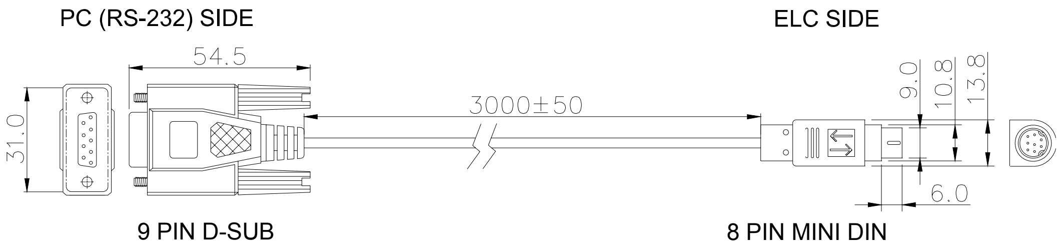
Protocol: 9600 Baud, 7 Data bits, Even Parity, 1 Stop Bit

Programming Port:



Pin no.	Abbreviation	Pin no.	Abbreviation
1	+5V	5	Tx
2	+5V	6	GND
3	GND	7	NC
4	Rx	8	GND

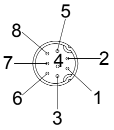
ELC-CBPCELC3:



PC/HMI COM Port ◄─► ELC COM1 Port
9 PIN D-SUB female 8 PIN MINI DIN

Rx 2 ◄─► 5 Tx
Tx 3 ◄─► 4 Rx
GND 5 ◄─► 8 GND
1,2 5V

1, 4, 6
7, 8



1.2 ELC Series

1.2.1 Specifications

1.2.1.1 Functions Specification

- **ELC-PB**

Items				Specifications		Remarks
Control method				Stored program, cyclic scan system		
I/O processing method				Batch processing method (when END instruction is executed)		Fast I/O refresh instruction can override batch update
Execution speed				Basic instructions – 3.5μ seconds minimum		Application instructions varies per instruction
Program language				Instruction List, Ladder Logic and SFC		
Program capacity				3792 Steps		Built-in EEPROM
Instructions				32 Basic instructions, Application instructions: 109		
Bit	X		External inputs	X0~X177, octal number system, 128 points max.	Total 256 I/O	Physical input points
	Y		External outputs	Y0~Y177, octal number system, 128 points max.		Physical output points
	M	Auxiliary relay	General	M0~M511, M768~M999 744 points Note 1	Total 1280 bits	Main internal relay area for general use.
			Latched	M512~M767, 256 points Note 3		
			Special	M1000~M1279, 280 points, some are latched		
	T	Timer	100ms	T0~T63, 64 points	Total 128 bits	Contact = ON when timer reaches preset value.
			10ms (M1028=ON)	T64~T126, 63 points		
			1ms	T127 1 points		
	C	Counter	16-bit count up	C0~C111, Note 1	Total 141 bits	Contact = ON when counter reaches preset value.
				C112~C127, Note 3		
			32bit high-speed count up/down	C235~C238, C241, C242, C244, 1 phase 1 input, 7 points Note 4		
				C246, C247, C249, 1 phase 2 input, 3 points Note 4		
				C251, C252, C254, 2 phase 2 input, 3 points Note 4		

Items				Specifications		Remarks
Bit	S	Step point	Initial step point	S0~S9, 10 points, Note 4	Total 128 bits	SFC usage S10~S19 is used with IST instruction
			Zero return	S10~S19, 10 points, Note 4		
			Latched	S20~S127, Note 4		
Word Register	T	Current value		T0~T127, 128 words		
	C	Current value		C0~C127, 16-bit counter,		
				C235~C254, 32-bit counter		
	D	Data register	General	D0~D407, Note 1	Total 912 words	General storage for word length data.
			Latched	D408~D599, Note 3		
			Special	D1000~D1311, 312 words		
			Index	E=D1028, F=D1029, Note 1		
Pointer	N	Master control loop		N0~N7, 8 points		
	P	Pointer		P0~P63, 64 points		Subroutines pointer
	I	Interrupt Service	External interrupt	I001 (X0), I101 (X1), I201 (X2), I301 (X3); 4 points (all are rising-edge trigger)		Address for interrupt subroutines
			Time interrupt	I610~I699, 1 points (Timer resolution = 1ms)		
			Communication	I150, 1 point		
Constant	K	Decimal		K-32,768 ~ K32,767 (16-bit operation) K-2,147,483,648 ~ K2,147,483,647 (32-bit operation)		
	H	Hexadecimal		H0000 ~ HFFFF (16-bit operation), H00000000 ~ HFFFFFFFF (32-bit operation)		
Serial ports				COM1: RS-232 (Slave), COM2: RS-485 (Master/Slave), Both can be used at the same time.		
Clock/Calendar (RTC)				None		
Special expansion modules				Attach up to 8 modules of any type analog I/O extension modules		

Notes:

1. Data area is non-latched.
2. Default is non-latched, optionally can be set to latched.
3. Default is latched, optionally can be set to non-latched.
4. Data area is latched.

■ ELC-PC/PA/PH

Items				Specifications		Remarks
Control method				Stored program, cyclic scan system		
I/O processing method				Batch processing method (when END instruction is executed)		Fast I/O refresh instruction can override batch update
Execution speed				Basic instructions – 2.5μ seconds minimum		Application instructions varies per instruction
Program language				Instruction List, Ladder Logic and SFC		
Program capacity				7920 STEPS		SRAM + Battery
Instructions				32 Basic instructions		178 Application instructions
Bit	X	External inputs		X0~X177, octal number system, 128 points max.	Total 256 I/O	Physical input points
	Y	External outputs		Y0~Y177, octal number system, 128 points max.		Physical output points
	M	Auxiliary relay	General	M0~M511, Note 1	Total 4096 bits	Main internal relay area for general use.
			Latched	M512~M999, Note 3		
				M2000~M4095, Note 3		
			Special	M1000~M1999 some are latched		
	T	Timer	100ms	T0~T199, Note 1	Total 256 bits	Contact = ON when timer reaches preset value.
				T192~T199 for Subroutine		
				T250~T255(accumulative), 6 points Note 4		
			10ms	T200~T239, Note 2		
				T240~T245(accumulative), 6 points, Note 4		
			1ms	T246~T249(accumulative), 4 points, Note 4		
	C	Counter	16-bit count up	C0~C95, Note 1	Total 235 bits	Contact = ON when counter reaches preset value.
				C96~C199, Note 3		
			32-bit count up/down	C200~C215, Note 1		
				C216~C234, Note 3		
			PC/PA series, 32bit high-speed count up/down	C235~C244, 1 phase 1 input, 9 points, Note 3	Total 16 bits	
				C246, C247, C249, 1 phase 2 input, 3 points, Note 1		
				C251, C252, C253, C254, 2 phase 2 input, 4 points, Note 3		

Items				Specifications		Remarks
Bit	C	Counter	PH series, 32bit high-speed count up/down	C235~C245, 1 phase 1 input, 11 points, Note 3	Total 19 bits	ELC-PH12xxxx only
				C246, C247, C249, C250, 1 phase 2 input, 4 points Note 1		
				C251, C252, C254, C255, 2 phase 2 input, 4 points, Note 3		
	S	Step point	Initial step point	S0~S9, 10 points Note 1	Total 1024 bits	Sequential Function Chart (SFC) usage
			Zero point return	S10~S19, 10 points (use with IST instruction) Note 1		
			General	S20~S511, 492 points Note 1		
			Latched	S512~S895, 384 points Note 3		
			Alarm	S896~S1023, 128 points Note 3		
Word Register	T	Current value		T0~T255, 256 words		
	C	Current value		C0~C199, 16-bit counter, 200 words		
				C200~C254, 32-bit counter		
	D	Data register	General	D0~D199, Note 1	Total 5000 words	General storage for word length data
			Latched	D200~D999, Note 3		
				D2000~D4999, Note 3		
			Special	D1000~D1999, 1000 words		
			Index	E0~E3, F0~F3, Note 1		
	None	File register		0~1599, 1600 words Note 4		Additional storage area to be used
Pointer	N	Master control loop		N0~N7, 8 points		Master control nested loop
	P	Pointer		P0~P255, 256 points		Subroutine pointer
	I	Interrupt Service	External interrupt	I001 (X0), I101 (X1), I201 (X2), I301 (X3), I401 (X4), I501 (X5); 6 points (all are rising-edge trigger)		Address for interrupt subroutines
			Time interrupt	I601~I699, I701~I799, 2 points (Timer resolution = 1ms)		
			Hi-speed counter	I010, I020, I030, I040, I050, I060; 6 points		
			Communication	I150, 1 points		

Items			Specifications
Constant	K	Decimal	K-32,768 ~ K32,767 (16-bit operation), K-2,147,483,648 ~ K2,147,483,647 (32-bit operation)
	H	Hexadecimal	H0000 ~ HFFFF (16-bit operation), H00000000 ~ HFFFFFFFF (32-bit operation)
Serial ports			COM1: RS-232 (Slave), COM2: RS-485 (Master/Slave) Both can be used at the same time. COM1 is typically the programming port.
Clock/Calendar (RTC)			Year, Month, Day, Week, Hours, Minutes, Seconds
Analog volume dial			ELC-PC12xxxx, ELC-PH12xxxx only
Special expansion modules			Attach up to 8 modules of any type analog I/O extension modules

Notes:

1. Data area is non-latched.
2. Default is non-latched, optionally can be set to latched.
3. Default is latched, optionally can be set to non-latched.
4. Data area is latched.

ELC-PV

Items				Specifications		Remarks
Control method				Stored program, cyclic scan system		
I/O processing method				Batch processing method (when END instruction is executed)		Fast I/O refresh instruction can override batch update
Execution speed				Basic instructions – 0.24μ seconds minimum		Application instructions varies per instruction
Program language				Instructions, Ladder Logic and SFC		
Program capacity				15872 STEPS		SRAM + Battery
Instructions				32 Basic instructions		197 Application instructions
Bit	X	External inputs		X0~X377, octal number system, 256 points max.	Total 512 I/O	Physical input points
	Y	External outputs		Y0~Y377, octal number system, 256 points max.		Physical output points
	M	Auxiliary relay	General	M0~M511, Note 2	Total 4096 bits	Main internal relay area for general use.
			Latched	M512~M999, Note 3		
				M2000~M4095, Note 3		
			Special	M1000~M1999 some are latched		
	T	Timer	100ms	T0~T199, Note 2	Total 256 bits	Contact = ON when timer reaches preset value.
				T192~T199 for Subroutine		
				T250~T255(accumulative), 6 points Note 4		
			10ms	T200~T239, Note 2		
				T240~T245(accumulative), 6 points, Note 4		
			1ms	T246~T249(accumulative), 4 points, Note 4		
	C	Counter	16-bit count up	C0~C99, Note 2	Total 235 bits	Contact = ON when counter reaches preset value.
				C100~C199, Note 3		
			32-bit count up/down	C200~C219, Note 2		
				C220~C234, Note 3		
			32bit high-speed count up/down	C235~C244, 1 phase 1 input, 10 points, Note 3	Total 18 bits	
				C246~C249, 1 phase 2 input, 4 points, Note 3		
				C251~C254, 2 phase 2 input, 4 points, Note 3		

Items				Specifications		Remarks
Bit	S	Step point	Initial step point	S0~S9, 10 points Note 2	Total 1024 bits	Sequential Function Chart (SFC) usage
			Zero point return	S10~S19, 10 points (use with IST instruction) Note 2		
			General	S20~S499, 480 points Note 2		
			Latched	S500~S899, 400 points Note 3		
			Alarm	S900~S1023, 124 points Note 3		
Word Register	T	Current value		T0~T255, 256 words		
	C	Current value		C0~C199, 16-bit counter, 200 words		
				C200~C254, 32-bit counter, 53 words		
	D	Data register	General	D0~D199, Note 2	Total 10000 words	General storage for word length data
			Latched	D200~D999, Note 3		
				D2000~D9999, Note 3		
			Special	D1000~D1999, 1000 words		
			Index	E0~E7, F0~F7, Note 1		
	None	File register		0~9999, 10000 words, Note 4		Additional storage area to be used
Pointer	N	Master control loop		N0~N7, 8 points		Master control nested loop
	P	Pointer		P0~P255, 256 points		Subroutine pointer
	I	Interrupt Service	External interrupt	I000/I001(X0), I100/I101(X1), I200/I201(X2), I300/I301(X3), I400/I401(X4), I500/I501(X5), 6 points (01, rising-edge trigger _|¯, 00, falling-edge trigger ¯|_)		Address for interrupt subroutines
			Time interrupt	I601~I699, I701~I799, 2 points (Timer resolution = 1ms) I801~I899, 1 points (Timer resolution = 0.1ms)		
			Interruption inserted when high-speed counter reaches target	I010, I020, I030, I040, I050, I060, 6 points		
			Pulse interruption	I110, I120, I130, I140, 4 points		
			Hi-speed counter	I010, I020, I030, I040, I050, I060; 6 points		
			Communication	I150, I160, I170, 3 points		

Items			Specifications	Remarks
Constant	K	Decimal	K-32,768 ~ K32,767 (16-bit operation), K-2,147,483,648 ~ K2,147,483,647 (32-bit operation)	
	H	Hexadecimal	H0000 ~ HFFFF (16-bit operation), H00000000 ~ HFFFFFFFF (32-bit operation)	
Serial ports			COM1: RS-232 (Slave), COM2: RS-485 (Master/Slave) Both can be used at the same time. COM1 is typically the programming port.	
Clock/Calendar (RTC)			Year, Month, Day, Week, Hours, Minutes, Seconds	
Analog volume dial			2	
Special expansion modules			Attach up to 8 modules of any type analog I/O extension modules	
High speed expansion modules			Left side expansion port: Attach up to 8 high speed modules	

Notes:

1. Data area is non-latched.
2. Default is non-latched, optionally can be set to latched.
3. Default is latched, optionally can be set to non-latched.

1.2.1.2 Electrical Specifications

- **ELC-PB**

Model Item	ELC-PB14NNDR	ELC-PB14NNDT
Power supply voltage	24VDC (-15%~+20%) (the counter-connection protection towards the DC input power polarity is included)	
Fuse	2A / 250VAC	
Power consumption	3.5W MAX	
Weight (approx.)	109g	93g

- **ELC-PC**

Model Item	ELC-PC12NNDR	ELC-PC12NNDT	ELC-PC12NNAR
Power supply voltage	24VDC (-15%~+20%) (With DC input reverse polarity protection) Expansion Unit: supplied by the ELC		
Fuse	2A / 250VAC		
Power consumption	3.5W MAX		
Weight (approx.)	140g	135g	140g

- **ELC-PA**

Model Item	ELC-PA10AADR	ELC-PA10AADT
Power supply voltage	24VDC (-15%~+20%) (With DC input reverse polarity protection) Extension Unit: supplied by the ELC	
Fuse	2A / 250VAC	
Power consumption	5W MAX	
Weight (approx.)	139g	135g

- **ELC-PH**

Model Item	ELC-PH12NNDT
Power supply voltage	24VDC (-15%~20%) (With DC input reverse polarity protection), Extension Unit: supplied by the MPU
Fuse	2A / 250VAC
Power consumption	4W MAX
Weight (approx.)	136g

- **ELC-PV**

Model / Item	ELC-PV28NNDR	ELC-PV28NNDT
Power supply voltage	24VDC (-15% ~ 20%) (with counter-connection protection on the polarity of DC input power)	
Inrush current	Max. 2.2A@24VDC	
Fuse	2.5A / 30VDC, Polyswitch	
Power consumption	6W MAX	
Weight (approx.)	266g	240g

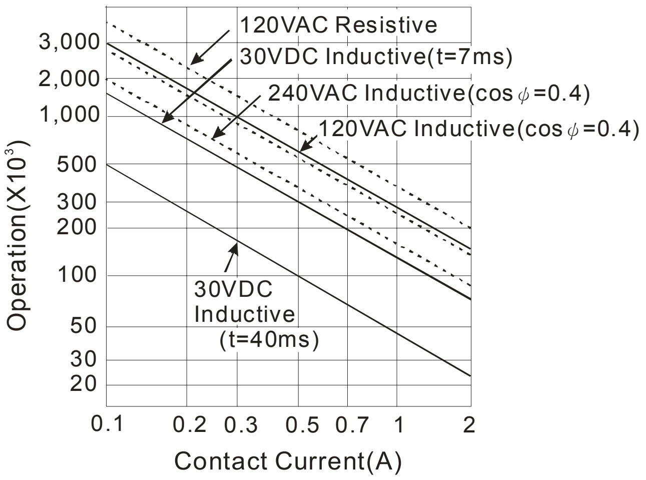
1.2.1.3 Input/Output Point Electrical Specifications

- **ELC-PB**

DC Input Point Electrical Specification			
Input no.		X0, X1	X2 ~ X7
Input type		DC (SINK or SOURCE)	
Input current		24VDC 5mA	
Active level	Off→On	> 18.5VDC	> 16.5VDC
	On→Off	< 5VDC	
Responds time	Off→On	< 3.5μs	< 8μs
	On→Off	< 20μs	< 60μs
Filter time		Adjustable within 0 ~ 20ms by D1020 (Default: 10ms)	

Output Point Electric Specifications				
Output type		Relay-R	Transistor-T	
Output no.		Y0 ~ Y3	Y0, Y1	Y2 ~ Y5
Voltage specifications		< 240VAC, 30VDC	30VDC	
Max. load	Resistive	1.5A/1 point (5A/COM)	0.3A/1 point @ 40℃; When the output of Y0 and Y1 is high-speed pulse, Y0 and Y1 = 30mA	
	Inductive	#1	9W (30VDC)	
	Lamp	20WDC/100WAC	1.5W (30VDC)	
Responds time	Off→On	About 10ms	< 20us	< 100us
	On→Off		< 30us	< 100us

#1: Life curves



- **ELC-PC**

DC Input Point Electrical Specification			
Input no.		X0, X1	X2 ~ X7
Input type		DC (SINK or SOURCE)	
Input current		24VDC 5mA	
Active level	Off→On	> 18.5VDC	> 16.5VDC
	On→Off	< 5VDC	
Responds time	Off→On	< 3.5μs	< 8μs
	On→Off	< 20μs	< 60μs
Filter time		Adjustable within 0 ~ 20ms by D1020 (Default: 10ms)	

AC Input Point Electrical Specification	
Rated input voltage	100 to 120 VAC (-15%~+10%)
Max. Input current	Less than 20mA
Min. On voltage	80VAC
Max. Off voltage	30VAC

Output Point Electrical Specification					
Output type		Relay-R	Transistor-T		
Output no.		Y0 ~ Y3	Y0	Y1	Y2 ~ Y3
Voltage specification		< 240VAC, 30VDC	30VDC		
Max. load	Resistive	1.5A/1 point (5A/COM)	0.3A/1 point @ 40°C; When the output of Y0 and Y1 is high-speed pulse, Y0 and Y1 = 30mA		
	Inductive	#1	9W (30VDC)		
	Lamp	20WDC/100WAC	1.5W (30VDC)		
Responds time	Off→On	About 10ms	< 150ns	< 20us	< 100us
	On→Off		< 3us	< 30us	< 100us

#1: For relay life curves, refer to the ELC-PB controller above.

ELC-PA

DC Input Point Electrical Specification			
Input no.		X0, X1	X2, X3
Input type		DC (SINK or SOURCE)	
Input current		24VDC 5mA	
Active level	Off→On	> 18.5VDC	> 16.5VDC
	On→Off	< 5VDC	
Responds time	Off→On	< 3.5μs	< 8μs
	On→Off	< 20μs	< 60μs
Filter time		Adjustable within 0 ~ 20ms by D1020 and D1021 (Default: 10ms)	

Output Point Electrical Specification				
Output type		Relay-R	Transistor-T	
Output no.		Y0, Y1	Y0	Y1
Voltage specification		< 240VAC, 30VDC	30VDC	
Max. load	Resistive	1.5A/1 point (5A/COM)	0.3A/1 point @ 40˚C; When the output of Y0 and Y1 is high-speed pulse, Y0 and Y1 = 30mA	
	Inductive	#1	9W (30VDC)	
	Lamp	20WDC/100WAC	1.5W (30VDC)	
Responds time	Off→On	About 10ms	< 150ns	< 20us
	On→Off		< 3us	< 30us

#1: For relay life curves, refer to the ELC-PB controller above..

Items	Analog/ Digital (A/D)		Digital/Analog (D/A) Module	
	Voltage input	Current input	Voltage Output	Current Output
Analog output range	±10V	±20mA	±10V	±20mA
Digital data range	±2,000	±1,000	±2,000	±2,000
Resolution	12 bits (1_{LSB}=5mV)	11 bits (1_{LSB}=20μA)	12 bits (1_{LSB}=5mV)	12 bits (1_{LSB}=10μA)
Input impedance	200kΩ and above	250Ω	-	
Output impedance	-		0.5Ωor lower	
Carried impedance	-		1KΩ~2MΩ	0～500Ω
Overall accuracy	±1% of full scale during 0~55˚C (32~131˚F)			
Response time	10ms × channels			
Absolution input range	±15 V	±32 mA	-	
Digital data format	2’s complement of 16-bit, (11 Significant Bits)			
Average function	Yes		-	
Isolation method	There is no isolation between digital and analog circuitry.			

Items	Analog/ Digital (A/D)		Digital/Analog (D/A) Module	
	Voltage input	Current input	Voltage Output	Current Output
Self diagnostic function self detection	Upper bound and lower bound detection per channel			
Protection	Voltage output has short circuit protection but short circuit for a long time may cause inner wiring damage and current output break.			

- **ELC-PH**

DC Input Point Electrical Specification			
Input no.		X0, X1, X10, X11	X2 ~ X5
Input type		Photo coupler Isolation	
Input current		24VDC 5mA	
Active level	Off→On	> 18.5VDC	> 16.5VDC
	On→Off	< 5VDC	
Responds time	Off→On	< 3.5μs	< 8μs
	On→Off	< 20μs	< 60μs
Filter time	X0 ~ X5	Adjustable within 0 ~ 20ms by D1020 (Default: 10ms)	
	X10, X11	The constant of filter time is 4.7us or 0~1,000 times by D1021	

Output Point Electrical Specification			
Output type		Transistor	
Output no.		Y0, Y1	Y10, Y11
Voltage specification		5 ~ 30VDC	
Max. load	Resistive	0.3A/1 point @ 40°C; When the output of Y0, Y1, Y10 and Y11 is high-speed pulse, Y0,Y1, Y10 and Y11 = 30mA	
	Inductive	9W (30VDC)	
	Lamp	1.5W (30VDC)	
Output protection	Internal	None	
	Outside	Rated value according to the load	
Responds time	Off→On	< 20us	< 0.2us
	On→Off	< 30us	< 0.2us

- **ELC-PV**

DC Input Point Electrical Specification			
Spec. Items	24VDC single common port input		
Input No.	X0, X1, X4, X5	X10, X11, X14, X15	X6, X7, X12, X13, X16, X17
Input voltage	24VDC, 5mA		
Input impedance	4.7K Ohm	3.3K Ohm	4.7K Ohm

DC Input Point Electrical Specification				
Spec. / Items		24VDC single common port input		
Active level	Off→On	> 4mA (16.5V)	> 6mA (18.5V)	> 4mA (16.5V)
	On→Off	< 1.5mA (5V)	< 2.2mA (5V)	< 1.5mA (5V)
Responds time	Off→On	< 150ns	< 3.5μs	< 8μs
	On→Off	< 3μs	< 20μs	< 60μs
Filter time		Adjustable within 10 ~ 60ms by D1020, D1021 (Default: 10ms)		

Output Point Electrical Specification					
Output point type		Relay-R	Transistor-T		
Output point number		All	Y0, Y1, Y2, Y3, Y4, Y6	Y5 ~ Y7, Y10 ~ Y13	Y14 ~ Y17, Y20 ~ [#1]
Voltage specification		< 240VAC, 30VDC	5 ~ 30VDC [#2]		
Max. load	Resistive	1.5A/1 point (5A/COM)	0.3A/1 point @ 40°C; When the output of Y0~Y4 and Y6 is high-speed pulse, Y0~Y4 and Y6 = 30mA		
	Inductive	[#3]	9W (30VDC)		
	Lamp	20WDC/100WAC	1.5W (30VDC)		
Responds time	Off → On	Approx .10ms	< 0.2μs	< 20us	<100μs
	On → Off		< 0.2μs	< 30us	<100μs

#1: Please refer to “I/O Terminal Layout” for the max. X/Y No. on each model.

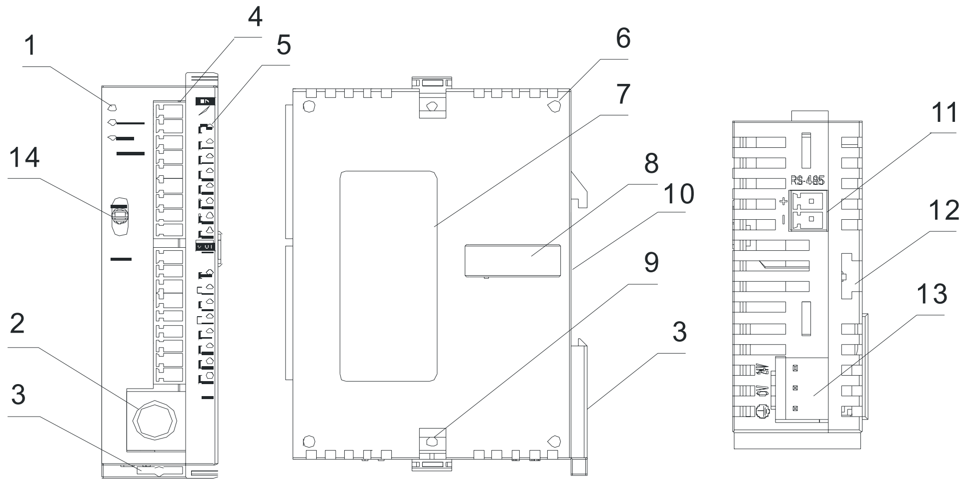
#2: UP, ZP must work with external auxiliary power supply 24VDC (-15% ~ +20%), rated consumption approx. 1mA/point.

#3: For relay life curves, refer to the ELC-PB controller above..

1.2.2 Product Outline and Dimension

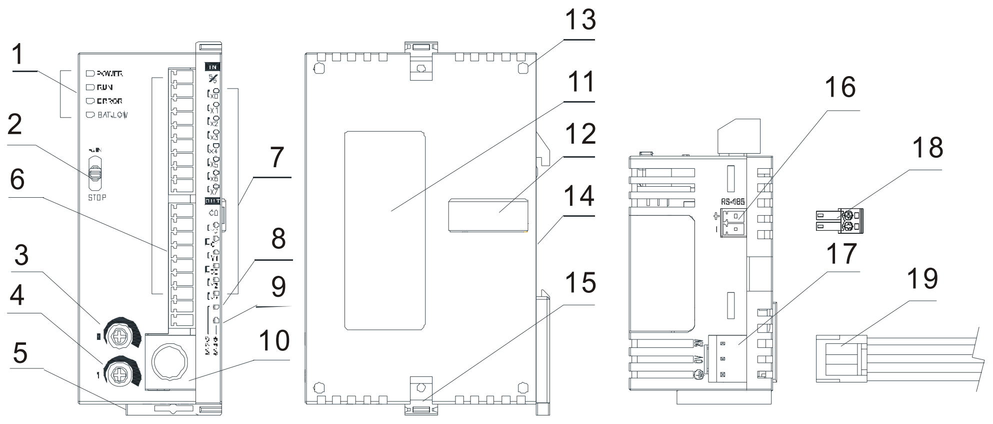
1.2.2.1 Product Outline

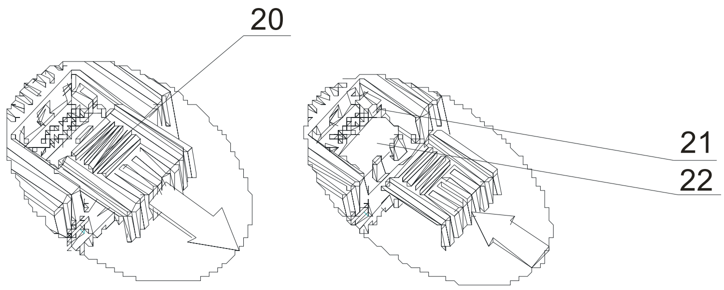
- **ELC-PB**



1.	Status indicator (Power, RUN and ERROR)	8.	Extension port
2.	COM1 (RS-232) programRS232 Programming port	9.	Extension hook
3.	DIN rail clip	10.	DIN rail mounting slot (35mm)
4.	I/O terminals	11.	COM2 (RS-485) communication port
5.	I/O point indicators	12.	Extension hook
6.	Mounting hole of the extension unit	13.	DC Power input
7.	Nameplate	14.	RUN/STOP switch

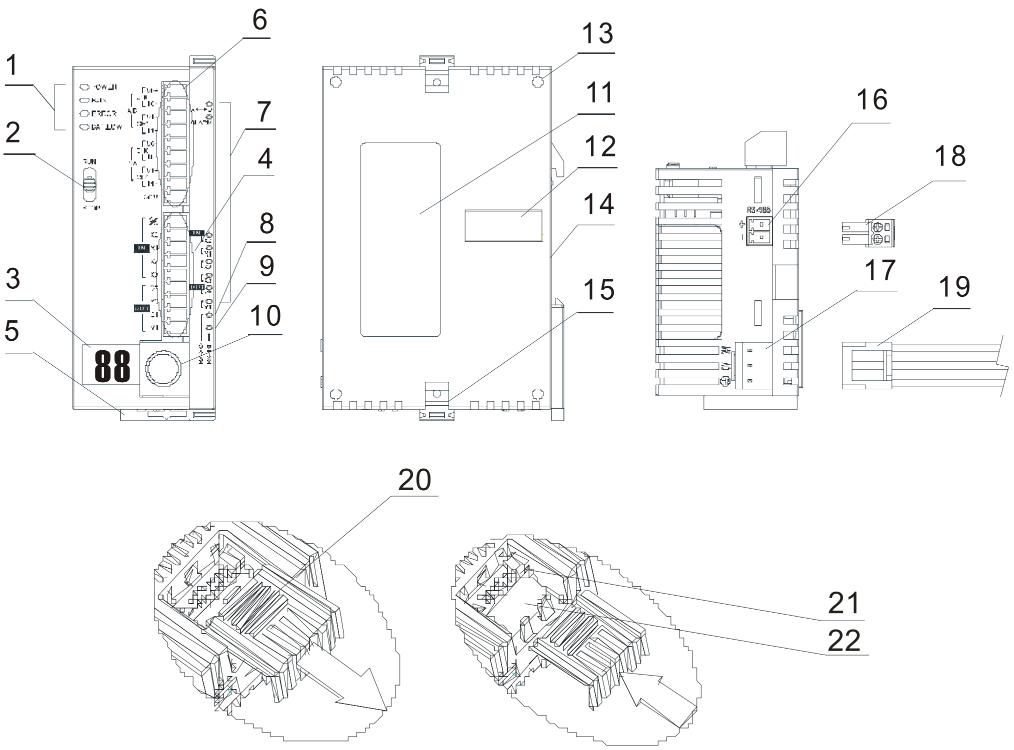
■ ELC-PC





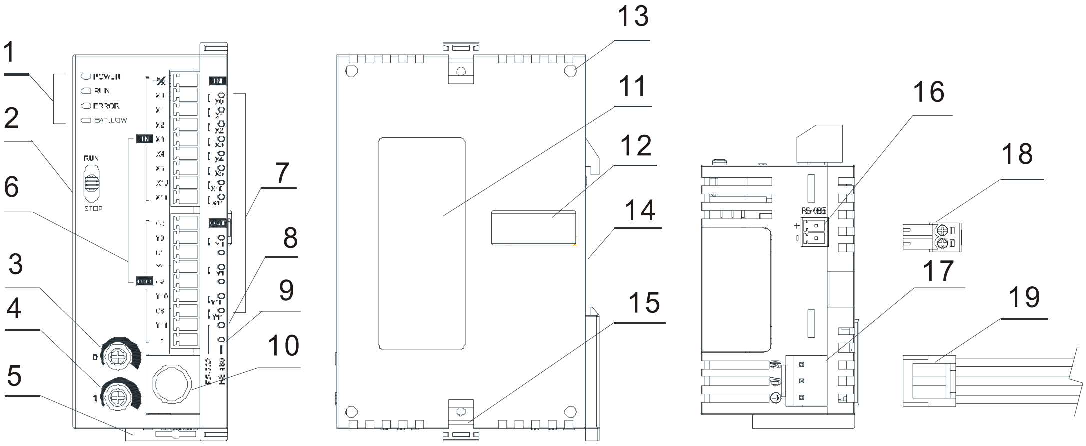
1. Status indicator: POWER, RUN, ERROR, BAT.LOW
2. RUN/STOP switch
3. VR0: M1178 Start-up/D1178 Corresponding value
4. VR1: M1179 Start-up/D1179 corresponding value
5. DIN rail clip
6. I/O terminals
7. I/O point indicators
8. COM1 (RS-232) (Rx) indicator
9. COM2 (RS-485) (Tx) indicator
10. COM1 (RS-232) programming port
11. Nameplate
12. Extension port
13. Mounting hole of the extension unit
14. DIN rail mounting slot (35mm)
15. Extension hook
16. COM2 (RS-485) Communication port
17. DC Power input
18. 2 pin removable terminal (standard accessory)
19. Power input cable (standard accessory)
20. Battery Cover
21. Battery socket connection
22. Battery mount

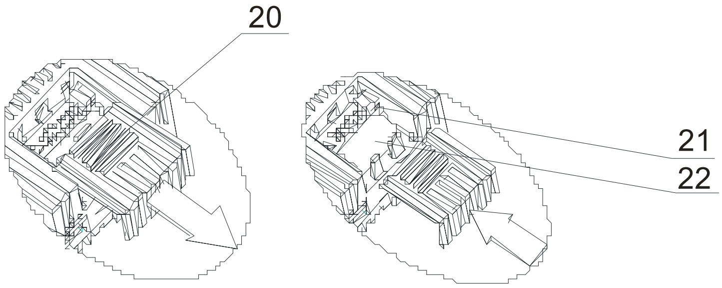
■ ELC-PA



1. Status indicator: POWER, RUN, ERROR, BAT.LOW, A↔D, ALARM	12. Extension port
2. RUN/STOP switch	13. Mounting hole of the extension unit
3. 2-digital 7-segment display	14. DIN rail mounting slot (35mm)
4. Digital I/O terminal	15. Extension hook
5. DIN rail clip	16. COM2 (RS-485) Communication port
6. Analog I/O terminals	17. DC Power input
7. I/O point indicators	18. 2 pin removable terminal (standard accessory)
8. COM1 (RS-232) (Rx) indicator	19. Power input cable (standard accessory)
9. COM2 (RS-485) (Tx) indicator	20. Battery cover
10. COM1 (RS-232) programming port	21. Battery socket connection
11. Nameplate	22. Battery mount

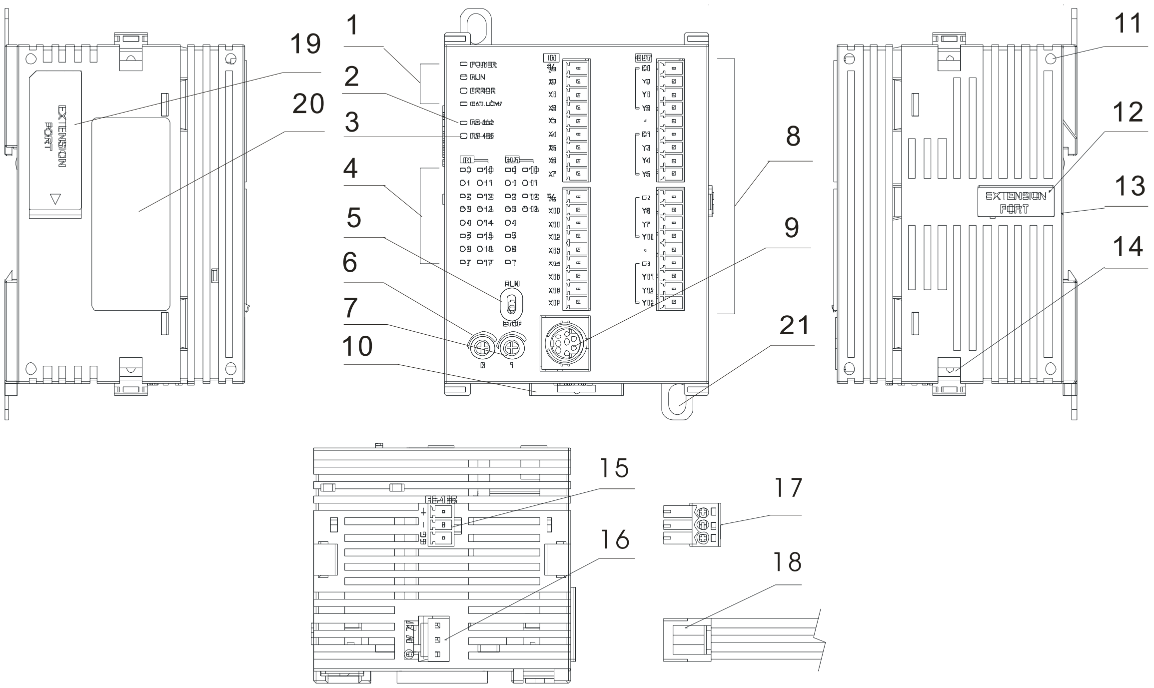
ELC-PH





1. Status indicators of POWER, RUN, ERROR and BAT.LOW
2. RUN/STOP switch
3. VR0: Start-up by M1178/D1178 Corresponding value
4. VR1: Start-up by M1179/D1179 Corresponding value
5. DIN rail clip
6. I/O terminals
7. I/O point indicators
8. COM1 (RS-232) (Rx) indicator
9. COM2 (RS-485) (Tx) indicator
10. COM1 (RS-232) programming port
11. Nameplate
12. Extension port
13. Mounting hole
14. DIN rail mounting slot (35mm)
15. Extension hook
16. COM2 (RS-485) communication port (Master/Slave)
17. DC Power input
18. 2 pin removable terminal (standard accessory)
19. Power input cable (standard accessory)
20. Battery cover
21. Battery socket connection
22. Battery holder

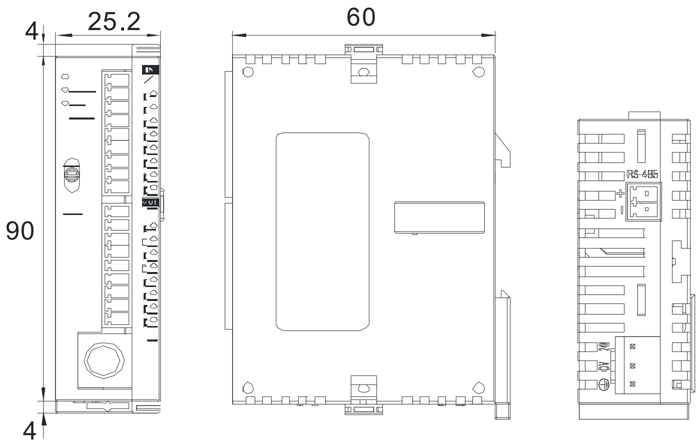
■ ELC-PV



1. Status indicators of POWER, RUN, BAT.LOW and ERROR
2. COM1 (RS-232) (Rx) indicator
3. COM2 (RS-485) (Tx) indicator
4. I/O point indicators
5. RUN/STOP switch
6. VR0: Start-up by M1178/D1178 corresponding value
7. VR1: Start-up by M1179/D1179 corresponding value
8. I/O terminal
9. COM1 (RS-232) programming port
10. DIN rail clip
11. Extension module positioning hole
12. Extension port for wire to connect extension module/unit
13. DIN rail mounting slot (35mm)
14. Extension hook
15. COM2 (RS-485) communication port (Master/Slave)
16. DC Power input
17. 3 pin removable terminal (standard component)
18. Power input cable (standard accessory)
19. High-speed extension module connection port
20. Nameplate
21. Direct mounting hole (retractable)

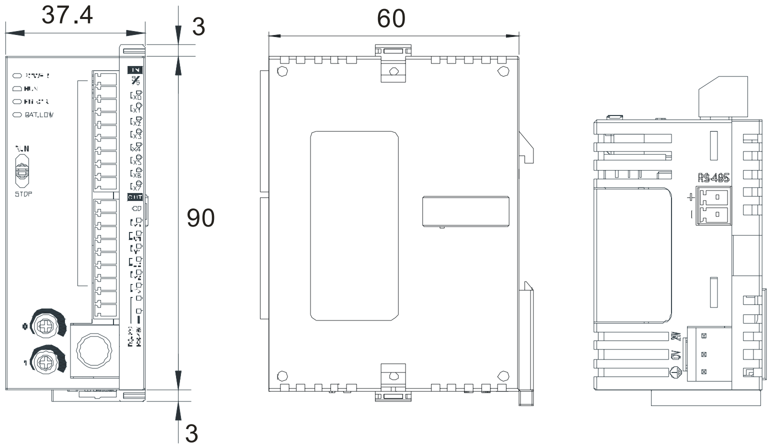
1.2.2.2 Dimension

- **ELC-PB**



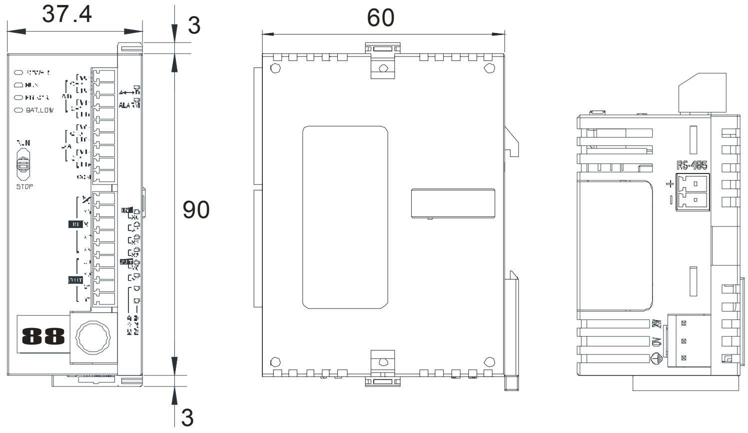
Unit: mm

- **ELC-PC**



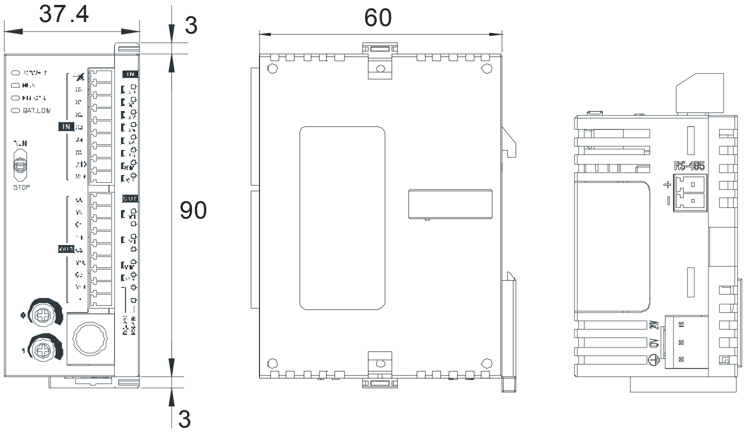
Unit: mm

- **ELC-PA**



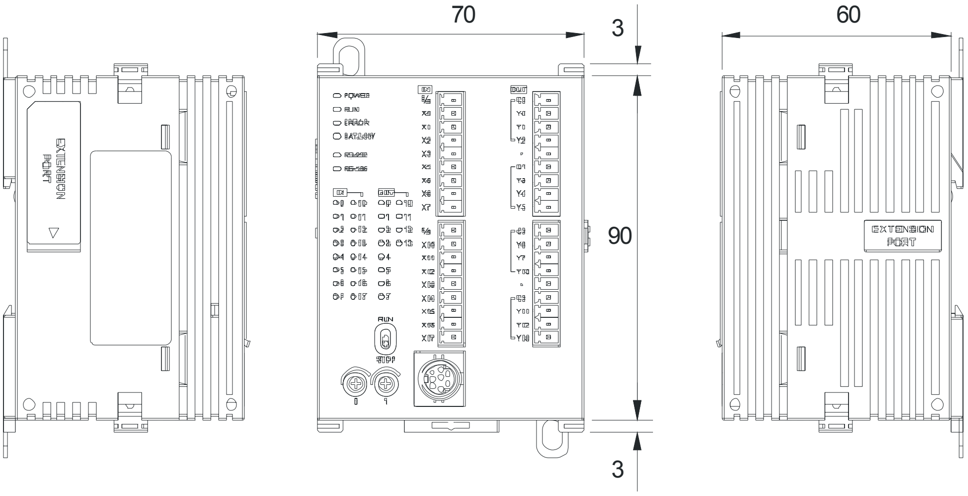
Unit: mm

- **ELC-PH**



Unit: mm

- **ELC-PV**



Unit: mm

1.2.3 Power Consumption

The current consumed at the power supply connector of the control unit is the sum of the current consumed by of the various units being used.

Type		Current consumption (at 24V DC)
Control unit	ELC-PA10AADR/T	210mA or less
	ELC-PB14NNDR/T	150mA or less
	ELC-PC12NNDR/T	150mA or less
	ELC-PC12NNAR	150mA or less
	ELC-PH12NNDT	170mA or less
	ELC-PV28NNDR/T	220mA or less

Type		Current consumption (at 24V DC)
Digital Input/Output extension unit	ELC-EX08NNDN	50mA or less
	ELC-EX08NNAN	50mA or less
	ELC-EX08NNNR/T	70mA or less
	ELC-EX08NNDR/T	70mA or less
	ELC-EX16NNDR/T	90mA or less
	ELC-EX06NNNI	70mA or less
	ELC-EX08NNSN	20mA or less
	ELC-CODNET	70mA or less
	ELC-COPBDP	50mA or less
Handheld Programmer	ELC-HHP	70mA or less

Current consumed when the unit requires an external power supply

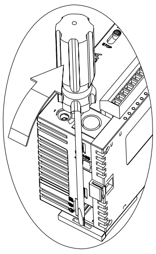
With an analog I/O unit, it is necessary to provide a power supply do drive internal circuits.

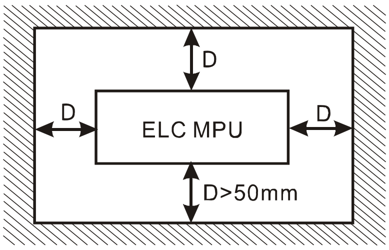
Type		Current consumption (at 24V DC)
Analog Input/Output extension unit	ELC-AN02NANN	125mA or less
	ELC-AN04ANNN	90mA or less
	ELC-PT04ANNN	90mA or less
	ELC-TC04ANNN	90mA or less
	ELC-AN06AANN	90mA or less
	ELC-AN04NANN	170mA or less
Motion Unit	ELC-MC01	110mA or less
Network Extension Units	ELC-CODNETM	110mA or less
	ELC-COENETM	65mA or less
	ELC-CAENET	90mA or less
	ELC-CARS485	70mA or less
	ELC-CADNET	90mA or less
	ELC-CAPBDP	110mA or less

1.2.4 Installation and Wiring

1.2.4.1 Installation

Install the ELC in an enclosure with sufficient space around it to allow heat dissipation, as shown in the figure.

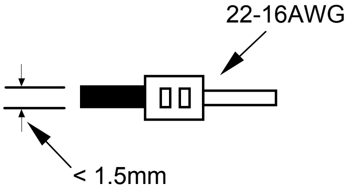




- **DIN Rail Mounting:** The ELC can be secured to a cabinet by using 35mm height and 7.5mm in depth DIN rail. When mounting the ELC to 35mm DIN rail, be sure to use the retaining clip to stop any side-to-side movement of the ELC and reduce the chance of wires coming loose. The retaining clip is at the bottom of the ELC. To secure the ELC to DIN rail, pull the clip down, place it onto the rail and push the clip back up. To remove the ELC, pull the retaining clip down with a flat screwdriver and remove the ELC from the DIN rail.
- **Direct Mounting:** Use M4 screws for direct mounting of the product.

1.2.4.2 Terminal Torque

1. Use the 22-16 AWG (1.5mm) single-core wire or multi-core wire for the I/O wiring. The specification of the terminal is shown in the figure on the right hand side. The ELC terminal screws should be tightened to 1.95 kg-cm (1.7 in-lbs).



2. DO NOT wire empty terminals. DO NOT place the input signal wire and output power wire in the same wiring circuit.
3. Field wiring terminals shall be marked with tightening torque.
4. DO NOT drop tiny metallic conductors into the ELC during installation.
   - Attach the dustproof sticker to the ELC before the installation to prevent conductive objects from dropping in.
   - Tear off the sticker before running the ELC to ensure normal heat dissipation.

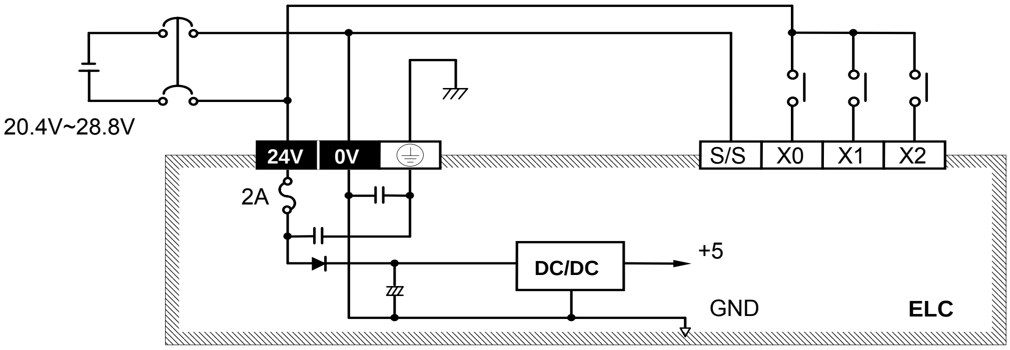
1.2.4.3 Power Supply

1. When DC voltage is supplied to the ELC, make sure the power is connected to the 24VDC and

0V terminals (power range is 20.4VDC~28.8VDC). When the voltage is below 20.4VDC, the ELC will stop operating, all outputs will turn OFF and the ERROR LED will flash continuously.

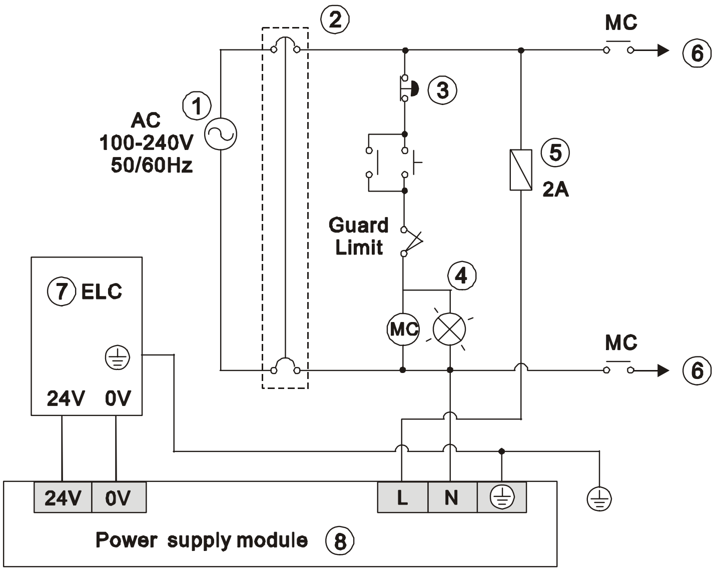
2. If the power dips for less than 10ms, the ELC will operate unaffected. If the power dip time is longer, the ELC will stop operating and all the outputs will be turned Off. Once the power is restored, the ELC will return to normal operation automatically.

DC Power Input



1.2.4.4 Safety Wiring

Below is the recommended wiring for the power input:



1.	AC power supply:100 ~ 240VAC, 50/60Hz		
2.	Circuit Breaker		
3.	Emergency Stop		
4.	Power Indicator	5.	Power Circuit Protection Fuse (2A)
6.	AC Power Loading	7.	ELC(main processing unit)
8.	ELC-PS01/24VDC Power Supply Module		

1.2.4.5 I/O Point Wiring

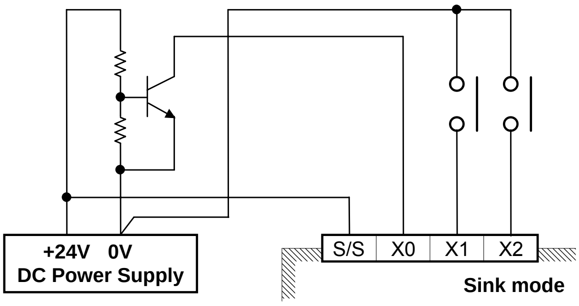
- **ELC-PB**

Input Point Wiring

There are 2 types of DC inputs, SINK and SOURCE. (Below is an example. or additional information, refer to the specifications for each module.)

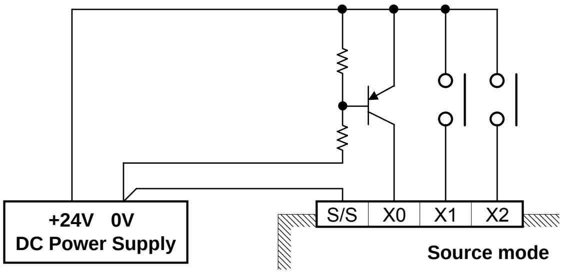
- DC Signal IN – SINK mode

  Input circuit

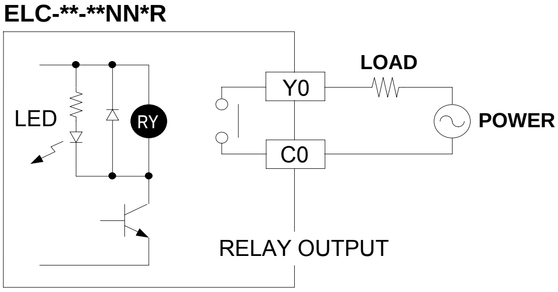


- DC Signal IN – SOURCE mode

  Input circuit



Output Wiring



1. ELC-PB series has two output types, relay and transistor. See “Functional Specifications” for additional information.
2. When output points are enabled, their corresponding indicators on the front panel will be on.
3. Isolation circuit: The optical coupler is used to isolate signals between the circuit inside ELC and input modules.

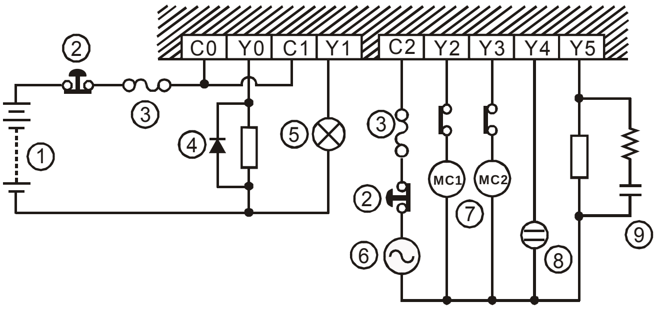
Overload Capacity of the Output Terminal

Every output contact has an overload capacity that is twice the rated current for 5 minutes. The common circuit has an overload capacity of 1.5 times the rated current for 2 minutes. If the range is exceeded, a failure of the contact may result. .

There are two types of output modules for the ELC: the relay and the transistor. Refer to Functions & Specifications for relevant electric specifications.

Isolation Circuit: the photocoupler is utilized as the signal isolation between the internal circuit of the ELC and output module.

The Relay Output Circuit Wiring



1. DC power supply	2. Emergency stop: Uses external switch
3. Fuse: Uses 5 ~ 10A fuse at the shared terminal of output contacts to protect the output circuit.	
4. Flywheel diode: To extend the life span of contact *1	
5. Incandescent light (resistive load)	6. AC power supply
7. Manually exclusive output *3	
8. Neon indicator	
9. Varistor: To reduce the interference on AC load *2	

*1: For switching direct current on inductive loads, a reverse-current protection diode should be installed in parallel with the load. The relay contact life decreases significantly if this is not done.

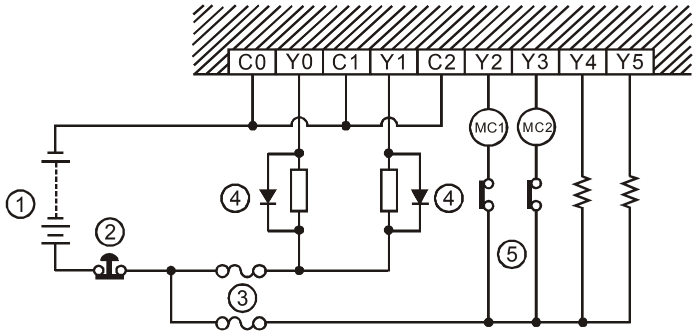
The reverse-current protection diode needs to satisfy the following specifications.

- The diode is rated for maximum reverse voltage of 5~10 times the load voltage.
- The forward current is more that the load current

*2: For switching AC on inductive loads, a surge absorber (0.1uF + “100ohm to 120ohm”) should be installed in parallel with the load. The relay contact life decreases significantly if this is not done.

*3: Ensure all loads are applied to the same side of each ELC output, see the figure above. Loads which should NEVER simultaneously operate (e.g. direction control of a motor), because of a critical safety situation, should not rely on the ELC’s sequencing alone. Mechanical interlocks MUST be fitted to all critical safety circuits.

The Transistor Output Circuit Wiring



1. DC power supply	2. Emergency stop
3. Circuit protection fuse	4. Flywheel diode + inductive load
5. Manually exclusive output *1	

*1: Transistor outputs use internal zener diode (39V) as protection circuitry. When driving the inductive load with a transistor output, a reverse-current protection diode can be installed in parallel with the load if necessary.

The reverse-current protection diode needs to satisfy the following specifications.

- The diode is rated for maximum reverse voltage of 5 to 10 times the load voltage.
- The forward current is more than the load current.

■ ELC-PC

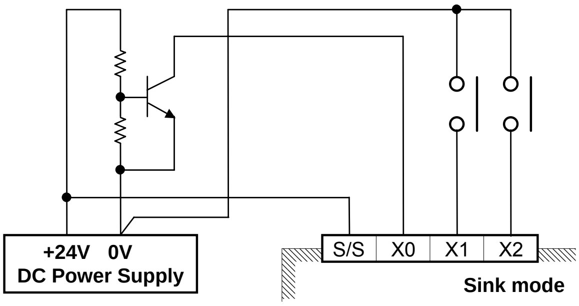
Input Wiring

DC Type Wiring

There are 2 types of DC inputs, SINK and SOURCE. (Below is an example. For additional information, refer to the specifications for each module.)

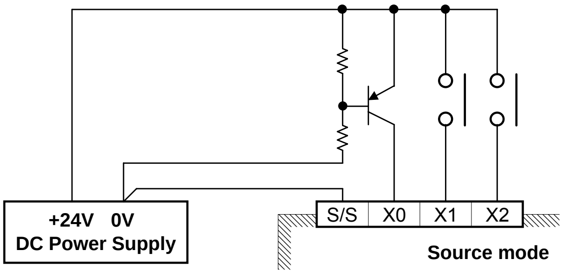
- DC Signal IN – SINK mode

  Input circuit

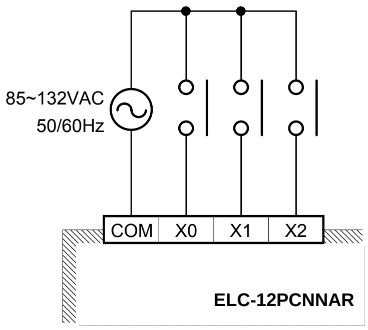


- DC Signal IN – SOURCE mode

Input circuit



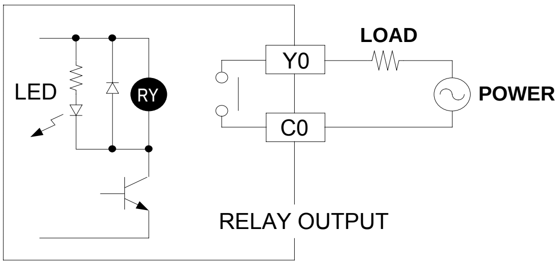
AC Type Wiring

Input Circuit Connection


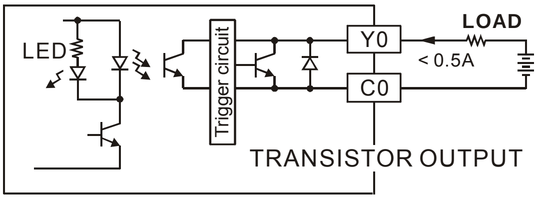
110V AC Input Specifications	
Input voltage	100~120VAC (-15%~+10%)
Input impedance	21Kohm/50Hz 18Kohm/60Hz
Input current	4.7mA 100VAC/50Hz 6.2mA 110VAC/60Hz
OFF→ON / ON→OFF	80V 3.8mA/30V 1.7mA
Response time	OFF→ON: 30ms ON→OFF: 50ms
Circuit isolation/Operation indication	Photocoupler/LED On

Output Wiring

ELC--**NN*R**

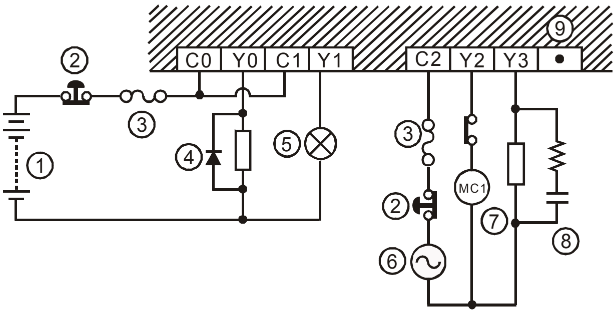


ELC--**NN*T**



1. ELC-PC series has two output types, relay and transistor. See "Function Specifications" for additional information.
2. When output points are enabled, their corresponding indicators on the front panel will be on.
3. Isolation circuit: The optical coupler is used to isolate signals between the circuit inside ELC and input modules.

The Relay Output Circuit Wiring



1. DC power supply — 2. Emergency stop: Uses external switch

3. Fuse: Uses 5 ~ 10A fuse at the shared terminal of output contacts to protect the output circuit.

4. Flywheel diode: To extend the life span of contact *1

5. AC power supply — 6. Incandescent light (resistive load)

7. Manually exclusive output *3

8. Varistor: To reduce the interference on AC load *2

9. Empty terminal: no in use

*1: For switching direct current on inductive loads, a reverse-current protection diode should be installed in parallel with the load. The relay contact life decreases significantly if this is not done.

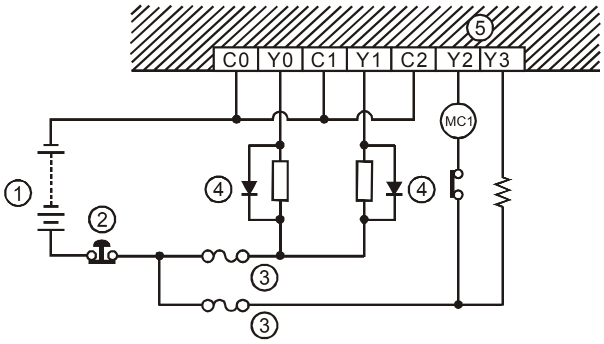
The reverse-current protection diode needs to satisfy the following specifications.

- The diode is rated for maximum reverse voltage of 5~10 times the load voltage.
- The forward current is more that the load current

*2: For switching AC on inductive loads, a surge absorber (0.1uF + “100ohm to 120ohm”) should be installed in parallel with the load. The relay contact life decreases significantly if this is not done.

*3: Ensure all loads are applied to the same side of each ELC output, see above figure. Loads which should NEVER simultaneously operate (e.g. direction control of a motor), because of a critical safety situation, should not rely on the ELC’s sequencing alone. Mechanical interlocks MUST be fitted to all critical safety circuits.

The Transistor Output Circuit Wiring



1. DC power supply
2. Emergency stop
3. Circuit protection fuse
4. Flywheel diode + inductive load
5. Manually exclusive output *1

*1: Transistor outputs use internal zener diode (39V) as protection circuitry. When driving the inductive load with transistor output, a reverse-current protection diode can be installed in parallel with the load if necessary.

The reverse-current protection diode needs to satisfy the following specifications.

- The diode is rated for maximum reverse voltage of 5 to 10 times the load voltage.
- The forward current is more than the load current.

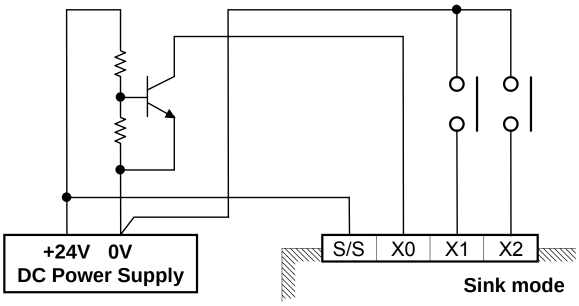
■ ELC-PA

Input Wiring

There are 2 types of DC inputs, SINK and SOURCE. (Below is an example. For additional information, refer to the specifications for each module.)

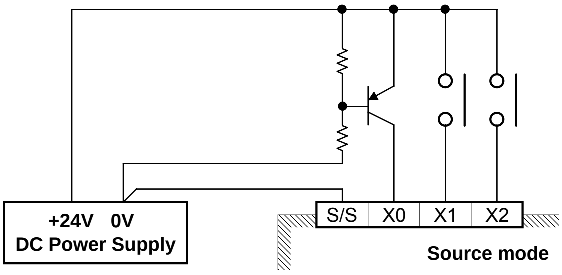
- DC Signal IN – SINK mode

  Input circuit



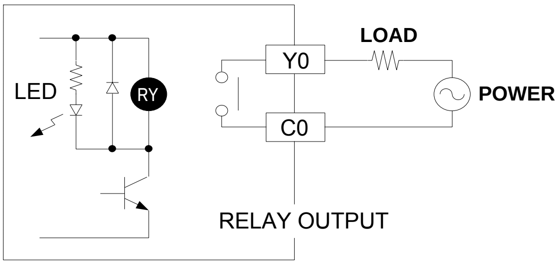
- DC Signal IN – SOURCE mode

  Input circuit

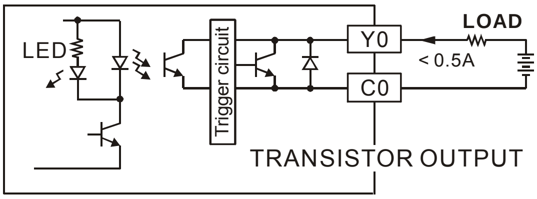


Output Wiring

ELC--**NN*R**



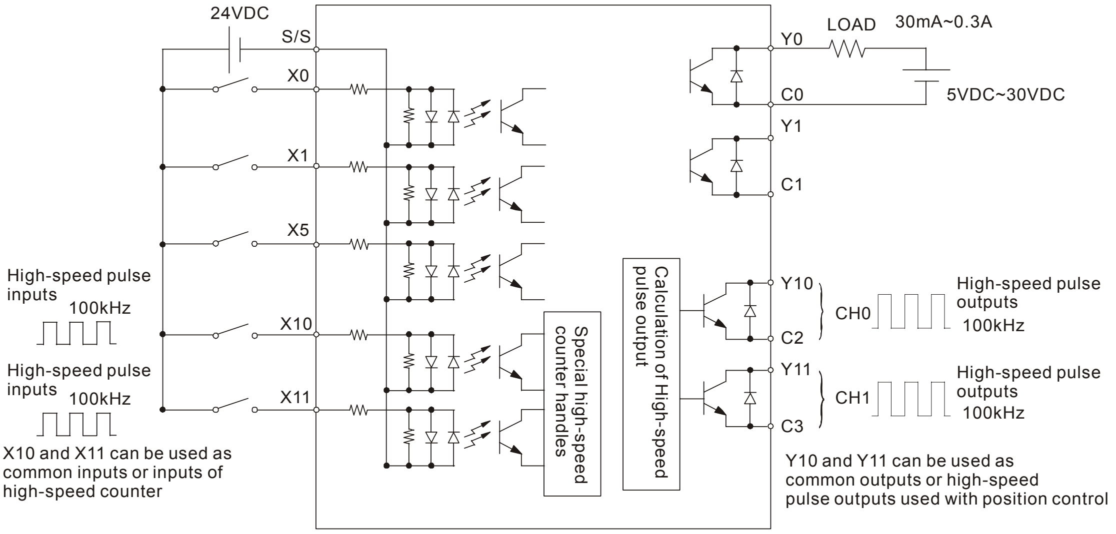
ELC--**NN*T**



1. ELC-PA series has two output types, relay and transistor. See “Function Specifications” for additional information.
2. When output points are enabled, their corresponding indicators on the front panel will be on.
3. Isolation circuit: The optical coupler is used to isolate signals between the circuit inside ELC and input modules.

■ ELC-PH

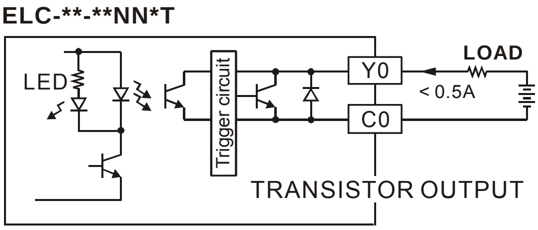
Input/Output Wiring



X10 and X11 can be used as common inputs or inputs of high-speed counter

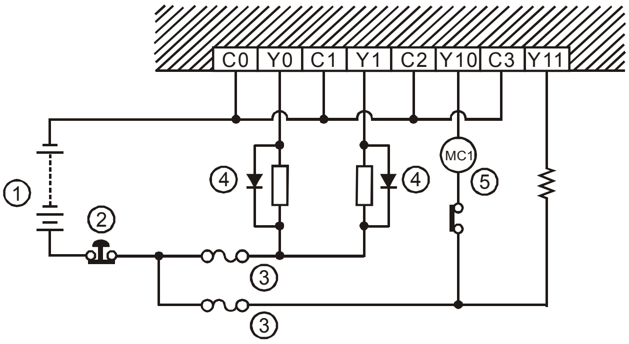
Y10 and Y11 can be used as common outputs or high-speed pulse outputs used with position control

Output Point Wiring



1. ELC-PH series has only transistor outputs. See “Function Specifications” for their additional information.
2. When output points are enabled, their corresponding indicators on the front panel will be on.
3. Isolation circuit: The optical coupler is used to isolate signals between the circuit inside ELC and input modules.

The Transistor Output Circuit Wiring



1. DC power supply	2. Emergency stop
3. Circuit protection fuse	4. Flywheel diode + inductive load
5. Manually exclusive output *1	

*1: Transistor outputs use internal zener diode (39V) as protection circuitry. When driving the inductive load with transistor output, a reverse-current protection diode can be installed in parallel with the load if necessary.

The reverse-current protection diode needs to satisfy the following specifications.

- The diode is rated for maximum reverse voltage of 5 to 10 times the load voltage.
- The forward current is more than the load current.

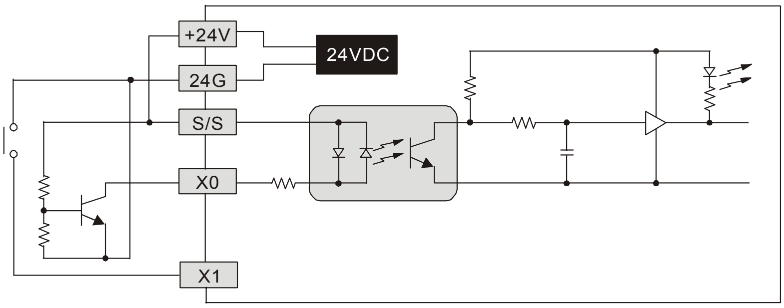
■ ELC-PV

Input wiring

There are 2 types of DC inputs, SINK and SOURCE. (Below is an example. For additional information, refer to the specifications for each module.)

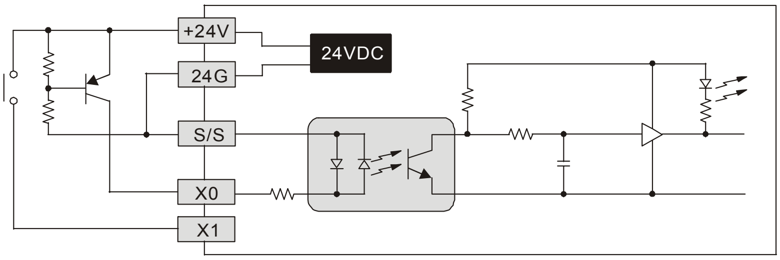
- DC Signal IN – SINK mode

  Input circuit



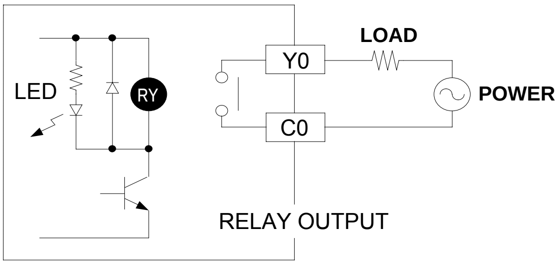
- DC Signal IN – SOURCE mode

  Input circuit

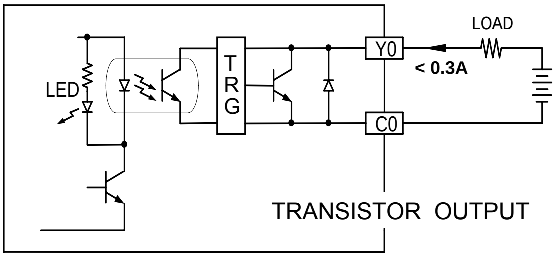


Output wiring

ELC--**NN*R**

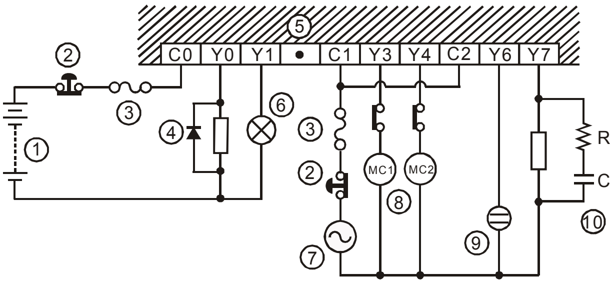


ELC--**-**-*T**



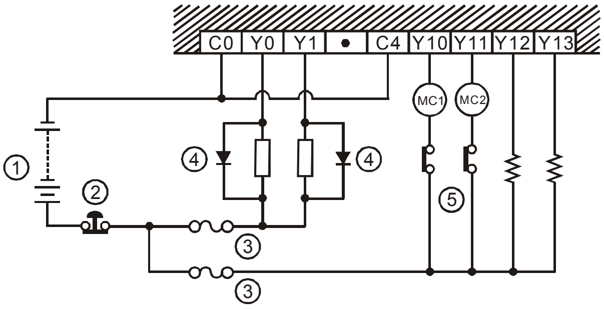
1. ELC-PV series has two output types, relay and transistor. See “Function Specifications” for additional information.
2. When output points are enabled, their corresponding indicators on the front panel will be on.
3. Isolation circuit: The optical coupler is used to isolate signals between the circuit inside ELC and input modules.

The Relay Output Circuit Wiring



1. DC power supply
2. Emergency stop: Uses external switch
3. Fuse: Uses 5 ~ 10A fuse at the common port of output contacts to protect the output circuit.
4. Flywheel diode (SB360 3A 60V): To extend the life span of contact
5. Empty terminal: not in use
6. Incandescent light (resistive load)
7. AC power supply
8. Manually exclusive output
9. Neon indicator
10. Varistor: To reduce the interference on AC load (R=100~120Ω, C=0.1~0.2uF)

The Transistor Output Circuit Wiring

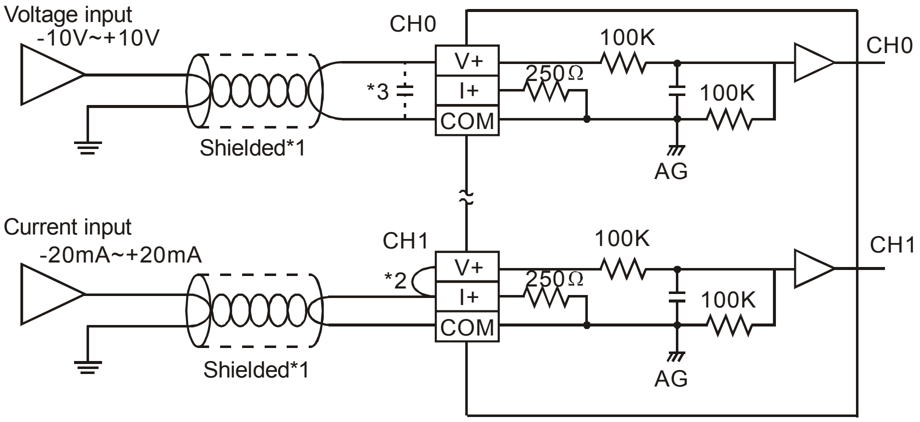


1. DC power supply
2. Emergency stop
3. Circuit protection fuse
4. Flywheel diode (SB360 3A 60V) + inductive load
5. Manually exclusive output

1.2.4.6 A/D and D/A External wiring

- **ELC-PA Series**

A/D Signal IN



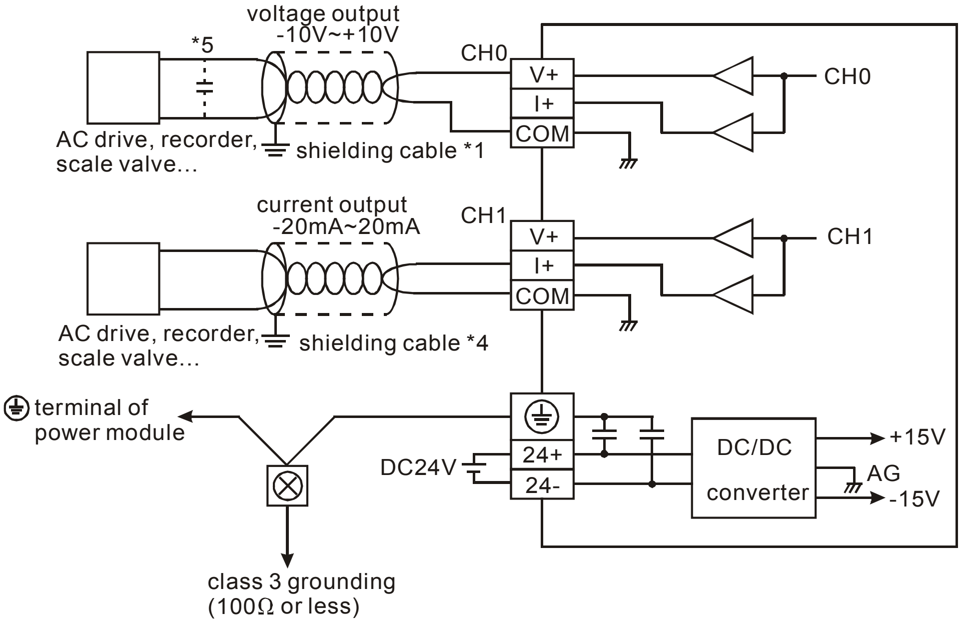
Note 1: Isolate analog input wires from power wiring.

Note 2: If input signal is current, place a jumper between the V+ and I+ terminals.

Note 3: If the noise interference from loaded input wiring terminal is significant, please connect a capacitor with 0.1~0.47μF 25V for noise filtering.

Warning: DO NOT wire to the non functional terminals •

D/A Signal OUT



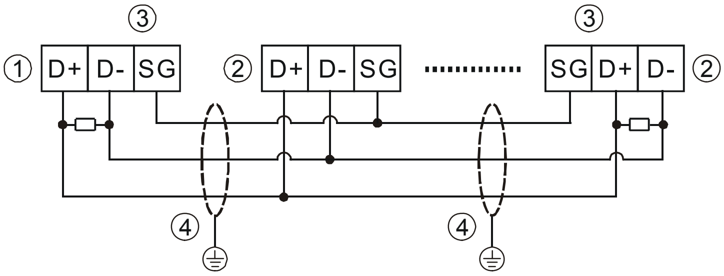
Note 1: Isolate analog output wires from power wiring.

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

Note 3: Connect ⏚ power module ground terminal and ⏚ analog output module ground terminal to a system earth ground.

Warning: DO NOT wire to the non functional terminals •

1.2.4.7 ELC-PV RS-485 Wiring



1. Master node	2. Slave node
3. Terminal resistor	4. Shielded cable

Note: 1. Terminal resistors are suggested to be connected to the devices at both physical ends of the network with 120 resistors.

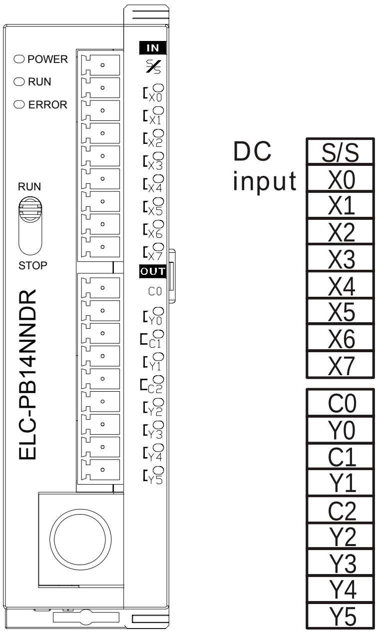
2. To ensure communication quality, please apply double shielded twisted pair cable (20AWG) for wiring.

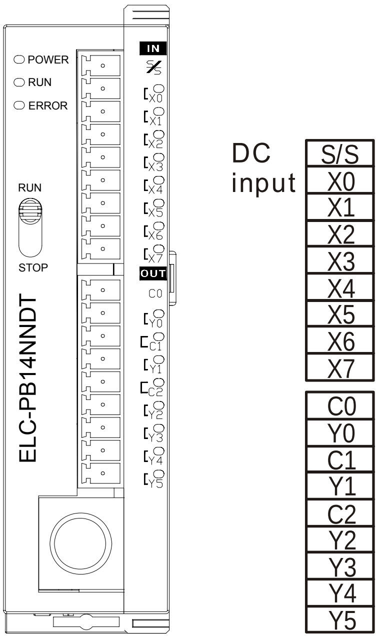
3. When voltage drop occurs between the internal ground references of two systems, connect the systems with Signal Ground point (SG) for achieving equal potential between systems so that a stable communication can be obtained.

1.2.5 Terminal Layout

1.2.5.1 ELC Series I/O Terminal Layout

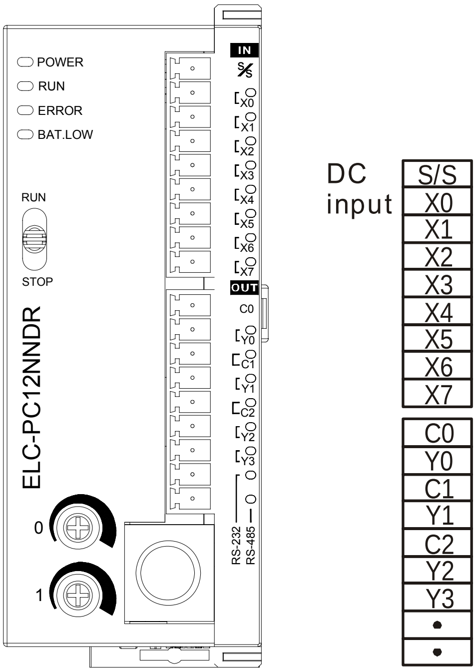
- **ELC-PB**

<table>
<tr><th>ELC-PB14NNDR</th><th>ELC-PB14NNDT</th></tr>
<tr><td>


</td><td>


</td></tr>
</table>

- **ELC-PC**

<table>
<tr><th>ELC-PC12NNDR</th><th>ELC-PC12NNDT</th></tr>
<tr><td>


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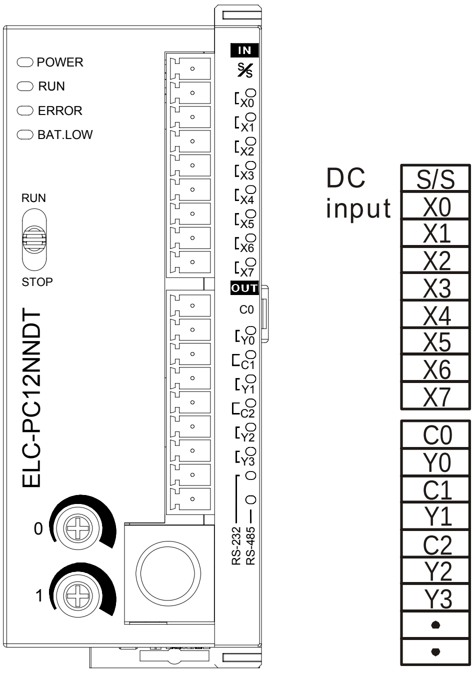

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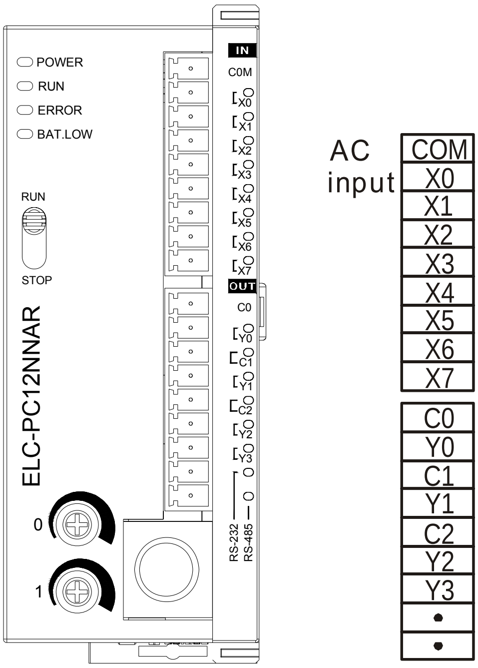
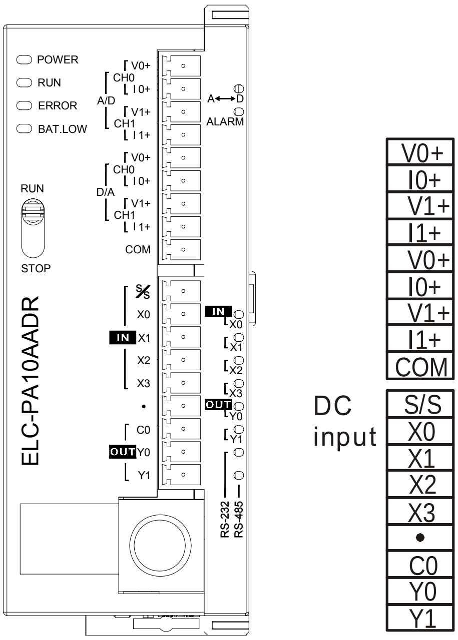
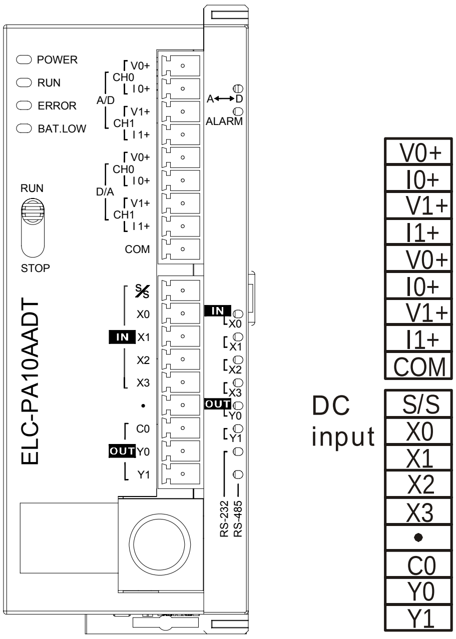
</table>

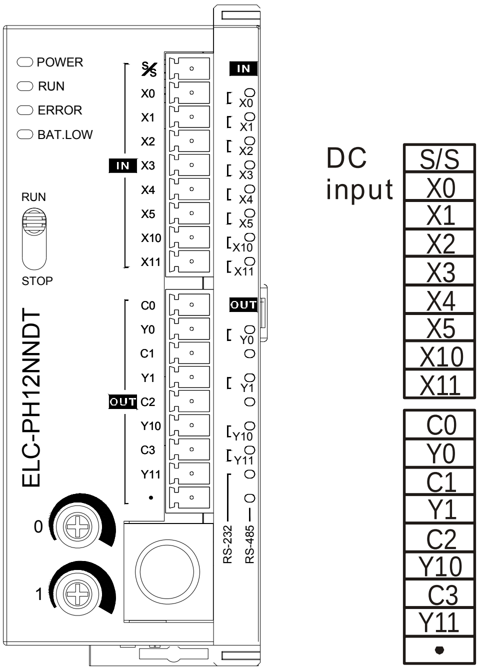
ELC-PC12NNAR


■ ELC-PA

ELC-PA10AADR	ELC-PA10AADT
	

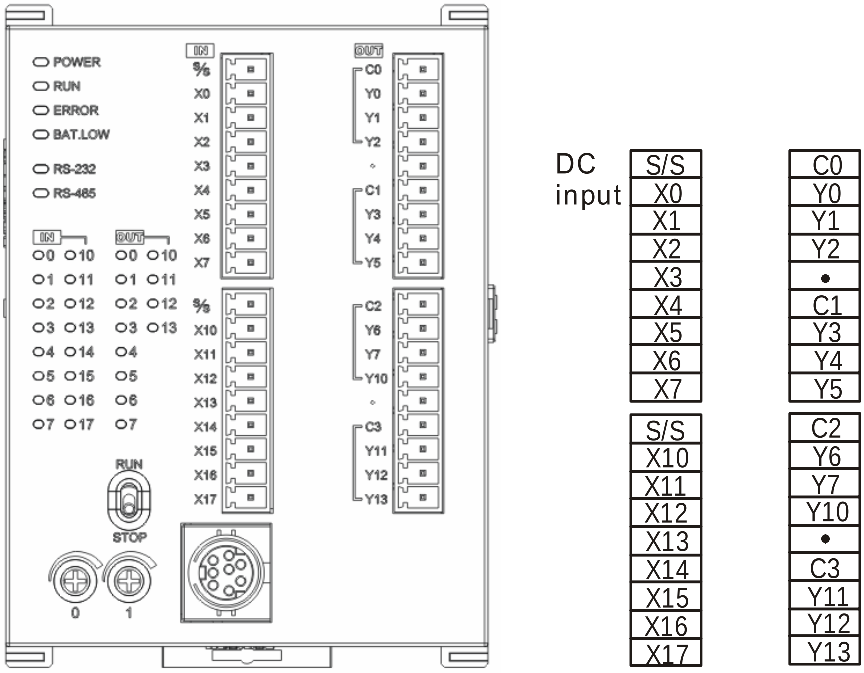
■ ELC-PH

ELC-PH12NNDT

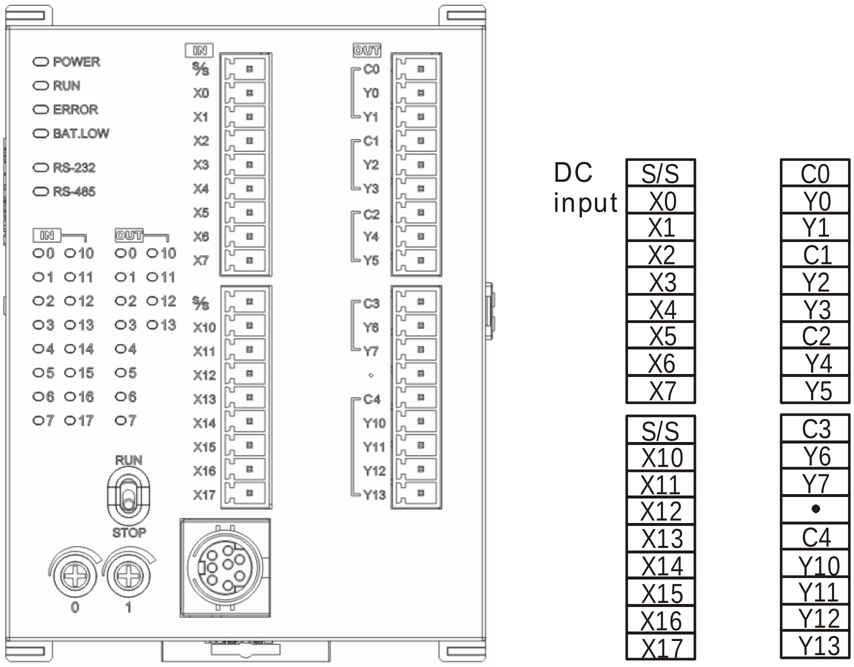


■ ELC-PV

ELC-PV28NNDR



ELC-PV28NNDT



1.2.5.2 ELC Series Digital Input/Output Extension Unit

The ELC controller automatically addresses discrete I/O based on the position of each I/O module with respect to the controller. Independent of the number of discrete I/O points on the controller,, the first Input on the first input module to the right of the controller will be X20. The first output on the first output module to the right of the controller will be Y20.

Example:

Extension unit	ELC Model	Input points	Output points	Input numbering	Output numbering
First extension	ELC-EX08NNDN	8	0	X20~X27	-
Second extension	ELC-EX06NNNI	0	6	-	Y20~Y25
Third extension	ELC-EX16NNDR	8	8	X30~X37	Y30~Y37
Fourth extension	ELC-EX08NNNR	0	8	-	Y40~Y47
Fifth extension	ELC-EX08NNDR	4	4	X40~X43	Y50~Y53

Note:

Even though the second extension unit ELC-EX06NNNI only has 6 outputs, the other two output addresses associated with it, Y26 and Y27 are invalid and should not be used.

1.2.5.3 ELC Series Analog Input/Output Extension Unit

The analog I/O modules are not included in the addressing associated with the discrete I/O modules. The data sent to and read from analog modules by the controller is accomplished via TO and FROM instructions used in the controller program. The addressing of discrete I/O modules completely ignores the presence of analog modules. Analog modules are addressed in the TO and FROM instructions by the location of each analog module with respect to their proximity to the controller. In other words, the first analog I/O module encountered to the right of the controller is addressed as 0. The next analog I/O module to the right of the controller and to the right of the first analog I/O module is address 1 and so on up to address 7. A maximum of eight analog I/O extension units can be connected to one controller (addresses 0-7).

