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EAT•N

ELC-PA10AADR
ELC-PA10AADT

Instruction Sheet

Logic Controller with Built-in Analog Input/Output

⚠ WARNING

- This Instruction Sheet only provides descriptions for electrical specifications, general specifications, installation & wiring, troubleshooting and peripherals. Other detail infromation about programming and commands is compatible with ELC-PC/PA/PH series; please see ELC Application Manual. For more information about the optional peripherals , please see individual product manual.

- This is an OPEN TYPE Controller. The ELC should be kept in an enclosure away from airborne dust, humidity, electric shock risk and vibration. Also, it is equipped with protective methods such as some special tools or keys to open the enclosure, so as to avoid the hazard to users and the damage to the ELC.

- 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.

- Battery replacement: use UL component type: TDRTL-2150/S lithium battery. Refer to following table for battery life. (NOTE: RTC should be reset after changing battery.)

Temperature((°C)	0	25	50	70
Life (Years)	9	8	6	5

Precision of calendar timer:

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

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

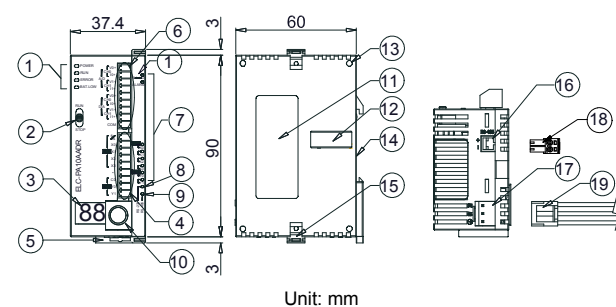At 55°C/131°F, less than –132 seconds error per month.

- Warning – Do not disconnect while circuit is live unless area is known to be non-hazardous.

- Power, input and output (I/O) wiring must be in accordance with Class 1, Div. 2 wiring methods - Article 501-10(B)(1) of the National Electrical Code.

- Suitable for use in Class 1, Division 2, Groups A, B, C, D or Non-Hazardous locations only.

- Warning – Explosion hazard - Substitution of components may impair suitability for Class 1, Division 2.

- Warning – Explosion hazard - Do not disconnect equipment unless power has been switched off or the area is known to be Non-Hazardous.

1   INTRODUCTION

1.1   Model Name Explanation and Peripherals

Thank you for choosing Eaton Logic Controller (ELC) series products. The ELC-PA series is a 10-point (4DI+2DO+2AI+2AO) controller unit. ELC-PA uses the same commands and functions as ELC-PA series, 2-CH 12-bit analog voltage/current input and 2-CH 12-bit analog voltage/current output are all bipolar. There is also built-in, 2-digit 7-segment display corresponds to internal register directly to display ELC station or user-defined code.
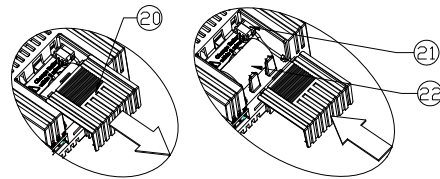
1.2   Product Profile and Outline

Unit: mm

Warning: Battery replacement: Please change the battery within 3 minutes, or the internal data of the ELC (including the program area, perpetual calendar and latched registers) could be lost or destroyed.

1	Status indicator: POWER, RUN, ERROR, BAT.LOW, A+D, ALARM
2	RUN/STOP switch
3	2-digital 7-segment display
4	Digital I/O terminal
5	DIN rail clip
6	Analog 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 hold of the extension unit
14	DIN rail (35mm)
15	Extension unit clip
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

