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# Programmable Relay ZEN V2 Units

CSM\_ZEN\_DS\_E\_5\_2

## Even Broader Applications with Increased Functionality and Higher Precision


- Increased functionality in a compact body (70 mm wide × 90 mm high).
- Easy programming is available using the LCD and operation buttons. (See note 1.)
- This single Unit easily provides relay, timer, counter, and time switch functions.
- Expansion is easy with Expansion I/O Units, allowing up to 44 I/O points. (See note 2.)
- Economy-type and Communications-type CPU Units have been added to series.
- Improved Weekly Timers (See note 1.)  
Increased timing accuracy with a monthly deviation of  $\pm 15$  s max. Multiple-day operation and pulse output operation have been added.
- Select from two power supply options:  
100 to 240 VAC or 12 to 24 VDC.

**Note:** 1. Not supported for ZEN-□C2□□-□-V2 models.  
2. When using CPU Units with 20 I/O points.

The information in this document applies to V2 Units.  
Refer to page 28 for details on differences with previous products.



UL US CE **NEW**

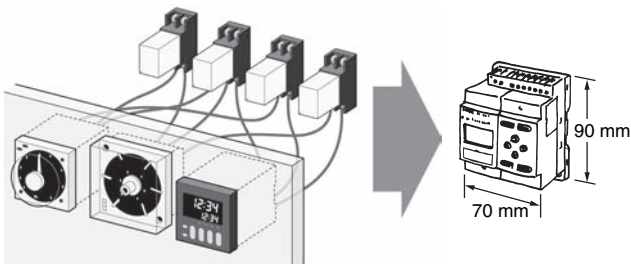
 Refer to *Safety Precautions* on page 33

## Features

### ■ Easy and Simple Programming for Automatic Small-scale Control

#### Saves Space, Wiring, and Installation Steps

- Versatile functionality in a compact body (70 mm wide × 90 mm high).
- This single Unit easily provides relay, timer, counter, and time switch functions. Wiring work is greatly reduced because separate wiring is not required for devices such as timers and counters.



#### Easy Programming

The LCD screen comes with 8 operation buttons on the front panel to enable programming in ladder view format. The LCD screen also has a backlight, making it easier to see when the ZEN is used in dark locations.

**Note:** Not supported for ZEN-□C2□□-□-V2 models.

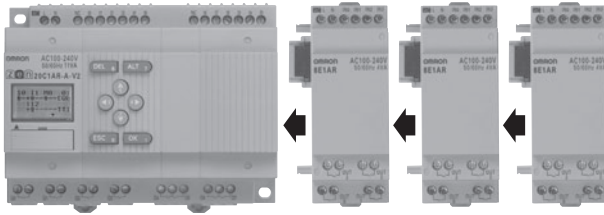




## Flexible Expansion Enables Up to 44 I/O Points

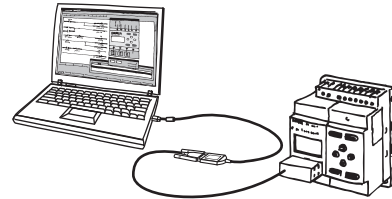
Up to three Expansion I/O Units can be connected if there are not enough I/O points. Expansion I/O Units are only 35 mm wide.

**Note:** CPU Units with 10 I/O points can be expanded to 34 I/O points. Expansion I/O Units cannot be connected to Economy-type CPU Units.



## Support Software with Simulation Function

- Programs can be easily written, saved, and monitored by personal computer.
- Programs can be simulated on the personal computer without connecting to the ZEN.



**Note:** For notebook computers that do not have an RS-232C serial port, connect the computer to the ZEN by connecting an OMRON CS1W-CIF31 USB-Serial Conversion Cable to the ZEN-CIF01 Connecting Cable.

## Other Versatile Functions

- Use of a Memory Cassette makes it easy to copy and save programs.
- Equipped with two analog input channels (CPU Units with DC power supply only).
- Password function ensures security. (See note.)
- Multi-language display in six languages (English, Japanese, German, French, Spanish, Italian). (See note.)
- Display user-set messages or analog-converted values. (See note.)