Example:

Extension unit	ELC Model	Input points	Output points	Input numbering	Output numbering
First extension	ELC-EX08NNDN	8	0	X20~X27	-
Second extension	ELC-AN06AANN	-	-	-	-
Third extension	ELC-EX16NNDR	8	8	X30~X37	Y20~Y27
Fourth extension	ELC-AN04ANNN	-	-	-	-
Fifth extension	ELC-EX08NNDR	4	4	X40~X43	Y30~Y33

Note:

The second extension module (ELC-AN06AANN) will be addressed as 0, and the fourth extension module (ELC-AN04ANNN) will be addressed as 1. Please refer to API 78(FROM), 79(TO) for more detailed information concerning reading and writing to analog I/O modules.

1.2.6 Pre-power up checks and Troubleshooting

1.2.6.1 Pre-power up checks

- **ELC-PB/PC/PA/PH/PV**

Before Turning ON the Power

After wiring, be sure to check the items below before turning ON the power supply to the ELC.

1. Installation
    - Does the unit type match the device list during the design stage?
    - Are all of the units firmly attached?
2. Power supply
    - Is operating voltage supplied correctly?
    - Is the power supply cable properly connected?
    - Are both voltage and polarity connected correctly for each connection
    - Protection against excess current: when overloaded, the output voltage dips. Although the output voltage will return to normal when the load returns to normal, be careful as long overloads or short-circuits will cause deterioration or destruction of internal circuits.
    - Attaching additional power supply units in parallel is not allowed! It may destroy internal circuits and the power supplies.
3. Check Input/Output terminals
    - Does the wiring on the connector and terminal match?
    - Is the operating voltage for the I/O devices correct?
    - Are the I/O connectors properly connected?
    - Is the wire size correct?

Note: These precautions concern the ELC-PS01/PS02 power supply units.

Turning the Power ON

After checking the items above, perform the trial operation by using to the following procedure.

1. Check the “POWER” LED on the front of the ELC extension units and the controller.
2. Check the “LV” LED on the front of the ELC extension units.

Check Communications with ELC controller

1. After Power up and the ELC completes its initial setup. The total number of extensive input/output points will be stored in special data registers of D1142 and D1143.
2. Please check D1142 and D1143 to confirm the number of discrete I/O points is accurate..

Power Indication

The “POWER” LED on the front of the ELC will be lit (green) if the power is on.

Preparation

1. Prior to applying power, please verify that the power connections and the input/output wiring are correct.
2. After downloading the program to the ELC controller, check that the ERROR LED on the controller is not on. If it is not on, this means that the program is legitimate, and is now waiting for the user to give the RUN command.

Operation & Test

1. If the “ERROR” LED on the ELC is not blinking, use the RUN/STOP switch or the programming software to provide the RUN command, and the RUN indicator will then turn on. If the “RUN” LED is not on, it indicates that there is no program in the ELC.
2. The ELC programming software can be utilized to monitor the program during operation..

Low Battery Voltage Indication (ELC-PC/PA/PH)

There is also a “BAT.LOW” LED at the front of the ELC. When the LED is on, it indicates that the battery voltage is insufficient. Please change the battery (within 1 minute of removing power) as soon as possible; otherwise the user programs and the data in latched areas may be lost.

Low Battery Voltage Indication (ELC-PV)

The rechargeable lithium-ion battery in ELC-PV is mainly used on the latched procedure and data storage. The lithium-ion battery has been fully charged in the factory and is able to retain the latched memory and data storage for 12 months. If ELC-PV has not been powered or used for more than 12 months, the battery will be out of power and the memory and data will be lost.

Input/Output Throughput (ELC-PB/PC/PA/PV)

The throughput time from the input signal to the output operation is calculated as follows:

Throughput Time = input delay time + program scan time + output delay time

Input delay time	Factory setting is 10ms. Please refer to special registers D1020~1021.
Program scan time	Refer to special register D1010.

Input/Output Throughput (ELC-PH)

The total throughput from the input signal to the output operation is calculated as follows:

Throughput Time = input delay time + program scan time + output delay time

Input delay time	X0~X5: 10ms (factory default), 0~20ms adjustable. Refer to special registers D1020. X10, X11: 0ms (factory default), 0~1,000ms adjustable. Refer to special registers D1021.
Program scan time	Refer to the usage of special register D1010.

1.2.6.2 Troubleshooting

The LEDs on the front of each controller can indicate the cause of a fault, per the following:

ELC-PB/PC/PA/PH/PV

"POWER" indicator

There is a "POWER" LED on the front of the ELC. When the ELC is powered On, the green LED will be on. If the indicator is not on when the ELC is powered up and if the input power is normal, it is an indication that the ELC has a hardware problem. Replace the unit.

"RUN" indicator

When the ELC is in the Run mode, this LED will be on. If the controller is placed into the Run mode with ELCSoft or the switch on the front of the controller and it does not enter the Run mode indicated by the Run LED, check the Error LED. There may be a program fault.

"ERROR" indicator (ELC-PB/PC/PA/PH)

1. If a program is downloaded to a controller with an improperly used instruction or other program issue or if the program size exceeds the allowable range for that controller, this indicator will blink. If this occurs, check the error code saved in the ELC data register D1004. The address where the error occurred will be stored in data register D1137.
2. When the ERROR LED is on (not blinking), Look at the state of special relay M1008 in the ELC. If it is On, it indicates that the execution time of the program has exceeded the watchdog time-out setting (set in D1000). Turn the ELC RUN/STOP switch to STOP, and view special data register D1008 to determine which program Step the error occurred on. The"WDT" instruction can be used to solve the problem if the watchdog time is being exceeded, by resetting the watchdog timer in the program. Or, simply move a larger watchdog timer value to D1000. The default is 200 (200ms).
3. After solving the programming issue and downloading the corrected program to the controller, this LED should be off.

"ERROR" indicator (ELC-PV)

1. If an illegal program is downloaded to the controller, where an instruction or device exceeds their range, this indicator will flash (approx. every 1 second). When this happens, obtain the error code from D1004 and the saved address where the error occurred in register D1137 (if the error is a general circuit error, the address of D1137 will be invalid). After determining the cause of the error, amend the program and download it to the controller. If you cannot connect to the ELC and this indicator is flashing quickly (approx. every 0.2 second), it means that the 24VDC power is insufficient. Please check if the 24V DC is overloaded.
2. If the ERROR indicator is on solid, check the special relay M1008. If M1008 is on this indicates that the execution time of the program exceeds the preset watchdog time (in D1000). In this case, turn the RUN/STOP switch to STOP and view special data register D1008 to determine which program Step the error occurred on. The "WDT" instruction can be used to solve the problem if the watchdog time is being exceeded, by resetting the watchdog timer in the program. Or, simply move a larger watchdog timer value to D1000. The default is 200 (200ms).

3. For additional information concerning error codes (in D1004), see the “ELC Programming Manual.

“Input” indicator

There is an LED indicator for each input. If the LED is not ON when the input device is ON, check the input status using the programming software. If the input status also indicates the input is Off, check the following:.

1. Check the wiring of the input devices.
   Check that power is properly supplied to the input terminals and that the input device is properly wired to the input.
   - At this point, if the power is properly supplied to the input terminal and the wiring is proper, there is probably a problem with the ELC’s input circuit.
   - If power is not present at the input circuit, there is most likely a problem with the input device or the power source. C
2. Check the input condition if the input LED is ON when the input device is OFF.
   Monitor the input condition using the programming software.
   - If the input status is OFF, but the input LED is ON there is probably a problem with the ELC’s input circuit.
   - If the input status is ON, but the LED is OFF, check the leakage current at the input device. There could also be a problem with the input circuit.

“Output” indicator

Output LED indicates if the output signals are turned On or Off by the program. Check the following when the LED On/Off indication does not correspond to the program:

1. Check that the output is not used in the program in multiple locations. The outputs states are written to the actual outputs at the end of each program scan. Therefore, the last occurrence of each output in the program determines whether it is turned On or Off at the terminal. It is recommended that all logic controlling each physical output be placed on a single rung with that output rather than using a particular output multiple times in the program.
2. Check the wiring and verify that the screws are tight.
3. Check the voltage at the output terminals and at the load to determine if the output circuit or the load are the problem.

“RS-232, RS-485” indicators (ELC-PC/PA/PH/PV)

“RS-232” LED will flash when the RS232 port is receiving data. The “RS-485” LED will flash when the RS-485 port is transferring data.

“A ↔D” indicator (ELC-PA)

The A ↔D LED indicator will blink if the PA controller is running.

“ALARM” indicator (ELC-PA)

The “ALARM” LED will blink if AD/DA conversion data exceeds its range when the PA controller is in the RUN mode.

“BAT.LOW” indicator (ELC-PC/PA/PH)

When the battery voltage is low, the “BAT.LOW” LED will be on. Change the battery within 3 minutes of removing the old battery to retain the ELC’s internal user programs and data).

Recover mechanism (ELC-PC/PA/PH)

If the battery is in low voltage (before the power is switched off when the BAT.LOW indicator is on) and the power is off for more than 1 minute, ELC will automatically restore the data in the latched area in the program and transfer Flash ROM into SRAM memory next time when it is re-powered.

Battery life: (ELC-PC/PA/PH)

Temperature (ºC)	0	25	50	70
Life (year)	9	8	6	5

“BAT.LOW” indicator (ELC-PV)

1. The rechargeable lithium-ion battery in the ELC-PV controllers is mainly used for the latched memory and data storage.
2. The lithium-ion battery has been fully charged in the factory and is able to retain the latched memory and data storage for 12 months. If ELC-PV has not been powered and used for more than 12 months, the battery will be out of power upon normal consumption and the memory and data will be lost.
3. The lithium-ion battery has a longer life span than ordinary batteries; therefore there is no need to change the battery frequently. You can charge the battery at any time without having to worry about a decrease in chargeability. You can also recharge the battery even when there is still power in the battery. The battery is charging when power is supplied to the controller.
4. Please be aware of the date of manufacturing; the charged battery can sustain for 12 months from this date. If you find that the BAT.LOW indicator stays on after ELC is powered, the battery voltage is low and the battery is being charged. ELC-PV controller must remain powered for more than 24 hours to fully charge the battery. If the indicator turns from on to flashing (once every second), it indicates that the battery cannot be charged anymore. Save your program and send the ELC back to Eaton for a new battery.

Precision of the Real Time Clock (RTC): (ELC-PC/PA/PH/PV)

At 0°C/32°F, less than 117 seconds error per month.

At 25°C/77°F, less than 52 seconds error per month.

At 55°C/131°F, less than 132 seconds error per month.

1.3 ELCM Series

1.3.1 Specifications

1.3.1.1 Functions Specification

- **ELCM-PH/PA**

Items				Specifications		Remarks
Control method				Stored program, cyclic scan system		
I/O processing method				Batch processing method (when END instruction is executed)		Immediate I/O refresh instruction can override batch update
Execution speed				Basic instructions – 0.54µs		MOV instruction – 3.4µs
Program language				Instructions + Ladder Logic + SFC		
Program capacity				15872 STEPS		Flash-ROM
Instructions				32 Basic instructions		200 Application instructions
Bit	X	External inputs		X0~X377, octal number system, 256 points max, Note 4	Total 256+ 16 I/O	Physical input points
	Y	External outputs		Y0~Y377, octal number system, 256 points max, Note 4		Physical output points
	M	Auxiliary relay	General	M0~M511, 512 points, Note 1 M768~M999, 232 points, Note 1 M2000~M2047, 48 points, Note 1	Total 4096 points	Main internal relay area for general use.
			Latched	M512~M767, 256 points, Note 2 M2048~M4095, 2048 points, Note 2		
			Special	M1000~M1999, 1000 points, some are latched		
	T	Timer	100ms (M1028=ON, T64~T126: 10ms)	T0~T126, 127 points, Note 1 T128~T183, Note 1	Total 256 points	Contact = ON when timer reaches preset value.
				T184~T199 for Subroutines, 16 points, Note 1		
				T250~T255(accumulative), 6 points Note 1		
			10ms (M1038=ON, T200~T245: 1ms)	T200~T239, 40 points, Note 1		
				T240~T245(accumulative), 6 points, Note 1		

Items					Specifications		Remarks
			1ms		T127, 1 points, Note 1 T246~T249(accumulative), 4 points, Note 1		
Bit	C	Counter	16-bit count up		C0~C111, 112 points, Note 1 C128~C199, 72 points, Note 1	Total 232 points	Contact = ON when counter reaches preset value.
					C112~C127,16 points, Note 2		
			32-bit count up/down		C200~C223, 24 points, Note 1		
					C224~C231, 8 points, Note 2		
			32bit high-speed count up/down	Soft-ware	C235~C242, 1 phase 1 input, 8 points, Note 2	Total 23 points	
					C232~C234, 2 phase 2 input, 3 points, Note 2		
				Hard-ware	C243~C244, 1 phase 1 input, 2 points, Note 2		
					C245~C250, 1 phase 2 input, 6 points, Note 2		
					C251~C254 2 phase 2 input, 4 points, Note 2		
	S	Step point	Initial step point		S0~S9, 10 points, Note 2	Total 1024 points	Sequential Function Chart (SFC) usage
			Zero point return		S10~S19, 10 points (use with IST instruction), Note 2		
			Latched		S20~S127, 108 points, Note 2		
			General		S128~S911, 784 points, Note 1		
			Alarm		S912~S1023, 112 points, Note 2		
Word Register	T	Current value			T0~T255, 256 words		
	C	Current value			C0~C199, 16-bit counter, 200 words		
					C200~C254, 32-bit counter, 55 words		
Word Register	D	Data register	General		D0~D407, 408 words, Note 1 D600~D999, 400 words, Note 1 D3920~D9999, 6080 words, Note 1	Total 10000 points	General storage for word length data
			Latched		D408~D599, 192 words, Note 2 D2000~D3919, 1920 words, Note 2		
			Special		D1000~D1999, 1000 words, some are latched		General storage for word length data
			For AIO modules		D9900~D9999，100 words , Note 1, Note 5		
			Index		E0~E7, F0~F7, 16 words, Note 1		

Items				Specifications	Remarks
Pointer	N	Master control loop		N0~N7, 8 points	Master control nested loop
	P	Pointer		P0~P255, 256 points	The location point of CJ, CALL
	I	Interrupt Service	External interrupt	I000/I001(X0), I100/I101(X1), I200/I201(X2), I300/I301(X3), I400/I401(X4), I500/I501(X5), I600/I601(X6), I700/I701(X7), 8 points (01, rising-edge trigger ↑, 00, falling-edge trigger ↓)	Address for interrupt subroutines
			Timer interrupt	I602~I699, I702~I799, 2 points (Timer resolution = 1ms)	
			High-speed counter interrupt	I010, I020, I030, I040, I050, I060, I070, I080,8 points	
			Communication interrupt	I140(COM1), I150(COM2), I160(COM3), 3 points, Note 3	
Constant	K	Decimal		K-32,768 ~ K32,767 (16-bit operation), K-2,147,483,648 ~ K2,147,483,647 (32-bit operation)	
	H	Hexadecimal		H0000 ~ HFFFF (16-bit operation), H00000000 ~HFFFFFFFF (32-bit operation)	
Serial ports				COM1: built-in RS-232 ((Master/Slave), COM2: built-in RS-485 (Master/Slave), COM3: built-in RS-485 (Master/Slave), COM1 is typically the programming port.	
Clock/Calendar (RTC)				Year, Month, Day, Week, Hours, Minutes, Seconds	
Special modules				Up to 8 AIO modules can be connected	

Notes:

1. Data area is non-latched.
2. Data area is latched.
3. COM1: built-in RS232 port. COM2: built-in RS485 port. COM3: built-in RS485 port.
4. When 256 input points(X) are used, only 16 output points(Y) are available. Also, when 256 points(Y) are used, only 16 input points(X) are available..
5. This area is applicable only when AIO modules are used with the controller. Each AIO module occupies 10 words.

1.3.1.2 Electrical Specifications

- **ELCM-PH/PA**

Model Item	PH16	PH24	PH32	PH40	PA20
Power supply voltage	100 ~ 240VAC (-15% ~ 10%), 50/60Hz ± 5%				

Model Item	PH16	PH24	PH32	PH40	PA20
Connector	European standard removable terminal block (Pin pitch: 5mm)				
Operation	ELCM-PH/PA starts to power up when the power rises to 95 ~ 100VAC and shuts down when the power drops to 70VAC and below. If the power is suddenly cut off, the controller will continue running for 10ms.				
Power supply fuse	2A/250VAC				
Power consumption	30VA	30VA	30VA	30VA	30VA
DC24V current output	500mA	500mA	500mA	500mA	500mA
Power supply protection	DC24V output short circuit protection				
Weight (R/T)	377g 351g	414g 387g	489g 432g	554g 498g	462g 442g

1.3.1.3 Input/Output Point Electrical Specifications

- **ELCM-PH/PA**

DC Input Point Electrical Specification				
Input no.		X0, X2	X1, X3 ~ X7	X10 ~ X17,X20 ~ [#1]
Input point type		Digital input		
Input type		DC (SINK or SOURCE)		
Input current		24VDC, 5mA		
Input impedance		4.7KΩ		
Max. frequency		100kHz	10kHz	60Hz
Active level	Off→On	>15VDC		
	On→Off	< 5VDC		
Response time	Off→On	< 2.5μs	< 20μs	< 10ms
	On→Off	< 5μs	< 50μs	< 15ms
Filter time	X0 ~ X7	Adjustable within 0 ~ 20ms in D1020 (Default: 10ms)		

Output Point Electrical Specification					
Output point type		Relay-R	Transistor-T		
Output point number		All	Y0, Y2	Y1, Y3	Y4 ~ Y17, Y20 ~ [#1]
Voltage specification		< 240VAC, 30VDC	5 ~ 30VDC [#2]		
Max. frequency		1Hz	100kHz	5kHz	1kHz
Max. load	Resistive	2A/1 point (5A/COM)	0.5A/1 point (2A/COM) [#4]		
	Inductive	[#3]	15W (30VDC)		
	Lamp	20WDC/100WAC	2.5W (30VDC)		

Output Point Electrical Specification					
Responds time	Off→On	Approx .10ms	< 2μs	< 20μs	< 100μs
	On→Off		< 3μs	< 30μs	< 100μs

#1: Refer to “I/O Terminal Layout” for the number of I/O for each model.

#2: UP, ZP must work with external auxiliary power supply 24VDC (-15% ~ +20%), rated current approx. 1mA/point.

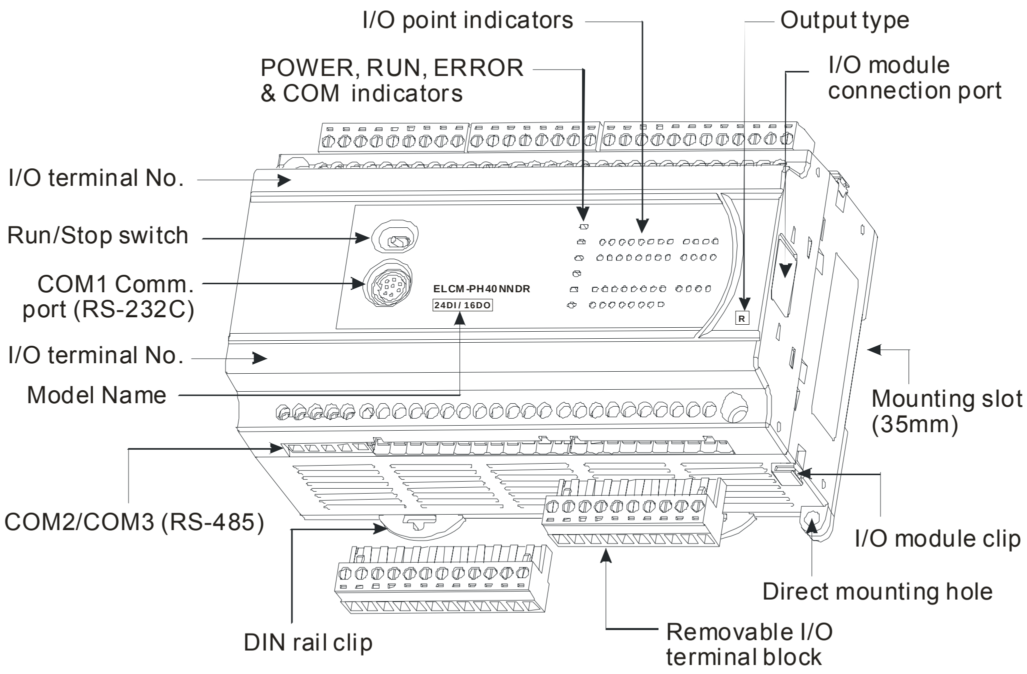
#3: For life curves, refer to the specifications for the ELC-PB controller.

#4: ZP for NPN COM, UP for PNP COM.

1.3.2 Product Layout and Dimension

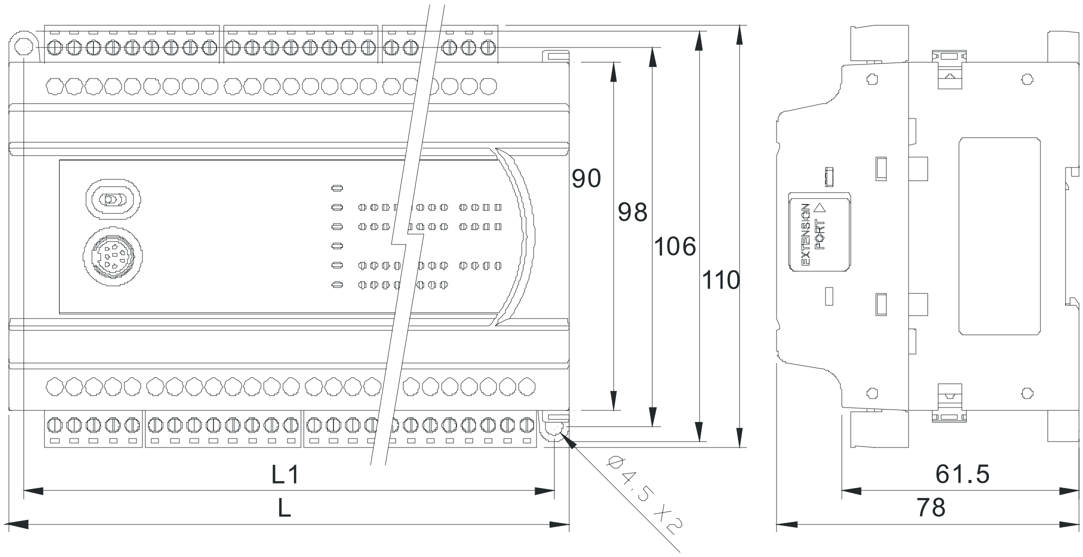
1.3.2.1 Product Layout

- **ELCM-PH/PA**



1.3.2.2 Dimension

- **ELCM-PH/PA**



Unit: mm

Model	L	L1
ELCM-PH16NNDR/T	105	97
ELCM-PH24NNDR/T	125	117
ELCM-PH32NNDR/T	145	137
ELCM-PH40NNDR/T	165	157
ELCM-PA20AADR/T	145	137

1.3.3 Power Usage

1.3.3.1 Supply Current and Current Consumption of the controllers (+24VDC)

Item / Model	Internal Supply Current[#1] (mA)	External Supply Current[#2] (mA)	Internal Max Current Consumption (mA)		Internal Max Current Consumption for AIO (mA)	External Max Current Consumption for DIO (mA)	
PH16NNDR/T	500	500	85	50	0	40	48
PH24NNDR/T			85	50	0	80	88
PH32NNDR/T			130	60	0	80	96
PH40NNDR/T			130	60	0	120	136
PA20AADR/T			80	60	160	40	46

#1: Items supplied by Internal Supply Current: Internal Max Current Consumption + Internal Max Current Consumption for IO-BUS.

#2: Items supplied by External Supply Current: External Max Current Consumption for DIO on the controller + External Max Current Consumption for DIO modules + External Max Current Consumption for AIO modules

1.3.3.2 Supply Current and Current Consumption of DIO Modules (+24VDC)

Item Model	Internal Max Current Consumption for IO-BUS (mA)	External Max Current Consumption for DIO (mA)
ELCM-EX08NNDN	10	40
ELCM-EX08NNDR	30	20
ELCM-EX08NNDT	10	24
ELCM-EX08NNNR	50	0
ELCM-EX08NNNT	10	8
ELCM-EX16NNDN	15	80
ELCM-EX16NNDR	15	80
ELCM-EX16NNDT		48
ELCM-EX16NNNR	15	80
ELCM-EX16NNNT		16

1.3.3.3 Current Consumption of AIO Modules (+24VDC)

+24VDC power is required to supply AIO modules

Item Model	Internal Max Current Consumption for IO-BUS (mA)	External Max Current Consumption for AIO (mA)
ELCM-AN04ANNN	28	40
ELCM-AN02NANN		80
ELCM-AN04NANN		120
ELCM-AN06AANN		95
ELCM-PT04ANNN		40
ELCM-TC04ANNN		30

1.3.3.4 Calculating System Current Consumption

Example: ELCM-PH32NNDR + ELCM-EX08NNNR x 3 + AN04ANNN + AN04NANN

Model Name	Internal Current Consumption	External Current Consumption
ELCM-PH32NNDR	130mA	80mA
ELCM-EX08NNNR	50mA	0mA
ELCM-EX08NNNR	50mA	0mA
ELCM-EX08NNNR	50mA	0mA
ELCM-AN04ANNN	28mA	40mA
ELCM-AN04NANN	28mA	120mA
System Current Consumption	336mA	200mA

System Current Consumption:

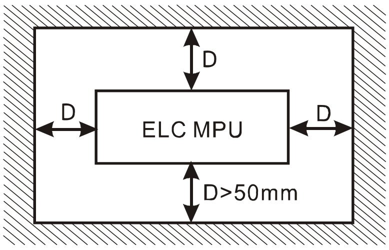
Internal → 130 + 50x3 + 28 + 28 = 336 (mA) < 500(mA) OK

External → 80 + 0 + 40 + 120 = 240 (mA) < 500(mA) OK

1.3.4 Installation and Wiring

1.3.4.1 Installation

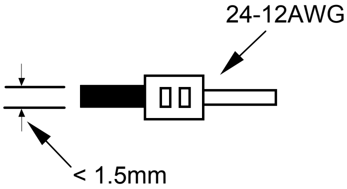
Install the ELC in an enclosure with sufficient space around it to allow heat dissipation, as shown in the figure below.



- **DIN Rail Mounting:** The ELC can be secured to a cabinet by using 35mm height and 7.5mm in depth DIN rail. When mounting the ELC to 35mm DIN rail, be sure to use the retaining clip to stop any side-to-side movement of the ELC and reduce the chance of wires coming loose. The retaining clip is at the bottom of the ELC. To secure the ELC to DIN rail, pull the clip down, place it onto the rail and push the clip back up. To remove the ELC, pull the retaining clip down with a flat screwdriver and remove the ELC from the DIN rail.
- **Direct Mounting:** Use M4 screws for direct mounting of the product.

1.3.4.2 Terminal Torque

1. Use the 12-24 AWG single-core wire or the multi-core wire for the I/O wiring. The ELC terminal screws should be tightened to 3.80 kg-cm (3.30 in-lbs) and please use 60/75°C copper conductor only.



2. DO NOT wire empty terminals. DO NOT place the input signal wire and output power wire in the same wiring circuit.
3. DO NOT drop tiny metallic conductors into the ELC during installation..
    - Please attach the dustproof sticker to the ELC before the installation to prevent conductive objects from dropping in.
    - Tear off the sticker before running the ELC to ensure normal heat dissipation.

1.3.4.3 Power Supply

The power input type for ELCM-PH/PA model is AC. When operating the ELCM-PH/PA, please note the following points:

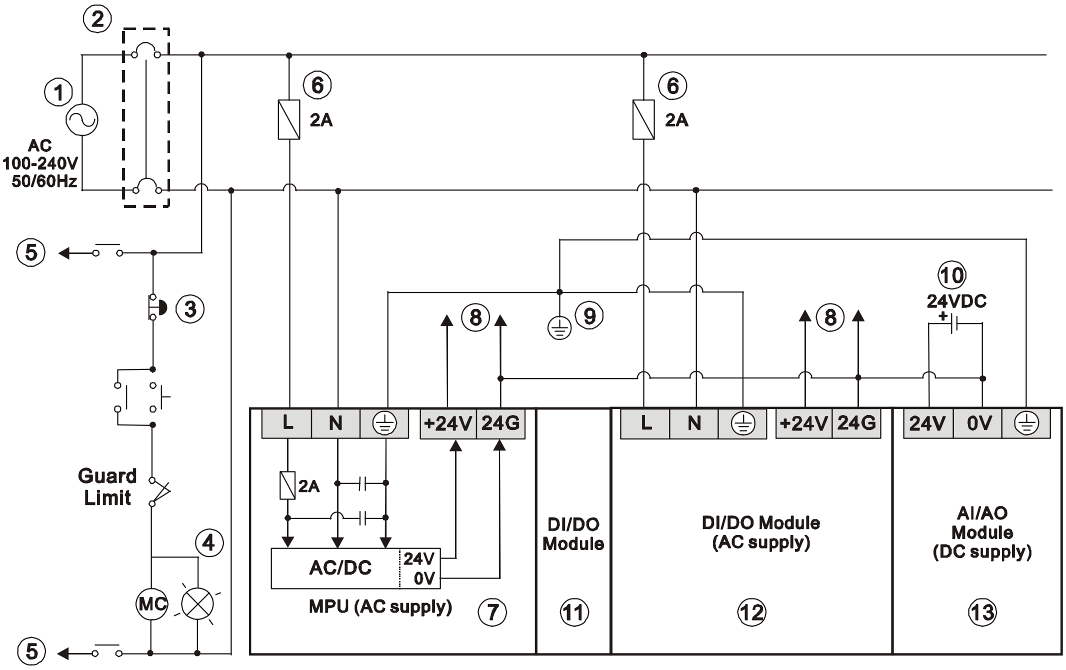
1. The range of the input voltage should be 100 ~ 240VAC. The power supply should be

connected to L and N terminals. Please note that wiring 110V AC or 220V AC to +24V output terminal or digital input points will result in serious damage to the ELC.

2. The AC power for the controller and for the digital I/O modules should be turned ON and OFF at the same time.
3. Use 1.6mm wire for grounding of the ELC.
4. The power shutdown of less than 10ms will not affect the operation of the ELC.
5. The +24VDC output voltage is rated at 0.5A from the controller. DO NOT connect other external power supplies to this terminal. Each input draws 5 ~ 7mA. A 16-point input module will require approximately 100mA. Therefore, the +24V output power cannot provide power for an external load that is more than 400mA.

1.3.4.4 Safety Wiring

In an ELC control system, many devices are controlled at the same time and actions of any device could influence another. Therefore, we suggest you wire a protection circuit at the power supply input terminals, per the figure below.



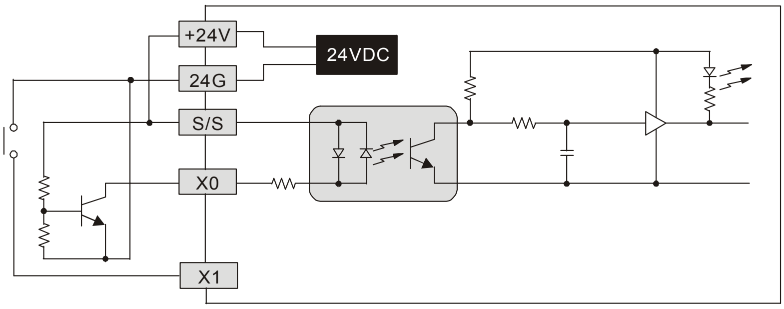
1. AC power supply:100 ~ 240VAC, 50/60Hz
2. Breaker
3. Emergency stop
4. Power indicator
5. AC power supply load
6. Power supply circuit protection fuse (2A)
7. ELC (main processing unit)
8. DC power supply output: 24VDC, 500mA
9. Grounding resistance: < 100Ω
10. DC power supply: 24VDC
11. Digital I/O module (DC supply)
12. Digital I/O module (AC supply)
13. Analog I/O module (DC supply)

1.3.4.5 I/O Point Wiring

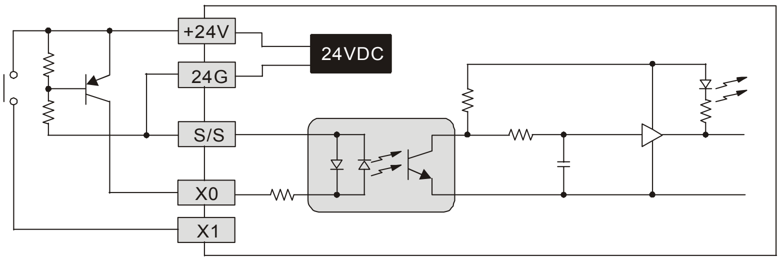
ELCM-PH/PA

There are 2 types of DC inputs, SINK and SOURCE. (See the example below. For additional information, please refer to the specifications for each module.)

- DC Signal IN – SINK mode

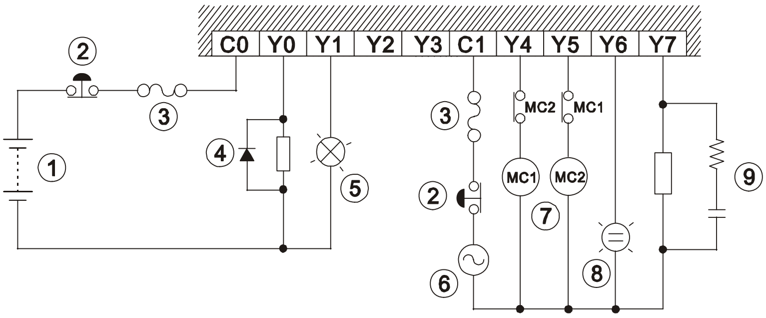


- DC Signal IN – SOURCE mode



Output Wiring

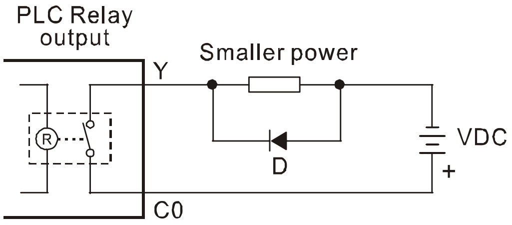
The Relay Output Circuit Wiring



1. DC power supply
2. Emergency stop: Uses external switch
3. Fuse: Uses 5 ~ 10A fuse at the shared terminal of output contacts to protect the output circuit

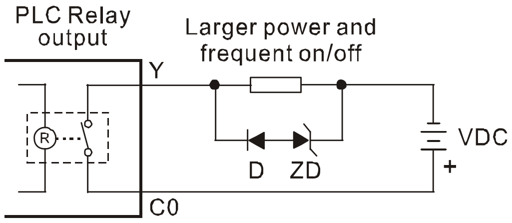
4. Transient voltage suppressor: To extend the life span of contact.

a. Diode suppression of DC load: Used for lower power applications.



D: 1N4001 diode or equivalent component

b. Diode + Zener suppression of DC load: Used for higher power and frequent On/Off switching applications.



D: 1N4001 diode or equivalent component
ZD: 9V Zener, 5W

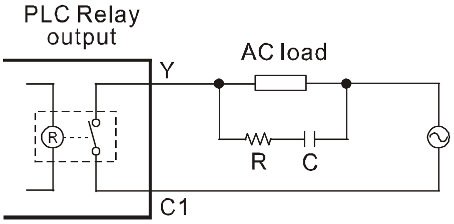
5. Incandescent light (resistive load)

6. AC power supply

7. Manually exclusive output

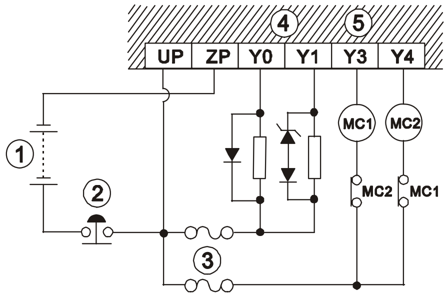
8. Neon indicator

9. Absorber: To reduce the interference from AC loads.



R: 100~120Ω
C: 0.1~0.24uF

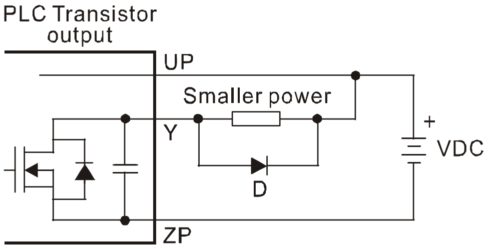
The Transistor Output Circuit Wiring



1. DC power supply
2. Emergency stop
3. Circuit protection fuse

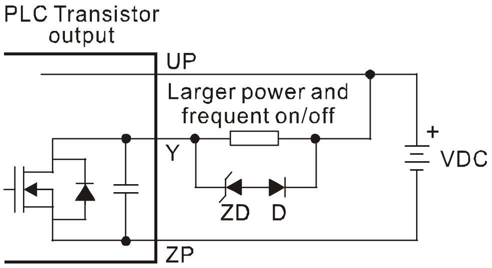
4. The output of the transistor model is “open collector”. If Y0/Y1 is set to pulse output, the output current has to be 0.05 ~ 0.5A to ensure normal operation.

   a. Diode suppression: Used for lower power applications.



D: 1N4001 diode or equivalent component

   b. Diode + Zener suppression: Used for higher power and frequent On/Off switching applications.



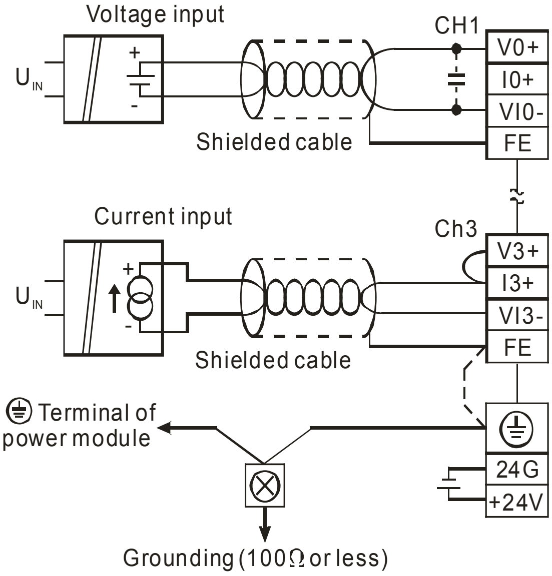
D: 1N4001 diode or equivalent component
ZD: 9V Zener, 5W

5. Manually exclusive output

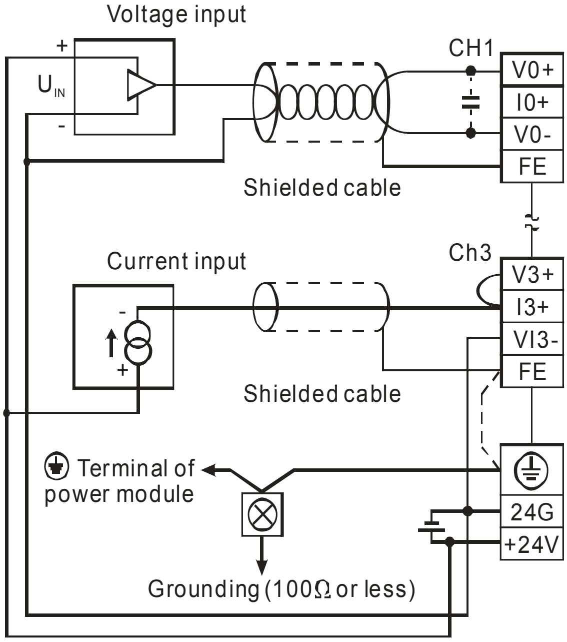
1.3.4.6 A/D and D/A External wiring

- **ELCM-PA Series**

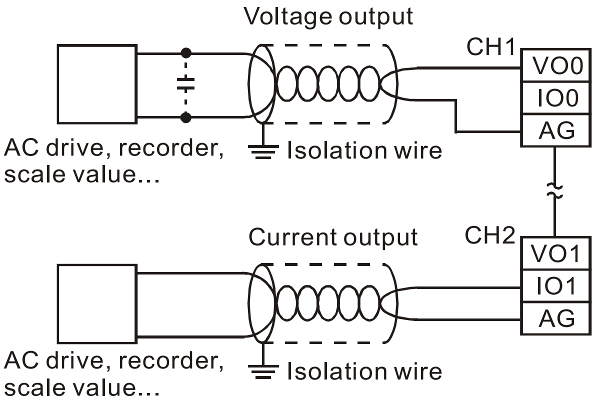
A/D Signal IN: Active



A/D Signal IN: Passive

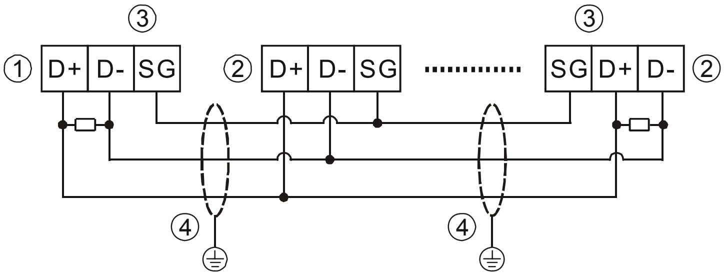


D/A Signal OUT



Note: When the A/D module is connected to current signals, make sure to jumper "V+" and "I+" terminals.

1.3.4.7 RS-485 Wiring



1. Master node	2. Slave node
3. Terminating resistor	4. Shielded cable

Note: 1. Terminating resistors are suggested to be connected to the master and the last slave with resistor value of 120Ω. Place the resistors across the + and – RS485 terminals.

2. To ensure communication quality, please apply double shielded twisted pair cable (20AWG) for wiring.

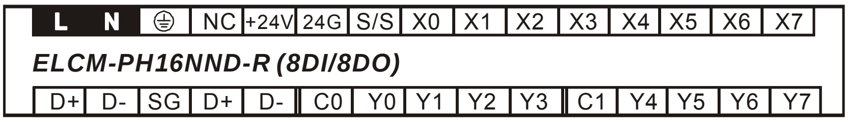
3. When voltage drop occurs between the internal ground references of two systems, connect the systems with Signal Ground point (SG) for achieving equal potential between systems so that a stable communication can be obtained.

1.3.5 Terminal Layout

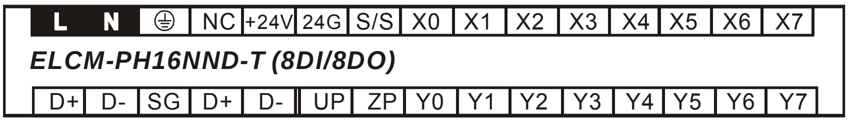
1.3.5.1 ELCM Series I/O Terminal Layout

- **ELCM-PH/PA**

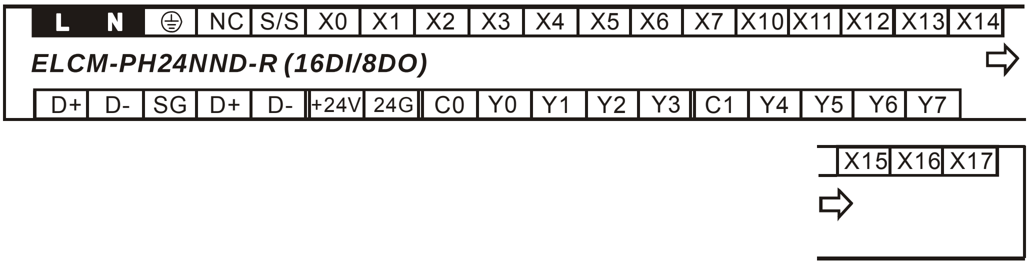
- ELCM-PH16NNDR



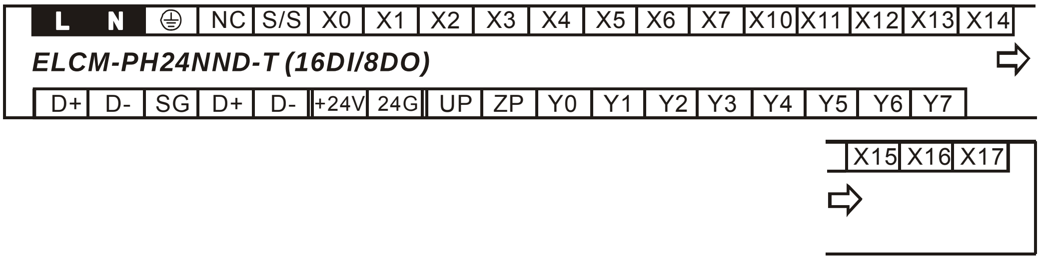
- ELCM-PH16NNDT



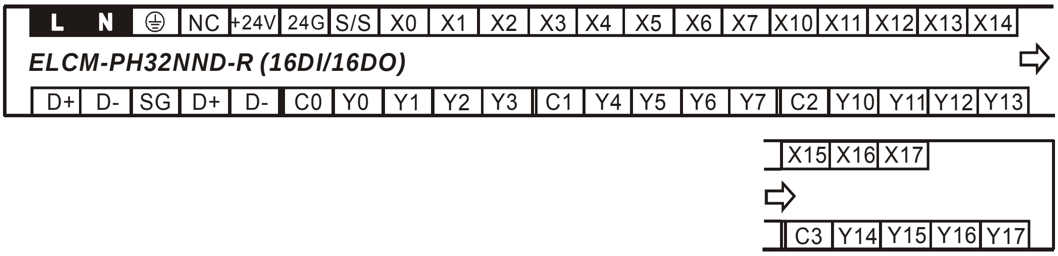
- ELCM-PH24NNDR



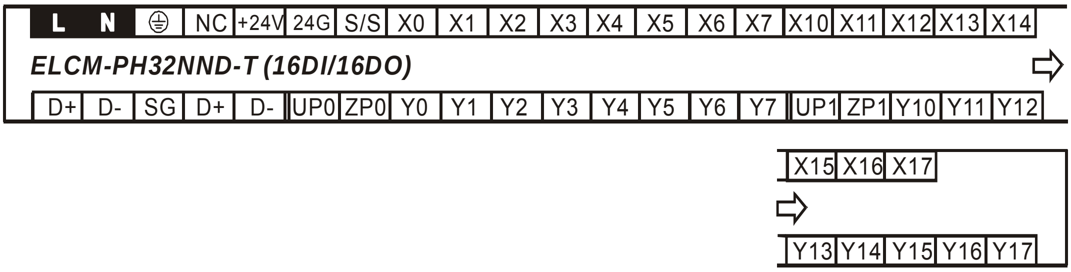
- ELCM-PH24NNDT



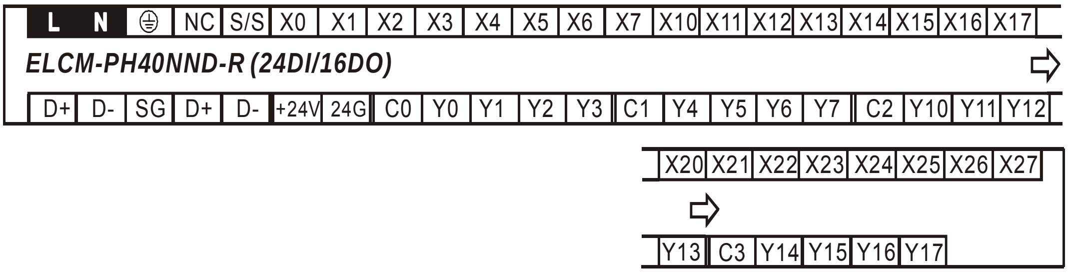
- ELCM-PH32NNDR



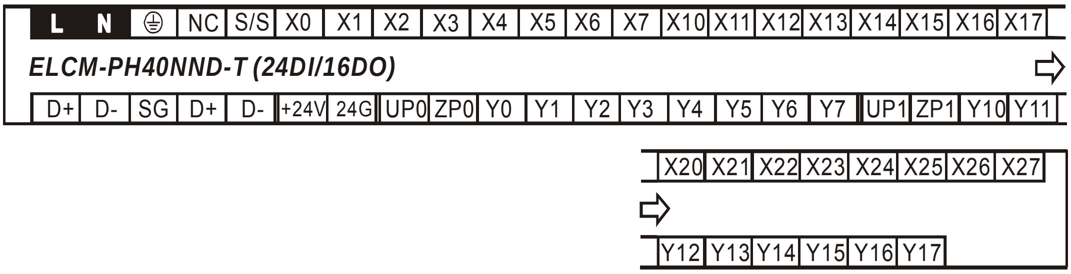
- ELCM-PH32NNDT



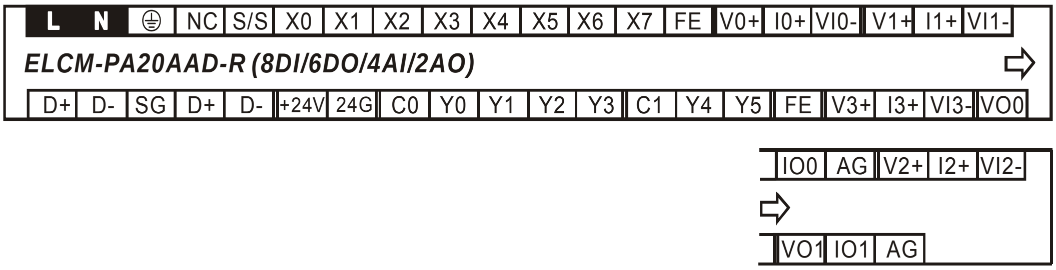
- ELCM-PH40NNDR



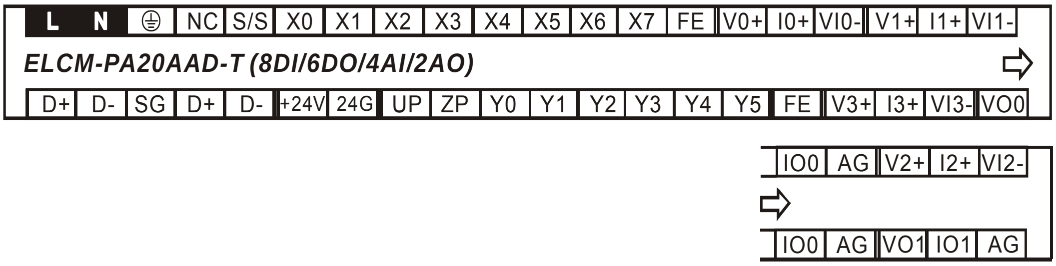
- ELCM-PH40NNDT



- ELCM-PA20AADR



- ELCM-PA20AADT



1.3.5.2 ELCM Digital Input/Output Extension Units

Number and Function of External I/O [X] / [Y]

- **Addressing for I/O points (Octal):**

  X0 ~ X7, X10 ~ X17, X20 ~ X27......, X70 ~ X77, X100 ~ X107...

  Y0 ~ Y7, Y10 ~ Y17, Y20 ~ Y27......, Y70 ~ Y77, Y100 ~ Y107...

- **I/O point addressing:**

  The expansion I/O are numbered in octal and are used in multiples of 8. I/O points less than 8 will still be regarded as 8. The expandable I/O capabilities can reach 256 input points with 16 output points or 256 output points with 16 input points.

I/O on the ELC controllers

Model	Input (X)	Output (Y)	Analog input	Analog output
PH16NNDR/T [#1]	X0~X7(8DI)	Y0~Y7(8DO)	-	-
PA20AADR/T	X0~X7(8 DI)	Y0~Y5(6 DO)	4 CH(12 bits)	2 CH(12 bits)
PH24NNDR/T	X0~X17(16 DI)	Y0~Y17(16 DO)	-	-
PH32NNDR/T	X0~X17(16 DI)	Y0~Y17(16 DO)	-	-
PH40NNDR/T	X0~X27(24 DI)	Y0~Y17(16 DO)	-	-
Expandable I/O	X20(X30) ~ X377 [#2]	Y20 ~Y377	-	-

#1: R: relay output. T: transistor output

#2: The addresses for expansion I/O begin with X20 and Y20 except for ELCM-PH40, where expansion I/O begins with X30, Y20. The expansion I/O points are numbered in octal and are in multiples of 8.

I/O Allocation of DIO Modules

Model	Input (X)	Output (Y)
ELCM-EX08NNDN	X20~X27(8DI)	-
ELCM-EX08NNNR/T	-	Y20~Y27(8DO)
ELCM-EX08NNDR/T [#1]	X20~X23(4DI)	Y20~Y23(4DO)
ELCM-EX16NNDN	X20~X37(16DI)	-
ELCM-EX16NNNR/T	-	Y20~Y37(16DO)
ELCM-EX16NNDR/T	X20~X27(8DI)	Y20~Y27(8DO)

#1: I/O points less than 8 will still be regarded as 8

Digital I/O Allocation Example

Allocation	Model	Input points	Output points	Input No.	Output No.
MPU	ELCM-PH32NNDR	16	16	X0~X17	Y0~Y17
DIO module 1 [#1]	ELCM-EX08NNDR	4	4	X20~X23	Y20~Y23
DIO module 2	ELCM-EX16NNDR	8	8	X30~X37	Y30~Y37

Allocation	Model	Input points	Output points	Input No.	Output No.
DIO module 3	ELCM-EX16NNNR	0	16	-	Y40~Y57

#1: The number of I/O points on the 1st digital I/O module listed above (ELCM-EX08NNDR) are 4 inputs and 4 outputs, but each is regarded as 8. The high 4 input addresses (X24-X27) and high 4 output addresses (Y24-Y27) should not be used.

ELCM Analog Input/Output Expansion Units

Description

The modules are numbered from 0 to 7 by their position with respect to the controller. Max. 8 modules are allowed to be connected to a controller and will not use any digital I/O points.

Model	Analog input	Analog output
ELCM-AN04ANNN	CH1~CH4(14bit)	-
ELCM-AN04NANN	-	CH1~CH4(14bit)
ELCM-AN02NANN	-	CH1~CH2(14bit)
ELCM-AN06AANN	CH1~CH4(14bit)	CH5~CH6(14bit)
ELCM-TC04ANNN	CH1~CH4(16bit)	-
ELCM-PT04ANNN	CH1~CH4(16bit)	-

Allocation Example of Mixed I/O

Allocation	Model	Input points	Output points	AIO No.	Input No.	Output No.
MPU	PH32NNDR/T	16DI	16DO	-	X0~X17	Y0~Y17
DIO module 1	EX08NNDN	8DI	-	-	X20~X27	-
AIO module 1	AN06 AANN	4AI	2AO	0	-	-
DIO module 2	EX16NNDR/T	8DI	8DO	-	X30~X37	Y20~Y27
AIO module 2	AN04ANNN	4AI	-	1	-	-
DIO module 3	EX08NNDR/T	4DI	4DO	-	X40~X43	Y30~Y33

1.3.6 Pre-power up checks and Troubleshooting

1.3.6.1 Trial Operation

- **ELCM-PH/PA**

Power Indication

The “POWER” LED indicator on the front of ELCM controllers and extension modules will be on (green) when the controller is powered. If the controller is powered but the indicator is not on check the power source.. Also, be sure that the 24vdc generated by the controller is not overloaded.

Preparation

1. Before powering the ELCM system, be sure to verify the I/O wiring. Damag could occur to

the ELCM if 110V AC or 220V AC is directly connected to input terminals or if the output wiring is short-circuited.

2. When the programming software downloads a program to the ELC: If the ERROR indicator does not flash, the program is legal.

Operation & test

1. If the ERROR indicator does not flash, you can use RUN/STOP switch or the programming software to place the controller into the RUN mode and the RUN indicator should be continuously on at this time. If the RUN indicator flashes, this indicates the ELCM controller does not have a program in it.
2. When the ELCM controller is in operation, use the programming software to monitor the operation of the program.

Low voltage indication

If the “LOW.V” (LV) indicator on the front panel of an ELC extension module is on, this indicates that the input voltage is insufficient. All outputs of the module are disabled when this indicator is on.

Input/Output Reaction Time

How to calculate the response time from the input signal to output operation of the ELC:

Response time = input delay time + program scan time (executed by the user) + output delay time

Input delay time	10ms (default); 0 ~ 60ms (adjustable). Refer to special register D1020 ~ D1021 in the ELC Programming Manual.
Program scan time	Refer to special register D1010 in the ELC Programming Manual.

1.3.6.2 Troubleshooting

■ **ELCM-PH/PA**

LED Indicators:

“POWER” indicator

When the ELC is powered, the POWER indicator on the front panel will be on (green). If this indicator is not on when the ELC is powered, check the power source. If the power source is ok, verify the current draw for all devices connected to the controller, to verify that the controller’s power supply is not being overdrawn.

“RUN” indicator

When the ELC controller is in the Run mode, this indicator will be on. Use the programming software or the switch on the front of the controller to place the controller into the RUN or STOP mode.

“ERROR” indicator

1. If you download an illegal program into an ELCM controller or use instructions or devices

that exceed their range, this indicator will flash (approx. every 1 sec.). When this happens, obtain the error code from D1004 and the address where the error occurred in register D1137 (if the error is a general circuit error, the address of D1137 will be invalid). Determine the cause of the error, correct the program and download the program to the ELCM controller. If you cannot connect to the ELCM and this indicator continues to flash quickly (approx. every 0.2 sec.), there may be insufficient 24VDC power from the internal power supply.. Verify the total current draw from all connected devices.

2. For details on error codes see the “ELC Programming Manual” and the hex error code descriptions for D1004.
3. When the ERROR LED is on (not blinking), Check the state of special relay M1008 in the ELC. If it is On, it indicates that the execution time of the program has exceeded the watchdog time-out setting (set in D1000). Turn the ELCM RUN/STOP switch to STOP, and view special data register D1008 to determine which program Step the error occurred on. The ”WDT” instruction can be used to solve the problem if the watchdog time is being exceeded, by resetting the watchdog timer during the program. Or, simply move a larger watchdog timer value to D1000. The default is 200 (200ms).

“Input” indicator

The On/Off state of each input point is indicated by an LED on the module, or the status may be viewed by going online with the controller with the programming software. If the LED for a particular input does not appear to be working properly, use the programming software to verify the state of that input. Also, check the I/O wiring and the power source used to drive the inputs.

“Output” indicator

The On/Off status of each output point is indicated by an LED. When the output indicator does not reflect the correct state of an output, check the following:

1. The output may be connected to a short-circuited load, or the output has failed.
2. The output may be wired incorrectly or the screws were not properly tightened.

Accuracy (month/second) of RTC

Temperature (ºC/ºF)	0/32	25/77	55/131
Max. inaccuracy (second)	-117	52	-132

1.4 ELCB Series

1.4.1 Specifications Introduction

1.4.1.1 Functions Specification

- **ELCB-PB**

<table>
<tr><th colspan="4">Items</th><th colspan="2">Specifications</th><th>Remarks</th></tr>
<tr><td colspan="4">Control method</td><td colspan="2">Stored program, cyclic scan system</td><td></td></tr>
<tr><td colspan="4">I/O processing method</td><td colspan="2">Batch processing method (when END instruction is executed)</td><td>Fast I/O refresh instruction can override batch update</td></tr>
<tr><td colspan="4">Execution speed</td><td colspan="2">Basic instructions – 3.5µ seconds minimum</td><td>Application instructions varies per instruction</td></tr>
<tr><td colspan="4">Program language</td><td colspan="2">Instructions + Ladder Logic + SFC</td><td></td></tr>
<tr><td colspan="4">Program capacity</td><td colspan="2">3792 Steps</td><td>Built-in EEPROM</td></tr>
<tr><td colspan="4">Instructions</td><td colspan="3">32 Basic instructions, Application instructions: 109</td></tr>
<tr><td rowspan="13">Bit</td><td>X</td><td colspan="2">External inputs</td><td>X0~X177, octal number system, 128 points max.</td><td rowspan="2">Total 256 I/O</td><td>Physical input points</td></tr>
<tr><td>Y</td><td colspan="2">External outputs</td><td>Y0~Y177, octal number system, 128 points max.</td><td>Physical output points</td></tr>
<tr><td rowspan="3">M</td><td rowspan="3">Auxiliary relay</td><td>General</td><td>M0~M511, M768~M999 744 points Note 1</td><td rowspan="3">Total 1280 bits</td><td rowspan="3">Main internal relay area for general use.</td></tr>
<tr><td>Latched</td><td>M512~M767, 256 points Note 3</td></tr>
<tr><td>Special</td><td>M1000~M1279, 280 points, some are latched</td></tr>
<tr><td rowspan="3">T</td><td rowspan="3">Timer</td><td>100ms</td><td>T0~T63, 64 points</td><td rowspan="3">Total 128 bits</td><td rowspan="3">Contact = ON when timer reaches preset value.</td></tr>
<tr><td>10ms (M1028=ON)</td><td>T64~T126, 63 points</td></tr>
<tr><td>1ms</td><td>T127 1 points</td></tr>
<tr><td rowspan="5">C</td><td rowspan="5">Counter</td><td rowspan="2">16-bit count up</td><td>C0~C111, Note 1</td><td rowspan="5">Total 141 bits</td><td rowspan="5">Contact = ON when counter reaches preset value.</td></tr>
<tr><td>C112~C127, Note 3</td></tr>
<tr><td rowspan="3">32bit high-speed count up/down</td><td>C235~C238, C241, C242, C244, 1 phase 1 input, 7 points Note 4</td></tr>
<tr><td>C246, C247, C249, 1 phase 2 input, 3 points Note 4</td></tr>
<tr><td>C251, C252, C254, 2 phase 2 input, 3 points Note 4</td></tr>
</table>

Items				Specifications		Remarks
Bit	S	Step point	Initial step point	S0~S9, 10 points, Note 4	Total 128 bits	SFC usage S10~S19 is used with IST instruction
			Zero return	S10~S19, 10 points, Note 4		
			Latched	S20~S127, Note 4		
Word Register	T	Current value		T0~T127, 128 words		
	C	Current value		C0~C127, 16-bit counter,		
				C235~C254, 32-bit counter		
	D	Data register	General	D0~D407, Note 1	Total 912 words	General storage for word length data.
			Latched	D408~D599, Note 3		
			Special	D1000~D1311, 312 words		
			Index	E=D1028, F=D1029, Note 1		
Pointer	N	Master control loop		N0~N7, 8 points		
	P	Pointer		P0~P63, 64 points		Subroutines pointer
	I	Interrupt Service	External interrupt	I001 (X0), I101 (X1), I201 (X2), I301 (X3); 4 points (all are rising-edge trigger)		Address for interrupt subroutines
			Time interrupt	I610~I699, 1 points (Timer resolution = 1ms)		
			Communication	I150, 1 point		
Constant	K	Decimal		K-32,768 ~ K32,767 (16-bit operation) K-2,147,483,648 ~ K2,147,483,647 (32-bit operation)		
	H	Hexadecimal		H0000 ~ HFFFF (16-bit operation), H00000000 ~ HFFFFFFFF (32-bit operation)		
Serial ports				COM1: RS-232 (Slave), COM2: RS-485 (Master/Slave), Both can be used at the same time.		
Clock/Calendar (RTC)				None		
Special expansion modules				Attach up to 8 modules of any type analog I/O extension modules		

Notes:

1. Data area is non-latched.
2. Default is non-latched, optionally can be set to latched.
3. Default is latched, optionally can be set to non-latched.
4. Data area is latched.

1.4.1.2 Electrical Specifications

- **ELCB-PB**

Model Item	PB10	PB14	PB16	PB20	PB24	PB30	PB32	PB40
Power supply voltage	100 ~ 240VAC (-15% ~ 10%), 50/60Hz ± 5%							
Operation	ELCB-PB starts to run when the power supply rises to 95 ~ 100VAC and stops when the power supply drops to 70VAC. It continues to run for 10ms after the power supply is cut off.							
Power supply fuse	2A/250VAC							
Power consumption	12VA		15.6VA					
DC24V current output	200mA		300mA					
Power supply protection	DC24V output short circuit protection							
Weight (R/T)	192g 180g	202g 185g	212g 190g	255g 230g	275g 240g	280g 245g	290g 250g	340g 300g

1.4.1.3 Input/Output Point Electrical Specifications

- **ELCB-PB**

DC Input Point Electrical Specification				
Input no.		X0, X1	X2 ~ X7	X20 ~ [#1]
Input point type		Digital input		
Input type		DC (SINK or SOURCE)		
Input current		24VDC 5mA		
Max. frequency		20kHz	10kHz	60Hz
Active level	Off→On	> 15VDC		
	On→Off	< 5VDC		
Responds time	Off→On	< 25us	< 50us	< 10ms
	On→Off	< 10us	< 20us	< 15ms
Filter time	X0 ~ X7	Adjustable within 0 ~ 20ms by D1020 (Default: 10ms)		

Output Point Electrical Specification			
Output point type		Relay-R	Transistor-T
Voltage specification		< 240VAC, 30VDC	5 ~ 30VDC [#2]
Max. load	Resistive	2A/1 point (5A/COM)	0.5A/1 point (2A/COM) [#4]
	Inductive	[#3]	15W (30VDC)
	Lamp	20WDC/100WAC	2.5W (30VDC)
Max. frequency		1Hz	1kHz
Responds time	Off→On	About 10ms	< 30us
	On→Off		< 350us

#1: Please refer to "I/O Terminal Layout" for the number of I/O on each model.

#2: UP, ZP must work with external auxiliary power supply 24VDC (-15% ~ +20%), rated consumption approx. 1mA/point.

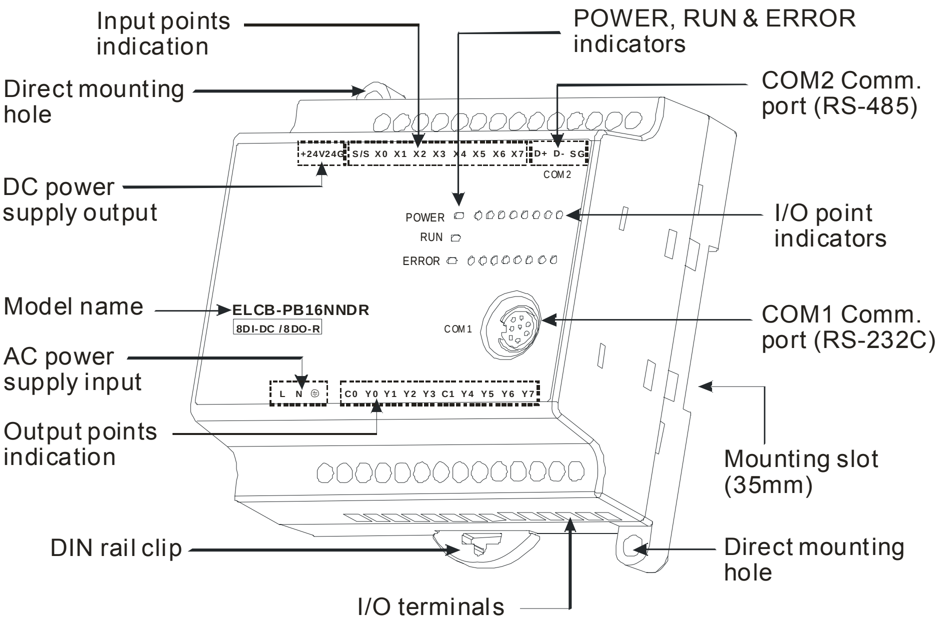
#3: For relay life curves, refer to the ELC-PB controller earlier in this document.

#4: ZP for NPN COM, UP for PNP COM.

1.4.2 Product Outline and Dimension

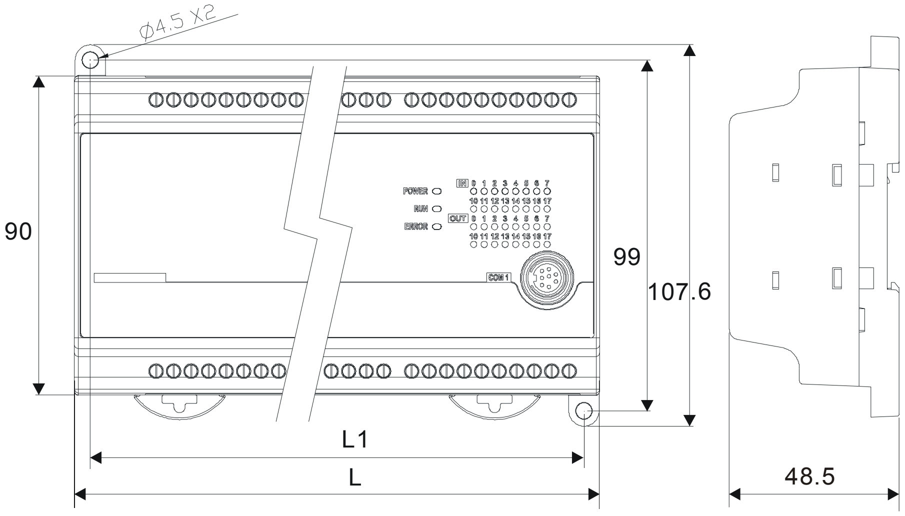
1.4.2.1 Product Outline

- **ELCB-PB**



1.4.2.2 Dimension

- **ELCB-PB**



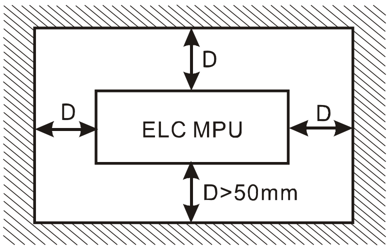
Unit: mm

Model	L	L1
ELCB-PB10NNDR/T	95	86
ELCB-PB14NNDR/T		
ELCB-PB16NNDR/T		
ELCB-PB20NNDR/T	150	141
ELCB-PB24NNDR/T		
ELCB-PB30NNDR/T		
ELCB-PB32NNDR/T		
ELCB-PB40NNDR/T	164	155

1.4.3 Installation and Wiring

1.4.3.1 Installation

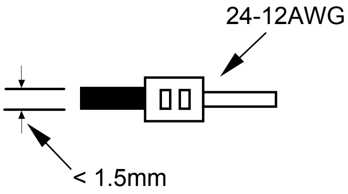
Install the ELC in an enclosure with sufficient space around it to allow heat dissipation, as shown in the figure below.



- **DIN Rail Mounting:** The ELC can be secured to a cabinet by using 35mm height and 7.5mm in depth DIN rail. When mounting the ELC to 35mm DIN rail, be sure to use the retaining clip to stop any side-to-side movement of the ELC and reduce the chance of wires coming loose. The retaining clip is at the bottom of the ELC. To secure the ELC to DIN rail, pull the clip down, place it onto the rail and push the clip back up. To remove the ELC, pull the retaining clip down with a flat screwdriver and remove the ELC from the DIN rail.
- **Direct Mounting:** Use M4 screws according to the dimension of the product.

1.4.3.2 Terminal Torque

1. Use the 12-24 AWG single-core wire or the multi-core wire for the I/O wiring. The ELC terminal screws should be tightened to 3.80 kg-cm (3.30 in-lbs) and use 60/75°C copper conductor only.



2. DO NOT wire empty terminals. DO NOT place the input signal wire and output power wire in the same wiring circuit.
3. DO NOT drop tiny metallic conductors into the ELC during installation..
    - Attach the dustproof sticker to the ELC before the installation to prevent conductive objects from dropping in.
    - Tear off the sticker before running the ELC to ensure normal heat dissipation.

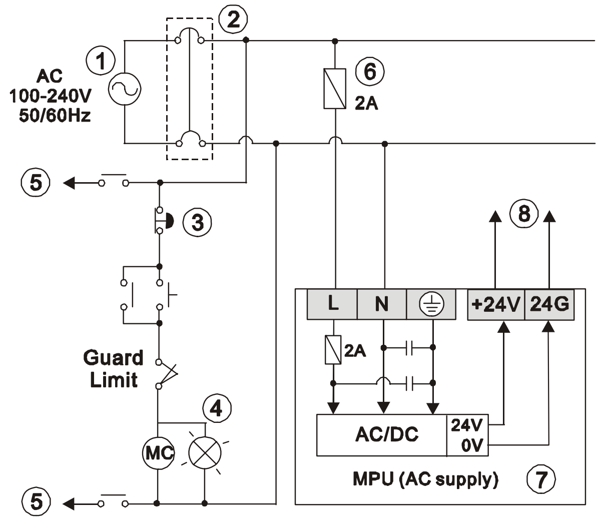
1.4.3.3 Power Supply

The power input type for ELCB-PB model is AC. When operating ELCB-PB, please note the following points:

1. The range of the input voltage should be 100 ~ 240VAC. The power supply should be connected to L and N terminals. Please note that wiring 110V AC or 220V AC to +24V output terminals or digital input points will result in serious damage on the ELC.
2. The AC power inputs for the controller and the digital I/O module power should be ON or OFF at the same time.
3. Use 1.6mm wire for the grounding of the ELC.
4. A power dip of less than 10ms will not affect the operation of the ELC.
5. The +24V output is rated at 0.5A from the controller. DO NOT connect other external power supplies to this terminal. Each input terminal draws 5 ~ 7mA. A 16-point input module will require approximately 100mA. Therefore, the +24V output power cannot provide power for an external load that is more than 400mA.

1.4.3.4 Safety Wiring

In an ELC control system, many devices are controlled at the same time and actions of any device could influence another. Therefore, we suggest you wire a protection circuit at the power supply input terminals, per the figure below.



1. AC power supply:100 ~ 240VAC, 50/60Hz	2. Breaker
3. Emergency stop	
4. Power indicator	5. AC power supply load
6. Power supply circuit protection fuse (2A)	7. ELC (main processing unit)
8. DC power supply output: 24VDC	

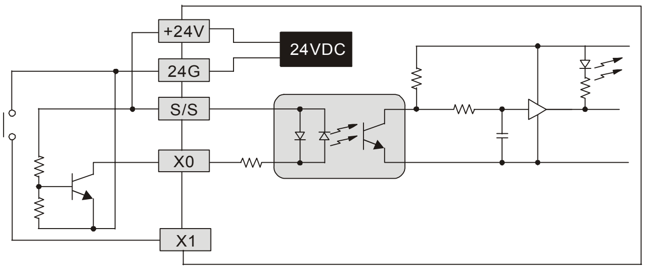
1.4.3.5 I/O Point Wiring

■ ELCB-PB

There are 2 types of DC inputs, SINK and SOURCE. (See the examples below. For additional information, please refer to the specifications for each module.)

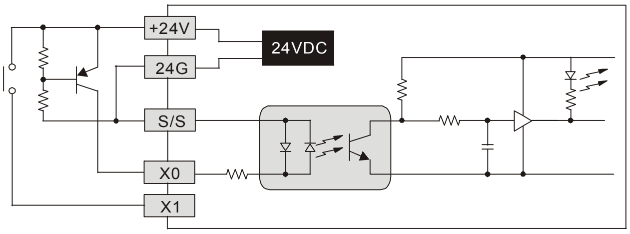
- DC Signal IN – SINK mode

  Input circuit



- DC Signal IN – SOURCE mode

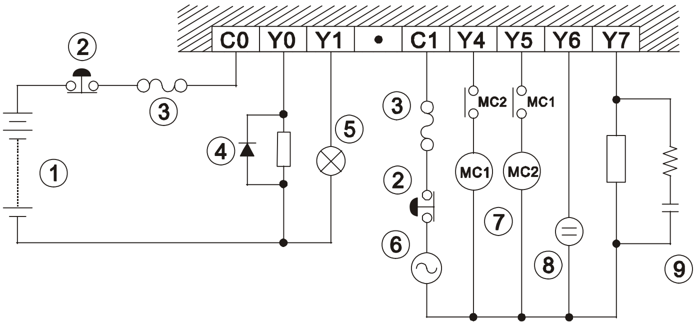
  Input circuit



Below is an example. For additional information, please refer to specifications for each module.

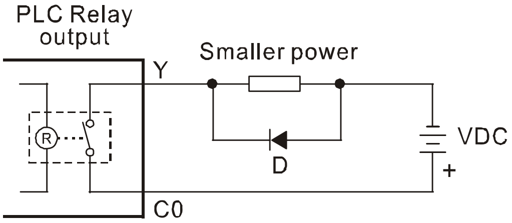
Output Wiring

The Relay Output Circuit Wiring



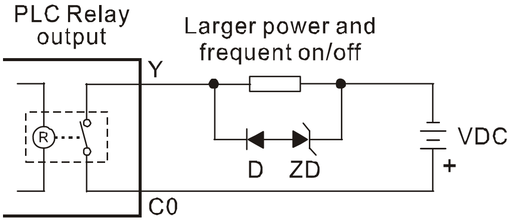
1. DC power supply
2. Emergency stop: Uses external switch
3. Fuse: Uses 5 ~ 10A fuse at the shared terminal of output contacts to protect the output circuit
4. Transient voltage suppressor: To extend the life of the contacts.

a. Diode suppression for DC loads: Used for lower power applications.



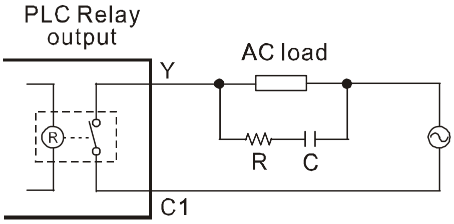
D: 1N4001 diode or equivalent component

b. Diode + Zener suppression for DC loads: Used for higher power and frequent ON/OFF switching applications..



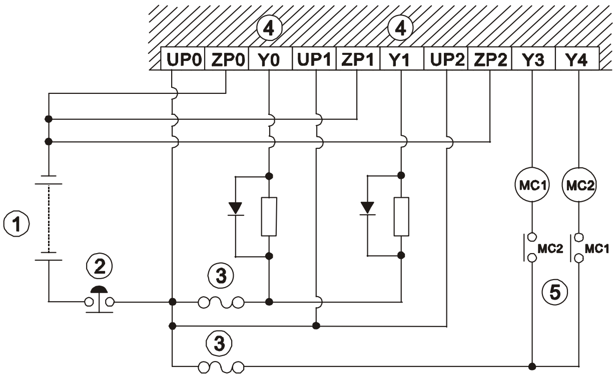
D: 1N4001 diode or equivalent component
ZD: 9V Zener, 5W

5. Incandescent light (resistive load)
6 AC power supply
7. Manual exclusive output
8. Neon indicator
9. Absorber: To reduce the interference on AC loads (Figure 10)



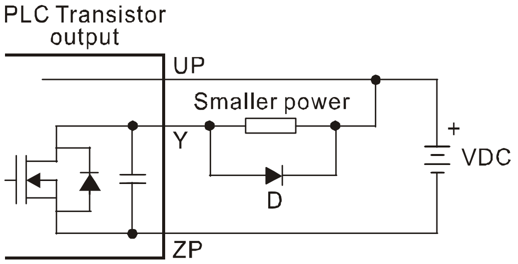
R: 100~120Ω
C: 0.1~0.24uF

The Transistor Output Circuit Wiring



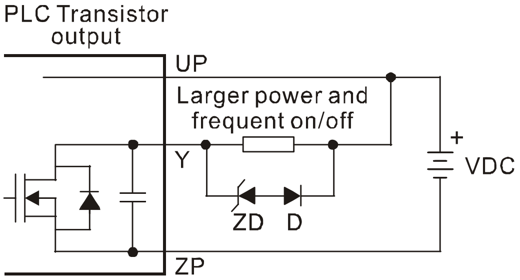
1. DC power supply
2. Emergency stop
3. Circuit protection fuse
4. The output of the transistor model is “open collector”. If Y0/Y1 is set to pulse output, the output current must be 0.05 ~ 0.5A to ensure normal operation of the model.

   a. Diode suppression: Used for lower power applications.



D: 1N4001 diode or equivalent component

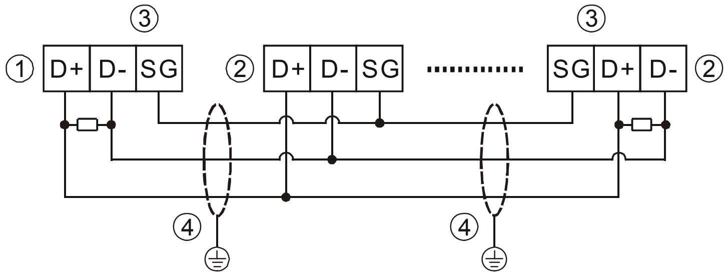
   b. Diode + Zener suppression: Used for higher power and frequent ON/OFF switching applications.



D: 1N4001 diode or equivalent component
ZD: 9V Zener, 5W

5. Manual exclusive output

1.4.3.6 RS-485 Wiring



1. Master node	2. Slave node
3. Terminal resistor	4. Shielded cable

Note: 1. Termination resistors are suggested to both physical ends of the network with 120Ω resistors.

2. To ensure communication quality, apply double shielded twisted pair cable (20AWG) for the wiring.

3. When a voltage drop occurs between the internal ground references of two systems, connect the systems to a Signal Ground point (SG) for achieving equal potential between the systems for stable communications.

1.4.4 Terminal Layout

1.4.4.1 ELCB Series I/O Terminal Layout

- **ELCB-PB**

- ELCB-PB10NNDR

+24V	24G	S/S	X0	X1	X2	X3	X4	X5	•	•	D+	D-	SG

ELCB-PB10NNDR (6DI-DC/4DO-R)

L	N	⏚	•	C0	Y0	Y1	Y2	Y3

- ELCB-PB10NNDT

+24V	24G	S/S	X0	X1	X2	X3	X4	X5	•	•	D+	D-	SG

ELCB-PB10NNDT (6DI-DC/4DO-T)

L	N	⏚	•	UP	ZP	Y0	Y1	Y2	Y3

- ELCB-PB14NNDR

+24V	24G	S/S	X0	X1	X2	X3	X4	X5	X6	X7	D+	D-	SG

ELCB-PB14NNDR (8DI-DC/6DO-R)

L	N	⏚	•	C0	Y0	Y1	Y2	Y3	C1	Y4	Y5

- ELCB-PB14NNDT

+24V	24G	S/S	X0	X1	X2	X3	X4	X5	X6	X7	D+	D-	SG

ELCB-PB14NNDT (8DI-DC/6DO-T)

L	N	⏚	•	UP	ZP	Y0	Y1	Y2	Y3	Y4	Y5

- ELCB-PB16NNDR

+24V	24G	S/S	X0	X1	X2	X3	X4	X5	X6	X7	D+	D-	SG

ELCB-PB16NNDR (8DI-DC/8DO-R)

L	N	⏚	•	C0	Y0	Y1	Y2	Y3	C1	Y4	Y5	Y6	Y7

- ELCB-PB16NNDT

+24V	24G	S/S	X0	X1	X2	X3	X4	X5	X6	X7	D+	D-	SG

ELCB-PB16NNDT (8DI-DC/8DO-T)

L	N	⏚	•	UP	ZP	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7

- ELCB-PB20NNDR

+24V	24G	S/S	X0	X1	X2	X3	X4	X5	X6	X7	X10	X11	X12	X13	•	•	•	•	•	•	D+	D-	SG

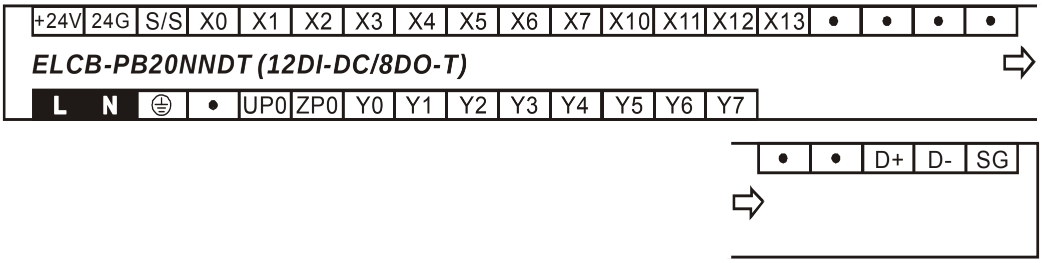
ELCB-PB20NNDR (12DI-DC/8DO-R) ⇨

L	N	⏚	•	C0	Y0	Y1	Y2	Y3	C1	Y4	Y5	Y6	Y7

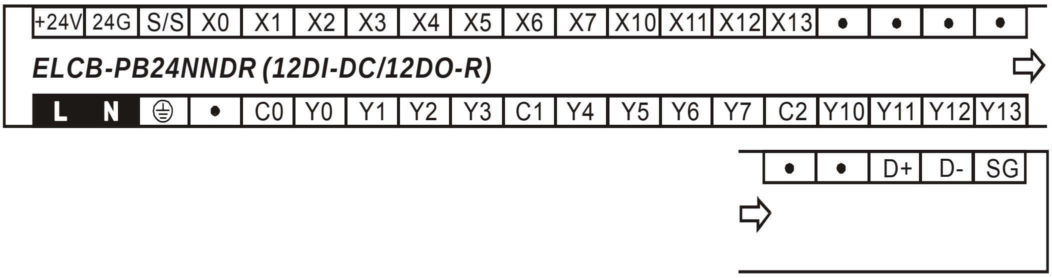
⇨

•	•	D+	D-	SG

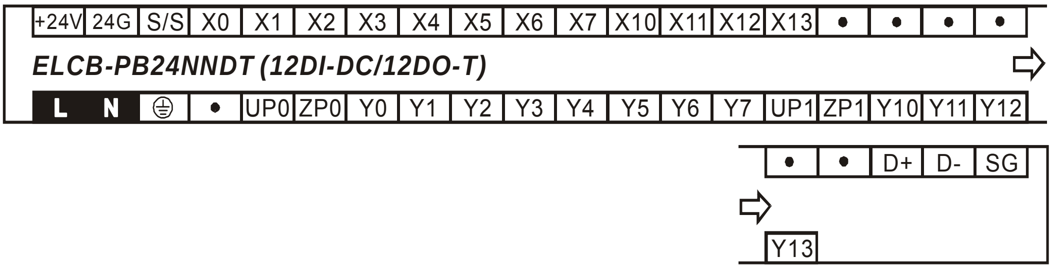
- ELCB-PB20NNDT



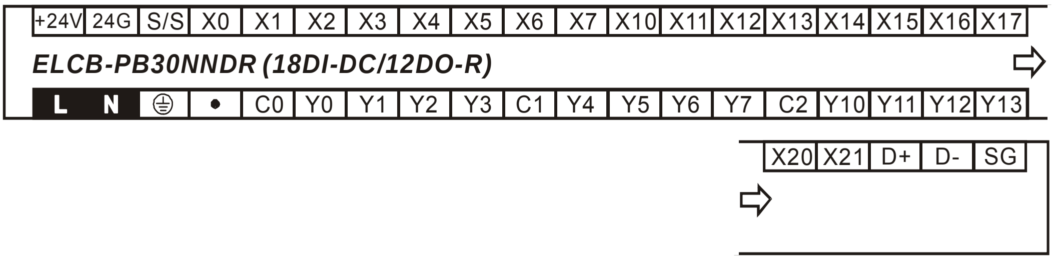
- ELCB-PB24NNDR



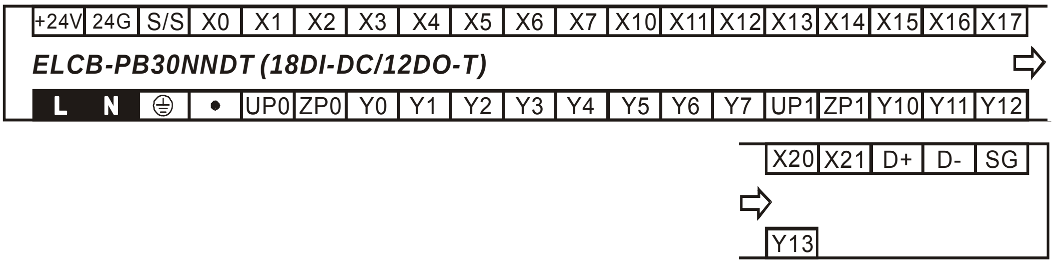
- ELCB-PB24NNDT



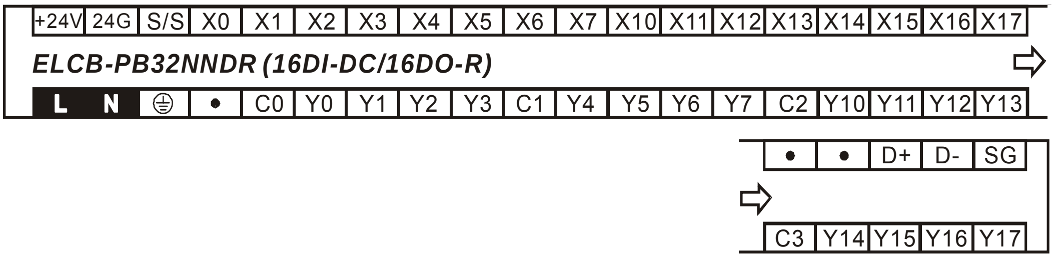
- ELCB-PB30NNDR



- ELCB-PB30NNDT



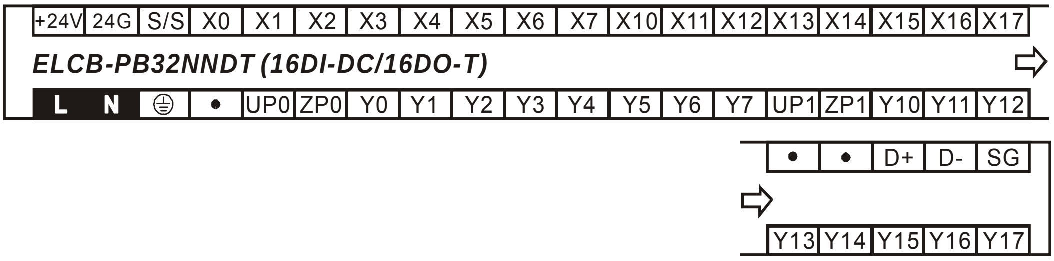
- ELCB-PB32NNDR



+24V	24G	S/S	X0	X1	X2	X3	X4	X5	X6	X7	X10	X11	X12	X13	X14	X15	X16	X17	
L	N	⏚	•	C0	Y0	Y1	Y2	Y3	C1	Y4	Y5	Y6	Y7	C2	Y10	Y11	Y12	Y13	

•	•	D+	D-	SG
C3	Y14	Y15	Y16	Y17

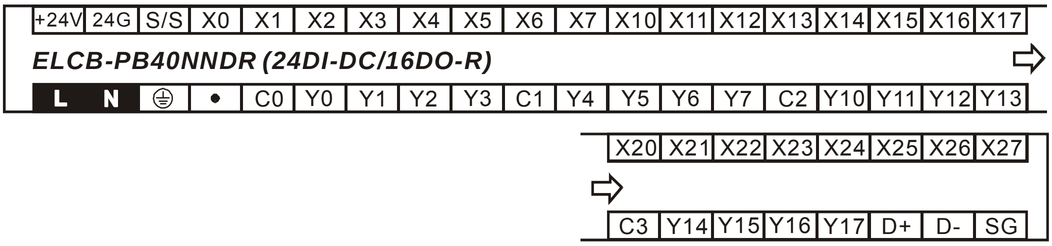
- ELCB-PB32NNDT



+24V	24G	S/S	X0	X1	X2	X3	X4	X5	X6	X7	X10	X11	X12	X13	X14	X15	X16	X17
L	N	⏚	•	UP0	ZP0	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	UP1	ZP1	Y10	Y11	Y12

•	•	D+	D-	SG
Y13	Y14	Y15	Y16	Y17

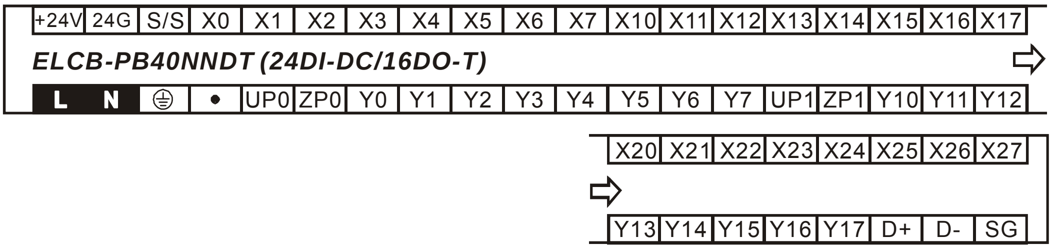
- ELCB-PB40NNDR



+24V	24G	S/S	X0	X1	X2	X3	X4	X5	X6	X7	X10	X11	X12	X13	X14	X15	X16	X17
L	N	⏚	•	C0	Y0	Y1	Y2	Y3	C1	Y4	Y5	Y6	Y7	C2	Y10	Y11	Y12	Y13

X20	X21	X22	X23	X24	X25	X26	X27
C3	Y14	Y15	Y16	Y17	D+	D-	SG

- ELCB-PB40NNDT



+24V	24G	S/S	X0	X1	X2	X3	X4	X5	X6	X7	X10	X11	X12	X13	X14	X15	X16	X17
L	N	⏚	•	UP0	ZP0	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	UP1	ZP1	Y10	Y11	Y12

X20	X21	X22	X23	X24	X25	X26	X27
Y13	Y14	Y15	Y16	Y17	D+	D-	SG

1.4.5 Trial Operation and Troubleshooting

1.4.5.1 Trial Operation

■ **ELCB-PB**

Power Indication

The “POWER” LED indicator on the front of ELCB controllers and extension modules will be on (green) when the controller is powered. If the controller is powered but the indicator is not on check the power source.. Also, be sure that the 24vdc generated by the controller is not overloaded.

Preparation

1. Before powering the ELCB, checked that the I/O wiring is correct. Damage the ELCB could occur if 110V AC or 220V AC is connected to input terminals or if the output wiring is short-circuited.
2. When the programming software downloads a program to the ELCB: If the ERROR indicator does not flash, the program you are using is legal and ELCB is ready to RUN..

Operation & test

1. If the ERROR indicator does not flash, you can use RUN/STOP switch or the programming software to place the controller into the RUN mode and the RUN indicator should be continuously on at this time. If the RUN indicator flashes, this indicates the ELC controller does not have a program in it.

2. When the ELC controller is in operation, use the programming software to monitor the operation of the program.

Low voltage indication

If the “LOW.V” (LV) indicator on the front panel of an ELC extension module is on, this indicates that the input voltage is insufficient. All outputs on the module are disabled when this indicator is on.

Input/Output Throughput

How to calculate the response time from the input signal to output operation of the ELC:

Response time = input delay time + program scan time + output delay time

Input delay time	10ms (default); 0 ~ 60ms (adjustable). Refer to special registers D1020 ~ D1021.
Program scan time	Refer to special register D1010.

1.4.5.2 Troubleshooting

■ ELCB-PB

“POWER” indicator

The “POWER” LED indicator on the front of ELCM controllers and extension modules will be on (green) when the controller is powered. If the controller is powered but the indicator is not on check the power source.. Also, be sure that the 24vdc generated by the controller is not overloaded.

“RUN” indicator

When ELC is running, the RUN indicator will be on.

“ERROR” indicator

1. If you download an illegal program into an ELCM controller or use instructions or devices that exceed their range, this indicator will flash (approx. every 1 sec.). When this happens, obtain the error code from D1004 and the address where the error occurred in register

D1137 (if the error is a general circuit error, the address of D1137 will be invalid). Determine the cause of the error, correct the program and download the program to the ELCM controller. If you cannot connect to the ELCM and this indicator continues to flash quickly (approx. every 0.2 sec.), there may be insufficient 24VDC power from the internal power supply.. Verify the total current draw from all connected devices.