2   FUNCTION SPECIFICATIONS

Items			Specifications	Remarks
Control Method			Stored program, cyclic scan system	
I/O Processing Method			Batch processing method (when END command is executed)	I/O refresh command is available
Execution Speed			Basic commands (several us)	Application Commands (10~hundreds us)
Program Language			Commands + Ladder Logic + SFC	Including the Step commands
Program Capacity			7,920 STEPS	SRAM + Battery
Commands			32 Basic sequential commands (including STL/RET)	168 Application commands
Relay (bit mode)	X	External Input Relay	X0~X177, octal number system, 128 points · Total 256 points	Correspond to external I/O points
	Y	External Output Relay	Y0~Y177, octal number system, 128 points	
	M Aux. Relay	General	M0~M511, 512 points (*1) · Total 4,096 points	Contacts can switch to On/Off in program
		Latched	M512~M999, 488 points (*3)	
			M2000~M4095, 2,096 points (*3)	
		Special	M1000~M1999, 1,000 points (some are latched)	
	T Timer	100ms	T0~T199, 200 points (*1) · Total 256 points	When the timer that set by TMR command reaches the preset value, the T contact with the same number will be On.
			T192~T199 for Subroutine	
			T250~T255, 6 points Accumulative (*4)	
		10ms	T200~T239, 40 points (*2)	
			T240~T245, 6 points Accumulative (*4)	
		1ms	T246~T249, 4 points Accumulative (*4)	
	C Counter	16-bit Count Up	C0~C95, 96 points (*1) · Total 250 points	When the counter that set by CNT (DCNT) command reaches the preset value, the C contact with the same number will be On.
			C96~C199, 104 points (*3)	
		32-bit Count Up/Dn	C200~C215, 16 points (*1)	
			C216~C234, 19 points (*3)	
		32bit High-speed Count Up/Dn	C235~C242, 1 phase 1 input, 9 points (*3)	
			C246~C249, 1 phase 2 inputs, 3 points (*3)	
			C251~C254, 2 phase 2 inputs, 3 points (*3)	
	S Step point	Initial Step Point	S0~S9, 10 points (*1) · Total 1,024 points	Usage device of step ladder diagram (SFC) Latched Range: Start: D1214 (K512) End: D1215 (K895)
		Zero Point Reset	S10~S19, 10 points (use with IST command) (*1)	
		General	S20~S511, 492 points (*1)	
		Latched	S512~S895, 384 points (*3)	
		Alarm	S896~S1023, 124 points (*3)	
Register (WORD data)	T	Current Value of the Timer	T0~T255, 256 points	When the timer reaches the preset value, the contact of timer will be On.
	C	Current Value of the Counter	C0~C199, 16-bit counter, 200 points	When the counter reaches the preset value, the contact of counter will be On.
			C200~C254, 32-bit counter, 50 points	
	D Data Register	General	D0~D199, 200 points (*1) · Total 5,000 points	Can be memory area for storing data. E and F can be used as the special purpose of index indication.
		Latched	D200~D999, 800 points (*3)	
			D2000~D4999, 3,000 points (*3)	
		Special	D1000~D1999, 1000 points (*3)	
		Index	E0~E3, F0~F3, 8 points (*1)	
None		File Register	0~1,599 (1,600 points) (*4)	Extension register for storing data.
Pointer	N	For Master Control Nested Loop	N0~N7, 8 points	Control point of master control nested loop
	P	For CJ, CALL Commands	P0~P255, 256 points	The location point of CJ, CALL.
	I Interrupt	External Interrupt	I001 (X0), I101 (X1), I201 (X2), I301 (X3), I401 (X4), I501 (X5); 6 points (all are rising-edge trigger)	The location pointer of interrupt subroutine
		Time Interrupt	I6□□ (1ms), I7□□ (1ms), (□□=1~99ms)	
		Hi-speed Counter	I010, I020, I030, I040, I060, 6 points	
		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)	
Programming Port			COM1: RS-232, COM2: RS-485 (Master/Slave), They can be used at the same time.	
Analog Volume / RTC			ELC built-in bipolar 2-CH A/D, D/A, 12 bits, 2-digital 7-segment display, built-in RTC	
Special Extension Module			Use the same modules of ELC series. (Max. 8 Extension Unit points)	

*1: The non-latched area is fixed, and can't be changed.

*2: The non-latched area can be changed to a latched area with parameter setting.

*3: The latched area can be changed to a non-latched area with parameter setting.

*4: The latched area is fixed, and can't be changed.