**Note:** Not supported for ZEN-C2□□-□-V2 models.

## Enhanced Features of V2 CPU Units

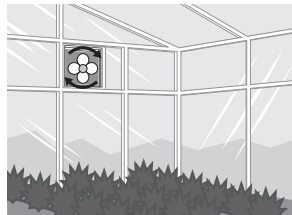
### Improved Weekly Timer and Calendar Timer Functions

**Note:** Not supported for ZEN-C2□□-□-V2 models.

- The time precision has been increased.  
Conventional model: 2-min difference/month  
↓  
-V2 models:  $\pm 15$ -s difference/month (at 25°C)
- Multiple-day operation and pulse-output operation are now possible.
- These improved functions are convenient for time-controlled applications such as lighting and air conditioning control.



Lighting control



Air conditioning control

### Economy-type Added to the Series

- Economy-type CPU Units with a more affordable price have been added to the series, although Expansion I/O Units cannot be added.

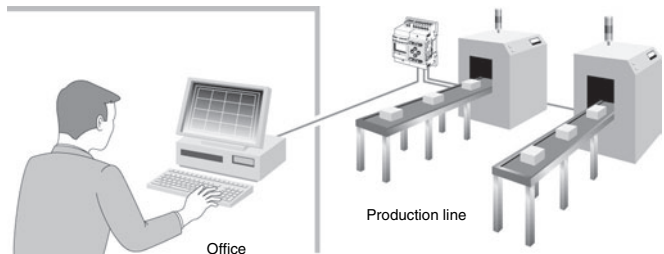
### 12 to 24 VDC Line Voltage Operation

Operation is now possible with 12 VDC.

Expansion I/O Units have been reduced to half-size (35 mm wide).

### RS-485 Communications Model Added to Series

Production line conditions can be remotely monitored by monitoring the ZEN control status.



### More Precise Analog Input

Conventional model:  $\pm 10\%$  FS  $\rightarrow$  -V2 models:  $\pm 1.5\%$  FS  
DC power supply models are equipped with two analog inputs (0 to 10 V). There are four analog comparators. The increased precision makes it even easier to use the Unit in simple control applications with voltage, current, temperature, and other analog values.

### 8-digit Counter, 150-Hz Counter

- An 8-digit counter and 8-digit comparator have been added.
- The maximum count for DC power supply models is 150 Hz.

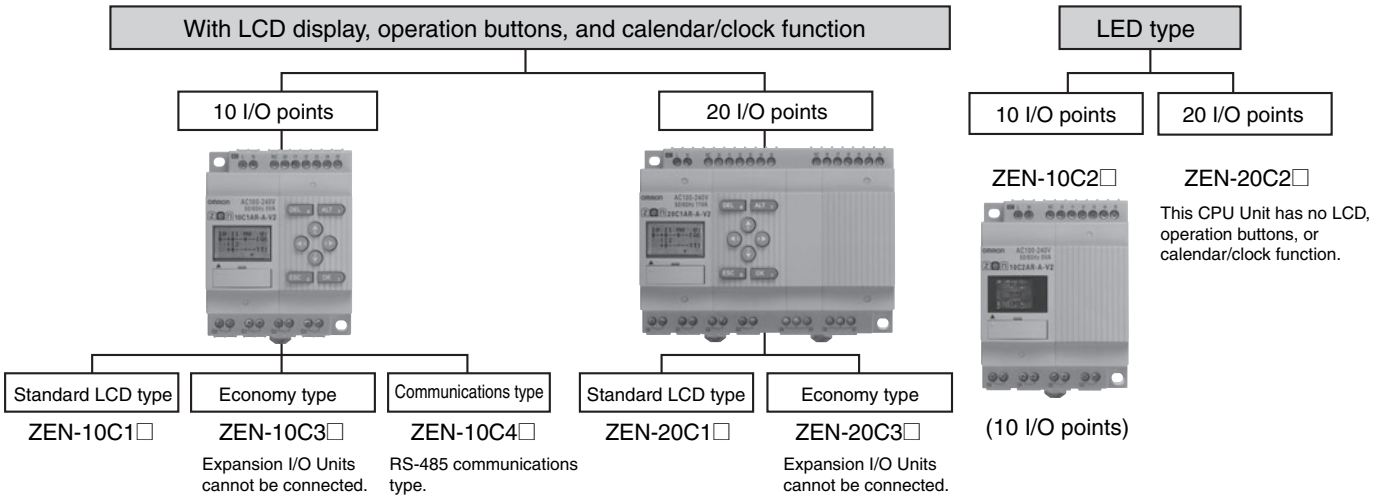
### Twin-timer Operation Added

Twin-timer operation allows you to set ON and OFF times separately, greatly simplifying intermittent operation.