2. For details on error codes see the “ELC Programming Manual” and the hex error code descriptions for D1004.
3. When the ERROR LED is on (not blinking), Check the state of special relay M1008 in the ELC. If it is On, it indicates that the execution time of the program has exceeded the watchdog time-out setting (set in D1000). Turn the ELCM RUN/STOP switch to STOP, and view special data register D1008 to determine which program Step the error occurred on. The ”WDT” instruction can be used to solve the problem if the watchdog time is being exceeded, by resetting the watchdog timer during the program. Or, simply move a larger watchdog timer value to D1000. The default is 200 (200ms).

“Input” indicator

The On/Off state of each input point is indicated by an LED on the module, or the status may be viewed by going online with the controller with the programming software. If the LED for a particular input does not appear to be working properly, use the programming software to verify the state of that input. Also, check the I/O wiring and the power source used to drive the inputs.

“Output” indicator

The On/Off status of each output point is indicated by an LED. When the output indicator does not reflect the correct state of an output, check the following:

1. The output may be connected to a short-circuited load, or the output has failed.
2. The output may be wired incorrectly or the screws were not properly tightened.

Accuracy (month/second) of RTC

Temperature (ºC/ºF)	0/32	25/77	55/131
Max. inaccuracy (seconds)	-117	52	-132

2

DIDO Units

Table of Content

2.1 ELC Series

2.1.1 Specifications

2.1.1.1 Electrical Specifications

- **ELC-EX DIDO**

Model Item	08NNDN 08NNAN	16NNDN	08NNNR 08NNNT	08NNDR 08NNDT	16NNDR 16NNDT	16NNDP	06NNNI
Power supply voltage	Supplied by bus power form the controller						
Power consumption	1W	2W	1.5W	1.5W	2W	2W	1.5W
Weight (R/T)	162g 141g	146g	154g 146g	141g 136g	162g 154g	151g	200g

- **ELC-EX08NNSN**

Model Items	EX08NNSN
Power voltage	Supplied by bus power form the controller
Power consumption	0.5W
Weight (g)	60g

2.1.1.2 Input/Output Point Electrical Specifications

- **ELC-EX DIDO**

Input Point Electrical Specification			
Input type Item		DC Type	AC Type
Input type		DC (SINK or SOURCE)	-
Input impedance		-	14.5 Kohm/50Hz 12 Kohm/60Hz
Input voltage/current		24VDC 5mA	85~132VAC 50~60Hz 9.2 mA 110VAC/60Hz
Active level	Off→On	> 16.5VDC	> 80VAC
	On→Off	< 5VDC	< 30VAC
Responds time	Off→On	< 10ms	< 15ms
	On→Off	< 15ms	< 20ms
Circuit isolation/ operation indication		Photocoupler/LED On	
Max. Off current		1.8 mA	2 mA

Output Point Electrical Specification				
Output type Item		Relay-R	Relay-R #1	Transistor-T
Voltage specification		240VAC, below 30VDC	240VAC, below 30VDC	30VDC
Max. load	Resistive	1.5A/1 point (5A/COM)	6A/1 point	55°C 0.1A/1 point, 50°C 0.15A/1 point, 45°C 0.2A/1 point, 40°C 0.3A/1 point
	Inductive	#2		9W (30VDC)
	Lamp	20WDC/100WAC		1.5W (30VDC)
Responds time	Off→On	About 10ms		< 100us
	On→Off			< 100us

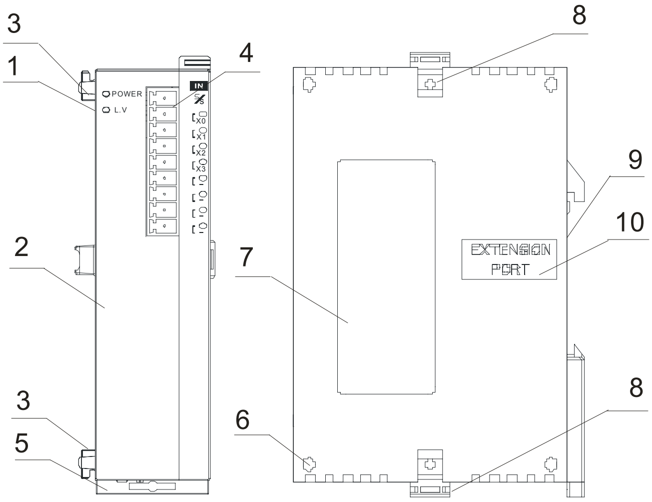
#1: Only for model ELC-EX06NNNI

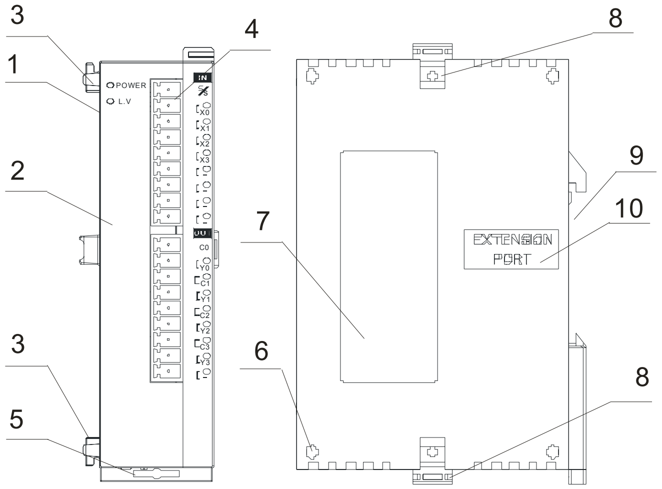
#2: For information on life curves, refer to the specifications for the ELC-PB controller in section 1.2.1.3.

2.1.2 Product Outline and Dimension

2.1.2.1 Product Outline

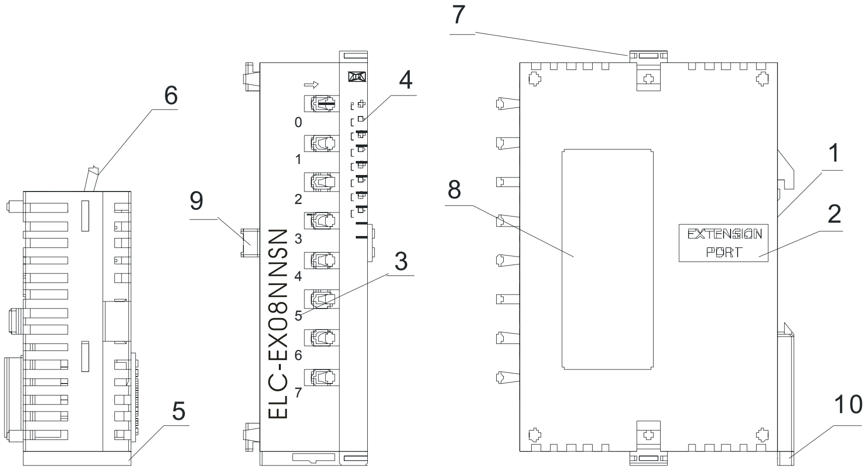
- **ELC-EX DIDO**





1. Status indicator (Power and low voltage)	6. Mounting hole of the extension unit
2. Model Name	7. Nameplate
3. Extension unit clip	8. Extension hook
4. Input/output terminal	9. DIN rail mounting slot (35mm)
5. DIN rail clip	10. Extension port

■ ELC-EX08NNSN

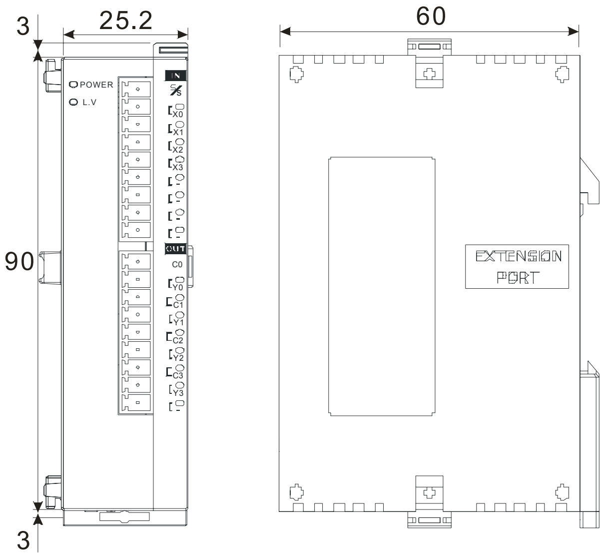


1. DIN rail mounting slot (35mm)	6. Input switch
2. Extension unit/module connection port	7. Extension hook
3. Model name	8. Nameplate
4. Input indicators	9. Extension unit/module connection port
5. DIN rail clip	10. DIN rail clip

2.1.2.2 Dimensions

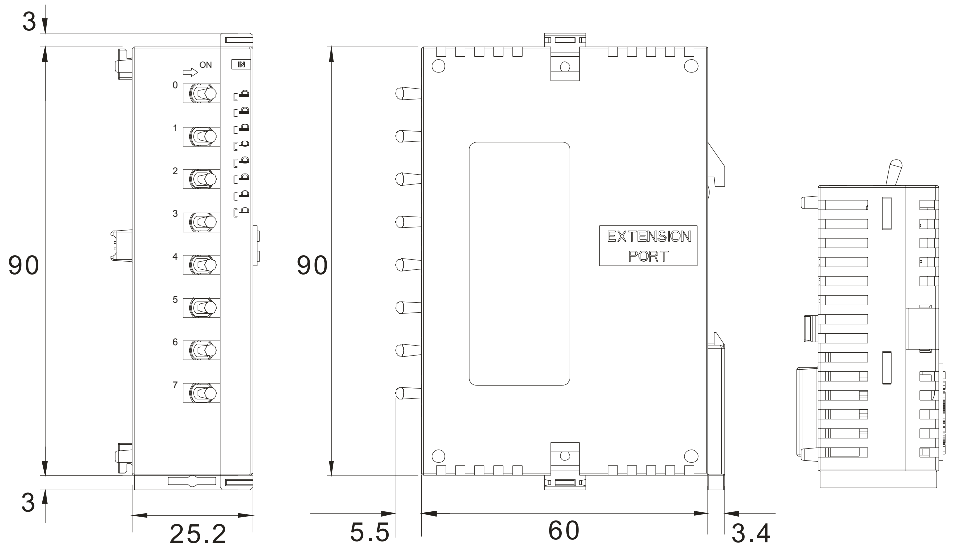
- **ELC-EX DIDO**

Model
ELC-EX08NNDR/T
ELC-EX16NNDR/T
ELC-EX08NNAN
ELC-EX08NNDN
ELC-EX08NNNR/T
ELC-EX06NNNI
ELC-EX16NNDN
ELC-EX16NNDP



Unit: mm

- **ELC-EX08NNSN**

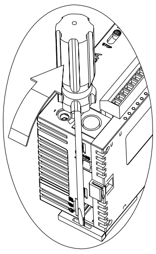


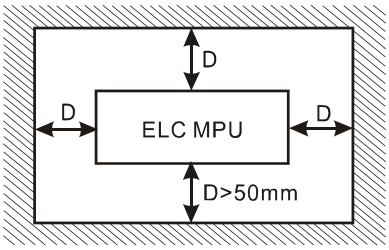
Unit: mm

2.1.3 Installation and Wiring

2.1.3.1 Installation

Install the ELC in an enclosure with sufficient space around it to allow heat dissipation, as shown in the figure below.

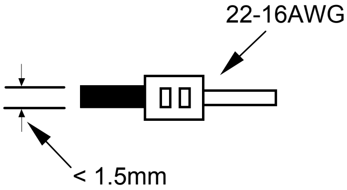




- **DIN Rail Mounting:** The ELC may be secured to a cabinet by using 35mm in height and 7.5mm in depth DIN rail. When mounting the ELC to 35mm DIN rail, be sure to use the retaining clip to stop any side-to-side movement of the ELC and reduce the chance of wires coming loose. The retaining clip is at the bottom of the ELC. To secure the ELC to DIN rail, pull down the clip, place it onto the rail and push it up to lock it in place. To remove the ELC, pull the retaining clip down with a flat screwdriver and remove the ELC from DIN rail.

2.1.3.2 Terminal Torque

1. Use 22-16 AWG (1.5mm) single-core wire or the multi-core wire for the I/O wiring. The specification of the terminal is shown in the figure on the right hand side. The ELC terminal screws should be tightened to 1.95 kg-cm (1.7 in-lbs). Also, use 60/75°C copper conductor only.



2. DO NOT wire empty terminals. DO NOT place the input signal wire and output power wire in the same wiring circuit.
3. Field wiring terminals shall be marked with tightening torque.
4. DO NOT drop tiny metallic conductor into the ELC while screwing and wiring.
    - Please attach the dustproof sticker to the ELC before the installation to prevent conductive objects from dropping in.
    - Tear off the sticker before running the ELC to ensure normal heat dissipation.

2.1.3.3 I/O Point Wiring

- **ELC-EX DIDO**

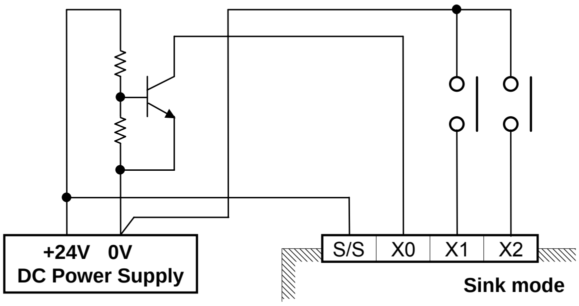
Input Wiring

Wiring DC Inputs

There are 2 types of DC inputs, SINK and SOURCE. (Below are examples. For additional information, please refer to specifications for each module.)

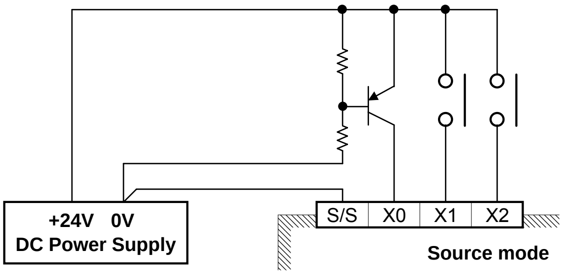
- DC Signal IN – SINK mode

  Input circuit

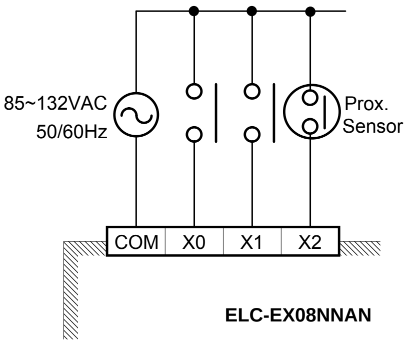


- DC Signal IN – SOURCE mode

  Input circuit



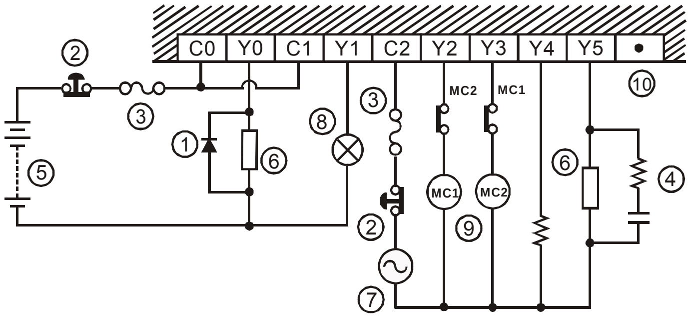
Wiring AC Inputs

Input Circuit Connection


110V AC Input Specifications	
Input voltage	85~132VAC 50~60Hz
Input impedance	14.5Kohm/50Hz 12Kohm/60Hz
Input current	9.2mA 110VAC/60Hz
On/Off Voltage Level	above 80VAC
	below 30VAC
Response time	Off → On < 15 ms
	On → Off < 20 ms
Circuit isolation/ Operation indication	Photocoupler/LED On

Output Wiring

Relay Output Circuit Wiring



1. Reverse-current protection diode, *1	
2. Emergency stop	3. Fuse
4. Surge absorber (0.1uf capacitor+100~120ohm resistor, *3	
5. DC power Supply	6. Inductive load
7. AC power Supply	8. Incandescent lamp
9. External Mechanical Interlock, *2	10. Do not use this terminal

*1: The ELC does not have any internal protection circuitry on the relay outputs. For switching DC inductive loads, a reverse-current protection diode should be installed in parallel with the load. The relay contact life decreases significantly if this is not done.

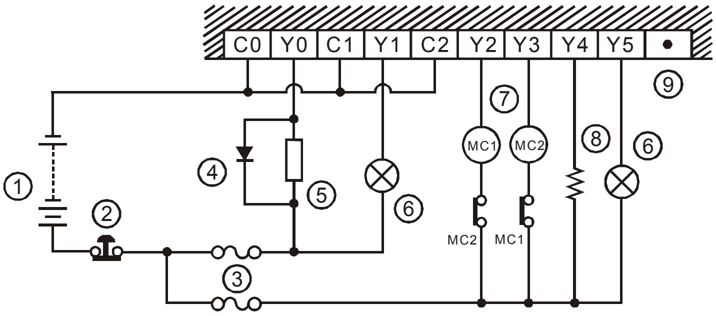
The reverse-current protection diode needs to satisfy the following specifications.

- The diode is rated for maximum reverse voltage of 5~10 times the load voltage.
- The forward current is more that the load current

*2: Ensure all loads are applied to the same side of each ELC output, see the figureabove. Loads which should NEVER simultaneously operate (e.g. direction control of a motor), because of a critical safety criteria, should not rely on the ELC's sequencing alone. Mechanical interlocks MUST be fitted to all critical safety circuits.

*3: The ELC does not have any internal protection circuitry on the relay output. For switching AC inductive loads, a surge absorber (0.1uF + "100ohm to 120ohm") should be installed in parallel with the load. The relay contact life decreases significantly if this is not done. Besides protecting the internal circuitry of the ELC, a surge absorber decreases the noise emissions to the load.

Transistor Output Circuit Wiring



1. DC Power Supply	2. Emergency Stop
3. Fuse	4. Reverse-current protection diode, *1
5. Inductive load	6. Incandescent Lamp
7. External Mechanical Interlock	8. Resistive load
9. Do not use this terminal	

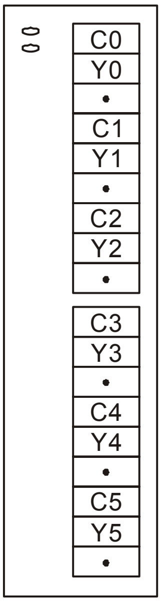
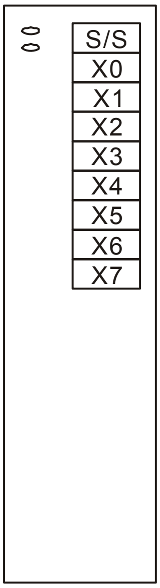
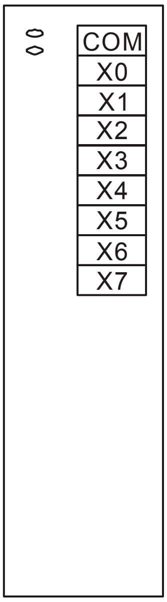
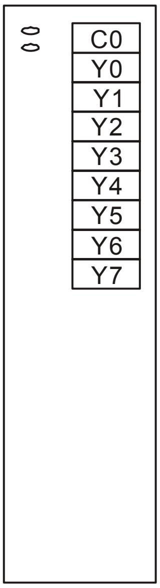
*1: Ensure all loads are applied to the same side of each ELC output, see the figure above. Loads which should NEVER simultaneously operate (e.g. control of a reversing motor), because of a critical safety criteria, should not rely on the ELC's sequencing alone. Mechanical interlocks MUST be fitted to all critical safety circuits.

*2: Transistor outputs use internal zener diode (39V) as protection circuitry. When driving the inductive load with a transistor output, a reverse-current protection diode can be installed in parallel with the load if necessary.
The reverse-current protection diode needs to satisfy the following specifications.
- The diode is rated for maximum reverse voltage of 5 to 10 times the load voltage.
- The forward current is more than the load current.

2.1.4 Terminal Layout

2.1.4.1 ELC Series Digital I/O Modules Terminal Layout

- **ELC-EX DIDO**

EX06NNNI	EX08NNDN	EX08NNAN	EX08NNNR
			

EX08NNNT	EX08NNDR	EX08NNDT	EX16NNDN
C0 Y0 Y1 Y2 Y3 Y4 Y5 Y6 Y7	S/S X0 X1 X2 X3 • • • • C0 Y0 C1 Y1 C2 Y2 C3 Y3 •	S/S X0 X1 X2 X3 • • • • C0 Y0 C1 Y1 C2 Y2 C3 Y3 •	S/S X0 X1 X2 X3 X4 X5 X6 X7 S/S X10 X11 X12 X13 X14 X15 X16 X17

EX16NNDR	EX16NNDT	EX16NNDP
S/S X0 X1 X2 X3 X4 X5 X6 X7 C0 Y0 Y1 Y2 Y3 Y4 Y5 Y6 Y7	S/S X0 X1 X2 X3 X4 X5 X6 X7 C0 Y0 Y1 Y2 Y3 Y4 Y5 Y6 Y7	S/S X0 X1 X2 X3 X4 X5 X6 X7 UP Y0 Y1 Y2 Y3 Y4 Y5 Y6 Y7 ZP

2.2 ELCM Series

2.2.1 Specifications

2.2.1.1 Electrical Specifications

- **ELCM-EX DIDO**

Model Item	EX08 NNDN	EX08 NND□	EX08 NNN□	EX16 NNDN	EX16 NND□	EX16 NNN□
Power supply voltage	Supplied by bus power from MPU				24VDC (-15% ~ 10%)	
Power consumption	1.2W	R:1.2W T:1W	R:1.2W T:0.5W	2.4W	R:2.4W T:1.6W	R:2.4W T:1W
DC24V current output	-					
Power supply protection	-				Power reverse protection	
Weight (R/T)	105g	120g 107g	135g 109g	148g	179g 149g	209g 143g

2.2.1.2 Input/Output Electrical Specifications

- **ELCM-EX DIDO**

Input Point Electrical Specifications		
Input type		Digital input
Input type		DC (SINK or SOURCE)
Input current		24VDC 5mA
Input impedance		4.7KΩ
Max. frequency		60Hz
Active level	Off→On	>15VDC
	On→Off	< 5VDC
Responds time	Off→On	10ms ± 10%
	On→Off	15ms ± 10%

Output Point Electrical Specification			
Output type		Relay-R	Transistor-T
Voltage specification		Below 240VAC, 30VDC	5~30VDC [#2]
Max. load	Resistive	2A/1 point (5A/COM)	0.5A/1 point (4A/COM) [#4]
	Inductive	[#3]	15W (30VDC)
	Lamp	20WDC/100WAC	2.5W (30VDC)
Switching frequency [#1]		1Hz	1kHz
Responds time	Off→On	Approx .10ms	< 50μs
	On→Off		< 200μs

#1: The actual frequency will be affected by the scan period.

#2: UP, ZP work with the external auxiliary power supply 24VDC (-15% ~ +20%), rated consumption approx. 1mA/point.

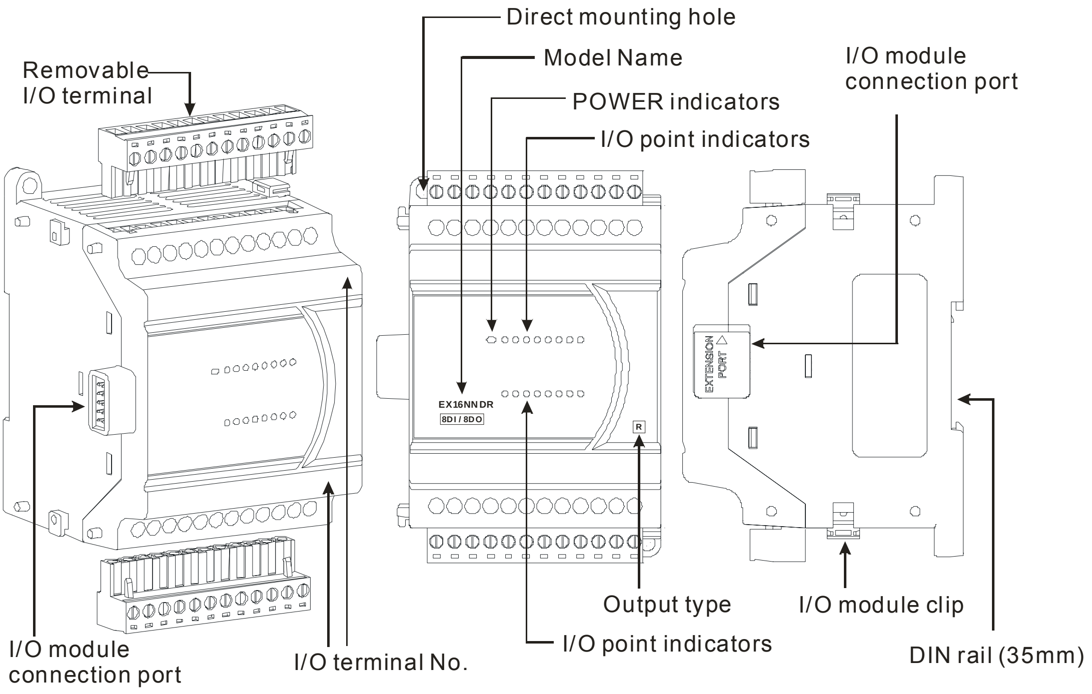
#3: Life curves, for more details refer to the specificatios in section 1.2.1.3 for the ELC-PB.

#4: ZP for NPN COM, UP for PNP COM.

2.2.2 Product Outline and Dimension

2.2.2.1 Product Outline

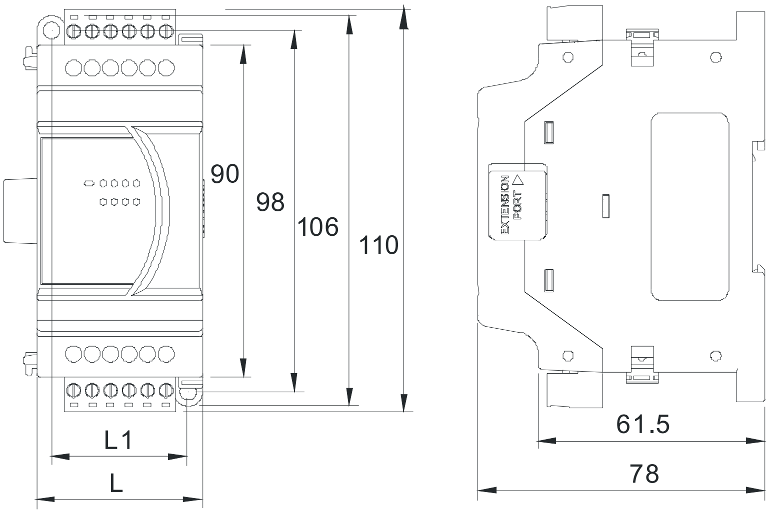
- **ELCM-EX DIDO**



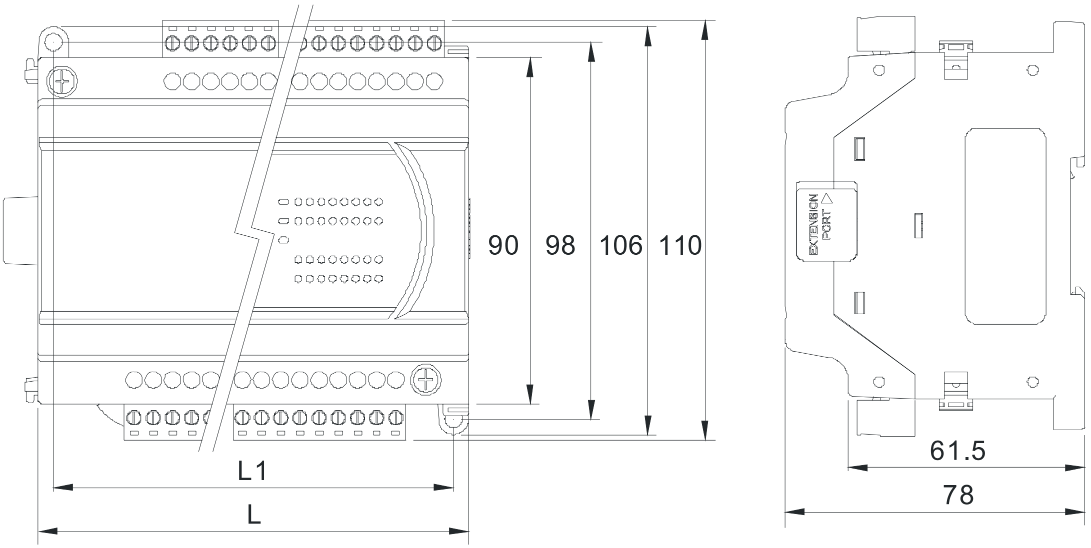
2.2.2.2 Dimension

- **ELCM-EX DIDO**

Model	L	L1	Type
EX08NNDN	45	37	①
EX08NND☐			
EX08NNN☐			
EX16NNDN	70	62	②
EX16NND☐			
EX16NNN☐			



①



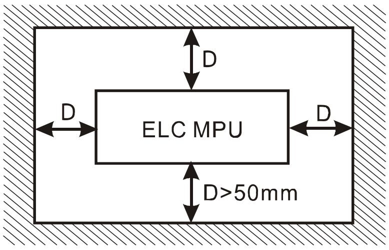
②

Unit: mm

2.2.3 Installation and Wiring

2.2.3.1 Installation

Install the ELC in an enclosure with sufficient space around it to allow heat dissipation as shown in the figure below.

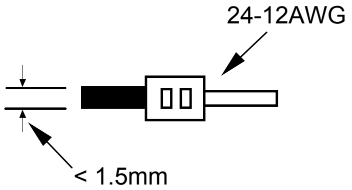


- **DIN Rail Mounting:** The ELC can be secured to a cabinet by using 35mm height and 7.5mm in depth DIN rail. When mounting the ELC to 35mm DIN rail, be sure to use the retaining clip to stop any side-to-side movement of the ELC and reduce the chance of wires coming loose. The retaining clip is at the bottom of the ELC. To secure the ELC to DIN rail, pull the clip down, place it onto the rail and push the clip back up. To remove the ELC, pull the retaining clip down with a flat screwdriver and remove the ELC from the DIN rail.

- **Direct Mounting:** Use M4 screws for direct mounting of the product.

2.2.3.2 Terminal Torque

1. Use the 12-24 AWG single-core wire or the multi-core wire for the I/O wiring. The ELC terminal screws should be tightened to 3.80 kg-cm (3.30 in-lbs) and please use 60/75°C copper conductor only.



2. DO NOT wire empty terminals. DO NOT place the input signal wire and output power wire in the same wiring circuit.
3. DO NOT drop tiny metallic conductor into the ELC during installation..
   - Please attach the dustproof sticker to the ELC before the installation to prevent conductive objects from dropping in.
   - Tear off the sticker before running the ELC to ensure normal heat dissipation.

2.2.3.3 Power Supply

■ **ELCM-EX DIDO**

ELCM-EX DIDO work with ELCM-PH/PA series controllers. Please note the following:

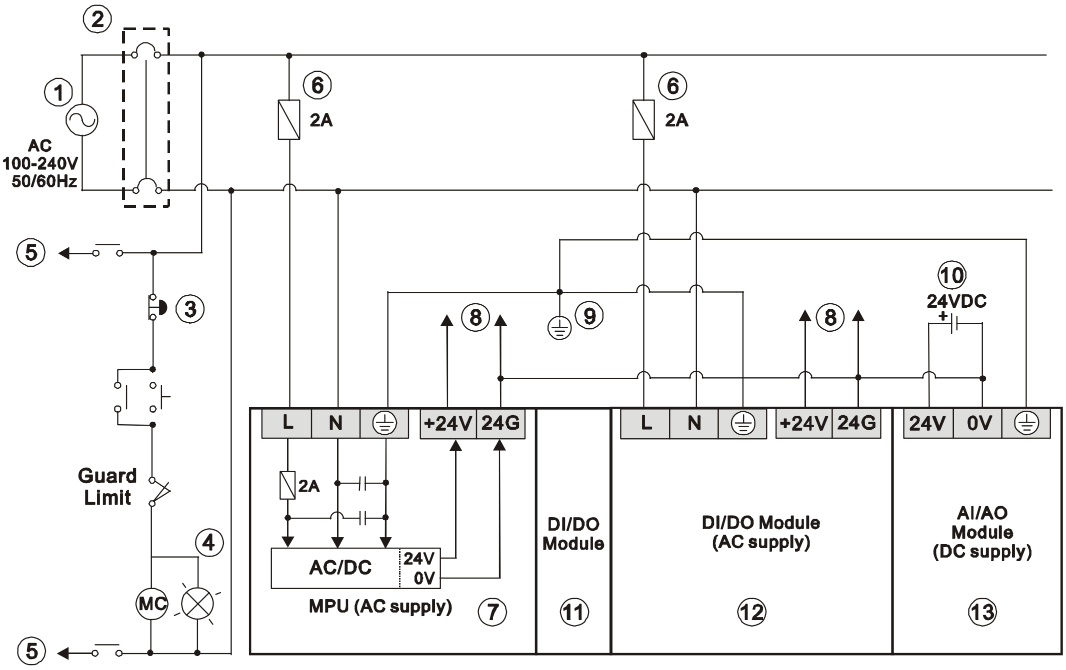
1. The AC power supply voltage range for ELCM-PH/PA controllers is 100 ~ 240VAC. Connect the AC power supply to L and N terminals and note that connecting 110VAC or 220VAC to +24VDC output terminals or digital input terminals will damage the ELC.
2. The power supply for digital I/O points is 24VDC. Please make sure the 24VDC power supply is correctly connected.
3. It is highly suggested that the power sources for the controller and ELCM digital I/O modules is applied and removed at the same time.
4. Use 1.6mm wire for the grounding of the ELC.

A loss of power for less than 10ms will not affect the operation of the ELC. However, a loss of power that is longer than 10ms or will stop the ELC, and all outputs will be turned “OFF”. When the power supply returns to normal again, the ELC will automatically return to its operation.

2.2.3.4 Safety Wiring

- **ELCM-EX DIDO**

In an ELC control system, many devices are controlled at the same time and the actions of any device could influence another, i.e. the breakdown of any device may cause the breakdown of the entire control system. Therefore, we suggest wiring a protection circuit at the power supply input. See the figure below.



1. AC power supply:100 ~ 240VAC, 50/60Hz	2. Breaker
3. Emergency stop	
4. Power indicator	5. AC power supply load
6. Power supply circuit protection fuse (2A)	7. ELC (main processing unit)
8. DC power supply output: 24VDC, 500mA	9. Grounding resistance: < 100Ω
10. DC power supply: 24VDC	11. Digital I/O module (DC supply)
12. Digital I/O module (AC supply)	13. Analog I/O module (DC supply)

2.2.3.5 I/O Point Wiring

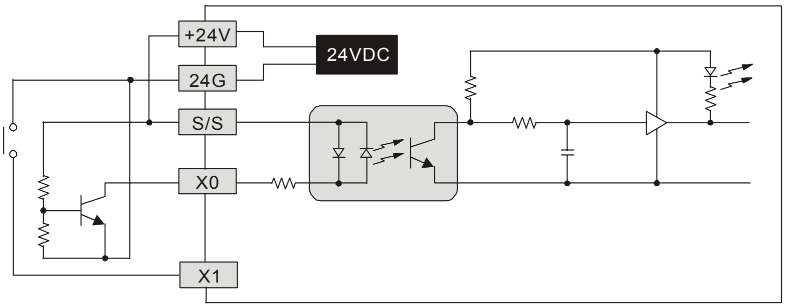
- **ELCM-EX DIDO**

- **Input Wiring**

There are 2 types of DC inputs, SINK and SOURCE. (See the examples below. For additional information, please refer to the specifications for each module.)

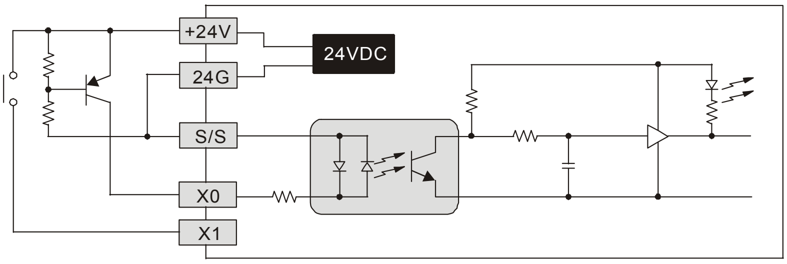
- DC Signal IN – SINK mode

  Input circuit



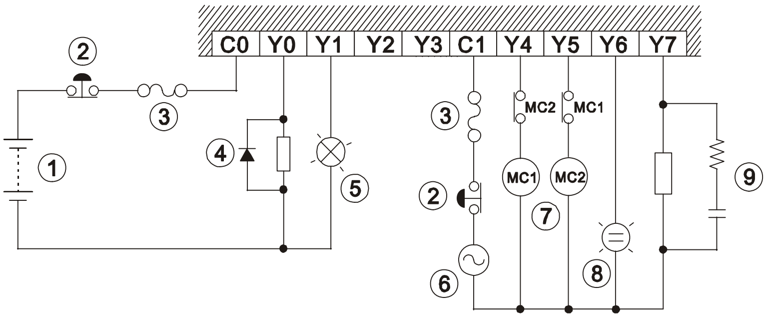
- DC Signal IN – SOURCE mode

  Input circuit

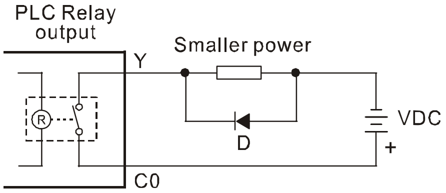


Output Wiring

The Relay Output Circuit Wiring

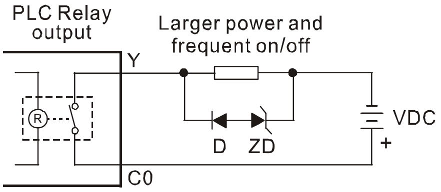


1. DC power supply
2. Emergency stop: Uses external switch
3. Fuse: Uses 5 ~ 10A fuse at the shared terminal of output contacts to protect the output circuit
4. Transient voltage suppressor: To extend the life of the contacts.
   a. Diode suppression of DC load: Used for lower power applications.



D: 1N4001 diode or equivalent component

b. Diode + Zener suppression of DC load: Used for higher power and frequent On/Off switching applications.



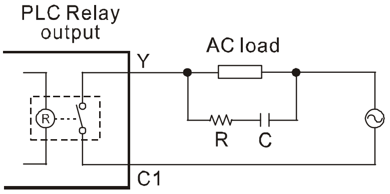
D: 1N4001 diode or equivalent component
ZD: 9V Zener, 5W

5. Incandescent light (resistive load)
6. AC power supply

7. Manually exclusive output

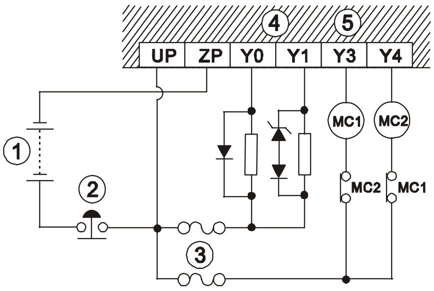
8. Neon indicator

9. Absorber: To reduce the interference of the AC load.



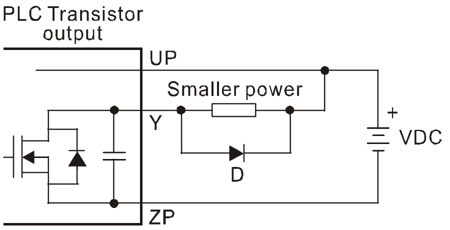
R: 100~120Ω
C: 0.1~0.24uF

The Transistor Output Circuit Wiring



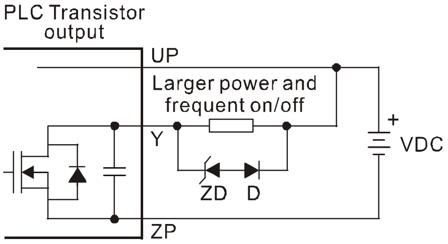
1. DC power supply
2. Emergency stop
3. Circuit protection fuse

4. The output of the transistor module is "open collector".
   a. Diode suppression: Used for lower power applications



D: 1N4001 diode or equivalent component

b. Diode + Zener suppression: Used for higher power and frequent On/Off switching applications.



D: 1N4001 diode or equivalent component
ZD: 9V Zener, 5W

5.

Manually exclusive output. For safety, use external mechanical interlocks as well as program interlocks..

2.2.4 Terminal Layout

2.2.4.1 ELCM Series Digital I/O Modules Terminal Layout

- **ELCM-EX DIDO**

- ELCM-EX08NNDN

S/S	X0	X1	X2	X3	NC

ELCM-EX08NNDN (8DI)

NC	X4	X5	X6	X7	NC

- ELCM-EX08NNNR

C0	Y0	Y1	Y2	Y3	NC

ELCM-EX08NNNR (8DO)

C1	Y4	Y5	Y6	Y7	NC

- ELCM-EX08NNNT

NC	NC	Y0	Y1	Y2	Y3

ELCM-EX08NNNT (8DO)

UP	ZP	Y4	Y5	Y6	Y7

- ELCM-EX08NNDR

S/S	X0	X1	X2	X3	NC

ELCM-EX08NNDR (4DI/4DO)

C0	Y0	Y1	Y2	Y3	NC

- ELCM-EX08NNDT

S/S	X0	X1	X2	X3	NC

ELCM-EX08NNDT (4DI/4DO)

UP	ZP	Y0	Y1	Y2	Y3

- ELCM-EX16NNDN

S/S	X0	X1	X2	X3	X4	X5	X6	X7	NC		
ELCM-EX16NNDN (16DI)											
S/S	X10	X11	X12	X13	X14	X15	X16	X17	NC	NC	NC

- ELCM-EX16NNNR

C0	Y0	Y1	Y2	Y3	C1	Y4	Y5	Y6	Y7		
ELCM-EX16NNNR (16DO)											
24V	0V	⏚	C2	Y10	Y11	Y12	Y13	Y14	Y15	Y16	Y17

- ELCM-EX16NNNT

UP0	ZP0	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7		
ELCM-EX16NNNT (16DO)											
UP1	ZP1	⏚	Y10	Y11	Y12	Y13	Y14	Y15	Y16	Y17	NC

- ELCM-EX16NNDR

S/S	X0	X1	X2	X3	X4	X5	X6	X7	NC		
ELCM-EX16NNDR (8DI/8DO)											
24V	0V	⏚	C0	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7

- ELCM-EX16NNDT

S/S	X0	X1	X2	X3	X4	X5	X6	X7	NC		
ELCM-EX16NNDT (8DI/8DO)											
UP	ZP	⏚	Y0	Y1	Y2	Y3	Y4	Y5	Y6	Y7	NC

MEMO

3

AIAO Units

Table of Content

3.1 ELC Series

3.1.1 ELC-AN04ANNN Analog Input Module

3.1.1.1 The A/D Conversion – Analog Input Modules

In industrial automation, many devices transmit data via analog signals. The most common analog signals are -10 ~ 10V and -20 ~ 20mA. The analog input modules convert these analog signals to digital values for the ELC controller.
For example, the voltage -10 ~ 10V is first converted into values -8,000 ~ +8,000 decimal by an A/D module. The ELC reads/writes to the control registers (CR) in the analog modules with FROM/TO instructions.

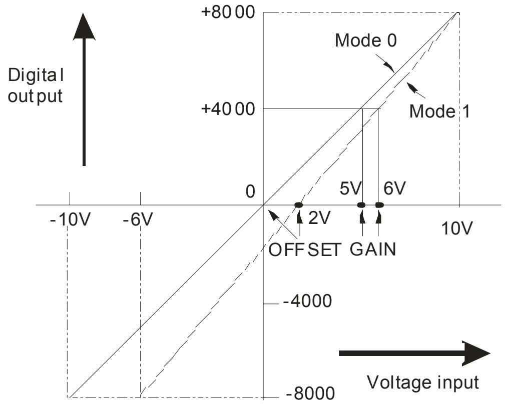
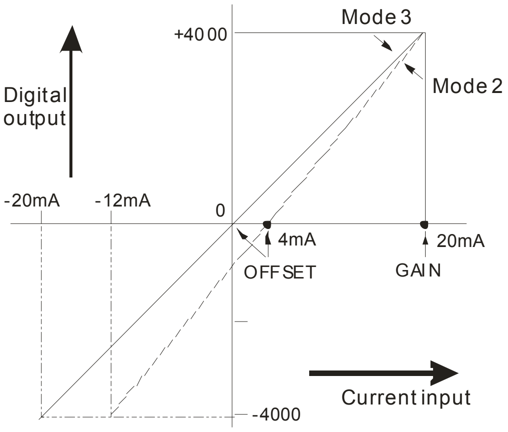
3.1.1.2 Introduction

This analog input module has 4 analog signal inputs (voltage or current) and converts them into 14-bit decimal values. The ELC program reads/writes data to/from the ELC-AN04ANNN analog input module by using the FROM / TO instructions. There are 49 16-bit CR (Control Registers) in the ELC-AN04ANNN.

3.1.1.3 Specifications

- **Functional Specifications**

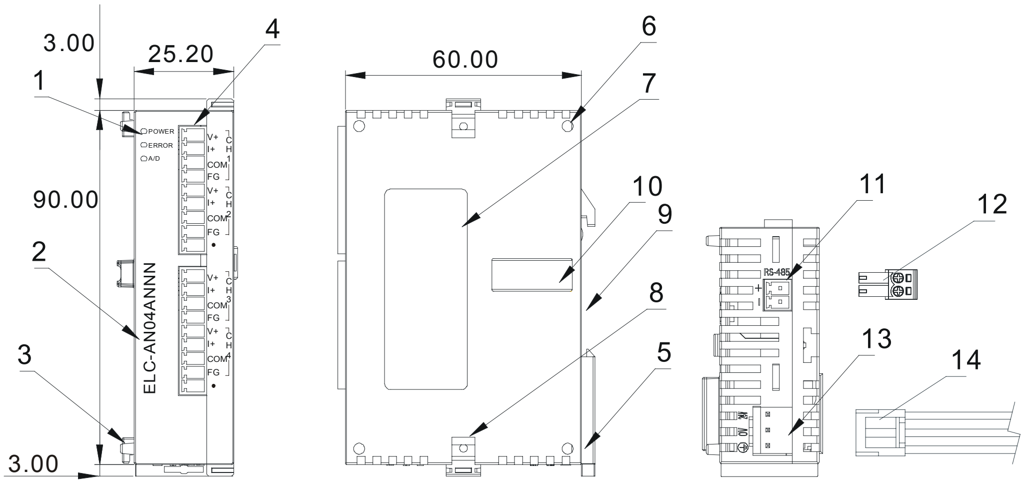
Analog/Digital module	Voltage input	Current input
Power supply voltage	24 VDC (20.4VDC ~ 28.8VDC) (-15% ~ +20%)	
Analog input channel	4 channels or 6 channels/module	
Range of analog input	±10V	±20mA
Range of digital conversion	±8,000	±4,000
Resolution	14 bits(1_{LSB} = 1.25mV)	13 bits (1_{LSB} = 5μA)
Input impedance	> 200 KΩ	250Ω
Overall accuracy	±0.5% when in full scale (25°C, 77°F) ±1% when in full scale within the range of 0 ~ 55°C (32 ~ 131°F)	
Response time	3 ms × the number of channels	
Isolation	Isolation between digital area and analog area. No isolation among analog channels.	
Range of absolute input	±15V	±32mA
Digital data format	13 significant bits out of 16 bits are available; in 2's complement	
Average function	Yes. Available for setting up in CR#2 ~ CR#5. Range: K1 ~ K100	
Self-diagnosis	Upper and lower bound detection/channels	
Communication mode (RS-485)	ASCII/RTU mode Communication speed: 4,800/9,600/19,200/38,400/57,600/115,200 bps ASCII data format: 7-bit, Even, 1 stop bit (7, E, 1) RTU data format: 8-bit, Even, 1 stop bit (8, E, 1) RS-485 cannot be used when connected to ELC MPU in series.	

When connected to ELC controllers	The modules are numbered from 0 to 7 based on their location with respect to the controller.. 0 is the closest module to the controller and 7 is the furthest. A Max.of 8 special modules are allowed to be connected to a controller.
A/D conversion curve (Default: mode 0)	Mode 0: (-10V ~ +10V), Mode 1: (-6V ~ +10V) 
	Mode 2: (-12 mA ~ +20 mA), Mode 3: (-20mA ~ +20mA) 

■ Electrical Specification

Max. rated power consumption	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 temperature	Operation: 0°C~55°C (temperature), 50~95% (humidity), pollution degree: 2; Storage: -25°C~70°C (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

3.1.1.4 Product Profile and Outline



Units: mm

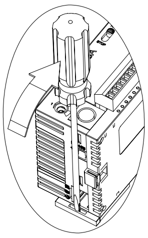
1. Status indicator (Power, ERROR and A/D)	2. Model Name
3. Extension unit clip	4. I/O terminals
5. DIN rail clip	6. Mounting hole of the extension unit
7. Nameplate	8. Extension hook
9. DIN rail mounting slot (35mm)	10. Extension port
11. RS-485 Communication port	12. 2 pin removable terminal (standard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

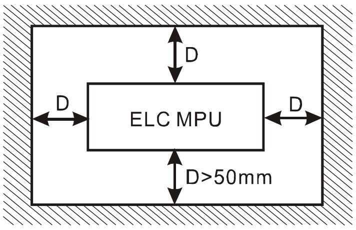
3.1.1.5 Installation and Wiring

- **Installation on DIN rail**

1. The ELC can be secured to a cabinet by using 35mm height and 7.5mm in depth DIN rail. When mounting the ELC to 35mm DIN rail, be sure to use the retaining clip to stop any side-to-side movement of the ELC and reduce the chance of wires coming loose. The retaining clip is at the bottom of the ELC. To secure the ELC to DIN rail, pull the clip down, place it onto the rail and push the clip back up. To remove the ELC, pull the retaining clip down with a flat screwdriver and remove the ELC from the DIN rail.

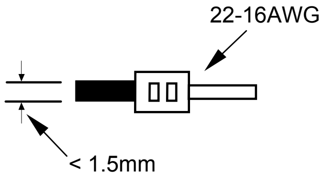
2. Install the ELC in an enclosure with sufficient space around it to allow heat dissipation, as shown in the figure.



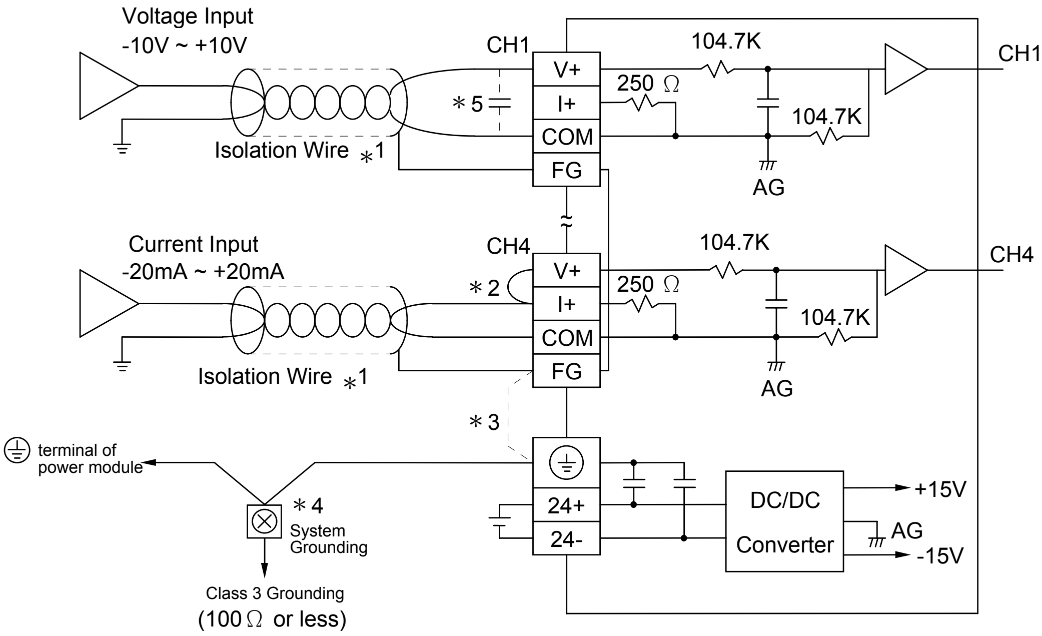


Wiring

1. Use 22-16 AWG (1.5mm) shielded cable for analog I/O wiring. The specification of the terminal is shown in the figure on the left hand side. The ELC terminal screws should be tightened to 1.95 kg-cm (1.7 in-lbs) and please use 60/75°C copper conductor only.
2. Analog signal wires and power supply wires should not be run in the same multi-wire cable or conduit.



External Wiring



Note 1: For current inputs, jumper the V+ and I+ terminals.

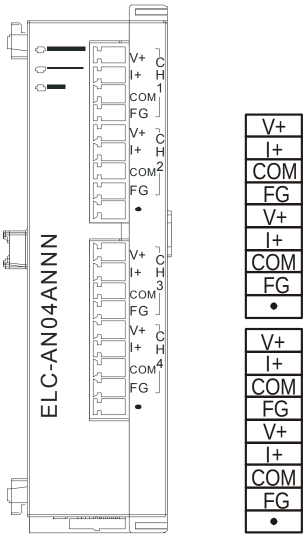
Note 3: Connect FG to ground to reduce electrical noise.

Note 4: Connect ⏚ terminal of the power supply and ⏚ terminal of analog input module to a system earth ground point.

Note 5: A 0.1~0.47uf 25V capacitor can be used to further reduce the effects of electrical noise on the analog input.

Warning: DO NOT wire to the No function terminals.

3.1.1.6 Terminal Layout



3.1.1.7 CR (Control Register)

ELC-AN04ANNN					EXPLANATION
CR No	Param. Comm. Add.	Latched		Register Name	bit 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0
#0	H'4000	O	R	Module type	System used, data length is 8bits (b7~b0). ELC-AN04ANNN model code =H'88
#1	H'4001	O	R/W	Configuration word for the analog input channels	Reserved | CH4 | CH3 | CH2 | CH1 Input mode: factory setting is H0000. Mode 0: voltage mode (-10V~+10V). Mode 1: voltage mode (-6V~+10V). Mode 2: current mode (-12mA~+20mA) Mode 3: current mode (-20mA~+20mA) Mode 4: Reserved.
#2	H'4002	O	R/W	CH1 average number	Number of samples used for calculating average analog input values for channels CH1~CH4. Range is K1~K100 samples and the default setting is K10 samples.
#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	Average values of CH1~CH4 input signals
#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	
#12	H'400C	X	R	Present value of CH1 input signal	Present values of CH1~CH2 input signals
#13	H'400D	X	R	Present value of CH2 input signal	

<table>
<tr><th colspan="5">ELC-AN04ANNN</th><th colspan="16">EXPLANATION</th></tr>
<tr><th rowspan="2">CR No</th><th rowspan="2">Param. Comm. Add.</th><th rowspan="2" colspan="2">Latched</th><th rowspan="2">Register Name</th><th colspan="16">bit</th></tr>
<tr><th>15</th><th>14</th><th>13</th><th>12</th><th>11</th><th>10</th><th>9</th><th>8</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>#14</td><td>H’400E</td><td>X</td><td>R</td><td>Present value of CH3 input signal</td><td colspan="16" rowspan="2">Present values of CH3~CH4 input signals</td></tr>
<tr><td>#15</td><td>H’400F</td><td>X</td><td>R</td><td>Present value of CH4 input signal</td></tr>
<tr><td>#18</td><td>H’4012</td><td>O</td><td>R/W</td><td>To adjust OFFSET value of CH1</td><td colspan="16" rowspan="4">Offset for CH1~CH4. Factory setting is K0..
Voltage input: range is K-4,000 ~K4,000
Current input: range is K-4,000 ~K4,000</td></tr>
<tr><td>#19</td><td>H’4013</td><td>O</td><td>R/W</td><td>To adjust OFFSET value of CH2</td></tr>
<tr><td>#20</td><td>H’4014</td><td>O</td><td>R/W</td><td>To adjust OFFSET value of CH3</td></tr>
<tr><td>#21</td><td>H’4015</td><td>O</td><td>R/W</td><td>To adjust OFFSET value of CH4</td></tr>
<tr><td>#24</td><td>H’4018</td><td>O</td><td>R/W</td><td>To adjust GAIN value of CH1</td><td colspan="16" rowspan="4">GAIN of CH1~CH4. Factory setting is K4,000.
Voltage input: range is K-3,200 ~K16,000.
Current input: range is K-3,200 ~K10,400.</td></tr>
<tr><td>#25</td><td>H’4019</td><td>O</td><td>R/W</td><td>To adjust GAIN value of CH2</td></tr>
<tr><td>#26</td><td>H’401A</td><td>O</td><td>R/W</td><td>To adjust GAIN value of CH3</td></tr>
<tr><td>#27</td><td>H’401B</td><td>O</td><td>R/W</td><td>To adjust GAIN value of CH4</td></tr>
<tr><td>#30</td><td>H’401E</td><td>X</td><td>R</td><td>Error status</td><td colspan="16">Error code. Please refer to fault code chart for details.</td></tr>
<tr><td>#31</td><td>H’401F</td><td>O</td><td>R/W</td><td>Communication address setting</td><td colspan="16">RS-485 communication address. Range is 01~255 and factory setting is K1</td></tr>
<tr><td>#32</td><td>H’4020</td><td>O</td><td>R/W</td><td>Communication baud rate setting</td><td colspan="16">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 parity, 1 stop bit (7, E, 1). Communication format of RTU mode is 8Bit, even parity, 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</td></tr>
</table>

<table>
<tr><th colspan="5">ELC-AN04ANNN</th><th colspan="16">EXPLANATION</th></tr>
<tr><th rowspan="2">CR No</th><th rowspan="2">Param. Comm. Add.</th><th rowspan="2" colspan="2">Latched</th><th rowspan="2">Register Name</th><th colspan="16">bit</th></tr>
<tr><th>15</th><th>14</th><th>13</th><th>12</th><th>11</th><th>10</th><th>9</th><th>8</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td rowspan="2">#33</td><td rowspan="2">H’4021</td><td rowspan="2">O</td><td rowspan="2">R/W</td><td rowspan="2">Reset to factory default settings and inhibit modifying Gain and Offset values</td><td colspan="4">Reserved</td><td colspan="3">CH4</td><td colspan="3">CH3</td><td colspan="3">CH2</td><td colspan="3">CH1</td></tr>
<tr><td colspan="16">Factory setting H0000
Example for CH1:
1. When b0=0, user can set OFFSET and GAIN values for CH1 (CR#18, CR#24). When b0=1, inhibit the user from modifying OFFSET and GAIN values for CH1.
2. b1=0 (factory setting, latched), b1=1 (not latched).
3. When b2 is set to 1, all settings will reset to factory default settings.</td></tr>
<tr><td>#34</td><td>H’4022</td><td>O</td><td>R</td><td>System Version</td><td colspan="16">Software version in hexadecimal. For example: H’010A represents 1.0A.</td></tr>
<tr><td colspan="4">#35~#48</td><td colspan="17">System used</td></tr>
<tr><td colspan="21">O means latched. X means not latched. (available when using RS-485 communication, not available when connected to a controller)
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.</td></tr>
</table>

- Description of the Control Registers CR

CR#0: Model Type

1. ELC-AN04ANNN model code = H’0088
2. Read the module code in the program to verify the correct extension module.

CR#1: Configuration Word

The configuration word for the analog input module channels. There are 4 modes for each channel, which can be set up individually. The default setting = H’000

For example, to set CH1 to mode 0 (b2 ~ b0 = 000), CH2 to mode 1 (b5 ~ b3 = 001), CH3 to mode 2 (b8 ~ b6 = 010), and CH4 to mode 3 (b11 ~ b9 = 011), CR#1 must be set to H’0688. The higher bits (b12 ~ b15) are reserved.

CR#2, 3, 4, 5: : Number of samples for the average analog input values CH1 ~ CH4

Number of samples for averaging the CH1 ~ CH4 input signals. Note that the number of samples in CR#2 ~ CR#5 only need to be written in once.

The setup range for this parameter for ELC-AN04ANNN: K1 ~ K100 samples. Default = K10 samples.

CR#6, 7, 8, 9: Input average values at CH1 ~ CH4

Averaged Analog input signals for CH1 ~ CH4. These averaged signals are based on the settings in CR#2 ~ CR#5. For example, if the values in CR#2 ~ CR#5 are 10 samples, the content in CR#6 ~ CR#9 will be the average of the most recent 10 signals at CH1 ~ CH4.

CR#12, 13, 14, 15: Present value of analog inputs for CH1 ~ CH4

The present value of input signals at CH1 ~ CH4.

CR#18, 19, 20, 21: Adjusted OFFSET value of CH1 ~ CH4

1. The adjusted OFFSET value for CH1 ~ CH4, representing the analog input voltage or current when the analog signal is converted into digital value 0.
   The adjustable range of voltage: -5V ~ +5V ($-4,000_{LSB}$ ~ $+4,000_{LSB}$)
   The adjustable range of current: - 20mA ~ +20mA ($-4,000_{LSB}$ ~ $+4,000_{LSB}$)
2. Default setting = K0; unit: LSB.

CR#24, 25, 26, 27: Adjusted GAIN value of CH1 ~ CH4

1. The adjusted GAIN value of CH1 ~ CH4, representing the analog input voltage or current when the analog signal is converted into digital value 4,000.
   The adjustable range of voltage: -4V ~ +20V ($-3,200_{LSB}$ ~ $+16,000_{LSB}$)
   The adjustable range of current: -16mA ~ +52mA ($-3,200_{LSB}$ ~ $+10,400_{LSB}$)
2. Please note that: GAIN value – OFFSET value = $+800_{LSB}$ ~ $+12,000_{LSB}$ (voltage) or $+800_{LSB}$ ~ $+6,400_{LSB}$ (current). When GAIN – OFFSET is small, the resolution of the input signal will be finer and variation on the digital value will be greater. When GAIN – OFFSET is large, the resolution of the input signal will be grainier and the variation on the digital value will be smaller.
3. Default setting = K0; unit: LSB.

CR#30: Data register for storing all errors

CR#30 is the 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

Fault description	Content	b15~b8	b7	b6	b5	b4	b3	b2	b1	b0
Command error	K128(H80)		1	0	0	0	0	0	0	0
Note: Each fault code will have a corresponding bit (b0~b7). Two or more faults may happen at the same time. 0 means normal and 1 means having a fault.										

CR#31: RS-485 communication address setting

The settings of RS-485 communication address. Range: 01 ~ 255. Default = K1. This setting is only valid for RS-485 communication and will be invalid when connected to an ELC controller.

CR#32: Communication speed (baud rate) setting

The interface settings for the RS-485 communications: data rate: 4,800, 9,600, 19,200, 38,400, 57,600 and 115,200bps (bits per second). Default = H'0002.

b0 = 1: 4,800 bps
b1 = 1: 9,600 bps (default)
b2 = 1: 19,200 bps
b3 = 1: 38,400 bps
b4 = 1: 57,600 bps
b5 = 1: 115,200 bps
b6 ~ b13: Reserved
b14: High/low byte exchange of CRC checksum (only valid in RTU mode)
b15: Switch between ASCII/RTU mode. 0: ASCII (default); 1: RTU. ASCII data format: 7-bit, Even, 1 stop bit (7, E, 1); RTU data format: 8-bit, Even, 1 stop bit (8, E, 1). This setting is only valid for RS-485 communication and will be invalid when connected to an ELC controller.

CR#33: Returning to default settings and OFFSET/GAIN tuning authorization

For authorization to modify the OFFSET/GAIN values.. Default setting = H'0000. CH1 example:

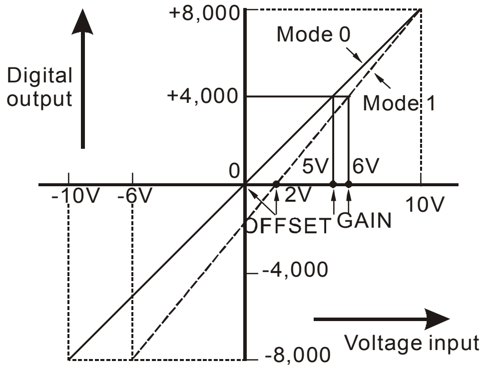
1. When b0 = 0, the user is allowed to modify CR#18 (OFFSET) and CR#24 (GAIN) of CH1. When b0 = 1, the user is not allowed to modify CR#18 (OFFSET) and CR#24 (GAIN) of CH1.
2. b1 represents whether the OFFSET/GAIN tuning registers are latched. b1 = 0: OFFSET/GAIN tuning registers are latched; b1 = 1: OFFSET/GAIN tuning registers are not latched. This function is only valid when in RS-485 communication mode, i.e. when not connected to an ELC controller.
3. When b2 = 1, all settings will return to default values except for CR#31 and CR#32.

CR#34: Firmware version

Displays the current firmware version in hex, e.g. version V1.00 is shown as H'0100.

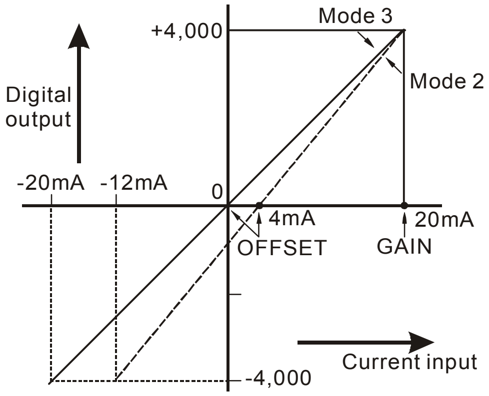
3.1.1.8 A/D Conversion Curve

- **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 for adjusting A/D conversion characteristic curves for the voltage input mode and current input mode. Users can adjust the conversion characteristic curve by changing OFFSET values (CR#18~CR#21) and GAIN values (CR#24~CR#27) depending on the application.

LSB (Least Significant Bit):

1. Voltage input: 1LSB=10V/8,000=1.25mV.
2. current input: 1LSB=20mA/4,000=5μA.

■ Adjusting A/D Conversion Curve in Voltage Input Mode

1. Description
   - Take ELC-AN04ANNN for example. When CR#1 is set as voltage input mode (mode 0), the OFFSET value will be set as 0V (K0) and GAIN value as 5V (K4,000), i.e. input voltage -10V ~ +10V will correspond to values -8,000 ~ +8,000.
   - When CR#1 is set to voltage input mode (mode 1), the OFFSET value will be set as 2V (K1,600) and GAIN value as 6V (K4,800), i.e. input voltage -6V ~ +10V will correspond to values -8,000 ~ +8,000.
   - If you cannot use the default voltage input mode (mode 0 and mode 1), you can make adjustments on the A/D conversion curve according to your actual needs. For example, Set the OFFSET of CH1 ~ CH4 to 0V (K0) and GAIN to 2.5V (K2,000).
   - You only need to set up the A/D conversion curve once. Then set up CR#33 (OFFSET/GAIN tuning authorization) to prevent these values from being changed..
2. Devices
   - X0 = On: Configure the input mode for the analog inputs at CH1 ~ CH4 to mode 1.
   - X1 = On: Set the OFFSET values of CH1 ~ CH4 to 0V (K0) and the GAIN value to 2.5V (K2,000).
   - M0 = On: Disable the ability to modify the offset and gain.
3. Program explanation
   - When X0 = On, set CR#1 to K585 (H'249, i.e. 0000 0010 0100 1001 in binary) and the signal input mode at CH1 ~ CH4 as mode 1 (-6VDC – 10VDC voltage input mode).
   - When X1 = On, write K0 (OFFSET value of CH1 ~ CH4) into CR#18 ~ 21 and K2,000 (GAIN value of CH1 ~ CH4) into CR#24 ~ 27.
   - When X1 goes from On to Off, set M0 = On to disable modifying the Gain and Offset. Write K585 (H'249, i.e. 0000 <u>0010 0100 1001</u> in binary) into CR#33.

4. Program example

Ladder diagram:

Explanation:

Set CH1 ~ CH4 as mode 1 (voltage input mode)

Set the OFFSET value of CH1 ~ CH4

Set the GAIN value of CH1 ~ CH4

Disable modifying the Gain and Offset

■ Adjusting A/D Conversion Curve in Current Input Mode

1. Description
   - For this example use the ELC-AN04ANNN analog input module. When CR#1 is set for current input mode (mode 2), the OFFSET value will be set to 4mA (K800) and the GAIN value as 20mA (K4,000), i.e. input current -12mA ~ +12mA will correspond to values -4,000 ~ +4,000.
   - When CR#1 is set to current input mode (mode 3), the OFFSET value will be set to 0mA (K0) and GAIN value as 20mA (K4,000), i.e. input current -20mA ~ +20mA will correspond to values -4,000 ~ +4,000.
   - If you cannot use the default current input mode (mode 2 and mode 3), you can make adjustments on the A/D conversion curve according to your actual needs. For example, Set the OFFSET of CH1 ~ CH4 to 5mA (K1,000) and GAIN to 20mA (K4,000).
   - You only need to set up the A/D conversion curve once. Set up CR#33 (OFFSET/GAIN tuning authorization) to prevent modifying the Gain and Offset values.
2. Devices
   - X0 = On: Set the input mode of the signals at CH1 ~ CH4 to mode 3.
   - X1 = On: Set the OFFSET values of CH1 ~ CH4 to 5mA (K1,000) and the GAIN value to 20mA (K4,000).
   - M0 = On: Disable modifying the Gain and Offset values.
3. Program description
   - When X0 = On, set CR#1 to K1755 (H'6DB, i.e. 0000 0110 1101 1011 in binary) and the signal input mode for CH1 ~ CH4 as mode 3 (current input mode).
   - When X1 = On, write K1,000 (OFFSET value of CH1 ~ CH4) into CR#18 ~ 21 and

K4,000 (GAIN value of CH1 ~ CH4) into CR#24 ~ 27.

- When X1 goes from On to Off, set M0 = On to turn M0 on. When M0 turn on, write K585 (H’249, i.e. 0000 0010 0100 1001 in binary) into CR#33 to disable modifying the Gain and Offset values for CH1 ~ CH4.

4. Program example

Ladder Diagram:

Explanation:

Set CH1 ~ CH4 as mode 3 (current input mode)

Set the OFFSET value of CH1 ~ CH4

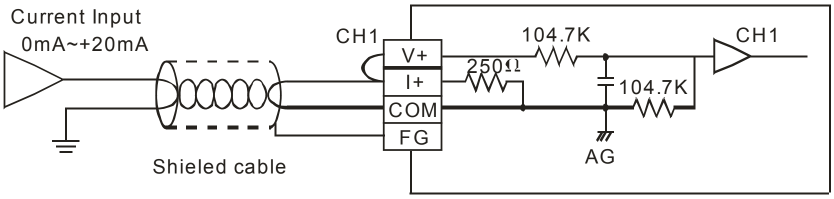
Set the GAIN value of CH1 ~ CH4

Disable adjustment on A/D conversion curve

3.1.1.9 Applications

- **Measuring Current**

1. Description
   - Assume there is an external device that sends an analog current signal of 0mA ~ 20mA to the ELC-AN04ANNN module. Then store these values in register D0 for monitoring the current.
   - Set the input signals of the A/D module to mode 3, i.e. the current input mode (-20mA ~ +20mA).
2. Place the following values from the AN04 module into the following ELC registers:
   - D40: average value of the input signals
   - D50: present value of input signal
   - D0: actual value of the present measured current
3. Wiring
   - Connect the current signal to be measured to CH1 and short-circuit V+ and I+ (as shown below).



4. Program description
   - When the ELC goes from STOP to RUN, set CH1 to current input mode (mode 3), and set the number of samples for the average value of the input signals for CH1 to 10.
   - Save the average value of the input signals in D40 and the present value of the input signals in D50.
   - In current loop mode, The value range for 0 ~ 20mA is K0 ~ K4,000. D50 is 200 times of the actual current value (i.e. 4,000/20 = 200). Divide the value in D50 by 200 and store the value obtained into D0 which will be the actual value of the present measured current.
5. Program example

Ladder diagram:

Explanation:

Set CH1 to mode 3 (current input mode)

Set the number of samples for averaging to 10 for CH1.

Store the average value of CH1 input signals into D40

Store the present value of CH1 input signal into D50

D0 is the actual value of the present measured current at CH1

3.1.2 ELC-AN02NANN / ELC-AN04NANN Analog Output Modules

3.1.2.1 The D/A Conversion

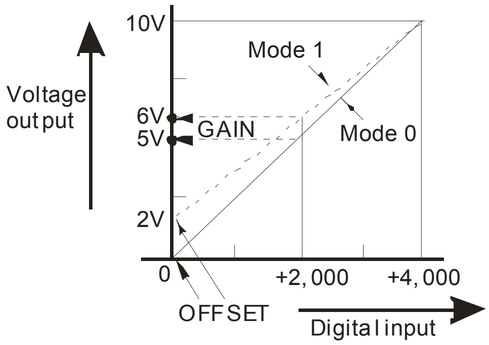
The most frequently used analog signals in Industrial applications are 0 ~ 10VDC and current 0 ~ 20mA. The analog output modules discussed in this chapter support these analog signals for controlling analog devices. These signals are represented by the same decimal range in the ELC controllers: 0 ~ 4,000.

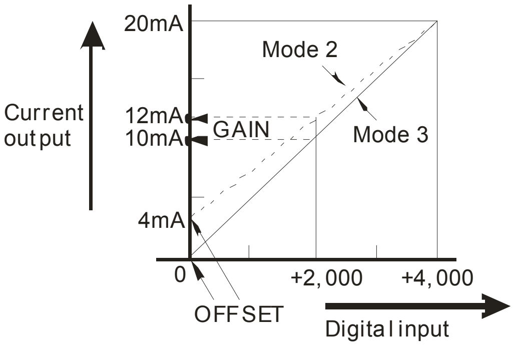
3.1.2.2 Introduction

The analog output modules ELC-AN02NANN and ELC-AN04NANN are configured and controlled by an ELC controller or a Modbus master device. When using these analog output modules with an ELC controller the FROM / TO instructions are used to configure and control these modules. The analog output module receives 12-bit digital data from the ELC controller and converts it to an analog output signal (voltage or current). There are 49 CR (Control Register) in each module and each register is 16 bits in length.

3.1.2.3 Specification

Functions Specification

Digital/Analog module	Voltage output	Current output
Power supply voltage	24 V DC (20.4 ~ 28.8V DC) (-15% ~ +20%)	
Analog output channel	2 channels or 4 channels/module	
Range of analog output	0 ~ 10V	0 ~ 20mA
Range of digital data	0 ~ 4,000	0 ~ 4,000
Resolution	12 bits (1_{LSB} = 2.5mV)	12 bits (1_{LSB} = 5μA)
Output impedance	0.5Ω or lower	
Overall accuracy	±0.5% when in full scale (25°C, 77°F); ±1% when in full scale within the range of (0 ~ 55°C, 32 ~ 131°F)	
Response time	3 ms × the number of channels	
Max. output current	20mA (1KΩ ~ 2MΩ)	-
Tolerance load impedance	-	0 ~ 500Ω
Digital data format	11 significant bits out of 16 bits are available; in 2's complement	
Isolation	Internal circuit and analog output terminals are isolated by optical couplers. There is no isolation between analog channels.	
Protection	Voltage outputs are protected from short circuit. Short circuit lasting for too long may cause damage on internal circuits. Current output can be open circuit.	
Communication mode (RS-485)	ASCII/RTU mode. Communication speed: 4,800/9,600/19,200/38,400/57,600/115,200 bps. ASCII data format: 7-bit, Even, 1 stop bit (7, E, 1), RTU data format: 8-bit, Even, 1 stop bit (8, E, 1). RS-485 cannot be used when connected to ELC MPU in series.	
When connected to ELC in series	The modules are numbered from 0 to 7 by their position with respect to the ELC controller. 0 is the closest to the controller and 7 is the furthest. A maximum of 8 special modules are allowed per ELC controller and they do not count against the number of digital I/O points allowed for each controller.	
D/A conversion curve (Default: mode 0)	Mode 0: (0V ~ +10V), Mode 1: (2V ~ +10V)  	

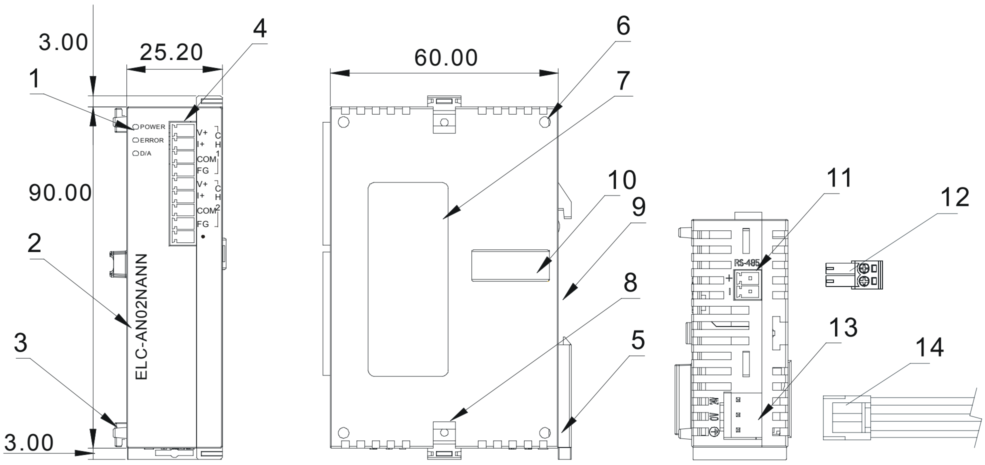
D/A conversion curve (Default: mode0)	Mode 2: (4mA ~ +20 mA), Mode 3: (0mA ~ +20mA) 

Electrical Specifications

	ELC-AN02NANN	ELC-AN04NANN
Max. rated power consumption	24 VDC (20.4VDC~28.8VDC) (–15%~+20%), 3W, supply from external 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 the wire used for 24V and 0V (if numerous ELCs are used at the same time, make sure that each ELC is grounded)	
Vibration/Shock Immunity	International Standard Regulations: IEC61131-2, IEC 68-2-6 (TEST Fc)/ IEC61131-2 & IEC 68-2-27 (TEST Ea)	
Operation/storage temperature	Operation: 0°C ~55°C (temperature), 50~95% (humidity), pollution degree: 2; Storage: -25°C ~70°C (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	

3.1.2.4 Product Profile and Outline

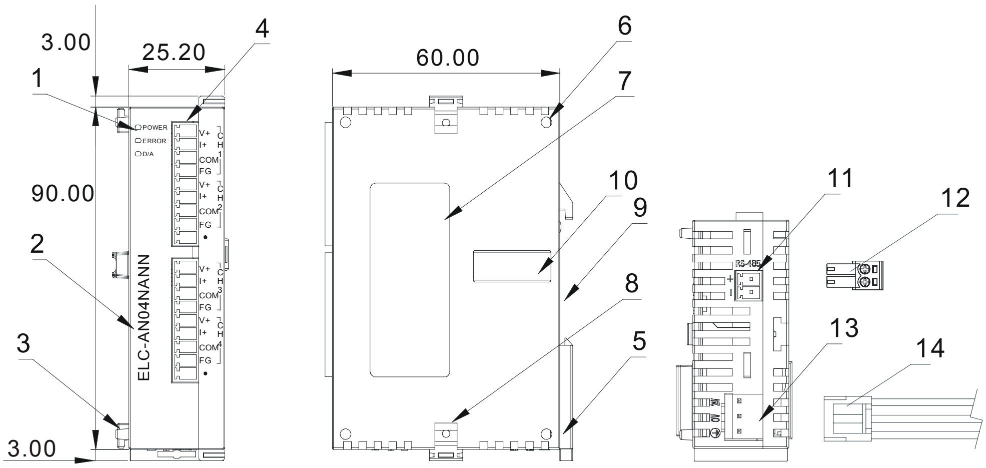
- **ELC-AN02NANN**



Units: mm

1.	Status indicator (Power, ERROR and D/A)	2.	Model Name
3.	Extension unit clip	4.	I/O terminals
5.	DIN rail clip	6.	Mounting hole of the extension unit
7.	Nameplate	8.	Extension hook
9.	DIN rail mounting slot (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)

- **ELC-AN04NANN**



Units: mm

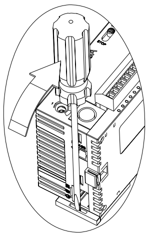
1.	Status indicator (Power, ERROR and D/A)	2.	Model Name
3.	Extension unit clip	4.	I/O terminals

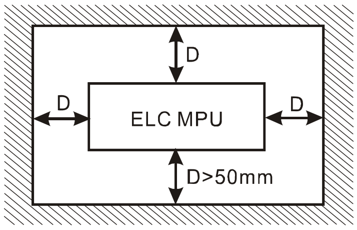
5. DIN rail clip	6. Mounting hole of the extension unit
7. Nameplate	8. Extension hook
9. DIN rail mounting slot (35mm)	10. Extension port
11. RS-485 Communication port	12. 2 pin removable terminal (standard accessory)
13. DC power input	14. Power input cable (standard accessory)

3.1.2.5 Installation and Wiring

- **Installation of the DIN rail**

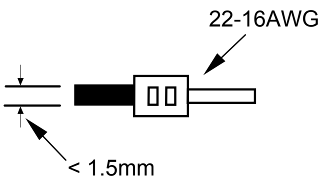
1. The ELC may be secured to a cabinet by using 35mm in height and 7.5mm in depth DIN rail. When mounting the ELC to 35mm DIN rail, be sure to use the retaining clip to stop any side-to-side movement of the ELC and reduce the chance of wires coming loose. The retaining clip is at the bottom of the ELC. To secure the ELC to DIN rail, pull down the clip, place it onto the rail and push it up to lock it in place. To remove the ELC, pull the retaining clip down with a flat screwdriver and remove the ELC from DIN rail.
2. Install the ELC in an enclosure with sufficient space around it to allow heat dissipation, as shown in the figure below.



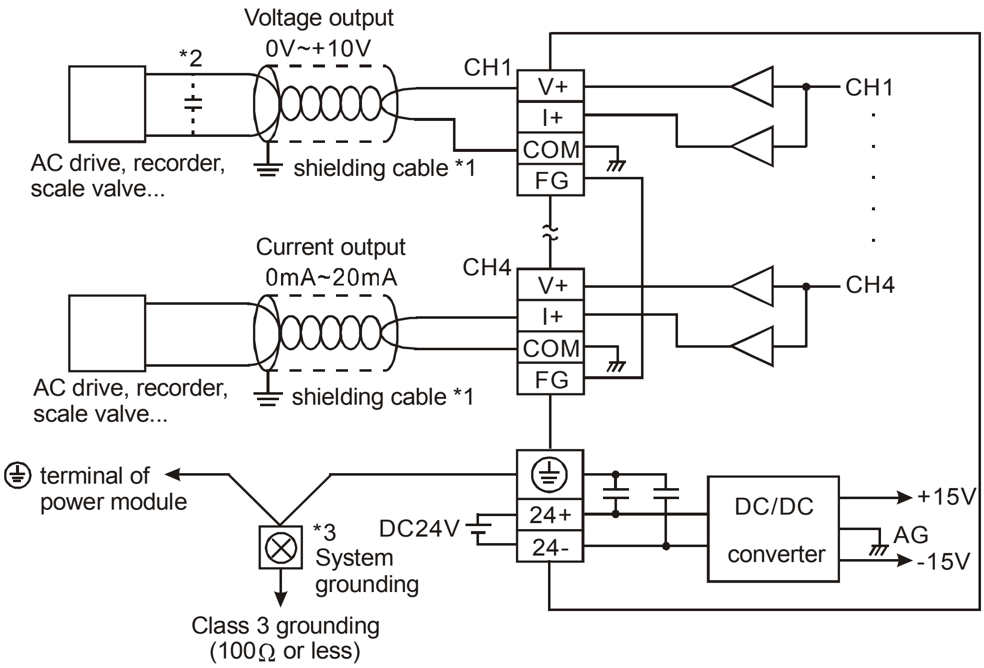


- **Wiring**

1. Use 22-16 AWG (1.5mm) single-core wire or the multi-core wire for the I/O wiring. The specification of the terminal is shown in the figure below on the right hand side. The ELC terminal screws should be tightened to 1.95 kg-cm (1.7 in-lbs). Also, use 60/75°C copper conductor only.
2. I/O signal wires and power supply wires should not run through the same multi-wire cable or conduit.



External Wiring



Note 1: Isolate analog output and power wiring.

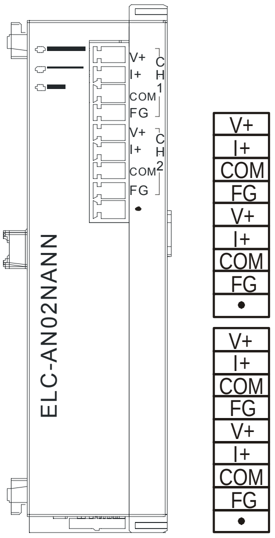
Note 2: To avoid electrical noise issues, connect a 0.1~0.47μF 25V capacitor for noise filtering.

Note 3: Connect ⏚ power module terminal and ⏚ analog output module terminal to system earth ground.

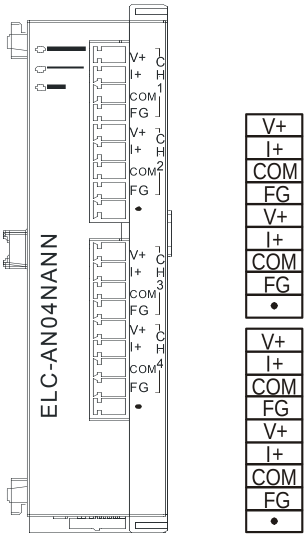
Warning: DO NOT wire to the No function terminals.

3.1.2.6 Terminal Layout

- **ELC-AN02NANN**



- **ELC-AN04NANN**



3.1.2.7 CR (Control Registers)

- **ELC-AN02NANN**

ELC-AN02NANN					EXPLANATION
CR No	Param. Comm. Add.	Latched		Register Name	bit 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
#0	H'4032	O	R	Module type	System used, data length is 8 bits (b7~b0). ELC-AN02NANN module code=H'49
#1	H'4033	O	R/W	Configuration word for the analog output channels	Reserved | 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.
#10	H'403C	X	R/W	CH1 out value	The decimal output range for channels CH1~CH2 is K0~K4000.
#11	H'403D	X	R/W	CH2 out value	
#22	H'4048	O	R/W	To adj. OFFSET value of CH1	Used to set the OFFSET value for CH1~CH2. The range is K-2,000~K2,000. The factory setting is K0.
#23	H'4049	O	R/W	To adj. OFFSET value of CH2	
#28	H'404E	O	R/W	To adj. GAIN value of CH1	Used to set the GAIN value for CH~CH2. The range is K-1,600~K8,000. The factory setting is K2,000.
#29	H'404F	O	R/W	To adj. GAIN value of CH2	
#30	H'4050	X	R	Error status	The 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 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 7 Bit, even parity, 1 stop bit (7 E 1). Communication format for RTU mode is 8 Bit, even parity, 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

<table>
<tr><th colspan="5">ELC-AN04ANNN</th><th colspan="16">EXPLANATION</th></tr>
<tr><th rowspan="2">CR No</th><th rowspan="2">Param. Comm. Add.</th><th rowspan="2" colspan="2">Latched</th><th rowspan="2">Register Name</th><th colspan="16">bit</th></tr>
<tr><th>15</th><th>14</th><th>13</th><th>12</th><th>11</th><th>10</th><th>9</th><th>8</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td rowspan="2">#33</td><td rowspan="2">H’4053</td><td rowspan="2">O</td><td rowspan="2">R/W</td><td rowspan="2">Reset to factory default settings and inhibit modifying Gain and Offset values</td><td colspan="10">Reserved</td><td colspan="3">CH2</td><td colspan="3">CH1</td></tr>
<tr><td colspan="16">Factory setting H0000
Example for CH1:
1. When b0=0, user can set OFFSET and GAIN values for CH1 (CR#18, CR#24). When b0=1, inhibit the user from modifying OFFSET and GAIN values for CH1.
2. b1=0 (factory setting, latched), b1=1 (not latched).
When b2 is set to 1, all settings will reset to factory default settings.</td></tr>
<tr><td>#34</td><td>H’4054</td><td>O</td><td>R</td><td>System Version</td><td colspan="16">Software version in hexadecimal. For example: H’010A represents 1.0A.</td></tr>
<tr><td colspan="4">#35~#48</td><td colspan="17">System use</td></tr>
<tr><td colspan="21">O means latched. X means not latched. (available when using RS-485 communication, not available when connected to MPU)
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.</td></tr>
</table>

- ■ Description of CR values

CR#0: Module Type

1. ELC-AN02NANN module code = H’0049
2. Read the module code in the program to verify the correct extension module.

CR#1: Configuration Word

CR#1 is used to configure the two analog output channels. Each channel has four modes that can be set individually. For example: setting CH1 to mode 2 (b2~b0=010), CH2 to mode 1(b5~b3=001). The factory setting of CR#1 is H0000.

CR#10, 11: The output values at CH1 ~ CH2

The decimal range for the analog outputs is: K0 ~ K4,000. Default = K0. Unit: LSB.

CR#22, 23: Adjusted OFFSET value of CH1 ~ CH2

1. The adjusted OFFSEST value for CH1 ~ CH2, representing the analog output voltage or current when the digital output value is 0. Default = K0. Unit: LSB. Range: -2,000 ~ +2,000.
2. The adjustable range of voltage: -5V ~ +5V (-2,000$_{LSB}$ ~ +2,000$_{LSB}$).
3. The adjustable range of current: -10mA ~ +10mA (-2,000$_{LSB}$ ~ +2,000$_{LSB}$).

CR#28, 29: Adjusted GAIN value of CH1 ~ CH2

1. The adjusted GAIN value for CH1 ~ CH2 on the ELC-AN02NANN, representing the analog output voltage or current when the digital output value is 2,000. Default = K2,000. Unit: LSB.
2. The adjustable range of voltage: -4V ~ +20V (0_{LSB} ~ $+4,000_{LSB}$).
3. The adjustable range of current: -8mA ~ +40mA (0_{LSB} ~ $+4,000_{LSB}$).
4. Please note that: GAIN value – OFFSET value = $+400_{LSB}$ ~ $+6,000_{LSB}$ (voltage or current). When GAIN – OFFSET is small, the resolution of output signal will be finer and variation on the digital value will be greater. When GAIN – OFFSET is large, the resolution of output signal will be grainier and the variation on the digital value will be smaller.

CR#30: Data register for storing all errors

CR#30 is the 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.										

CR#31: RS-485 communication address setting

The settings for the RS-485 communication address. Range: 01 ~ 255. Default = K1. This setting is only valid for RS-485 communication and will be invalid when connected to an ELC controller.

CR#32: Communication speed (baud rate) setting

The interface settings for the RS-485 communications: data rate: 4,800, 9,600, 19,200, 38,400, 57,600 and 115,200bps (bits per second). Default = H’0002.

b0 = 1: 4,800 bps
b1 = 1: 9,600 bps (default)
b2 = 1: 19,200 bps

b3 = 1:	38,400 bps
b4 = 1:	57,600 bps
b5 = 1:	115,200 bps
b6 ~ b13:	Reserved
b14:	High/low byte exchange of CRC checksum (only valid in RTU mode)
b15:	Switch between ASCII/RTU mode. 0: ASCII (default); 1: RTU. ASCII data format: 7-bit, Even, 1 stop bit (7, E, 1); RTU data format: 8-bit, Even, 1 stop bit (8, E, 1). This setting is only valid for RS-485 communication and will be invalid when connected to an ELC controller.

CR#33: Returning to default setting; modifying OFFSET/GAIN authorization

For authorization of OFFSET/GAIN tuning. The latched function will store the output setting in the internal memory before the power is removed. Default setting = H'0000. For example, CH1 on the ELC-AN02NANN module:

1. When b0 = 0, the user is allowed to modify CR#22 (OFFSET) and CR#28 (GAIN) for CH1. When b0 = 1, the user is not allowed to modify CR#22 (OFFSET) and CR#28 (GAIN) of CH1.
2. b1 represents whether the OFFSET/GAIN tuning registers are latched. b1 = 0: OFFSET/GAIN tuning registers are latched; b1 = 1: OFFSET/GAIN tuning registers are non-latched. This function is only valid when using RS-485 communications.
3. When b2 = 1, all settings will return to default value except for CR#31 and CR#32.

CR#34: Firmware version

Displaying the current firmware version in hex, e.g. version V1.00 is displayed as H'0100.