M Auxiliary Relay	General	Latched	Special auxiliary relay	Latched
	M0~M511	M512~M999	M1000~M1999	M2000~M4095
	Non-latched (fixed)	Latched (default) Start: D1200 (K512) End: D1201 (K999)	Some are latched and can't be changed	Latched (default) Start: D1202 (K2,000) End: D1203 (K4,095)

T Timer	100 ms	10 ms	10ms	1 ms	100 ms
	T0~T199	T200~T239	T240~T245	T246~T249	T250~T255
	Non-latched (fixed)	Non-latched (fixed)	Accumulative Latched (fixed)		

C Counter	16-bit count up		32-bit count up/down		32-bit high-speed count up/down	
	C0~C95	C96~C199	C200~C215	C216~C234	C235~C245	C246~C255
	Non-latched (fixed)	Latched (default) Start: D1208 (K96) End: D1209 (K199)	Non-latched (fixed)	Latched (default) Start: D1210 (K216) End: D1211 (K234)	Latched (default) Start: D1212 (K235) End: D1213 (K255)	

S Step relay	General	Latched	Special register	Latched	General
	S0~S9	S10~S19	S20~S511	S512~S895	S896~S1023
	It is fixed to be non-latched		Factory setting is latched		It is fixed to be latched

D Register		Start: D1214 (K512)		
		End: D1215 (K895)		
	General	Latched	Special registers	Latched
	D0~D199	D200~D999	D1000~D1999	D2000~D4999
	Non-latched (fixed)	Factory setting is latched.	Some are latched and can't be changed.	Factory setting is latched.
		Start: D1216 (K200) End: D1217 (K999)		Start: D1218 (K2,000) End: D1219 (K4,999)
File Register		K0~K1,599, Latched (fixed)		

When switching between power On/Off or ELC RUN/STOP modes:

| Memory Type	POWER Off⇒On	STOP⇒RUN	RUN⇒STOP	Clear all M1031 non-latched area	Clear all M1032 latched area	Factory Setting
Non-latched	Clear	Unchanged	M1033=Off, clear	Clear	Unchanged	0
			M1033=On, unchanged			
Latched	Unchanged			Unchanged	Clear	0
Special M, Special D, Index register	Initial value	Unchanged		Unchanged		Initial value
File register	Unchanged					0

3   BUILT-IN ANALOG I/O AND 7-SEGMENT DISPLAY

Built-in 2-CH 12-bit A/D and 2-CH 12-bit D/A are bipolar. It can read A/D converted digital value and get designated analog output by reading special D or writing into special D.

This built-in display corresponds to special D directly. User can use it to display error code or station when executing ELC LINK. It is great convenience for system maintenance. Refer following table for corresponding special D.

Device No.	Function
D1056	Present value of AD channel 0 (CH0)
D1057	Present value of AD channel 1 (CH1)
D1110	Average value of AD channel 0 (CH0)
D1111	Average value of AD channel 1 (CH1)
D1116	DA channel 0 (CH0)
D1117	DA channel 1 (CH1)
D1118	Conversion sampling time (ms)

Built-in Display

2-digital 7-segment display
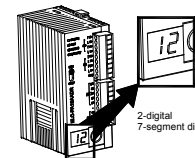
Device No.	Function
M1196	Number system setting for display (Off: Decimal, On: Hexadecimal)
M1197	The decimal point setting between the middle and the right-most numbers
M1198	The decimal point setting after the right-most number
D1196	Display content

4   ELECTRICAL SPECIFICATIONS

Item / Model	ELC-PA10AADR/T
Power supply voltage	ELC: 24VDC (-15%~+20%) (With DC input reverse polarity protection), Extension Unit: supplied by the ELC
Fuse	2A / 250VAC
Power Consumption	5W MAX
Insulation Resistance	> 5 MΩ at 500 VDC (Between all inputs / outputs and earth)
Noise Immunity	ESD: 8KV Air Discharge EFT: Power Line: 2KV, Digital I/O: 1KV, Analog & Communication I/O: 250V RS: 26MHz~1GHz, 10V/m
Grounding	The diameter of grounding wire cannot be smaller than the wire diameter of terminals 24V and 0V (All ELC units should be grounded directly to the ground pole).
Environment	Operation: 0°C~55°C (Temperature), 50~95% (Humidity), Pollution degree 2; D/A output operation: 0°C~50°C (Temperature); 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
Vibration / Shock Resistance	Standard: IEC61131-2, IEC 68-2-6 (TEST Fc) / IEC61131-2 & IEC 68-2-27 (TEST Ea)
Weight (approx.) (g)	158