## Series Configuration

### CPU Units

Power supply voltage: 100 to 240 VAC, 12 to 24 VDC, Output: Relay, transistor output



### Expansion I/O Units

Only 35-mm wide.  
4 input, 4 output points



### Power Supply Unit

Same shape and design as ZEN.  
24 VDC, 30 W



### Support Software

Allows easy programming and operation simulation.



# Model Number Structure

## ■ Model Number Legend

**Note:** This model number legend includes combinations that are not available.  
Please check *List of Models* on page 5 for availability.

### CPU Units

ZEN-□C□□□□-□-V2  
1 2 3 4 5

#### 1. Number of I/O points

- 10: 6 inputs and 4 outputs (See note.)
- 20: 12 inputs and 8 outputs

#### 2. Type classifier

- 1: Standard LCD type with display
- 2: LED type without display
- 3: Economy type with display  
(Expansion I/O Units cannot be connected.)
- 4: Communications type with display

**Note:** The Communications-type CPU Unit has 6 inputs and 3 outputs.

#### 3. Input type

- A: AC input
- D: DC input

#### 4. Output type

- R: Relay
- T: Transistor

#### 5. Supply voltage

- A: AC power supply
- D: DC power supply

### Expansion I/O Units

ZEN-8E1□□  
1 2 3 4

#### 1. Number of I/O points

- 8: 4 inputs and 4 outputs

#### 2. Unit version classifier

- E1: Can connect to V2 CPU Units (See note.)

**Note:** Use a ZEN-8E□□/-4E□ to connect to pre-V1 and V1 CPU Units.

#### 3. Input type

- A: AC input
- D: DC input

#### 4. Output type

- R: Relay
- T: Transistor

This data sheet is provided as a guideline for selecting products. Be sure to refer to the following user manuals for application precautions and other information required for operation before attempting to use the product.

*ZEN Operation Manual* (Cat. No. Z211)

*ZEN Communications Manual* (Cat. No. Z212)

*ZEN Support Software Operation Manual* (Cat. No. Z184-E1-03)

The PDF versions of these manuals can be downloaded from the following website.

ZEN Website <http://www.fa.omron.co.jp>

## Ordering Information

### List of Models

#### CPU Units and Expansion I/O Units

Unit	Name	No. of I/O points	LCD display	Power supply voltage	Inputs	Outputs	Buttons, calendar, and clock	Analog input	Model			
CPU Units	Standard LCD type	10	Yes	100 to 240 VAC	6	100 to 240 VAC	Yes	No	ZEN-10C1AR-A-V2			
				12 to 24 VDC		12 to 24 VDC		Yes	ZEN-10C1DR-D-V2			
		20		100 to 240 VAC	12	100 to 240 VAC		8	Relays	No	ZEN-20C1AR-A-V2	
				12 to 24 VDC		12 to 24 VDC			Transistors	Yes	ZEN-20C1DR-D-V2	
		LED type without display (See note 1.)		10	No	100 to 240 VAC		6	100 to 240 VAC	No	No	ZEN-10C2AR-A-V2
						12 to 24 VDC			12 to 24 VDC		Yes	ZEN-10C2DR-D-V2
	20	100 to 240 VAC	12	100 to 240V AC		8	Relays	No	ZEN-20C2AR-A-V2			
		12 to 24 VDC		12 to 24 VDC			Transistors	Yes	ZEN-20C2DR-D-V2			
	Economy type (Expansion I/O Units cannot be connected)	10	Yes	100 to 240 VAC		6	100 to 240 VAC	Yes	No		ZEN-10C3AR-A-V2	
				12 to 24 VDC			12 to 24 VDC		Yes		ZEN-10C3DR-D-V2	
	20	100 to 240 VAC		12	100 to 240 VAC	8	Relays		No	ZEN-20C3AR-A-V2		
		12 to 24 VDC			12 to 24 VDC		Transistors		Yes	ZEN-20C3DR-D-V2		
Communications type	9	100 to 240 VAC		6	100 to 240 VAC	3	Relays		No	ZEN-10C4AR-A-V2		
					12 to 24 VDC				12 to 24 VDC	Yes	ZEN-10C4DR-D-V2	
ZEN Kit			Set containing CPU Unit (ZEN-10C1AR-A-V2), Connecting Cable, ZEN Support Software, and manual.							ZEN-KIT01-EV4		
ZEN Kit			Set containing CPU Unit (ZEN-10C1DR-D-V2), Connecting Cable, ZEN Support Software, and manual.							ZEN-KIT02-EV4		
Expansion I/O Units	8		---	100 to 240 VAC	4	100 to 240 VAC		4	Relays	---	ZEN-8E1AR (See notes 2, 3.)	
						12 to 24 VDC					12 to 24 VDC	ZEN-8E1DR (See note 2.)
		---				---	ZEN-8E1DT (See note 2.)					