- **ELC-AN04NANN**

ELC-AN04NANN					EXPLANATION															
CR No	Param. Comm. Add.	Latched		Register Name	bit															
					15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
#0	H'4032	O	R	Module type	System used, data length is 8 bits (b7~b0). ELC-AN04NANN module code=H'89															
#1	H'4033	O	R/W	Configuration word for the analog output channels	Reserved				CH4			CH3			CH2			CH1		
					Output mode settings: 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															
#6	H'4038	X	R/W	CH1 out value	The decimal output range for channels CH1~CH2 is K0~K4000.															
#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																

<table>
<tr><th colspan="5">ELC-AN04NANN</th><th colspan="16">EXPLANATION</th></tr>
<tr><th rowspan="2">CR No</th><th rowspan="2">Param. Comm. Add.</th><th rowspan="2" colspan="2">Latched</th><th rowspan="2">Register Name</th><th colspan="16">bit</th></tr>
<tr><th>15</th><th>14</th><th>13</th><th>12</th><th>11</th><th>10</th><th>9</th><th>8</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>#18</td><td>H’4044</td><td>O</td><td>R/W</td><td>To adj. OFFSET value of CH1</td><td colspan="16" rowspan="4">It is used to set the OFFSET value for CH1~CH4. The range is K-2,000~K2,000. The factory setting is K0 and unit is LSB.</td></tr>
<tr><td>#19</td><td>H’4045</td><td>O</td><td>R/W</td><td>To adj. OFFSET value of CH2</td></tr>
<tr><td>#20</td><td>H’4046</td><td>O</td><td>R/W</td><td>To adj. OFFSET value of CH3</td></tr>
<tr><td>#21</td><td>H’4047</td><td>O</td><td>R/W</td><td>To adj. OFFSET value of CH4</td></tr>
<tr><td>#24</td><td>H’404A</td><td>O</td><td>R/W</td><td>To adj. GAIN value of CH1</td><td colspan="16" rowspan="4">It is used to set the GAIN value for CH~CH4. The range is K-1,600~K8,000. The factory setting is K2,000 and unit is LSB.</td></tr>
<tr><td>#25</td><td>H’404B</td><td>O</td><td>R/W</td><td>To adj. GAIN value of CH2</td></tr>
<tr><td>#26</td><td>H’404C</td><td>O</td><td>R/W</td><td>To adj. GAIN value of CH3</td></tr>
<tr><td>#27</td><td>H’404D</td><td>O</td><td>R/W</td><td>To adj. GAIN value of CH4</td></tr>
<tr><td>#30</td><td>H’4050</td><td>X</td><td>R</td><td>Error status</td><td colspan="16">Data register to save all error status. Please refer to fault code chart for detail.</td></tr>
<tr><td>#31</td><td>H’4051</td><td>O</td><td>R/W</td><td>Communication address setting</td><td colspan="16">Used to set the RS-485 communication address. The range is from 01 to 255 and the factory setting is K1.</td></tr>
<tr><td>#32</td><td>H’4052</td><td>O</td><td>R/W</td><td>Communication Baud Rate setting</td><td colspan="16">Used to set communication baud rate (4,800, 9,600, 19,200, 38,400, 57,600, 115,200bps). Communication format: ASCII mode is 7 Bit, even parity, 1 stop bit (7 E 1). Communication format of RTU mode is 8 Bit, even parity, 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</td></tr>
<tr><td rowspan="2">#33</td><td rowspan="2">H’4053</td><td rowspan="2">O</td><td rowspan="2">R/W</td><td rowspan="2">Reset to factory Reset Reset to factory default settings and inhibit modifying Gain and Offset values</td><td colspan="3">Reserved</td><td colspan="3">CH4</td><td colspan="3">CH3</td><td colspan="3">CH2</td><td colspan="4">CH1</td></tr>
<tr><td colspan="16">Factory setting H0000
Example for CH1:
1. When b0=0, user can set OFFSET and GAIN values for CH1 (CR#18, CR#24). When b0=1, inhibit the user from modifying OFFSET and GAIN values for CH1.
2. b1=0 (factory setting, latched), b1=1 (not latched).
3. When b2 is set to 1, all settings will reset to factory default settings.will reset to factory settings.</td></tr>
<tr><td>#34</td><td>H’4054</td><td>O</td><td>R</td><td>Software version</td><td colspan="16">Software version in hexadecimal. For example: H’010A represents 1.0A.</td></tr>
</table>

ELC-AN04NANN				EXPLANATION															
CR No	Param. Comm. Add.	Latched	Register Name	bit															
				15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
#35~#48			System use																
O means latched. X means not latched. (available when using RS-485 communication, not available when connected to MPU) 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.																			

- Description of CR Values

CR#0: Model name

1. ELC-AN04NANN model code = H'0089
2. Read the module code in the program to verify the correct extension module

CR#1: Configuration Word

When configuring CH1 for mode 0 (b2 ~ b0 = 000), CH2 for mode 1 (b5 ~ b3 = 001), CH3 for mode 2 (b8 ~ b6 = 010) and CH4 for mode 3 (b11 ~ b9 = 011), CR#1 must be set to H'0688. The higher bits (b12 ~ b15) are reserved. The default setting is H'0000. For example, CH1:

Mode 0 (b0 ~ b2 = 000): Voltage output (0V ~ 10V).

Mode 1 (b0 ~ b2 = 001): Voltage output (2V ~ 10V).

Mode 2 (b0 ~ b2 = 010): Current output (4mA ~ 20mA).

Mode 3 (b0 ~ b2 = 011): Current output (0mA ~ 20mA).

CR#6, 7, 8, 9: The output values for CH1 ~ CH4

The decimal range for the analog outputs is: K0 ~ K4,000. Default = K0. Unit: LSB.

CR#18, 19, 20, 21: Adjusted OFFSET value for CH1 ~ CH4

1 The adjusted OFFSEST value for CH1 ~ CH4, representing the analog output voltage or current when the digital output value is 0. Default = K0. Unit: LSB. Range: -2,000 ~ +2,000.

2 The adjustable range of voltage: -5V ~ +5V (-$2,000_{LSB}$ ~ +$2,000_{LSB}$).
The adjustable range of current: -10mA ~ +10mA (-$2,000_{LSB}$ ~ +$2,000_{LSB}$).

CR#24, 25, 26, 27: Adjusted GAIN value for CH1 ~ CH4

1. The adjusted GAIN value for CH1 ~ CH4 for the ELC-AN04NANN, representing the analog output voltage or current when the digital output value is 2,000. Default = K2,000.

Unit: LSB.

2. The adjustable range of voltage: -4V ~ +20V (0_{LSB} ~ $+4,000_{LSB}$).
3. The adjustable range of current: -8mA ~ +40mA (0_{LSB} ~ $+4,000_{LSB}$).
4. Note that: GAIN value – OFFSET value = $+400_{LSB}$ ~ $+6,000_{LSB}$ (voltage or current). When GAIN – OFFSET is small, the resolution of output signal will be finer and variation on the digital value will be greater. When GAIN – OFFSET is large, the resolution of output signal will be granier and the variation on the digital value will be smaller.

CR#30: Data register for storing all errors

CR#30 is the 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 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 a fault occurred.										

CR#31: RS-485 communication address setting

The settings for the RS-485 communication address. Range: 01 ~ 255. Default = K1. This setting is only valid for RS-485 communication and will be invalid when connected to an ELC controller.

CR#32: Communication speed (baud rate) setting

The RS-485 communication settings. Data rates: 4,800, 9,600, 19,200, 38,400, 57,600 and 115,200bps (bits per second). Default = H’0002.

b0 = 1:	4,800 bps
b1 = 1:	9,600 bps (default)
b2 = 1:	19,200 bps
b3 = 1:	38,400 bps
b4 = 1:	57,600 bps
b5 = 1:	115,200 bps
b6 ~ b13:	Reserved
b14:	High/low bit exchange of CRC checksum (only valid in RTU mode)
b15:	Switch between ASCII/RTU mode. 0: ASCII (default); 1: RTU. ASCII data

format: 7-bit, Even parity, 1 stop bit (7, E, 1); RTU data format: 8-bit, Even parity, 1 stop bit (8, E, 1). This setting is only valid for RS-485 communication and will be invalid when connected to an ELC controller.

CR#33: Returning to default settings and modifying OFFSET/GAIN authorization

For authorization of OFFSET/GAIN tuning. The latched function will store the output setting in the internal memory before the power is removed. Default setting = H'0000. For example, CH1 on the ELC-AN04NANN module:

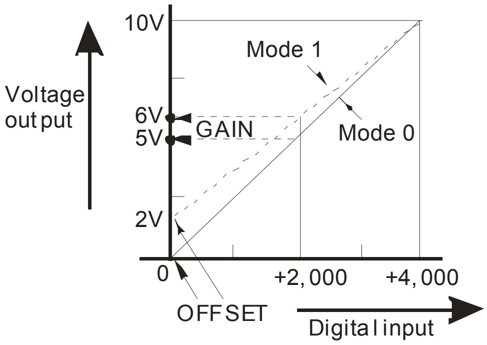
1. When b0 = 0, the user is allowed to modify CR#22 (OFFSET) and CR#28 (GAIN) for CH1. When b0 = 1, the user is not allowed to modify CR#22 (OFFSET) and CR#28 (GAIN) of CH1.
2. b1 represents whether the OFFSET/GAIN tuning registers are latched. b1 = 0: OFFSET/GAIN tuning registers are latched; b1 = 1: OFFSET/GAIN tuning registers are non-latched. This function is only valid when using RS-485 communications.
3. When b2 = 1, all settings will return to default value except for CR#31 and CR#32.

CR#34: Firmware version

Displaying the current firmware version in hex, e.g. version V1.00 is displayed as H'0100.

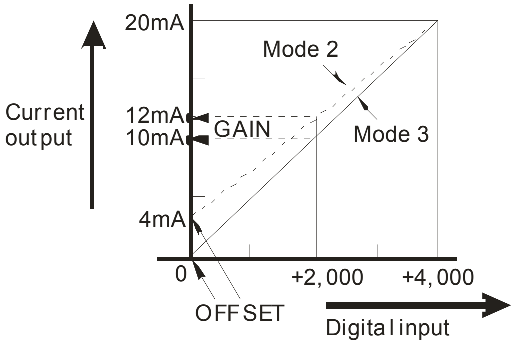
3.1.2.8 D/A Conversion Curve

- **Voltage output mode:**



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

- **Current output mode:**



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

Above is a D/A conversion characteristic curve of the voltage output mode and current output mode. Users can adjust the conversion characteristic curve by changing the OFFSET values (CR#18~CR#23) and GAIN values (CR#24~CR#29) based on the application.

LSB(Least Significant Bit):

1. Voltage output: 1LSB=10V/4,000=2.5mV
2. Current output: 1LSB=20mA/4,000=5Ma

- **Adjusting D/A Conversion Curve (Gain and Offset) in Voltage Output Mode**

1. Description
   - ELC-AN04NANN example. When CR#1 is set for voltage output mode (mode 0), the OFFSET value will be set to 0V (K0) and GAIN value to 5V (K2,000), i.e. output voltage 0 ~ 10V will correspond to values 0 ~ +4,000.
   - When CR#1 is set to voltage output mode (mode 1), the OFFSET value will be set to 2V (K800) and the GAIN value to 6V (K2,400), i.e. output voltage 2V ~ +10V will correspond to values 0 ~ +4,000.
   - If you cannot use the default voltage output mode (mode 0 and mode 1), you can make adjustments to the D/A conversion curve according to the application requirements. For example, Set the OFFSET of CH1 ~ CH4 to 0V (K0) and GAIN to 2.5V (K1,000).
   - You only need to set up the D/A conversion curve once.

2. Devices
   - X0 = On: Set the output mode for channels CH1 ~ CH4 to mode 1.
   - X1 = On: Set the OFFSET value for CH1 ~ CH4 to 0V (K0) and GAIN value to 2.5V (K1,000).
   - M0 = On: Disable the ability to modify the Gain and Offset values.
3. Program explanation
   - When X0 = On, set CR#1 to K585 (H’249, i.e. 0000 0010 0100 1001 in binary) and the signal output mode for CH1 ~ CH4 to mode 1 (voltage output mode).
   - When X1 = On, write K0 (OFFSET value for CH1 ~ CH4) into CR#18 ~ 21 and K1,000 (GAIN value for CH1 ~ CH4) into CR#24 ~ 27.
   - When X1 goes from On to Off, set M0 = On to disable modifying the Gain and Offset values. Write K585 (H’249, i.e. 0000 0010 0100 1001 in binary) into CR#33 to disable the Gain and Offset values for CH1 ~ CH4.
4. Program example

Ladder diagram:

Explanation:

Set CH1 ~ CH4 to mode 1 (voltage output mode)

Set the OFFSET value of CH1 ~ CH4

Set the GAIN value of CH1 ~ CH4

Disable modifying the Gain and Offset values

■ Adjusting D/A Conversion Curve (Gain and Offset) in Current Output Mode

1. Description
   - Example for the ELC-AN04NANN. When CR#1 is settos current output mode (mode 2), the OFFSET value will be set to 4mA (K800) and the GAIN value to 12mA (K2,400), i.e. the input current 4mA ~ +20mA will correspond to values 0 ~ +4,000.
   - When CR#1 is set to current output mode (mode 3), the OFFSET value will be set to0mA (K0) and GAIN value to 10mA (K2,000), i.e. output current 0mA ~ +20mA will correspond to values 0 ~ +4,000.
   - If you cannot use the default current output mode (mode 2 and mode 3), you can make adjustments to the D/A conversion curve according to the application requirements. For example, set the OFFSET of CH1 ~ CH4 to 6mA (K1,200) and the

GAIN to 13mA (K2,600).

- X0 = On: Set the output mode for channels CH1 ~ CH4 to mode 3.
- X1 = On: Set the OFFSET value for CH1 ~ CH4 to 6mA (K1,200) and the GAIN value to 13mA (K2,600).
- M0 = On: Disable modifying the Gain and Offset values.

2. Program explanation
   - When X0 = On, set CR#1 to K1755 (H'6DB, i.e. 0000 0110 1101 1011 in binary) and the output mode for CH1 ~ CH4 to mode 3 (current output mode).
   - When X1 = On, write K0 (OFFSET value for CH1 ~ CH4) to CR#18 ~ 21 and K2,600 (GAIN value for CH1 ~ CH4) to CR#24 ~ 27.
   - When X1 goes from On to Off, set M0 = On to disable the adjustment on D/A conversion curve. Write K585 (H'249, i.e. 0000 0010 0100 1001 in binary) into CR#33 to disable the adjustment on D/A conversion curve in CH1 ~ CH4.
3. Program example

Ladder diagram:

Explanation:

Set CH1 ~ CH4 to mode 3 (current output mode)

Set the OFFSET value of CH1 ~ CH4

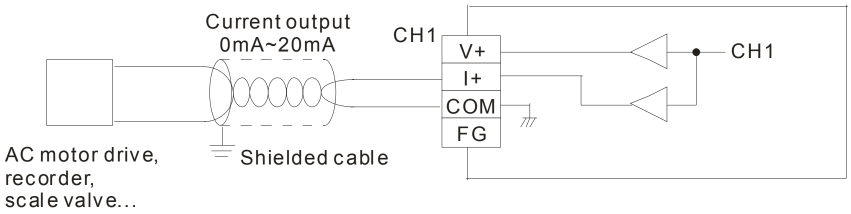
Set the GAIN value of CH1 ~ CH4

Disable modifying the Gain and Offset values

3.1.2.9 Applications

- **Analog Current Output**

1. Explanation
   - Assume there is a device that requires a 0-20ma analog signal for control.
   - Configure analog output channel CH1 to mode 3, i.e. the current output mode (0mA ~ 20mA)
2. Addresses
   - D0: current (ma) output for CH1
   - D40: digital value corresponding to the output current for CH1
3. Wiring
   - Connect the analog current output (CH1) of the ELC-AN04NANN module as shown below:

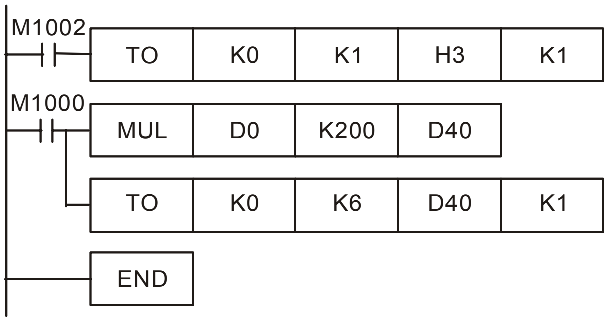


4. Program Description

- When the ELC goes from STOP to RUN, set CH1 to current output mode (mode 3).
- In the current mode for the ELC-AN04NANN, the range for 0 ~ 20mA is K0 ~ K4,000. D0 is the current output value in ma, which is 1/200 of the actual output current digital value (i.e. 20/4,000 = 1/200). Multiply the value in D0 by 200 and store the value obtained into data register D40, which is sent to the ELC-AN04NANN for analog output channel CH1.

5. Example program

Ladder diagram:



Explanation:

Set CH1 to mode 3 (current output mode)

D0 is the current output value for CH1

D40 is the corresponding digital value of the output current for CH1

3.1.3 ELC-AN06AANN

3.1.3.1 The A/D, D/A Conversion

In industrial automation, many devices transmit data via analog signals. The most common analog signals are -10 ~ 10V and -20 ~ 20mA. The analog input modules convert these analog signals to digital values for the ELC controller. Analog output modules convert digital values to analog signals. The AN06AANN has both analog inputs and outputs.

For example, the voltage -10 ~ 10V is first converted into a decimal range with an A/D module. These are analog inputs. Analog outputs convert a specified decimal range from the controller into analog signals such as 0ma ~ 20ma. The ELC reads/writes to the control registers (CR) in the analog modules with FROM/TO instructions for configuration and reading/writing analog data.

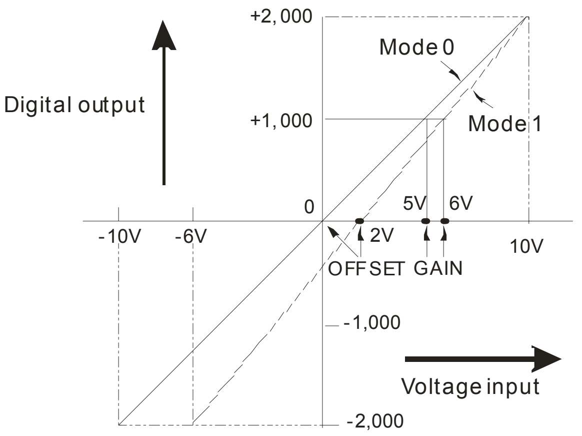
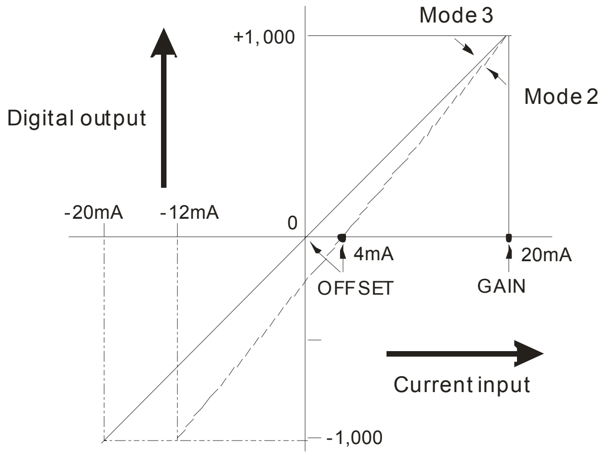
3.1.3.2 Introduction

The ELC-AN06AANN module is a combination analog I/O module. It has 4 analog inputs and 2 analog outputs (voltage or current). This module converts analog input data into a 12 bit digital values. The analog outputs convert digital values from the controller into analog signals. The module is configured by the controller via TO instructions in the ladder logic program. Other data such as the actual analog data is transmitted between the controller and the analog modules via TO and FROM instructions in the controller. There are 49 Controlled Registers (CR) in the AN06AANN module (each register is a 16 bit value).

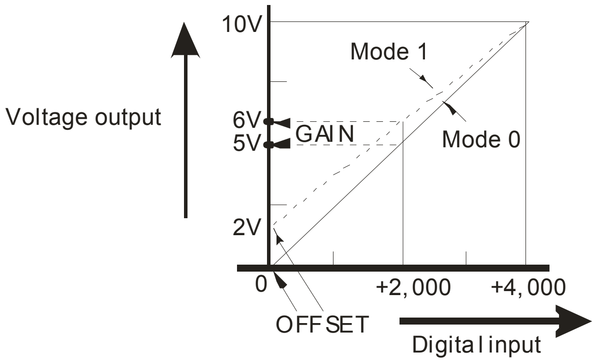
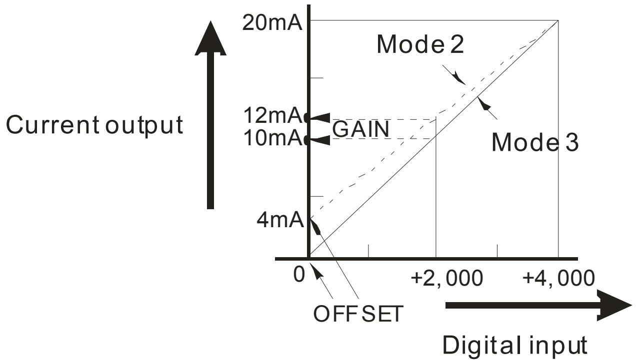
3.1.3.3 Specification

- **Functional Specifications**

Analog/Digital (A/D)	Voltage input	Current input
Power supply voltage	24V DC (20.4V DC ~ 28.8V DC) (-15% ~ +20%)	
Analog input channel	4 channels/module	
Range of analog input	±10V	±20mA
Range of digital conversion	±2,000	±1,000
Resolution	12 bits (1_{LSB} = 5mV)	11 bits (1_{LSB} = 20μA)
Input impedance	200KΩ or higher	250Ω
Overall accuracy	±0.5% when in full scale (25°C, 77°F) ±1% when in full scale within the range 0 ~ 55°C, 32 ~ 131°F	
Response time	3ms × the number of channels	
Isolation	Between analog and digital channels	
Range of absolute input	±15V	±32mA
Digital data format	13 significant bits out of 16 bits are available; in 2's complement	
Average function	Yes; available for setting up in CR#2 ~ CR#5 Range: K1 ~ K4,096 (06XA-S), K1 ~ K20 (06XA-H)	

Analog/Digital (A/D)	Voltage input	Current input
Self-diagnosis	Upper and lower bound detection/channel	
A/D conversion curve (Default: mode 0)	Mode 0: (-10V ~ +10V), Mode 1: (-6V ~ +10V)  	
	Mode 2: (-12mA ~ +20mA), Mode 3: (-20mA ~ +20mA)  	

Digital/Analog (D/A)	Voltage output	Current output
Analog output channel	2 channels/module	
Range of analog output	0 ~ 10V	0 ~ 20mA
Range of digital data	0 ~ 4,000	0 ~ 4,000
Resolution	12 bits (1_{LSB} = 2.5 mV)	12 bits (1_{LSB} = 5μA)
Overall accuracy	±0.5% when in full scale (25°C, 77°F) ±1% when in full scale within the range 0 ~ 55°C, 32~131°F	
Output impedance	0.5Ω or lower	
Response time	3 ms × the number of channels	
Max. output current	20mA (1KΩ ~ 2MΩ)	-
Tolerable load impedance	-	0 ~ 500Ω
Digital data format	13 significant bits out of 16 bits are available; in 2's complement	
Isolation	Isolation between inner circuit and analog output terminal. There is no isolation between channels.	

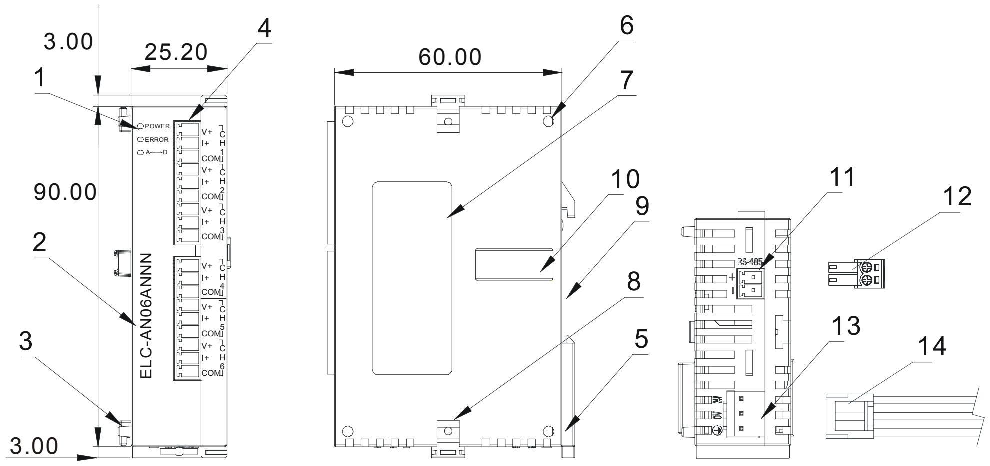
Digital/Analog (D/A)	Voltage output	Current output
Protection	The voltage output is protected from short circuit. Also be aware that a short circuit condition existing for too long of a time may cause damage on internal circuits. The current output can be open circuit.	
Communication mode (RS-485)	ASCII/RTU mode. Communication baud rates available: 4,800/9,600/19,200/38,400/57,600/115,200 bps. ASCII data format: 7-bit, Even, 1 stop bit (7, E, 1). RTU data format: 8-bit, Even, 1 stop bit (8, E, 1). RS-485 cannot be used when connected to ELC MPU in series.	
When connected to ELC MPU in series	The modules are numbered from 0 to 7 with respect to their position from from the controller. 0 is the closest to the controller and 7 is the furthest. Max. 8 modules are allowed per controller and they do not count agains the allowable digital I/O.	
Conversion characteristic curve (default setting is 0)	Mode 0: (0V ~ +10V), Mode 1: (2V ~ +10V)  	Mode 2: (4mA ~ +20 mA), Mode 3: (0mA ~ +20mA) 

■ Electrical Specifications

Max. rated power consumption	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 ground wire cannot be smaller than that of the wire used for the 24V and 0V connections.
Vibration/Shock Immunity	International Standard Regulations: IEC61131-2, IEC 68-2-6 (TEST Fc)/ IEC61131-2 & IEC 68-2-27 (TEST Ea)
Operation/storage temperature	Operation: 0°C ~55°C (temperature), 50~95% (humidity), pollution degree: 2; Storage: -25°C ~70°C (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

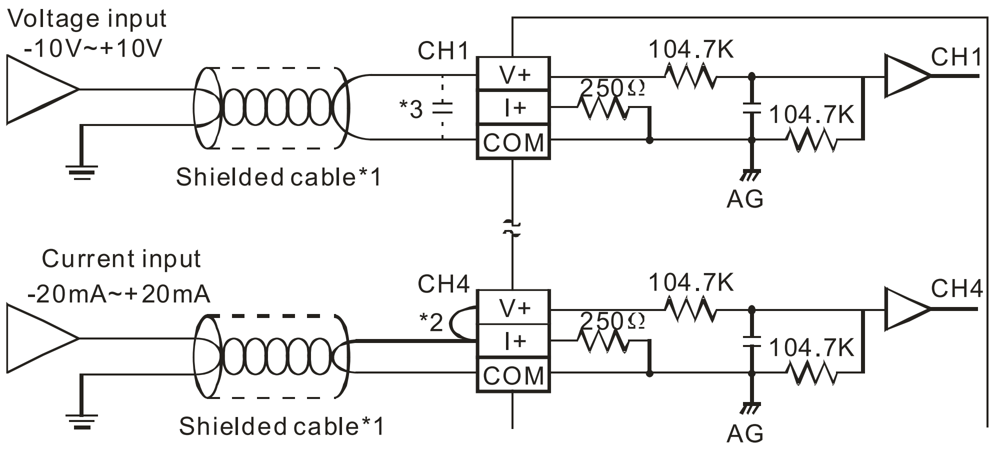
3.1.3.4 Product Profile and Outline

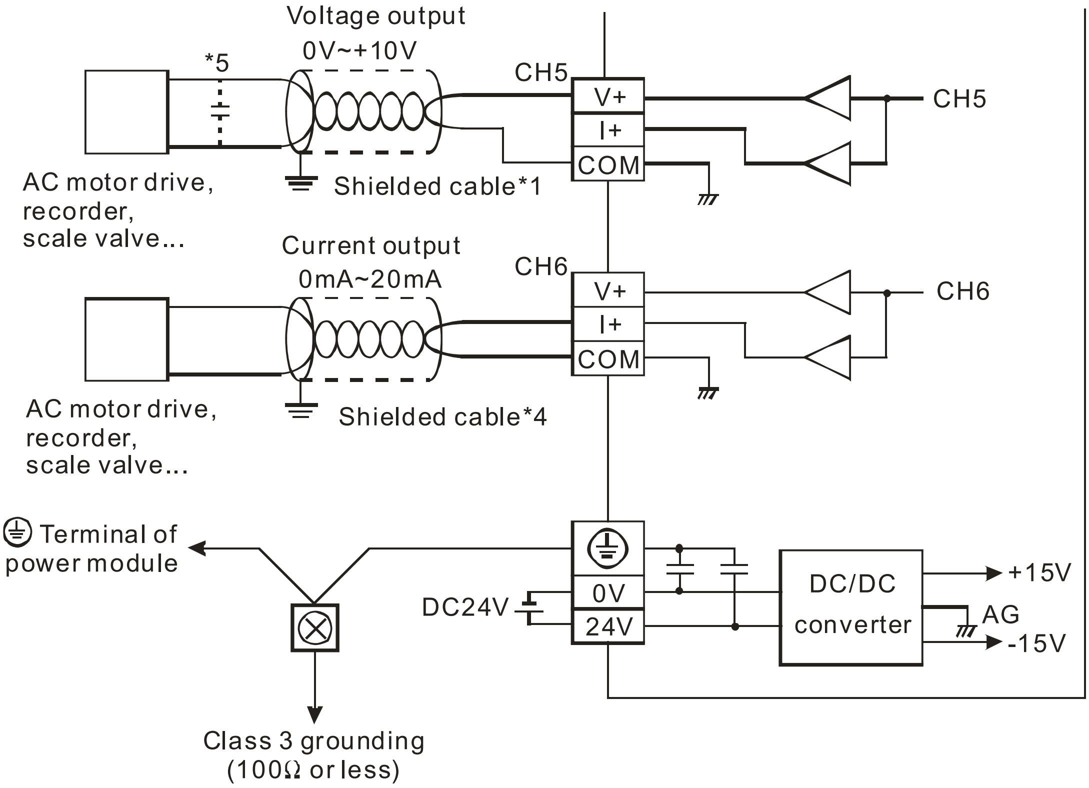


Units: mm

1.	Status indicator (Power, ERROR and A←→D)	2.	Model Name
3.	Extension unit clip	4.	I/O terminals
5.	DIN rail clip	6.	Mounting hole of the extension unit
7.	Nameplate	8.	Extension hook
9.	DIN rail mounting slot (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)

3.1.3.5 Installation and Wiring





Note 1: Isolate analog I/O wires from power wiring.

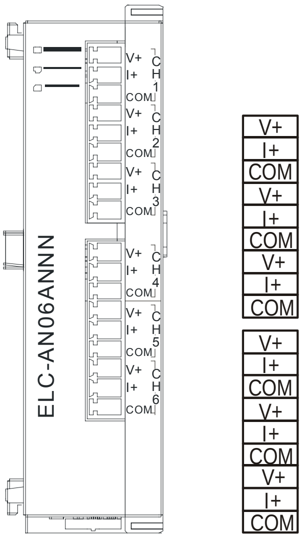
Note 2: If analog current inputs are used, be sure to jumper the V+ and I+ terminals.

Note 3: To help avoid electrical noise issues, use a capacitance: 0.1~0.47μF 25V for the analog inputs and outputs.

Note 4: Isolate analog outputs from power wiring.

Note 6: Connect ⏚ terminal of the power supply and ⏚ terminal of analog output module to system earth ground.

3.1.3.6 Terminal Layout



3.1.3.7 CR (Control Register)

ELC- AN06AANN					EXPLANATION
CR No	Param. Comm. Add.	Latched		Register Name	bit 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
#0	H'40C8	O	R	Module type	Data length is 8 bits (b7~b0). ELC-AN06AANN module code= H'CC
#1	H'40C9	O	R/W	Configuration word for the analog channels	CH6 CH5 CH4 CH3 CH2 CH1 Factory Setting is H0000. Input mode setting: (CH1~CH4). 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). Output mode setting: (CH5~CH6) 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).
#2	H'40CA	O	R/W	CH1 average number	Number of samples used for calculating average analog input values for channels CH1~CH4. Range is K1~K100 samples and the default setting is K10 samples.
#3	H'40CB	O	R/W	CH2 average number	
#4	H'40CC	O	R/W	CH3 average number	
#5	H'40CD	O	R/W	CH4 average number	
#6	H'40CE	X	R	Average value for CH1 input signal	Display average value of CH1~CH4 input signals
#7	H'40CF	X	R	Average value for CH2 input signal	
#8	H'40D0	X	R	Average value for CH3 input signal	
#9	H'40D1	X	R	Average value for CH4 input signal	
#10	H'40D2	X	R/W	CH5 output signal value	Output value for CH5~CH6, the decimal range is K0~K4,000. The factory setting is K0 and the unit is LSB.
#11	H'40D3	X	R/W	CH6 output signal value	
#12	H'40D4	X	R	Present value of CH1 input signal	Display present value of CH1~CH4 input signal
#13	H'40D5	X	R	Present value of CH2 input signal	
#14	H'40D6	X	R	Present value of CH3 input signal	
#15	H'40D7	X	R	Present value of CH4 input signal	
#18	H'40DA	O	R/W	To adj. Offset value of CH1	Offset setting for CH1~CH2. Factory setting is K0 and unit is LSB. Voltage input: range is K-1,000 ~K1,000 Current input: range is K-1,000 ~K1,000
#19	H'40DB	O	R/W	To adj. Offset value of CH2	

<table>
<tr><th colspan="5">ELC- AN06AANN</th><th colspan="16">EXPLANATION</th></tr>
<tr><th rowspan="2">CR No</th><th rowspan="2">Param. Comm. Add.</th><th colspan="2" rowspan="2">Latched</th><th rowspan="2">Register Name</th><th colspan="16">bit</th></tr>
<tr><th>15</th><th>14</th><th>13</th><th>12</th><th>11</th><th>10</th><th>9</th><th>8</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>#20</td><td>H’40DC</td><td>O</td><td>R/W</td><td>To adj. Offset value of CH3</td><td colspan="16" rowspan="2">Offset setting for CH3~CH4. Factory setting is K0 and unit is LSB.
Voltage input: range is K-1,000 ~K1,000
Current input: range is K-1,000 ~K1,000</td></tr>
<tr><td>#21</td><td>H’40DD</td><td>O</td><td>R/W</td><td>To adj. Offset value of CH4</td></tr>
<tr><td>#22</td><td>H’40DE</td><td>O</td><td>R/W</td><td>To adj. Offset value of CH5</td><td colspan="16" rowspan="2">Offset setting for CH5~CH6. Factory setting is K0 and unit is LSB.
The range is K-2,000~K2,000</td></tr>
<tr><td>#23</td><td>H’40DF</td><td>O</td><td>R/W</td><td>To adj. Offset value of CH6</td></tr>
<tr><td>#24</td><td>H’40E0</td><td>O</td><td>R/W</td><td>To adj. GAIN value of CH1</td><td colspan="16" rowspan="4">GAIN setting for CH1~CH4. Factory setting is K1,000 and unit is LSB.
Voltage input: range is K-800 ~K4,000
Current input: range is K-800 ~K2,600</td></tr>
<tr><td>#25</td><td>H’40E1</td><td>O</td><td>R/W</td><td>To adj. GAIN value of CH2</td></tr>
<tr><td>#26</td><td>H’40E2</td><td>O</td><td>R/W</td><td>To adj. GAIN value of CH3</td></tr>
<tr><td>#27</td><td>H’40E3</td><td>O</td><td>R/W</td><td>To adj. GAIN value of CH4</td></tr>
<tr><td>#28</td><td>H’40E4</td><td>O</td><td>R/W</td><td>To adj. GAIN value of CH5</td><td colspan="16" rowspan="2">GAIN setting for CH5~CH6. Factory setting is K2,000 and unit is LSB.
The range is K-1,600~K8,000</td></tr>
<tr><td>#29</td><td>H’40E5</td><td>O</td><td>R/W</td><td>To adj. GAIN value of CH6</td></tr>
<tr><td>#30</td><td>H’40E6</td><td>X</td><td>R</td><td>Error status</td><td colspan="16">Data register stores the error status, refer to fault code chart for details.</td></tr>
<tr><td>#31</td><td>H’40E7</td><td>O</td><td>R/W</td><td>Communication address setting</td><td colspan="16">RS-485 communication address.
The range is K1~K255 and factory setting is K1</td></tr>
<tr><td>#32</td><td>H’40E8</td><td>O</td><td>R/W</td><td>Communication baud rate setting</td><td colspan="16">Communication baud rate (4,800, 9,600, 19,200, 38,400, 57,600 and 115,200 bps).
For ASCII mode, data format is 7 Bits, even parity, 1 stop bit (7,E,1). For RTU mode, data format is 8 Bits, even parity, 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: switch between low byte and high byte of CRC code (only for RTU mode)
b15: RTU mode</td></tr>
</table>

<table>
<tr><th colspan="5">ELC- AN06AANN</th><th colspan="16">EXPLANATION</th></tr>
<tr><th rowspan="2">CR No</th><th rowspan="2">Param. Comm. Add.</th><th colspan="2" rowspan="2">Latched</th><th rowspan="2">Register Name</th><th colspan="16">bit</th></tr>
<tr><th>15</th><th>14</th><th>13</th><th>12</th><th>11</th><th>10</th><th>9</th><th>8</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td rowspan="2">#33</td><td rowspan="2">H’40E9</td><td rowspan="2">O</td><td rowspan="2">R/W</td><td rowspan="2">Reset to factory default settings and inhibit modifying Gain and Offset values</td><td colspan="2">CH6</td><td colspan="2">CH5</td><td colspan="3">CH4</td><td colspan="3">CH3</td><td colspan="3">CH2</td><td colspan="3">CH1</td></tr>
<tr><td colspan="16">Example: Setting of CH1
1. When b0=0, user can modify OFFSET and GAIN values for CH1 (CR#18, CR#24). When b0=1, inhibit the user from modifying the OFFSET and GAIN values for CH1.
2. b1: b1=0 (factory setting, latched), b1=1 (not latched).
3. b2: Set to 1 and ELC-AN06AANN will be reset to factory settings.
The setting of CH5~CH6, Example CH5:
b13, b12:
00: can be adjusted, latched.
01: can be adjusted, non-latched.
10: inhibit adjust.
11: reset to factory settings and clear b12, b13 to 0.</td></tr>
<tr><td>#34</td><td>H’40EA</td><td>O</td><td>R</td><td>System Version</td><td colspan="16">Display software version in hexadecimal. Example: H’010A = version 1.0A.</td></tr>
<tr><td colspan="5">#35~#48</td><td colspan="16">System used</td></tr>
<tr><td colspan="21">O means latched. X means non-latched. (available when using RS-485 communication, not available when connected to MPU)
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/2,000=5mV.
2. Current input: 1_{LSB}=20mA/1,000=20μA.
3. Voltage output: 1_{LSB}=10V/4,000=2.5mV.
4. Current output: 1_{LSB}=20mA/4,000=5μA.</td></tr>
</table>

■ Description of CR values

CR#0: Module Type

1. ELC-AN06AANN Module code = H’00CC.
2. Read the module code in the program to verify the correct extension module

CR#1: Configuration word

1. b0 ~ b11 are used to configure the 4 analog input channels CH1-CH4). There are 4 mode selections for each channel. For example, if CH1 is configured for: mode 0 (b2 ~ b0 = 000), CH2: mode 1 (b5 ~ b3 = 001), CH3: mode 2 (b8 ~ b6 = 010), and CH4: mode 3 (b11 ~ b9 = 011), b0 ~ b11 will have the value H’688.
2. b12 ~ b15 are used to configure the two analog output channels (CH5-CH6). There are 4 mode selections for each channel. For example, if CH5 is configured for mode 2 (b13 ~ b12 = 10) and CH6: mode 1 (b15 ~ b14 = 01), b12 ~ b15 will have the value H’5. Default value for this word is H’0000.

3. Configuration for the input channels (CH1 ~ CH4): CH1 example:
   Mode 0 (b2 ~ b0 = 000): Voltage output (-10V ~ +10V).
   Mode 1 (b2 ~ b0 = 001): Voltage output (-6V ~ +10V).
   Mode 2 (b2 ~ b0 = 010): Current output (-12mA ~ +20mA).
   Mode 3 (b2 ~ b0 = 011): Current output (-20mA ~ +20mA).
4. Configuration for the output channels (CH5 ~ CH6): CH5 example:
   Mode 0 (b13 ~ b12=00): Voltage output (0V ~ 10V).
   Mode 1 (b13 ~ b12=01): Voltage output (2V ~ 10V).
   Mode 2 (b13 ~ b12=10): Current output (4mA ~ 20mA).
   Mode 3 (b13 ~ b12=11): Current output (0mA ~ 20mA).

CR#2, 3, 4, 5: Number of samples for the average analog input values CH1 ~ CH4

Number of samples for averaging the CH1 ~ CH4 input signals. Note that the number of samples in CR#2 ~ CR#5 only need to be written in once.
The setup range for this parameter for ELC-AN04ANNN: K1 ~ K4,096 samples. Default = K10 samples.

CR#6, 7, 8, 9: Average analog input values for CH1 ~ CH4

1. The average of the signals at CH1 ~ CH4 obtained from the settings in CR#2 ~ CR#5.
2. If the settings for CR#2 ~ CR#5 are 10, the contents in CR#6 ~ CR#9 will be the average of the most recent 10 signals at CH1 ~ CH4.

CR#10, 11: Analog output values for CH5 ~ CH6

The analog output values for CH5 and CH6. Range: K0 ~ K4,000. Default = K0. Unit: LSB.

CR#12, 13, 14, 15: Present analog input values for CH1 ~ CH4

The present values of the analog input signals for CH1 ~ CH4.

CR#18, 19, 20, 21: Adjusted OFFSET value of CH1 ~ CH4

1. The OFFSET settings for signals at CH1 ~ CH4. Default = K0. Unit: LSB.
   Range for voltage inputs: K-1,000 ~ K1,000
   Range for current inputs: K-1,000 ~ K1,000.
2. The adjusted OFFSET value for CH1 ~ CH4, represents the analog input voltage or current when the analog signal is converted into a digital value 0.
   The adjustable range for voltage: -5V ~ +5V (-$1,000_{LSB}$ ~ +$1,000_{LSB}$).
   The adjustable range for current: -20mA ~ +20mA (-$1,000_{LSB}$ ~ +$1,000_{LSB}$).

CR#22, 23: Adjusted OFFSET value of CH5 ~ CH6

1. The OFFSET settings for signals at CH5 ~ CH6. Default = K0. Unit: LSB. Range: K-2,000 ~ K2,000.
2. The adjusted OFFSET values for CH5 ~ CH6, representing the analog output voltage or current when the digital output value is 0. Range: -2,000 ~ +2,000
   The adjustable range for voltage: -5V ~ +5V (-1,000$_{LSB}$ ~ +1,000$_{LSB}$).
   The adjustable range for current: -20mA ~ +20mA (-1,000$_{LSB}$ ~ +1,000$_{LSB}$).

CR#24, 25, 26, 27: Adjusted GAIN value of CH1 ~ CH4

1. The GAIN settings for the signals at CH1 ~ CH4. Default = K1,000. Unit: LSB.
   Range for voltage inputs: K-800 ~ K4,000
   Range for current inputs: K-800 ~ K2,600.
2. The adjusted GAIN value for CH1 ~ CH4, representing the analog input voltage or current when the analog signal is converted into digital value 1,000.
   The adjustable range for voltage: -4V ~ +20V (-800$_{LSB}$ ~ +4,000$_{LSB}$).
   The adjustable range for current: -16mA ~ +52mA (800$_{LSB}$ ~ +2,600$_{LSB}$).
3. Note: GAIN value – OFFSET value = +200$_{LSB}$ ~ +3,000$_{LSB}$ (voltage) or +200$_{LSB}$ ~ +1,600 $_{LSB}$ (current). When GAIN – OFFSET is small, the resolution of the output signal will be finer and the variation on the digital value will be greater. When GAIN – OFFSET is large, the resolution of the input signal will be grainier and the variation on the digital value will be smaller.

CR#28, 29: Adjusted GAIN value of CH5 ~ CH6

1. The GAIN settings for the signals at CH5 ~ CH6. Default = K2,000. Unit: LSB. Range: K0 ~ K4,000.
2. The adjusted GAIN values for CH5 ~ CH6, represent the analog output voltage or current when the digital output value is 2,000.
   The adjustable range for voltage: -4V ~ +20V (0$_{LSB}$ ~ +4,000$_{LSB}$).
   The adjustable range for current: -8mA ~ +40mA (0$_{LSB}$ ~ +4,000$_{LSB}$).
3. Note: GAIN value – OFFSET value = +400$_{LSB}$ ~ +6,000$_{LSB}$ (voltage or current). When GAIN – OFFSET is small, the resolution of the output signal will be finer and the variation on the digital value will be greater. When GAIN – OFFSET is large, the resolution of output signal will be granier and the variation on the digital value will be smaller.

CR#30: Fault Register

CR#30 contains the present fault code. Refer to the following chart.

Fault description	Content	b15~b8	b7	b6	b5	b4	b3	b2	b1	b0
Power source abnormal (Low voltage alarm)	K1(H1)	Reserved	0	0	0	0	0	0	0	1
User setting D/A output exceeds range	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.										

CR#31: RS-485 communication address setting

The RS-485 communication address. Range: 01 ~ 255. Default = K1. This setting is only valid for RS-485 communication and will be invalid when connected to an ELC controller.

CR#32: Communication speed (baud rate) setting

The RS-485 communication data rates: 4,800, 9,600, 19,200, 38,400, 57,600 and 115,200bps (bits per second). Default = H'0002.

b0 = 1:	4,800 bps
b1 = 1:	9,600 bps (default)
b2 = 1:	19,200 bps
b3 = 1:	38,400 bps
b4 = 1:	57,600 bps
b5 = 1:	115,200 bps
b6 ~ b13:	Reserved
b14:	High/low bit exchange for CRC checksum (only valid in RTU mode)
b15:	Switch between ASCII/RTU mode. 0: ASCII (default); 1: RTU. ASCII data format: 7-bit, Even parity, 1 stop bit (7, E, 1); RTU data format: 8-bit, Even parity, 1 stop bit (8, E, 1). This setting is only valid for RS-485 communications and will be invalid when connected to an ELC controller.

CR#33: Returning to factory defaults and OFFSET/GAIN tuning authorization

For authorization on modifying the OFFSET/GAIN values. Default setting = H'0000.

Example for CH1:

1. When b0 = 0, modifying CR#18 (OFFSET) and CR#24 (GAIN) for CH1 is allowed. When

b0 = 1, Modifying the values for CR#18 (OFFSET) and CR#24 (GAIN) of CH1 is not allowed.

2. b1 determines whether the OFFSET/GAIN values are latched. b1 = 0: OFFSET/GAIN registers are latched; b1 = 1: OFFSET/GAIN registers are non-latched. This function is only valid when using RS-485 communications and when the module is not connected to an ELC controller.
3. When b2 = 1, all settings will return to default values except for CR#31 and CR#32.

Example for CH5:

1. (b13, b12) = 00: Adjustable, latched
2. (b13, b12) = 01: Adjustable, non-latched
3. (b13, b12) = 10: Not adjustable
4. (b13, b12) = 11: Returning to default setting except for CR#31 and CR#32 and reset b13 and b12 as 0

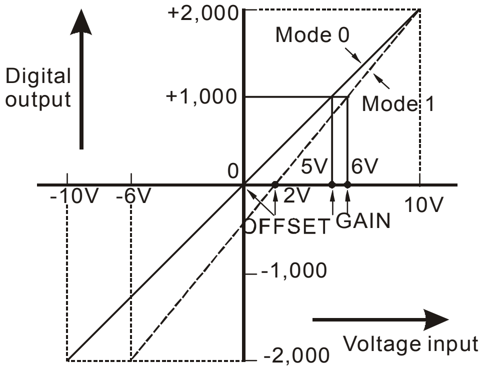
CR#34: Firmware version

Displaying the current firmware version in hex, e.g. version V1.00 is displayed as H’0100.

3.1.3.8 A/D, D/A Conversion Curve

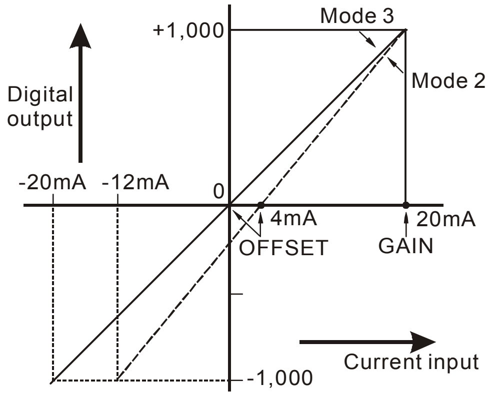
- **A/D Conversion Characteristic Curve for CH1~CH4**

  - Voltage input mode:



Mode 0 for CR#1:	GAIN=5V(1,000LSB), OFFSET=0V (0LSB).
Mode 1 for CR#1:	GAIN=6V(1,200LSB), OFFSET=2V (400LSB).
GAIN:	Voltage input value when digital output is 1,000. Setting range is -4V~+20V(-800LSB~ +4,000LSB)
OFFSET:	Voltage input value when digital output is 0. Setting range: -5V~+5V(-1,000LSB ~ +1,000LSB)
GAIN－OFFSET:	Setting range is +1V~+15V (+200LSB~ +3,000LSB)

- Current input mode:



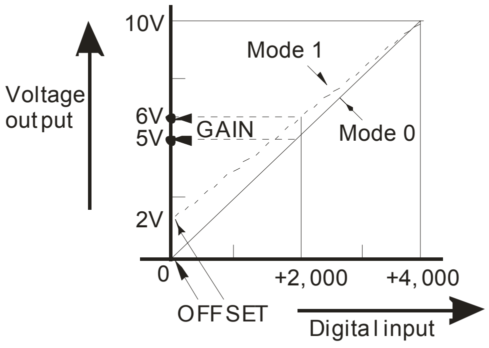
Mode 2 for CR#1:	GAIN = 20mA(1,000LSB), OFFSET=4mA (200LSB).
Mode 3 for CR#1:	GAIN = 20mA(1,000LSB), OFFSET=0mA (0LSB).
GAIN:	Current input value when digital output is +1,000. Setting range is -16 mA ~+52 mA (-800LSB ~ +2,600LSB)
OFFSET:	Current input value when digital output value is 0. Setting range is -20 mA~+20 mA (-1,000LSB ~ +1,000LSB)
GAIN－OFFSET:	Setting range is +4mA ~ +32mA (200LSB~ +1,600LSB)

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

Voltage input: 1LSB=10V/2,000=5mV. Current input 1LSB=20mA/1,000= 20µA.

D/A Conversion Characteristic Curve for CH5~CH6

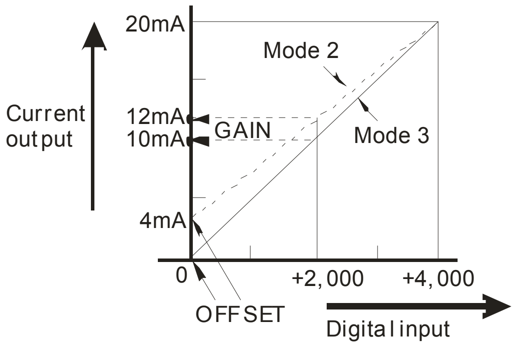
- Voltage output mode:



Mode 0 for CR#1:	GAIN = 5V(2,000LSB), OFFSET=0V (0LSB)
Mode 1 for CR#1:	GAIN = 6V(2,400LSB), OFFSET=2V (800LSB).
GAIN:	Voltage output value when digital input is K2,000. Setting range is -4V~+20V(-1,600LSB ~+8,000 LSB).
OFFSET:	Voltage output value when digital input is K0. Setting range: -5V~+5V(-2,000LSB ~ +2,000 LSB).

GAIN－OFFSET:	Setting range is +1V~+15V(+400LSB ~ +6,000 LSB)

- Current output mode:



Mode 2 for CR#1:	GAIN = 12mA(2,400LSB),OFFSET=4mA (800LSB).
Mode 3 for CR#1:	GAIN = 10mA(2,000LSB), OFFSET=0mA (0LSB).
GAIN:	Current output value when digital input value is K2,000. Setting range is -8 mA ~ +40 mA (-1,600LSB ~+8,000LSB).
OFFSET:	Current output value when digital input is K0. Setting range is -10 mA ~ +10 mA (-2,000LSB ~+2,000LSB).
GAIN－OFFSET:	Setting range is +2mA~+30mA(+400LSB ~+6,000LSB)

The chart above is to adjust D/A conversion characteristic curve for voltage output mode and current output mode. The conversion characteristic curve can be modified by changing the OFFSET values (CR#14~CR#15) and GAIN values (CR#18~CR#19) depending on the application.

Voltage output: 1LSB=10V/4,000=2.5mV.

Current output: 1LSB=20mA/4,000=5μA.

- **Example #1: Adjusting the A/D Conversion Curve in Voltage Input Mode**

1. Description:

   Example using the ELC-AN06AANN:

   - When CR#1 (b11 ~ b0) is set to voltage input mode (mode 0), the OFFSET value is set to 0V (K0) and the GAIN value to 5V (K4,000), i.e. input voltage range -10V ~ +10V will correspond to decimal values -2,000 ~ +2,000.
   - When CR#1 (b11 ~ b0) is set to voltage input mode (mode 1), the OFFSET value will be set to 2V (K400) and the GAIN value to 6V (K1,200), i.e. input voltage -6V ~ +10V will correspond to values -2,000 ~ +2,000.

2. Addresses Used:

   X0=On: Set the input mode of the signals at CH1 as mode 1.
   X1=On: Set the OFFSET value of CH1 as 0V (K0) and GAIN value as 2.5V (K500).
   M0=On: Disable adjustment on A/D conversion curve

3. Program Description
   - When X0 = On, set CR#1 to K1 (H'1, i.e. 0000 <u>0000 0000 0001</u> in binary) and the signal input mode at CH1 ~ CH4 to mode 1 (voltage input mode).
   - When X1 = On, write K0 (OFFSET value of CH1) into CR#18 and K500 (GAIN value of CH1) into CR#24.
   - When X1 goes from On to Off, set M0 = On to disable the ability to modify the A/D conversion curve. Write K1 (H'1, i.e. 0000 <u>0000 0000 0001</u> in binary) into CR#33 to disable modifying the A/D conversion curve for CH1.
4. Program example

Ladder diagram:

Explanation:

Set CH1 to mode 1 (voltage input mode)

Write the OFFSET value for CH1

Write the GAIN value for CH1

Disable modifying the A/D conversion curve for CH1

■ Example #2: Adjusting A/D Conversion Curve in Current Input Mode

1. Description

   Example for the ELC-AN06AANN:
   - When CR#1 (b11 ~ b0) is set to current input mode (mode 2), the OFFSET value will be set to 4mA (K200) and the GAIN value to 20mA (K1,000), i.e. input current range -12mA ~ +20mA will correspond to decimal values -1,000 ~ +1,000.
   - When CR#1 (b11 ~ b0) is set to current input mode (mode 3), the OFFSET value will be set to 0mA (K0) and the GAIN value to 20mA (K1,000), i.e. input current range -20mA ~ +20mA will correspond to decimal values -1,000 ~ +1,000.
   - If you cannot use the default current input modes (mode 2 and mode 3), you can make adjustments to the A/D conversion curve according to the application requirements. For example, Set the OFFSET of CH1 ~ CH4 to 5mA (K250) and the GAIN to 20mA (K1,000).
   - You only need to set up the A/D conversion curve once.
2. Addresses Used:
   - X0=On: Set the input mode for CH1 ~ CH4 to mode 3.
   - X1=On: Set the OFFSET values for CH1 ~ CH4 to 5mA (K250) and the GAIN values

to 20mA (K1,000).

- M0=On: Disable modifying the A/D conversion curve.

3. Program Description
    - When X0 = On, set CR#1 to K1755 (H’6DB, i.e. 0000 0110 1101 1011 in binary) and the signal input mode for CH1 ~ CH4 to mode 3 (current input mode).
    - When X1 = On, write K250 (OFFSET value for CH1 ~ CH4) into CR#18 ~ 21 and K1,000 (the GAIN values for CH1 ~ CH4) into CR#24 ~ 27.
    - When X1 goes from On to Off, set M0 = On to disable modifying the A/D conversion curve. Write K585 (H’249, i.e. 0000 0010 0100 1001 in binary) into CR#33 to disable modifying the A/D conversion curve for CH1 ~ CH4.

4. Program example

Ladder diagram:

Explanation:

Set CH1 ~ CH4 to mode 3 (current input mode)

Set the OFFSET value for CH1 ~ CH4

Set the GAIN value for CH1 ~ CH4

Disable modifying the A/D conversion curve

- **Example #3: Adjusting the D/A Conversion Curve for the Voltage Output Mode**

1. Description:

    Example for ELC-AN06AANN.

    - When CR#1 (b15 ~ b12) is set to voltage output mode (mode 0), the OFFSET value will be set to 0V (K0) and the GAIN value to 5V (K2,000), i.e. output voltage 0 ~ +10V will correspond to decimal values 0 ~ +4,000.
    - When CR#1 (b15 ~ b12) is set to voltage output mode (mode 1), the OFFSET value will be set to 2V (K800) and the GAIN value to 6V (K2,400), i.e. output voltage 2V ~ +10V will correspond to decimal values 0 ~ +4,000.
    - If the default voltage input mode (mode 0 and mode 1) does not meet the application requirements, adjustments can be made to the D/A conversion curve. For example, Set the OFFSET for CH5 ~ CH6 to 0V (K0) and the GAIN to 2.5V (K1,000).
    - The D/A conversion curve only needs to be configured once.

2. Addresses Used:
    - X0=On: Set the output mode for CH5 ~ CH6 to mode 1.
    - X1=On: Set the OFFSET values for CH5 ~ CH6 to 0V (K0) and the GAIN values to

2.5V (K1,000).

- M0=On: Disable modifying the D/A conversion curve.

3. Program Description

- When X0 = On, write K20,480 (H’5000, i.e. 0101 0000 0000 0000 in binary) to CR#1 to configure CH5 ~ CH6 to mode 1 (voltage output mode).
- When X1 = On, write K0 (OFFSET value for CH51 ~ CH6) into CR#22 ~ 23 and K1,000 (GAIN value for CH5 ~ CH6) into CR#28 ~ 29.
- When X1 goes from On to Off, set M0 = On to disable modifying the D/A conversion curve. Write K4,096 (H’A000, i.e. 1010 0000 0000 0000 in binary) into CR#33 to disable modifying the D/A conversion curve in CH5 ~ CH6.

4. Program Example

Ladder diagram:

Explanation:

Set CH5 ~ CH6 to mode 1 (voltage output mode)

Set the OFFSET value for CH5 ~ CH6

Set the GAIN value for CH5 ~ CH6

Disable modifying the D/A conversion curve

Example#4: Adjusting the D/A Conversion Curve for the Current Output Mode

1. Description

Example for ELC-AN06AANN.

- When CR#1 is set to current output mode (mode 2), the OFFSET value will be set to 4mA (K800) and the GAIN value to 12mA (K2,400), i.e. input current 4mA ~ +20mA will correspond to values 0 ~ +4,000.
- When CR#1 is set to current output mode (mode 3), the OFFSET value will be set to 0mA (K0) and GAIN value to 10mA (K2,000), i.e. output current 0mA ~ +20mA will correspond to values 0 ~ +4,000.
- If the default current output mode (mode 2 and mode 3) does not meet the application requirements, adjustments can be made to. For example, Set the OFFSET for CH5 ~ CH6 to 6mA (K1,200) and the GAIN to 13mA (K2,600).
- The D/A conversion curve only needs to be configured once.

2. Addresses Used:
    - X0=On: Set the output mode for CH5 ~ CH6 to mode 3.
    - X1=On: Set the OFFSET values for CH5 ~ CH6 to 6mA (K1,200) and the GAIN values to 13mA (K2,600).
    - M0=On: Disable modifying the D/A conversion curve.
3. Program Description
    - When X0 = On, write H'F000 to CR#1, (i.e. 1111 0000 0000 0000 in binary) to configure CH5 ~ CH6 to mode 3 (current output mode).
    - When X1 = On, write K1,200 (OFFSET values for CH5 ~ CH6) into CR#22 ~ 23 and K2,600 (GAIN values for CH5 ~ CH6) into CR#28 ~ 29.
    - When X1 goes from On to Off, set M0 = On to disable modifying the D/A conversion curve. Write H'A000 (i.e. 1010 0000 0000 0000 in binary) into CR#33 to disable modifying the D/A conversion curve in CH5 ~ CH6.
4. Program example

Ladder diagram:

Explanation:

Set CH5 ~ CH6 to mode 3 (current output mode)

Set the OFFSET value for CH5 ~ CH6

Set the GAIN value for CH5 ~ CH6

Disable modifying the D/A conversion curve

3.1.4 ELC-PT04ANNN

3.1.4.1 The Basic Concepts of Platinum Temperature Sensors (PT100)

Platinum temperature sensor is highly accurate and stable and the quality of linearity between -200°C and 600°C is fairy good. Generally speaking, the temperature coefficient of PT100 temperature sensors is significant at low temperatures -200°C ~ -100°C, and the quality of linearity is good at middle temperature 100°C ~ 300°C. The temperature coefficient becomes small for higher temperatures, i.e. 300°C ~ 500°C. The resistance of PT100 is 100Ω when the temperature is 0°C, which is the standard for a metallic temperature sensor.

The rated current for temperature sensore should be less than 2mA. The self-heating of 1mW for a PT100 will cause a temperature variation of 0.02°C ~ 0.75°C. Therefore, reducing the current of a PT100 can also reduce the temperature variation. However, if the current is too small, the PT100 signal can be affected by electrical noise. For this reason, it is recommended to confine the current to the range 0.5mA and 2mA.

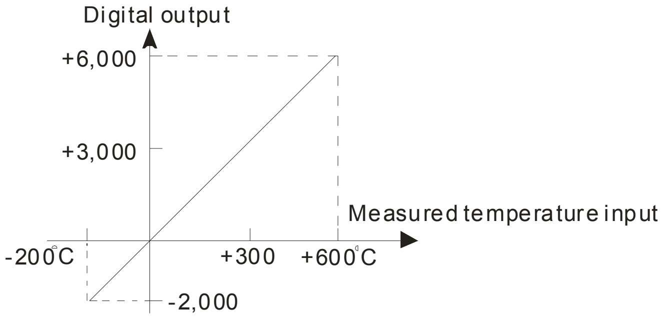
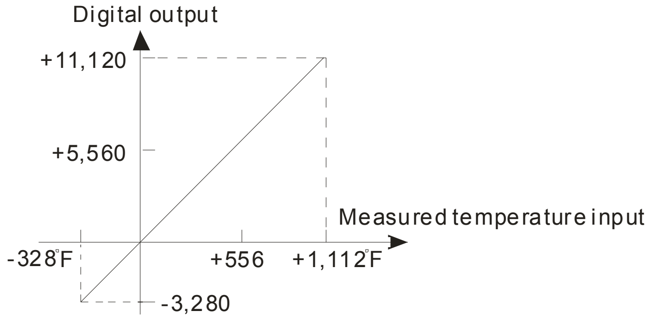
3.1.4.2 Introduction

The ELC-PT04ANNN allows the connection of four platinum temperature sensors (PT100 3-WIRE 100Ω 3850 PPM/°C(DIN 43760 JIS C1604-1989)). The ELC Platinum Thermocouple module converts the sensor inputs into a 14 bit digital value, which may then be read into the ladder program by using TO and FROM instructions. There are 49 Controlled Registers (CR) in this module (each register is 16 bits). The ELC controller program can read/write the CR data of the Platinum Temperature Sensor Module, ELC-PT04ANNN using the FROM / TO instructions.

3.1.4.3 Specification

- **Functional Specifications**

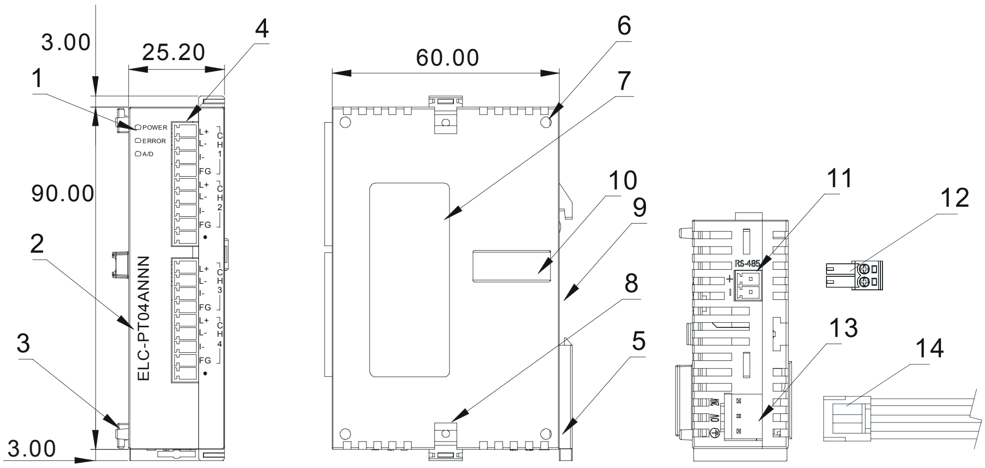
Temperature measurement module	Celsius (°C)	Fahrenheit (°F)
Power supply voltage	24V DC (20.4V DC ~ 28.8V DC) (-15% ~ +20%)	
Analog input channel	4 channels/module	
Applicable sensors type	3-WIRE PT100Ω 3850 PPM/°C (DIN 43760 JIS C1604-1989)	
Current excitation	1mA	
Temperature input range	-200 ~ 600	-328 ~ 1,112
Range of digital conversion	K-2,000 ~ K6,000	K-3,280 ~ K11,120
Resolution	14 bits (0.1°C)	14 bits (0.1°F)
Overall accuracy	±0.5% when in full scale (25°C, 77°F) ±1% when in full scale within the range of 0 ~ 55°C, 32 ~ 131°F	
Response time	200ms × the number of channels	
Isolation	Isolation between digital area and analog area. No isolation among channels.	
Digital data format	13 significant bits out of 16 bits are available; in 2's complement.	

Average function	Configure using CR#2 ~ CR#5. Range for ELC-TC04ANNN: K1 ~ K100.
Self-diagnosis	Upper and lower limit detection/channel
Communication mode (RS-485)	ASCII/RTU mode. Communication speed: 4,800/9,600/19,200/38,400/57,600/115,200 bps. ASCII data format: 7-bit, Even parity, 1 stop bit (7, E, 1), RTU data format: 8-bit, Even parity, 1 stop bit (8, E, 1). RS-485 cannot be used when connected to an ELC controller.
When connected to an ELC controller	The modules are numbered from 0 to 7 based on their position with respect to the controller.. 0 is the closest to controller and 7 is the furthest. A maximum of 8 special modules are allowed per controller.
Temperature/digital curve	Temperature mode: °C 
	Temperature mode: °F 

Electrical Specifications

Max. rated power consumption	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 ground wire cannot be smaller than the wire used for the connections to the 24V and 0V terminals.
Vibration/Shock Immunity	International Standard Regulations: IEC61131-2, IEC 68-2-6 (TEST Fc)/ IEC61131-2 & IEC 68-2-27 (TEST Ea)
Operation/storage temperature	Operation: 0°C ~55°C (temperature), 50~95% (humidity), pollution degree: 2; Storage: -25°C ~70°C (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

3.1.4.4 Product Profile and Outline



Unit: mm

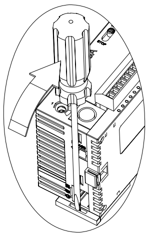
1.	Status indicator (Power, ERROR and A/D)	2.	Model Name
3.	Extension unit clip	4.	I/O terminals
5.	DIN rail clip	6.	Mounting hole of the extension unit
7.	Nameplate	8.	Extension hook
9.	DIN rail mounting slot (35mm)	10.	Extension port
11.	RS-485 Communication port	12.	2 pin removable terminal (standard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

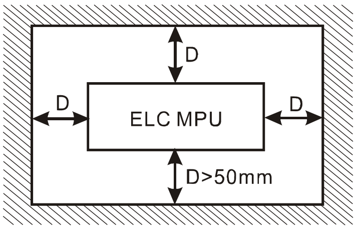
3.1.4.5 Installation and Wiring

- **Installation of the DIN rail**

1. The ELC may be secured to a cabinet by using 35mm in height and 7.5mm in depth DIN rail. When mounting the ELC to 35mm DIN rail, be sure to use the retaining clip to stop any side-to-side movement of the ELC and reduce the chance of wires coming loose. The retaining clip is at the bottom of the ELC. To secure the ELC to DIN rail, pull down the clip, place it onto the rail and push it up to lock it in place. To remove the ELC, pull the retaining clip down with a flat screwdriver and remove the ELC from DIN rail.

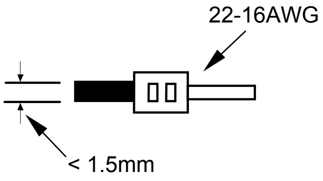
2. Install the ELC in an enclosure with sufficient space around it to allow heat dissipation, as shown in the figure below.



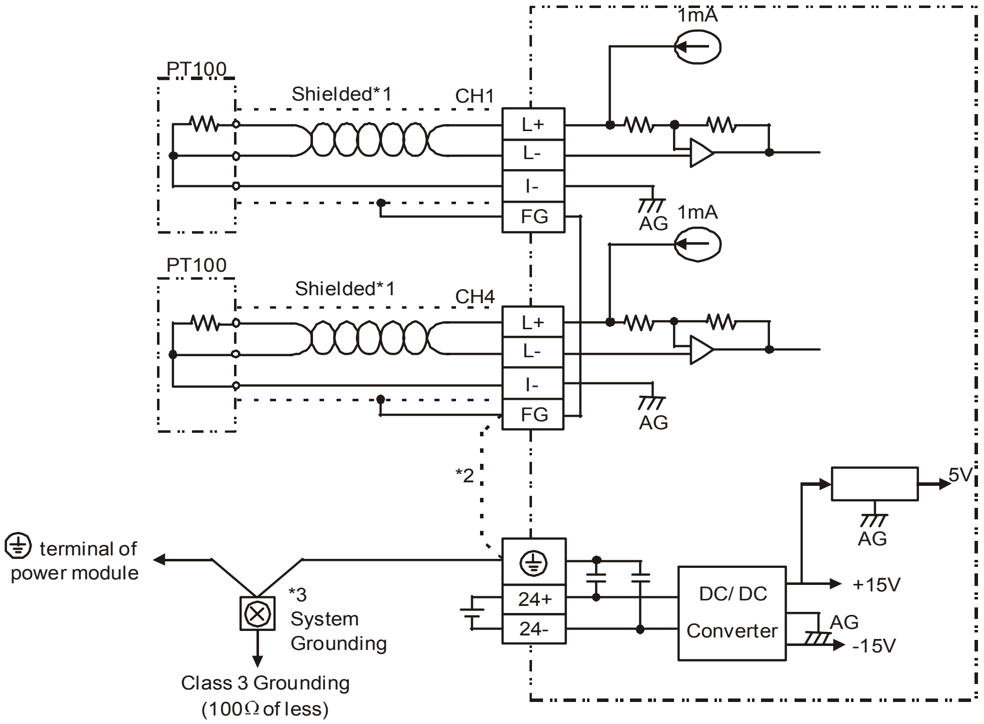


■ Wiring

1. Use 22-16 AWG (1.5mm) single-core wire or the multi-core wire for the I/O wiring. The specification of the terminal is shown in the figure on the right hand side. The ELC terminal screws should be tightened to 1.95 kg-cm (1.7 in-lbs). Also, use 60/75°C copper conductor only.
2. I/O signal wires and power supply wires should not run through the same multi-wire cable or conduit.



■ External Wiring



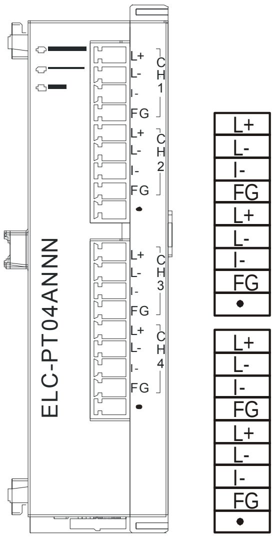
Note 1: Use only the wires that are supplied with the temperature sensor. ELC terminal screws should be tightened to 1.95 kg-cm (1.7 lb-in).

Note 2: Terminal FG is the grounding terminal for noise suppression.

Note 3: Please connect ⏚ terminal of the power supply module and ⏚ terminal of the ELC-PT04ANNN platinum temperature sensors module to system earth ground.

Warning: DO NOT connect wires to the No Connection terminals.

3.1.4.6 Terminal Layout



3.1.4.7 CR (Control Register)

ELC- PT04ANNN					EXPLANATION															
CR No	Param. Comm. Add.	Latched		Register Name	bit															
					15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
#0	H'4064	○	R	Module type	Data length is 8bits (b7~b0). ELC-PT04ANNN module code = H'8A															
#2	H'4066	○	R/W	CH1 average number	The number of samples used for "average" temperature on channels CH1~CH4. Range is K1~ K100 and factory setting is K10.															
#3	H'4067	○	R/W	CH2 average number																
#4	H'4068	○	R/W	CH3 average number																
#5	H'4069	○	R/W	CH4 average number																
#6	H'406A	X	R	CH1 average	Average temperature for channels CH1~CH4. (unit: 0.1 degrees C)															
#7	H'406B	X	R	CH2 average																
#8	H'406C	X	R	CH3 average deg(°C)																
#9	H'406D	X	R	CH4 average																
#12	H'4070	X	R	CH1 average deg.(°F)	Average temperature for channels CH1~CH4. (unit: 0.1 degrees F)															
#13	H'4071	X	R	CH2 average deg.(°F)																
#14	H'4072	X	R	CH3 average deg.(°F)																
#15	H'4073	X	R	CH4 average deg.(°F)																
#18	H'4076	X	R	Present temp. of CH1(°C)	Present temperature for channels CH1~CH4. (unit: 0.1 degrees C)															
#19	H'4077	X	R	Present temp. of CH2(°C)																
#20	H'4078	X	R	Present temp. of CH3(°C)																
#21	H'4079	X	R	Present temp. of CH4(°C)																

<table>
<tr><th colspan="5">ELC- PT04ANNN</th><th colspan="16">EXPLANATION</th></tr>
<tr><th rowspan="2">CR No</th><th rowspan="2">Param. Comm. Add.</th><th rowspan="2" colspan="2">Latched</th><th rowspan="2">Register Name</th><th colspan="16">bit</th></tr>
<tr><th>15</th><th>14</th><th>13</th><th>12</th><th>11</th><th>10</th><th>9</th><th>8</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>#24</td><td>H’407C</td><td>X</td><td>R</td><td>Present temp. of CH1(°F)</td><td colspan="16" rowspan="4">Present temperature for channels CH1~CH4.
(unit: 0.1degrees F)</td></tr>
<tr><td>#25</td><td>H’407D</td><td>X</td><td>R</td><td>Present temp. of CH2(°F)</td></tr>
<tr><td>#26</td><td>H’407E</td><td>X</td><td>R</td><td>Present temp. of CH3(°F)</td></tr>
<tr><td>#27</td><td>H’407F</td><td>X</td><td>R</td><td>Present temp. of CH4(°F)</td></tr>
<tr><td>#30</td><td>H’4082</td><td>X</td><td>R</td><td>Error status</td><td colspan="16">Data register stores the error status, refer to fault code chart for details.</td></tr>
<tr><td>#31</td><td>H’4083</td><td>O</td><td>R/W</td><td>Comm. Address</td><td colspan="16">Range is 01~255 and factory setting is K1</td></tr>
<tr><td>#32</td><td>H’4084</td><td>O</td><td>R/W</td><td>Communication baud rate setting</td><td colspan="16">Communication baud rate (4,800, 9,600, 19,200, 38,400, 57,600 and 115,200 bps). For ASCII mode, data format is 7 Bits, even parity, 1 stop bit (7 E 1). For RTU mode, data format is 8 Bits, even parity, 1 stop bit (8 E 1).
b0: 4,800 bps (bit/sec)
b1: 9600 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 byte and high byte of CRC code (For RTU mode)
b15: RTU mode</td></tr>
<tr><td rowspan="2">#33</td><td rowspan="2">H’4085</td><td rowspan="2">O</td><td rowspan="2">R/W</td><td rowspan="2">Reset to factory setting</td><td colspan="3">Def. f ERR LED</td><td colspan="3">CH4</td><td colspan="3">CH3</td><td colspan="3">CH2</td><td colspan="4">CH1</td></tr>
<tr><td colspan="16">Example: 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 or external contact has no connection, ERR LED flashes.
2.b13 corresponds to CH2: when b13=1, scale exceeds the range or external contact has no connection, ERR LED flashes.
3.b14 corresponds to CH3: when b14=1, scale exceeds the range or external contact has no connection, ERR LED flashes.
4.b15 corresponds to CH4: when b15=1, scale exceeds the range or external contact has no connection, ERR LED flashes.</td></tr>
<tr><td>#34</td><td>H’4086</td><td>O</td><td>R</td><td>System Version</td><td colspan="16">Display software version in hexadecimal.
Example: H’010A = version 1.0A.</td></tr>
<tr><td colspan="4">#35~#48</td><td colspan="17">System used</td></tr>
</table>

ELC- PT04ANNN				EXPLANATION															
CR No	Param. Comm. Add.	Latched	Register Name	bit															
				15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
O means latched. X means not latched. (available when using RS-485 communication, not available when connected to MPU) R means can read data by using FROM command or RS-485. W means can write data by using TO command or RS-485.																			

Description of the CRs

CR#0: Module Type

1. ELC- PT04ANNN model code = H'008A.
2. Read the module code in the program to verify the correct extension module.

CR#2, 3, 4, 5: Number of samples for the average values for CH1 ~ CH4

1. The number of samples used to determine the average temperature values for CH1 ~ CH4.
2. Range for ELC- PT04ANNN: K1 ~ K100. Default = K10.

CR#6, 7, 8, 9: Average Celsius temperature measured at CH1 ~ CH4

1. The average Celsius temperature measured at CH1 ~ CH4 obtained from the number of samples in CR#2 ~ CR#5. Unit: 0.1°C.
2. For example, if the number of samples is set to 10, the contents in CR#6 ~ CR#9 will be the average of the most recent 10 temperature values in Celsius at CH1 ~ CH4.

CR#12, 13, 14, 15: Average Fahrenheit temperature measured at CH1 ~ CH4

1. The average Fahrenheit temperature measured at CH1 ~ CH4 obtained from the number of samples in CR#2 ~ CR#5. Unit: 0.1°F.
2. For example, if the number of samples is set to 10, the contents in CR#12 ~ CR#15 will be the average of the most recent 10 temperature values in Fahrenheit at CH1 ~ CH4.

CR#18, 19, 20, 21: Present Celsius temperature measured at CH1 ~ CH4

The present temperature in Celsius at CH1 ~ CH4. Unit: 0.1°C.

CR#24, 25, 26, 27: Present Fahrenheit temperature measured at CH1 ~ CH4

The present temperature in Fahrenheit at CH1 ~ CH4. Unit: 0.1°F.

CR#30: Data register for storing all errors

CR#30: error status value. See the table below:

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.										

CR#31: RS-485 communication address setting

The RS-485 communication address. Range: 01 ~ 255. Default = K1. This setting is only valid for RS-485 communication and will be invalid when connected to an ELC controller.

CR#32: Communication speed (baud rate) setting

The RS-485 communication speed: 4,800, 9,600, 19,200, 38,400, 57,600 and 115,200bps (bits per second). Default = H’0002.

b0 = 1: 4,800 bps
b1 = 1: 9,600 bps (default)
b2 = 1: 19,200 bps
b3 = 1: 38,400 bps
b4 = 1: 57,600 bps
b5 = 1: 115,200 bps
b6 ~ b13: Reserved
b14: High/low byte exchange of CRC checksum (only valid in RTU mode)
b15: Switch between ASCII/RTU mode. 0: ASCII (default); 1: RTU. ASCII data format: 7-bit, Even parity, 1 stop bit (7, E, 1); RTU data format: 8-bit, Even parity, 1 stop bit (8, E, 1). This setting is only valid for RS-485 communications and will be invalid when connected to an ELC controller.

CR#33: Returning to default setting; definition of ERR LED

Default = H’F000. Example for vCH1:

b0 and b1 are reserved. When b2 is set as 1, all the settings will return to default settings except for CR#31 and CR#32.

Definition of ERR LED:

b12 corresponds to CH1. When b12 = 1 or the scale exceeds the range, ERR LED will flash.

b13 corresponds to CH2. When b13 = 1 or the scale exceeds the range, ERR LED will flash.

b14 corresponds to CH3. When b14 = 1 or the scale exceeds the range, ERR LED will flash.

b15 corresponds to CH4. When b15 = 1 or the scale exceeds the range, ERR LED will flash.

CR#34: Firmware version

Displaying the current firmware version in hex, e.g. version V1.00 is indicated as H'0100.

3.1.4.8 Applications

■ **PT100 Temperature Measurement System**

1. Description
   - Measuring temperature with a PT100 temperature sensor.
2. Devices
3. Addresses
   - D20 ~ D23: average Celsius temperature at CH1 ~ CH4
   - D30 ~ D33: average Fahrenheit temperature at CH1 ~ CH4
   - D40 ~ D43: present Celsius temperature at CH1 ~ CH4
   - D50 ~ D53: present Fahrenheit temperature at CH1 ~ CH4
4. Program explanation
   - When ELC goes from STOP to RUN, set the number of samples for the average input signals at CH1 ~ CH4 to 10.
   - Store the average Celsius temperature for CH1 ~ CH4 into D20 ~ D23.
   - Store the average Fahrenheit temperature for CH1 ~ CH4 into D30 ~ D33.
   - Store the present Celsius temperature for CH1 ~ CH4 into D40 ~ D43.
   - Store the present Fahrenheit temperature for CH1 ~ CH4 into D50 ~ D53.
5. Program example

Ladder diagram:

Explanation:

Set the number of samples at for CH1 ~ CH4 to 10

Read average Celsius degrees from CH1 ~ CH4

Read average Fahrenheit degrees from CH1 ~ CH4

Read present Celsius temperature from CH1 ~ CH4

Read present Fahrenheit temperature from CH1 ~ CH4

3.1.5 ELC-TC04ANNN

3.1.5.1 The Thermocouple Temperature Sensor

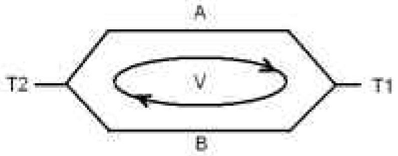
A thermocouple is composed of conductors of two different materials. When a temperature difference occurs at the two ends of the thermocouple, the thermocouple will generate a voltage signal in proportional to the temperature difference. The voltage signal ranges from tens of uV to thousands of uV; therefore, we need to magnify the voltage when using it.

The thermocouple temperature sensor indicates temperature by differential voltage, and this eliminated eliminates external interferences the two pairs of data are a differential operation. Therefore, it is much more stable than a thermistor, resistive thermometer or thermal resistor and is widely applied in the industry.

The thermocouple is a loop constructed by two different metallic wires welded or twisted together (see the figure below). Different metals make two junctions in the loop. One junction is called “measuring junction” or “hot junction”, and the other is “reference junction” or “cold junction”. Placing the two junctions in different temperatures will cause a loop voltage (i.e. Seebeck Effect), and the loop voltage is in proportional to the temperature difference between the two junctions. The loop voltage and the two junctions equate equation:

$$V = \int_{T_1}^{T_2} (Q_A - Q_B) dT \qquad \text{(A)}$$

In which Q = the heat conduction coefficient of the metal



How a thermocouple works

The heat conduction coefficient of QA and QB have nothing to do with the temperature. Therefore, equation (A) can be simplified into equation (B), a more frequently used equation:

$$V = \alpha\, (T_2 - T_1) \qquad \text{(B)}$$

There are two types of thermocouple thermocouples, wrapped thermocouple thermocouples and bare thermocouples. The wrapped thermocouple is wrapped with a layer of metal as protection. The wrapped thermocouple is used for measuring temperature of a liquid and the bare thermocouple is for measuring gas temperatures. Different thermocouples sense different temperature ranges and have different output signals, . The maximum temperature varies with different materials and wires of different diameters.

3.1.5.2 Introduction

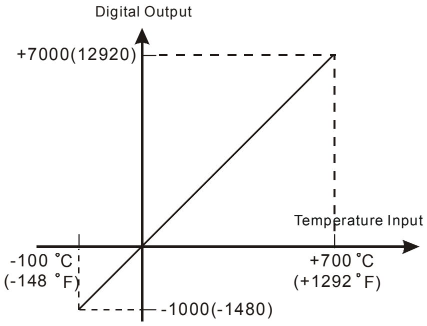
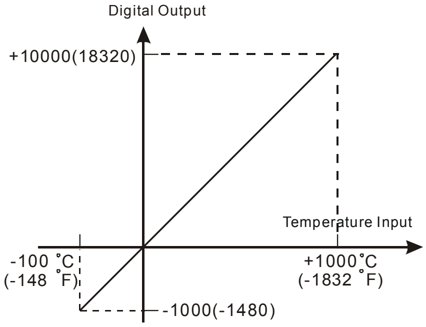
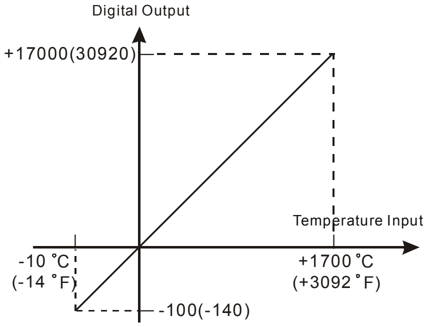
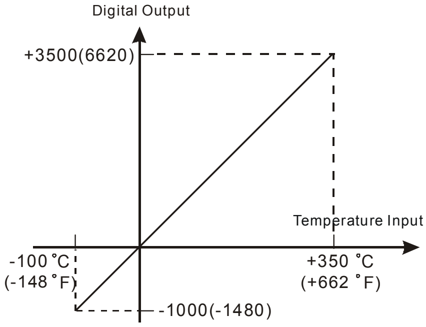
The ELC-TC04ANNN allows the connection of four thermocouple sensors (Type J.K.R.S.T). There are 49 Controlled Registers in each module (each register is 16 bits). This module (ELC-TC04ANNN) can read/write configuration and operational data via the FROM / TO instructions in the ELC program.

The ELC-TC04ANNN supplies both Centigrade and Fahrenheit temperatures The input resolution for Centigrade is 0.1 degrees and for Fahrenheit is 0.1 degrees.

3.1.5.3 Specifications

- **Functions Specification**

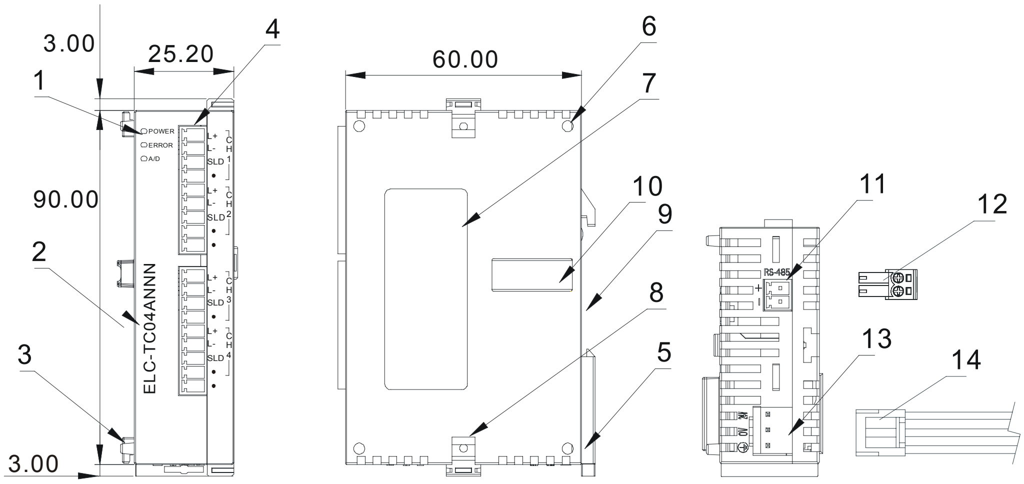
Temperature Measurement Module	Celsius (°C)	Fahrenheit (°F)
Power supply voltage	24V DC (20.4V DC ~ 28.8V DC) (-15% ~ +20%)	
Analog input channel	4 channels/module	
Applicable sensor types	J-type, K-type, R-type, S-type, T-type Floating thermocouple	
Range of input temperature	J-type: -100°C ~ 700°C K-type: -100°C ~ 1000°C R-type: -10°C ~ 1,700°C S-type: -10°C ~ 1,700°C T-type: -100°C ~ 350°C	J-type: -148°F ~ 1,292°F K-type: -148°F ~ 1,832°F R-type: -14°F ~ 3,092°F S-type: -14°F ~ 3,092°F T-type: -148°F ~ 662°F
Range of digital conversion	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 (0.1°F)
Overall accuracy	±0.5% when in full scale (25°C, 77°F) ±1% when in full scale within the range of 0 ~ 55°C (32 ~ 131°F)	
Response time	200ms × the number of channels	
Isolation method	Opto isolation between digital area and analog area. 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	
Digital data format	13 significant bits out of 16 bits are available; in 2's complement	
Average function	Yes; available for setting up in CR#2 ~ CR#5; range: K1 ~ K100	
Self-diagnosis	Upper and lower bound detection/channel	
Communication mode (RS-485)	ASCII/RTU mode. Communication speed: 4,800/9,600/19,200/38,400/57,600/115,200 bps. ASCII data format: 7-bit, Even parity, 1 stop bit (7, E, 1), RTU data format: 8-bit, Even parity, 1 stop bit (8, E, 1). RS-485 cannot be used when connected to an ELC controller.	
When connected to ELC MPU in series	The modules are numbered from 0 to 7 based on their position from with repect to the controller. 0 is the closest to the controller and 7 is the furthest. MaximumA maximum of 8 special modules are allowed per controller.	

Temperature/digital curve(Centigrade/Fahrenheit)	Temperature mode: °C J-type thermocouple  K-type thermocouple 
	Temperature mode: °F R/S-type thermocouple  T-type thermocouple 

■ Electrical Specifications

Max. rated power consumption	24 VDC(20.4VDC~28.8VDC) (–15%～+20%), 1.2W, 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 the wires connecting to the 24V and 0V terminals
Vibration/Shock Immunity	International Standard Regulations: IEC61131-2, IEC 68-2-6 (TEST Fc)/ IEC61131-2 & IEC 68-2-27 (TEST Ea)
Operation/storage temperature	Operation: 0°C~55°C (temp.), 50~95% (humidity), Pollution degree2 Storage: -25°C~70°C (temp.), 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

3.1.5.4 Product Profile and Outline



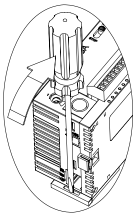
Units: mm

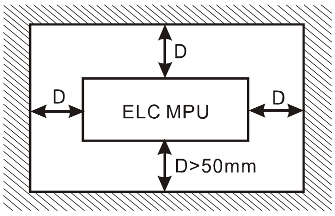
1. Status indicator (Power, ERROR and A/D)	2. Model Name
3. Extension unit clip	4. I/O terminals
5. DIN rail clip	6. Mounting hole of the extension unit
7. Nameplate	8. Extension hook
9. DIN rail mounting slot (35mm)	10. Extension port
11. RS-485 Communication port	12. 2 pin removable terminal (standard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

3.1.5.5 Installation and Wiring

- **Installation of the DIN rail**

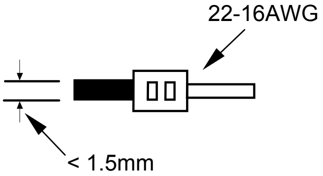
1. The ELC may be secured to a cabinet by using 35mm in height and 7.5mm in depth DIN rail. When mounting the ELC to 35mm DIN rail, be sure to use the retaining clip to stop any side-to-side movement of the ELC and reduce the chance of wires coming loose. The retaining clip is at the bottom of the ELC. To secure the ELC to DIN rail, pull down the clip, place it onto the rail and push it up to lock it in place. To remove the ELC, pull the retaining clip down with a flat screwdriver and remove the ELC from DIN rail.
2. Install the ELC in an enclosure with sufficient space around it to allow heat dissipation, as shown in the figure below.



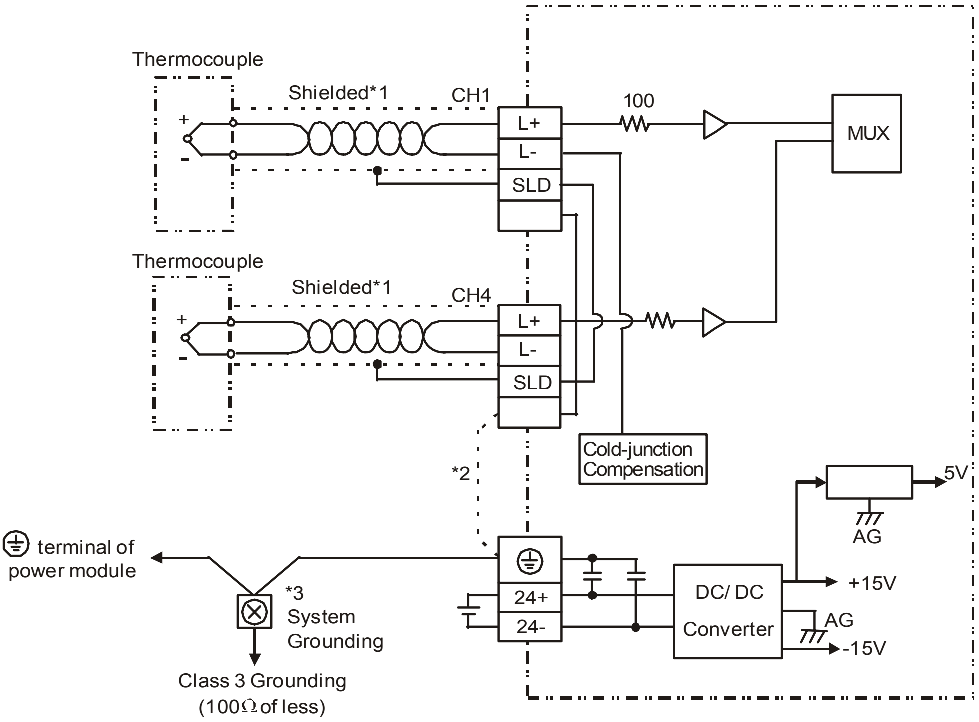


■ \Wiring

1. Use 22-16 AWG (1.5mm) single-core wire or the multi-core wire for the I/O wiring. The specification of the terminal is shown in the figure below on the right hand side. The ELC terminal screws should be tightened to 1.95 kg-cm (1.7 in-lbs). Also, use 60/75°C copper conductor only.
2. I I/O signal wires and power supply wires should not run through the same multi-wire cable or conduit.



■ External Wiring



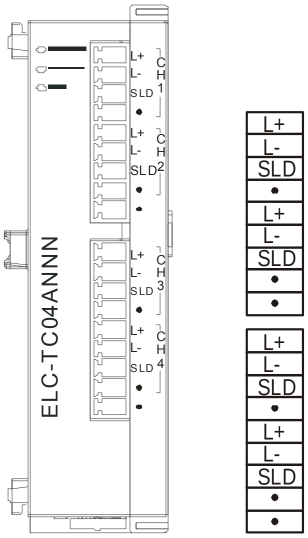
Note 1: Use only the wires that are supplied with your thermocouple sensor. ELC terminal screws should be tightened to 1.95 kg-cm (1.7 lb-in).