DC Input Point Electrical Specification				
Input Type	DC (SINK or SOURCE)			
Input Current	24VDC 5mA			
Active Level	Off→On	X0,X1: above18.5VDC	On→Off	X0~X3: below 8VDC
		X2,X3: above16.5VDC		
Responding Time	About 10ms (An adjustment range of 0~20ms could be selected through D1020 and D1021)			

Output Point Electrical Specification			
Output Type	Relay-R		Transistor-T
Current Specification	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
Voltage Specification	Below 250VAC, 30VDC		30VDC
Maximum Loading	75VA (Inductive)		When the output of Y0 and Y1 is high-speed pulse, Y0 and Y1 = 0.9W (Y0 = 32kHz, Y1 = 10kHz), Y0 can be 50kHz using D registers.
	90 W (Resistive)	9W/1 point	

Responding Time	Adjustable 0-20ms, default is10 ms	Off→On 20us On→Off 30us	Y0 and Y1 are specified points for high-speed pulse

5 MODEL NAME & I/O CONFIGURATION

Model	Power	Input				Output			
		Point		Type		Point		Type	
		DI	AI	DI	AI	DO	AO	DO	AO
ELC-PA10AADR	24VDC +20% -15%	4	2	DC24V/5 mA Sink or Source	-20~20mA range (-1,000~+1,000) -10~+10V range (-2,000~+2,000)	2	2	Relay	-20~20mA (range:-2,000~+2,000)
ELC-PA10AADT		4	2			2	2	Resistor	-10~+10V (range:-2,000~+2,000)

6 INSTALLATION & WIRING

6.1 Installation of the DIN rail

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

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

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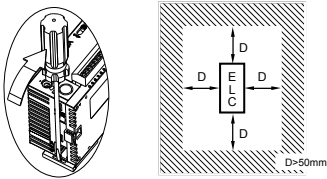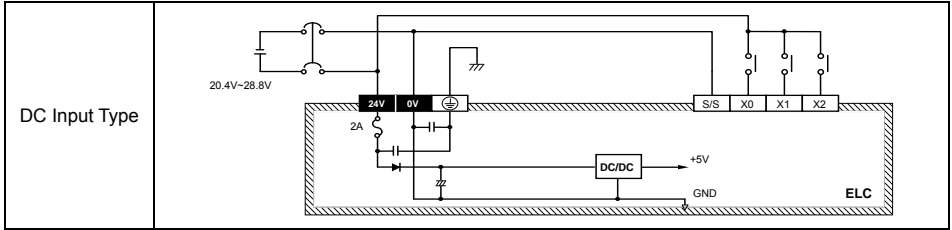
6.2 Wiring

1. Please use 22-16AWG (1.5mm) wiring (either single or multiple core) for I/O wiring terminals. The specification for the terminals is as shown on the left. ELC terminal screws should be tightened to 1.95 kg-cm (1.7 lb-in). Use Copper Conductor Only, 60/75 °C.
2. I/O signal wires or power supply should not run through the same multi-wire cable or conduit.
3. DO NOT store the ELC in an atmosphere that is dusty, smoky, with metallic debris or high temperature or high humidity.
4. DO NOT install the ELC on a shelf or on an unstable surface.
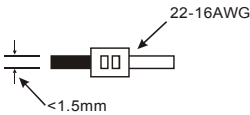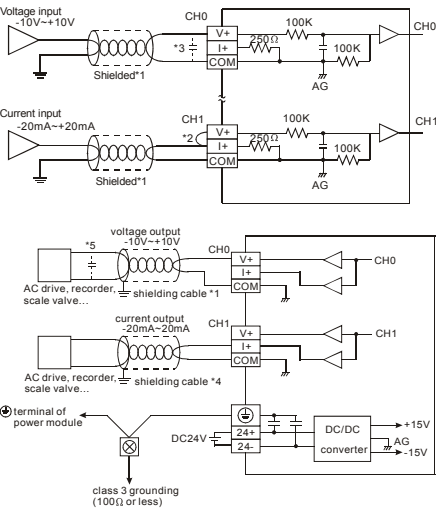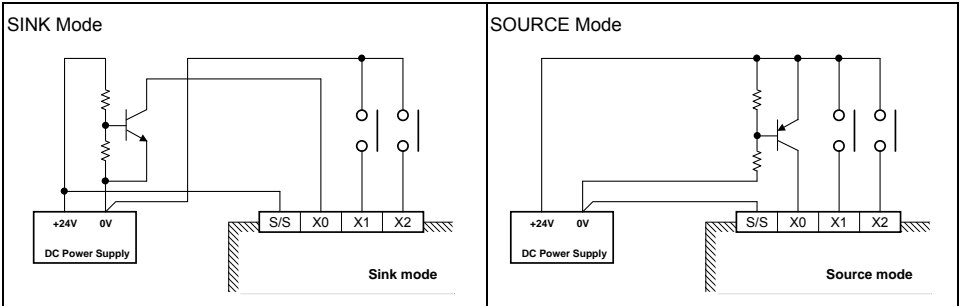
6.3 Power Input Wiring