- Note:**
1. Programming is not possible using only the CPU in the LED-type CPU Unit. ZEN Support Software or a Memory Cassette is required.
  2. Cannot be connected to pre-V1 and V1 CPU Units.
  3. The ZEN-8E1AR cannot be connected to a CPU Unit with DC power supply.

#### Power Supply Unit

Power ratings	Input voltage	Output voltage	Output current	Model
30 W	100 to 240 VAC	24 VDC	1.3 A	ZEN-PA03024

**Note:** Refer to the *ZEN-PA03024 Datasheet* (Cat. No. L103) for detailed specifications.

## Accessories (Order Separately)

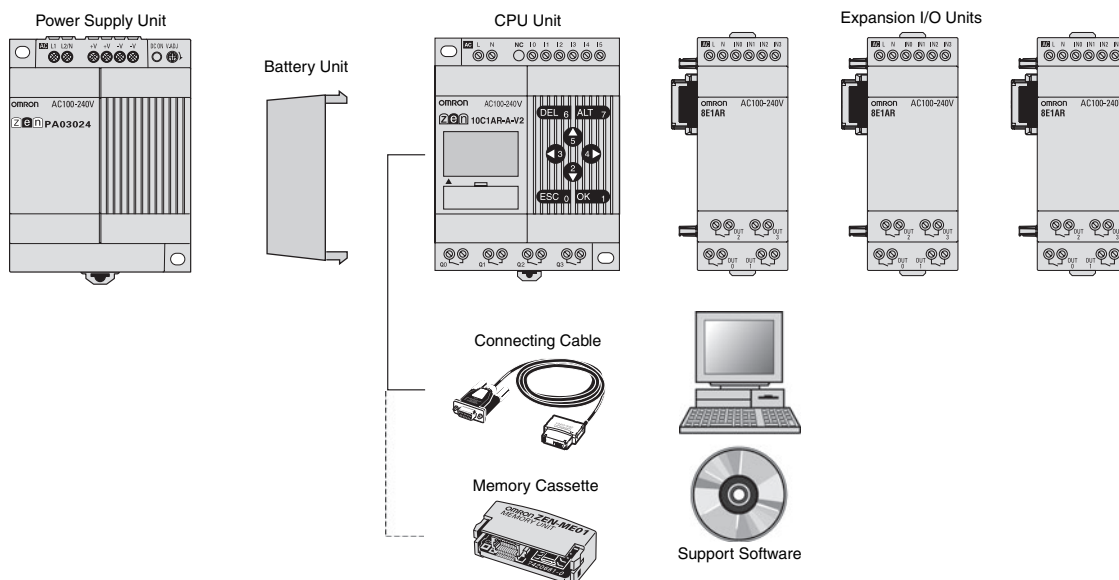
Name	Specifications	Remarks	Model		
Memory Cassette	EEPROM (for data security and copying)	Enables programs and parameter settings to be saved or copied to another ZEN. (See note 1.)	ZEN-ME01		
		LCD-type CPU Unit with display (See note 2.)		LED-type CPU Unit without display (See note 3.)	
		Transfer from ZEN to Memory		Supported	Not supported
		Transfer from Memory Cassette to ZEN		Supported	Automatic transfer when power turned ON
		Memory Cassette initialization		Supported	Not supported
Connecting Cable	2 m RS-232C (9-pin D-sub connector)	---	ZEN-CIF01		
Battery Unit	10 years min. Battery life (at 25°C)	Ladder programs and parameter settings are saved to the CPU Unit EEP-ROM but calendar, clock, and holding timer bits and holding timer/counter present values are held by the capacitor. Therefore, if the power supply is interrupted for 2 days or more (at 25°C), this data will be reset. Use a Battery Unit for systems where the power supply may be interrupted for long periods.	ZEN-BAT01		
ZEN Support Software	Runs on Windows 95, 98, 2000, ME, XP, NT 4.0, Vista or 7. (See note 4.)	Specifically designed for the ZEN (CD-ROM).	ZEN-SOFT01-V4		