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.

3.1.5.6 Terminal Layout



3.1.5.7 CR (Control Registers)

<table>
<tr><th colspan="5">ELC-TC04ANNN</th><th colspan="16">EXPLANATION</th></tr>
<tr><th rowspan="2">CR No</th><th rowspan="2">Param. Comm. Add.</th><th colspan="2" rowspan="2">Latched</th><th rowspan="2">Register Name</th><th colspan="16">bit</th></tr>
<tr><th>15</th><th>14</th><th>13</th><th>12</th><th>11</th><th>10</th><th>9</th><th>8</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td>#0</td><td>H’4096</td><td>O</td><td>R</td><td>Module type</td><td colspan="16">System used, data length is 8bits (b7~b0).
ELC-TC04ANNN module code = H’8B</td></tr>
<tr><td rowspan="2">#1</td><td rowspan="2">H’4097</td><td rowspan="2">O</td><td rowspan="2">R/W</td><td rowspan="2">Thermocouple type</td><td colspan="4">Reserved</td><td colspan="3">CH4</td><td colspan="3">CH3</td><td colspan="3">CH2</td><td colspan="3">CH1</td></tr>
<tr><td colspan="16">Example: Configuring 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.</td></tr>
<tr><td>#2</td><td>H’4098</td><td>O</td><td>R/W</td><td>CH1 average number of samples</td><td colspan="16" rowspan="4">The number of samples used for “average” temperature on channels CH1~CH4.
Range is K1~K100 and factory setting is K10.</td></tr>
<tr><td>#3</td><td>H’4099</td><td>O</td><td>R/W</td><td>CH2 average number of samples</td></tr>
<tr><td>#4</td><td>H’409A</td><td>O</td><td>R/W</td><td>CH3 average number of samples</td></tr>
<tr><td>#5</td><td>H’409B</td><td>O</td><td>R/W</td><td>CH4 average number of samples</td></tr>
<tr><td>#6</td><td>H’409C</td><td>X</td><td>R</td><td>CH1 average degrees (°C)</td><td colspan="16" rowspan="4">Average degrees for channels CH1~CH4.
(unit: 0.1 degrees C)</td></tr>
<tr><td>#7</td><td>H’409D</td><td>X</td><td>R</td><td>CH2 average degrees (°C)</td></tr>
<tr><td>#8</td><td>H’409E</td><td>X</td><td>R</td><td>CH3 average degrees (°C)</td></tr>
<tr><td>#9</td><td>H’409F</td><td>X</td><td>R</td><td>CH4 average degrees (°C)</td></tr>
</table>

<table>
<tr><th colspan="5">ELC-TC04ANNN</th><th colspan="16">EXPLANATION</th></tr>
<tr><th rowspan="2">CR No</th><th rowspan="2">Param. Comm. Add.</th><th colspan="2" rowspan="2">Latched</th><th rowspan="2">Register Name</th><th colspan="16">bit</th></tr>
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<tr><td>#10</td><td>H’40A0</td><td>X</td><td>R</td><td>CH1 average degrees (°F)</td><td colspan="16" rowspan="4">Average degrees for channels CH1~CH4.
(unit: 0.1 degrees F)</td></tr>
<tr><td>#11</td><td>H’40A1</td><td>X</td><td>R</td><td>CH2 average degrees (°F)</td></tr>
<tr><td>#12</td><td>H’40A2</td><td>X</td><td>R</td><td>CH3 average degrees (°F)</td></tr>
<tr><td>#13</td><td>H’40A3</td><td>X</td><td>R</td><td>CH4 average degrees (°F)</td></tr>
<tr><td>#14</td><td>H’40A4</td><td>X</td><td>R</td><td>Present temp. of CH1 (°C)</td><td colspan="16" rowspan="4">Present temperature for channels CH1~CH4.
(unit: 0.1 degrees C)</td></tr>
<tr><td>#15</td><td>H’40A5</td><td>X</td><td>R</td><td>Present temp. of CH2 (°C)</td></tr>
<tr><td>#16</td><td>H’40A6</td><td>X</td><td>R</td><td>Present temp. of CH3 (°C)</td></tr>
<tr><td>#17</td><td>H’40A7</td><td>X</td><td>R</td><td>Present temp. of CH4 (°C)</td></tr>
<tr><td>#19</td><td>H’40A9</td><td>X</td><td>R</td><td>Present temp. of CH1 (°F)</td><td colspan="16" rowspan="4">Present temperature for channels CH1~CH4.
(unit: 0.1degrees F)</td></tr>
<tr><td>#20</td><td>H’40AA</td><td>X</td><td>R</td><td>Present temp. of CH2 (°F)</td></tr>
<tr><td>#21</td><td>H’40BB</td><td>X</td><td>R</td><td>Present temp. of CH3 (°F)</td></tr>
<tr><td>#22</td><td>H’40BC</td><td>X</td><td>R</td><td>Present temp. of CH4 (°F)</td></tr>
<tr><td>#24</td><td>H’40AE</td><td>O</td><td>R/W</td><td>CH1 OFFSET Value</td><td colspan="16" rowspan="4">Adjust offset value of channels CH1~CH4. The range is -1,000~+1,000 and factory setting is K0.
(unit: 0.1 degrees C)</td></tr>
<tr><td>#25</td><td>H’40AF</td><td>O</td><td>R/W</td><td>CH2 OFFSET Value</td></tr>
<tr><td>#26</td><td>H’40B0</td><td>O</td><td>R/W</td><td>CH3 OFFSET Value</td></tr>
<tr><td>#27</td><td>H’40B1</td><td>O</td><td>R/W</td><td>CH4 OFFSET Value</td></tr>
<tr><td>#30</td><td>H’40B4</td><td>X</td><td>R</td><td>Error status</td><td colspan="16">Data register stores the error status; refer to fault code chart for details.</td></tr>
<tr><td>#31</td><td>H’40B5</td><td>O</td><td>R/W</td><td>Communication address setting</td><td colspan="16">RS-485 communication address.
Setting range is 01~255 and factory setting is K1</td></tr>
<tr><td>#32</td><td>H’40B6</td><td>O</td><td>R/W</td><td>Communication baud rate setting</td><td colspan="16">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 byte and high byte of CRC code (only for RTU mode)
b15: RTU mode.</td></tr>
</table>

<table>
<tr><th colspan="5">ELC-TC04ANNN</th><th colspan="16">EXPLANATION</th></tr>
<tr><th rowspan="2">CR No</th><th rowspan="2">Param. Comm. Add.</th><th rowspan="2" colspan="2">Latched</th><th rowspan="2">Register Name</th><th colspan="16">bit</th></tr>
<tr><th>15</th><th>14</th><th>13</th><th>12</th><th>11</th><th>10</th><th>9</th><th>8</th><th>7</th><th>6</th><th>5</th><th>4</th><th>3</th><th>2</th><th>1</th><th>0</th></tr>
<tr><td rowspan="2">#33</td><td rowspan="2">H’4085</td><td rowspan="2">O</td><td rowspan="2">R/W</td><td rowspan="2">Reset to factory defaults</td><td colspan="4">Def. of ERR LED</td><td colspan="3">CH4</td><td colspan="3">CH3</td><td colspan="3">CH2</td><td colspan="3">CH1</td></tr>
<tr><td colspan="16">Example: Setting for 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.</td></tr>
<tr><td>#34</td><td>H’40B8</td><td>O</td><td>R</td><td>System version</td><td colspan="16">Display software version in hexadecimal.
Example: H’010A = version 1.0A.</td></tr>
<tr><td colspan="4">#35~#48</td><td colspan="17">System used</td></tr>
<tr><td colspan="21">O means latched. X means not latched. (available when using RS-485 communications, not available when connected to a controller)
R means can read data by using FROM command or RS-485.
W means can write data by using TO command or RS-485.</td></tr>
</table>

■ Description of CR Values

CR#0: Module Type

1. ELC-TC04ANNN model code = H’008A.
2. Read the module code in the program to verify the correct extension module

CR#1: Thermocouple type

1. The thermocouple type for each channel is selected with this configuration word. There are 5 types (J-type, K-type, R-type, S-type and T-type) for each channel which can be configured separately. Default = H’0000.
2. Example CH1:

   When (b2, b1, b0) is set as (0,0,0), choose J-type
   When (b2, b1, b0) is set as (0,0,1), choose K-type
   When (b2, b1, b0) is set as (0,1,0), choose R-type
   When (b2, b1, b0) is set as (0,1,1), choose S-type
   When (b2, b1, b0) is set as (1,0,0), choose T-type

3. When CH1 is configured for J-type (b2 ~ b0 = 000), CH2 as K-type (b5 ~ b3 = 001), CH3 as R-type (b8 ~ b6 = 010) and CH4 as S-type (b11 ~ b9 = 011), the value of CR#1 is H'0688. The higher bits (b12 ~ b15) are reserved.

CR#2, 3, 4, 5: Number of samples for average values for CH1 ~ CH4

1. The number of samples used to average the temperature measured at CH1 ~ CH4.
2. Range of ELC-TC04ANNN: K1 ~ K100. Default = K10.

CR#6, 7, 8, 9: Average Celsius temperature from CH1 ~ CH4

1. The average Celsius temperature from CH1 ~ CH4 obtained from the number of samples set in CR#2 ~ CR#5. Unit: 0.1°C.
2. For example, if the number of samples is set as 10, the contents in CR#6 ~ CR#9 will be the average of the most recent 10 temperature signals in Celsius at CH1 ~ CH4.

CR#10, 11, 12, 13: Average Fahrenheit temperature from CH1 ~ CH4

1. The average Fahrenheit temperature measured at CH1 ~ CH4 obtained from the number of samples set in CR#2 ~ CR#5. Unit: 0.1°F.
2. For example, if the number of samples is set as 10, the contents in CR#10 ~ CR#13 will be the average of the most recent 10 temperature signals in Fahrenheit at CH1 ~ CH4.

CR#14, 15, 16, 17: Present Celsius temperature measured at CH1 ~ CH4

The present temperature in Celsius at CH1 ~ CH4. Unit: 0.1°C.

CR#19, 20, 21, 22: Present Fahrenheit temperature measured at CH1 ~ CH4

The present temperature in Fahrenheit at CH1 ~ CH4. Unit: 0.1°F..

CR#24, 25, 26, 27: OFFSET value of CH1 ~ CH4.

Adjustable OFFSET settings for CH1 ~ CH4. Range: -1,000 ~ +1,000. Default = K0. Unit: 0.1°C

CR#30: Data register for storing all errors

CR#30: error status value. See the table below:

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

Fault description	Content	b15~b8	b7	b6	b5	b4	b3	b2	b1	b0
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 a corresponding bit (b0~b7). Two or more faults may happen at the same time. 0 means normal and 1 means having fault.										

CR#31: RS-485 communication address setting

The RS-485 communication address. Range: 01 ~ 255. Default = K1. This setting is only valid for RS-485 communications and will be invalid when connected to an ELC controller.

CR#32: Communication speed (baud rate) setting

The RS-485 communication speed: 4,800, 9,600, 19,200, 38,400, 57,600 and 115,200bps (bits per second). Default = H'0002.

b0 = 1: 4,800 bps

b1 = 1: 9,600 bps (default)

b2 = 1: 19,200 bps

b3 = 1: 38,400 bps

b4 = 1: 57,600 bps

b5 = 1: 115,200 bps

b6 ~ b13: Reserved

b14: High/low byte exchange of CRC checksum (only valid in RTU mode)

b15: Switch between ASCII/RTU mode. 0: ASCII (default); 1: RTU. ASCII data format: 7-bit, Even parity, 1 stop bit (7, E, 1); RTU data format: 8-bit, Even parity, 1 stop bit (8, E, 1). This setting is only valid for RS-485 communication and will be invalid when connected to an ELC controller.

CR#33: Returning to default settings; definition of ERR LED

Default = H'F000. Example CH1: b0 and b1 are reserved. When b2 is set as 1, all the settings will return to default settings except for CR#31 and CR#32.

Definition of ERR LED:

1. b12 corresponds to CH1. When b12 = 1 or the scale exceeds the range, ERR LED will flash.
2. b13 corresponds to CH2. When b13 = 1 or the scale exceeds the range, ERR LED will flash.
3. b14 corresponds to CH3. When b14 = 1 or the scale exceeds the range, ERR LED will flash.
4. b15 corresponds to CH4. When b15 = 1 or the scale exceeds the range, ERR LED will flash.

CR#34: Firmware version

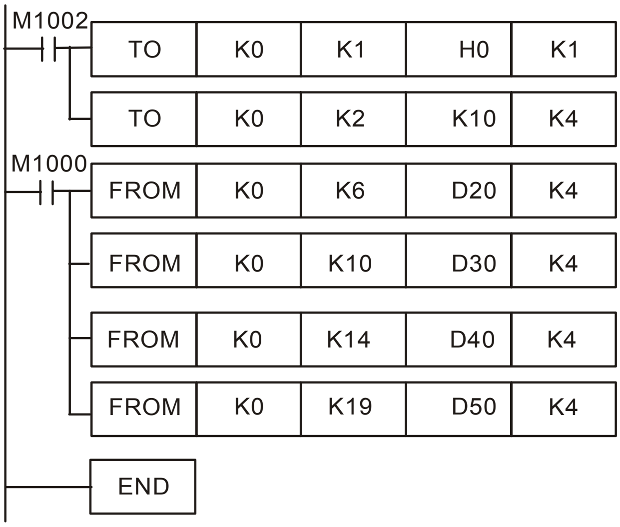
Displaying the current firmware version in hex, e.g. version V1.00 is indicated as H'0100.

3.1.5.8 Application Example

■ Thermocouple Temperature Measurement System

1. Description
   - Measuring temperature with thermocouple temperature sensor.
2. Addresses
   - D20 ~ D23: average Celsius temperature at CH1 ~ CH4
   - D30 ~ D33: average Fahrenheit temperature at CH1 ~ CH4
   - D40 ~ D43: present Celsius temperature at CH1 ~ CH4
   - D50 ~ D53: present Fahrenheit temperature at CH1 ~ CH4
3. Program description
   - When the ELC goes from STOP to RUN, set the number of samples for the average temperatures for CH1 ~ CH4 to 10.
   - Store the average Celsius temperature at CH1 ~ CH4 into D20 ~ D23.
   - Store the average Fahrenheit temperature at CH1 ~ CH4 into D30 ~ D33.
   - Store the present Celsius temperature at CH1 ~ CH4 into D40 ~ D43.
   - Store the present Fahrenheit temperature at CH1 ~ CH4 into D50 ~ D53.
4. Program example

Ladder diagram:



Explanation:

Set the thermocouple for CH1 ~ CH4 to J-type

Set the average time for CH1 ~ CH4 to 10

Read average Celsius degrees from CH1 ~ CH4

Read average Fahrenheit degrees from CH1 ~ CH4

Read present Celsius temperature from CH1 ~ CH4

Read present Fahrenheit temperature from CH1 ~ CH4

3.2 ELCM Series

3.2.1 ELCM-AN04ANNN

3.2.1.1 The A/D Conversion

In industrial automation, many devices transmit data via analog signals. The most common analog signals are -10 ~ 10V and -20 ~ 20mA. The analog input modules convert these analog signals to digital values for the ELC controller..

For example, the voltage -10 ~ 10V is first converted into values -32,000 ~ +32,000 decimal by an A/D module. The ELC reads/writes to the control registers (CR) in the analog modules with FROM/TO instructions.

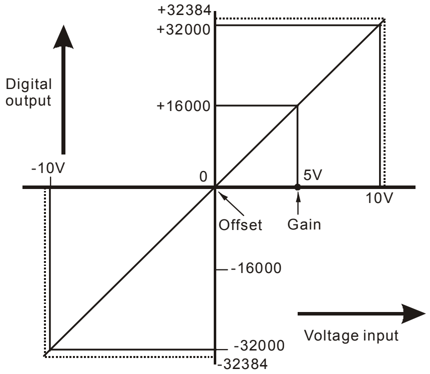
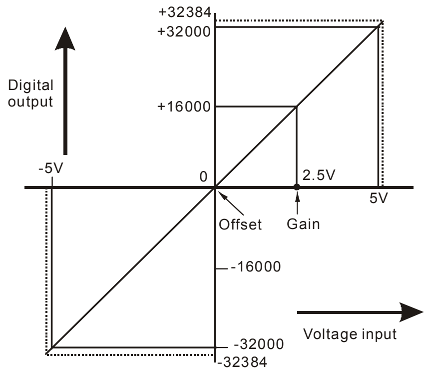
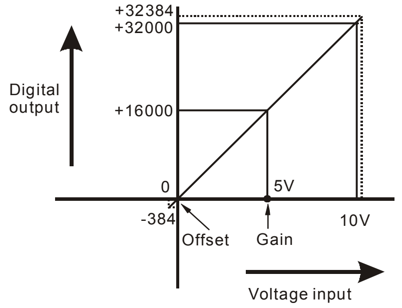
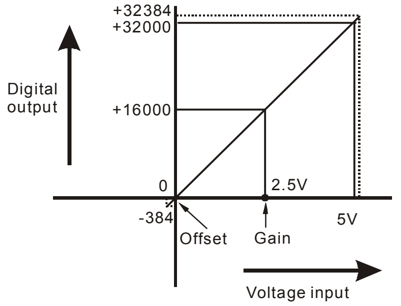
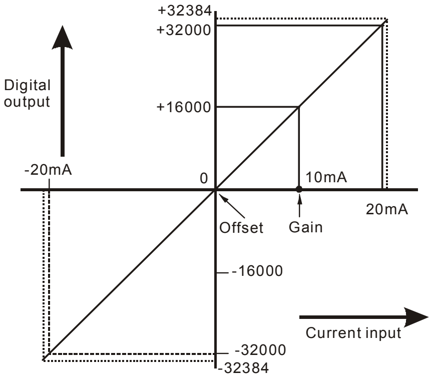
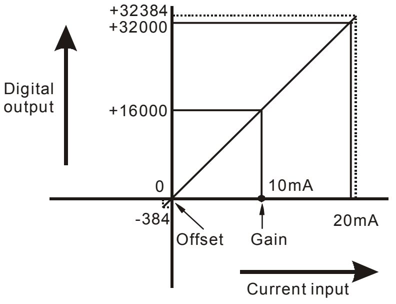
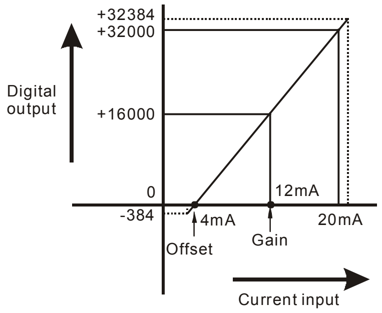
3.2.1.2 Introduction

This analog input module has 4 analog signal inputs (voltage or current) and converts them into 16-bit decimal values with 14 bit resolution. The ELC program reads/writes data to/from the ELC-AN04ANNN analog input module by using the FROM / TO instructions.
(Refer to special registers D9900 ~ D9999).

3.2.1.3 Specifications

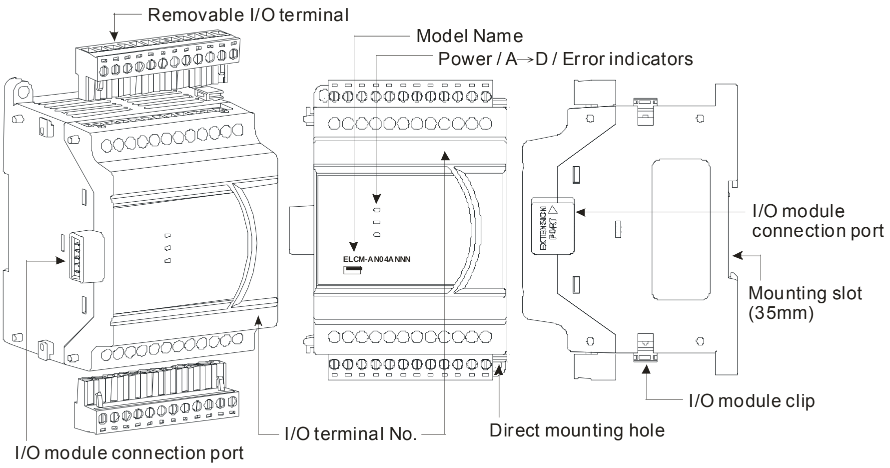
- **Functions Specification**

ELCM-AN04ANNN	Voltage input		Current input		
Power supply voltage	24 VDC (20.4VDC ~ 28.8VDC) (-15% ~ +20%)				
Connector	European standard fixed terminal block (Hole diameter: 5mm)				
Analog input channel	4 channels				
Range of analog input	±10V	±5V	±20mA	0~20mA	4~20mA
Range of digital conversion	±32,000	±32,000	±32,000	0~32,000	0~32,000
Max./Min. output range of digital data	±32,384	±32,384	±32,384	-384~+32,384	-384~+32,384
Resolution	14 bits 20V/64000	14 bits 10V/64000	14 bits 40mA/64000	14 bits 20mA/32000	14 bits 16mA/32000
Input impedance	> 200 KΩ		250Ω		
Overall accuracy	±0.5% when in full scale (25°C, 77°F) ±1% when in full scale within the range of 0 ~ 55°C (32 ~ 131°F)				
Response time	3 ms / all channels				
Isolation	Optical coupler isolation between digital circuits and analog circuits. No isolation among analog channels. 500VDC between digital circuits and Ground 500VDC between analog circuits and Ground 500VDC between analog circuits and digital circuits 500VDC between 24VDC and Ground				
Range of absolute input	±15V		±32mA		
Digital data format	16 significant bits out of 16 bits are available; in 2's complement				

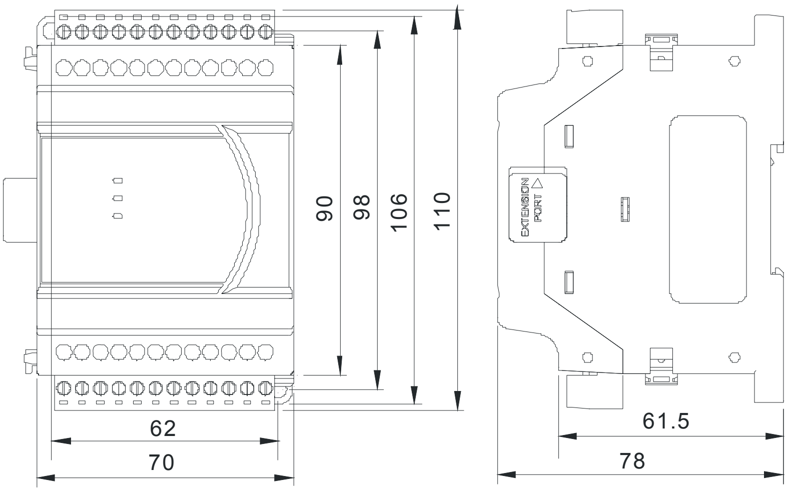
<table>
<tr><td>Average function</td><td colspan="2">Supported. Available for setting up sampling range in CR#8 ~ CR#11. Range: K1 ~ K100.</td></tr>
<tr><td>Self-diagnosis</td><td colspan="2">Upper and lower bound detection in all channels</td></tr>
<tr><td>Series connection to ELCM MPU</td><td colspan="2">The modules are numbered from 0 to 7 distancebased on their position with respect to the controller. Max. 8 modules are allowed per controller</td></tr>
<tr><td rowspan="2">A/D conversion curve (Default: mode 0)</td><td>Mode 0 (H'0000): (-10V ~ +10V)

 </td><td>Mode 1 (H'0001): (-5V ~ +5V)

 </td></tr>
<tr><td>Mode 2 (H'0002): (0V~+10V)

 </td><td>Mode 3 (H'0003): (0V~+5V)

 </td></tr>
<tr><td rowspan="2">A/D conversion curve (Default: mode 0)</td><td>Mode 4 (H'0004): (-20mA~ +20mA)

 </td><td>Mode 5 (H'0005): (0 ~ +20mA)

 </td></tr>
<tr><td>Mode 6 (H'0006): (+4mA ~ +20mA)

 </td><td>Mode -1 (H'FFFF): Channel unavailable. Average value and present value of input channels will be displayed as 32,767(H'7FFF).</td></tr>
</table>

Operation/storage temperature	1. Operation: 0°C ~ 55°C (temperature), 50 ~ 95% (humidity), pollution degree 2 2. Storage: -25°C ~ 70°C (temperature), 5 ~ 95% (humidity)
Vibration/shock immunity	International standards: IEC61131-2, IEC 68-2-6 (TEST Fc)/IEC61131-2 & IEC 68-2-27 (TEST Ea)
Max. rated power consumption	24VDC (20.4VDC ~ 28.8VDC) (-15% ~ +20%), 1W, supplied by external power source
Weight	174g

3.2.1.4 Product Profile and Outline



- **External Dimensions**



Units: mm

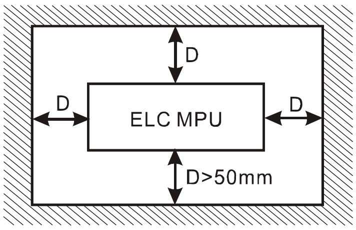
3.2.1.5 Installation and Wiring

- **Installation of the DIN rail**

1. The ELC may be secured to a cabinet by using 35mm in height and 7.5mm in depth DIN rail. When mounting the ELC to 35mm DIN rail, be sure to use the retaining clip to stop any side-to-side movement of the ELC and reduce the chance of wires coming loose. The retaining clip is at the bottom of the ELC. To

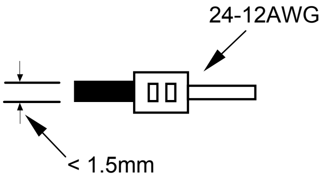
secure the ELC to DIN rail, pull down the clip, place it onto the rail and push it up to lock it in place. To remove the ELC, pull the retaining clip down with a flat screwdriver and remove the ELC from DIN rail.

2. Install the ELC in an enclosure with sufficient space around it to allow heat dissipation, as shown in the figure below..



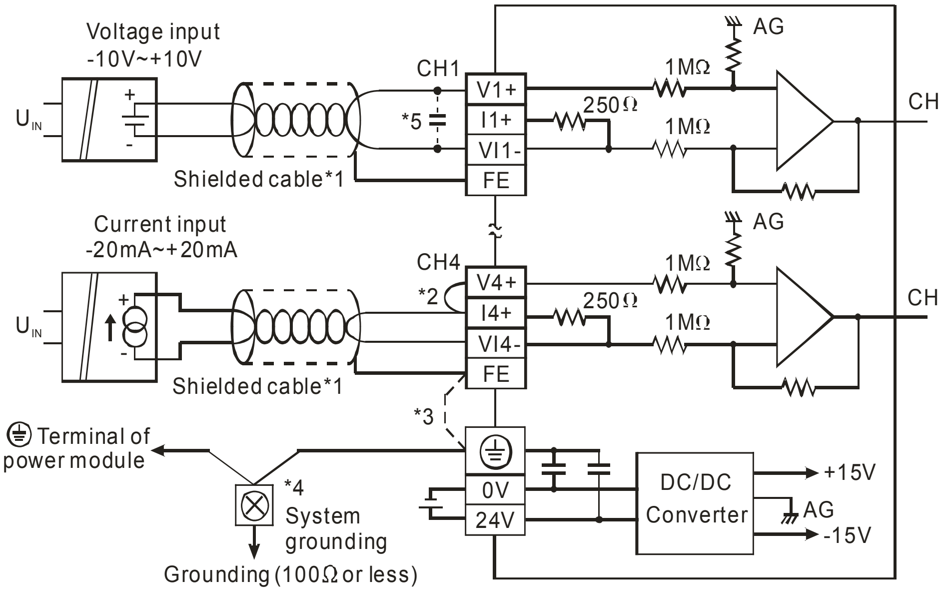
- **Wiring**

1. Use 22-16 AWG (1.5mm) single-core wire or the multi-core wire for the I/O wiring. The specification of the terminal is shown in the figure below on the right hand side. The ELC terminal screws should be tightened to 1.95 kg-cm (1.7 in-lbs). Also, use 60/75°C copper conductor only.
2. DO NOT wire empty terminals. DO NOT place the signal wires and power wires in the same wiring circuit.
3. DO NOT drop metallic conductors into the ELC during installation.
    - Attach the dustproof sticker to the ELC before installation to prevent conductive objects from dropping in.
    - Tear off the sticker before running the ELC to ensure normal heat dissipation.

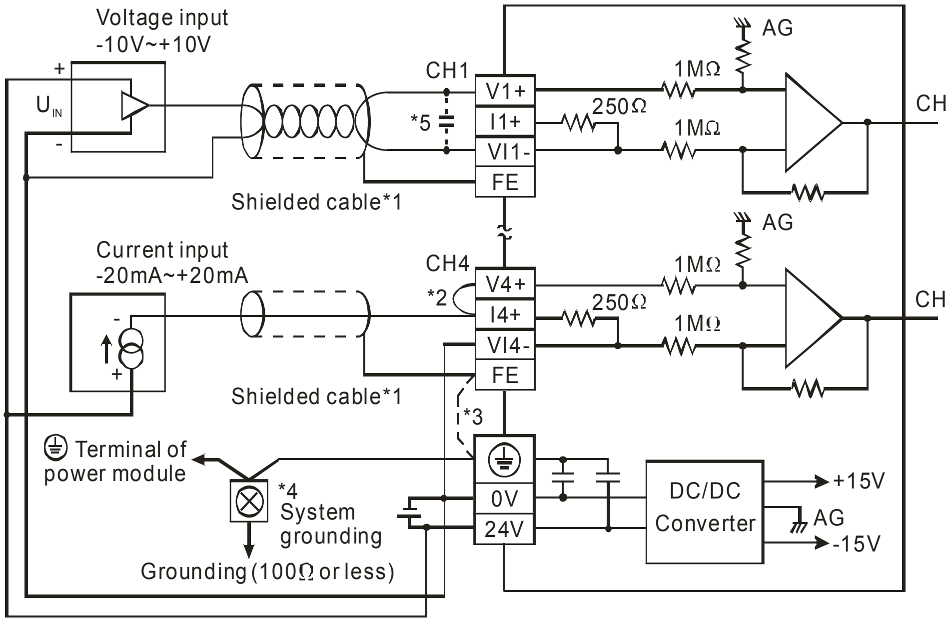


External Wiring

1. Active-type



2. Passive-type



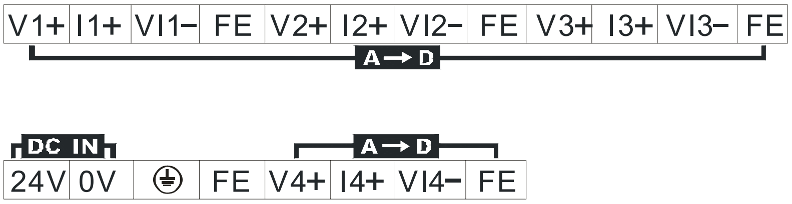
Note 1: When analog current signals are used, be sure to jumper the “V+” and “I+” terminals.

Note 2: If electrical noise issues occur, connect FE to the grounding terminal.

Note 3: Connect the ⏚ terminal on both the power supply and analog module to the system earth ground.

Note 4: If electrical noise at the input terminals is significant, connect the following capacitor: 0.1 ~ 0.47μF 25V.

3.2.1.6 Terminal Layout



3.2.1.7 CR (Control Register)

CR#	Attrib.		Register name	Explanation
#0	O	R	Module type	ELCM-AN04ANNN module code = H'0080
#1	O	R	Firmware version	Display the current firmware version in hex.
#2	O	R/W	CH1 input mode setting	Input mode: Default = H'0000. CH1 example: Mode 0 (H'0000): Voltage input (±10V) Mode 1 (H'0001): Voltage input (±5V) Mode 2 (H'0002): Voltage input (0 ~ +10V) Mode 3 (H'0003): Voltage input (0 ~ +5V) Mode 4 (H'0004): Current input (±20mA) Mode 5 (H'0005): Current input (0 ~ +20mA) Mode 6 (H'0006): Current input (+4~ +20mA) Mode -1 (H'FFFF): Channel 1 unavailable
#3	O	R/W	CH2 input mode setting	
#4	O	R/W	CH3 input mode setting	
#5	O	R/W	CH4 input mode setting	
#8	O	R/W	CH1 number of samples	Set the number of samples for CH1 ~ CH4: Range = K1 ~ K100 Default = K10
#9	O	R/W	CH2 number of samples	
#10	O	R/W	CH3 number of samples	
#11	O	R/W	CH4 number of samples	
#12	X	R	CH1 average input value	Average value of input signals at CH1 ~ CH4
#13	X	R	CH2 average input value	
#14	X	R	CH3 average input value	
#15	X	R	CH4 average input value	
#20	X	R	CH1 present input value	Present value of input signals at CH1 ~ CH4
#21	X	R	CH2 present input value	
#22	X	R	CH3 present input value	
#23	X	R	CH4 present input value	
#28	O	R/W	Adjusted Offset value of CH1	Set the adjusted Offset value of CH1 ~ CH4. Default = K0 Definition of Offset in ELCM-AN04ANNN: The corresponding voltage (current) input value when the digital input value = 0.
#29	O	R/W	Adjusted Offset value of CH2	
#30	O	R/W	Adjusted Offset value of CH3	
#31	O	R/W	Adjusted Offset value of CH4	
#34	O	R/W	Adjusted Gain value of CH1	Set the adjusted Gain value in CH1 ~ CH4. Default = K16,000 Definition of Gain in ELCM-AN04ANNN: The corresponding voltage (current) input value when the digital input value = 16,000.
#35	O	R/W	Adjusted Gain value of CH2	
#36	O	R/W	Adjusted Gain value of CH3	
#37	O	R/W	Adjusted Gain value of CH4	

CR#	Attrib.		Register name	Explanation
#40	O	R/W	Function: Prohibited changing values	Prohibit modifying the Gain and Offset values for CH1~CH4. Default= H’0000.
#41	X	R/W	Function: Save all configuration values	Save all the configuration values, Default =H’0000
#42	X	R/W	Function: Return to default settings	Set all values to default settings, Default = H’0000
#43	X	R	Error status	Register for storing all error status. Refer to table of error status for more information.
#100	O	R/W	Function: Enable/Disable limit detection	Enable/Disable the upper and lower limit detection function. Default= H’0000.
#101	X	R/W	Upper and lower bound status	Display the upper and lower limit values, Default =H’0000
#102	O	R/W	Set value of CH1 upper bound	Set the CH1~CH4 upper limits. Default = K32000.
#103	O	R/W	Set value of CH2 upper bound	
#104	O	R/W	Set value of CH3 upper bound	
#105	O	R/W	Set value of CH4 upper bound	
#108	O	R/W	Set value of CH1 lower bound	Set theCH1~CH4 lower limits. Default = K-32000.
#109	O	R/W	Set value of CH2 lower bound	
#110	O	R/W	Set value of CH3 lower bound	
#111	O	R/W	Set value of CH4 lower bound	

O: When CR#41 is set to H’5678, the set value of CR will be saved.
X: set value will not be saved.
R: able to read data by using FROM instruction.
W: able to write data by using TO instruction.

■ Explanation on CR

CR#0: Module type

1. ELCM-AN04ANNN module code = H’0080
2. Read the module code in the program to verify the correct extension module.

CR#1: Firmware version

Display the current firmware version in hex, e.g. version V1.00 is indicated as H’0100.

CR#2, 3, 4, 5: Configuration words for CH1~CH2

Configure the four analog input channels. There are 8 modes for each channel which can be configured separately.

When CH1 is configured for mode 1 (H’0001) CR#2 must be set as H’0001. The default setting = H’0000. CH1 example:

Mode 0 (H’0000): Voltage input (-10V ~ +10V).

Mode 1 (H’0001): Voltage input (-5V ~ +5V).

Mode 2 (H’0002): Voltage input (0V ~ +10V).

Mode 3 (H’0003): Voltage input (0V ~ +5V).

Mode 4 (H’0004): Current input (-20mA ~ +20mA).

Mode 5 (H’0005): Current input (0mA ~ +20mA).

Mode -1 (H’FFFF): Channel 1 unavailable.

CR#8, 9, 10, 11: Number of samples used for the average input values for CH1 ~ CH4

1. The number of samples for the average input values for CH1 ~ CH4.
2. Range: K1 ~ K100. Default = K10. If the value exceeds K100, the value will be set to K100; if the set value is lower than K1, it will be set to K1.

CR#12, 13, 14, 15: Average input values for CH1 ~ CH4

The average input values from CH1 ~ CH4 are calculated using the number of samples for each channel set in CR#8 ~ CR#11. For example, if the values in CR#8 ~ CR#11 are K20, the contents in CR#12 ~ CR#15 will be the average of the most recent 20 signals in CH1 ~ CH4.

CR#20, 21, 22, 23: Present input value at CH1 ~ CH4

Display the present value of input signals in CH1 ~ CH4.

CR#28, 29, 30, 31: Adjusted Offset value of CH1 ~ CH4

1. Set the adjustable Offset value for CH1 ~ CH4, which represents the corresponding voltage (current) input value when the digital intput value = 0
2. Default setting = K0.

CR#34, 35, 36, 37: Adjusted Gain value of CH1 ~ CH4

1. Set the adjusted Gain value of CH1 ~ CH4, which represents the corresponding voltage (current) input value when the digital input value = 16,000.
2. Default setting = K16,000.

CR#40: Function: Prohibit changing configuration values, Default = H’0000

Description	
bit0	b0=0, CH1 changing allowed; b0=1, CH1 changing prohibited
bit1	b1=0, CH2 changing allowed; b1=1, CH2 changing prohibited
bit2	b2=0, CH3 changing allowed; b2=1, CH3 changing prohibited
bit3	b3=0, CH4 changing allowed; b3=1, CH4 changing prohibited
bit4 ~ bit15	Reserved

Parameters prohibited or allowed by b0~b3 above	
CR#2 ~ CR#5	Input mode setting for CH1 ~ CH4
CR#8 ~ CR#11	Number of samples for CH1 ~ CH4
CR#28 ~ CR#31	Adjusted Offset values for CH1 ~ CH4
CR#34 ~ CR#37	Adjusted Gain values for CH1 ~ CH4
CR#42	Return to default settings
CR#100	Function: Enable/Disable limit detection
CR#102~CR#105	Set value of CH1~CH4 upper limit
CR#108~CR#111	Set value of CH1~CH4 lower limit

CR#41: Function: Save all configuration values. Default=H0000

Save configuration settings. Save all the configuration values to internal flash memory. When saving is completed, CR#41 will be set to H’FFFF.

Set value	Function
H0	No action
HFFFF	Saving complete
H5678	Saving enabled.

Note: Default setting = H0. When set value = H’5678, saving will be enabled, and CR#41 will be set to H’FFFF when saving is complete.

CR#42: Function: Return to factory default settings. Default=H0000

Description	
bit0	b0=0, no action on CH1; b0=1, set CH1 to default settings
bit1	b1=0, no action on CH2; b1=1, set CH2 to default settings
bit2	b2=0, no action on CH3; b2=1, set CH3 to default settings
bit3	b3=0, no action on CH4; b3=1, set CH4 to default settings
bit4 ~ bit15	Reserved

Note: Set designated bit to 1 and the corresponding channel will be returned to default settings. When this process is complete, the value will be set to 0 again. If CR#40 is enabled, this operation will not execute and. Error Code bit 12 of CR#43 will be set to 1.

Relative Parameters	
CR#2 ~ CR#5	Input mode setting of CH1 ~ CH4
CR#8 ~ CR#11	Sampling range of CH1 ~ CH4
CR#28 ~ CR#31	Adjusted Offset value of CH1 ~ CH4
CR#34 ~ CR#37	Adjusted Gain value of CH1 ~ CH4
CR#100	Function: Enable/Disable limit detection

Relative Parameters	
CR#102~CR#105	Set value of CH1~CH4 upper bound
CR#108~CR#111	Set value of CH1~CH4 lower bound

CR#43: Error status. Default=H’0000

CR#43: error status value. See the table below:

Description					
bit0	K1 (H’1)	Power supply error	bit6	K64 (H’40)	CH4 Conversion
bit1	K2 (H’2)	Hardware error	bit9	K512(H’0200)	Configuration error
bit2	K4 (H’4)	Upper/lower limit error	bit10	K1024(H’0400)	Sampling range error
bit3	K8 (H’8)	CH1 Conversion error	bit11	K2048(H’0800)	Upper / lower limit error
bit4	K16 (H’10)	CH2 Conversion error	bit12	K4096(H’1000)	changing configuration values prohibited
bit5	K32 (H’20)	CH3 Conversion error	bit13	K8192(H’2000)	Communication breakdown on next module

✐Note: Each error status is determined by the corresponding bit (b0 ~ b13) and there may be more than 2 errors occurring at the same time. 0 = normal; 1 = error

CR#100: Function: Enable/Disable limit detection

Description	
bit0=1	Enable CH1 limit detection
bit1=1	Enable CH2 limit detection
bit2=1	Enable CH3 limit detection
bit3=1	Enable CH4 limit detection
bit4 ~ bit15	Reserved

CR#101: Upper and lower limit status

Description	
bit0=1	CH1 exceeds lower limit
bit1=1	CH2 exceeds lower limit
bit2=1	CH3 exceeds lower limit
bit3=1	CH4 exceeds lower limit
bit4 ~ bit7	Reserved
bit8=1	CH1 exceeds upper limit

Description	
bit9=1	CH2 exceeds upper limit
bit10=1	CH3 exceeds upper limit
bit11=1	CH4 exceeds upper limit
bit12 ~ bit15	Reserved

CR#102, 103, 104, 105: Set value of CH1 ~ CH4 upper limit

Set the upper limit value of CH1 ~ CH4. Default = K32,000

CR#108, 109, 110, 111: Set value of CH1 ~ CH4 lower limit

Set the lower limit value of CH1 ~ CH4. Default = K-32,000

3.2.1.8 Description of special registers D9900~D9999

When the ELCM controller is connected to extension modules, registers D9900~D9999 will be reserved for storing values from those modules. Use the MOV instruction read/write values in D9900~D9999.

When the ELCM controller is connected to an ELCM-AN04ANNN, the configuration of special registers is per the following:

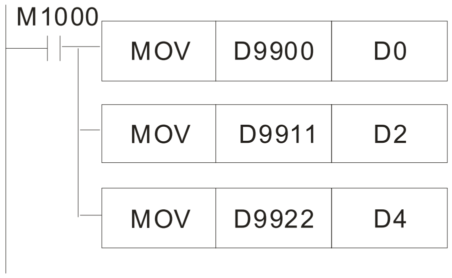
Module0	Module1	Module2	Module3	Module4	Module5	Module6	Module7	Description
D1320	D1321	D1322	D1323	D1324	D1325	D1326	D1327	Model code
D9900	D9910	D9920	D9930	D9940	D9950	D9960	D9970	CH1 average input value
D9901	D9911	D9921	D9931	D9941	D9951	D9961	D9971	CH2 average input value
D9902	D9912	D9922	D9932	D9942	D9952	D9962	D9972	CH3 average input value
D9903	D9913	D9923	D9933	D9943	D9953	D9963	D9973	CH4 average input value

1. D9900~D9999 are average input values for CH1 ~ CH4 and the number of samples is K1~K100. When the number of samples is set to K1, the values displayed in D9900~D9999 are current values. Use: 1. ELCM_AIO Configuration Function in ELCSoft or 2. FROM/TO instructions (CR#8~CR#11) to set the sampling range to K1.

2. Example:

Ladder diagram:

Explanation:



Save CH1 average input value of Module#0 to D0

Save CH2 average input value of Module#1 to D2

Save CH3 average input value of Module#2 to D4

3.2.1.9 A/D Conversion Curve

Adjust the conversion curves according to the application requirements by changing the Offset values (CR#28 ~ CR#31) and Gain values (CR#34 ~ CR#37).

Gain: The corresponding voltage/current input value when the digital output value = 16,000.

Offset: The corresponding voltage/current input value when the digital output value = 0.

- For voltage input Mode0/Mode2: 0.3125mV = 20V/64,000 = 10V/32,000

  Equation:

  $$Y = \frac{16000 \times \left(\frac{X(V)}{10(V)} \times 32000 - Offset \right)}{(Gain - Offset)}$$

  Y=Digital output, X=Voltage input

- For voltage input Mode1/Mode3: 0.15625mV = 10V/64,000 = 5V/32,000

  Equation:

  $$Y = \frac{16000 \times \left(\frac{X(V)}{5(V)} \times 32000 - Offset \right)}{(Gain - Offset)}$$

  Y=Digital output, X=Voltage input

- For current input Mode4/Mode5: 0.625μA = 40mA/64,000 = 20mA/32,000

  Equation:

$$Y = 16000 \times \left(\frac{X\,(mA)}{20(mA)} \times 32000 - Offset \right) \Big/ (Gain - Offset)$$

  Y=Digital output, X= Current input

- For current input Mode6: 0.5μA = 16mA/32,000

  Use the Equation for current input Mode4/Mode5, substitute Gain for 19200 (12mA) and Offset for 6400 (4mA)

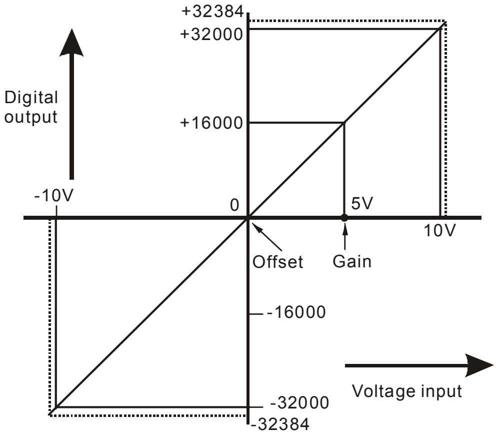
  Equation:

$$Y = 16000 \times \left(\frac{X\,(mA)}{20(mA)} \times 32000 - 6400 \right) \Big/ (19200 - 6400)$$

  Y=Digital output, X= Current input

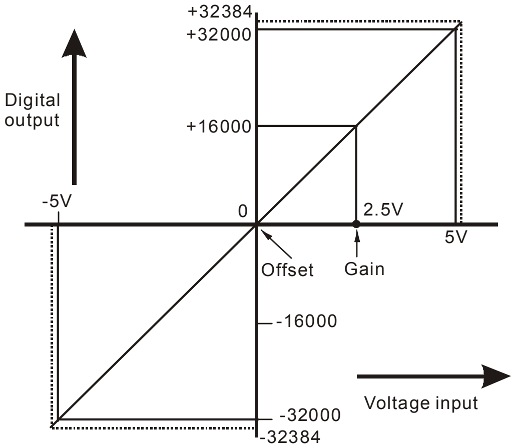
■ Voltage Input Mode

- Mode 0 (H'0000): (-10V ~ +10V)



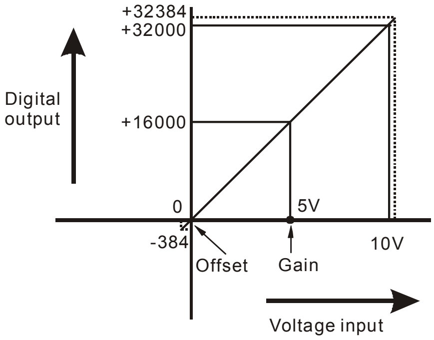
Mode 0 of CR#2~ CR#5	-10V ~ +10V, Gain = 5V (16,000), Offset = 0V (0).
Gain (CR#28 ~ CR#31)	The corresponding voltage input value when the digital output value = 16,000.
Offset (CR#34 ~ CR#37)	The corresponding voltage input value when the digital output value = 0.
Range of digital conversion	-32,000 ~ +32,000
Max./Min. output range of digital data	-32,384 ~ +32,384

- Mode 1 (H'0001): (-5V ~ +5V)



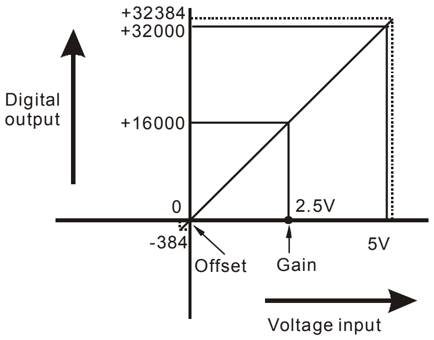
Mode 1 of CR#2~ CR#5	-5V ~ +5V, Gain = 2.5V (16,000), Offset = 0V (0).
Gain (CR#28 ~ CR#31)	The corresponding voltage input value when the digital output value = 16,000.
Offset (CR#34 ~ CR#37)	The corresponding voltage input value when the digital output value = 0.
Range of digital conversion	-32,000 ~ +32,000
Max./Min. output range of digital data	-32,384 ~ +32,384

- Mode 2 (H'0002): (0V~+10V)



Mode 2 of CR#2~ CR#5	0V ~ +10V, Gain = 5V (16,000), Offset = 0V (0).
Gain (CR#28 ~ CR#31)	The corresponding voltage input value when the digital output value = 16,000.
Offset (CR#34 ~ CR#37)	The corresponding voltage input value when the digital output value = 0.
Range of digital conversion	0 ~ 32,000
Max./Min. output range of digital data	-384 ~ +32,384

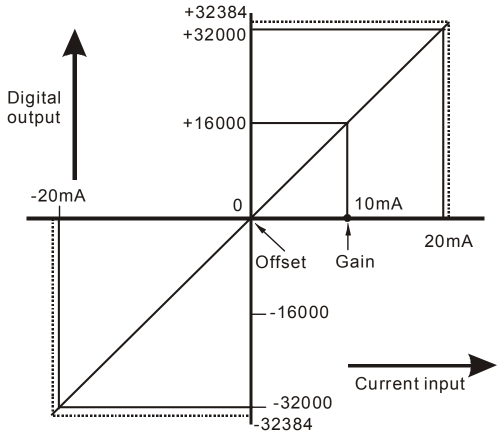
- Mode 3 (H'0003): (0V~+5V)



Mode 3 of CR#2~ CR#5	0V ~ +5V, Gain = 2.5V (16,000), Offset = 0V (0).
Gain (CR#28 ~ CR#31)	The corresponding voltage input value when the digital output value = 16,000.
Offset (CR#34 ~ CR#37)	The corresponding voltage input value when the digital output value = 0.
Range of digital conversion	0 ~ 32,000
Max./Min. output range of digital data	-384 ~ +32,384

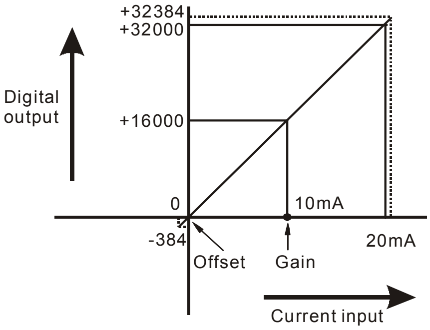
Current Input Mode:

- Mode 4 (H'0004): (-20mA~ +20mA)



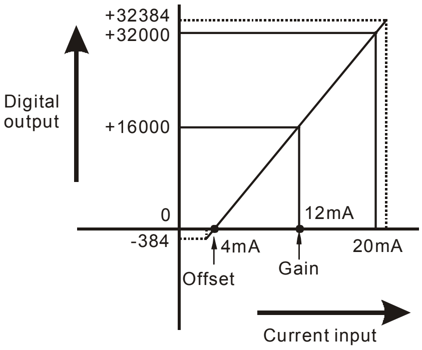
Mode 4 of CR#2~ CR#5	-20mA ~ +20mA, Gain = 10mA (16,000), Offset = 0mA (0).
Gain (CR#28 ~ CR#31)	The corresponding current input value when the digital output value = 16,000.
Offset (CR#34 ~ CR#37)	The corresponding current input value when the digital output value = 0.
Range of digital conversion	-32,000 ~ +32,000
Max./Min. output range of digital data	-32,384 ~ +32,384

- Mode 5 (H'0005): (0 ~ +20mA)



Mode 5 of CR#2~ CR#5	0mA ~ +20mA, Gain = 10mA (16,000), Offset = 0mA (0).
Gain (CR#28 ~ CR#31)	The corresponding current input value when the digital output value = 16,000.
Offset (CR#34 ~ CR#37)	The corresponding current input value when the digital output value = 0.
Range of digital conversion	0 ~ 32,000
Max./Min. output range of digital data	-384 ~ +32,384

- Mode 6 (H'0006): (+4mA ~ +20mA)



Mode 6 of CR#2~ CR#5	+4mA ~ +20mA, Gain = 12mA (19,200), Offset = 4mA (6,400).
Gain (CR#28 ~ CR#31)	The corresponding current input value when the digital output value = 16,000.
Offset (CR#34 ~ CR#37)	The corresponding current input value when the digital output value = 0.
Range of digital conversion	0 ~ 32,000
Max./Min. output range of digital data	-384 ~ +32,384

■ Adjusting A/D Conversion Curve in Voltage Input Mode 0 & Mode2

1. Description
   - CH1 example, when CR#2 is set to voltage input mode (mode 0), the Offset value will be set to 0V (0) and the Gain value to 5V (5V/0.3215mV=16,000), i.e. input voltage -10V ~ +10V will correspond to values -32,000 ~ +32,000.
   - When CR#2 is set to voltage input mode (mode 2), the Offset value will be set to 0V (0) and the Gain value to 5V (5V/0.3215mV=16,000), i.e. input voltage 0V ~ +10V will correspond to values 0 ~ +32,000.
   - If for any reason the default voltage input modes (mode 0 or mode 2), cannot be used, make adjustments to the A/D conversion curve according to the application requirements. For example, set the Offset of CH1 to 2V (2V/0.3215mV=6,400) and the Gain to 6V (6V/0.3215mV=19,200).

$$Y = \left. 16000\times\left(\frac{X(V)}{10(V)}\times 32000-Offset\right) \middle/ \left(Gain-Offset\right) \right.$$

Example: If X=6V, Y=?

$$Y = \left. 16000\times\left(\frac{6(V)}{10(V)}\times 32000-6400\right) \middle/ \left(19200-6400\right) \right. = 16000$$

   - The A/D conversion curve needs to be set up only one time. Then set CR#40 to prohibit further changes.

2. Addresses
   - X0 = On: Set the input mode of the signals in CH1 to mode 0.
   - X1 = On: Set Offset value of CH1 to 2V (6,400) and the Gain value to 6V (19,200).
   - M0 = On: Prohibit changes to the configuration for CH1.

3. Program description
   - When X0 = On, set CR#2 to K0 (H'0000) - mode 0 (voltage input mode).
   - When X1 = On, write K6,400 (Offset value for CH1) into CR#28 and K19,200 (Gain value for CH1) into CR#34.
   - When X1 goes from On to Off, set M0 = On to disable modifying the A/D conversion curve. Write K1 (H'1) into CR#40 b0=1 to disable CH1 configuration changes.

4. Program example

Ladder diagram:

Explanation:

Set CH1 to mode 0 (voltage input mode)

Set the Offset value for CH1

Set the Gain value for CH1

Prohibit changing CH1 configuration parameters

■ Adjusting A/D Conversion Curve in Voltage Input Mode 1 & Mode 3

1. Description
   - CH2 example, when CR#3 is set to voltage input mode (mode 1), the Offset value will be set to 0V (0) and the Gain value to 2.5V (2.5V/0.15625mV=16,000), i.e. input voltage -5V ~ +5V will correspond to values -32,000 ~ +32,000.
   - When CR#3 is set to voltage input mode (mode 3), the Offset value will be set to 0V (0) and the Gain value to 2.5V (2.5V/0.15625mV=16,000), i.e. input voltage 0V ~ +5V will correspond to values 0 ~ +32,000.
   - If the default voltage input mode (mode 1 and mode 3) does not meet the application requirements, adjustments can be made to the A/D conversion curve. For example, set the Offset for CH2 to 1V (1V/0.15625mV=6,400) and the Gain to 3V (3V/0.15625mV=19,200).

$$Y = {16000 \times \left(\frac{X(V)}{5(V)} \times 32000 - Offset \right)} \Big/ {(Gain - Offset)}$$

Example: If X=3V, Y=?

$$Y = {16000 \times \left(\frac{3(V)}{5(V)} \times 32000 - 6400 \right)} \Big/ {(19200 - 6400)} = 16000$$

   - The A/D conversion curve needs to be set up only one time. Then set CR#40 to prohibit further changes.

2. Addresses
   - X0 = On: Set the input mode for CH2 to mode 1.
   - X1 = On: Set the Offset value for CH2 to 1V (6,400) and the Gain value to 3V

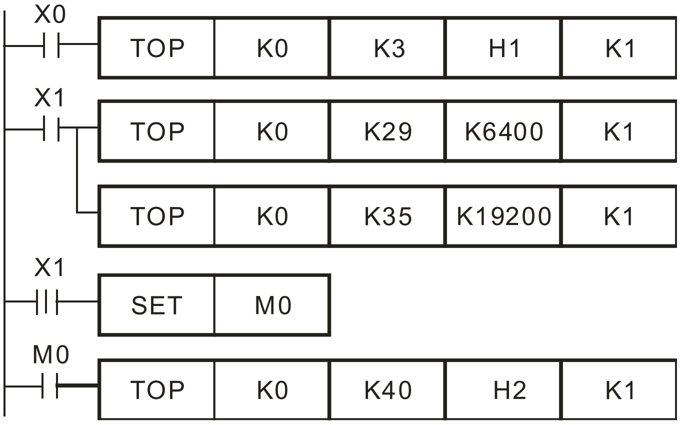
(19,200).

- M0 = On: Disable changing configuration parameters for CH2.

3. Program description
   - When X0 = On, write K1 (H'0001) to CR#3, which sets CH2 to mode 1 (voltage input mode).
   - When X1 = On, write K6,400 (Offset value for CH2) into CR#29 and K19,200 (Gain value of CH2) into CR#35.
   - When X1 goes from On to Off, set M0 = On to disable modifications to the A/D conversion curve. Write K2 (H'2) into CR#40 b1=1 to disable CH2 configuration changes.
4. Program example

Ladder diagram:

Explanation:



Set CH2 to mode 1 (voltage input mode)

Set the Offset value for CH2

Set the Gain value for CH2

Disable CH2 configuration changes

■ Adjusting A/D Conversion Curve in Current Input Mode 4, Mode 5 and Mode 6

1. Description
   - CH3 example. When CR#4 is set to current input mode (mode 4), the Offset value will be set to 0mA (0) and the Gain value to 10mA (10mA/0.625μA=16,000), i.e. input current -20mA ~ +20mA will correspond to values -32,000 ~ +32,000.
   - When CR#4 is set to current input mode (mode 5), the Offset value will be set to 0mA (0) and the Gain value to 10mA (10mA/0.625μA=16,000), i.e. input current 0mA ~ +20mA will correspond to values 0 ~ +32,000.
   - When CR#4 is set to current input mode (mode 6), the Offset value will be set to 4mA (4mA/0.625μA=6,400) and the Gain value to 12mA (12mA/0.625μA=19,200), i.e. input current 4mA ~ +20mA will correspond to values 0 ~ +32,000.
   - If the default current input mode (mode 4 ~ mode 6) does not meet the application requirements, make adjustments to the A/D conversion curve. For example, set the Offset for CH3 to 8mA (8mA/0.625μA=12,800) and the Gain to 14mA

(14mA/0.625μA=22,400).

$$Y = 16000 \times \left(\frac{X\,(mA)}{20(mA)} \times 32000 - Offset \right) \Big/ \left(Gain - Offset \right)$$

Example: If X=14mA, Y=?

$$Y = 16000 \times \left(\frac{14(mA)}{20(mA)} \times 32000 - 12800 \right) \Big/ \left(22400 - 12800 \right) = 16000$$

- The A/D conversion curve needs to be set up only one time. Then set CR#40 to prohibit further changes

2. Addresses

   X0 = On: Set the input mode of the signals in CH3 to mode 4.

   X1 = On: Set the Offset value for CH3 to 8mA (12,800) and the Gain value to 14mA (22,400).

   M0 = On: Disable CH3 configuration changes.

3. Program description
   - When X0 = On, set CR#4 to K4 (H'4) and the signal input mode in CH3 to mode 4 (current input mode).
   - When X1 = On, write K12,800 (Offset value for CH3) into CR#30 and K22,400 (Gain value for CH3) into CR#36.
   - When X1 goes from On to Off, set M0 = On to disable modifications to the A/D conversion curve. Write K4 (H'4) into CR#40 to disable CH3 configuration changes.

4. Program example

   Ladder Diagram:

   Explanation:

Set CH3 to mode 4 (current input mode)

Set the Offset value for CH3

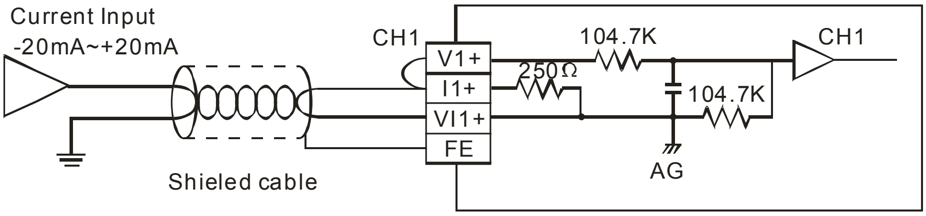
Set the Gain value for CH3

Disable CH3 configuration changes

3.2.1.10 Application

- **Measuring Current**

1. Description
   - Assume the ELC is to convert a current (-20mA ~ 20mA) analog signal into digital signals then display the current value in D0.
   - Configure the analog input channels to mode 4, i.e. the current input mode (-20mA ~ +20mA).
2. Addresses
   - D40: average value of the input signals
   - D50: present value of the input signal
   - D0: actual value of the present measured current
3. Wiring
   - Connect the current signal to be measured to CH1 of ELCM-AN04ANNN and jumper V+ and I+ (as shown below).



4. Program description
   - When the ELC goes from STOP to RUN, set CH1 to current input mode 4 (-20mA ~ +20mA) (CR#2), and set the number of samples for CH1 to 10 (CR#8).
   - Save the average value of the input signals into D40 and the present value of the input signals into D50.
   - In the current mode for the ELCM-AN04ANNN, the value range -20mA ~ 20mA corresponds to K-32,000 ~ K32,000. D50 is 1600 times the actual current value (i.e. 32,000/20 = 1,600). Divide the value in D50 by 1,600 and store the value obtained into D0 which will be the actual value of the present measured current.

5. Program example

Ladder diagram:

Explanation:

Set CH1 to mode 4 (current input mode)

Set the sampling range of CH1 to 10

Store the average value of CH1 input signals into D40

Store the present value of CH1 input signal into D50

D50/1600 = D0 (the actual value of the present measured current in CH1)

3.2.2 ELCM-AN02NANN / ELCM-AN04NANN

3.2.2.1 The D/A Conversion

In industrial automation, many control signals are analog signals. The most frequently used analog signals are voltage -10V ~ 10V and current 0 ~ 20mA. Data in ELC controllers can be converted into analog signals for controlling analog devices via analog output modules like the ELCM-AN02NANN and the ELCM-AN04NANN.

For example, the data range -32,000 ~ 32,000 in the ELC controller is converted into -10V ~ 10V by one of these analog output modules. The output voltage can therefore be used to control any standard analog device.

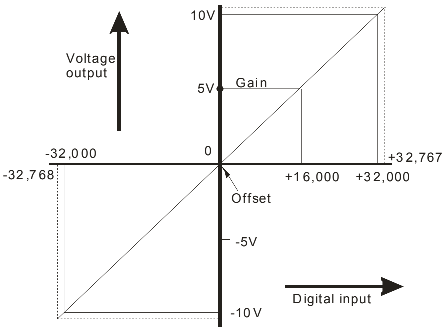
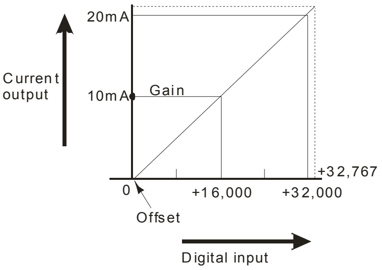
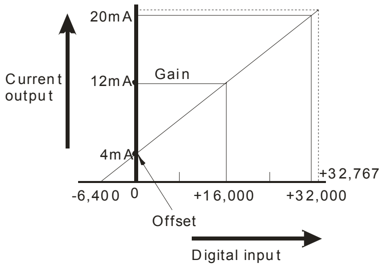
3.2.2.2 Introduction

ELCM-AN02NANN (ELCM-AN04NANN) analog output module receives 2 (4) groups of 16-bit digital data from the ELC and converts the digital data into 2 (4) analog output signals (voltage or current). In addition, all data in the analog modules can be accessed via FROM/TO instructions in the ELC controller program. Or the output values for each channel can be directly accessed by using MOV instructions to/from special registers D9900 ~ D9999 as decribed earlier in this document.

3.2.2.3 Specifications

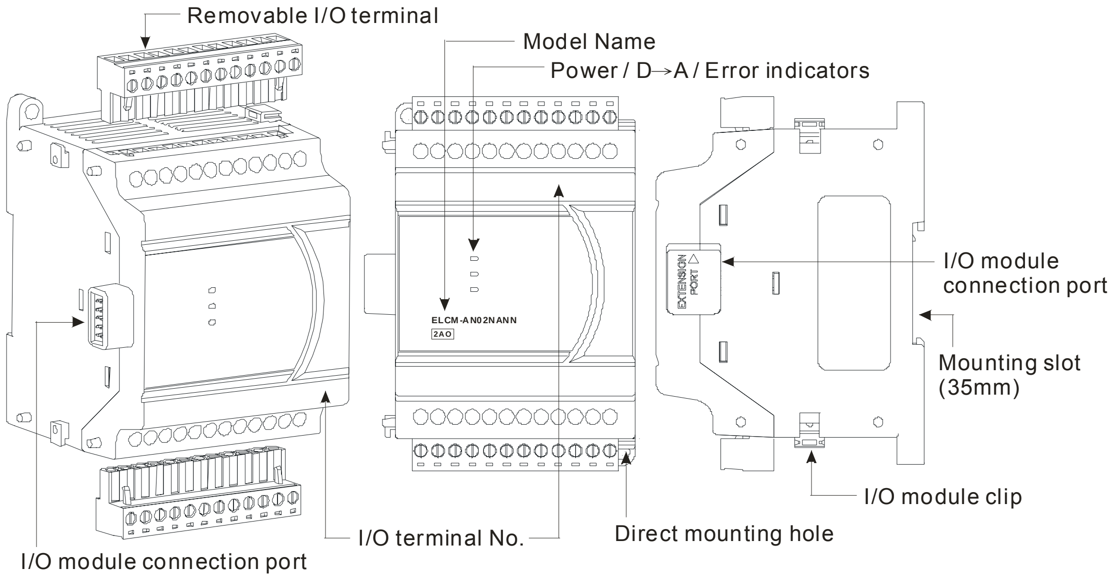
- Functional Specifications

ELCM-AN02NANN ELCM-AN04NANN	Voltage output	Current output	
Power supply voltage	24 V DC (20.4 ~ 28.8V DC) (-15% ~ +20%)		
Connector	European standard fixed terminal block (Hole diameter: 5mm)		
Analog output channel	2 channels or 4 channels		
Range of analog output	-10V ~ 10V	0 ~ 20mA	4mA ~ 20mA

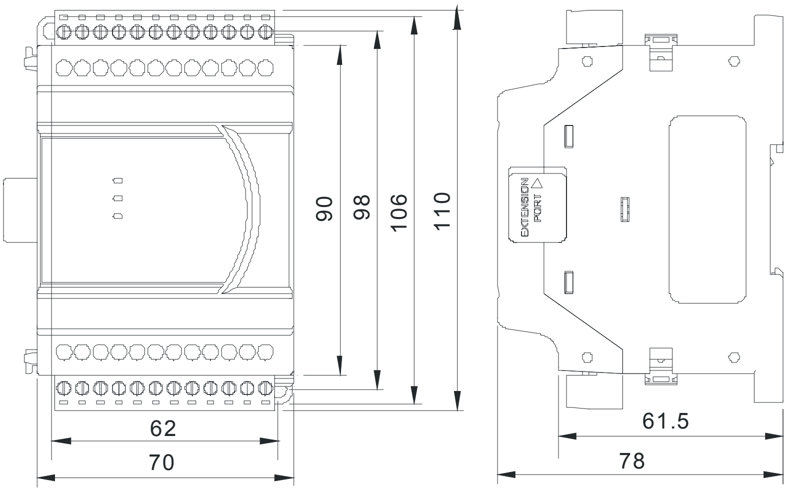
ELCM-AN02NANN ELCM-AN04NANN	Voltage output	Current output	
Range of digital conversion	-32,000 ~ +32,000	0 ~ +32,000	0 ~ +32,000
Max./Min. input range of digital data	-32,768 ~ +32,767	0 ~ +32,767	-6,400 ~ +32,767
Resolution	14 bits 20V/64000	14 bits 20mA/32000	14 bits 16mA/32000
Output impedance	0.5Ω or less		
Overall accuracy	±0.5% when in full scale (25°C, 77°F); ±1% when in full scale within the range of (0 ~ 55°C, 32 ~ 131°F)		
Response time	3 ms/ all channels		
Max. output current	20mA (1KΩ ~ 2MΩ)	-	
Tolerance load impedance	-	0 ~ 500Ω	
Digital data format	16 significant bits out of 16 bits are available; in 2's complement		
Isolation	Optical coupler isolation between analog circuits and digital circuits. No isolation among analog channels. 500VDC between digital circuits and Ground 500VDC between analog circuits and Ground 500VDC between analog circuits and digital circuits 500VDC between 24VDC and Ground		
Protection	Voltage output is protected from short circuits. However, short circuit conditions lasting for too long may cause damage to the internal circuits. Current output can be open circuit.		
Series connection to ELCM controllers	The modules are numbered from 0 to 7 based on their position with respect to the controller. Max. 8 modules are allowed per controller		
D/A conversion curve (Default: mode 0)	Mode 0 (H'0000): (-10V ~ +10V) 	Mode 1 (H'0001): (0mA ~ +20mA) 	
	Mode 2 (H'0002): (+4mA ~ +20 mA) 	Mode -1 (H'FFFF): Channel unavailable. The channel is disabled. Output voltage = 0; output current = 0.	
Operation/storage	1. Operation: 0°C ~ 55°C (temperature), 50 ~ 95% (humidity); pollution degree 2 2. Storage: -25°C ~ 70°C (temperature), 5 ~ 95%（humidity）		
Vibration/shock immunity	International standards: IEC61131-2, IEC 68-2-6 (TEST Fc) / IEC61131-2 & IEC 68-2-27 (TEST Ea)		

ELCM-AN02NANN ELCM-AN04NANN	Voltage output	Current output
Max. rated power consumption	24V DC (20.4 ~ 28.8V DC) (-15% ~ +20%), ELCM-AN04NANN :1.5W ELCM-AN04NANN :3W, supplied by external power source.	
Weight	ELCM-AN02NANN:190g, ELCM-AN04NANN:202g	

3.2.2.4 Product Profile and Outline



- **External Dimensions**



Unit: mm

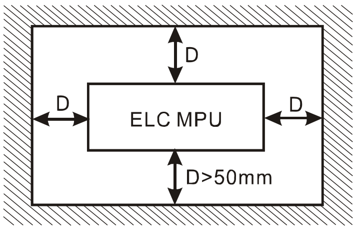
3.2.2.5 Installation and Wiring

- **Installation of the DIN rail**

1. The ELC may be secured to a cabinet by using 35mm in height and 7.5mm in depth DIN rail. When mounting the ELC to 35mm DIN rail, be sure to use the retaining clip to stop any side-to-side movement of the ELC and reduce the

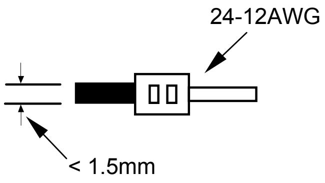
chance of wires coming loose. The retaining clip is at the bottom of the ELC. To secure the ELC to DIN rail, pull down the clip, place it onto the rail and push it up to lock it in place. To remove the ELC, pull the retaining clip down with a flat screwdriver and remove the ELC from DIN rail.

2. Install the ELC in an enclosure with sufficient space around it to allow heat dissipation, as shown in the figure below

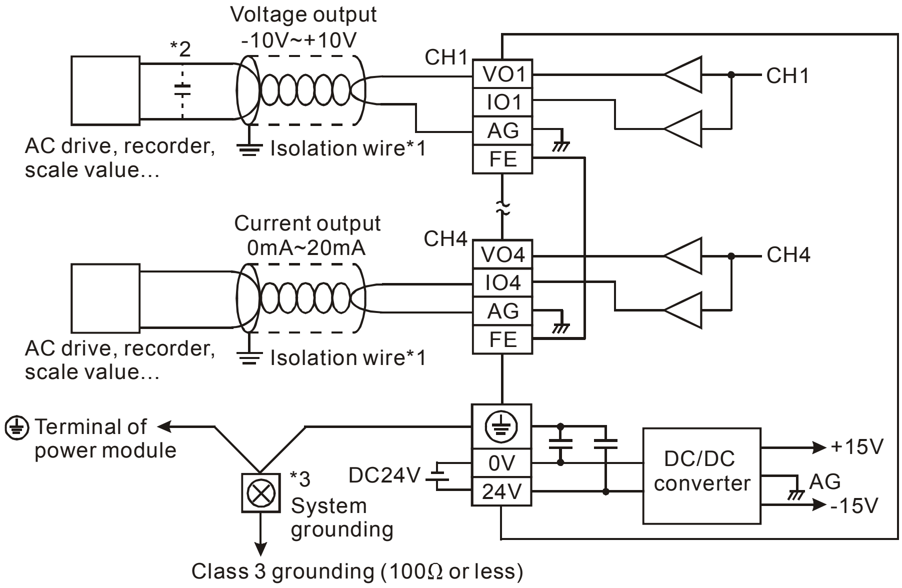


- **Direct Mounting:** Please use M4 screw according to the dimension of the product.
- **Wiring**

1. Use 22-16 AWG (1.5mm) single-core wire or the multi-core wire for the I/O wiring. The specification of the terminal is shown in the figure below on the right hand side. The ELC terminal screws should be tightened to 1.95 kg-cm (1.7 in-lbs). Also, use 60/75°C copper conductor only.
2. DO NOT wire empty terminals. DO NOT place the signal wires and power wires in the same wiring circuit.
3. DO NOT drop metallic conductors into the ELC during installation.
    - Attach the dustproof sticker to the ELC before the installation to prevent conductive objects from dropping in.
    - Tear off the sticker before running the ELC to ensure normal heat dissipation.



- **External Wiring**



Note 1: If electrical noise issues are encountered, connect the following capacitor: 0.1 ~ 0.47μF 25V for noise filtering.

Note 2: Please connect ⏚ power module terminal and ⏚ analog output module terminal to system earth ground.

3.2.2.6 Terminal Layout

- **ELCM-AN02NANN**

24 V	0V	⏚	FE	FE	FE	VO1	IO1	AG	VO2	IO2	AG

- **ELCM-AN042NANN**

VO1	IO1	AG	FE	VO2	IO2	AG	FE	VO3	IO3	AG	FE

24 V	0V	⏚	FE	VO4	IO4	AG	FE

3.2.2.7 CR (Control Registers)

CR#	Attrib.		Register name	Explanation
#0	O	R	Module type	Set up by the system, module code: ELCM-AN02NANN = H'0041; ELCM-AN02NANN = H'0081
#1	O	R	Firmware version	Display the current firmware version in hex.
#2	O	R/W	CH1 output mode setting	Output mode: Default = H'0000. CH1 example: Mode 0 (H'0000): Voltage output (±10V) Mode 1 (H'0001): Current output (0~+20mA)
#3	O	R/W	CH2 output mode setting	
#4	O	R/W	CH3 output mode setting	

CR#	Attrib.		Register name	Explanation
#5	O	R/W	CH4 output mode setting	Mode 2 (H'0002): Current output (+4~+20mA) Mode -1 (H'FFFF): All channels are unavailable
#16	X	R/W	CH1 output signal value	Voltage output range: K-32,000~K32,000. Current output range: K0~K32,000. Default: K0. CR#18~CR#19 of ELCM-AN02NANN are reserved.
#17	X	R/W	CH2 output signal value	
#18	X	R/W	CH3 output signal value	
#19	X	R/W	CH4 output signal value	
#28	O	R/W	Adjusted Offset value of CH1	Set the adjusted Offset value of CH1 ~ CH4. Default = K0 Definition of Offset: The corresponding voltage (current) input value when the digital output value = 0
#29	O	R/W	Adjusted Offset value of CH2	
#30	O	R/W	Adjusted Offset value of CH3	
#31	O	R/W	Adjusted Offset value of CH4	
#34	O	R/W	Adjusted Gain value of CH1	Set the adjusted Gain value of CH1 ~ CH4. Default = K16,000. Definition of Gain: The corresponding voltage (current) input value when the digital output value = 16,000
#35	O	R/W	Adjusted Gain value of CH2	
#36	O	R/W	Adjusted Gain value of CH3	
#37	O	R/W	Adjusted Gain value of CH4	
#40	O	R/W	Function: Set value changing prohibited	Prohibit configuration changes for CH1 ~ CH4. Default= H'0000.
#41	X	R/W	Function: Save all the set values	Save all configuration values. Default =H'0000.
#42	X	R/W	Function: Return to default setting	Set all values to default settings. Default = H'0000
#43	X	R	Error status	Register for storing all error status. Refer to table of error status for more information.
#100	O	R/W	Function: Enable/Disable limit detection	Enable/Disable the upper and lower limits detection function. Default= H'0000.
#101	X	R/W	Upper and lower limit status	Display the upper and lower limit value. Default =H'0000.
#102	O	R/W	Set value of CH1 upper limit	Set value of CH1~CH3 upper limit. Default = K32000.
#103	O	R/W	Set value of CH2 upper limit	
#104	O	R/W	Set value of CH3 upper limit	
#105	O	R/W	Set value of CH4 upper limit	
#108	O	R/W	Set value of CH1 lower limit	Set value of CH1~CH4 lower limit. Default = K-32000.
#109	O	R/W	Set value of CH2 lower limit	
#110	O	R/W	Set value of CH3 lower limit	
#111	O	R/W	Set value of CH4 lower limit	
#114	O	R/W	Output update time of CH1	Set value of CH1~CH4 lower limit. Default =H'0000.
#115	O	R/W	Output update time of CH2	
#116	O	R/W	Output update time of CH3	
#117	O	R/W	Output update time of CH4	
#118	O	R/W	LV output mode setting	Set the output mode of CH1~CH4 when the power is at LV (low voltage) condition. Default= H'0000.

O: When CR#41 is set to H'5678, the configuration values will be saved.
X: set value will not be saved.
R: able to read data by using FROM instruction.
W: able to write data by using TO instruction.

- **Description of CR values**

CR#0: Module Type

1. ELCM-AN02NANN module code = H’0041
2. ELCM-AN04NANN module code = H’0081
3. Read the module code in the program to verify the correct extension module

CR#1: Firmware version

Display the current firmware version in hex, e.g. version V1.00 is indicated as H’0100.

CR#2, 3, 4, 5: CH1 ~ CH4 configuration

Set the mode for the channels in the analog output modules. There are 4 modes for each channel which can be configured separately.

To set CH1 to mode 1 (H’0001) CR#2 must be set to H’0001. The default setting = H’0000.

CH1 example:

Mode 0 (H’0000): Voltage output (-10V ~ +10V).
Mode 1 (H’0001): Current output (0mA ~ 20mA).
Mode 2 (H’0002): Current output (4mA ~ 20mA).
Mode -1 (H’FFFF): CH1 unavailable.

CR#28, 29, 30, 31: Adjusted Offset value of CH1 ~ CH4

1. Set the adjusted Offset value of CH1 ~ CH4, which represents the corresponding voltage (current) output value when the digital input value = 0
2. Default setting = K0.

CR#34, 35, 36, 37: Adjusted Gain value of CH1 ~ CH4

1. Set the adjusted Gain value of CH1 ~ CH4, which represents the corresponding voltage (current) output value when the digital input value = 16,000.
2. Default setting = K16,000.

CR#40: Function: Prohibit changing configuration values, Default = H’0000

Description	
bit0	b0=0, CH1 changing allowed; b0=1, CH1 changing prohibited
bit1	b1=0, CH2 changing allowed; b1=1, CH2 changing prohibited
bit2	b2=0, CH3 changing allowed; b2=1, CH3 changing prohibited
bit3	b3=0, CH4 changing allowed; b3=1, CH4 changing prohibited
bit4 ~ bit15	Reserved

Configuration parameters affected by CR#40	
CR#2 ~ CR#5	Output mode setting of CH1 ~ CH4
CR#28 ~ CR#31	Adjusted Offset value of CH1 ~ CH4
CR#34 ~ CR#37	Adjusted Gain value of CH1 ~ CH4
CR#42	Return to default setting
CR#100	Function: Enable/Disable limit detection
CR#102~CR#105	Set value of CH1~CH4 upper bound
CR#108~CR#111	Set value of CH1~CH4 lower bound
CR#114~CR#117	Output update time of CH1 ~ CH4
CR#118	LV output mode setting

CR#41: Save all configuration values, Default =H’0000

Save all the configuration values to the internal flash memory. When saving is completed, CR#41 will be set to H’FFFF.

Set value	Function
H0	No action
HFFFF	Saving completed
H5678	Saving enabled.

Note: Default setting = H0. When the CR#41value = H’5678, saving is enabled. CR#41 will be set to H’FFFF when the save process is complete. If the value of CR#41 is not H’5678, it will remain H’0. For example, write K1 into CR#41, and the value will remain H’0.

CR#42: Function: Return to default settings. Default =H’0000

Description	
bit0	b0=0, no action on CH1; b0=1, set CH1 to default setting
bit1	b1=0, no action on CH2; b1=1, set CH2 to default setting
bit2	b2=0, no action on CH3; b2=1, set CH3 to default setting
bit3	b3=0, no action on CH4; b3=1, set CH4 to default setting
bit4 ~ bit15	Reserved

Note: Set the appropriate bit to 1 and the corresponding channel will return to default settings. When complete, the value will be reset to 0. If CR#40 is enabled, CR#42 will be invalid when attempting to reset to defaults, and all configuration values will remain unchanged. Error Code bit 12 of CR#43 will be set to 1.

Affected Parameters	
CR#2 ~ CR#5	Output mode setting of CH1 ~ CH4
CR#28 ~ CR#31	Adjusted Offset value of CH1 ~ CH4

Affected Parameters	
CR#34 ~ CR#37	Adjusted Gain value of CH1 ~ CH4
CR#100	Function: Enable/Disable limit detection
CR#102~CR#105	Set value of CH1~CH4 upper bound
CR#108~CR#111	Set value of CH1~CH4 lower bound
CR#114~CR#117	Output update time of CH1 ~ CH4
CR#118	LV output mode setting

CR#43: Error Status. Default=H'0000

CR#43: Error status value. See the table below:

Description					
bit0	K1 (H'1)	Power supply error	bit11	K2048 (H'0800)	Upper / lower bound setting error
bit1	K2 (H'2)	Hardware error	bit12	K4096 (H'1000)	Set value changing prohibited
bit2	K4 (H'4)	Upper / lower bound error	bit13	K8192 (H'2000)	Communication breakdown on next module
bit9	K512(H'0200)	Mode setting error			
Note: Each error is determined by the corresponding bit (b0 ~ b13) and there may be more than 2 errors occurring at the same time. 0 = normal; 1 = error					

CR#100: Function: Enable/Disable limit detection

Description	
bit0=1	Enable CH1 limit detection
bit1=1	Enable CH2 limit detection
bit2=1	Enable CH3 limit detection
bit3=1	Enable CH4 limit detection
bit4 ~ bit7	Reserved
bit8=1	Disable output when CH1 exceeds the limit
bit9=1	Disable output when CH2 exceeds the limit
bit10=1	Disable output when CH3 exceeds the limit
bit11=1	Disable output when CH4 exceeds the limit
bit12 ~ bit15	Reserved

CR#101: Upper and lower limit status

Description	
bit0=1	CH1 exceeds lower bound

Description	
bit1=1	CH2 exceeds lower bound
bit2=1	CH3 exceeds lower bound
bit3=1	CH4 exceeds lower bound
bit4 ~ bit7	Reserved
bit8=1	CH1 exceeds upper bound
bit9=1	CH2 exceeds upper bound
bit10=1	CH3 exceeds upper bound
bit11=1	CH4 exceeds upper bound
bit12 ~ bit15	Reserved

CR#102, 103, 104, 105: Configuration value for CH1 ~ CH4 upper limit

Set the upper limit value for CH1 ~ CH4. Default: K32,000

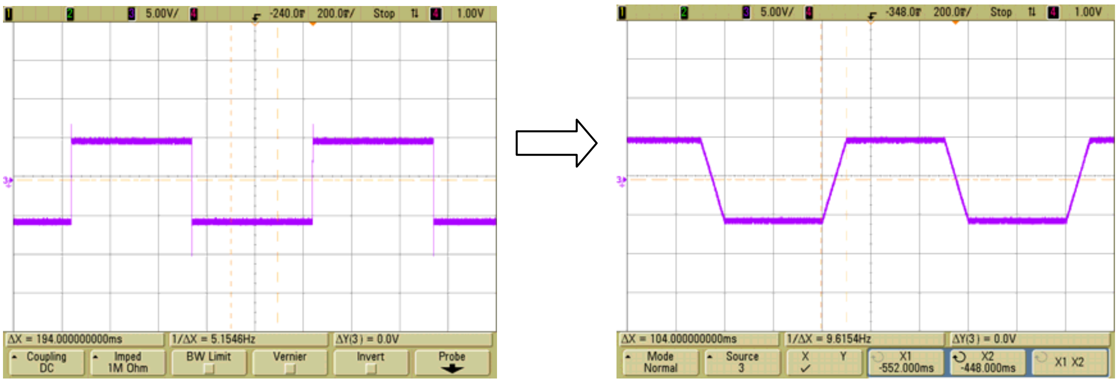
CR#108, 109, 110, 111: Configuration value for CH1 ~ CH4 lower limit

Set the lower limit value for CH1 ~ CH4. Default: K-32,000

CR#114, 115, 116, 117: Output update time of CH1 ~ CH4

Unit: 100ms

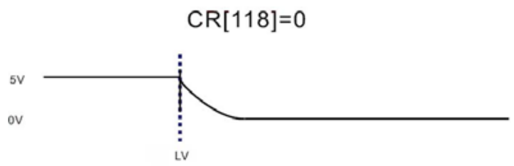
Range	Default
1~100 (0.1s~10s)	0 (unavailable)

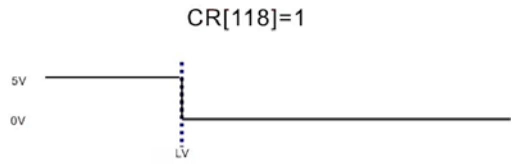


CR#118: LV output mode setting of CH1 ~ CH4. Default=0

CR[118]=0: When the power supply is in a LV (low voltage) condition, the output performs natural discharge.

CR[118]=1: When the power supply is in a LV condition, set the output value to 0. See the curve below:





3.2.2.8 Explanation on special registers D9900~D9999

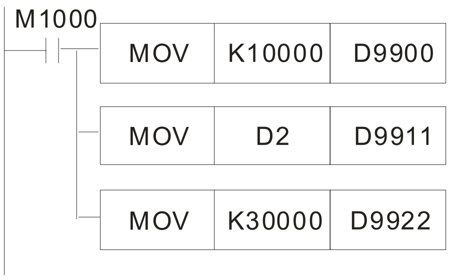
When an ELCM controller is connected to I/O modules, registers D9900~D9999 will be reserved for storing values from those I/O modules. Use the MOV instruction in the controller program to read/write values in D9900~D9999.

When an ELCM controller has ELCM-AN02NANN / ELCM-AN04NANN connected, these special registers are assigned per the table below:

Module0	Module1	Module2	Module3	Module4	Module5	Module6	Module7	Description
D1320	D1321	D1322	D1323	D1324	D1325	D1326	D1327	Module Code
D9900	D9910	D9920	D9930	D9940	D9950	D9960	D9970	CH1 output value
D9901	D9911	D9921	D9931	D9941	D9951	D9961	D9971	CH2 output value
D9902	D9912	D9922	D9932	D9942	D9952	D9962	D9972	CH3 output value
D9903	D9913	D9923	D9933	D9943	D9953	D9963	D9973	CH4 output value

Example

Ladder diagram:



Explanation:

Write K10000 to analog output CH1 of module 0

Write the value in D2 to analog output CH2 of module 1

Write K30000 to analog output CH3 of module 0

3.2.2.9 D/A Conversion Curve

Adjust the conversion curves according to the application requirements by modifying the Offset values (CR#28 ~ CR#31) and Gain values (CR#34 ~ CR#37) for CH1 ~ CH4.

Gain: The corresponding voltage (current) output value when the digital input value = 16,000.

Offset: The corresponding voltage (current) output value when the digital input value = 0.

- For voltage output Mode 0: 0.3125mV = 20V/64,000

  Equation:

  $$Y(V)=\left[\frac{X\times(Gain-Offset)}{16000}+Offset\right]\times\left(\frac{10(V)}{32000}\right)$$

  Y= Voltage output, X= Digital input

- For current output Mode 1: 0.625μA = 20mA/32,000

  Equation:

  $$Y(mA)=\left[\frac{X\times(Gain-Offset)}{16000}+Offset\right]\times\left(\frac{20(mA)}{32000}\right)$$

  Y= Current output, X= Digital input

- For current output Mode 2: 0.5μA = 16mA/32,000

  Use the current output mode 1 equation, then use 19,200(12mA) for the Gain and 6,400(4mA) for the Offset.

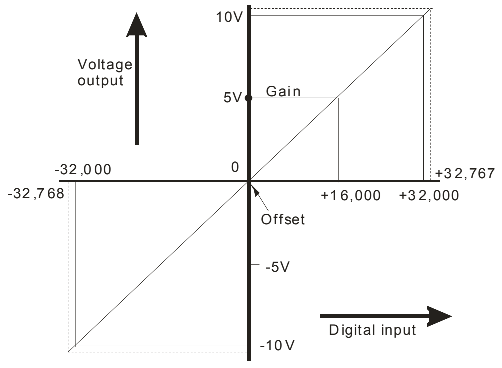
  Equation:

  $$Y(mA)=\left[\frac{X\times(19200-6400)}{16000}+6400\right]\times\left(\frac{20(mA)}{32000}\right)$$

  Y= Current output, X= Digital input

■ **Voltage Output Mode**

- Mode 0 (H'0000): (-10V ~ +10V)

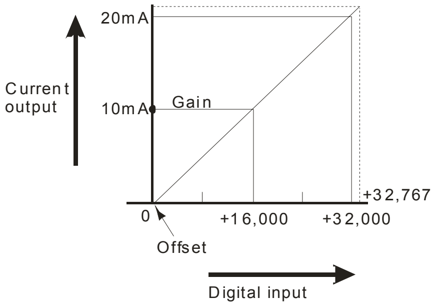


Mode 0 of CR#2~ CR#5	-10V ~ +10V, Gain = 5V (16,000), Offset = 0V (0).
Gain (CR#28 ~ CR#31)	The corresponding voltage output value when the digital input value = 16,000.

Offset (CR#34 ~ CR#37)	The corresponding voltage output value when the digital input value = 0.
Range of digital conversion	-32,000 ~ +32,000
Max./Min. input range of digital data	-32,768 ~ +32,767

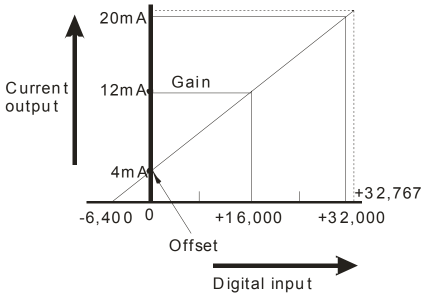
- **Current Output Mode1**

- Mode 1 (H'0001): (0mA ~ +20mA)



Mode 1 of CR#2~ CR#5	0mA ~ +20mA, Gain = 10mA (16,000), Offset = 0mA (0).
Gain (CR#28 ~ CR#31)	The corresponding current output value when the digital input value = 16,000.
Offset (CR#34 ~ CR#37)	The corresponding current output value when the digital input value = 0.
Range of digital conversion	0 ~ +32,000
Max./Min. range of digital data	0 ~ +32,767

- Mode 2 (H'0002): (4mA ~ +20mA)



Mode 2 of CR#2~ CR#5	4mA ~ +20mA, Gain = 12mA (19,200), Offset = 4mA (6,400).
Gain (CR#28 ~ CR#31)	The corresponding current output value when the digital input value = 19,200.
Offset (CR#34 ~ CR#37)	The corresponding current output value when the digital input value = 6,400.
Range of digital conversion	0 ~ +32,000
Max./Min. input range of digital data	-6400 ~ +32,767

■ Adjusting D/A Conversion Curve in Voltage Output Mode

1. Description
   - CH1 example, when CR#2 is configured for voltage output mode (mode 0), the Offset value will be set to 0V (0) and the Gain value to 5V (5V/0.3215mV=16,000), i.e. the output voltage -10V ~ 10V will correspond to decimal values -32,000 ~ +32,000.
   - If the default voltage output mode (mode 0) is not appropriate for the application, make adjustments to the D/A conversion curve according to the application requirements. For example, set the Offset for CH1 to 2V (2V/0.3215mV=6,400) and the Gain to 6V (6V/0.3215mV=19,200).

$$Y(V)=\left[\frac{X\times(Gain-Offset)}{16000}+Offset\right]\times\left(\frac{10(V)}{32000}\right)$$

Example: If X=16000, Y=?

$$Y(V)=\left[\frac{16000\times(19200-6400)}{16000}+6400\right]\times\left(\frac{10(V)}{32000}\right)=6(V)$$

   - The D/A conversion curve only needs to be set up once. Use CR#40 to protect these settings.
2. Addresses
   - X0 = On: Set the output mode of CH1 to mode 0.
   - X1 = On: Set the Offset value of CH1 to 2V (6,400) and the Gain value to 6V (19,200).
   - M0 = On: Disable modifying CH1 configuration values.
3. Program Description
   - When X0 = On, set CR#2 to K0 (H'0000) and configure CH1 for mode 0 (voltage output mode).
   - When X1 = On, write K6,400 (Offset value for CH1) into CR#28 and K19,200 (Gain value for CH1) into CR#34.
   - When X1 goes from On to Off, set M0 = On to disable modifications to the D/A conversion curve. Write K1 (H'1) into CR#40 b0=1 to disable CH1.