1. When DC voltage is supplied to the ELC, make sure the power is at terminals 24VDC and 0V (power range is 20.4VDC~28.8VDC). When voltage is lower than 20.4VDC, ELC will stop operating, all outputs will turn OFF and the ERROR LED will flash continuously.
2. If the power-cut time is less than 10ms, the ELC still operates unaffectedly. If the power-cut time is too long or the power voltage drops, the ELC will stop operating and all the outputs will be Off. Once the power is restored, the ELC will return to operate automatically. (There are latched auxiliary relays and registers inside of the ELC, please be aware when programming.)

6.4 Input Point Wiring

There are two types of DC type wiring: SINK and SOURCE, defined as follows:

Note 1: Please isolate analog input and other power wiring.

Note 2: If input signal is in current, please short out between 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.

Note 4: Please isolate analog output and other power wiring.

Note 5: If the noise interference from loaded input wiring terminal is significant, please connect a capacitor with 0.1~0.47µF 25V for noise filtering.

Note 6: Please connect ⊕ power module terminal and ⊕ analog output module terminal to system earth point and make system earth point be grounded or connects to machine cover.

Warning: DO NOT wire to the No function terminal ●

6.5 Output Point Wiring
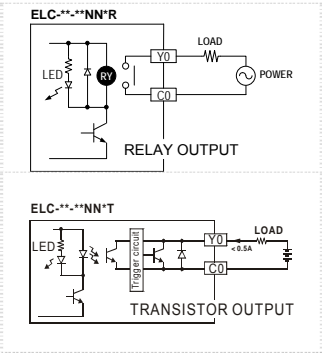
1. ELC-PA series have two output modules, relay and transistor. See "Function Specifications" for their specifications.
2. Please watch out the connection of common terminals whilewire the outputs. For example, when wiring ELC-PA10NNDR/T, output terminal Y0~Y1 use one common terminal C0, as shown below:

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.

7 TRIAL RUN

■ Preparation

1. Prior to applying power, please verify that the power lines and the input/output wiring are correct. And be advised not to supply AC110V or AC220V into the I/O terminals, or it might short-circuit the wiring and would cause direct damage to the ELC.
2. After using the peripheral devices to write the program into the ELC and that the ERROR LED of the ELC is not on, it means that the program in use is legitimate, and it is now waiting for the user to give the RUN command.
3. Use ELC-HHP to execute the forced On/Off test of the output contact.

■ Operation & Test

If the "ERROR" LED of the ELC is not blinking, use RUN/STOP switch or the peripheral devices (ELC-HHP or ELCSoft) to give the RUN command, and the RUN indicator will then be on. If the "RUN" LED is not on, it indicates that there is no program inside the ELC.