4. Program example

Ladder diagram:

Explanation:

Set CH1 to mode 0 (voltage output mode)

Set the Offset value of CH1

Set the Gain value of CH1

Disable modifying CH1 configuration

■ Adjusting D/A Conversion Curve in Current Output Mode 1 and Mode 2

1. Description

- CH1 example, when CR#2 is set to current output mode (mode 1), the Offset value will be set to 0mA (0) and the Gain value to 10mA (10mA/0.625μA=16,000), i.e. output current 0mA ~ +20mA will correspond to values 0 ~ +32,000.
- When CR#2 is set to current output mode (mode 2), the Offset value will be set to 4mA (4mA/0.625μA=6,400) and the Gain value to 12mA (12mA/0.625μA=19,200), i.e. input current 4mA ~ +20mA will correspond to values 0 ~ +32,000.
- If the default current output modes (mode 1 and mode 2) is not appropriate for the application, make adjustments to the D/A conversion curve according to application requirements. For example, set the Offset for CH1 to 6mA (6mA/0.625μA=9,600) and the Gain to 13mA (13mA/0.625μA=20,800).

$$Y(mA)=\left[\frac{X\times(Gain-Offset)}{16000}+Offset\right]\times\left(\frac{20(mA)}{32000}\right)$$

Example: If X=16000, Y=?

$$Y(mA)=\left[\frac{16000\times(20800-9600)}{16000}+9600\right]\times\left(\frac{20(mA)}{32000}\right)=13(mA)$$

2. Addresses

- X0 = On: Set the output mode for CH1 to mode 1.
- X1 = On: Set the Offset value for CH1 to 6mA (9,600) and the Gain value to 13mA (20,800).

- M0 = On: Disable modifying CH1 configuration values.

3. Program Description
    - When X0 = On, write K1 (H’0001) to CR#2 to configure CH1 for mode 1 (current output mode).
    - When X1 = On, write K9,600 (Offset value for CH1) into CR#28 and K20,800 (Gain value for CH1) into CR#34.
    - When X1 goes from On to Off, set M0 = On to disable modifying the D/A conversion curve. Write K1 (H’1) into CR#40 b0=1.
4. Program example

Ladder diagram: Explanation:

Set CH1 to mode 1 (current output mode)

Set the Offset value for CH1

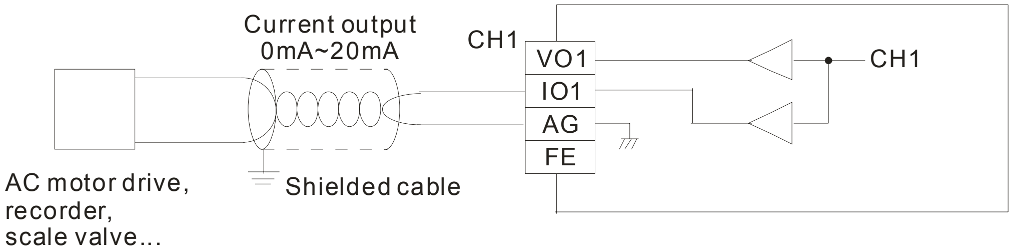
Set the Gain value for CH1

Disable modifying CH1 configuration values

3.2.2.10 Applications

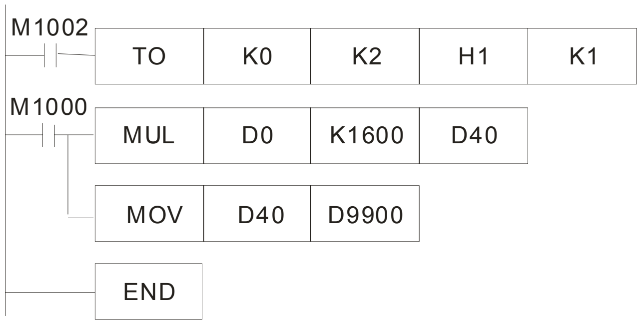
■ **Analog Current Output**

1. Description
    - Assume a device requires a 0-20ma signal for control.
    - Configure an analog output channel for mode 1, i.e. the current output mode (0mA ~ 20mA)
2. Addresses
    - D0: target current output value for CH1
    - D40: digital value converted moved to the target output current for CH1
3. Wiring
    - Connect the analog input terminal on the equipment to CH1 of ELCM-AN04NANN (as shown below).



4. Program explanation
   - When the ELC goes from STOP to RUN, configure CH1 for current output mode 1(0mA ~20mA)
   - In current output mode 1, the analog range 0 ~ 20mA corresponds to K0 ~ K32,000 decimal. D0 is the current output value for CH1, which must be multiplied by 1600 (i.e. 20/32,000 = 1/1,600) to obtain the decimal output value. Multiply the value in D0 by 1,600 and store the result in data register D40.
5. Example program

Ladder diagram:



Explanation:

Set CH1 to mode 1 (current output mode)

D0 is the current output value for CH1

D40 is the corresponding digital value for the output current specified in D0

3.2.3 ELCM-AN06AANN

3.2.3.1 Analog Input/Output Module

In industrial automation, many control signals are analog signals. The most frequently used analog signals are voltage -10V ~ 10V and current 0 ~ 20mA. Data in ELC controllers can be converted into analog signals for controlling analog devices via analog input/output modules like the ELCM-AN06AANN.

For example, the data range -32,000 ~ 32,000 in the ELC controller is converted into -10V ~ 10V by one of these analog outputs on this module. The output voltage can therefore be used to control any standard analog device. Analog inputs can be used to monitor the operation of any device with an analog output.

3.2.3.2 Introduction

ELCM-AN06AANN combination analog input/output module contains 4 analog inputs (voltage or current) and 2 analog outputs (voltage or current). The data in the module can be accessed by the controller via FROM/TO instructions or by reading the average value or writing the output value for all channels directly by using MOV instructions (Refer to special registers D9900 ~ D9999).

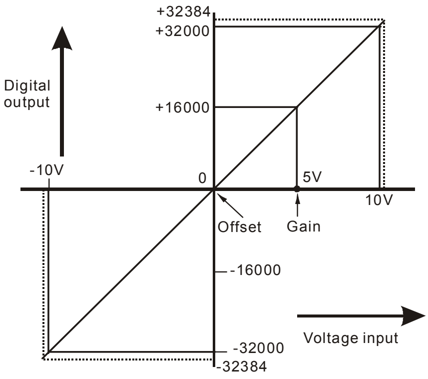
3.2.3.3 Specification

- **Functions Specification**

ELCM-AN06AANN					
Analog/Digital (A/D)	Voltage input		Current input		
Power supply voltage	24 VDC (20.4VDC ~ 28.8VDC) (-15% ~ +20%)				
Connector	European standard fixed terminal block (Hole diameter: 5mm)				
Analog input channel	4 channels				
Range of analog input	±10V	±5V	±20mA	0~20mA	4~20mA
Range of digital conversion	±32,000	±32,000	±32,000	0~32,000	0~32,000
Max./Min. output range of digital data	±32,384	±32,384	±32,384	-384~+32,384	-384~+32,384
Resolution	14 bits 20V/64000	14 bits 10V/64000	14 bits 40mA/64000	14 bits 20mA/32000	14 bits 16mA/32000
Input impedance	> 200 KΩ		250Ω		
Overall accuracy	±0.5% when in full scale (25°C, 77°F) ±1% when in full scale within the range of 0 ~ 55°C (32 ~ 131°F)				
Response time	3 ms / all channels				
Isolation	Optical coupler isolation between digital circuits and analog circuits. No isolation among analog channels. 500VDC between digital circuits and Ground 500VDC between analog circuits and Ground 500VDC between analog circuits and digital circuits 500VDC between 24VDC and Ground				
Range of absolute input	±15V			±32mA	

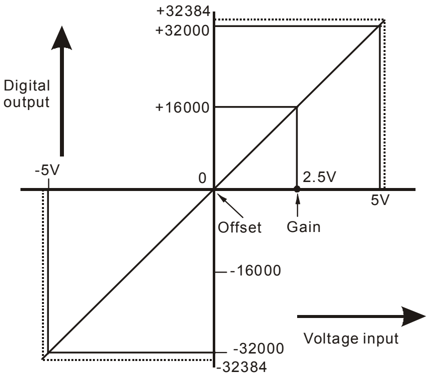
<table>
<tr><td>Digital data format</td><td colspan="2">16 significant bits out of 16 bits are available; in 2's complement</td></tr>
<tr><td>Average Function</td><td colspan="2">Supported. Available for setting up sampling range in CR#8 ~ CR#11. Range: K1 ~ K100.</td></tr>
<tr><td>Self-diagnosis</td><td colspan="2">Upper and lower bound detection in all channels</td></tr>
<tr><td>Series connection to ELCM MPU</td><td colspan="2">The modules are numbered from 0 to 7 automatically by their distance from MPU. Max. 8 modules are allowed to connect to MPU and will not occupy any digital I/O points.</td></tr>
<tr><td rowspan="3">A/D conversion curve (Default: mode 0)</td><td>

Mode 0 (H'0000): (-10V ~ +10V)



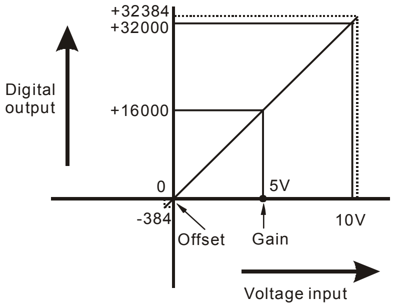
</td><td>

Mode 1 (H'0001): (-5V ~ +5V)



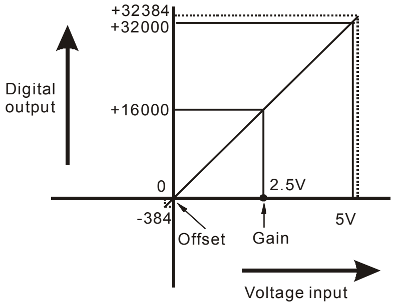
</td></tr>
<tr><td>

Mode 2 (H'0002): (0V~+10V)



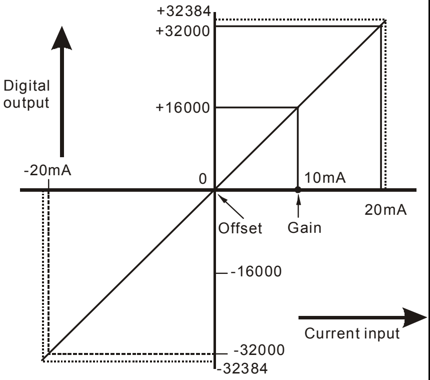
</td><td>

Mode 3 (H'0003): (0V~+5V)



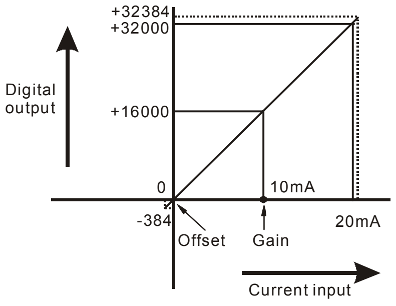
</td></tr>
<tr><td>

Mode 4 (H'0004): (-20mA~ +20mA)

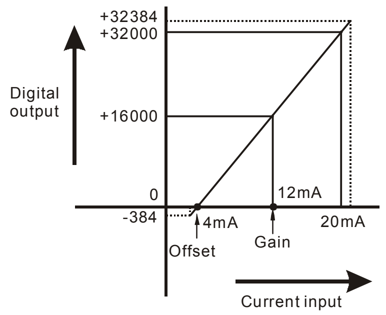


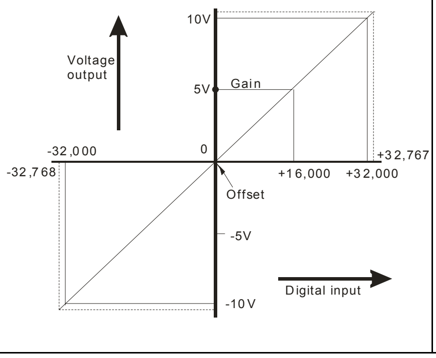
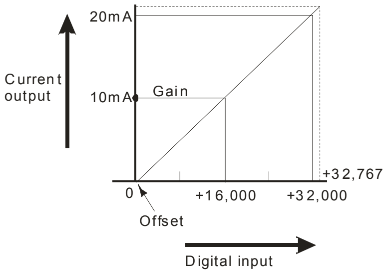
</td><td>

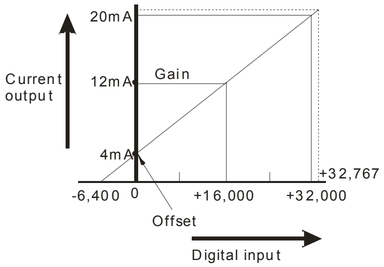
Mode 5 (H'0005): (0 ~ +20mA)



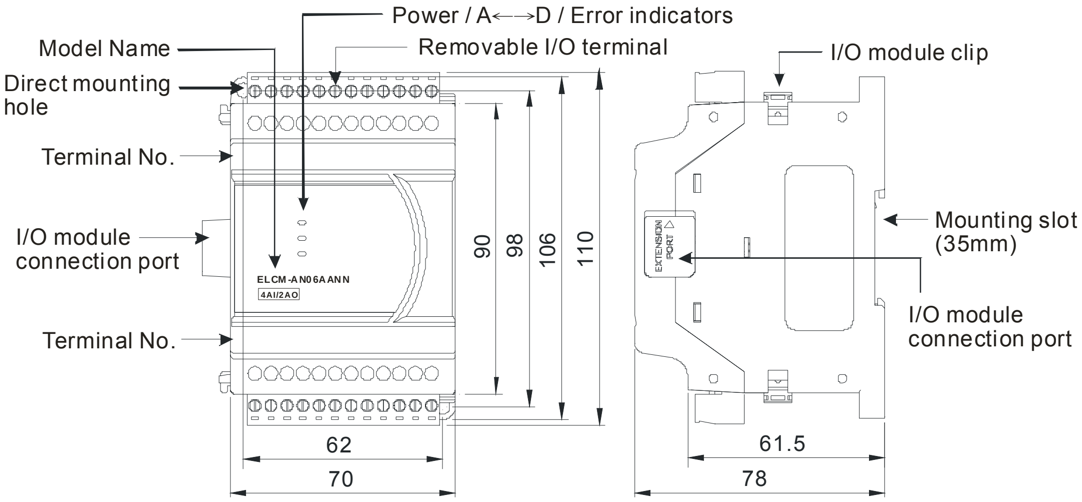
</td></tr>
</table>

A/D conversion curve (Default: mode 0)	Mode 6 (H'0006): (+4mA ~ +20mA)  	Mode -1 (H'FFFF): Channel unavailable. Average value and present value of input channels will be displayed as 32767(H'7FFF)

Digital/Analog (D/A)	Voltage output	Current output	
Analog output channel	2 channels		
Range of analog output	-10V ~ 10V	0 ~ 20mA	4mA ~ 20mA
Range of digital conversion	-32,000 ~ +32,000	0 ~ +32,000	0 ~ +32,000
Max./Min. input range of digital data	-32,768 ~ +32,767	0 ~ +32,767	-6,400 ~ +32,767
Resolution	14 bits 20V/64000	14 bits 20mA/32000	14 bits 16mA/32000
Output impedance	0.5Ω or lower		
Overall accuracy	±0.5% when in full scale (25°C, 77°F); ±1% when in full scale within the range of (0 ~ 55°C, 32 ~ 131°F)		
Response time	3 ms/ all channels		
Max. output current	20mA (1KΩ ~ 2MΩ)	-	
Tolerance load impedance	-	0 ~ 500Ω	
Digital data format	16 significant bits out of 16 bits are available; in 2's complement		
Isolation	Optical coupler isolation between digital circuits and analog circuits. No isolation among analog channels. 500VDC between digital circuits and Ground 500VDC between analog circuits and Ground 500VDC between analog circuits and digital circuits 500VDC between 24VDC and Ground		
Protection	Voltage output is protected by short circuit. Short circuit lasting for too long may cause damage on internal circuits. Current output can be open circuit.		
D/A conversion curve (Default: mode 0)	Mode 0 (H'0000): (-10V ~ +10V)  	Mode 1 (H'0001): (0mA ~ +20mA)  	

Digital/Analog (D/A)	Voltage output	Current output
	Mode 2 (H'0002): (+4mA ~ +20 mA)  	Mode -1 (H'FFFF): Channel unavailable. The channel is disabled. Output voltage = 0; output current = 0.
Operation/storage	1. Operation: 0°C ~ 55°C (temperature), 50 ~ 95% (humidity), pollution degree 2 2. Storage: -25°C ~ 70°C (temperature), 5 ~ 95% (humidity)	
Vibration/shock immunity	International standards: IEC61131-2, IEC 68-2-6 (TEST Fc) / IEC61131-2 & IEC 68-2-27 (TEST Ea)	
Max. rated power consumption	24V DC (20.4 ~ 28.8V DC) (-15% ~ +20%), 2.5W, supplied by external power source	
Weight	213g	

3.2.3.4 Product Profile and Outline



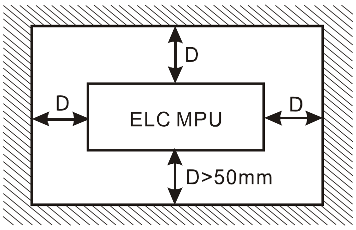
Units: mm

3.2.3.5 Installation and Wiring

- **Installation of the DIN rail**

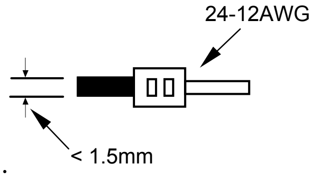
1. The ELC may be secured to a cabinet by using 35mm in height and 7.5mm in depth DIN rail. When mounting the ELC to 35mm DIN rail, be sure to use the retaining clip to stop any side-to-side movement of the ELC and reduce the chance of wires coming loose. The retaining clip is at the bottom of the ELC. To secure the ELC to DIN rail, pull down the clip, place it onto the rail and push it up to lock it in place. To remove the ELC, pull the retaining clip down with a flat screwdriver and remove the ELC from DIN rail.

2. Install the ELC in an enclosure with sufficient space around it to allow heat dissipation, as shown in the figure below.



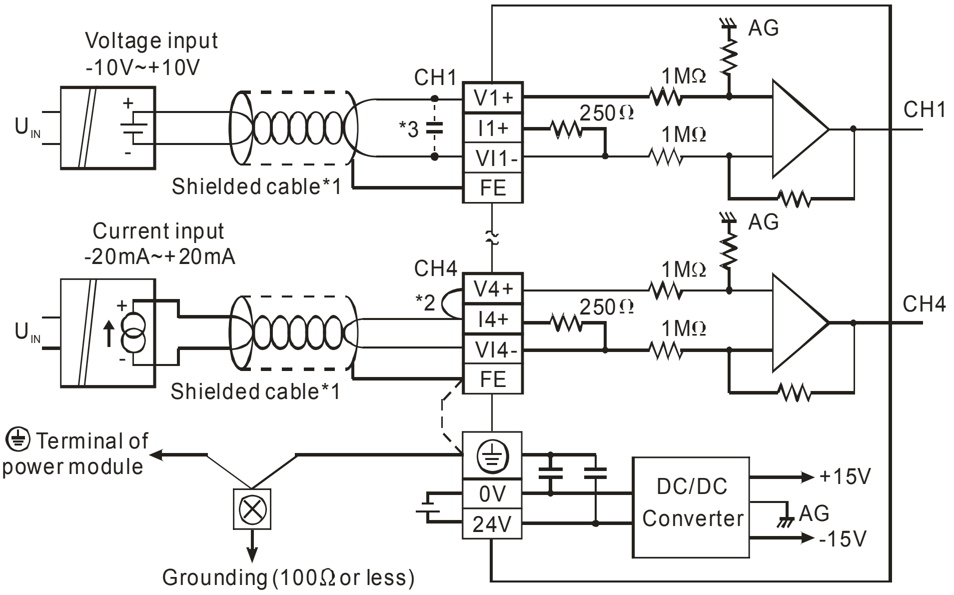
- **Wiring**

1. Use 22-16 AWG (1.5mm) single-core wire or the multi-core wire for the I/O wiring. The specification of the terminal is shown in the figure below on the right hand side. The ELC terminal screws should be tightened to 1.95 kg-cm (1.7 in-lbs). Also, use 60/75°C copper conductor only.
2. DO NOT wire empty terminals. DO NOT place the signal wires and power wires in the same conduit.
3. DO NOT drop metallic conductors into the ELC during installation.
   - Attach the dustproof sticker to the ELC before installation to prevent conductive objects from dropping in.
   - Tear off the sticker before running the ELC to ensure normal heat dissipation

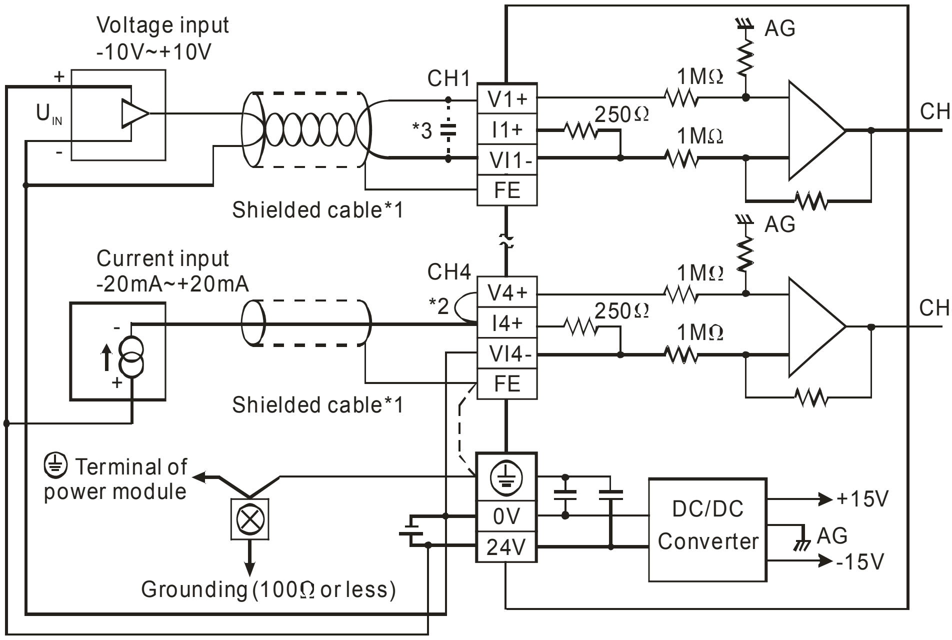


- **External Wiring**

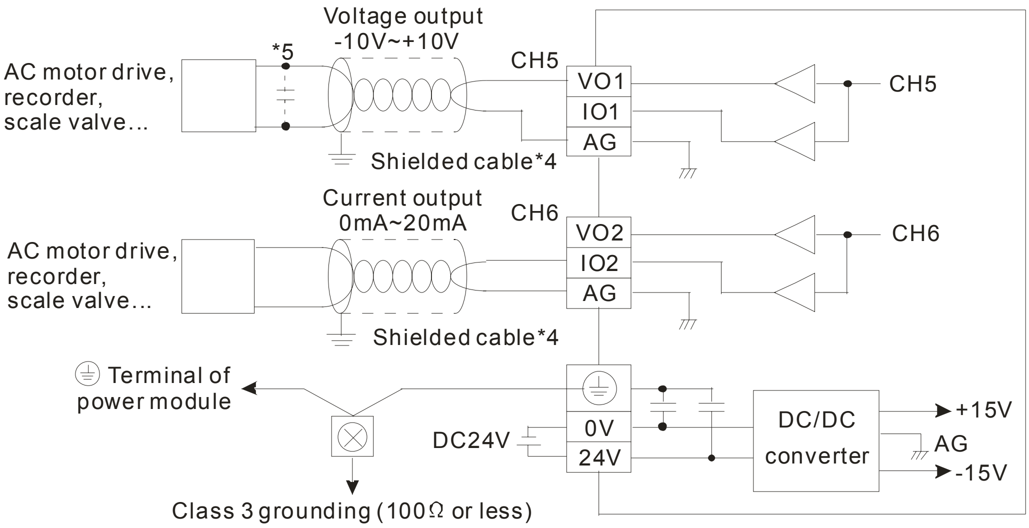
  - Input: Active-type



- Input: Passive-type



- Output



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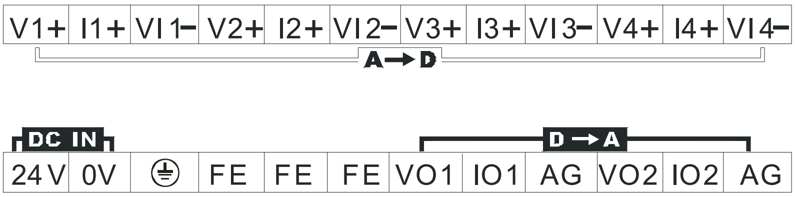
Note 1: When the Analog inputs are connected to current signals, make sure to jumper the "V+" and "I+" terminals.

Note 2: If electrical noise is an issue for analog inputs or outputs, connect a 0.1 ~ 0.47μF 25V capacitor.

Note 3: Connect the ⏚ terminal on both the power module and Analog module to the system earth ground.

3.2.3.6 Terminal Layout



3.2.3.7 CR (Control Register)

CR#	Attrib.		Register name	Explanation
#0	O	R	Module Type	ELCM-AN06AANN model code = H’00C4
#1	O	R	Firmware version	Display the current firmware version in hex.
#2	O	R/W	CH1 configuration word	Input mode: Default = H’0000. CH1 example: Mode 0 (H’0000):Voltage input (±10V) Mode 1 (H’0001):Voltage input (±5V) Mode 2 (H’0002):Voltage input (0 ~+10V) Mode 3 (H’0003):Voltage input (0 ~+5V) Mode 4 (H’0004):Current input (±20mA) Mode 5 (H’0005):Current input (0 ~+20mA) Mode 6 (H’0006):Current input (4 ~+20mA) Mode -1 (H’FFFF):Channel 1 unavailable
#3	O	R/W	CH2 configuration word	
#4	O	R/W	CH3 configuration word	
#5	O	R/W	CH4 configuration word	
#6	O	R/W	CH5 configuration word	Output mode: Default = H’0000. CH5 example: Mode 0 (H’0000):Voltage output (±10V) Mode 1 (H’0001):Current output (0~+20mA) Mode 2 (H’0002):Current output (4~+20mA) Mode -1 (H’FFFF):Channel 5 unavailable
#7	O	R/W	CH6 configuration word	
#8	O	R/W	CH1 number of samples	Set the number of samples for CH1 ~ CH4: Range = K1 ~ K100 Default = K10
#9	O	R/W	CH2 number of samples	
#10	O	R/W	CH3 number of samples	
#11	O	R/W	CH4 number of samples	
#12	X	R	CH1 average input value	Average value of analog inputs for CH1 ~ CH4
#13	X	R	CH2 average input value	
#14	X	R	CH3 average input value	
#15	X	R	CH4 average input value	
#16	X	R/W	CH5 output signal value	Analog outputs: Voltage output range: K-32,000~K32,000. Current output range: K0~K32,000. Default: K0.
#17	X	R/W	CH6 output signal value	
#20	X	R	CH1 present input value	Present value of analog inputs at CH1 ~ CH4
#21	X	R	CH2 present input value	
#22	X	R	CH3 present input value	
#23	X	R	CH4 present input value	

CR#	Attrib.		Register name	Explanation
#28	O	R/W	Adjusted Offset value of CH1	Set the adjusted Offset value of CH1 ~ CH6 Default = K0. Definition of Offset in ELCM-AN06AANN: The corresponding voltage (current) input value when the digital output value = 0
#29	O	R/W	Adjusted Offset value of CH2	
#30	O	R/W	Adjusted Offset value of CH3	
#31	O	R/W	Adjusted Offset value of CH4	
#32	O	R/W	Adjusted Offset value of CH5	
#33	O	R/W	Adjusted Offset value of CH6	
#34	O	R/W	Adjusted Gain value of CH1	Set the adjusted Gain value in CH1 ~ CH6 Default = K16,000. Definition of Gain in ELCM-AN06AANN: The corresponding voltage (current) input value when the digital output value = 16,000.
#35	O	R/W	Adjusted Gain value of CH2	
#36	O	R/W	Adjusted Gain value of CH3	
#37	O	R/W	Adjusted Gain value of CH4	
#38	O	R/W	Adjusted Gain value of CH5	
#39	O	R/W	Adjusted Gain value of CH6	
#40	O	R/W	Set value changing prohibited	Prohibit configuration changes for CH1 ~ CH4 Default= H'0000.
#41	X	R/W	Save all the set values	Save all configuration values, Default =H'0000
#42	X	R/W	Return to default setting	Set all values to default settings, Default = H'0000
#43	X	R	Error status	Register for storing all error status. Refer to table of error status for more information.
#100	O	R/W	Enable/Disable limit detection	Enable/Disable the upper and lower limit detection function. Default= H'0000.
#101	X	R/W	Upper and lower bound status	Display the upper and lower limit values, Default =H'0000
#102	O	R/W	Set value of CH1 upper bound	Value of CH1~CH6 upper limit. Default = K32000.
#103	O	R/W	Set value of CH2 upper bound	
#104	O	R/W	Set value of CH3 upper bound	
#105	O	R/W	Set value of CH4 upper bound	
#106	O	R/W	Set value of CH5 upper bound	
#107	O	R/W	Set value of CH6 upper bound	
#108	O	R/W	Set value of CH1 lower bound	Value of CH1~CH6 lower limit. Default = K-32000.
#109	O	R/W	Set value of CH2 lower bound	
#110	O	R/W	Set value of CH3 lower bound	
#111	O	R/W	Set value of CH4 lower bound	
#112	O	R/W	Set value of CH5 lower bound	
#113	O	R/W	Set value of CH6 lower bound	
#114	O	R/W	Output update time of CH5	Set output update time for CH5 ~ CH6
#115	O	R/W	Output update time of CH6	
#118	O	R/W	LV output mode setting of Ch5 ~ Ch6	Set the output mode of CH5~CH6 when the power is is in a LV (low voltage) condition. Default=0

CR#	Attrib.	Register name	Explanation
O: When CR#41 is set to H'5678, the set value of CR will be saved. X: set value will not be saved. R: able to read data by using FROM instruction. W: able to write data by using TO instruction.			

■ Description of the CR values

CR#0: Module Type

1. ELCM-AN06AANN module code = H'00C4.
2. Read the module code in the program to verify the correct extension module.

CR#1: Firmware version

Display the current firmware version in hex, e.g. version V1.00 is indicated as H'0100.

CR#2, 3, 4, 5: CH1 ~ CH4 input mode setting

Configure the input channels of the analog input/output module. There are 8 modes for each channel.

When you configure CH1 to mode 1 (H'0001) CR#2 must be set to H'0001. The default setting = H'0000. CH1 example:

Mode 0 (H'0000): Voltage input (-10V ~ +10V).
Mode 1 (H'0001): Voltage input (-5V ~ +5V).
Mode 2 (H'0002): Voltage input (0V ~ +10V).
Mode 3 (H'0003): Voltage input (0V ~ +5V).
Mode 4 (H'0004): Current input (-20mA ~ +20mA).
Mode 5 (H'0005): Current input (0mA ~ +20mA).
Mode 6 (H'0006): Current input (+4mA ~ +20mA).

CR#6, 7: CH5 ~ CH6 output mode configuration

Configure the output channels of the analog input/output module. There are 4 modes for each channel.

When you configure CH5 to mode 1 (H'0001) CR#6 must be set to H'0001. The default setting = H'0000. CH5 example:

Mode 0 (H'0000): Voltage output (-10V ~ +10V).
Mode 1 (H'0001): Current output (0mA ~ 20mA).
Mode 2 (H'0002): Current output (4mA ~ 20mA).

CR#8, 9, 10, 11: CH1 ~ CH4 number of samples

1. The number of samples of the input signals for CH1 ~ CH4, used for the average input values.
2. Allowable range: K1 ~ K100. Default = K10. If the value exceeds K100, the value will be set to K100; if the value is less than K1, the value will be set to K1

CR#12, 13, 14, 15: Average input values at CH1 ~ CH4

The average value of the signals at CH1 ~ CH4 is calculated based on the number of samples parameter set in CR#8 ~ CR#11. For example, if the value in CR#8 ~ CR#11 is K20, the content in CR#12 ~ CR#15 will be the average from the most recent 20 signals in CH1 ~ CH4.

CR#16, 17: The output values for CH5 ~ CH6

Output value for CH5 ~ CH6: K-32,000 ~ K32,000. Default = K0.

CR#20, 21, 22, 23: Present input value at CH1 ~ CH4

The present value of input signals at CH1 ~ CH4.

CR#28, 29, 30, 31: Adjusted Offset values for CH1 ~ CH4

1. Set the adjusted Offset value of CH1 ~ CH4, which represents the voltage (current) input value corresponds to digital value 0.
2. Default setting = K0.

CR#32, 33: Adjusted Offset values for CH5 ~ CH6

1. Set the adjusted Offset values for CH5 ~ CH6, which represent the voltage (current) output value corresponds to digital value 0
2. Default setting = K0.

CR#34, 35, 36, 37: Adjusted Gain values for CH1 ~ CH4

1. Set the adjusted Gain values for CH1 ~ CH4, which represent the voltage (current) input value corresponds to digital value 16,000.
2. Default setting = K16,000.

CR#38, 39: Adjusted Gain values for CH5 ~ CH6

1. Set the adjusted Gain values for CH5 ~ CH6, which represent the voltage (current) output values corresponds to digital value 16,000.
2. Default setting = K16,000.

CR#40: Function: Prohibited configuration changes, Default = H’0000

Description	
bit0	b0=0, CH1 changing allowed; b0=1, CH1 changing prohibited
bit1	b1=0, CH2 changing allowed; b1=1, CH2 changing prohibited
bit2	b2=0, CH3 changing allowed; b2=1, CH3 changing prohibited
bit3	b3=0, CH4 changing allowed; b3=1, CH4 changing prohibited
bit4	b4=0, CH5 changing allowed; b4=1, CH5 changing prohibited
bit5	b5=0, CH6 changing allowed; b5=1, CH6 changing prohibited
bit6 ~ bit15	Reserved

Affected Parameters	
CR#2 ~ CR#5	Input mode setting at CH1 ~ CH4
CR#6 ~ CR#7	Output mode setting at CH5 ~ CH6
CR#8 ~ CR#11	Sampling range of CH1 ~ CH4
CR#28 ~ CR#33	Adjusted Offset value of CH1 ~ CH6
CR#34 ~ CR#39	Adjusted Gain value of CH1 ~ CH6
CR#42	Return to default setting
CR#100	Function: Enable/Disable limit detection
CR#102~CR#107	Set value of CH1~CH6 upper bound
CR#108~CR#113	Set value of CH1~CH6 lower bound
CR#114~CR#115	Output update time of CH5~ CH6
CR#118	LV output mode setting of Ch5 ~ Ch6

CR#41: Function: Save all configuration values. Default=H’0000

Save all the configuration values to the internal flash memory. When saving is completed, CR#41 will be set to H’FFFF.

Set value	Function
H0	No action
HFFFF	Saving completed
H5678	Saving enabled.

Note: Default setting = H0. When the CR#41 value = H’5678, saving will be enabled, and CR#41 will be set to H’FFFF when saving is complete.

CR#42: Function: Return to default settings. Default = H0000

Description	
bit0	b0=0, no action on CH1; b0=1, set CH1 to default setting
bit1	b1=0, no action on CH2; b1=1, set CH2 to default setting
bit2	b2=0, no action on CH3; b2=1, set CH3 to default setting
bit3	b3=0, no action on CH4; b3=1, set CH4 to default setting
bit4	B4=0, no action on CH5; b4=1, set CH5 to default setting
bit5	B5=0, no action on CH6; b5=1, set CH6 to default setting
bit6 ~ bit15	Reserved

Note: Set the appropriate bit to 1 and the corresponding channel will be returned to default settings. When complete, the value will be set to 0. If CR#40 (Prohibit Configuration changes) is enabled, setting defaults will be invalid, and all configuration values will remain unchanged. Error Code bit 12 of CR#43 will be set to 1.

Affected Parameters	
CR#2 ~ CR#5	Input mode setting of CH1 ~ CH4
CR#6 ~ CR#7	Output mode setting at CH5 ~ CH6
CR#8 ~ CR#11	Sampling range of CH1 ~ CH4
CR#28 ~ CR#33	Adjusted Offset value at CH1 ~ CH6
CR#34 ~ CR#39	Adjusted Gain value at CH1 ~ CH6
CR#100	Function: Enable/Disable limit detection
CR#102~CR#107	Set value of CH1~CH6 upper bound
CR#108~CR#113	Set value of CH1~CH6 lower bound
CR#114~CR#115	Output update time of CH5 ~ CH6
CR#118	LV output mode setting

CR#43: Error status. Default=H'0000

CR#43: error status value. See the table below:

Description		
bit0	K1 (H'1)	Power Supply error
bit1	K2 (H'2)	Hardware error
bit2	K4 (H'4)	Upper / lower limit error
bit3	K8 (H'8)	CH1 Conversion error
bit4	K16 (H'10)	CH2 Conversion error
bit5	K32 (H'20)	CH3 Conversion error
bit6	K64 (H'40)	CH4 Conversion error

Description		
bit7	K128 (H'80)	CH5 Conversion error
bit8	K256 (H'100)	CH6 Conversion error
bit9	K512(H'0200)	Mode setting error
bit10	K1024(H'0400)	Sampling range error
bit11	K2048(H'0800)	Upper / lower bound setting error
bit12	K4096(H'1000)	Set value changing prohibited
bit13 ~ bit15		Reserved
✐***Note:*** *Each error status is determined by the corresponding bit (b0 ~ b15) and there may be more than 2 errors occurring at the same time. 0 = normal; 1 = error*		

CR#100: Function: Enable/Disable limit detection

Description	
bit0=1	Enable CH1 limit detection
bit1=1	Enable CH2 limit detection
bit2=1	Enable CH3 limit detection
bit3=1	Enable CH4 limit detection
bit4=1	Enable CH5 limit detection
bit5=1	Enable CH6 limit detection
bit6 ~ bit7	Reserved
bit8=1	Disable output when CH5 exceeds the limit
bit9=1	Disable output when CH6 exceeds the limit
bit12 ~ bit15	Reserved

CR#101: Upper and lower limit status

Description	
bit0=1	CH1 exceeds lower limit
bit1=1	CH2 exceeds lower limit
bit2=1	CH3 exceeds lower limit
bit3=1	CH4 exceeds lower limit
bit4=1	CH5 exceeds lower limit
bit5=1	CH6 exceeds lower limit
bit6 ~ bit7	Reserved
bit8=1	CH1 exceeds upper limit
bit9=1	CH2 exceeds upper limit
bit10=1	CH3 exceeds upper limit

Description	
bit11=1	CH4 exceeds upper limit
bit12=1	CH5 exceeds upper limit
bit13=1	CH6 exceeds upper limit
bit14 ~ bit15	Reserved

CR#102, 103, 104, 105, 106, 107: Configuration value for CH1 ~ CH6 upper limit

Set the upper limit value for CH1 ~ CH6. Default: K32,000

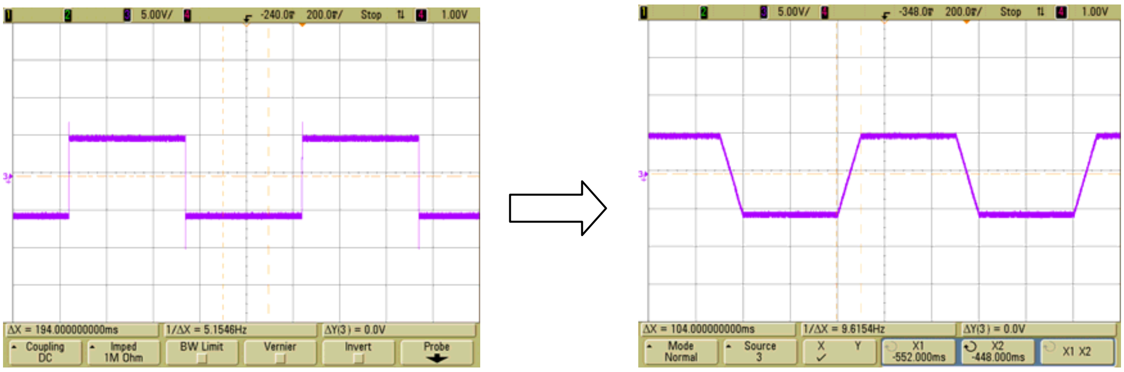
CR#108, 109, 110, 111, 112, 113: Configuration value for CH1 ~ CH6 lower limit

Set the lower limit value for CH1 ~ CH6. Default: -32,000

CR#114, 115: Output update time for CH5~ CH6

Unit: 100ms

Range	Default
1~100 (0.1s~10s)	0



CR#118: LV output mode configuration for CH5 ~ CH6. Default=0

CR[118]=0: When the power is in a LV (low voltage) condition, the output performs natural discharge.

CR[118]=1: When the power is in a LV condition, set the output value to 0. See the curve below:

CR[118]=0

CR[118]=1

3.2.3.8 Explanation on special registers D9900~D9999

When the ELCM controller is connected to special I/O modules, registers D9900~D9999 are reserved for storing values from these modules. Use the MOV instruction to rea/write to D9900~D9999.

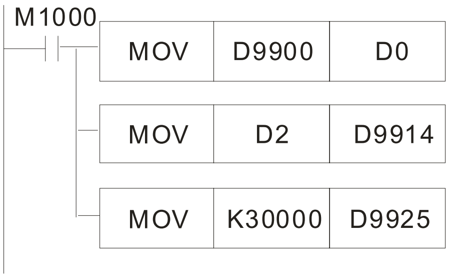
When the ELCM controller is connected to an ELCM-AN06AANN, the configuration of special registers follows:

Module0	Module1	Module2	Module3	Module4	Module5	Module6	Module7	Description
D1320	D1321	D1322	D1323	D1324	D1325	D1326	D1327	Model Code
D9900	D9910	D9920	D9930	D9940	D9950	D9960	D9970	CH1 average input value
D9901	D9911	D9921	D9931	D9941	D9951	D9961	D9971	CH2 average input value
D9902	D9912	D9922	D9932	D9942	D9952	D9962	D9972	CH3 average input value
D9903	D9913	D9923	D9933	D9943	D9953	D9963	D9973	CH4 average input value
D9904	D9914	D9924	D9934	D9944	D9954	D9964	D9974	CH5 output value
D9905	D9915	D9925	D9935	D9945	D9955	D9965	D9975	CH6 output value

1. D9900~D9999 are average input values for CH1 ~ CH6 and the sampling range is K1~K100. When the number of samples is set to K1, the values displayed in D9900~D9999 are present values. Use: 1. ELCM_AIO Configuration Function in ELCSoft or 2. FROM/TO instructions (CR#8~CR#11) to set the number of samples to K1.

2. Example:

Ladder diagram:



Explanation:

Save CH1 average input value of Module#0 to D0

Set the output value for Module#1, CH5 from the value in D2

Set the output value for Module#2, CH6 to K30000

3.2.3.9 A/D, D/A Conversion Curve

- **Adjusting A/D Conversion Curve of CH1 ~ CH4**

You can adjust the conversion curves according to the application requirements by changing the Offset value (CR#28 ~ CR#31) and Gain value (CR#34 ~ CR#37).

Gain: The voltage (current) input value corresponding to digital value 16,000.

Offset: The voltage (current) input value corresponding to digital value 0.

- For voltage input Mode0/Mode2: 0.3125mV = 20V/64,000 = 10V/32,000

  Equation:

$$Y = 16000\times\left(\frac{X(V)}{10(V)}\times 32000-Offset\right)\Big/(Gain-Offset)$$

  Y=Digital value, X=Voltage input

- For voltage input Mode1/Mode3: 0.15625mV = 10V/64,000 = 5V/32,000

  Equation:

$$Y = 16000\times\left(\frac{X(V)}{5(V)}\times 32000-Offset\right)\Big/(Gain-Offset)$$

  Y=Digital value, X=Voltage input

- For current input Mode4/Mode5: 0.625μA = 40mA/64,000 = 20mA/32,000

  Equation:

$$Y = 16000\times\left(\frac{X(mA)}{20(mA)}\times 32000-Offset\right)\Big/(Gain-Offset)$$

  Y=Digital value, X= Current input

- For current input Mode6: 0.5μA = 16mA/32,000

  Adopt the equation of current input mode4/mode5, substitute Gain for 19,200(12mA) and Offset for 6,400(4mA)

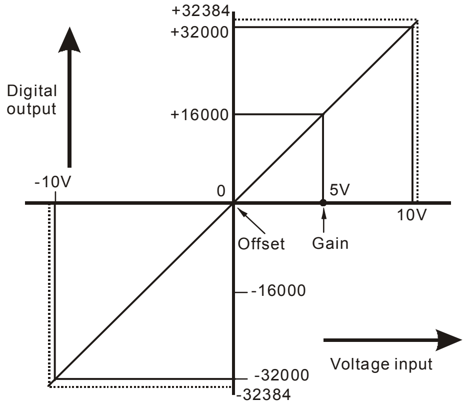
  Equation:

$$Y = 16000\times\left(\frac{X(mA)}{20(mA)}\times 32000-6400\right)\Big/(19200-6400)$$

  Y=Digital value, X= Current input

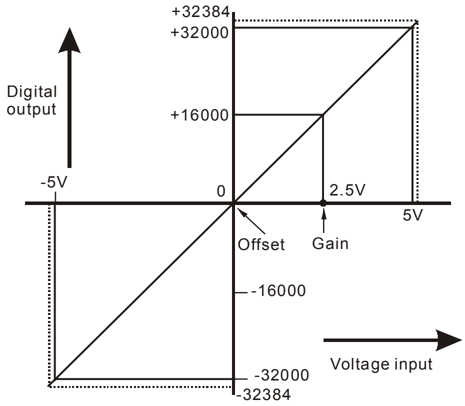
Voltage input mode

- Mode 0 (H'0000): (-10V ~ +10V)



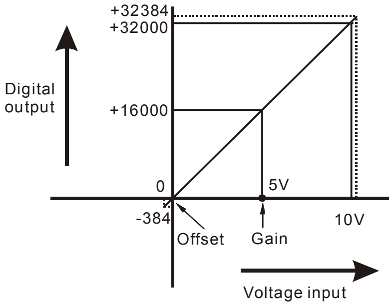
Mode 0 of CR#2~ CR#5	-10V ~ +10V, Gain = 5V (16,000), Offset = 0V (0).
Gain (CR#34 ~ CR#37)	The voltage input value corresponds to digital value 16,000.
Offset (CR#28 ~ CR#31)	The voltage input value corresponds to digital value 0.
Range of digital conversion	-32,000 ~ +32,000
Max./Min. output range of digital data	-32,384 ~ +32,384

- Mode 1 (H'0001): (-5V ~ +5V)



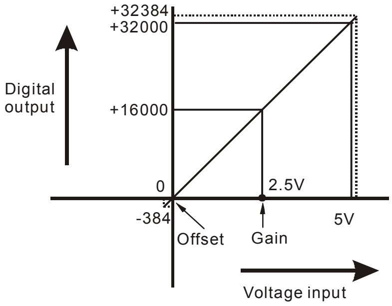
Mode 1 of CR#2~ CR#5	-5V ~ +5V, Gain = 2.5V (16,000), Offset = 0V (0).
Gain (CR#34 ~ CR#37)	The voltage input value corresponds to digital value 16,000.
Offset (CR#28 ~ CR#31)	The voltage input value corresponds to digital value 0.
Range of digital conversion	-32,000 ~ +32,000
Max./Min. output range of digital data	-32,384 ~ +32,384

- Mode 2 (H'0002): (0V~+10V)



Mode 2 of CR#2~ CR#5	0V ~ +10V, Gain = 5V (16,000), Offset = 0V (0).
Gain (CR#34 ~ CR#37)	The voltage input value corresponds to digital value 16,000.
Offset (CR#28 ~ CR#31)	The voltage input value corresponds to digital value 0.
Range of digital conversion	0 ~ 32,000
Max./Min. output range of digital data	-384 ~ +32,384

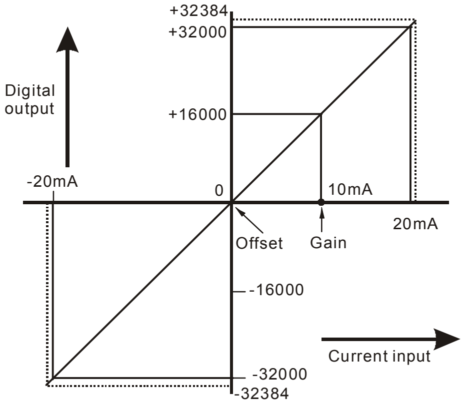
- Mode 3 (H'0003): (0V~+5V)



Mode 3 of CR#2~ CR#5	0V ~ +5V, Gain = 2.5V (16,000), Offset = 0V (0).
Gain (CR#34 ~ CR#37)	The voltage input value corresponds to digital value 16,000.
Offset (CR#28 ~ CR#31)	The voltage input value corresponds to digital value 0.
Range of digital conversion	0 ~ 32,000
Max./Min. output range of digital data	-384 ~ +32,384

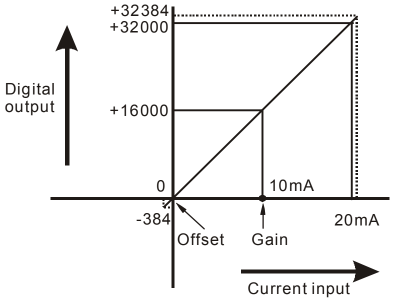
Current input mode

- Mode 4 (H’0004): (-20mA~ +20mA)



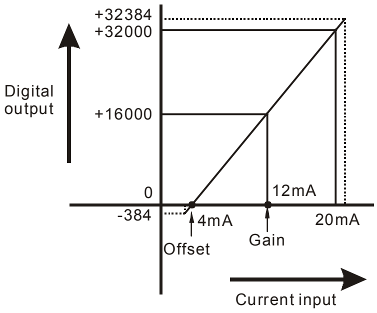
Mode 4 of CR#2~ CR#5	-20mA ~ +20mA, Gain = 10mA (16,000), Offset = 0mA (0).
Gain (CR#34 ~ CR#37)	The current input value corresponds to digital value 16,000.
Offset (CR#28 ~ CR#31)	The current input value corresponds to digital value 0.
Range of digital conversion	-32,000 ~ +32,000
Max./Min. output range of digital data	-32,384 ~ +32,384

- Mode 5 (H’0005): (0 ~ +20mA)



Mode 5 of CR#2~ CR#5	0mA ~ +20mA, Gain = 10mA (16,000), Offset = 0mA (0).
Gain (CR#34 ~ CR#37)	The current input value corresponds to digital value 16,000.
Offset (CR#28 ~ CR#31)	The current input value corresponds to digital value 0.
Range of digital conversion	0 ~ 32,000
Max./Min. output range of digital data	-384 ~ +32,384

- Mode 6 (H'0006): (+4mA ~ +20mA)



Mode 6 of CR#2~ CR#5	+4mA ~ +20mA, Gain = 12mA (19,200), Offset = 4mA (6,400).
Gain (CR#34 ~ CR#37)	The current input value when the digital output value = 16,000.
Offset (CR#28 ~ CR#31)	The current input value when the digital output value = 0.
Range of digital conversion	0 ~ 32,000
Max./Min. output range of digital data	-384 ~ +32,384

■ Adjusting D/A Conversion Curve of CH5 ~ CH6

You can adjust the conversion curves according to the application requirements by changing the Offset value (CR#32 ~ CR#33) and Gain value (CR#38 ~ CR#39).

Gain: The voltage (current) output value corresponding to digital value 16,000.

Offset: The voltage (current) output value corresponding to digital value 0.

- For voltage output Mode 0: 0.3125mV = 20V/64,000

  Equation

$$Y(V)=\left[\frac{X\times(Gain-Offset)}{16000}+Offset\right]\times\left(\frac{10(V)}{32000}\right)$$

  Y= Voltage output, X= Digital value

- For current output Mode 1: 0.625μA = 20mA/32,000.

  Equation

$$Y(mA)=\left[\frac{X\times(Gain-Offset)}{16000}+Offset\right]\times\left(\frac{20(mA)}{32000}\right)$$

  Y= Current output, X= Digital value

- For current output Mode 2: 0.5μA = 16mA/32,000

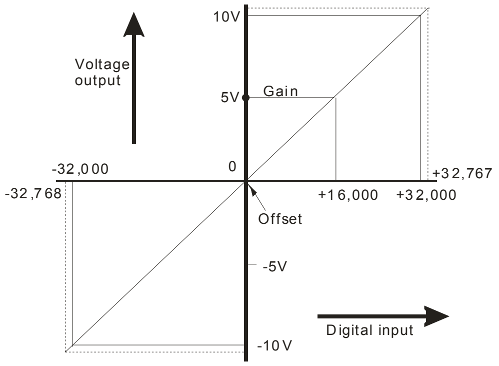
  Adopt the equation of current output Mode 1, substitute Gain for 19,200(12mA) and Offset for 6,400(4mA)

  Equation:

$$Y(mA)=\left[\frac{X\times(19200-6400)}{16000}+6400\right]\times\left(\frac{20(mA)}{32000}\right)$$

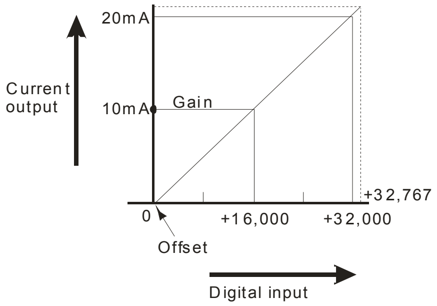
Y= Current output, X= Digital value

- **Voltage output mode**
  - Mode 0 (H'0000): (-10V ~ +10V)



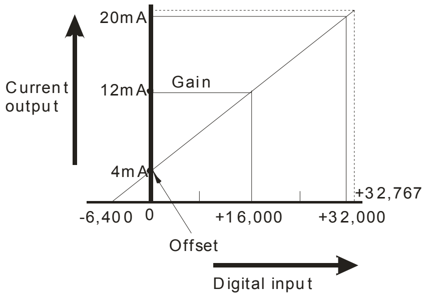
Mode 0 of CR#2~ CR#5	-10V ~ +10V, Gain = 5V (16,000), Offset = 0V (0).
Gain (CR#38 ~ CR#39)	The voltage output value corresponds to digital value 16,000.
Offset (CR#32 ~ CR#33)	The voltage output value corresponds to digital value 0.
Range of digital conversion	-32,000 ~ +32,000
Max./Min. input range of digital data	-32,768 ~ +32,767

- **Current output mode**
  - Mode 1 (H'0001): (0mA ~ +20mA)



Mode 1 of CR#2~ CR#5	0mA ~ +20mA, Gain = 10mA (16,000), Offset = 0mA (0).
Gain (CR#38 ~ CR#39)	The current output value corresponds to digital value 16,000.
Offset (CR#32 ~ CR#33)	The current output value corresponds to digital value 0.
Range of digital conversion	0 ~ +32,000
Max./Min. input range of digital data	0 ~ +32,767

- Mode 2 (H'0002): (4mA ~ +20mA)



Mode 2 of CR#2~ CR#5	4mA ~ +20mA, Gain = 12mA (19,200), Offset = 4mA (6,400).
Gain (CR#38 ~ CR#39)	The current output value corresponds to digital value 19,200.
Offset (CR#32 ~ CR#33)	The current output value corresponds to digital value 6,400.
Range of digital conversion	0 ~ +32,000
Max./Min. input range of digital data	-6400 ~ +32,767

■ Adjusting A/D Conversion Curve in Voltage Input Mode 0 & Mode2

1. Description

- CH1 example. When CR#2 is set to voltage input mode (mode 0), the Offset value will be set to 0V (0) and the Gain value to 5V (5V/0.3215mV=16,000), i.e. input voltage -10V ~ +10V will correspond to values -32,000 ~ +32,000.
- When CR#2 is set to voltage input mode (mode 2), the Offset value will be set to 0V (0) and the Gain value to 5V (5V/0.3215mV=16,000), i.e. input voltage 0V ~ +10V will correspond to values 0 ~ +32,000.
- If the default voltage input mode (mode 0 and mode 2) does not meet the needs of the application, make adjustments to the A/D conversion curve. For example, Set the Offset of CH1 to 2V (2V/0.3215mV=6,400) and the Gain to 6V (6V/0.3215mV=19,200).

$$Y = {16000 \times \left(\frac{X(V)}{10(V)} \times 32000 - Offset \right)} \Big/ {(Gain - Offset)}$$

Example: If X=6V, Y=?

$$Y = {16000 \times \left(\frac{6(V)}{10(V)} \times 32000 - 6400 \right)} \Big/ {(19200 - 6400)} = 16000$$

2. Addresses
    - X0 = On: Set the input mode for the signals at CH1 to mode 0.
    - X1 = On: Set the Offset value oforCH1 to 2V (6,400) and the Gain value to 6V (19,200).
    - M0 = On: Disable CH1 configuration changes.
3. Program description
    - When X0 = On, set CR#2 to K0 (H’0000) and the signal input mode for CH1 to mode 0 (voltage input mode).
    - When X1 = On, write K6,400 (Offset value for CH1) into CR#28 and K19,200 (Gain value for CH1) into CR#24.
    - When X1 goes from On to Off, set M0 = On to disable modifications to the A/D conversion curve. Write K1 (H’1) into CR#40 b0=1.
4. Program example

Ladder diagram:

Explanation:

Set CH1 to mode 0 (voltage input mode)

Set the Offset value for CH1

Set the Gain value for CH1

Disable changing CH1 configuration

■ Adjusting A/D Conversion Curve in Voltage Input Mode 1 & Mode 3

1. Description
    - CH2 example. When CR#3 is set to voltage input mode (mode 1), the Offset value will be set to 0V (0) and the Gain value to 2.5V (2.5V/0.15625mV=16,000), i.e. input voltage -5V ~ +5V will correspond to values -32,000 ~ +32,000.
    - When CR#3 is set to voltage input mode (mode 3), the Offset value will be set to 0V (0) and the Gain value to 2.5V (2.5V/0.15625mV=16,000), i.e. input voltage 0V ~ +5V will correspond to values 0 ~ +32,000.
    - If the default voltage input modes (mode 1 and mode 3) do not meet the application requirements, make adjustments to the A/D conversion curve. For example, set the Offset for CH2 to 1V (1V/0.15625mV=6,400) and the Gain to 3V (3V/0.15625mV=19,200).

$$Y = \frac{16000 \times \left(\frac{X(V)}{5(V)} \times 32000 - Offset \right)}{(Gain - Offset)}$$

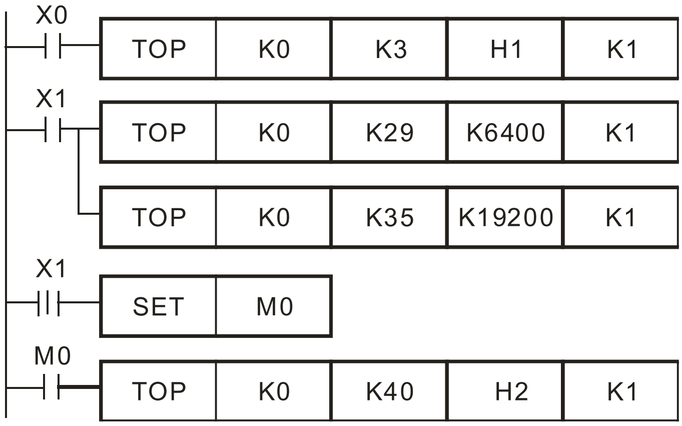
Example: If X=3V, Y=?

$$Y = \frac{16000 \times \left(\frac{3(V)}{5(V)} \times 32000 - 6400 \right)}{(19200 - 6400)} = 16000$$

2. Addresses
   - X0 = On: Set the input mode for CH2 to mode 1.
   - X1 = On: Set the Offset value for CH2 to 1V (6,400) and the Gain value to 3V (19,200).
   - M0 = On: Disable CH2 configuration changes.
3. Program explanation
   - When X0 = On, set CR#3 to K1 (H’0001),the input mode for CH2 to mode 1 (voltage input mode).
   - When X1 = On, write K6,400 (Offset value for CH2) into CR#29 and K19,200 (Gain value for CH2) into CR#35.
   - When X1 goes from On to Off, set M0 = On to disable modifying the A/D conversion curve. Write K2 (H’2) into CR#40 b1=1.
4. Program example

Ladder diagram:

Explanation:



Set CH2 to mode 1 (voltage input mode)

Set the Offset value for CH2

Set the Gain value for CH2

Disable modifying CH2 configuration

■ Adjusting A/D Conversion Curve in Current Input Mode 4, Mode 5 and Mode 6

1. Description
   - CH3 example. When CR#4 is set to current input mode (mode 4), the Offset value will be set to 0mA (0) and the Gain value to 10mA (10mA/0.625μA=16,000), i.e. input current -20mA ~ +20mA will correspond to values -32,000 ~ +32,000.

- When CR#4 is set to current input mode (mode 5), the Offset value will be set to 0mA (0) and the Gain value to 10mA (10mA/0.625µA=16,000), i.e. input current 0mA ~ +20mA will correspond to values 0 ~ +32,000.
- When CR#4 is set to current input mode (mode 6), the Offset value will be set to 4mA (4mA/0.625µA=6,400) and Gain value to 12mA (12mA/0.625µA=19,200), i.e. input current 4mA ~ +20mA will correspond to values 0 ~ +32,000.
- If the default current input modes (mode 4 ~ mode 6) do not meet the application requirements, make adjustments to the A/D conversion curve. For example, Set the Offset for CH3 to 8mA (8mA/0.625µA=12,800) and the Gain to 14mA (14mA/0.625µA=22,400).

$$Y = {16000 \times \left(\frac{X\,(mA)}{20(mA)} \times 32000 - Offset \right)} \Big/ {(Gain - Offset)}$$

Example: If X=14mA, Y=?

$$Y = {16000 \times \left(\frac{14(mA)}{20(mA)} \times 32000 - 12800 \right)} \Big/ {(22400 - 12800)} = 16000$$

2. Addresses
   - X0 = On: Set the input mode for CH3 to mode 4.
   - X1 = On: Set the Offset value for CH3 to 8mA (12,800) and the Gain value to 14mA (22,400).
   - M0 = On: Disable CH3 configuration changes.
3. Program description
   - When X0 = On, set CR#4 to K4 (H'4), CH3 to mode 4 (current input mode).
   - When X1 = On, write K12,800 (Offset value for CH3) into CR#30 and K22,400 (Gain value for CH3) into CR#36.
   - When X1 goes from On to Off, set M0 = On to disable modifications to the A/D conversion curve.

4. Program example

Ladder Diagram:

Explanation:

Set CH3 to mode 4 (current input mode)

Set the Offset value for CH3

Set the Gain value for CH3

Disable CH3 configuration changes.

Adjusting D/A Conversion Curve in Voltage Output Mode

1. Description
   - CH5 example. When CR#6 is set to voltage output mode (mode 0), the Offset value will be set to 0V (0) and the Gain value to 5V (5V/0.3215mV=16,000), i.e. output voltage -10V ~ 10V will correspond to values -32,000 ~ +32,000.
   - If the default voltage output mode (mode 0) does not meet the application requirements, make adjustments to the D/A conversion curve. For example, set the Offset of CH5 ~ CH6 to 2V (2V/0.3215mV=6,400) and the Gain to 6V (6V/0.3215mV=19,200).

$$Y(V) = \left[\frac{X \times (Gain - Offset)}{16000} + Offset\right] \times \left(\frac{10(V)}{32000}\right)$$

Example: If X=16000, Y=?

$$Y(V) = \left[\frac{16000 \times (19200 - 6400)}{16000} + 6400\right] \times \left(\frac{10(V)}{32000}\right) = 6(V)$$

2. Addresses
   - X0 = On: Set the output mode for CH5 to mode 0.
   - X1 = On: Set the Offset value for CH5 to 2V (6,400) and the Gain to 6V (19,200).
   - M0 = On: Disable changing CH5 configuration.
3. Program Description
   - When X0 = On, write K0 (H’0000) to CR#6 to configure CH5 to mode 0 (voltage output mode).
   - When X1 = On, write K6400 (Offset value for CH5) into CR#32 and K19,200 (Gain value for CH5) into CR#38.
   - When X1 goes from On to Off, set M0 = On to disable changes to the D/A conversion

curve. Write K16 (H'10) into CR#40 b4=1.

4. Program example

Ladder diagram:

Explanation:

Set CH5 to mode 0 (voltage output mode)

Set the Offset value for CH5

Set the Gain value for CH5

Disable CH5 configuration changes

■ Adjusting D/A Conversion Curve in Current Output Mode 1 and Mode 2

1. Description

- CH6 example. When CR#7 is set to current output mode (mode 1), the Offset value will be set to 0mA (0) and the Gain value to 10mA (10mA/0.625μA=16,000), i.e. output current 0mA ~ +20mA will correspond to values 0 ~ +32,000.
- When CR#7 is set to current output mode (mode 2), the Offset value will be set to 4mA (4mA/0.625μA=6,400) and the Gain value to 12mA (12mA/0.625μA=19,200), i.e. input current 4mA ~ +20mA will correspond to values 0 ~ +32,000.
- If the default current output modes (mode 1 and mode 2) do not meet the application requirements, make adjustments to the D/A conversion curve. For example, set the Offset for CH6 to 6mA (6mA/0.625μA=9,600) and the Gain to 13mA (13mA/0.625μA=20,800).

$$Y(mA)=\left[\frac{X\times(Gain-Offset)}{16000}+Offset\right]\times\left(\frac{20(mA)}{32000}\right)$$

Example: If X=16000, Y=?

$$Y(mA)=\left[\frac{16000\times(20800-9600)}{16000}+9600\right]\times\left(\frac{20(mA)}{32000}\right)=13(mA)$$

2. Addresses

- X0 = On: Set the output mode for CH6 to mode 1.
- X1 = On: Set the Offset value of CH6 to 6mA (9,600) and the Gain value to 13mA (20,800).

- M0 = On: Disable CH6 configuration changes

3. Program Description
   - When X0 = On, write K1 (H'0001) to CR#7 to configure CH6 for mode 1 (current output mode).
   - When X1 = On, write K9,600 (Offset value for CH6) into CR#33 and K20,800 (Gain value for CH6) into CR#39.
   - When X1 goes from On to Off, set M0 = On to disable configuration changes to the D/A conversion curve. Write K32 (H'20) into CR#40 b5=1.
4. Program example

Ladder diagram:

Explanation:

Set CH6 to mode 1 (current output mode)

Set the Offset value for CH6

Set the Gain value for CH6

Disable CH6 configuration changes

3.2.4 ELCM-PT04ANNN

3.2.4.1 The Basic Concepts of Platinum Temperature Sensors

Platinum temperature sensor is highly accurate and stable and the quality of linearity between -200°C and 600°C is fairy good. Generally speaking, the temperature coefficient of PT100 temperature sensors is significant at low temperatures -200°C ~ -100°C, and the quality of linearity is good at middle temperature 100°C ~ 300°C. The temperature coefficient becomes small for higher temperatures, i.e. 300°C ~ 500°C. The resistance of PT100 is 100Ω when the temperature is 0°C, which is the standard for a metallic temperature sensor.

The rated current for temperature sensore should be less than 2mA. The self-heating of 1mW for a PT100 will cause a temperature variation of 0.02°C ~ 0.75°C. Therefore, reducing the current of a PT100 can also reduce the temperature variation. However, if the current is too small, the PT100 signal can be affected by electrical noise. For this reason, it is recommended to confine the current to the range 0.5mA and 2mA.

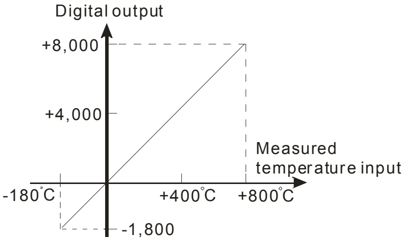
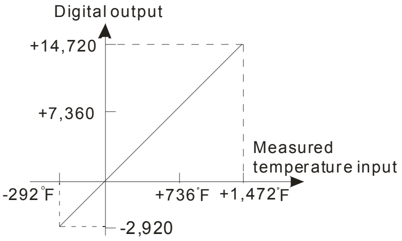
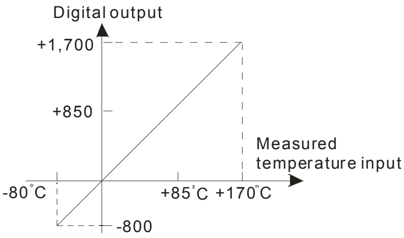
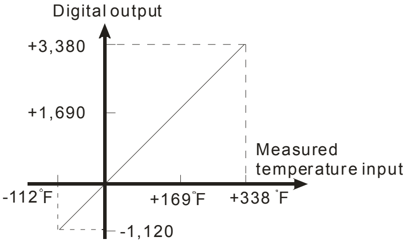
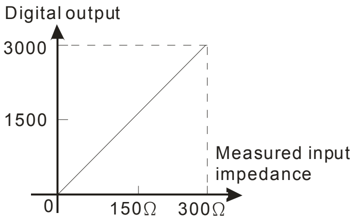
3.2.4.2 Introduction

ELCM-PT04ANNN temperature measurement module contains 4 inputs for platinum temperature sensors (PT100 3-WIRE 100Ω 3850 PPM/°C (DIN 43760 JIS C1604-1989)/ NI100 / PT1000 / NI1000) and converts these inputs into 16-bit digital signals. Users can select the temperature in Celsius (°C) or Fahrenheit (°F). Resolution of temperature in Celsius: 0.1°C and in Fahrenheit: 0.1°F. In addition, the data in the module can be accessed via FROM/TO instructions in the ELC program or by reading the average values for the channels directly by using MOV instructions (refer to special registers D9900 ~ D9999).

3.2.4.3 Specification

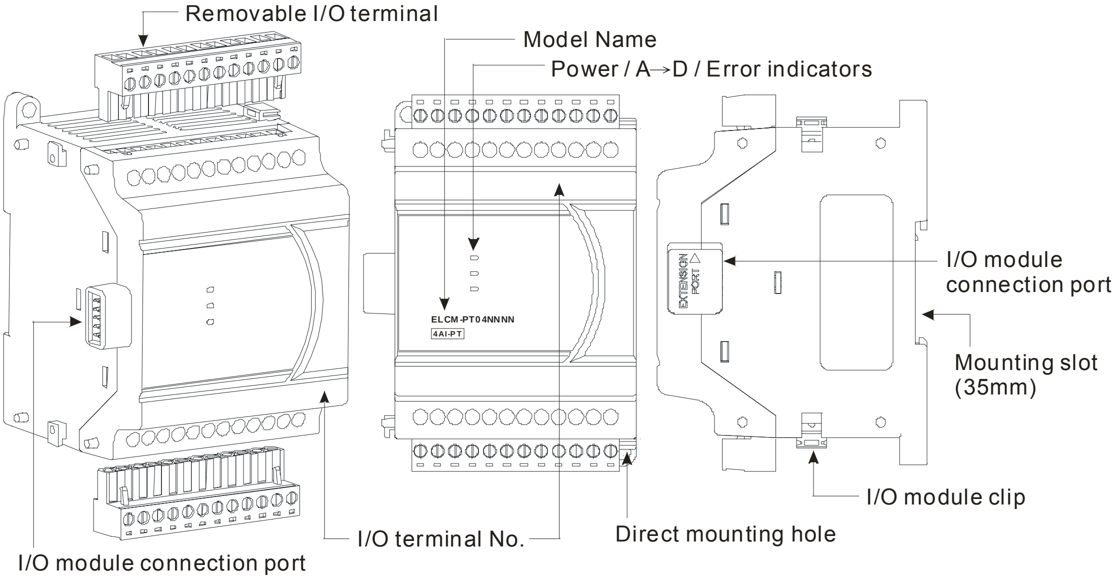
- **Functional Specifications**

ELCM-PT04ANNN	Celsius (°C)	Fahrenheit (°F)	Input Impedance
Power supply voltage	24V DC (20.4V DC ~ 28.8V DC) (-15% ~ +20%)		
Connector	European standard fixed terminal block (Hole diameter: 5mm)		
Analog input channel	4 channels		
Applicable sensor type	3-WIRE PT100 / NI100 / PT1000 / NI1000		
Current excitation	1mA		
Range of input	PT100: -180°C ~ 800°C NI100: -80°C ~ 170°C PT1000: -180°C ~ 800°C NI1000: -80°C ~ 170°C	PT100: -292°F ~ 1472°F NI100: -112°F ~ 338°F PT1000: -292°F ~ 1472°F NI1000: -112°F ~ 338°F	0~300Ω
Range of digital conversion	PT100: K-1,800 ~ K8,000 NI100: K-800 ~ K1,700 PT1000: K-1,800 ~ K8,000 NI1000: K-800 ~ K1,700	PT100: K-2920 ~ K14720 NI100: K-1120 ~ K3380 PT1000:K -2920~ K14720 NI1000: K-1120 ~ K3380	0~3000

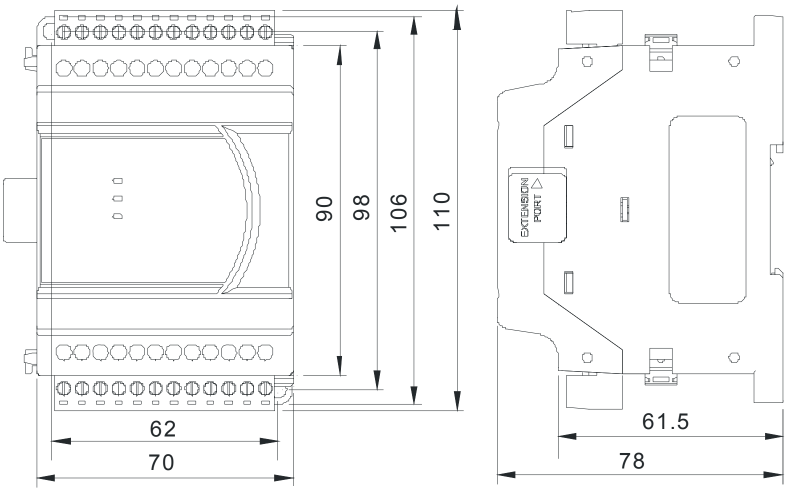
<table>
<tr><th>ELCM-PT04ANNN</th><th>Celsius (°C)</th><th>Fahrenheit (°F)</th><th>Input Impedance</th></tr>
<tr><td>Resolution</td><td>16 bits (0.1°C)</td><td>16 bits (0.18°F)</td><td>16 bits (0.1Ω)</td></tr>
<tr><td>Overall accuracy</td><td colspan="3">±0.5% when in full scale (25°C, 77°F)
±1% when in full scale within the range of 0 ~ 55°C, 32 ~ 131°F</td></tr>
<tr><td>Response time</td><td colspan="3">1.6 sec / all channels</td></tr>
<tr><td>Isolation</td><td colspan="3">Optical coupler isolation between digital circuits and analog circuits. No isolation among analog channels.
500VDC between digital circuits and Ground
500VDC between analog circuits and Ground
500VDC between analog circuits and digital circuits
500VDC between 24VDC and Ground</td></tr>
<tr><td>Digital data format</td><td colspan="3">16 significant bits are available; in 2's complement.</td></tr>
<tr><td>Average function</td><td colspan="3">Supported. Available for setting up sampling range in CR#8 ~ CR#11.
Range: K1 ~ K100.</td></tr>
<tr><td>Self-diagnosis</td><td colspan="3">Upper and lower bound detection in all channels</td></tr>
<tr><td>Series connection to ELCM MPU</td><td colspan="3">The modules are numbered from 0 to 7 automatically by their distance from MPU. No.0 is the closest to MPU and No.7 is the furthest. Maximum 8 modules are allowed to connect to MPU and will not occupy any digital I/O points.</td></tr>
<tr><td rowspan="3">Temperature/digital curve (Default: Mode 0)</td><td>Mode 0 (H'0000): PT100, °C
Mode 2 (H'0002): PT1000, °C

</td><td colspan="2">Mode 0 (H'0000): PT100, °F
Mode 2 (H'0002): PT1000, °F

</td></tr>
<tr><td>Mode 1 (H'0001): NI 100, °C
Mode 3 (H'0002): NI 1000, °C

</td><td colspan="2">Mode 1 (H'0001): NI 100, °F
Mode 3 (H'0002): NI 1000, °F

</td></tr>
<tr><td>Mode 4 (H'0004): 0~300 Ω

</td><td colspan="2">Mode -1 (H'FFFF): Channel unavailable. Average value and present value of input channels will be displayed as 32,767(H'7FFF)</td></tr>
</table>

ELCM-PT04ANNN	Celsius (°C)	Fahrenheit (°F)	Input Impedance
Operation/storage	1. Operation: 0°C ~ 55°C (temperature), 50 ~ 95% (humidity), pollution degree 2 2. Storage: -25°C ~ 70°C (temperature), 5 ~ 95%（humidity）		
Vibration/shock immunity	International standards: IEC61131-2, IEC 68-2-6 (TEST Fc)/IEC61131-2 & IEC 68-2-27 (TEST Ea)		
Max. rated power consumption	24V DC (20.4V DC ~ 28.8V DC) (-15% ~ +20%), 1.5W, supplied by external power source		
Weight	202g		

3.2.4.4 Product Profile and Outline



- **External Dimensions**

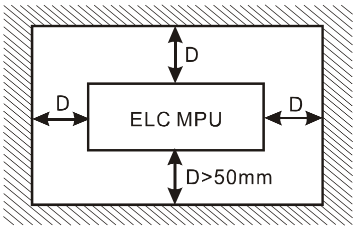


Unit: mm

3.2.4.5 Installation and Wiring

- **Installation on DIN rail**

1. The ELC may be secured to a cabinet by using 35mm in height and 7.5mm in depth DIN rail. When mounting the ELC to 35mm DIN rail, be sure to use the retaining clip to stop any side-to-side movement of the ELC and reduce the chance of wires coming loose. The retaining clip is at the bottom of the ELC. To secure the ELC to DIN rail, pull down the clip, place it onto the rail and push it up to lock it in place. To remove the ELC, pull the retaining clip down with a flat screwdriver and remove the ELC from DIN rail.
2. Install the ELC in an enclosure with sufficient space around it to allow heat dissipation, as shown in the figure below.

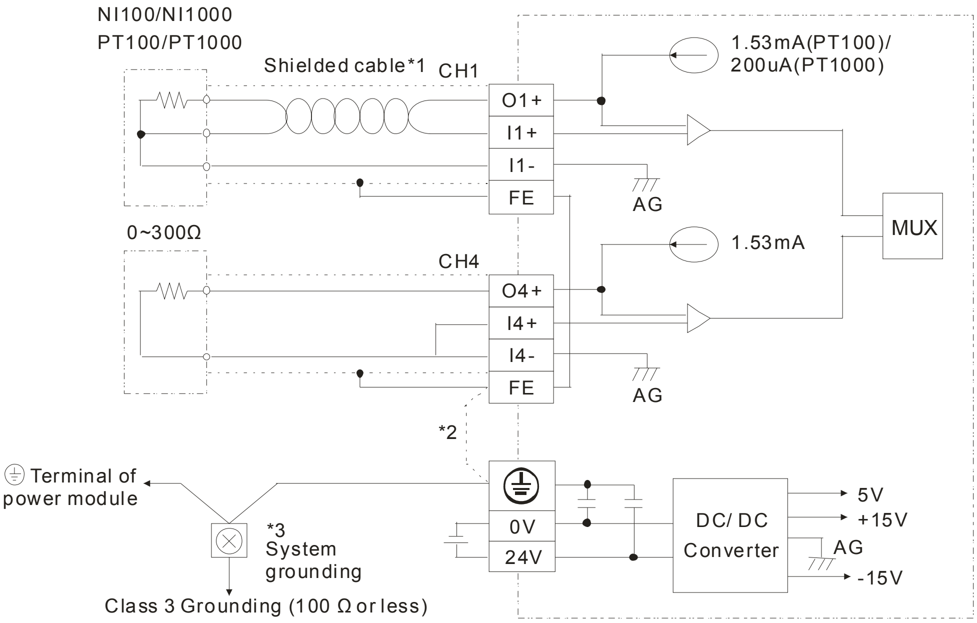


- **Direct Mounting:** Use M4 screws.
- **Wiring**

1. Use 22-16 AWG (1.5mm) single-core wire or the multi-core wire for the I/O wiring. The specification of the terminal is shown in the figure on the right hand side. The ELC terminal screws should be tightened to 1.95 kg-cm (1.7 in-lbs). Also, use 60/75°C copper conductor only.
2. DO NOT wire empty terminals. DO NOT place the signal wires and power wires in the same conduit.
3. DO NOT drop metallic conductors into the ELC during installation.
   - Attach the dustproof sticker to the ELC before installation to prevent conductive objects from dropping in.
   - Tear off the sticker before running the ELC to ensure normal heat dissipation.

.

External Wiring

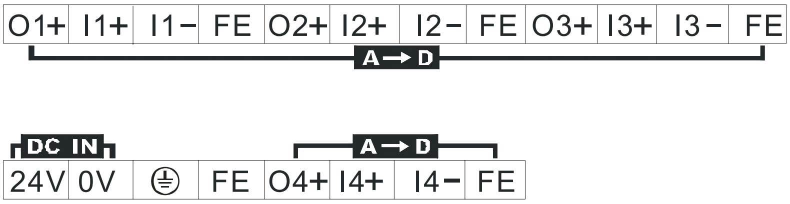


Note 1: Wiring should be done using PT100 / PT1000 temperature sensor or double shielded cables and should be separated from power cables that may cause electrical interference. Use 3 wires for PT100 / PT1000 if possible. If a 2 wire sensor is used, jumper the I+ and I- terminals.

Note 2: Connect FE to ⏚ terminal for noise suppression.

Note 3: Connect the ⏚ terminal on both the power supply and the PT04ANNN to the system ground.

3.2.4.6 Terminal Layout



3.2.4.7 CR (Control Register)

CR#	Attrib.		Register content	Description
#0	O	R	Module Type	ELCM-PT04ANNN model code = H’0082
#1	O	R	Firmware version	Display the current firmware version in hex.
#2	O	R/W	CH1 Input mode setting	Input mode: Default = H’0000. CH1 example: Mode 0 (H’0000): PT100: -180°C ~ 800°C Mode 1 (H’0001): NI100: -80°C ~ 170°C Mode 2 (H’0002): PT1000: -180°C ~ 800°C Mode 3 (H’0003): NI1000: -80°C ~ 170°C Mode 4 (H’0004): 0~300Ω.
#3	O	R/W	CH2 Input mode setting	
#4	O	R/W	CH3 Input mode setting	
#5	O	R/W	CH4 Input mode setting	

CR#	Attrib.		Register content	Description
#7	O	R/W	Temperature unit setting	Select the temperature units (Celsius °C / Fahrenheit °F). Default = H0(°C)
#8	O	R/W	CH1 number of samples	Set number of samples for CH1 ~ CH4 Range = K1 ~ K100 Default = K10
#9	O	R/W	CH2 number of samples	
#10	O	R/W	CH3 number of samples	
#11	O	R/W	CH4 number of samples	
#12	X	R	Average temperature measured at CH1	Average temperature measured at CH1 ~ CH4. Temperature units: set in CR#7 Average temperatures are based on the number of samples in CR#8-11.
#13	X	R	Average temperature measured at CH2	
#14	X	R	Average temperature measured at CH3	
#15	X	R	Average temperature measured at CH4	
#20	X	R	Present temperature measured at CH1	Present temperature measured at CH1 ~ CH4. Temperature units: set in CR#7
#21	X	R	Present temperature measured at CH2	
#22	X	R	Present temperature measured at CH3	
#23	X	R	Present temperature measured at CH4	
#28	O	R/W	Adjusted Offset value of CH1	Set the adjusted Offset value of Ch1 ~ Ch4. Default = K0 Range: K-400 ~ K400 Temperature unit: set in CR#7 Definition of Offset at Ch1 ~ Ch4 in ELCM-PT04ANNN: Deviation digital value from the target value.
#29	O	R/W	Adjusted Offset value of CH2	
#30	O	R/W	Adjusted Offset value of CH3	
#31	O	R/W	Adjusted Offset value of CH4	
#40	O	R/W	Function: Set value changing prohibited	Prohibit configuration changes for CH1 ~ CH4
#41	X	R/W	Function: Save all the set values	Save all configuration values, Default =H'0000
#42	X	R/W	Function: Return to default setting	Set all values to default setting, Default = H'0000
#43	X	R	Error status	Register for storing all error status. See the table of error status for more information.
#100	O	R/W	Function: Enable/Disable limit detection	Enable/Disable the upper and lower limit detection function. Default= H'0000.
#101	X	R/W	Upper and lower limit status	Display the upper and lower limit value, Default =H'0000
#102	O	R/W	Set value for CH1 upper limit	Set value of CH1~CH4 upper limit. Default = K32000.
#103	O	R/W	Set value for CH2 upper limit	
#104	O	R/W	Set value forCH3 upper limit	
#105	O	R/W	Set value for CH4 upper limit	
#108	O	R/W	Set value for CH1 lower limit	Set value of CH1~CH4 lower limit. Default = K-32000.
#109	O	R/W	Set value for CH2 lower limit	
#110	O	R/W	Set value for CH3 lower limit	
#111	O	R/W	Set value for CH4 lower limit	

CR#	Attrib.	Register content	Description
O: When CR#41 is set to H'5678, the configuration values will be saved. X: configuration value will not be saved. R: able to read data by using FROM instruction. W: able to write data by using TO instruction.			

- PID Control Registers

CR#				Attrib.		Register content	Description
CH1	CH2	CH3	CH4				
#120	#140	#160	#180	O	R/W	Set temperature value	Set the temperature value according to proper range of each sensor type. Default = K0
#121	#141	#161	#181	O	R/W	Sampling time (s)	Range: K1 ~ K30 (s). Default = K2
#122	#142	#162	#182	O	R/W	K_P	Proportional control constant. Default = K121
#123	#143	#163	#183	O	R/W	K_I	Integral constant. Default = K2,098
#124	#144	#164	#184	O	R/W	K_D	Derivative constant. Default = K-29
#125	#145	#165	#185	O	R/W	Upper limit of I value	Upper limit of I value. Default = K0
#126	#146	#166	#186	O	R/W	Lower limit of I value	Lower limit of I value. Default = K0
#127	#147	#167	#187	X	R	I value	Current accumulated offset value
#128	#148	#168	#188	O	R/W	Heating/cooling	0: Heater, 1: Cooler. Default = K0
#129	#149	#169	#189	O	R/W	Upper limit of output	Upper limit of output. Default = K32,000
#130	#150	#170	#190	O	R/W	Lower limit of output	Lower limit of output. Default = K0
#131	#151	#171	#191	X	R	Output percentage	Output percentage (Unit: 0.1%)
#132	#152	#172	#192	X	R	Output width (ms)	Width of control output. Unit: ms
#133	#153	#173	#193	X	R	Output cycle (ms)	Cycle of control output. Unit: ms
#134	#154	#174	#194	X	R	Output volume	Output volume
#135	#155	#175	#195	X	R/W	PID_RUN/STOP	0: STOP, 1: RUN. Default = K0
#136	#156	#176	#196	X	R/W	Auto-tuning	0: Disabled, 1: Auto-tuning. Default = K0

■ Explanation on CR

CR#0: Module Type

1. ELCM-PT04ANNN module code = H'0082.
2. Read the module code in the program to verify the correct extension module

CR#1: Firmware version

Display the current firmware version in hex, e.g. version V1.00 is indicated as H'0100.

CR#2, 3, 4, 5: CH1 ~ CH4 input mode

Set the mode of the input channels for the input module. There are 6 modes for each channel which can be set up separately.

When CH1 is configured for mode 1 (H'0001) CR#2 must be set to H'0001. The default setting = H'0000. CH1 example:

Mode 0 (H'0000): PT100 (-180°C ~ 800°C).
Mode 1 (H'0001): NI100 (-80°C ~ 170°C).
Mode 2 (H'0002): PT1000 (-180°C ~ 800°C).
Mode 3 (H'0003): NI1000 (-80°C ~ 170°C).
Mode 4 (H'0004): 0~300Ω.
Mode-1 (H'FFFF): Channel 1 unavailable.

CR#7: Temperature units

Select the temperature units for average temperature and present temperature. (Celsius °C / Fahrenheit °F). Default = H'0000.

Mode 0 (H'0000): Celsius °C.
Mode 1 (H'0001): Fahrenheit °F.

CR#8, 9, 10, 11: CH1 ~ CH4 number of samples

1. The number of samples used for the average temperature values for CH1 ~ CH4.
2. Range: K1 ~ K100. Default = K10. If the value exceeds K100, the value will be set to K100; if the value is less than K1, it will be set to K1.

CR#12, 13, 14, 15: Average temperature measured at CH1 ~ CH4

The average temperature measured at CH1 ~ CH4. These values are calculated based on the number of samples set in CR#8 ~ CR#11. Temperature units: set in CR#7. For example, if the sampling range is set as K10, the contents in CR#12 ~ CR#15 will be the average of the most recent 10 temperature signals in CH1 ~ CH4.

CR#20, 21, 22, 23: Present temperature measured at CH1 ~ CH4

The present temperature at CH1 ~ CH4. Temperature units: set in CR#7.

CR#28, 29, 30, 31: Adjusted Offset value for CH1 ~ CH4

1. Set the adjusted Offset value for CH1 ~ CH4
2. Range: K-400~K400
3. Default setting = K0

Mode 0 ~ Mode 3:

Equation:

$$Y = \left(\frac{X(^\circ)}{0.1(^\circ)} - Offset \right)$$

Y = digital output, X = measured input temperature

Mode 4:

Equation:

$$Y = \left(\frac{X\,(\mathrm{Ohm})}{0.1(\mathrm{Ohm})} - Offset \right)$$

Y = digital output, X = measured input impedance

CR#40: Function: Set prohibit configuration changes, Default = H’0000

Description	
bit0	b0=0, CH1 changing allowed; b0=1, CH1 changing prohibited
bit1	b1=0, CH2 changing allowed; b1=1, CH2 changing prohibited
bit2	b2=0, CH3 changing allowed; b2=1, CH3 changing prohibited
bit3	b3=0, CH4 changing allowed; b3=1, CH4 changing prohibited
bit4 ~ bit15	Reserved

Affected Parameters	
CR#2 ~ CR#5	Input mode configuration for CH1 ~ CH4
CR#8 ~ CR#11	Sampling range for CH1 ~ CH4
CR#28 ~ CR#31	Offset settings for CH1 ~ CH4
CR#42	Returning to default settings
CR#100	Function: Enable/Disable limit detection
CR#102~CR#105	Setting of CH1~CH4 upper limit
CR#108~CR#111	Setting of CH1~CH4 lower limit
CR#120~CR#196	PID relative settings

CR#41: Function: Save all the configuration values. Default=H’0000

Save configuration settings. Save all the configuration values to the internal flash memory. When saving is complete, CR#41 will be set to H’FFFF.

Set value	Function
H0	No action
HFFFF	Saving complete
H5678	Saving enabled.

Note: Default = H0. When the value = H’5678, saving will be enabled, and CR#41 will be set to H’FFFF when saving is complete.

CR#42: Function: Return to default settings, Default = H’0000

Description	
bit0	b0=0, no action on CH1; b0=1, set CH1 to default settings
bit1	b1=0, no action on CH2; b1=1, set CH2 to default settings
bit2	b2=0, no action on CH3; b2=1, set CH3 to default settings
bit3	b3=0, no action on CH4; b3=1, set CH4 to default settings
bit4 ~ bit15	Reserved

Note: Set the appropriate bit to 1 and the corresponding channel will be returned to default settings. When complete, the value will be set to 0. If CR#40(configuration changes prohibited) is enabled, CR#42 will be invalid, and all configuration values will remain unchanged. Error Code bit 12 of CR#43 will be set to 1

Affected Parameters	
CR#2 ~ CR#5	Input mode configuration for CH1 ~ CH4
CR#8 ~ CR#11	Sampling range for CH1 ~ CH4
CR#28 ~ CR#31	Offset settings for CH1 ~ CH4
CR#100	Function: Enable/Disable limit detection
CR#102~CR#105	Setting of CH1~CH4 upper limit
CR#108~CR#111	Setting of CH1~CH4 lower limit
CR#120~CR#196	PID relative settings

CR#43: Error status. Default=H’0000

CR#43: Error status value. See the table below:

Description					
bit0	K1 (H’1)	Power supply error	bit6	K64 (H’40)	CH4 Conversion error
bit1	K2 (H’2)	Hardware error	bit9	K512(H’0200)	Mode setting error
bit2	K4 (H’4)	Upper / lower bound error	bit10	K1024(H’0400)	Number of samples
bit3	K8 (H’8)	CH1 Conversion error	bit11	K2048(H’0800)	Upper / lower limit configuration error
bit4	K16 (H’10)	CH2 Conversion error	bit12	K4096(H’1000)	Configuration changes prohibited
bit5	K32 (H’20)	CH3 Conversion error	bit13	K8192(H’2000)	Communication fault on next module

✍*Note: Each error status is determined by the corresponding bit (b0 ~ b13) and there may be more than 2 errors occurring at the same time. 0 = normal; 1 = error*

CR#100: Function: Enable/Disable limit detection. Default =H’0000

Description	
bit0=1	Enable CH1 limit detection
bit1=1	Enable CH2 limit detection
bit2=1	Enable CH3 limit detection
bit3=1	Enable CH4 limit detection
bit4 ~ bit15	Reserved

CR#101: Upper and lower limit status. Default =H’0000

Description	
bit0=1	CH1 exceeds lower limit
bit1=1	CH2 exceeds lower limit
bit2=1	CH3 exceeds lower limit
bit3=1	CH4 exceeds lower limit
bit4 ~ bit7	Reserved
bit8=1	CH1 exceeds upper limit
bit9=1	CH2 exceeds upper limit
bit10=1	CH3 exceeds upper limit
bit11=1	CH4 exceeds upper limit
bit12 ~ bit15	Reserved

CR#102, 103, 104, 105: Set the upper limit for CH1 ~ CH4. Default =H’0000

Set the upper limit value for CH1 ~ CH4. Default = K32,000

CR#108, 109, 110, 111: Set the lower limit value for CH1 ~ CH4. Default =H’0000

Set the lower limit value for CH1 ~ CH4. Default = K-32,000

CR#120, 140, 160, 180: Set temperature value for PID

1. Set the temperature value (units: 0.1 degree) based on the proper range for each sensor type, i.e., if the target temperature is 100°C, write K1000 into the specified CR by using TO instruction.
2. Default = K0.