ELC-HHP could be utilized to monitor the settings and the registered values of the timer (T), the counter (C) and the data register (D) during operation, and moreover, to force the output contacts to conduct the On/Off action. If the ERROR LED is on (but not blinking), it means that the setting of the user's program has exceeded the preset overtime limit, thus users have to double check the program and perform the On/Off function again. (The ELC is at this moment back to STOP automatically)

■ ELC Input/Output Reaction Time

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

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

Input delay time	10ms (factory default), 0~20ms adjustable. Refer to the usage of special registers D1020~1021.
Program scan time	Please refer to the usage of special register D1010.
Output delay time	Relay module: 10ms. Transistor module: 20~30us.

■ Basic Commands and Application Commands of the ELC:

1. The basic commands and the application commands of the ELC of this series are totally applicable to the ELC. Refer to the ELC Technique Application Manual for relevant basic commands and application commands.
2. The ELC-HHP handheld programming panel and the ELCSoft (Windows version) editing program of the ladder diagram are both good for use with the ELC. Also, the ELC could connect with the ELC-PA10AADR/T through specific transmission wire to execute the program transmission, the ELC control and the program monitoring.

8 AD/DA SPECIFICATIONS

Items	Analog/ Digital (A/D)		Digital/Analog (D/A) Module	
	Voltage input	Current input	Voltage Output	Current Output
Analog Output Range	±10V	±20 mA	±10V	±20 mA
Digital Data Range	±2,000	±1,000	±2,000	±2,000
Resolution	12 bits (1_{LSB}=5 mV)	11 bits (1_{LSB}=20 µA)	12 bits (1_{LSB}=5 mV)	12 bits (1_{LSB}=10 µA)
Input Impedance	200 KΩ and above	250Ω	-	
Output Impedance	-		0.5Ω or lower	
Carried Impedance	-		1KΩ ~2MΩ	0 ~ 500Ω
Overall Accuracy	±1% of full scale during 0~55℃ (32~131℉)			
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.			
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.			

9 TROUBLESHOOTING

Judge the errors by the indicators on the front panel. When errors occurred on ELC, please check:

☼ "POWER" LED

There is a "POWER" LED at the front of the ELC. When the ELC is powered On, the green LED light will be on. If the indicator is not on when the ELC is powered up and with the input power being normal, it is an indication that the ELC is out of order. Please have this machine replaced or have it repaired at a dealer near you.

☼ ELC "RUN" LED

Identify the status of the ELC. When the ELC is in operation, this light will be on, and users could thus use ELC-HHP or the editing program of the ladder diagram to give commands to make the ELC "RUN" or "STOP".

☼ "ERROR" LED

If incorrect programs are input to the ELC, or that the commands and the components exceed the allowable range, the indicator will blink. At this moment, the user should check both the error codes saved in the ELC data register D1004. The address that the error occurs will be stored in data register D1137 (the address saved in D1137 is invalid in case of common loop error).

When the ERROR LED is on (not blinking), users should make a judgment from the special relay M1008 of the ELC. If it is On, it indicates that the execution time of the program loop has exceeded the time-out setting (set by D1000). Please turn the ELC RUN/STOP switch to STOP, and find out the address of the time-out program by special data register D1008. "WDT" command can be used to solve the problem.

☼ "BAT.LOW" LED

When the battery voltage is low, the "BAT.LOW" LED will be on, and the battery should be replaced as soon as possible; otherwise the user program and the data in latched area will be lost. (On the unplugged ELC, please change the battery within 3 minutes to retain the ELC's internal user programs and data).

☼ "Input" LED

The On/Off signals of the input point could be displayed through the "Input" LED, or the status of the input point could be monitored through the device monitoring function of ELC-HHP.

☼ "Output" LED

Output LED indicates if the output signals are On or Off. Please check the following items when the LED On/Off indication does not correspond to the commands: 1. Output contacts may be melted and stuck together due to a short circuit or current overload. 2. Check wiring and verify that the screws are tight.

☼ "A ↔D" LED

A ↔D LED indicator. A ↔D LED will blink if PA MPU is RUN.

☼ "ALARM" LED

"ALARM" LED will blink if AD/DA conversion data exceeds usage range when PA MPU is RUN.

☼ "RS-232, RS-485" LED

"RS-232" LED will light when RS-232 is receiving data, "RS-485" LED will light when RS-485 is transferring data.