CR#121, 141, 161, 181: Sampling time (s)

1. Configure the time interval between each sample taken.. If the temperature in the control environment does not vary significantly, configure a longer sampling time. If the temperature changes often, configure a shorter sampling time.
2. Range: 1 ~ 30, Default =K2. The conversion time for each channel is approximately 1 second. Therefore, if the value is less than 1, 1 will be written into the CR. If the value is larger than 30, 30 will be written into the CR.
3. Output cycle time (ms) is equal to the setup sampling time (s), i.e. if the sampling time is set to 2, the output cycle will be 2,000.

CR#122, 142, 162, 182: K_P value, Default =K121

K_P: The proportional control constant, i.e. proportional band. The proportional control refers to the output being in proportion to the error. Please refer to the PID operation formula.

Output MV (%) = E / K_P × 100%

MV : Output value

K_P : Proprotional gain

$E(t)$: Error value

Example:

$K_P = 10$, $E = 1$, $K_I = 0$, $K_D = 0$ (Close K_I, K_D)

MV (%) = 1 / 10 × 100% = 10%

The output percentage displayed in CR#131, 151, 171, 191 will be 10%.

CR#123, 143, 163, 183: K_I value, Default = K2098

K_I: Integral constant.

1. If only proportional control were applied, there will be certain deviations between the set value and the actual temperature. If integral control is applied, the deviation will decrease gradually and the target temperature can be achieved.
2. Integral control function will be disabled if K0 is written to the CRs.
3. If the curve is too gradual, adjust K_I. The closer K_I is to 0, the more abrupt the curve becomes.

CR#124, 144, 164, 184: K_D value, Default = K-29

K_D: Derivative constant.

1. Derivative control enhances disturbance rejection and helps the control status get back to the target temperature quickly.
2. Derivative control function will be disabled if K0 is written to the CRs.

3. If the output percentage fluctuates greatly, adjust K_D. The closer K_D is to 0, the less fluctuation there will be in the output percentage.

CR#125, 145, 165, 185: Upper limit of I value, Default = K0
CR#126, 146, 166, 186: Lower limit of I value, Default = K0

1. When both upper limit and lower limit are 0, the upper/lower limit function for I value will be disabled, meaning there will be no upper/lower limit for the I value.
2. If the upper limit is set smaller than the lower limit, the upper and lower limits will be set to the same value.

CR#127, 147, 167, 187: I value

Current accumulated offset value.

CR#128, 148, 168, 188: Heating/cooling

Select heating or cooling control. Set the CR to "0" if your control target is for heating. Set the CR to "1" if your control target is for cooling. The default setting = H'0000.

Mode 0 (H'0000): Heating.
Mode 1 (H'0001): Cooling.

CR#129, 149, 169, 189: Upper limit of output. Default = K32,000
CR#130, 150, 170, 190: Lower limit of output. Default = K0

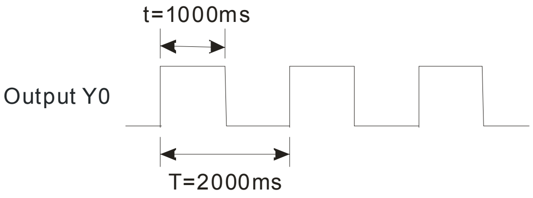
1. The output volume is calculated from the upper and lower limits.
2. For example, if the upper/lower limits are set to 0 ~ 32000, when the output reaches 50%, the output volume will be 16000. Set this CR according to the analog output you are using.

CR#131, 151, 171, 191: Output percentage (0.1%)

The result obtained from the PID operation. Units: 0.1%. For example, if the PID operating result is 100, the output percentage will be 10%.

CR#132, 152, 172, 192: Output width (ms)
CR#133, 153, 173, 193: Output cycle (ms)

If the cyclic control mode is used to control the target, read the two CRs. For example, if the cycle is 2,000 and width 1,000, the output pulse will look like the following:



CR#134, 154, 174, 194: Output volume

Formula for output volume:

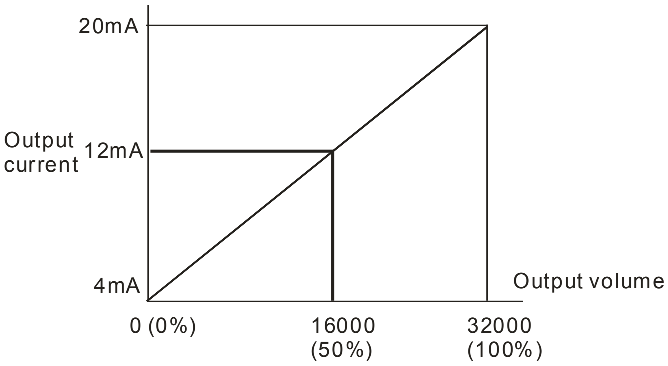
Output Volume = (Output Upper Limit – Output Lower Limit) × Output % + Output Lower Limit

Example:

Control with current 4 ~ 20mA (0 ~ 32,000)

Output upper limit: 32,000

Output lower limit: 0



CR#135, 155, 175, 195: PID_RUN/STOP

1. To apply the auto-tuning function, enable the auto-tuning function before changing the PID function to RUN. When auto-tuning is completed, CR#136, 156, 176, 196 will be cleared to 0, and the value for K_P / K_I / K_D will be stored into the corresponding CRs.
2. PID_RUN/STOP, K0: STOP, K1: RUN. Default = K0.

CR#136, 156, 176, 196: Auto-tuning

1. To apply the auto-tuning function, set the auto-tuning CR to K1 to enable the auto-tuning function before changing PID function to RUN. When auto-tuning is complete, CR#136, 156, 176, 196 will be cleared to 0, and the value of K_P / K_I / K_D will be stored into the corresponding CRs.
2. Auto-tuning, K0: Disabled, K1: Auto-tuning. Default = K0.

Notes:

1. Set K_P, K_I, and K_D to “0" to disable the PID function. If you want to use proportional

control only, set K_I and K_D to “0”.

2. If you do not know how to tune the PID parameters in your control environment, use “auto-tuning” to generate K_P, K_I and K_D and further modify them into better K_P, K_I and K_D. To utilize the auto-tuning, set the auto-tuning CR to K1. After the auto-tuning is complete, the CR will automatically return to K0.

3. To enter K_P, K_I and K_D manually, set K_P first, then set K_I and K_D to “0” to disable the integral and derivative control functions. When K_P is set, modify K_I and K_D. It is recommend to decrease K_I and K_D downward from 0.

4. If the output percentage fluctuates too much, adjust K_D. The closer K_D is to 0, the less fluctuation there will be in the output percentage. If the curve is too gradual, adjust K_I. The closer the K_I is to 0, the more abrupt the curve becomes.

3.2.4.8 Description of Special Registers D9900~D9999

When the ELCM controller is connected to special I/O modules, registers D9900~D9999 will be reserved for storing values from those modules. Use the MOV instruction to read values in D9900~D9999.

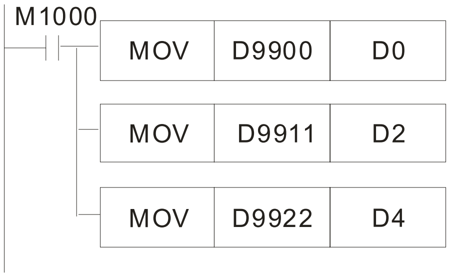
When the ELCM controller is connected to an ELCM-PT04ANNN, the following parameters can be accessed per the table below:

Module0	Module1	Module2	Module3	Module4	Module5	Module6	Module7	Description
D1320	D1321	D1322	D1323	D1324	D1325	D1326	D1327	Module code
D9900	D9910	D9920	D9930	D9940	D9950	D9960	D9970	CH1 average temperature
D9901	D9911	D9921	D9931	D9941	D9951	D9961	D9971	CH2 average temperature
D9902	D9912	D9922	D9932	D9942	D9952	D9962	D9972	CH3 average temperature
D9903	D9913	D9923	D9933	D9943	D9953	D9963	D9973	CH4 average temperature

1. D9900~D9999 are average input values for CH1 ~ CH4. When the number of samples is set to K1, the values displayed in D9900~D9999 are present values.

2. Example:

Ladder diagram:



Explanation:

Save CH1 average temperature for Module#0 to D0

Save CH2 average temperature for Module#1 to D2

Save CH3 average temperature for Module#2 to D4

3.2.4.9 Temperature Conversion in ELCM-PT04ANNN

Adjust the conversion curves according to the actual application requirements by changing the Offset value (CR#28 ~ CR#31).

- For temperature input Mode 0~3: $1_{SCALE} = 0.1°$.

  Equation:

  $$Y = \left(\frac{X(^\circ)}{0.1(^\circ)} + Offset\right)$$

  Y=Digital output, X= Measured input

- For input impedance Mode 4: $1_{SCALE} = 300\Omega/3{,}000 = 0.1$ Ohm.

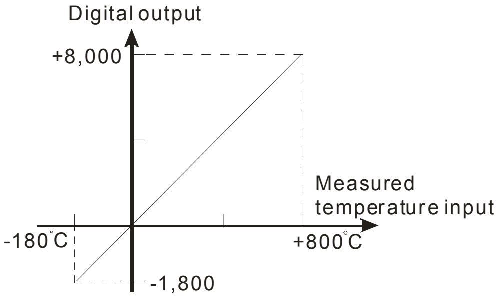
  Equation:

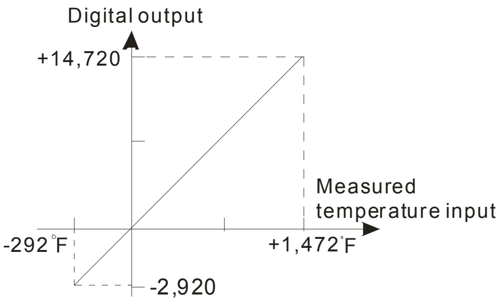
  $$Y = \left(\frac{X(\mathrm{Ohm})}{0.1(\mathrm{Ohm})} + Offset\right)$$

  Y=Digital output, X=Input impedance

Conversion Curve

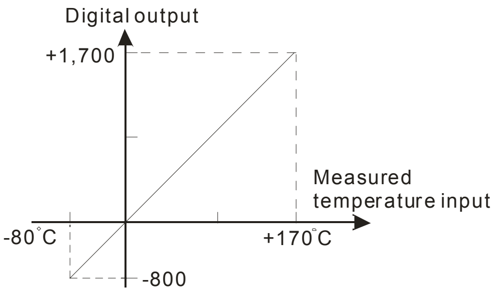
- Mode 0 (H'0000): PT100 mode °C (°F) / Mode 2 (H'0002): PT1000 mode °C (°F)

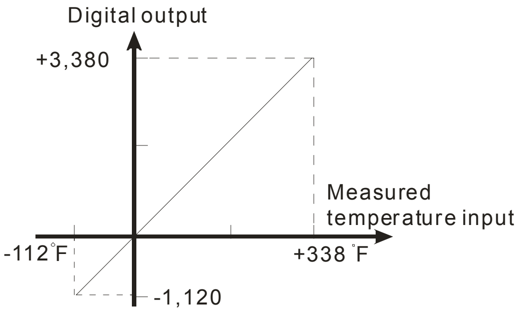




Mode 0, 2 of CR#2~ CR#5	-180°C ~ 800°C (-1800~8000), -292°F ~ 1472°F (-2920~14720)
Offset (CR#34 ~ CR#37)	Offset value

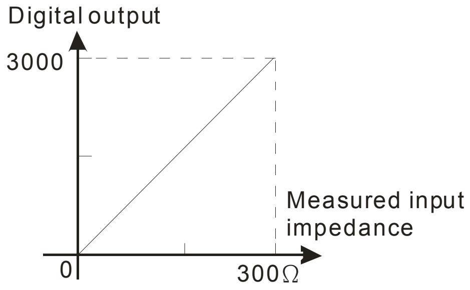
- Mode 1 (H'0001): NI100 mode °C (°F) / Mode 3 (H'0003): NI1000 mode °C (°F)





Mode 1, 3 of CR#2~ CR#5	-80°C ~ 170°C (-800~1700) , -112°F ~ 338°F (-1120~3380)
Offset (CR#34 ~ CR#37)	Offset value

- Mode 4 (H’0004): 0~300 Ω



Mode 1, 3 of CR#2~ CR#5	0 ~ 300Ω (0~3000)
Offset (CR#34 ~ CR#37)	Offset value

Adjusting PT Conversion Curve

1. Description
    - If there are deviations in the measurement results, make adjustments to the Offset value to modify the conversion curve. For example, if the temperature deviation from the target temperature (measured temperature) is -2°C, set the Offset of CH1 to 2°C (2°C /0.1°C = 20).

$$Y = \left(\frac{X\,(°\mathrm{C})}{0.1(°\mathrm{C})} + Offset \right)$$

Example: If X= -2°C, Y=?

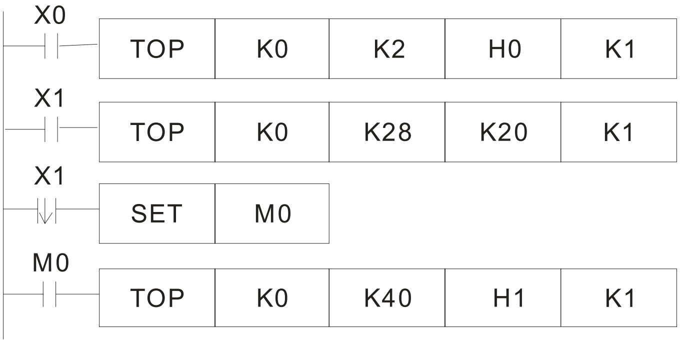
$$Y = \left(\frac{-2(°\mathrm{C})}{0.1(°\mathrm{C})} + 20 \right) = 0$$

    - You only need to configure the PT conversion curve for once. Then configure CR#40 to prevent configuration changes.
2. Addresses
    - X0 = On: Set the input mode for CH1 to mode 0.
    - X1 = On: Set the Offset value of CH1 to 2°C (20).
    - M0 = On: Disable CH1 configuration changes.
3. Program description
    - When X0 = On, set CR#2 to K0 (H’0000), i.e. CH1 to mode 0 (PT100 mode).
    - When X1 = On, write K20 (Offset value for CH1) into CR#28.
    - When X1 goes from On to Off, set M0 = On to disable changes to the PT conversion curve. Write K1 (H’1) into CR#40 b0=1.

4. Program example

Ladder diagram:

Explanation:



Set CH1 to mode 0 (PT100 mode)

Set the Offset value for CH1

Disable CH1 configuration changes

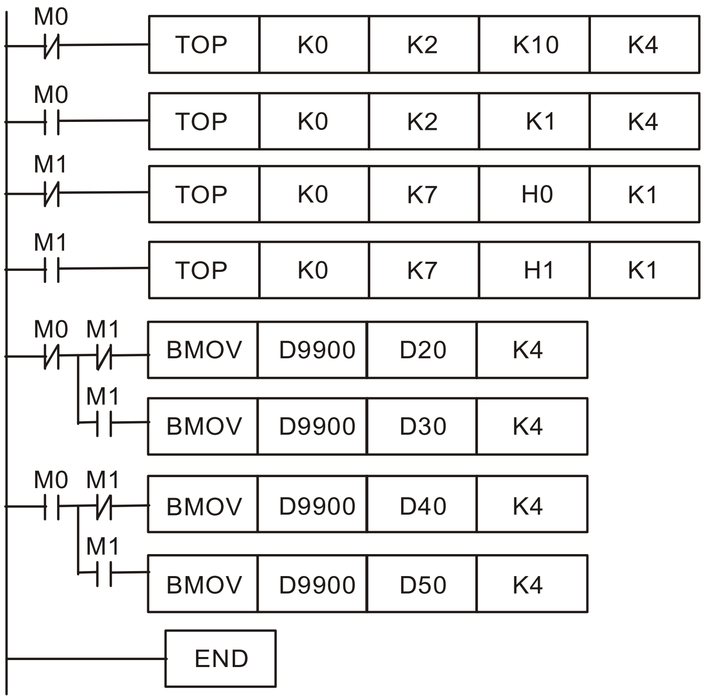
3.2.4.10 Applications

- **PT100 Temperature Measurement System**

1. Description
   - Measuring temperature with the PT100 temperature sensor.
2. Addresses
   - M0: set the sampling range.
   - M1: switch the temperature units for average and present temperature
   - D20 ~ D23: average Celsius temperature for CH1 ~ CH4
   - D30 ~ D33: average Fahrenheit temperature for CH1 ~ CH4
   - D40 ~ D43: present Celsius temperature for CH1 ~ CH4
   - D50 ~ D53: present Fahrenheit temperature for CH1 ~ CH4
3. Program Description
   - M0=Off, set the sampling range for CH1 ~ CH4 to 10; M0=On set the number of samples to 1.
   - M1=Off, temperature units = °C; M1=On temperature units = °F.
   - M0=Off, M1=Off, store the average Celsius temperatures for CH1 ~ CH4 into D20 ~ D23.
   - M0=Off, M1=On, store the average Fahrenheit temperatures for CH1 ~ CH4 into D30 ~ D33.
   - M0=On, M1=Off, store the present Celsius temperatures for CH1 ~ CH4 into D40 ~ D43.
   - M0=On, M1=On, store the present Fahrenheit temperatures for CH1 ~ CH4 into D50 ~ D53.
   - ELCM-PT04ANNN also stores the temperature values to special registers (D9900-D9999). This allows reading the contents from these special registers to obtain the temperature values. Units of temperature: 0.1°C or 0.1°F.

4. Program example

Ladder diagram:



Explanation:

Set the number of samples for CH1 ~ CH4 to 10

Set the number of samples for CH1 ~ CH4 to 1

Celsius degrees (°C)

Fahrenheit degrees (°F)

Read the average Celsius temperature for CH1 ~ CH4

Read the average Fahrenheit temperature for CH1 ~ CH4

Read the present Celsius temperature for CH1 ~ CH4

Read the present Fahrenheit temperature for CH1 ~ CH4

3.2.5 ELCM-TC04ANNN

3.2.5.1 The Thermocouple Temperature Sensor

A thermocouple is composed of conductors of two different materials. When a temperature difference occurs at the two ends of the thermocouple, the thermocouple will generate a voltage signal in proportional to the temperature difference. The voltage signal ranges from tens of uV to thousands of uV; therefore, we need to magnify the voltage when using it.

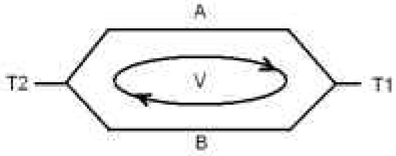
The thermocouple temperature sensor indicates temperature by differential voltage, and this eliminates external interferences the two pairs of data are a differential operation. Therefore, it is much more stable than a thermistor, resistive thermometer or thermal resistor and is widely applied in the industry.

The thermocouple is a loop constructed by two different metallic wires welded or twisted together (see the figure below). Different metals make two junctions in the loop. One junction is called “measuring junction” or “hot junction”, and the other is “reference junction” or “cold junction”. Placing the two junctions in different temperatures will cause a loop voltage (i.e. Seebeck Effect), and the loop voltage is in proportional to the temperature difference between the two junctions.

The loop voltage and the two junctions’ equation:

$$V = \int_{T_1}^{T_2} (Q_A - Q_B) dT \qquad \text{(A)}$$

In which Q = the heat conduction coefficient of the metal



How a thermocouple works

The heat conduction coefficient of Q_A and Q_B has nothing to do with the temperature. Therefore, equation (A) can be simplified into equation (B), a more frequently used equation:

$$V = \alpha (T_2 - T_1) \qquad \text{(B)}$$

There are two types of thermocouples, wrapped thermocouple and bare thermocouple. The wrapped thermocouple is wrapped with a layer of metal for protection, similar to an electrically-heated spoon. The wrapped thermocouple is used for measuring temperature of liquid and the bare thermocouple is used for measuring gas temperature. Different thermocouples sense different temperature ranges and output signals, and the maximum temperature varies with different materials and wires of different diameters.

3.2.5.2 Introduction

The ELCM-TC04ANNN temperature measurement module contains 4 inputss for external thermocouple temperature sensors (J-type, K-type, R-type, S-type, T-type, E-type, N-type, ±80mV). It converts them into 16-bit digital signals. Select temperatures in Celsius (resolution:

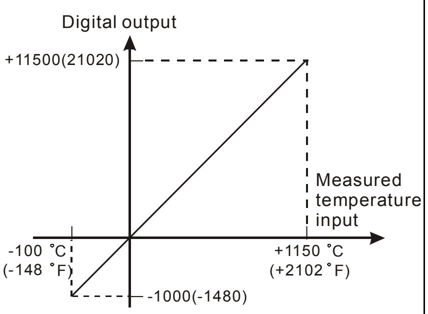
0.1°C) or Fahrenheit (resolution: 0.1°F). Access the data in the module by using FROM/TO instructions or read the average temperature values directly by using MOV instructions (Please refer to special registers D9900 ~ D9999).

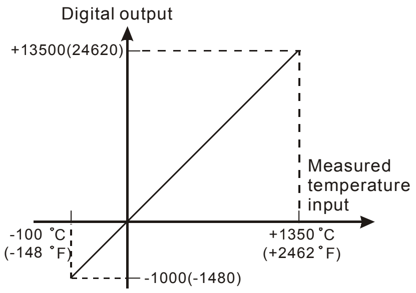
3.2.5.3 Specifications

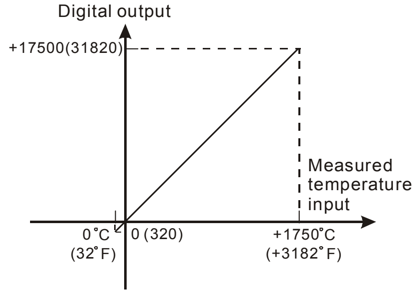
■ Functional Specifications

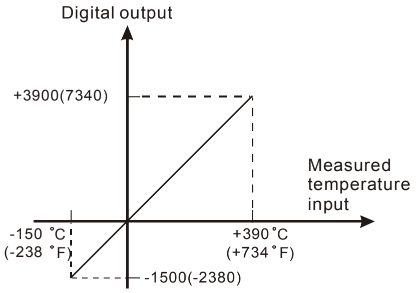
ELCM-TC04ANNN	Celsius (°C)	Fahrenheit (°F)	Voltage input
Power supply voltage	24V DC (20.4V DC ~ 28.8V DC) (-15% ~ +20%)		
Connector	European standard fixed terminal block (Hole diameter: 5mm)		
Analog input channel	4 channels		
Applicable sensor types	J-type, K-type, R-type, S-type, T-type, E-type, N-type thermocouple		
Range of input	J-type: -100°C ~1,150°C K-type: -100°C ~ 1,350°C R-type: 0°C ~ 1,750°C S-type: 0°C ~ 1,750°C T-type: -150°C ~ 390°C E-type: -150°C ~ 980°C N-type: -150°C ~ 1,280°C	J-type: -148°F ~ 2,102°F K-type: -148°F ~ 2,642°F R-type: 32°F ~ 3,182°F S-type: 32°F ~ 3,182°F T-type: -238°F ~734°F E-type: -238°F ~ 1,796°F N-type: -238°F ~2336°F	±80mV
Range of digital conversion	J-type: K-1000 ~ 1,1500 K-type: K-1000 ~ 1,3500 R-type: K0 ~ 1,7500 S-type: K0 ~ 1,7500 T-type: K-1500 ~ 3900 E-type: K-1500 ~ 9800 N-type: K-1500 ~ 1,2800	J-type: K-1480 ~ K2,1020 K-type: K-1480 ~ K26420 R-type: K320 ~ K3,1820 S-type: K320 ~ K3,1820 T-type: K-2380 ~K7340 E-type: K-2380 ~ K1,7960 N-type: K-2380 ~K23360	±8,000
Resolution	24 bits (0.1°C)	24 bits (0.18°F)	24 bits (0.01mV)
Overall accuracy	±0.5% when in full scale (25°C, 77°F) ±1% when in full scale within the range of 0 ~ 55°C (32 ~ 131°F)		
Response time	1s / all channels		
Isolation	Optical coupler isolation between digital circuits and analog circuits. No isolation among analog channels. 500VDC between digital circuits and Ground 500VDC between analog circuits and Ground 500VDC between analog circuits and digital circuits 500VDC between 24VDC and Ground		
Digital data format	16 significant bits are available; in 2's complement		
Average function	Supported. Available for setting up sampling range in CR#8 ~ CR#11. Range: K1 ~ K100.		
Self-diagnosis	Upper and lower bound detection in all channels		
Series connection to ELCM MPU	The modules are numbered from 0 to 7 based on their location with respect to the controller.. 0 is the closest module to the controller and 7 is the furthest. A Max.of 8 special modules are allowed to be connected to a controller..		

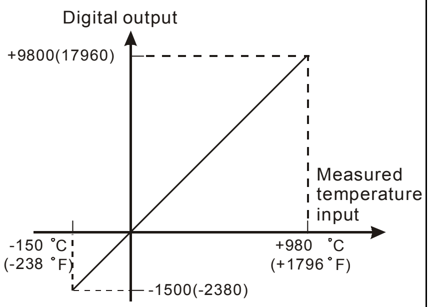
<table>
<tr><th>ELCM-TC04ANNN</th><th>Celsius (°C)</th><th>Fahrenheit (°F)</th><th>Voltage input</th></tr>
<tr><td rowspan="4">Temperature/digital curve
(Default: Mode 0)</td><td colspan="2">Mode 0 (H’0000): J-type, °C (°F)

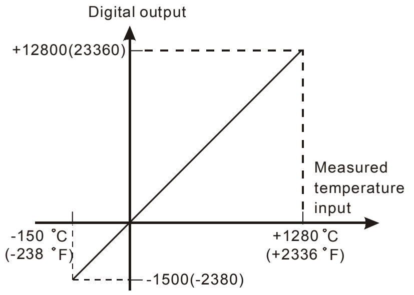

</td><td>Mode 1 (H’0001): K-type, °C (°F)

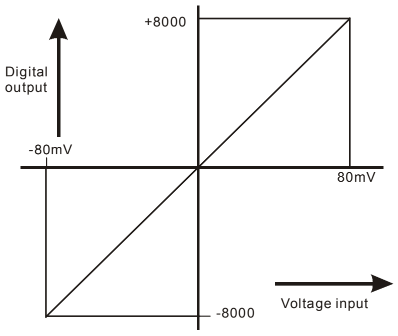

</td></tr>
<tr><td colspan="2">Mode 2 (H’0002): R-type, °C (°F)
Mode 3 (H’0003): S-type, °C (°F)


</td><td>Mode 4 (H’0004): T-type, °C (°F)


</td></tr>
<tr><td colspan="2">Mode 5 (H’0005): E-type, °C (°F)

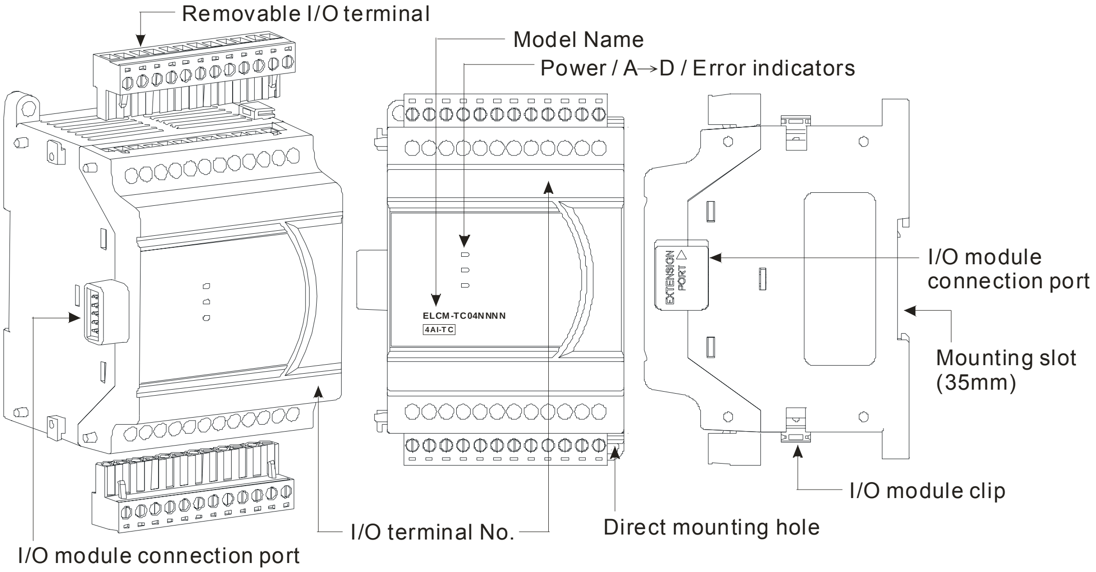

</td><td>Mode 6 (H’0006): N-type, °C (°F)


</td></tr>
<tr><td colspan="2">Mode 7 (H’0007): -80mV~+80mV

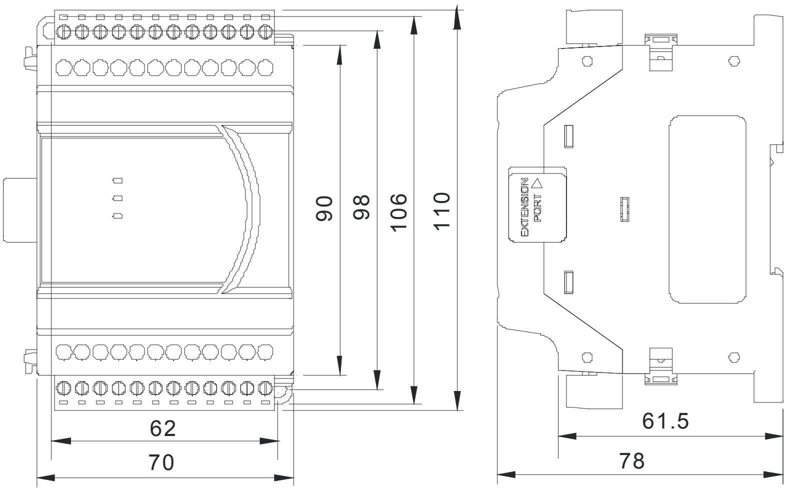

</td><td>Mode -1 (H’FFFF): Channel unavailable. Average value and present value of input channels will be displayed as 32,767(H’7FFF)</td></tr>
<tr><td>Operation/storage</td><td colspan="3">1. Operation: 0°C ~ 55°C (temperature), 50 ~ 95% (humidity), pollution degree 2
2. Storage: -25°C ~ 70°C (temperature), 5 ~ 95% (humidity)</td></tr>
</table>

Vibration/shock immunity	International standards: IEC61131-2, IEC 68-2-6 (TEST Fc)/IEC61131-2 & IEC 68-2-27 (TEST Ea)
Max. rated power consumption	24V DC (20.4V DC ~ 28.8V DC) (-15% ~ +20%), 1.2W, supplied by external power
Weight	203g

3.2.5.4 Product Profile and Outline



- **External Dimensions**



Unit: mm

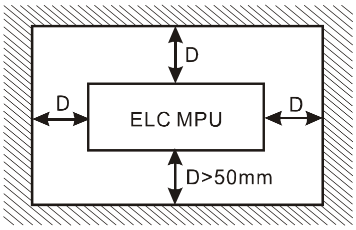
3.2.5.5 Installation and Wiring

- **Installation on DIN rail**

1. The ELC may be secured to a cabinet by using 35mm in height and 7.5mm in depth DIN rail. When mounting the ELC to 35mm DIN rail, be sure to use the retaining clip to stop any side-to-side movement of the ELC and reduce the chance of wires coming loose. The retaining clip is at the bottom of the ELC. To

secure the ELC to DIN rail, pull down the clip, place it onto the rail and push it up to lock it in place. To remove the ELC, pull the retaining clip down with a flat screwdriver and remove the ELC from DIN rail.

2. Install the ELC in an enclosure with sufficient space around it to allow heat dissipation, as shown in the figure below



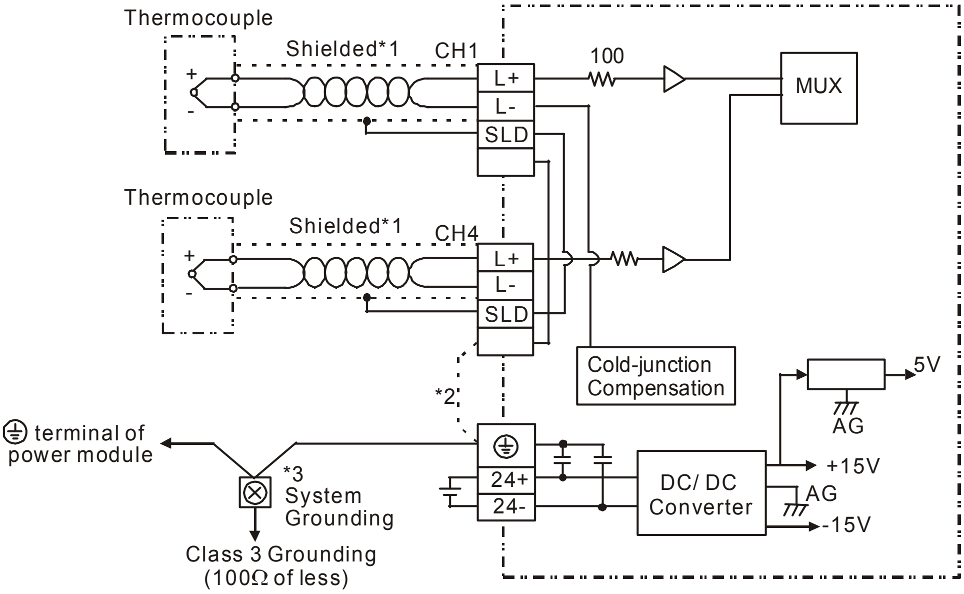
- **Direct Mounting:** Use M4 screws.

- **Wiring**

1. Use 22-16 AWG (1.5mm) single-core wire or the multi-core wire for the I/O wiring. The specification of the terminal is shown in the figure below on the right hand side. The ELC terminal screws should be tightened to 1.95 kg-cm (1.7 in-lbs). Also, use 60/75°C copper conductor only.
2. DO NOT wire empty terminals. DO NOT place the signal wires and power wires in the same wiring circuit.
3. DO NOT drop metallic conductors into the ELC during installation.

- Attach the dustproof sticker to the ELC before installation to prevent conductive objects from dropping in.
- Tear off the sticker before running the ELC to ensure normal heat dissipation.

- **External Wiring**



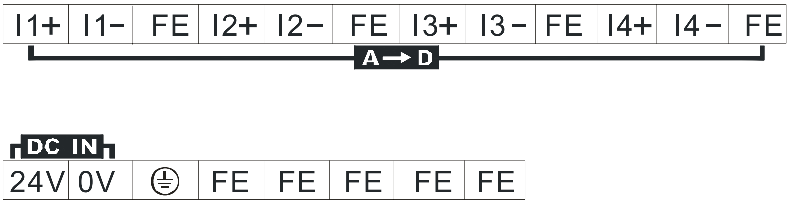
Note 1: Use only the wires that are supplied with your thermocouple sensor. ELC terminal screws should be tightened to 1.95 kg-cm (1.7 lb-in).

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.

3.2.5.6 Terminal Layout



3.2.5.7 CR (Control Register)

CR#	Attrib.		Register content	Description
#0	O	R	Module Type	ELCM-TC04ANNN module code = H'0083
#1	O	R	Firmware version	Display the current firmware version in hex.
#2	O	R/W	CH1 Input mode setting	Input mode: Default = H'0000. CH1 example: Mode 0 (H'0000): J-type (-100°C ~1,150°C) Mode 1 (H'0001): K-type (-100°C ~ 1,350°C) Mode 2 (H'0002): R-type (0°C ~ 1,750°C) Mode 3 (H'0003): S-type (0°C ~ 1,750°C) Mode 4 (H'0004): T-type (-150°C ~ 390°C) Mode 5 (H'0005): E-type (-150°C ~ 980°C) Mode 6 (H'0006): N-type (-150°C ~ 1,280°C) Mode 7 (H'0007): -80mV~+80mV Mode -1(H'FFFF): Close
#3	O	R/W	CH2 Input mode setting	
#4	O	R/W	CH3 Input mode setting	
#5	O	R/W	CH4 Input mode setting	
#7	O	R/W	Configure Temperature units	Select the temperature unit (Celsius °C / Fahrenheit °F). Default = H0(°C)
#8	O	R/W	CH1 sampling range	Set number of samples at CH1 ~ CH4 Range = K1 ~ K100 Default = K10
#9	O	R/W	CH2 sampling range	
#10	O	R/W	CH3 sampling range	
#11	O	R/W	CH4 sampling range	
#12	X	R	Average temperature measured at CH1	Average temperature measured at CH1 ~ CH4 Temperature units: set in CR#7
#13	X	R	Average temperature measured at CH2	
#14	X	R	Average temperature measured at CH3	
#15	X	R	Average temperature measured at CH4	

CR#	Attrib.		Register content	Description
#20	X	R	Present temperature measured at CH1	Present temperature measured at CH1 ~ CH4 Temperature units: set in CR#7
#21	X	R	Present temperature measured at CH2	
#22	X	R	Present temperature measured at CH3	
#23	X	R	Present temperature measured at CH4	
#28	O	R/W	Adjusted Offset value of CH1	Set the adjusted Offset value for Ch1 ~ Ch4. Default = K0 Range: K-400 ~ K400 Temperature unit: set in CR#7 Definition of Offset at Ch1 ~ Ch4 in ELCM-TC04ANNN: Deviation of the digital value from the target value.
#29	O	R/W	Adjusted Offset value of CH2	
#30	O	R/W	Adjusted Offset value of CH3	
#31	O	R/W	Adjusted Offset value of CH4	
#40	O	R/W	Function: Prohibit configuration changes	Prohibit configuration changes for CH1 ~ CH4
#41	X	R/W	Function: Save all configuration values	Save all configuration values, Default =H'0000
#42	X	R/W	Function: Return to default setting	Set all values to default settings, Default = H'0000
#43	X	R	Error status	Register for storing all error status. See the table of error status for more information.
#100	O	R/W	Function: Enable / Disable limit detection	Enable / Disable the upper and lower limit detection function. Default= H'0000.
#101	X	R/W	Upper and lower limit status	Display the upper and lower limit values, Default =H'0000
#102	O	R/W	Set value for CH1 upper limit	Set upper limit values for CH1~CH4. Default = K32000.
#103	O	R/W	Set value for CH2 upper limit	
#104	O	R/W	Set value for CH3 upper limit	
#105	O	R/W	Set value for CH4 upper limit	
#108	O	R/W	Set value for CH1 lower limit	Set lower limit values for CH1~CH4. Default = K-32000.
#109	O	R/W	Set value for CH2 lower limit	
#110	O	R/W	Set value for CH3 lower limit	
#111	O	R/W	Set value for CH4 lower limit	

- PID Control Registers

CR#				Save		Register content	Description
CH1	CH2	CH3	CH4				
#120	#140	#160	#180	O	R/W	Set temperature value	Set the temperature value according to proper range for each sensor type. Default = K0
#121	#141	#161	#181	O	R/W	Sampling time (s)	Range: K1 ~ K30 (s). Default = K2
#122	#142	#162	#182	O	R/W	K_P	Proportional control constant. Default = K121
#123	#143	#163	#183	O	R/W	K_I	Integral constant. Default = K2,098

CR#				Save		Register content	Description
CH1	CH2	CH3	CH4				
#124	#144	#164	#184	O	R/W	K_D	Derivative constant. Default = K-29
#125	#145	#165	#185	O	R/W	Upper limit of I value	Upper limit of I value. Default = K0
#126	#146	#166	#186	O	R/W	Lower limit of I value	Lower limit of I value. Default = K0
#127	#147	#167	#187	X	R	I value	Current accumulated offset value
#128	#148	#168	#188	O	R/W	Heating/cooling	0: Heater, 1: Cooler. Default = K0
#129	#149	#169	#189	O	R/W	Upper limit of output	Upper limit of output. Default = K32,000
#130	#150	#170	#190	O	R/W	Lower limit of output	Lower limit of output. Default = K0
#131	#151	#171	#191	X	R	Output percentage	Output percentage (Unit: 0.1%)
#132	#152	#172	#192	X	R	Output width (ms)	Width of control output. Unit: ms
#133	#153	#173	#193	X	R	Output cycle (ms)	Cycle of control output. Unit: ms
#134	#154	#174	#194	X	R	Output volume	Output volume
#135	#155	#175	#195	X	R/W	PID_RUN/STOP	0: STOP, 1: RUN. Default = K0
#136	#156	#176	#196	X	R/W	Auto-tuning	0: Disabled, 1: Auto-tuning. Default = K0
Symbols: O: When CR#41 is set to H'5678, the configuration values will be saved. X: configuration values will not be saved. R: able to read data using FROM instructions. W: able to write data using TO instructions.							

■ Explanation on CR

CR#0: Module Type

1. ELCM-TC04ANNN module code = H'0083.
2. Read the module code in the program to verify the correct extension module

CR#1: Firmware version

Display the current firmware version in hex, e.g. version V1.00 is indicated as H'0100.

CR#2, 3, 4, 5: CH1 ~ CH4 input mode configuration

Set the mode for the channels in the TC04ANNN input module. There are 9 modes for each channel which can be set up separately.

When configuring CH1 to mode 1 (H'0001) CR#2 must be set to H'0001. The default setting = H'0000. CH1 example:

Mode 0 (H'0000): J-type (-100°C ~1,150°C).

Mode 1 (H'0001): K-type (-100°C ~ 1,350°C).

Mode 2 (H'0002): R-type (0°C ~ 1,750°C).

Mode 3 (H'0003): S-type (0°C ~ 1,750°C).

Mode 4 (H'0004): T-type (-150°C ~ 390°C).

Mode 5 (H’0005): E-type (-150°C ~ 980°C).

Mode 6 (H’0006): N-type (-150°C ~ 1,280°C).

Mode 7 (H’0007): -80mV~+80mV

Mode-1 (H’FFFF): Channel 1 unavailable

CR#7: Configure Temperature units

Select the temperature units for average and present temperatures. (Celsius °C / Fahrenheit °F). Default = H’0000.

Mode 0 (H’0000): Celsius °C.

Mode 1 (H’0001): Fahrenheit °F.

CR#8, 9, 10, 11: CH1 ~ CH4 number of samples

1. The number of samples for the average temperature values for CH1 ~ CH4.
2. Range for ELCM-TC04ANNN: K1 ~ K100. Default = K10. If the configured value exceeds K100, the value will be set to K100; if the configured value is less than K1, the value will be set to K1

CR#12, 13, 14, 15: Average temperatures measured at CH1 ~ CH4

The average temperature measured at CH1 ~ CH4 is calculated based on the number of samples set in CR#8 ~ CR#11. Temperature units: set in CR#7. For example, if the number of samples is set to K10, the contents of CR#12 ~ CR#15 will be the average of the most recent 10 temperature signals received in CH1 ~ CH4

CR#20, 21, 22, 23: Present temperature measured at CH1 ~ CH4

The present temperatures at CH1 ~ CH4. Temperature units: set in CR#7.

CR#28, 29, 30, 31: Adjusted Offset value for CH1 ~ CH4

1. Set the adjusted Offset value for CH1 ~ CH4.
2. Range: K-400~K400
3. Default setting = K0.

- Mode 0 ~ Mode 6: $1_{SCALE} = 0.1°$

  Equation:

$$Y = \left(\frac{X(^\circ)}{0.1(^\circ)} + Offset \right)$$

Y=Digital output, X= Measured input

- Mode 7: 1_{SCALE} = 80mV/8000=0.01 mV

  Equation:

  $$Y = \left(\frac{X\,(\mathrm{m}V)}{0.01(\mathrm{m}V)} + Offset \right)$$

  Y=Digital output, X= voltage input

CR#40: Function: Prohibited configuration changes, Default = H’0000

Description	
bit0	b0=0, CH1 changing allowed; b0=1, CH1 changing prohibited
bit1	b1=0, CH2 changing allowed; b1=1, CH2 changing prohibited
bit2	b2=0, CH3 changing allowed; b2=1, CH3 changing prohibited
bit3	b3=0, CH4 changing allowed; b3=1, CH4 changing prohibited
bit4 ~ bit15	Reserved

Affected Parameters	
CR#2 ~ CR#5	Input mode for CH1 ~ CH4
CR#8 ~ CR#11	Number of samples for CH1 ~ CH4
CR#28 ~ CR#31	Offset settings for CH1 ~ CH4
CR#42	Returning to default settings
CR#100	Function: Enable/Disable limit detection
CR#102~CR#105	Configured value for CH1~CH4 upper limit
CR#108~CR#111	Configured value for CH1~CH4 lower limit
CR#120~CR#196	PID settings

CR#41: Function: Save all configuration values. Default=H’0000

Save all the configuration values to the internal flash memory. When saving is complete, CR#41 will be set to H’FFFF.

Set value	Function
H0	No action
HFFFF	Saving complete
H5678	Saving enabled.

Note: Default setting = H0. When the value = H’5678, saving is enabled, and CR#41 will be set to H’FFFF when complete.

CR#42: Function: Return to default setting, Default = H’0000

Description	
bit0	b0=0, no action on CH1; b0=1, set CH1 to default settings
bit1	b1=0, no action on CH2; b1=1, set CH2 to default settings
bit2	b2=0, no action on CH3; b2=1, set CH3 to default settings
bit3	b3=0, no action on CH4; b3=1, set CH4 to default settings
bit4 ~ bit15	Reserved

Note: Set the designated bit to 1 and the corresponding channel will be returned to default settings. When complete, the value will be set to 0. If CR#40 (prohibit configuration changes) is enabled, CR#42 will be invalid, and all configured values will remain unchanged and Error Code bit 12 of CR#43 will be set to 1

Relative Parameters	
CR#2 ~ CR#5	Input mode for CH1 ~ CH4
CR#8 ~ CR#11	Number of samples for CH1 ~ CH4
CR#28 ~ CR#31	Offset settings for CH1 ~ CH4
CR#100	Function: Enable/Disable limit detection
CR#102~CR#105	Upper limit values for CH1~CH4
CR#108~CR#111	Lower limit values for CH1~CH4
CR#120~CR#196	PID settings

CR#43: Error status. Default=H’0000

CR#43: error status value. See the table below:

Description					
bit0	K1 (H’1)	Power supply error	bit6	K64 (H’40)	CH4 Conversion error
bit1	K2 (H’2)	Hardware error	bit9	K512(H’0200)	Mode setting error
bit2	K4 (H’4)	Upper / lower limit error	bit10	K1024(H’0400)	Number of samples error
bit3	K8 (H’8)	CH1 Conversion error	bit11	K2048(H’0800)	Upper / lower limit configuration error
bit4	K16 (H’10)	CH2 Conversion error	bit12	K4096(H’1000)	Configuration changes prohibited
bit5	K32 (H’20)	CH3 Conversion error	bit13	K8192(H’2000)	Communication fault on next module

✐ *Note: Each error status is determined by the corresponding bit (b0 ~ b13) and there may be more than 2 errors occurring at the same time. 0 = normal; 1 = error*

CR#100: Function: Enable/Disable limit detection. Default =H'0000

Description	
bit0=1	Enable CH1 limit detection
bit1=1	Enable CH2 limit detection
bit2=1	Enable CH3 limit detection
bit3=1	Enable CH4 limit detection
bit4 ~ bit15	Reserved

CR#101: Upper and lower limit status. Default =H'0000

Description	
bit0=1	CH1 exceeds lower limit
bit1=1	CH2 exceeds lower limit
bit2=1	CH3 exceeds lower limit
bit3=1	CH4 exceeds lower limit
bit4 ~ bit7	Reserved
bit8=1	CH1 exceeds upper limit
bit9=1	CH2 exceeds upper limit
bit10=1	CH3 exceeds upper limit
bit11=1	CH4 exceeds upper limit
bit12 ~ bit15	Reserved

CR#102, 103, 104, 105: Values for CH1 ~ CH4 upper limits. Default =H'0000

Set the upper limit values for CH1 ~ CH4

CR#108, 109, 110, 111: Values for CH1 ~ CH4 lower limits. Default =H'0000

Set the lower limit values for CH1 ~ CH4..

CR#120, 140, 160, 180: Set temperature value

1. Set the temperature values (unit: 0.1 degree) according to the proper range of each sensor type, i.e. if the target temperature is 100°C, write K1000 into the specified CR using the TO instruction.
2. Default =K0.

CR#121, 141, 161, 181: Sampling time (s)

1. Set up the time interval between each sample. If the temperature in the control environment does not vary significantly, use a longer sampling time; however if temperature varies changes often, use a shorter sampling time.
2. Range: 1 ~ 30, Default =K2. The conversion time for each channel in the temperature measurement module is approximately 1 second. Therefore, if the value is set smaller than 1, 1 will be written into the CR. If the value is larger than 30, 30 will be written into the CR.
3. Output cycle time (ms) is equal to the setup sampling time (s), i.e. if the sampling time is set as 2, the output cycle will be 2,000.

CR#122, 142, 162, 182: K_P value, Default =K121

K_P: The proportional control constant, i.e. proportional band. The proportional control refers to the output being proportional to the error. Refer to the PID operation formula.

Output MV (%) = E / K_P × 100%

MV : Output value

K_P : Proprotional gain

$E(t)$: Error value

Example:

Set up K_P = 10, E = 1, K_I = 0, K_D = 0 (Close K_I, K_D)
MV (%) = 1 / 10 × 100% = 10%
The output percentage displayed in CR#131, 151, 171, 191 will be 10%.

CR#123, 143, 163, 183: K_I value, Default = K2098

3

K_I: Integral constant.

1. If only proportional control is applied, there will be certain deviations between the set value and the actual temperature. If integral control is applied, the deviation will decrease gradually and the target temperature can be achieved.
2. Integral control function will be disabled if K0 is written to the CRs.
3. If the curve is too gradual, adjust K_I. The closer K_I is to 0, the more abrupt the curve becomes.

CR#124, 144, 164, 184: K_D value, Default = K-29

K_D: Derivative constant.

1. Derivative control enhances disturbance rejection and helps the control status get back to the target temperature quickly.

2. The Derivative control function will be disabled if K0 is written to the CRs.
3. If the output percentage fluctuates too much, adjust K_D. The closer K_D is to 0, the less fluctuation there will be in the output percentage.

CR#125, 145, 165, 185: Upper limit of I value, Default = K0

CR#126, 146, 166, 186: Lower limit of I value, Default = K0

1. When both upper limit and lower limit are 0, the upper/lower limit function for I value will be disabled, meaning there will be no upper/lower limit for the I value.
2. If the upper limit is set smaller than the lower limit, the upper and lower limits will be set to the same value.

CR#127, 147, 167, 187: I value

Current accumulated offset value.

CR#128, 148, 168, 188: Heating/cooling

Select heating or cooling control. Set the CR to “0” for heating and set the CR to “1” for cooling. The default setting = H’0000.

Mode 0 (H’0000): Heating.
Mode 1 (H’0001): Cooling.

CR#129, 149, 169, 189: Upper limit of output. Default = K32,000

CR#130, 150, 170, 190: Lower limit of output. Default = K0

1. The output volume is calculated from the upper limit and lower limit.
2. For example, if the upper/lower limit is set to 0 ~ 32,000, when the output reaches 50%, the output volume will be 16,000.

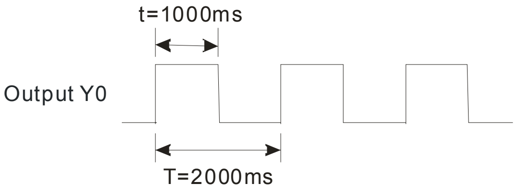
CR#131, 151, 171, 191: Output percentage (0.1%)

The result obtained from the PID operation. Unit: 0.1%. For example, if the PID operating result is 100, the output percentage will be 10%.

CR#132, 152, 172, 192: Output width (ms)

CR#133, 153, 173, 193: Output cycle (ms)

If the cyclic control mode is used to control, the target, read the two CRs. For example, if the cycle is 2,000 and width 1,000, the output pulse will look like the following:



CR#134, 154, 174, 194: Output volume

Formula for output volume:

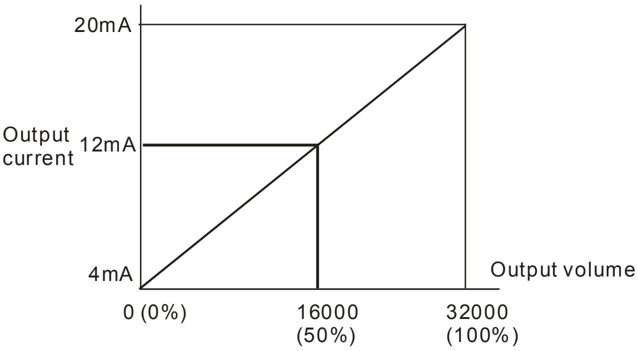
Output Volume = (Output Upper Limit – Output Lower Limit) × Output % + Output Lower Limit

Example:

Control with current 4 ~ 20mA (0 ~ 32,000)

Output upper limit: 32,000

Output lower limit: 0



CR#135, 155, 175, 195: PID_RUN/STOP

1. To apply the auto-tuning function, enable the auto-tuning function before changing the PID function to RUN. When auto-tuning is completed, CR#136, 156, 176, 196 will be cleared to 0, and the value for K_P / K_I / K_D will be stored into the corresponding CRs.
2. PID_RUN/STOP, K0: STOP, K1: RUN. Default = K0.

CR#136, 156, 176, 196: Auto-tuning

1. To apply the auto-tuning function, set the auto-tuning CR to K1 to enable the auto-tuning function before changing PID function to RUN. When auto-tuning is complete, CR#136, 156, 176, 196 will be cleared to 0, and the value of K_P / K_I / K_D will be stored into the corresponding CRs.
2. Auto-tuning, K0: Disabled, K1: Auto-tuning. Default = K0.

Notes:

1. Set K_P, K_I, and K_D to “0" to disable the PID function. If you want to use proportional control only, set K_I and K_D to “0”.

2. If you do not know how to tune the PID parameters in your control environment, use "auto-tuning" to generate K_P, K_I and K_D and further modify them into better K_P, K_I and K_D. To utilize the auto-tuning, set the auto-tuning CR to K1. After the auto-tuning is completed, the CR will automatically return to K0.
3. To enter K_P, K_I and K_D manually, set K_P first, then set K_I and K_D to "0" to disable the integral and derivative control functions. When K_P is set, modify K_I and K_D. It is recommend decreasing K_I and K_D downward from 0.
4. If the output percentage fluctuates too much, adjust K_D. The closer K_D is to 0, the less fluctuation there will be in the output percentage. If the curve is too gradual, adjust K_I. The closer the K_I is to 0, the more abrupt the curve becomes.

3.2.5.8 Description of the Special Registers D9900~D9999

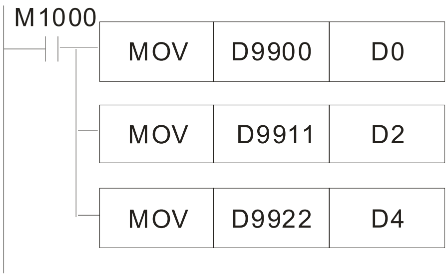
When the ELCM controller is connected to special I/O modules, registers D9900~D9999 will be reserved for storing values from those modules. Use the MOV instruction to read values in D9900~D9999.

When the ELCM controller is connected to an ELCM-TC04ANNN, the following parameters can be accessed per the table below:

Module0	Module1	Module2	Module3	Module4	Module5	Module6	Module7	Description
D1320	D1321	D1322	D1323	D1324	D1325	D1326	D1327	Model code
D9900	D9910	D9920	D9930	D9940	D9950	D9960	D9970	CH1 average temperature
D9901	D9911	D9921	D9931	D9941	D9951	D9961	D9971	CH2 average temperature
D9902	D9912	D9922	D9932	D9942	D9952	D9962	D9972	CH3 average temperature
D9903	D9913	D9923	D9933	D9943	D9953	D9963	D9973	CH4 average temperature

1. D9900~D9999 are average input values for CH1 ~ CH4 and the number of samples is K1~K100. When the number of samples is set to K1, the values in D9900~D9999 are present values. Use: 1. ELCM_AIO Configuration Wizard in ELCSoft or 2. FROM/TO instructions (CR#8~CR#11) to set the number of samples to K1
2. Example:

Ladder diagram:



Explanation:

Save CH1 average temperature for Module#0 to D0

Save CH2 average temperature for Module#1 to D2

Save CH3 average temperature for Module#2 to D4

3.2.5.9 Temperature Conversion in the ELCM-TC04ANNN

The conversion curves can be adjusted according to the application requirements by changing the Offset value (CR#28 ~ CR#31).

- For temperature measured Mode 0~6: $1_{SCALE} = 0.1°$.

  Equation:

$$Y = \left(\frac{X(°)}{0.1(°)} + Offset \right)$$

  Y=Digital output, X= Measured input

- For voltage input Mode 7: 1_{SCALE} = 80mV/8000=0.01 mV.

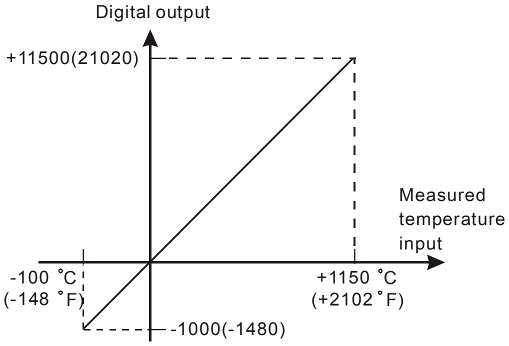
  Equation:

$$Y = \left(\frac{X(\mathrm{m}V)}{0.01(\mathrm{m}V)} + Offset \right)$$

  Y=Digital output, X= voltage input

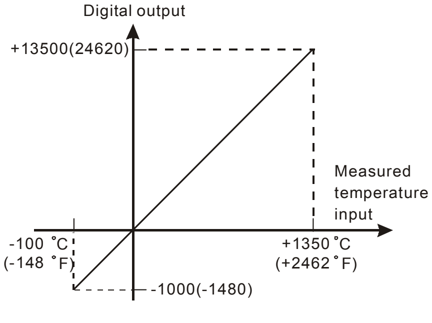
Conversion Curve

- Mode 0 (H’0000): J-type, °C (°F)



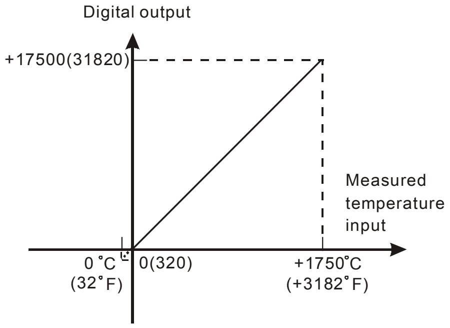
Mode 0 of CR#2~ CR#5	-100°C ~ 1150°C (-1000~11500) -148°F ~ 2102°F (-1480~21020)
Offset (CR#34 ~ CR#37)	Offset value

- Mode 1 (H’0001): K-type, °C (°F)



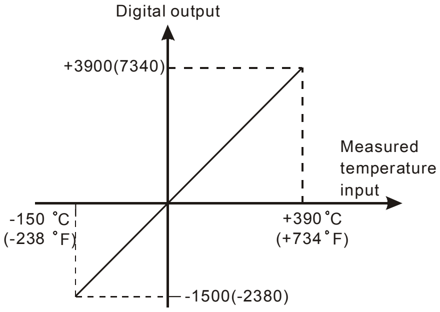
Mode 1 of CR#2~ CR#5	-100°C ~ 1350°C (-1000~13500) -148°F ~ 2462°F (-1480~24620)
Offset (CR#34 ~ CR#37)	Offset value

- Mode 2 (H’0002): R-type, °C (°F), Mode 3 (H’0003): S-type, °C (°F)



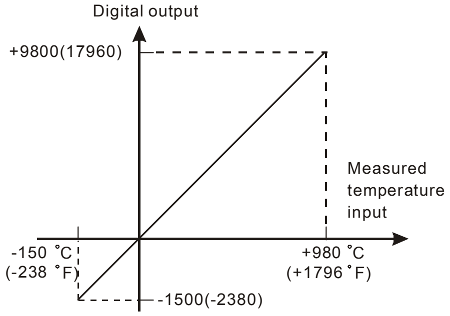
Mode 2, 3 of CR#2~ CR#5	0°C ~ 1750°C (0~17500) 32°F ~ 3182°F (320~31820)
Offset (CR#34 ~ CR#37)	Offset value

- Mode 4 (H’0004): T-type, °C (°F)



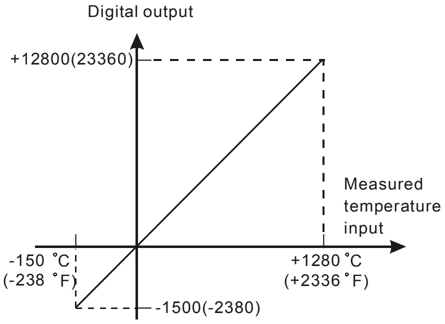
Mode 4 of CR#2~ CR#5	-150°C ~ 390°C (-1500~3900) -238°F ~ 734°F (-2380~7340)
Offset (CR#34 ~ CR#37)	Offset value

- Mode 5 (H’0005): E-type, °C (°F)



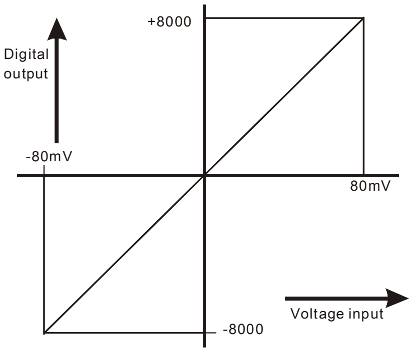
Mode 5 of CR#2~ CR#5	-150°C ~ 980°C (-1500~9800) -238°F ~ 1796°F (-2380~17960)
Offset (CR#34 ~ CR#37)	Offset value

- Mode 6 (H'0006): N-type, °C (°F)



Mode 6 of CR#2~ CR#5	-150°C ~ 1280°C (-1500~12800) -238°F ~ 2336°F (-2380~23360)
Offset (CR#34 ~ CR#37)	Offset value

- Mode 7 (H'0007): -80mV~+80mV



Mode 7 of CR#2~ CR#5	-80mV~+80mV (-8000~8000)
Offset (CR#34 ~ CR#37)	Offset value

■ Adjusting the Conversion Curve

1. Description

- If there is deviation in the measurement results, make adjustments to the Offset value to modify the conversion curve. For example, if the temperature deviation from the target temperature (measured temperature) is -2°C, set the Offset of CH1 to 2°C (2°C /0.1°C = 20).

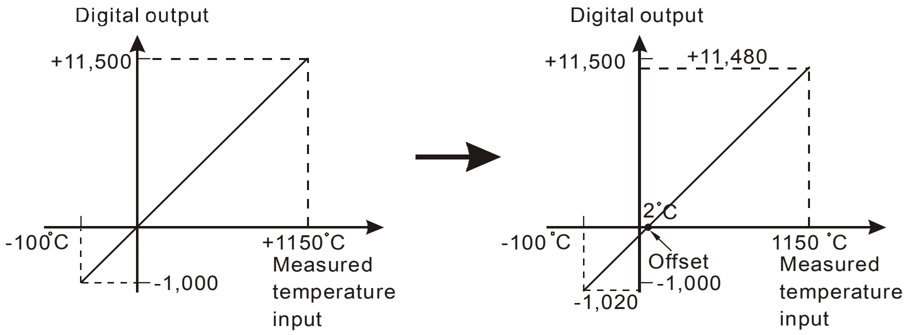
$$Y = \left(\frac{X\,(°\mathrm{C})}{0.1(°\mathrm{C})} + Offset \right)$$

Example: If X= -2°C, Y=?

$$Y=\left(\frac{-2(^\circ\mathrm{C})}{0.1(^\circ\mathrm{C})}+20\right)=0$$

- The PT conversion curve only needs to be configured once. Configure CR#40 (prohibit configuration changes) to prevent the values from being changed.

2. Adjusted Curve



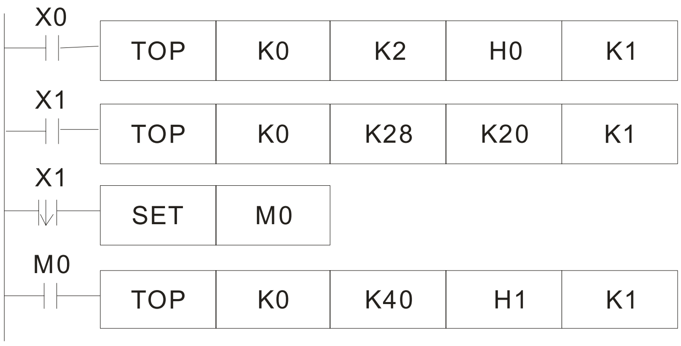
3. Addresses
   - X0 = On: Set the input mode for CH1 to mode 0.
   - X1 = On: Set the Offset value for CH1 to 2°C (20).
   - M0 = On: Disable CH1 configuration changes.

4. Program Description
   - When X0 = On, set CR#2 to K0 (H’0000) CH1 to mode 0 (J-Type).
   - When X1 = On, write K20 (Offset value for CH1) into CR#28.
   - When X1 goes from On to Off, set M0 = On to disable configuration changes to TC conversion curve. Write K1 (H’1) into CR#40, b0=1.

5. Program example

Ladder diagram:

Explanation:



Set CH1 to mode 0 (J-Type)

Set the Offset value for CH1

Disable CH1 configuration changes

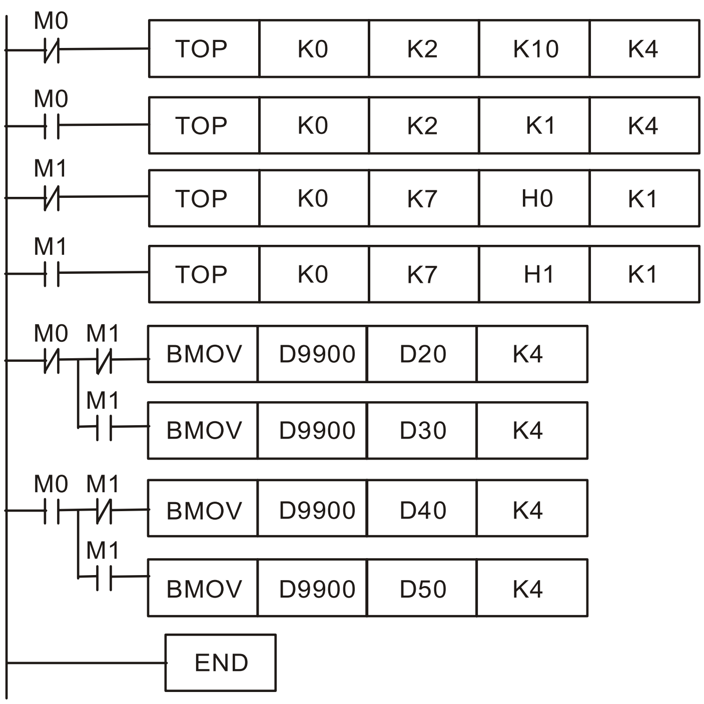
3.2.5.10 Applications

■ Thermocouple Temperature Measurement System

1. Description
    - Measuring temperature with a thermocouple temperature sensor.
2. Addresses
    - M0: set the number of samples.
    - M1: select the temperature units for the average and present temperatures
    - D20 ~ D23: average Celsius temperature for CH1 ~ CH4
    - D30 ~ D33: average Fahrenheit temperature for CH1 ~ CH4
    - D40 ~ D43: present Celsius temperature for CH1 ~ CH4
    - D50 ~ D53: present Fahrenheit temperature for CH1 ~ CH4
3. Program Description
    - M0=Off, set the number of samples for the input signals for CH1 to 10, M0=On set the number of samples for the input signals at CH1 to 1.
    - M1=Off, temperature units = °C; M1=On temperature units = °F.
    - M0=Off, M1=Off, Store the average Celsius temperature for CH1 ~ CH4 into D20 ~ D23.
    - M0=Off, M1=On, Store the average Fahrenheit temperature for CH1 ~ CH4 into D30 ~ D33.
    - M0=On, M1=Off, Store the present Celsius temperature for CH1 ~ CH4 into D40 ~ D43.
    - M0=On, M1=On, Store the present Fahrenheit temperature for CH1 ~ CH4 into D50 ~ D53.
    - ELCM-TC04ANNN module also stores the average temperature values to special registers (D9900-D9999). The contents of these special registers can be read with MOV instructions in the program to obtain the temperature values.

4. Program example

Ladder diagram:



Explanation:

Set the number of samples for CH1 ~ CH4 to 10

Set the number of samples for CH1 ~ CH4 to 1

Celsius degrees (°C)

Fahrenheit degrees (°F)

Read average Celsius degrees for CH1 ~ CH4

Read average Fahrenheit degrees for CH1 ~ CH4

Read present Celsius temperature for CH1 ~ CH4

Read present Fahrenheit temperature for CH1 ~ CH4

4

Positioning Units

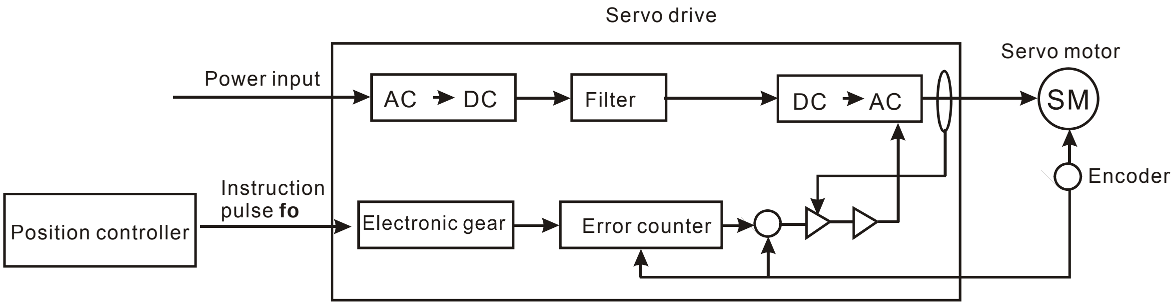
Table of Content

4.1 ELC Series

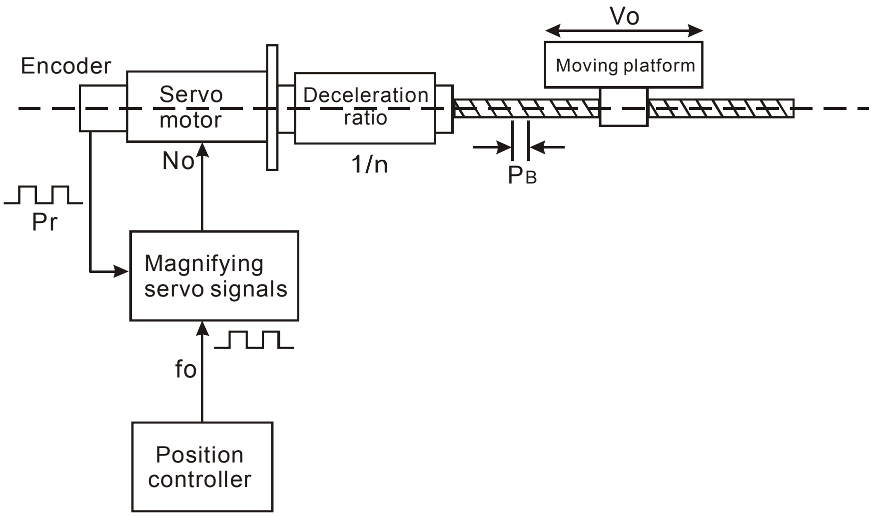
4.1.1 ELC-MC01

4.1.1.1 The Concept of a Servo Drive System

The speed and positioning control of the step or servo drive system are typically applied to a system requiring accurate control to transmit power. The servo drive system receives pulse instructions, pulses and frequency to control the angle and speed of the rotation of motor. See the configuration of the system below.



The instruction pulses are brought into the error counter via the electronic gear. The error counter counts the number of pulses and compares the pulses with the feedback pulses from the encoder. Then it adjusts the rotation speed of the servo motor until the frequencies of both streams of pulses are equal. The number of pulses and the frequency of pulses sent by the position controller are based on the equipment determined by the servo drive system and the speed or position determined by the application. See the figure below for the relationship between the equipment parameters and instruction pulses.



Equipment parameters:

P_B: Screw pitch

1/n: Deceleration ratio

△S: Linear movement of the working object for 1 revolution of the motor

$$\boxed{\Delta S = P_B \times \frac{1}{n}}$$

$\triangle\ell$: Linear movement of the working object obtained by each feedback pulse

P_f: Feedback pulses, i.e. pulses sent from 1 revolution of the encoder inside the servo motor. The value is usually fixed.

$$\boxed{\Delta\ell = \frac{\Delta S}{P_f} = \frac{P_B \times 1/n}{P_f}}$$

The positioning resolution (mm/pulse) $\Delta\ell_0$ will be determined by the equipment parameters, which is the linear movement of the working object generated by each instruction pulse sent.

$$f_0 \times \text{Electronic gear ratio} = P_f$$

$$\Delta\ell_0 = \frac{\Delta S}{f_0} = \frac{\Delta S}{P_f} \times \text{Electronic gear ratio}$$

When the electronic gear ratio > 1, $\triangle\ell_0 > \triangle\ell$, which means the positioning resolution is degrading.

Example 1:

Assume we know that the feedback pulses are 4,000ppr and want the rotation speed of the motor to be 3,000rpm when the instruction pulses are at 100KPPS. How should we set up the electronic gear ratio?

[Solution]

3,000rpm = 3,000 revolutions per minute = 50 revolutions per second

f_0 × electronic gear ratio = 4,000ppr × 50 revolutions per second ⇨ Electronic gear ratio = 2 (200KPPS / 100KPPS = 2).

Example 2:

Assume the feedback pulses P_f are at 4,000ppr, the screw pitch P_B = 10mm and the deceleration ratio 1/n = 1, what is the electronic gear ratio when the positioning resolution = 0.01mm/pulse?

[Solution]

$$\text{Electronic gear ratio} = \Delta\ell_0 \times \frac{P_f}{P_B \times 1/n} = 0.01 \times \frac{4000}{10} = 4$$

1 pulse sent by the instruction (pulse f_0) will be converted into 4 pulses by the electronic gear and the servo motor will rotate for 4 steps (1 step = 10/4,000mm) with a screw rotation of 0.01mm.

4.1.1.2 The Position Controller

The position controller estimates how many pulses, along with the pulse frequency that are required by the equipment parameters (speed and distance) to set up in the servo motor system and send the instruction to the servo drive. The last section discussed the equipment parameters. This section will address the two target parameters, speed and distance.

- The speed parameter

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}} = \underbrace{\frac{\text{Distance}}{\text{Circle}}}_{B} \times \underbrace{\frac{\text{Circle}}{\text{Number of pulses}}}_{1/A} \times \underbrace{\frac{\text{Number of pulses}}{\text{Time}}}_{PPS,\, pulse/sec}$$

$$V = \underbrace{\frac{\text{Number of pulses}}{\text{Time}}}_{PPS,\, pulse/sec} \propto \text{Speed}$$

A = number of pulses required for 1 motor revolution; B = distance moved for 1 motor revolution. Both A and B are set up in the position controller according to the equipment parameters in the servo system. “PPS” refers to “pulses per second”. The position controller will calculate the frequency and the number of pulses for the pulse instruction according to equipment parameters A, B and the speed.

- The position parameter

There are two ways to indicate position:

1. The number of pulses as the unit: Since the number of pulses required for the servo motor system to reach the target position are known, the positioning controller sends out the designated number of pulses according to the value set.
2. Distance as the unit: According to the parameters set in the servo motor system, the position controller converts the distance into the equivalent number of pulses and sends it to the servo.

4.1.1.3 Introduction

The maximum pulse frequency of the MC01 module is 200KPPS, and the pulse output interface uses the high-speed differential output (Line Driver). The MC01 module contains 8 motion control modes and 2 types of pulse acceleration curves, trapezoid curve and S curve. One MC01 module is able to control a 1-axis step or servo drive system. The ELC MPU is able to read/write the data in the module using FROM/TO instructions. A maximum of 8 MC01 modules may be connected to a single ELC controller for 8 independent axis of control.

4.1.1.4 Specification

■ Functions Specification

Item	Content
Power supply	DC24V (-15% ~ +20%) Current consumption 70±10mA; Startup peak current 1.3 A
Max. number of connected axes	8 units; (ELC series controllers can connect up to 8 specialty modules such as analog, thermocouple, RTD and MC01)

Item	Content
Distance instruction	Distance value is set by the CR parameters for the MC01 module. 1. Range: -2, 147,483,648~+2,147,483,647 2. Selectable units: um, mdeg, 10-4 inch, Pulse 3. Selectable rates: 100, 101, 102, 103; 4. Selectable position: absolute and relative position instruction
Speed instruction	Speed value is set by the CR parameters for the MC01 module. 1. Range: -2,147,483,648~+2,147,483,647 (conversion value of 10~200KPPS pulse) 2. Selectable units: pulse/s, cm/min, 10deg/min, inch/min
External output	Opto coupler is for isolation and there are LED indications for all output/input signals. Outputs: FP and RP (line driver output 5V) Output: CLR is the type of NPN open collector transistor output (5~24VDC, less than 20mA)
External input	Opto coupler is for isolation and there are LED indications for all output/input signals. Input point: START, STOP, LSP, LSN, DOG(contact or open collector transistor, 24VDC±10%, 5±1mA) Inputs: ΦA, ΦB(line driver or open collector transistor, 5~24VDC, 6~15mA) Input: PG0 (line driver or open collector transistor, 5~24VDC, 6~15mA)
Pulse output format	Three selectable modes: Pulse/Dir, FP (CW)/RP (CCW), A/B (all modes are line driver outputs)
Position program & data transmission	CR data can be read/written via FROM/TO instructions in the ELC controller. The 32-bit data is composed of 2 continuous CR numbers. The range of the 16-bit CR parameters is CR#0 ~ CR#48.
Connect to EATON ELC series	Modules are numbered from 0~7 with 0 being the closet module to the controller. Up to 8 modules may be connected.

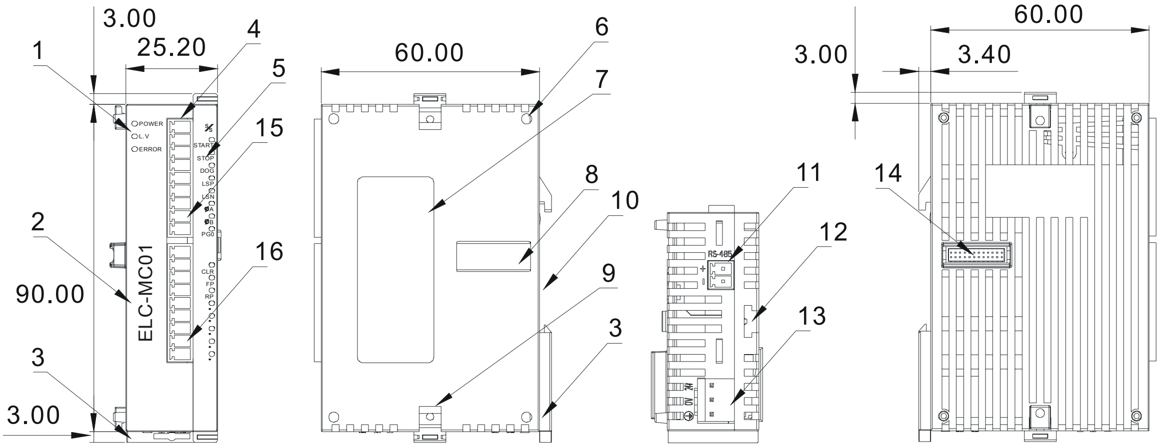
- Input Point Electrical Specifications

Item	START, STOP	LSN, LSP, DOG	ΦA±, ΦB±	PG0±
Input voltage	24V DC ± 10%		5 ~ 24V DC	
Signal format	SINK/SOURCE		Differential or transistor open collector	
Input current	5 ± 1mA		6 ~15mA	
Response feature	15ms	1ms	200kHz	1ms
Loop insulation	Opto coupler			
Operation indication	LED is On indicates the input signal is On.			

- Output Point Electrical Specifications

Item	FP±， RP±	CLR±
Output mode	Forward pulse (FP±)/reverse pulse (RP±) Pulse output (FP±)/direction control (RP±) A(FP±)/B (RP±) phase output	Clearing signals in the error counter in servo drive
Output format	Differential output	Transistor NPN open collector
Drive current	-	5 ~ 24V DC
Load current	-	Less than 20mA
Output voltage	Differential output 5V	-
Response feature	200kHz	130ms
Operation indication	LED is On indicates the input signal is On.	

4.1.1.5 Product Profile and Outline



Unit: mm

1. Status Indicator (Power, L.V. and ERROR)	2. Model name
3. DIN rail clip	4. I/O terminals
5. I/O point indicators	6. Mounting hole of the extension unit
7. Nameplate	8. Extension port
9. Extension hook	10. DIN rail mounting slot (35mm)
11. RS-485 communication port	12. Extension hook
13. DC Power input	14. Extension port to connect extension module
15. Upper row terminals	16. Lower row terminals

- Upper / Lower Terminals

Upper Row	S/S	START	STOP	DOG	LSP	LSN	PG0+	PG0-	A+
Lower Row	A-	B+	B-	CLR+	CLR-	FP+	FP-	RP+	RP-

4.1.1.6 I/O Terminals and LED Indicators

- I/O terminals

Type	Terminal	Description	Response feature
Power supply	+24V, 0V	Power input: DC24V (-15% ~ +20%), Current consumption: 100mA	-
Input	START	Start input	4ms/12ms
	STOP	Stop input	4ms
	LSP	Right limit input	1ms
	LSN	Left limit input	1ms
	ΦA+, ΦA-	MPG A-phase pulse input +, - (differential signal input)	200kHz
	ΦB+, ΦB-	MPG B-phase pulse input +, - (differential signal input)	200kHz
	PG0+, PG0-	Zero signal input terminal +, - (differential signal input)	4ms
	DOG	2 variations according to different operation modes: 1. DOG signal when in zero return 2. Interrupt signal inserted in signal-speed or 2-speed sections	1ms
	S/S	Common terminal of input points START, STOP, DOG, LSP, and LSN	-
Output	CLR+, CLR-	Clearing signal (clearing signals in the error counter in servo drive)	4ms
	FP+, FP-	1. FP/RP mode: forward pulse output 2. Pulse/direction: pulse output 3. A/B phase mode: A-phase output	200kHz
	RP+, RP-	1. FP/RP mode: reverse pulse output 2. Pulse/direction: direction output 3. A/B phase mode: B-phase output	200kHz

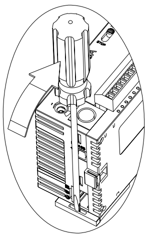
- LED Display

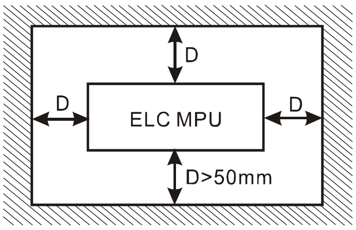
Power	Power indicator, +5V internal power is normal
L.V.	Low voltage indicator; On when the external power supply is less than 19.5V
ERROR	Error indicator (On/Off/flash); flashes when the error code register is not "0"
START	Start input indicator
STOP	Stop input indicator
DOG	DOG input indicator
FP	Forward pulse output indicator
RP	Reverse pulse output indicator
LSP	Right limit input indicator
LSN	Left limit input indicator
ΦA	MPG A-phase pulse input indicator
ΦB	MPG B-phase pulse input indicator
PG0	Zero signal input indicator
CLR	Clearing signal output indicator

4.1.1.7 Installation and Wiring

1. **Installation the DIN rail**

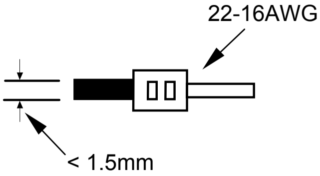
- The ELC can be secured to a cabinet by using DIN rail that is 35mm high with a depth of 7.5mm. When mounting the ELC on the DIN rail, be sure to use the end bracket to stop any side-to-side motion of the ELC. At the bottom of the ELC is a small retaining clip. To secure the ELC to the DIN rail, place it onto the rail and push up on the clip.
- When installing the ELC, make sure that it is installed in an enclosure with sufficient space around it for proper heat dissipation, as shown below.



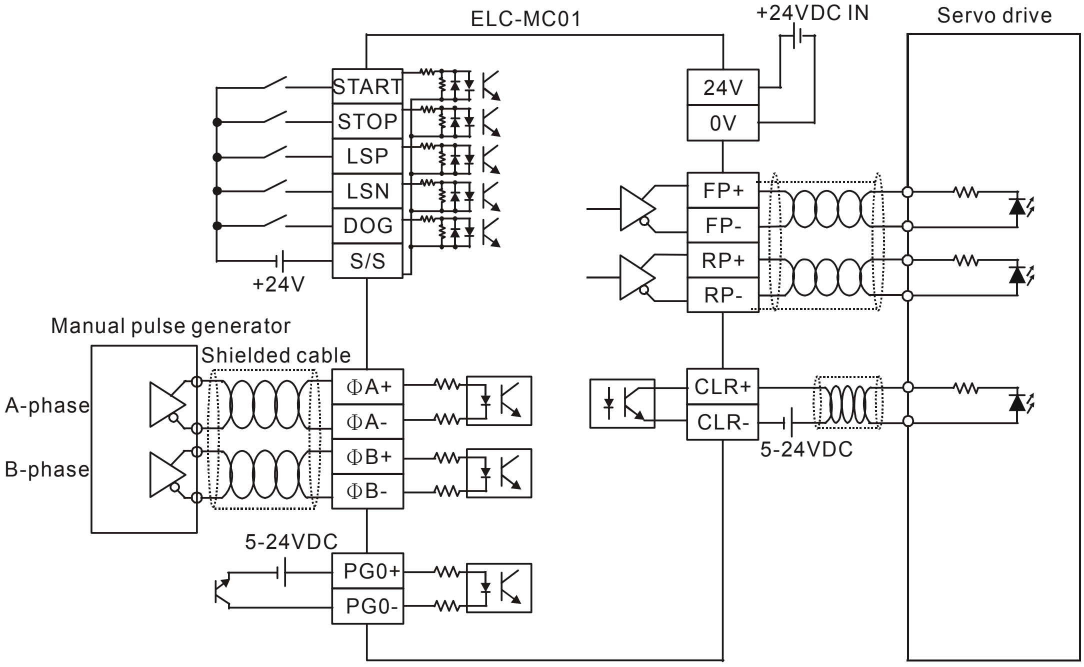


2. **Wiring**

- It is recommended that 22-16 AWG (1.5mm) single-core bare wire or multi-core wire is used for the I/O wiring. The specification for the terminal is shown in the figure below on the left side. The ELC terminal screws should be tightened to 1.95 kg-cm (1.7 in-lbs) and use 60/75°C copper conductor only.
- I/O signal wires and the power supply wires should not run through the same multi-wire cable or conduit.



3. Servo drive Wiring



Note 1: Do NOT put the I/O signal wires and power supply wires in the same wiring duct.

Note 2: Make sure the ground terminals ⏚ of the power module and of the ELC-MC01 are properly grounded.

4.1.1.8 CR (Control Register)

CR#		Address	Latched/ Attribute		Content	Setup range	Default
HW	LW						
	#0	H'4190	O	R	Model Type	Set up by the system; read only.	H'0110
#2	#1	H'4191	O	R/W	Number of pulses required for 1 motor revolution (A)	1 ~ +2,147,483,647 PLS/REV	2,000
#4	#3	H'4193	O	R/W	Distance the motor rotates for 1 revolution (B)	1 ~ +2,147,483,647 *1	1,000
	#5	H'4195	O	R/W	Various parameter settings	b0 ~ b15	H'0000
#7	#6	H'4196	O	R/W	Max. speed (V_{MAX})	0 ~ +2,147,483,647 *2	200,000
#9	#8	H'4198	O	R/W	Bias speed (V_{BIAS})	0 ~ +2,147,483,647 *2	0
#11	#10	H'419A	O	R/W	JOG speed (V_{JOG})	0 ~ +2,147,483,647 *2	5,000
#13	#12	H'419C	O	R/W	Zero return speed (V_{RT})	0 ~ +2,147,483,647 *2	50,000
#15	#14	H'419E	O	R/W	Zero return deceleration speed (V_{CR})	0 ~ +2,147,483,647 *2	1,000
	#16	H'41A0	O	R/W	The number of PG0 in zero return mode (N)	0 ~ +32,767 PLS	0
	#17	H'41A1	O	R/W	The number of pulses in zero return mode (P)	-32,768 ~ +32,767 PLS	0
	#18	H'41A2	O	R/W	Zero return mode	b0 ~ b1	B'00
#20	#19	H'41A3	O	R/W	Setup of zero point (HP)	0 ~ ±999,999 *1	0
	#21	H'41A5	O	R/W	Acceleration time (T_{ACC})	10 ~ +32,767 ms	100
	#22	H'41A6	O	R/W	Deceleration time (T_{DEC})	10 ~ +32,767 ms	100

CR#		Address	Latched/ Attribute		Content	Setup range	Default
HW	LW						
#24	#23	H'41A7	X	R/W	Target position (I) P(I)	-2,147,483,648 ~ +2,147,483,647 *1	0
#26	#25	H'41A9	X	R/W	Operation speed (I) V(I)	-2,147,483,648 ~ +2,147,483,647 *1	1,000
#28	#27	H'41AB	X	R/W	Target position (II) P(II)	-2,147,483,648 ~ +2,147,483,647 *1	0
#30	#29	H'41AD	X	R/W	Operation speed (II) V(II)	0 ~ +2,147,483,647 *1	2,000
	#31	H'41AF	X	R/W	Operation instruction	b0 ~ b13	H'0000
	#32	H'41B0	X	R/W	Work mode	b0 ~ b13	H'0001
#34	#33	H'41B1	X	R/W	Current position (CP)	-2,147,483,648 ~ +2,147,483,647 *1	0
#36	#35	H'41B3	X	R/W	Current speed (CS)	0 ~ +2,147,483,647 PPS	0
	#37	H'41B5	O	R/W	Communication address and baud rate setting	Default: ASCII, 9600,7,E,1; Communication address : 1	H'0182
	#38	H'41B6	X	R/W	Execution status	b0 ~ b10	H'XXXX
	#39	H'41B7	X	R	Error code		H'0000
	#40	H'41B8	X	R/W	Numerator of MPG electronic gearing		H'0001
	#41	H'41B9	X	R/W	Denominator of MPG electronic gearing		H'0001
#43	#42	H'41BA	X	R/W	Input frequency of MPG	Frequency of MPG pulse input	0
#45	#44	H'41BC	X	R/W	Accumulated number pulses by MPG	Accumulated by the number of pulse input from MPG	0
	#46	H'41BE	X	R/W	Response speed of MPG input	0 ~ 5	5
	#47	H'41BF	X	R	Terminal status		H'XXXX
	#48	H'41C0	O	R	Firmware version	Displayed in hex.	H'0100

*1: Selectable units: um/rev, m deg/rev and 10^{-4} inch/rev.

*2: The units are set in b0 and b1 of CR#5.

❖ The corresponding parameter addresses H'4190 ~ H'41C0 of CR#0 ~ CR#48 are for reading/writing this data via RS-485 Modbus communications.

1. Supports communication baud rates: 4800, 9600, 19200, 38400, 57600, and 115200 bps.
2. Modbus ASCII/RTU communication protocols: ASCII data format (7-bit, Even, 1 stop bit (7,E,1),); RTU data format (8-bit, Even, 1 stop bit (8,E,1)).
3. Function Codes supported: H'03 (read multiple registers); H'06 (write 1 register); H'10 (write multiple registers).

Description of the CR values

CR#0: Model Type

Set up by the system; read only. You can read the model type in the program to see if the extension module exists. The model type for the ELC-MC01 is H'0110.

CR#1, 2: Number of pulses required for 1 motor revolution (A); Range: 1 ~ 2,147,483,647 PLS/REV.

1. Typically, we can set up the electronic gear ratio in the servo drive. Therefore, the number of pulses required for 1 motor revolution does not always equal the number of pulses generated by the encoder for 1 servo motor revolution.

   Number of pulses required for 1 motor revolution (A) × electronic gear *(CMX/CDV)* = pulses generated by 1 encoder revolution.
2. The units are set in b0 and b1 of CR#5.. When the units are set as machine units or combined units, parameter A will be valid. **When the units are set as motor units, parameter A will be invalid.**

CR#3, 4: Distance the motor rotates for 1 revolution (B); Range: 1 ~ 2,147,483,647 units/REV.

1. There are 3 units available for b0 and b1 of CR#5.

   B = 1 ~ +2,147,483,647 (um/Rev, mdeg/Rev, 10^{-4} inch/Rev)
2. The units are set in b0 and b1 of CR#5.. When the units are set as machine units or combined units, parameter B will be valid. **When the units are set as motor unit, parameter B will be invalid.**

CR#5: Parameter setting

b0 ~ b15 represents the following:

1. The units are set in b0 and b1 of CR#5

b1	b0	Unit	Explanation
0	0	Motor	Units: pulses
0	1	Machine	Units: length, angle
1	0	Combined	Units for position: length, angle (machine units) Unit for speed: pulses (motor units)
1	1		

Item	Displacement	Motor units	Combined unit	Machine unit
Position	B_1	pulses	Um = 10^{-3} mm	
	B_2	pulses	m deg = 10^{-3} deg	
	B_3	pulses	10^{-4} inch	
Speed	B_1	pulses/sec (PPS)	cm/min	
	B_2	pulses/sec (PPS)	10 deg/min	
	B_3	pulses/sec (PPS)	inch/min	

Position:

Zero point 【HP】(CR#19,#20), target position (I)【P(I)】(CR#23,#24), target position (II)【P(II)】(CR#27,#28), current position【CP】(CR#33,#34).

Speed:

Maximum speed【V_{MAX}】(CR#6,#7), bias speed【V_{BIAS}】(CR#8,#9), JOG speed【V_{JOG}】(CR#10,#11), zero return speed【V_{RT}】(CR#12,#13), Zero return deceleration speed【V_{CR}】(CR#14,#15), operation speed (I)【V(I)】(CR#25,#26), operation speed (II)【V(II)】(CR#29,#30).

Example 1:

Motor unit b[1:0] = 00 ➪ Position: pulse; Speed: pulses/sec (PPS).

Settings: target position P(I): 10,000 (pulses); operation speed V(I): 10K (PPS)

The position control module only needs to send out 10,000 pulses (frequency: 10KPPS) to move to the target position. The distance moved by every pulse is calculated by the equipment parameter and has nothing to do with the settings in CR#1, #2 (A) and CR#3, #4 (B).

Example 2:

Machine unit b[1:0] = 01 ➪ Position: um; Speed: cm/min.

Assume CR#1, #2 (A) = 1,000 (pulse/REV), CR#3, #4 (B) = 100 (um/REV), target position P(I) = 10,000 (um), and operation speed V(I) = 1,000 (cm/min), what are the number of pulses and their frequency from the pulse instruction of the position control module?

$$\text{Distance} = \underbrace{\frac{\text{Distance}}{\text{Number of revolutions}}}_{B} \times \underbrace{\frac{\text{Number of revolutions}}{\text{Distance}}}_{1/A} \times \text{Number of pulses}$$

Number of pulses required from the position control module to move to P(I)

$$= \frac{P(I)um}{B/A} = P(I) \times \frac{A}{B} = 100{,}000 \text{ pulses}$$

Operation speed V(I): 6 (cm/min) = 60,000/60 (um/sec)

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}} = \underbrace{\frac{\text{Distance}}{\text{Number of revolutions}}}_{\text{B}} = \underbrace{\frac{\text{Number of revolutions}}{\text{Number of pulses}}}_{\text{1/A}} = \underbrace{\frac{\text{Number of pulses}}{\text{Time}}}_{\text{PPS, pulse/sec}}$$

The position control module calculates the pulse frequency (PPS)

$$= \text{V(I)} \times \frac{10^4}{60} \times \frac{\text{A}}{\text{B}} = \frac{60{,}000}{60} \times \frac{1{,}000}{100} = 10{,}000 \text{ PPS}$$

Example 3:

Combined unit b[1:0] = 10, 11 ⇨ Position: um; Speed: pulse/sec (PPS)

Assume CR#1, #2 (A) = 2,000 (Pulse/REV), CR#3, #4 (B) = 100 (um/REV), target position P(I) = 10,000 (um), and operation speed V(I) = 10K (PPS), what is the number of pulses from the pulse instruction of the position control module?

The position control module calculates the number of pulses required to reach P(I)

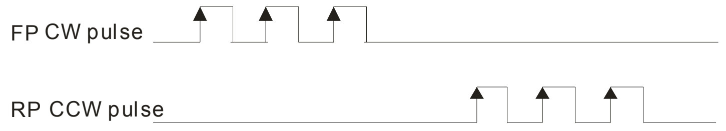
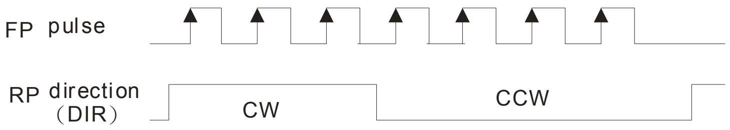
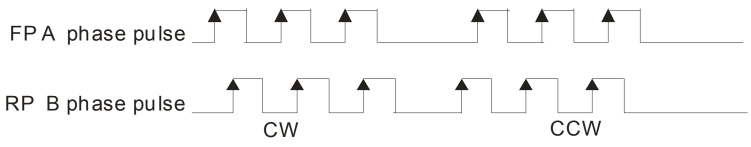
$$= \frac{\text{P(I) um}}{\text{B/A}} = \text{P(I)} \times \frac{\text{A}}{\text{B}} = 200{,}000 \text{ PULSE}$$

2. The multiplication of position is set in b2 and b3 of CR#5.

   Position: zero point【HP】(CR#19,#20), target position (I)【P(I)】(CR#23,#24), target position (II)【P(II)】(CR#27,#28) and current position【CP】(CR#33,#34). The【CP】(CR#33,#34) value must be multiplied by the values below:

b3	b2	Multiplication
0	0	Position × 10^0
0	1	Position × 10^1
1	0	Position × 10^2
1	1	Position × 10^3

3. The pulse output type is set in b4 and b5 of CR#5.

b5	b4	Pulse output type (positive logic)	Explanation
0	0		FP + RP
0	1		Pulse + direction
1	0		A/B phase pulse
1	1		

4. LSP input polarity is set in b6 of CR#5.

   b[6] = 0: positive logic enabled. When LSP input signal is On, LSP signal will be generated.

b[6] = 1: negative logic enabled. When LSP input signal is Off, LPS signal will be generated.

5. LSN input polarity is set in b7 of CR#5.
   b[7] = 0: positive logic enabled. When LSN input signal is On, LSN signal will be generated.
   b[7] = 1: negative logic enabled. When LSN input signal is Off, LSN signal will be generated.
6. The direction of zero return is set in b8 of CR#5.
   b[8] = 0: decreasing CP value towards zero
   b[8] = 1: increasing CP value towards zero
7. The rotation direction is set in b9 of CR#5.
   b[9] = 0: CP value increasing
   b[9] = 1: CP value decreasing
8. The DOG triggering mode is set in b10 of CR#5.
   b[10] = 0: triggering rising-edge
   b[10] = 1: triggering falling-edge (valid in interrupt single-speed position mode and interrupt 2-speed positioning mode)
9. The DOG polarity is set in b11 of CR#5.
   b[11] = 0: positive logic enabled. When DOG input signal is On, DOG signal will be generated.
   b[11] = 1: negative logic enabled. When DOG input signal is Off, DOG signal will be generated.
10. The type of acceleration curve is set in b12 of CR#5.
    b[12] = 0: trapezoid acceleration curve
    b[12] = 1, S acceleration curve
11. The START response time is set in b13 of CR#5.
    b[13] = 0: 4m
    b[13] = 1: 12ms (with input noise filter)
12. The START input polarity is set in b14 of CR#5.
    b[14] = 0: positive logic enable. When START input signal is On, the output will be enabled.
    b[14] = 1: negative logic enabled. When START input signal is Off, the output will be enabled.
13. The STOP input polarity is set in b15 of CR#5.
    b[15] = 0: positive logic enabled. When STOP input signal is On, the output will be enabled.
    b[15] = 1: negative logic enabled. When STOP input signal is Off, the output will be enabled.

CR#6, 7: Maximum speed (V_{MAX})

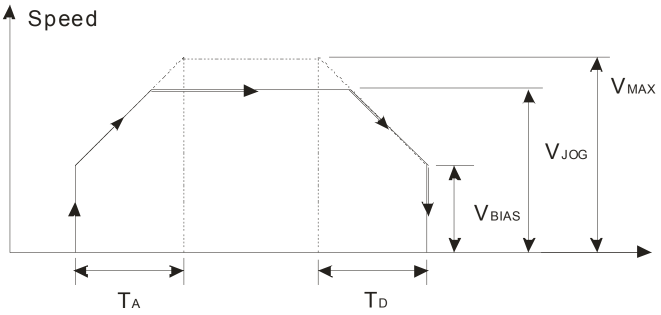
1. The maximum speed for all operation modes. Range: 0 ~ +2,147,483,647 (the units are set in b0 and b1 of CR#5).
2. The range is 10 ~ 200KPPS pulses. Pulses exceeding 200K will output at 200K; pulses less than 10 will output at 10.

CR#8, 9: Bias speed (V_{BIAS})

1. The starting speed of pulse output. Range: 0 ~ +2,147,483,647 (the units are set in b0 and b1 of CR#5).
2. The range is 10 ~ 200KPPS pulses. Pulses exceeding 200K will output at 200K; pulses less than 10 will output at 10.
3. Be aware of the frequency in the resonance area of the step motor in a step drive system. To safely activate the drive, set the bias speed above the frequency in the resonance area.

CR#10, 11: JOG speed (V_{JOG})

1. Range: 0 ~ +2,147,483,647 (The units are set in b0 and b1 of CR#5).
2. The range is 10 ~ 200KPPS pulses. Pulses exceeding 200K will output at 200K; pulses less than 10 will output at 10.
3. Range limitation: $V_{MAX} > V_{JOG} > V_{BIAS}$. If $V_{JOG} > V_{MAX}$, V_{JOG} output = V_{MAX}; if $V_{JOG} <$ V_{BIAS}, V_{JOG} output = V_{BIAS}.
4. V_{JOG} is not allowed to be changed during execution.



CR#12, 13: Zero return speed (V_{RT})

1. Range: 0 ~ +2,147,483,647 (The units are set in b0 and b1 of CR#5).
2. The range is 10 ~ 200KPPS pulses. Pulses exceeding 200K will output at 200K;

pulses less than 10 will output at 10.

3. Range limitation: $V_{MAX} > V_{RT} > V_{BIAS}$.
4. V_{RT} is not allowed to be changed during execution.

CR#14, 15: Zero return deceleration speed (V_{CR})

1. Range: 0 ~ +2,147,483,647 (The units are set in b0 and b1 of CR#5).
2. The range is 10 ~ 200KPPS pulses. Pulses exceeding 200K will output at 200K; pulses less than 10 will output at 10.
3. When zero return is executed, the motor will run at the zero return speed V_{RT}. When it reaches a DOG signal, the motor will decelerate to the zero return deceleration speed $V_{CR.}$
4. In order to accurately position at the zero point, we suggest setting V_{CR} to low speed.
5. V_{CR} is not allowed to be changed during execution.

CR#16: The number of PG0 in zero return mode (N)

1. Range: 0 ~ +32,767 (PULSE).
2. The reference signal for the motor to decelerate and stop. After detecting a DOG signal, the module will start to count the number of pulses (N) to the zero point. See CR#18 for more details on the zero return mode.

CR#17: The number of pulses in zero return mode (P)

1. Range: -32,768 ~ 32,767 (PULSE). The negative values are the numbers of pulses (P) in forward direction. The positive values are the numbers of pulses (P) in reverse direction.
2. The reference signal for the motor to decelerate and stop. See CR#18 for more details on the zero return mode.

CR#18: Zero return mode

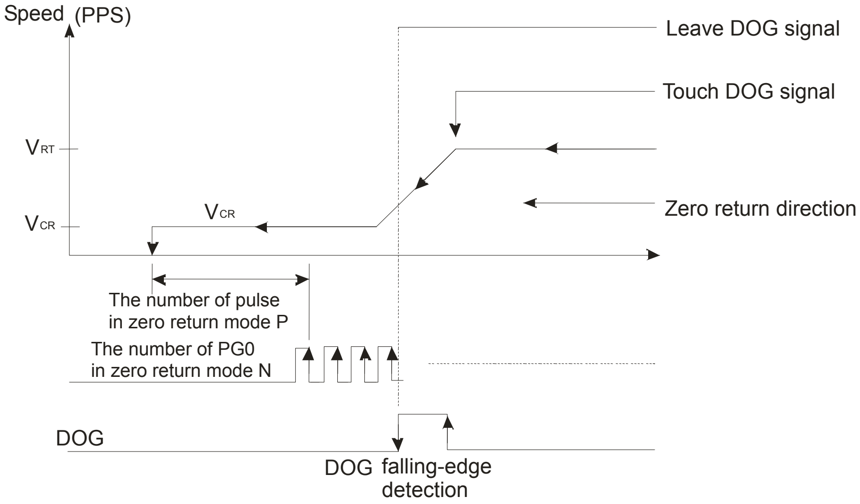
1. Zero return modes:
   b[0] = 0: normal mode
   b[0] = 1: overwrite mode
2. Detecting DOG falling-edge in zero return mode:
   b[1] = 0: On

b[1] = 1: Off

3. b[1:0] = 00 ⇨ normal mode; the DOG falling-edge detection in zero return mode is On.

   Zero return mode: The motor runs at the zero return speed V_{RT}, and when it reaches a DOG signal, the motor will decelerate to the zero return deceleration speed $V_{CR.}$ After it further detects a falling edge of a DOG signal, the motor will output N pulses and P pulses before it stops.

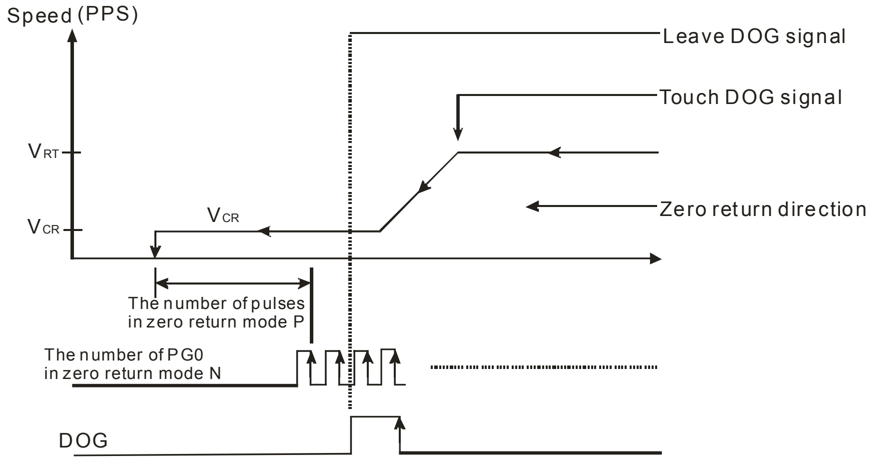
   - If N and P are too small, the motor will decelerate to V_{CR} when reaching a DOG signal. After the motor detects a DOG falling edge and if N is reached, the motor will stop immediately after P is reached even if the motor has not reached V_{CR}.
   - Assume N and P are set to “0”, the motor will stop immediately after it reaches a DOG signal and detects a DOG falling edge.



4. b[1:0] = 10 ⇨ normal mode; a DOG falling-edge detection in zero return mode is Off.

   Zero return mode: The motor runs at the zero return speed V_{RT}, and when it reaches a DOG signal, the motor will decelerate to the zero return deceleration speed $V_{CR.}$ After it outputs N pulses and P pulses, the motor will stop.

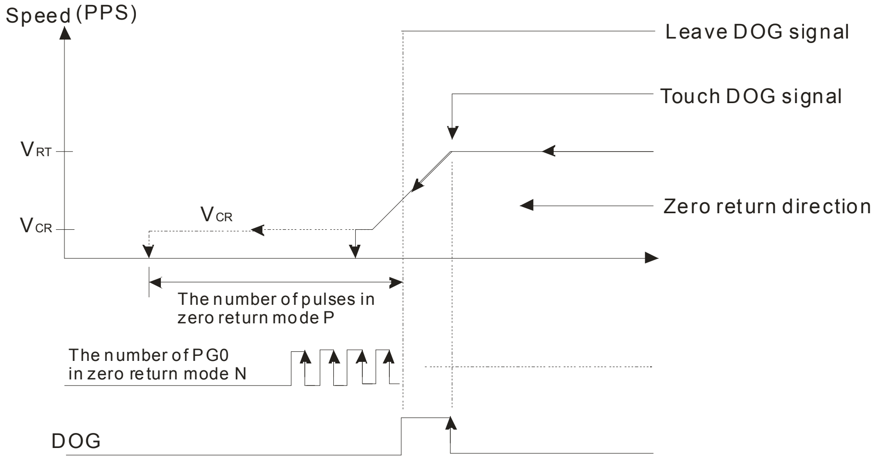
   - If N and P are too small, the motor will decelerate to V_{CR} when reaching a DOG signal. After N is reached, the motor will stop immediately after P is reached even if the motor has not arrived at V_{CR}.
   - Assume N and P are set to “0”, the motor will stop immediately after it reaches a DOG signal.



5. b[1:0] = 01 ⇨ overwrite mode; a DOG falling-edge detection in zero return mode is On.

   Zero return mode: The motor runs at the zero return speed V_{RT}, and when it reaches a DOG signal, the motor will decelerate to the zero return deceleration speed $V_{CR.}$ After it further detects a falling edge of a DOG signal, the motor will output N pulses and P pulses before it stops.

   - If N and P are too small, the motor will decelerate to V_{CR} when reaching a DOG signal. After the motor detects a DOG falling edge and if N is reached, the motor will stop immediately after P is reached even if the motor has not arrived at V_{CR}.
   - Assume N and P are set to “0”, the motor will stop immediately after it reaches a DOG signal.

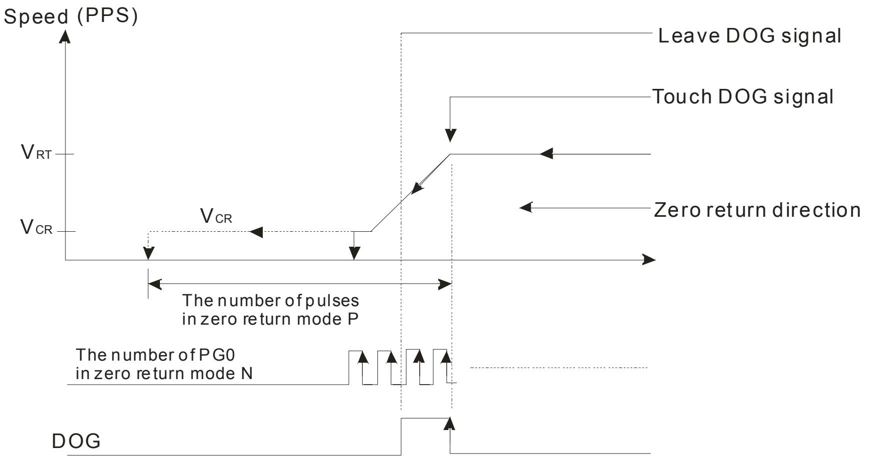


6. b[1:0] = 11 ⇨ overwrite mode; a DOG falling-edge detection in zero return mode in Off.

   Zero return mode: The motor runs at the zero return speed V_{RT}, and when it reaches a DOG signal, the motor will decelerate to the zero return deceleration speed $V_{CR.}$ After it outputs N pulses and P pulses, the motor will stop.

   - If N and P are too small, the motor will decelerate to V_{CR} when reaching a DOG signal. After N is reached, the motor will stop immediately after P is reached even if the motor has not arrived at V_{CR}.

- Assume N and P are set as “0”, the motor will stop immediately after it reaches a DOG signal.



CR#19, 20: Setup of zero point (HP)

1. Range: 0 ~ ±999,999 (The units are set in b0 and b1 of CR#5).
2. When the zero return is completed, the current position (CP) will be updated to a zero point (HP). (CP is set in CR#33, #34 for MC01)

CR#21: Acceleration time (T_{ACC})

1. Time required for the acceleration from the bias speed (V_{BIAS}) set in CR#8, #9 to the maximum speed V_{MAX} set in CR#6, #7.
2. T_{ACC} will be regarded as 10ms when it is set shorter than 10ms, and as 32,767ms when it is set longer than 32,767ms.
3. For an S acceleration curve, to obtain a complete S acceleration curve control, set V_{MAX} equivalent to the operation speed.

CR#22: Deceleration time (T_{DEC})

1. The time required for the deceleration from the maximum speed V_{MAX} set in CR#6, #7 to the bias speed (V_{BIAS}) set in CR#8, #9.
2. T_{DEC} will be regarded as 10ms when it is set shorter than 10ms, and as 32,767ms when it is set longer than 32,767ms.
3. For an S acceleration curve, to obtain a complete S acceleration curve control, set V_{MAX} equivalent to the operation speed.

CR#23, 24: Target position (I) (P(I))

1. Range: -2,147,483,648 ~ +2,147,483,647 (The units are set in b0 and b1 of CR#5).
2. Attribute of P(I):
   - Absolute coordinate (CR#31_b7=0)
     Representing the position starting from “0”. When P(I) is larger than the current position (CR#33, #34), the motor will be in forward rotation. When P(I) is smaller than the current position, the motor will be in reverse rotation.
   - Relative coordinate (CR#31_b7=1)
     Representing the distance the motor has travelled from the current position (CR#33, #34). When P(I) is a positive value, the motor will be in forward rotation. When P(I) is a negative value, the motor will be in reverse rotation.
3. The multiplication factor for P(I) should be modified according to the settings in b2 and b3 of CR#5.

CR#25, 26: Operation speed (I) (V(I))

1. Range: -2,147,483,648 ~ +2,147,483,647 (The units are set in b0 and b1 of CR#5).
2. The range is 10 ~ 200KPPS pulses. Pulses exceeding 200K will output at 200K; pulses less than 10 will output at 10.
3. Range limitation: $V_{MAX} > V(I) > V_{BIAS}$
4. When the module operates in variable speed (CR#32_b4=1), V(I) can be modified during the operation. “+” in front of V(I) refers to forward rotation, and “-“ refers to reverse rotation.

CR#27, 28: Target position (II) (P(II))

1. Range: -2,147,483,648 ~ +2,147,483,647 (The units are set in b0 and b1 of CR#5).
2. Attribute of P(II):
   - Absolute coordinate (CR#31_b7 = 0)
     Representing the position starting from “0”. When P(II) is larger than the current position (CR#33, #34), the motor will be in forward rotation. When P(II) is smaller than the current position, the motor will be in reverse rotation.
   - Relative coordinate (CR#31_b7 = 1)
     Representing the distance the motor has travelled from the current position (CR#33, #34). When P(II) is a positive value, the motor will be in forward rotation.

When P(II) is a negative value, the motor will be in reverse rotation.

3. The multiplication of P(II) should be modified according to the settings in b2 and b3 of CR#5.

CR#29, 30: Operation speed (II) (V(II))

1. Range: -2,147,483,648 ~ +2,147,483,647 (The units are set in b0 and b1 of CR#5).
2. The range is 10 ~ 200KPPS pulses. Pulses exceeding 200K will output at 200K; pulses less than 10 will output at 10.
3. Range limitation: $V_{MAX} > V(II) > V_{BIAS}$.

CR#31: Operation instruction

1. CR#31_b0 : error reset; timing: 0→1

   b[0] = 1: The error will be reset. The ERROR indicator will be off and the flag in CR#38_b5 (for MC01) will be reset to “0”.

2. CR#31_b1: software STOP; timing: 0→1

   b[1] = 0→1: The function is the same as external force STOP. The MC01 position control module will decelerate and stop positioning.

3. CR#31_b2: stop forward pulses; timing: 1

   b[2] = 1: Running forward is forbidden, and the running forward instruction will be invalid. An error message will appear if a running forward instruction is given.

4. CR#31_ b3: stop reverse pulses; timing: 1

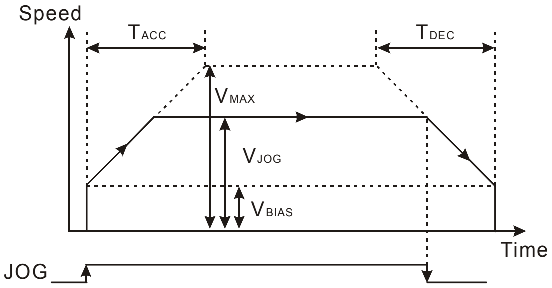
   b[3] = 1: Running reverse is forbidden, and the running reverse instruction will be invalid. An error message will appear if a running reverse- instruction is given.

5. CR#31_b4: enabling JOG+

   b[4] = 1: JOG+ sends out forward pulses (CW)

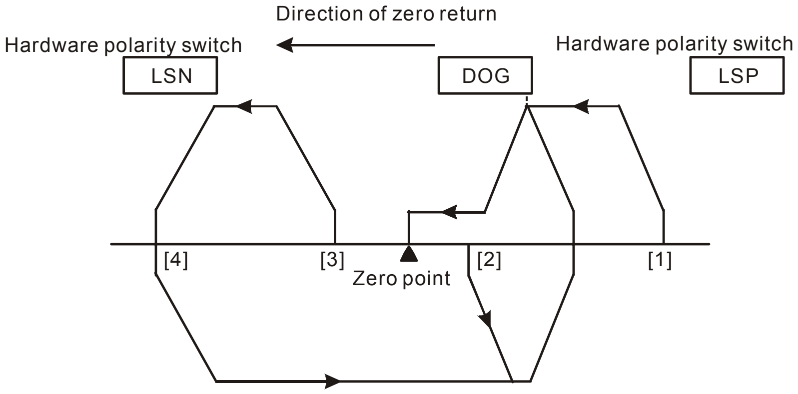
6. CR #31_b5: enabling JOG-

   b[5] = 1: JOG- sends out reverse pulses (CCW)



7. CR#31_b6: enabling zero return

b[6] = 0→1: Starting the execution of zero return. The motions of zero return vary depending on different current positions (CP). There are four different positions. Route of zero return operation:



CP1: Starting from position [1], to the right side of the zero point and DOG; DOG = Off.

CP2: Starting from position [2], to the right side of the zero point; DOG = On.

CP3: Starting from position [3], to the left side of the zero point and DOG; DOG = Off, LSN = Off.

CP4: Starting from position [4], to the left side of the zero point and DOG; DOG = Off, LSN = On.

8. CR#31_b7: absolute position setup

   b[7] = 0: Absolute coordinate positioning

   b[7] = 1: Relative coordinate positioning

9. CR#31_b8: software START

   b[8] = 0→1: Starting work mode as set in CR#32

10. CR#31_b10: clear CP

    b[10] = 0→1: CP cleared to “0"

11. CR#31_b12: CLR signal output mode

    b[12] = 0: When zero return is completed, CLR will output signals to the servo drive (for approx. 130ms) as the clear signal for the error counter in the servo.

    b[12] = 1: CLR: a general output point controlled by the state of b[13]

12. CR#31_b13: CLR output On/Off

    b[13] = 0: CLR is Off.

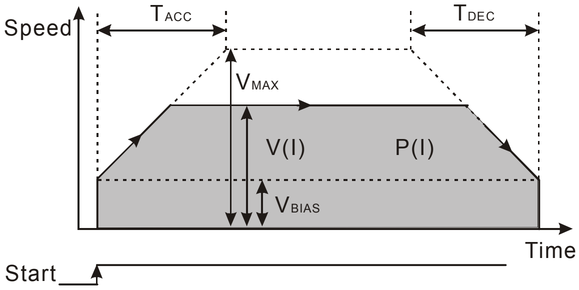
    b[13] = 1: CLR is On.

CR#32: Work mode

1. CR#32_b0: single-speed positioning operation

When b[0] is triggered and START ON, the 1st positioning program will start to execute. The number of motion steps and speed are determined by P(I) and V(I).

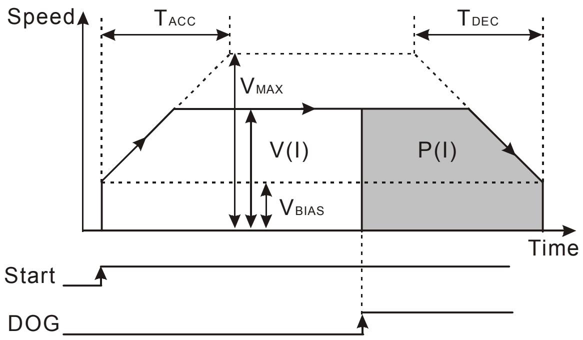
- The relative coordinate positioning is determined by the sign bit of the control register for P(I).
- The absolute coordinate positioning is determined by P(I) (set in CR#23, #24). Running forward when the absolute coordinate is bigger than the current position; running reverse when the absolute coordinate is smaller than the current position.
- The operation speed will be stable from V_{BIAS} accelerating to the expected V(I). When the speed is approaching the P(I) value set in the control register, the MC01 position control module will start to decelerate to V_{BIAS} and stop.
- The control registers involved: CR#8, #9 (V_{BIAS}), CR#25, #26 (V(I)), CR#6, #7 (V_{MAX}), CR#23, #24 (P(I)), CR#21 (T_{ACC}), and CR#22 (T_{DEC}).



2. CR#32_b1: interrupt single-speed positioning operation

When b[1] is triggered and START ON, the MC01 module will start to send out pulses. When the external DOG signal is executed, the P(I) value will be reloaded.

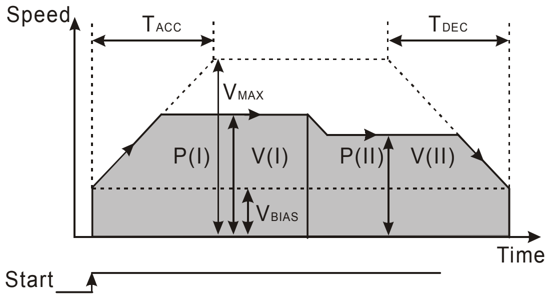
- The relative coordinate positioning is determined by the sign bit of the control register for P(I).
- The absolute coordinate positioning is determined by P(I) (set in CR#23, #24). Running forward when the absolute coordinate is bigger than the current position; running reverse when the absolute coordinate is smaller than the current position.
- The operation speed will be stable from V_{BIAS} accelerating to the expected V(I). When encountering DOG signals during the pulse output, the MC01 module will send out the number of steps in P(I). When the speed is approaching the P(I) value set in the control register, the MC01 module will start to decelerate to V_{BIAS} and stop.
- The control registers involved: CR#8, #9 (V_{BIAS}), CR#25, #26 (V(I)), CR#6, #7 (V_{MAX}), CR#23, #24 (P(I)), CR#21 (T_{ACC}), and CR#22 (T_{DEC}).



3. CR#32_b2: 2-speed positioning operation

When b[2] is triggered and START ON, the 2nd positioning program will start to execute. The 2nd positioning program will start immediately after the 1st positioning program reaches P(I).

- The relative coordinate positioning is determined by the sign bit of the control register for P(I).
- The absolute coordinate positioning is determined by P(I) (set in CR#23, #24). Running forward when the absolute coordinate is bigger than the current position; running reverse when the absolute coordinate is smaller than the current position.
- The operation speed will be stable from V_{BIAS} accelerating to the expected V(I). After the MC01 module sends out the number of pulses equivalent to P(I), it will accelerate/decelerate again from V(I) to V(II) and operate at V(II) stably until P(II) is reached. The MC01 module will then decelerate to V_{BIAS} and stop. Total P(I) + P(II) pulses are sent during the operation.
- The control registers involved: CR#8, #9 (V_{BIAS}), CR#25, #26 (V(I)), CR#6, #7 (V_{MAX}), CR#23, #24 (P(I)), CR#27, #28 (P(II)), CR#21 (T_{ACC}), and CR#22 (T_{DEC}).



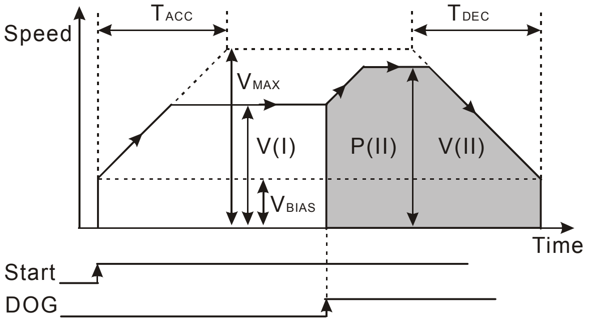
The output accelerates to V(I) and operates at V(I) stably until it reaches P(I). It will then accelerate or decelerate to V(II) and operates at V(II) stably until it reaches P(II) and stops.

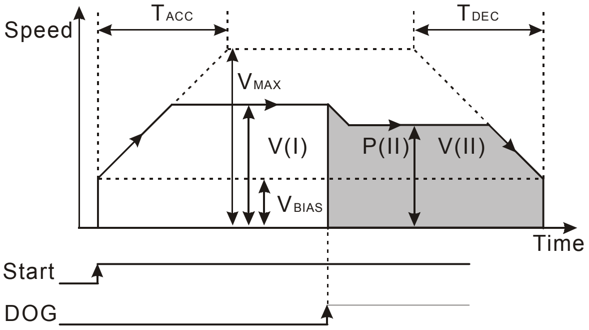
4. CR#32_b3: interrupt 2-speed positioning operation

When b[3] is triggered and START ON, the 2nd positioning program will start immediately after an external DOG signal is enabled during the 1st positioning program. The MC01 module will then start to send out pulses.

- The relative coordinate positioning is determined by the sign bit of the control register for P(I).

- The absolute coordinate positioning is determined by P(I) (set in CR#23, #24). Running forward when the absolute coordinate is bigger than the current position; running reverse when the absolute coordinate is smaller than the current position.
- The operation speed will be stable from V_{BIAS} accelerating to the expected V(I). When encountering DOG signals during the pulse output, the MC01 module will accelerate/decelerate again from V(I) to V(II) and operate at V(II) stably. In the 2nd positioning program, the external STOP input will force the MC01 module to immediately stop the pulse output.
- The control registers involved: CR#8, #9 (V_{BIAS}), CR#25, #26 (V(I)), CR#6, #7 (V_{MAX}), CR#23, #24 (P(I)), CR#27, #28 (P(II)), CR#21 (T_{ACC}), and CR#22 (T_{DEC}).





The output accelerates to V(I) and operates at V(I) stably until it reaches P(I). After the external DOG signal is enabled, the output will then accelerate or decelerate to V(II) and operates at V(II) stably until it reaches P(II) and stops.

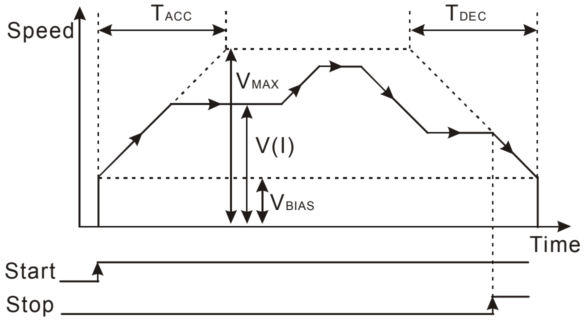
5. CR#32_b4: variable speed operation

   When b[4] is triggered and START ON, the MC01 module will start to operate at variable speed V(I) and send out pulses.

- The relative coordinate positioning is determined by the sign bit of the control register for P(I).
- The absolute coordinate positioning is determined by P(I) (set in CR#23, #24). Running forward when the absolute coordinate is bigger than the current position; running reverse when the absolute coordinate is smaller than the current position.
- The operation speed will be stable from V_{BIAS} accelerating to the expected V(I).

During the pulse output, the speed V(I) can be modified anytime and the MC01 module will accelerate or decelerate according to the setting. At this time, the external STOP input contact cannot force the MC01 module to stop sending out pulses. Stopping the pulse output, can only be accomplished by b1 of CR#31 (software STOP).

- The control registers involved: CR#8, #9 (V_{BIAS}), CR#25, #26 (V(I)), CR#6, #7 (V_{MAX}), CR#23, #24 (P(I)), CR#21 (T_{ACC}), and CR#22 (T_{DEC}).



6. CR#32_b5: manual pulse generator input operation

   b[5] = 1: enabling MGP input operation. For MC01, see CR#40 ~ CR#46.

7. CR#32_b6: STOP mode

   b[6] = 0: While the motor is running, when encountering a STOP signal input, the motor will decelerate to a stop. When the next motion instruction is executed, the motor will ignore the unfinished distance and immediately execute the distance in the next step.

   b[6] = 1: While the motor is running, when encountering a STOP signal input, the motor will decelerate to stop. When the next motion instruction is executed, the motor will complete the unfinished distance before executing the next positioning step.

8. CR#32_b7: manual pulse generator range

   b[7] = 0: No limitation on MPG pulse output.

   b[7] = 1: The range of MPG pulse output is limited within P(I) and P(II). When the range is exceeded, the pulse deceleration will stop.

9. CR#32_b8: LSP/LSN stop mode:

   b[8] = 0: While the motor is running, the motor decelerates to stop when encountering LSP/LSN signal inputs.

   b[8] = 1: While the motor is running, the motor stops immediately when encountering LSP/LSN signal inputs.

10. CR#32_b9, b10, b11: MASK setting

    MASK settings include single-speed positioning, 2-speed positioning, interrupt single-speed positioning, and interrupt 2-speed positioning.

    b[11 ~ 9] = K0(000) or other values: No MASK function.

b[11 ~ 9] = K1(001): Triggering the MASK by the rising edge of input terminal ΦA±

b[11 ~ 9] = K2(010): Triggering the MASK by the falling edge of input terminal ΦA±

b[11 ~ 9] = K3(011): Triggering the MASK by the rising edge of input terminal ΦB±

b[11 ~ 9] = K4(100): Triggering MASK the by the falling edge of input terminal ΦB±

11. CR#32_b12: returning to default settings

    b[12] = 1: All parameters return to default settings.

12. CR#32_b13: Settings of current position, current speed and display unit

    b[13] = 0: current position in CR#34, #33; current speed in CR#36, #35; display unit: pulse

    b[13] = 1: current position in CR#34, #33); current speed in CR#36, #35); display unit: unit

CR#33, 34: Current position

1. Range: -2,147,483,648 ~ +2,147,483,647.
2. The units are determined by CR#32_b13 (pulse/unit).
3. After the zero return is completed, the zero point position in CR#19, #20 will be put into CR#33, #34.

CR#35, 36: Current speed

1. Range: 0 ~ +2,147,483,647.
2. The units are determined by the setting of CR#32_b13 (pulse/unit).

CR#37: RS-485 communication protocol and communication

This setting is only valid for RS-485 communications and will be invalid when connected to an ELC MPU.

b[#]	Explanation
b0 = 1	4,800 bps
b1 = 1	9,600 bps (default)
b2 = 1	19,200 bps
b3 = 1	38,400 bps
b4 = 1	57,600 bps
b5 = 1	115,200 bps
b6 = 1	Reserved
b7	b7 = 0: RTU mode (Format: 8, E, 1)

b[#]	Explanation
	b7 = 1: ASCII mode (Format: 7, E, 1) (default)
b8 ~ b15	RS-485 communication address (default = K1); range: 01 ~ 255

CR# 38: execution status

b[#]	Explanation
b0	b[0] = 0: The system is waiting for running instruction. b[0] = 1: MC01 is executing position control (pulse output in progress).
b1	b[1] = 1: Forward pulse output is in progress.
b2	b[2] = 1: Reverse pulse output is in progress.
b3	b[3] = 1: Zero return is completed and is reset by the user program. When MC01 is re-powered, b[3] will be reset to “0”.
b4	b[4] = 1: The 32-bit "current position CP (CR#33, #34)" overflows. When MC01 is re-powered or when zero return is completed, b[4] will be reset to “0” automatically.
b5	b[5] = 1: An execution error is encountered. The error code is stored in CR#39.
b6	When MC01 executes zero return or resets an error (only when an error occurs), b[6] will be reset. When MC01 finishes zero return or general position control, b[6] will be set to “1”.
b7	When MC01 is operating and the STOP input is On, it will stop the output of MC01 and b[7] will be set to “1”, indicating that the operation of MC01 is currently paused.
b8	Reserved
b9	b[9] = 1: MPG pulse input (counting up)
b10	b[10] = 1: MPG pulse input (counting down)
b10 ~ b15	Reserved

CR#39: Error code

Error code	Explanation
H’0000	No error
H’0001	Incorrect target position (I)

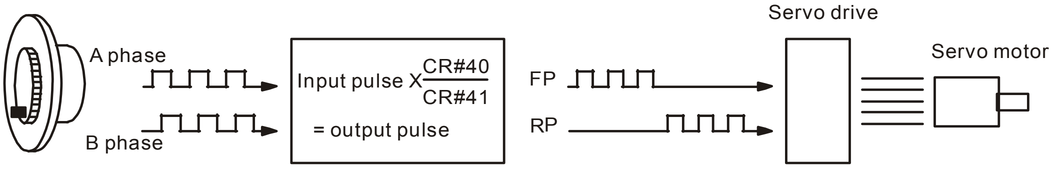
Error code	Explanation
H’0002	Incorrect target position (II)
H’0010	Incorrect operation speed (I)
H’0011	Incorrect operation speed (II)
H’0012	Incorrect zero return deceleration speed (V_{CR})
H’0013	Incorrect zero return speed (V_{RT})
H’0014	Incorrect JOG speed (V_{JOG})
H’0020	Forward pulse is forbidden
H’0021	Reverse pulse is forbidden
H’0030	Low voltage
H’0080	Hardware error in internal memory
H’0081	Incorrect written in data in internal memory

CR# 40: Numerator of MPG electronic gearing

Numerator of MPG electronic gearing

CR#41: Denominator of MPG electronic gearing

1. Set b5 of CR#32 to "1” to enable the work mode of the MPG input.
2. Generate A/B phase pulse input with MPG to ΦA and ΦB. See the figure below for the relation between FP/RP input pulse and output pulse.



3. During the operation, if LSP or LSN is enabled, the output will stop immediately. If LSP is enabled, the forward pulse will not be allowed and reverse pulse will be allowed. If LSN is enabled, the reverse pulse will not be allowed and forward pulse will be allowed.
4. CR#38 b6 = Off: Positioning is not complete. When the positioning is complete, CR#38 b6 = On.
5. The input pulses generated by MPG are proportional to the electronic gearing (CR#40, #41)

CR#42, 43: Input frequency of MPG

The frequency will not be affected by the MPG electronic gear ratio

CR#44, 45: Accumulated number of pulses by MPG

Forward pulses are added and reverse pulses are subtracted. The accumulated value will not be affected by the settings in CR#40 and CR#41 (electronic gear ratio).

CR#46: Response speed of MPG input

1. The faster the response speed, the more synchronous the pulse output and MPG pulse input.
2. The slower the response speed, the more likely the pulse output will lag behind the MPG pulse input

Set value	Response speed
≧5	4ms (default)
4	32ms
3	108ms
2	256ms
1 or 0	500ms

CR#47: Terminal status

bit #	Status	Description
b0	START input	When START input is On, b0 = On.
b1	STOP input	When STOP input is On, b1= On.
b2	DOG input	When DOG input is On, b2 = On.
b3	PG0 input	When PG0 input is On, b3 = On.
b4	LSP input	When LSP input is On, b4 = On.
b5	LSN input	When LSN input is On, b5 = On
b6	A phase input	When A phase input is On, b6 = On.
b7	B phase input	When B phase input is On, b7 = On.
b8	CLR output	When CLR output is On, b8 = On.
b9 ~ b15	Reserved	

CR#48: Firmware version

The firmware version is displayed in hex, e.g. V1.00 is indicated as H’0100.

4.1.1.9 Motion Modes and Application Examples

The MC01 module has 8 motion modes:

1. Mechanical zero return
2. JOG operation
3. Single-speed positioning
4. Interrupt single-speed positioning
5. 2-speed positioning
6. Interrupt 2-speed positioning
7. Variable speed operation
8. MPG input

The processing priority when multiple work modes are enabled at the same time:

1. STOP
2. Mechanical zero return
3. JOG+ operation
4. JOG- operation
5. MPG input
6. Variable speed operation
7. Single-speed positioning
8. Interrupting single-speed positioning
9. 2-speed positioning
10. Interrupting 2-speed positioning

When a work mode is enabled during the execution of another work mode, the MC01 module will remain in the original work mode.

There are two pulse acceleration curves:

1. Trapezoid curve
2. S curve

The corresponding control registers in different motion modes:

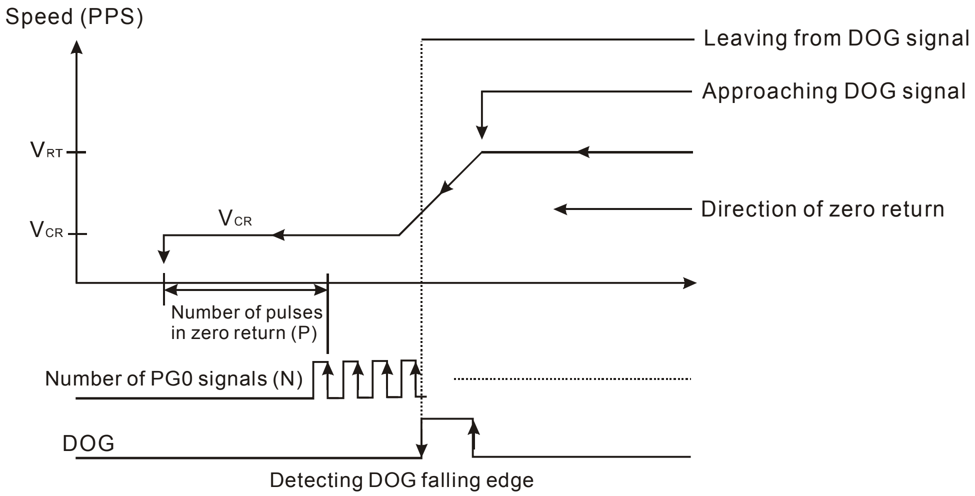
CR#		Parameter (Code)	Motion Modes							
HW	LW		JOG	Zero Return	Single-speed positioning	Interrupt single-speed positioning	2-speed positioning	Interrupt 2-speed positioning	Variable speed	MPG input
#2	#1	Number of pulses required per revolution of the motor (A)	No need to be set up if the unit (CR#5_b0, b1) is a motor. Machine unit or combined unit will need to be set up.							
#4	#3	Distance created for 1 motor revolution (B)								
-	#5	Parameter setting	◎	◎	◎	◎	◎	◎	◎	◎
#7	#6	Maximum speed (V_{MAX})	◎	◎	◎	◎	◎	◎	◎	◎
#9	#8	Bias speed (V_{BIAS})	◎	◎	◎	◎	◎	◎	◎	◎
#11	#10	JOG speed (V_{JOG})	◎	-	-	-	-	-	-	-
#13	#12	Zero return speed (V_{RT})	-	◎	-	-	-	-	-	-
#15	#14	Zero return deceleration speed (V_{CR})								
-	#16	Number of PG0 signals (N)								
-	#17	Number of pulse signals (P)								
-	#18	Zero return mode								
#20	#19	Definition of zero point (HP)								
-	#21	Acceleration time (T_{ACC})	◎	◎	◎	◎	◎	◎	◎	—
-	#22	Deceleration time (T_{DEC})	◎	◎	◎	◎	◎	◎	◎	—
#24	#23	Target position (I) (P(I))	-	-	◎	◎	◎	◎	-	◎

CR#		Parameter (Code)	Motion Modes							
HW	LW		JOG	Zero Return	Single-speed positioning	Interrupt single-speed positioning	2-speed positioning	Interrupt 2-speed positioning	Variable speed	MPG input
#26	#25	Operation speed (I) (V(I))	-	-	◎	◎	◎	◎	◎	-
#28	#27	Target position (II) (P(II))	-	-	-	-	◎	◎	-	◎
#30	#29	Operation speed (II) (V(II))	-	-	-	-	◎	◎	-	-
-	#31	Operation instruction	◎	◎	◎	◎	◎	◎	◎	◎
-	#32	Work mode	◎	◎	◎	◎	◎	◎	◎	◎
#34	#33	Current position CP (PLS)	◎	◎	◎	◎	◎	◎	◎	◎
#36	#35	Current speed CS (PPS)	◎	◎	◎	◎	◎	◎	◎	◎
-	#40	Numerator of electronic gear	-	-	-	-	-	-	-	◎
-	#41	Denominator of electronic gear	-	-	-	-	-	-	-	◎
#42	#43	MPG input frequency	-	-	-	-	-	-	-	◎
#44	#45	Accumulated number of MPG input pulses	-	-	-	-	-	-	-	◎
-	#46	Response speed of MPG input	-	-	-	-	-	-	-	◎

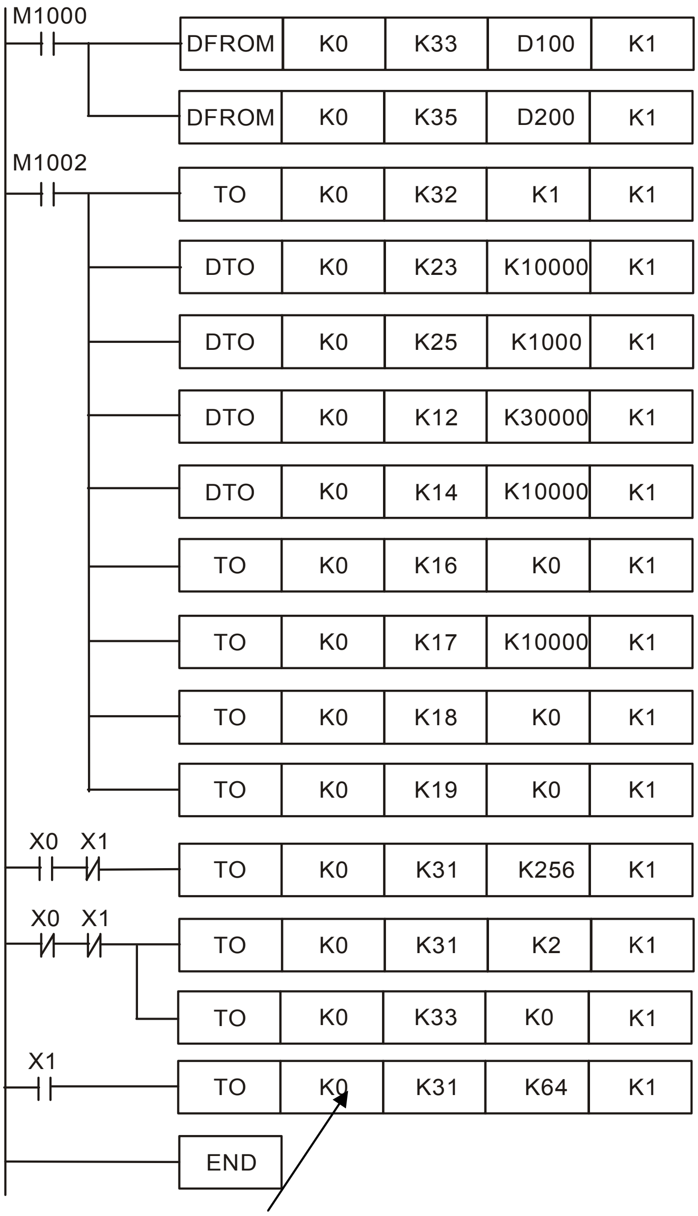
◎ refers to the control register for the motion mode.

- Zero Return

1. Control requirements
   - Write K64 (H’40, i.e. b6 = 1) into CR#31 to enable the zero return mode.
   - The zero return will be executed immediately after the DOG signal is triggered.
2. Devices
   - X0 = On: execute single-speed positioning
   - X1 = On: execute zero return
   - X0, X1 = Off: stop the execution and set the current position to 0
3. Zero return mode (normal mode, detecting DOG falling edge in zero return = On)



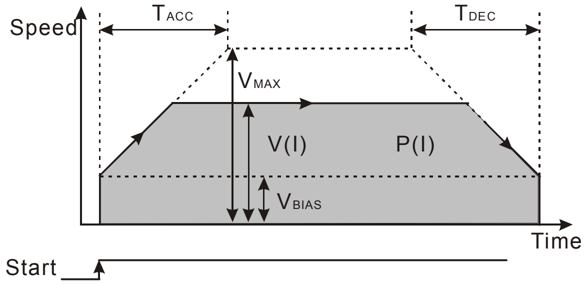
4. Program Description
   - Read CR#33, #34 (current position) and CR#35, #36 (current speed).
   - Write K1 (H'1, i.e. b0 = 1) into CR#32 to set up the single-speed positioning mode.
   - Set up CR#23, #24 (target position) and CR#25, #26 (operation speed V(I)).
   - Set up CR#12 ~ #19 to complete the parameter settings for zero return.
   - When X0 = On, write K256 (H'100, i.e. b8 = 1) into CR#31 to enter single-speed positioning mode.
   - When X1 = On, write K64 (H'40, i.e. b6 = 1) into CR#31 to enable the zero return.
   - When X0, X1 = Off, stop all the executions and set the current position to 0.
5. Program example



Ladder diagram:							Explanation:
M1000	DFROM	K0	K33	D100	K1		Read current position
	DFROM	K0	K35	D200	K1		Read current speed
M1002	TO	K0	K32	K1	K1		Set up as single-speed positioning mode
	DTO	K0	K23	K10000	K1		Set up target position
	DTO	K0	K25	K1000	K1		Set up operation speed
	DTO	K0	K12	K30000	K1		Set up zero return speed
	DTO	K0	K14	K10000	K1		Set up zero return deceleration speed
	TO	K0	K16	K0	K1		Set up the number of PG0 signals in zero return mode (N)
	TO	K0	K17	K10000	K1		Set up the number of pulse signals in zero return mode (P)
	TO	K0	K18	K0	K1		Select zero return mode
	TO	K0	K19	K0	K1		Define the position of zero point
X0 X1	TO	K0	K31	K256	K1		Enter single-speed positioning mode
X0 X1	TO	K0	K31	K2	K1		Stop all executions
	TO	K0	K33	K0	K1		Set the current position to 0
X1	TO	K0	K31	K64	K1		Enable zero return
	END						

- Single-speed Positioning

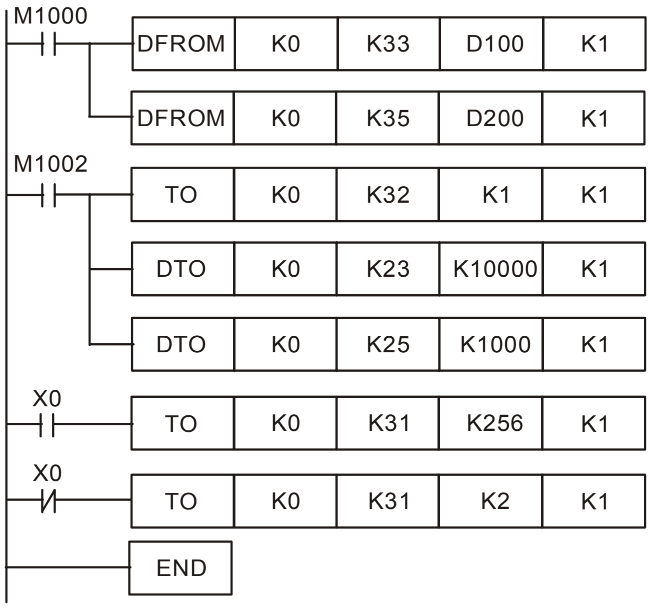
1. Control requirements
   - Write K1 (H’1, i.e. b0 = 1) into CR#32 to enable the single-speed positioning.
   - Set up CR#23, #24 (target position) and CR#25, #26 (target speed).
2. Devices
   - X0 = On: software starts (and stops after the target position and operation speed are reached)
   - X0 = Off: stop the execution (controlled by the software)
3. Single-speed positioning mode



4. Program Description
   - Read CR#33, #34 (current position) and CR#35, #36 (current speed).
   - Write K1 (H’1, i.e. b0 = 1) into CR#32 to set up the single-speed positioning mode
   - Set up CR#23, #24 (target position) and CR#25, #26 (operation speed).
   - When X0 = On, write K256 (H’100, i.e. b8 = 1) into CR#31 to enter the single-speed positioning mode.
   - When X0 = Off, stop the execution of single-speed positioning.
5. Program example

Ladder diagram:

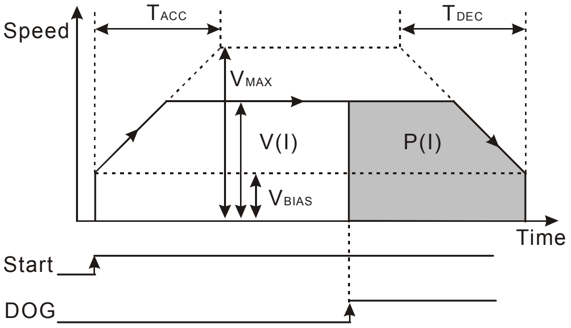
Explanation:



M1000	DFROM	K0	K33	D100	K1	Read the current position
	DFROM	K0	K35	D200	K1	Read the current speed
M1002	TO	K0	K32	K1	K1	Set up as single-speed positioning.
	DTO	K0	K23	K10000	K1	Set up the target position
	DTO	K0	K25	K1000	K1	Set up the operation speed
X0	TO	K0	K31	K256	K1	Enable the single-speed positioning mode
X0	TO	K0	K31	K2	K1	Stop all executions
	END					

- Single-speed Positioning Interrupt

1. Control requirements
   - Write K2 (H'2, i.e. b1 = 1) into CR#32 to enable the single-speed positioning interrupt.
   - Set up CR#23, #24 (target position) and CR#25, #26 (target speed).
   - The DOG signal must be input from the external DOG terminal.
2. Devices
   - X0 = On: software starts (The execution follows the operation speed. After the DOG signal is triggered, the target position will be calculated. The software will stop when the target position is reached.)
   - X0 = Off: stop the execution (controlled by the software)
3. Interrupt single-speed positioning mode

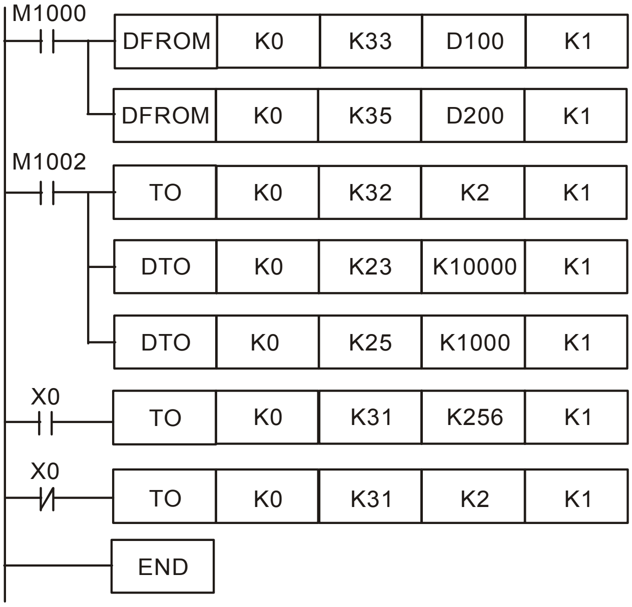


4. Program Description
   - Read CR#33, #34 (current position) and CR#35, #36 (current speed).
   - Write K2 (H'2, i.e. b1 = 1) into CR#32 to set up the single-speed positioning mode.
   - Set up CR#23, #24 (target position) and CR#25, #26 (operation speed).
   - When X0 = On, write K256 (H'100, i.e. b8 = 1) into CR#31 to enter the interrupt single-speed positioning mode.
   - The execution follows the operation speed. After the DOG signal is triggered, the target position will be calculated. The software will stop when the target position is reached.
   - When X0 = Off, stop the execution of interrupt single-speed positioning.

5. Program example

Ladder diagram:

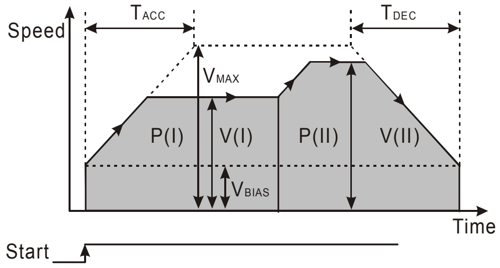
Explanation:



M1000	DFROM	K0	K33	D100	K1	Read the current position
	DFROM	K0	K35	D200	K1	Read the current speed
M1002	TO	K0	K32	K2	K1	Set up as interrupting single-speed positioning mode
	DTO	K0	K23	K10000	K1	Set up the target position
	DTO	K0	K25	K1000	K1	Set up operation speed
X0	TO	K0	K31	K256	K1	Enable the interrupting single-speed positioning mode
X0	TO	K0	K31	K2	K1	Stop all executions
	END					

- 2-speed Positioning

1. Control requirements
   - Write K4 (H’4, i.e. b2 = 1) into CR#32 to enable 2-speed positioning.
   - Set up CR#23, #24 (target position I) and CR#25, #26 (target speed I).
   - Set up CR#27, #28 (target position II) and CR#29, #30 (target speed II).
2. Devices
   - X0 = On: software starts
   - X0 = Off: stop the execution (controlled by the software)
3. 2-speed positioning mode



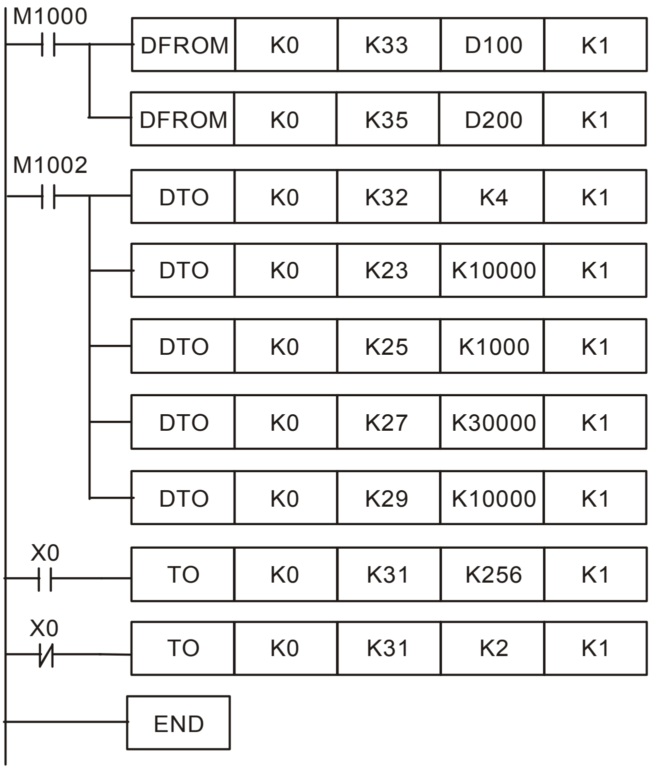
4. Program Description
   - Read CR#33, #34 (current position) and CR#35, #36 (current speed).
   - Write K4 (H’4, i.e. b2 = 1) into CR#32 to set up the 2-speed positioning mode.
   - Set up CR#23, #24 (target position I) and CR#25, #26 (target speed I).
   - Set up CR#27, #28 (target position II) and CR#29, #30 (target speed II).
   - When X0 = On, write K256 (H’100, i.e. b8 = 1) into CR#31 to enter the 2-speed positioning mode.

- Once the mode is enabled, the execution will follow the operation speed (I) and enter operation speed (II) after the 1st movement is complete. The execution will stop after operation speed (II) is reached.
    - When X0 = Off, stop the execution of 2-speed positioning.

5. Program example

Ladder diagram:

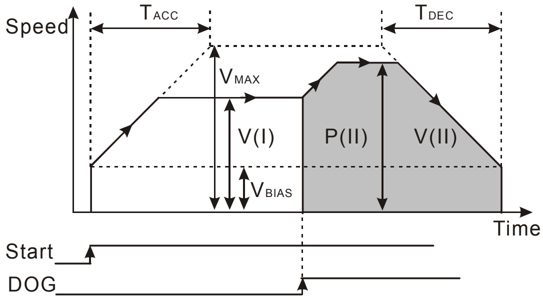
Explanation:



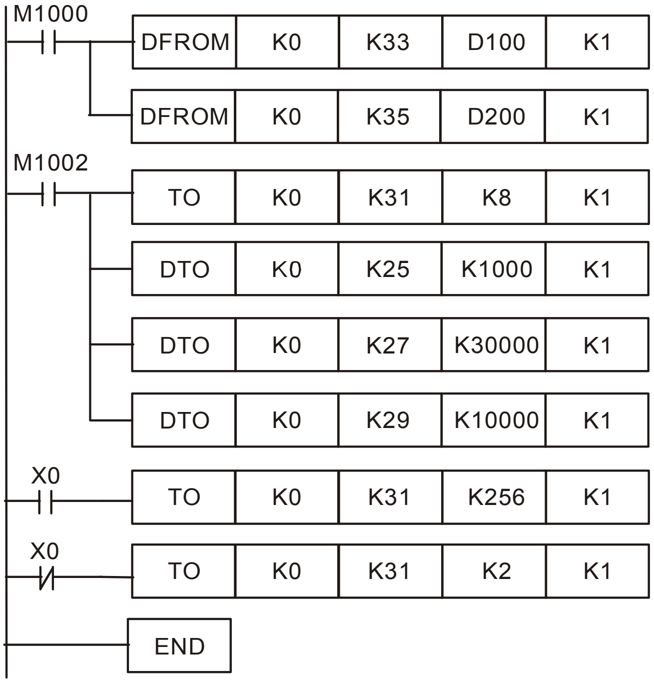
DFROM	K0	K33	D100	K1	Read the current position
DFROM	K0	K35	D200	K1	Read the current speed
DTO	K0	K32	K4	K1	Set up as 2-speed positioning mode
DTO	K0	K23	K10000	K1	Set up target position I
DTO	K0	K25	K1000	K1	Set up operation speed I
DTO	K0	K27	K30000	K1	Set up target position II
DTO	K0	K29	K10000	K1	Set up operation speed II
TO	K0	K31	K256	K1	Enable the 2-speed positioning mode
TO	K0	K31	K2	K1	Stop the execution
END					

- Interrupt 2-speed Positioning

1. Control requirements
    - Write K8 (H'8, i.e. b3 = 1) into CR#32 to enable interrupt 2-speed positioning
    - Set up CR#25, #26 (target speed I).
    - Set up CR#27, #28 (target position II) and CR#29, #30 (target speed II).
2. Devices
    - X0 = On: software starts.
    - X0 = Off: stop the execution (controlled by the software)
3. Interrupt 2-speed positioning mode



4. Program Description
   - Read CR#33, #34 (current position) and CR#35, #36 (current speed).
   - Write K8 (H'8, i.e. b3 = 1) into CR#32 to set up the interrupt 2-speed positioning mode.
   - Set up CR#25, #26 (target speed I). It is not necessary to set up CR#23, #24 (target position I) in this mode.
   - Set up CR#27, #28 (target position II) and CR#29, #30 (target speed II).
   - When X0 = On, write K256 (H'100, i.e. b8 = 1) into CR#31 to enter the interrupt 2-speed positioning mode.
   - The execution follows the operation speed (I). After the DOG signal is triggered, the execution will enter operation speed (II) and stop after the target position is reached.
   - When X0 = Off, stop the execution of interrupt 2-speed positioning.
5. Program example



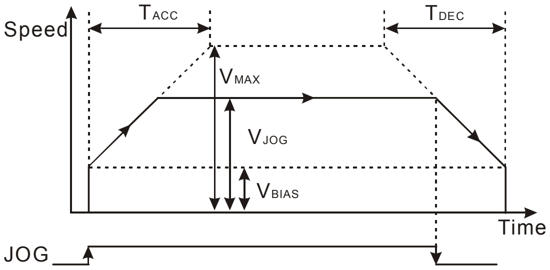
Ladder diagram:	Explanation:
M1000 ─┤├─ DFROM K0 K33 D100 K1	Read the current position
DFROM K0 K35 D200 K1	Read the current speed
M1002 ─┤├─ TO K0 K31 K8 K1	Set up as interrupting 2-speed positioning mode
DTO K0 K25 K1000 K1	Set up operation speed I
DTO K0 K27 K30000 K1	Set up target position II
DTO K0 K29 K10000 K1	Set up operation speed II
X0 ─┤├─ TO K0 K31 K256 K1	Enable the interrupting 2-speed positioning mode
X0 ─┤/├─ TO K0 K31 K2 K1	Stop the execution
END	

- ■ JOG Operation

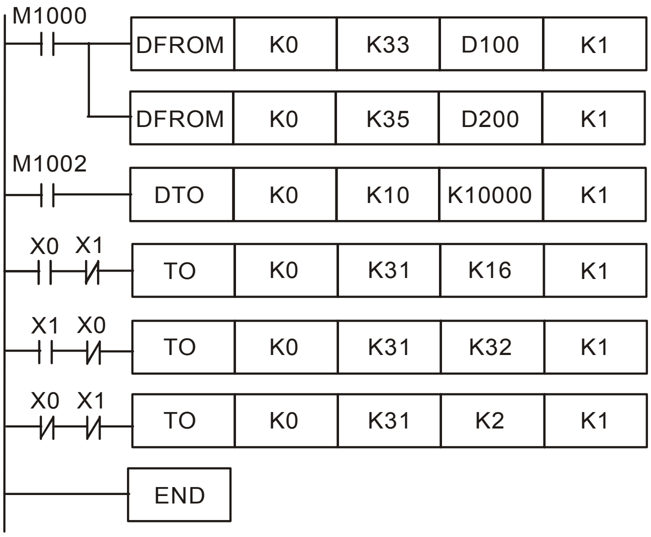
1. Control requirements
   - Set up JOG operation speed in CR#10.
   - Set up CR#31: K16 for forward pulses/K32 for reverse pulses/K0 for stopping output.
2. Devices
   - X0 = On: JOG forward pulse output.
   - X1 = On: JOG reverse pulse output.

- X0, X1 = Off: stop the execution.

3. JOG operation mode



4. Program explanation
   - Read CR#33, #34 (current position) and CR#35, #36 (current speed).
   - Set up JOG speed in CR#10, #11.
   - X0 = On: JOG+ forward pulse output
   - X1 = On: JOG- reverse pulse output
   - X0, X1 = Off: stop the JOG operation.
5. Program example

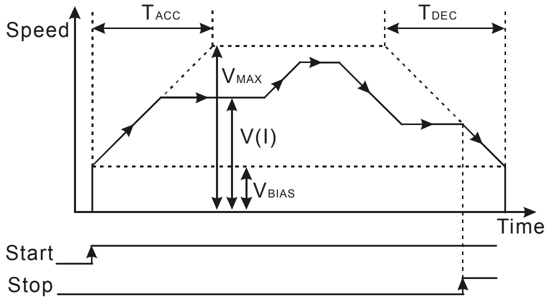


Ladder diagram:						Explanation:
M1000	DFROM	K0	K33	D100	K1	Read the current position
	DFROM	K0	K35	D200	K1	Read the current speed
M1002	DTO	K0	K10	K10000	K1	Set up as JOG operation mode
X0 X1	TO	K0	K31	K16	K1	JOG+ forward pulse output
X1 X0	TO	K0	K31	K32	K1	JOG- reverser pulse output
X0 X1	TO	K0	K31	K2	K1	Stop JOG operation
	END					

- Variable Speed Operation Mode

1. Control requirements
   - Set up CR#25 for variable speed operation (+/- for the direction).
   - Write K16 (H’10, i.e. b4 = 1) to enable the variable speed operation mode.
2. Devices
   - X0 = On/Off: enable/disable variable speed operation.
   - X1 = On: set up the variable speed as 50kHz.
   - X2 = On: set up the variable speed as 60kHz.
   - X3 = On: set up the variable speed as 70kHz.

3. Variable speed operation mode

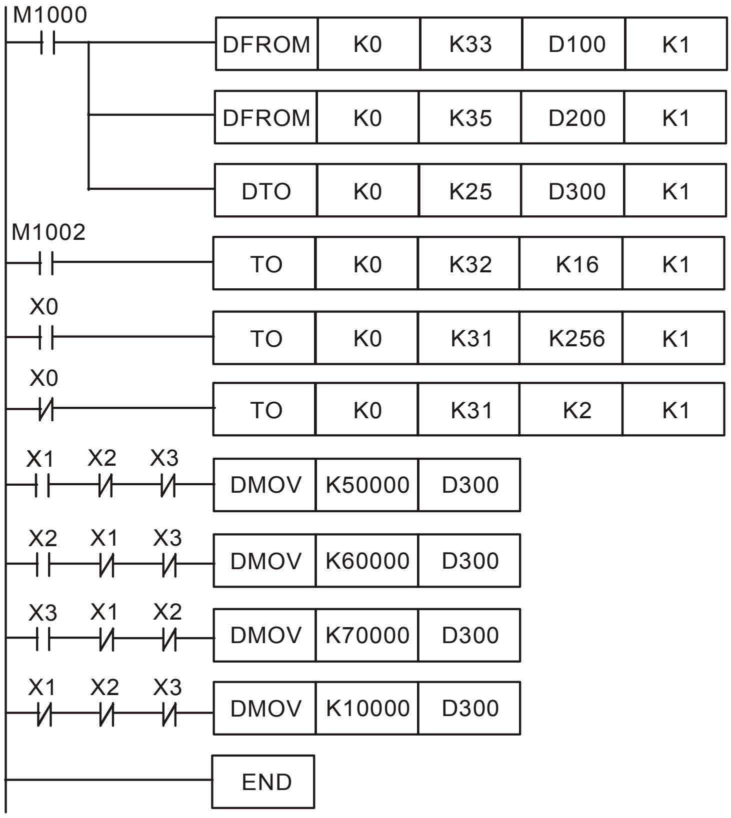


4. Program Description

- Read CR#33, #34 (current position) and CR#35, #36 (current speed).
- Set up CR#25, #26 for the variable speed operation and D300 as the register (+/- for the direction).
- Write K16 (H'10, i.e. b4 = 1) into CR#32 to set up as variable speed operation.
- Set X0 = On to enable the variable speed operation mode; set X0 = Off to disable the variable speed operation mode.
- When X1 = On, the variable speed = 50kHz.
- When X2 = On, the variable speed = 60kHz.
- When X3 = On, the variable speed = 70kHz.
- X1, X2, X3 = Off, the variable speed is fixed at 10kHz.

5. Program example

Ladder diagram:



Explanation:

Read the current position

Read the current speed

Set up as the operation speed mode

Set up as variable speed operation mode

Enable variable speed operation mode

Disable variable speed operation mode

Variable speed = 50kHz

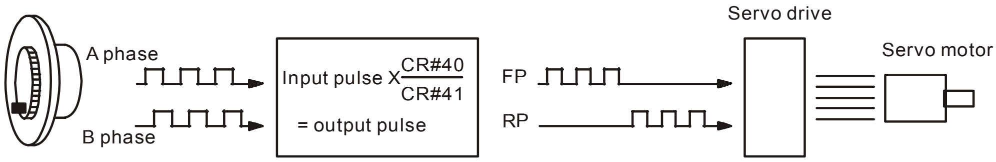
Variable speed = 60kHz

Variable speed = 70kHz

Variable speed fixed as 10kHz

- MPG (Manual Pulse Generator) Mode

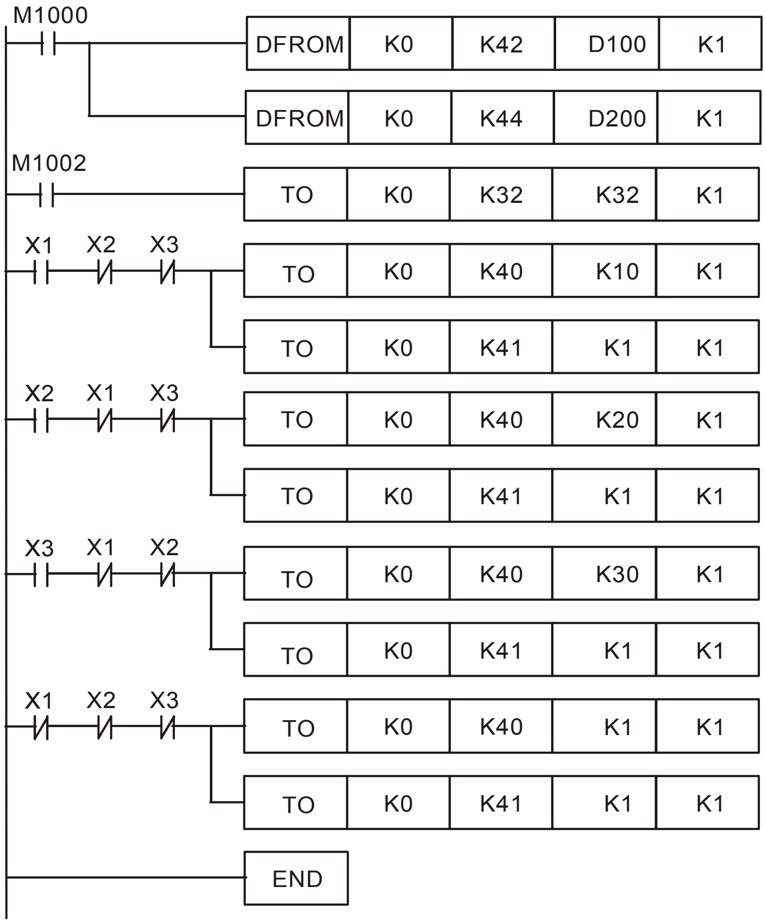
1. Control requirements
    - Read the MPG input frequency in CR#42, #43.
    - Read the number of MPG input pulses in CR#44, #45.
    - Write K32 (H’20, i.e. b5 = 1) into CR#32 to enable MPG mode.
    - Set up electronic gear ratio in CR#40 (numerator) and CR#41 (denominator).
2. Devices
    - Write K32 (H’20, i.e. b5 = 1) into CR#32 to set the gear ratio as 1: 1.
    - X1 = On: set up the gear ratio as 1: 10.
    - X2 = On: set up the gear ratio as 1: 20.
    - X3 = On: set up the gear ratio as 1: 30.
3. MPG mode



4. Program Description
    - Read CR#42, #43 (MPG input frequency) and CR#44, #45 (number of MPG input pulses)
    - Write K32 (H’20, i.e. b5 = 1) into CR#32 to set up as MPG input mode.
    - When X1 = On, the gear ratio = 1: 10.
    - When X2 = On, the gear ratio = 1: 20.
    - When X3 = On, the gear ratio = 1: 30.
    - X1, X2, X3 = Off, the gear ratio is fixed as 1: 1.

5. Program example:

Ladder diagram:



Explanation:

Read the MPG input frequency

Read the number of MPG input pulses

Set up as MPG input mode

MPG gear ratio = 1: 10.

MPG gear ratio = 1: 20

MPG gear ratio = 1: 30

MPG gear ratio = 1: 1

5

Communication Units

Table of Content

5.1 ELC Communication expansion modules

The modules listed in this section attach to ELC processors to provide expanded communications capability. Table 1 summarizes the modules described in this chapter and the processors they can be used with.

Module	Description	PV	PB, PC, PH, PA	User manual	Instruction Sheet
ELC-CODNET	DeviceNet Slave	yes	yes	MN05003005E	IL05003019E
ELC-COPBDP	Profibus DP Slave	yes	yes	MN05006003E	IL05003018E
ELC-CODNETM	DeviceNet Scanner	yes	no	MN05006002E	IL05001003E
ELC-COENETM	Modbus TCP Scanner	yes	no	MN05006001E	IL05001002E

5.2 ELC Distributed I/O Adapters

The modules listed in this section attach to ELC I/O modules to allow them to be used as distributed I/O. The distributed I/O can be used with ELC processors or with controllers from many different vendors. The table below shows the available distributed I/O modules.

Module	Description	User Manual	Instruction Sheet
ELC-CADNET	DeviceNet slave I/O	MN05002003E	IL05004007E
ELC-CAPBDP	Profibus DP Slave I/O		IL05004009E
ELC-CAENET	Modbus TCP and EtherNet/IP I/O		IL05001003E
ELC-CARS485	Modbus RTU (serial) I/O		IL05004008E

Users manuals and instruction sheets for these modules are available from the Eaton web site http://www.eaton.com/ Electrical/ .

6

Power and Adapter Units

Table of Content

6.1 ELC Series

6.1.1 ELC-PS01/ELC-PS02

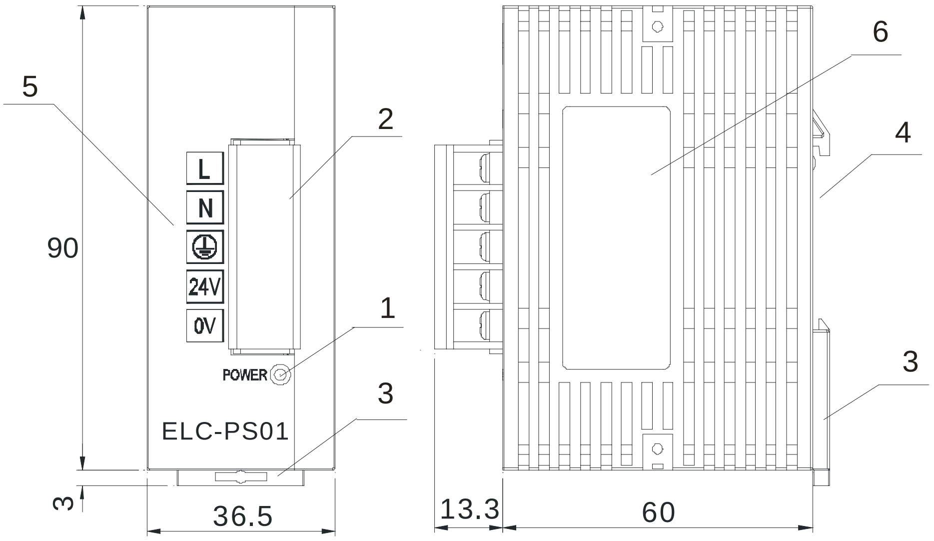
6.1.1.1 Specification

- **Electrical Specification**

Model Item	ELC-PS01	ELC-PS02
Power input	100~240 VAC (-15%~+10%)，50 / 60 Hz	
Output power	24VDC (±3%), output current: 1A max.	24VDC (±3%), output current: 2A max.
Ripple noise ($V_{p\text{-}p}$)	Under 100mV Typical at full load	Under 240mV Typical at full load
Efficiency	78%~87% Typical at full load	
Over load / short circuit protection	Auto Recovery	
Grounding	The diameter of grounding wire cannot be smaller than the wire diameter of terminals L and N (All ELC units should be grounded directly to the ground pole).	
Operation/storage temperature	Operation: 0°C~55°C (temperature), 50~95% (humidity), Pollution degree 2; Storage: -25°C~70°C (temperature), 5~95% (humidity)	
Agency Approvals	Underwriters Laboratories, Inc.: UL508 Listed(Industrial Control Equipment) UL1604, Class1, Division2 Operating temperature code: T5 (except ELC-PS01) European Community EMC Directive 89/336/EEC and Low Voltage Directive 73/23/EEC	
Weight (approx.)	158g	250g

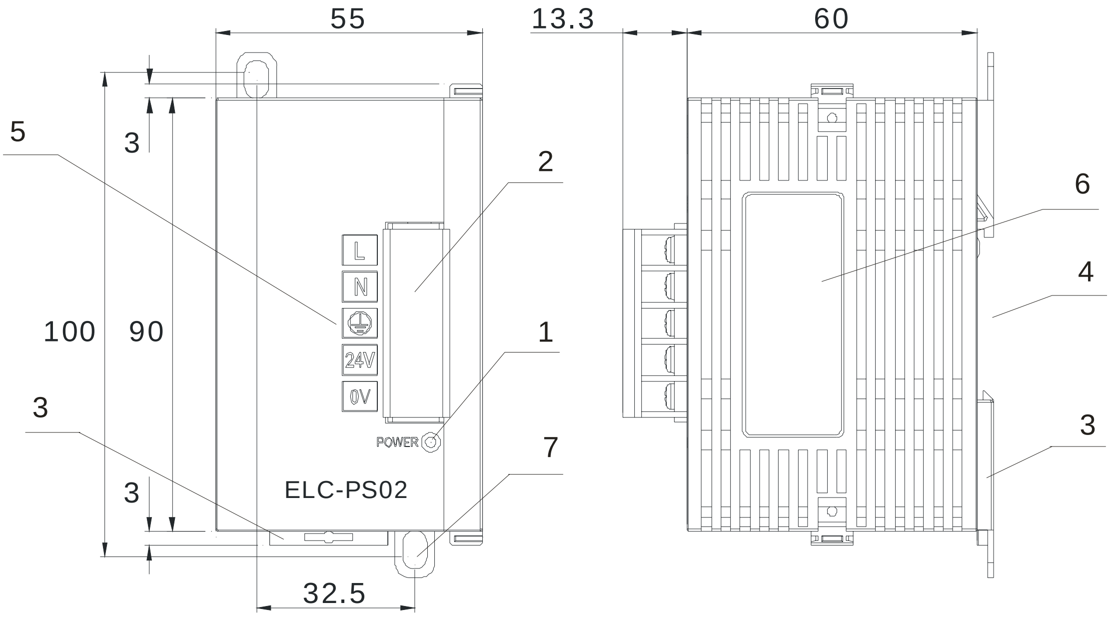
6.1.1.2 Product Profile and Outline

- **ELC-PS01**



Unit: mm

- **ELC-PS02**

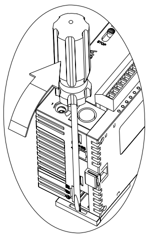


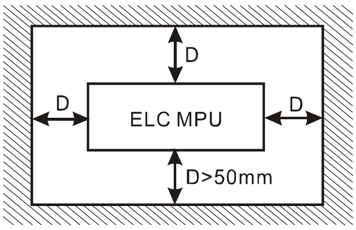
Unit: mm

1. Power LED indicator	5. I/O terminal label
2. Input/Output terminal (fixed terminal)	6. Nameplate
3. DIN rail clip	7. Direct Mounting holes (retractable)
4. DIN rail mounting slot (35mm)	

6.1.1.3 Installation and Wiring

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

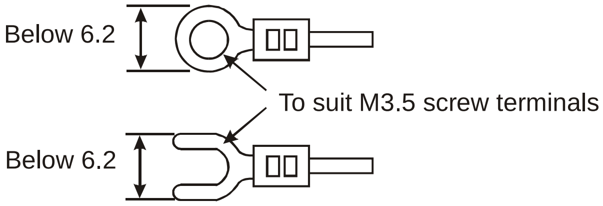




- **Direct Mounting:** Please use M4 screw according to the dimension of the product.

Wiring

- Please use O-type or Y-type terminals for I/O wiring terminals. The specification for the terminals is as shown on the right. Use Copper Conductor Only, 60 °C.
- Tighten ELC terminal screws to a torque of 5 to 8 kg-cm (4.3~6.9 in-lbs).



NOTICE:

- Connect the AC input (100VAC ~ 240VAC) to terminals L and N. Any AC110V or AC220V connected to the +24V terminal will permanently damage the ELC-PS01/PS02.
- Please use wires of 1.6mm and above for the grounding.
- If the power-cut time is less than 10ms, the ELC-PS01/PS02 still operates unaffectedly. If the power-cut time is too long, the ELC-PS01/PS02 will stop operating and all the outputs will be Off.

6.1.2 ELC-485APTR

6.1.2.1 Introduction

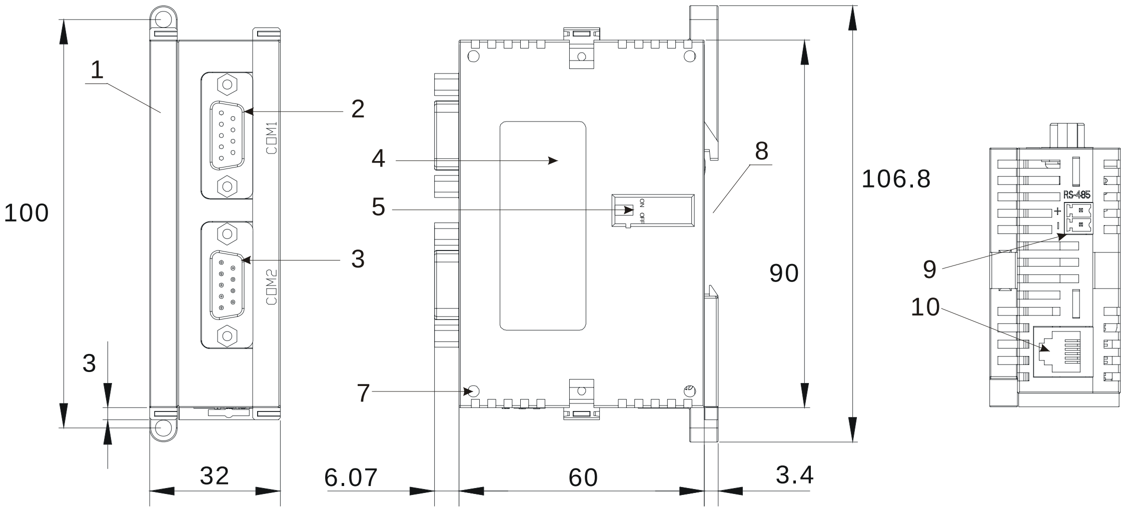
ELC-485APTR is mainly designed to connect Eaton product by RS-485 interface. It is equipped with surge absorber and limited current protection to ensure safe connection of different devices. Also, a switch enabled built-in terminator (120Ω).

6.1.2.2 Specification

- Environmental Specification

Operation	0°C~55°C (temperature), 50~95% (humidity), Pollution degree 2
Storage	-25°C~70°C (temperature), 5~95% (humidity)
UL Class 1 Div.2	Ambient Temperature 55℃, Operating temperature code: T5
Vibration/Shock resistance	International Standard: IEC61131-2, IEC 68-2-6（TEST Fc）/ IEC61131-2 & IEC 68-2-27 (TEST Ea)

6.1.2.3 Product Profile and Outline



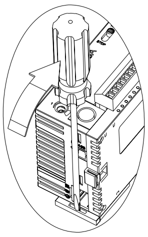
Unit: mm

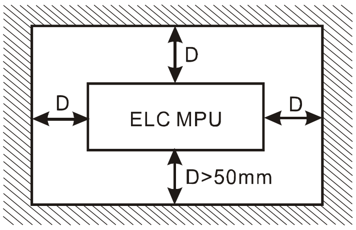
1. Mounting plate	2. COM 1 (DB9 female)
3. COM 2 (DB9 male)	4. Nameplate
5. ON/OFF of termination resistor (factory setting: OFF)	6. Extension unit/module clip
7. Mounting hole	8. DIN rail mounting slot (35mm)
9. RS-485 port	10. RJ12 port

6.1.2.4 Installation and Wiring

- **Installation of the DIN rail**

1. 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.
2. When installing the ELC, make sure that it is installed in an enclosure with sufficient space to its surroundings so as to allow heat dissipation. As shown on the below.





- **Direct Mounting:** Please use M4 screw according to the dimension of the product.

6.1.2.5 Configuration

Connection of ELC-485APTR and AC Motor Drive (please see AC motor drive user manual for detail information)

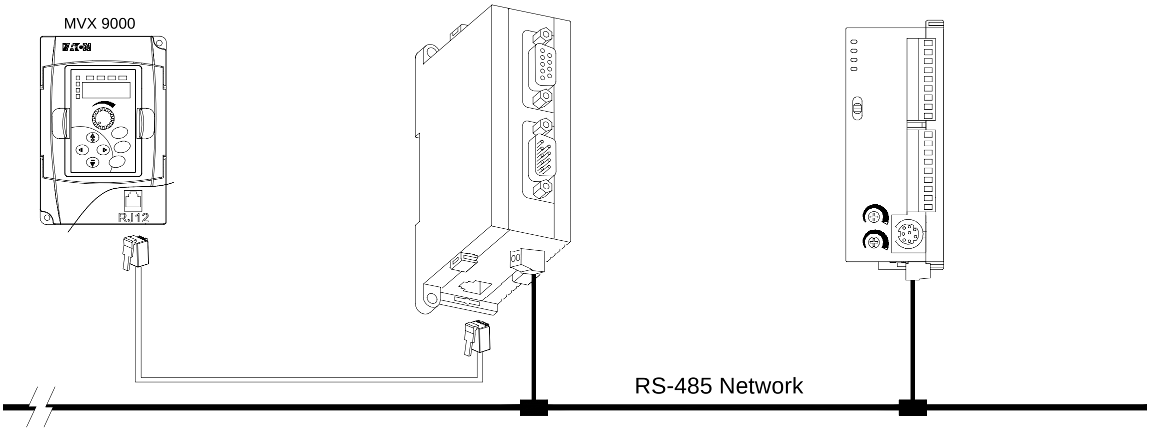


Fig.2: ELC controller connection with MVX9000

- **Compact Installation reference:**

See Fig. 3a in lower left, when ELC-485APTR is separated from mounting plate, it can be used as the last extension module with its RS-485 port connecting to ELC controller’s (see Fig. 3b for illustration). This connection is feasible for ELC controller to connect AC Motor Drive within 5 meters.

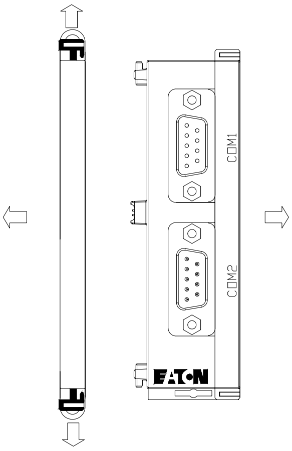


Fig. 3a

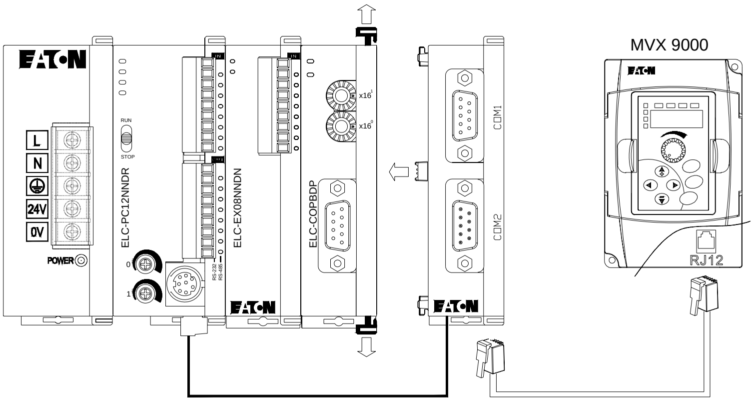
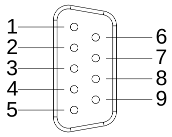
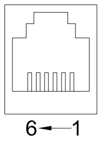
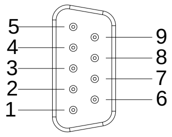
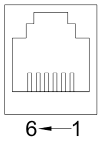


Fig. 3b

- **PIN Explanation of COM1, COM2, and RJ12**

COM1-DB9 female	PIN	Definition	RJ12 of AC Motor Drive side	PIN	Definition
	1	RS485-		1	+15V
	2	RS485+		2	GND
	3	RS485+		3	SG-
	4	RS485-		4	SG+
	5~9	NC		5, 6	Reserved

COM2-DB9 male	PIN	Definition	RJ12 of ELC-485APTR side	PIN	Definition
	3, 6	RS485-		3	RS-485+
	8	RS485+		4	RS-485-
	5, 9	GND		5	GND
	1, 2, 4, 7	NC		1, 2, 6	NC

- **Termination Resistor Application**

In all RS-485 installations, the cable must be correctly terminated with two sets of resistors, one set at each end of the network (4,000 feet maximum total cable length). This applies even if you are only using one slave node connected to one master device. The terminating resistors prevent reflection problems that can interfere with data transmission. The resistance value of the terminating resistors should match the characteristic impedance of the cable. A typical value is 120 ohms. The terminating resistors must be placed at the two farthest ends of the RS-485 network, regardless of where the master device is. In some cases master device RS-485 ports have built in or optional terminating resistors. Beware of your network (whether it has one node or 32 nodes) having only two sets of terminating resistors.

ELC-485APTR's Termination Resistor Switch is located inside of the adapter's extension port.
Switch ON the termination resistor for ELC-485APTR on the both ends only and switch OFF (factory setting) for the modules between both ends when modules are connecting in parallel.

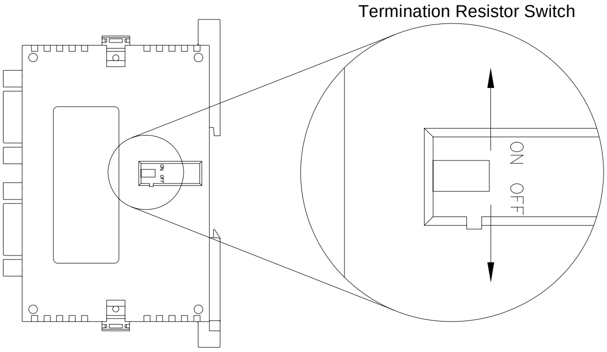


Fig. 4