- Note:**
1. Memory Cassettes created using a CPU Unit can be read to other CPU Units, regardless of which model is used. Restrictions, apply, however, to the functions that can be used, depending on the CPU Unit version combination. For details, refer to *Memory Cassette and CPU Unit Combinations* on page 31.
  2. Standard LCD-type, Economy-type, and Communications-type CPU Units (i.e., excluding ZEN-□C2□□-□-V2 models).
  3. LED-type CPU Unit without display (i.e., ZEN-□C2□□-□-V2 models).
  4. Except for 64-bit versions of Windows.

## Mounting Accessories (Order Separately)

Name	Specifications	Model
Mounting Track	50 cm (l) × 7.3 mm (t)	PFP-50N
	1 m (l) × 7.3 mm (t)	PFP-100N
	1 m (l) × 16 mm (t)	PFP-100N2
End Plate		PFP-M
Spacer		PFP-S

## System Configuration



- Note:**
1. Up to 3 Expansion I/O Units can be connected to any type of CPU Unit except for Economy-type CPU Units. Expansion I/O Units with AC Inputs, however, cannot be connected to CPU Units with DC Power Supplies.
  2. The Connecting Cable and Memory Cassette cannot be connected to the ZEN at the same time.
  3. Programs cannot be written to LED-type CPU Units (i.e., ZEN-□C2□□-□-V2 models) without the ZEN Support Software or a Memory Cassette.

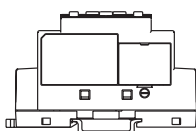
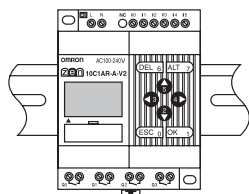
# Specifications

## ■ Ratings

Item	Specification	
	ZEN-□C□AR-A-V2/ZEN-8E1AR	ZEN-□C□D□-D-V2/ZEN-8E1D□
Rated supply voltage	100 to 240 VAC, 50/60 Hz	12 to 24 VDC (DC ripple rate: 5% max.)
Operating voltage range	85 to 264 VAC	10.8 to 28.8 VDC
Power consumption	<p>CPU Units without Expansion I/O Units</p> <ul style="list-style-type: none"> <li>ZEN-10C1AR-A-V2/ZEN-10C2AR-A-V2/ ZEN-10C3AR-A-V2 100 V AC: 5 VA max. 240 V AC: 7 VA max.</li> <li>ZEN-10C4AR-A-V2 100 V AC: 6 VA max. 240 V AC: 8 VA max.</li> <li>ZEN-20C□AR-A-V2 100 V AC: 7 VA max. 240 V AC: 10 VA max.</li> </ul> <p>CPU Units with three Expansion I/O Units</p> <ul style="list-style-type: none"> <li>ZEN-10C1AR-A-V2/ZEN-10C2AR-A-V2 100 V AC: 6 VA max. 240 V AC: 8 VA max.</li> <li>ZEN-10C4AR-A-V2 100 V AC: 7 VA max. 240 V AC: 9 VA max.</li> <li>ZEN-20C□AR-A-V2 100 V AC: 8 VA max. 240 V AC: 11 VA max.</li> </ul> <p>Expansion I/O Units</p> <ul style="list-style-type: none"> <li>ZEN-8E1AR 100 V AC: 3 VA max. 240 V AC: 4 VA max.</li> </ul>	<p>CPU Units without Expansion I/O Units</p> <ul style="list-style-type: none"> <li>ZEN-10C□DR-D-V2 12/24 V DC: 3 W max. (ZEN-10C3DR-D-V2: 2.8 W max.)</li> <li>ZEN-10C□DT-D-V2 12/24 V DC: 2 W max.</li> <li>ZEN-20C□DR-D-V2 12/24 V DC: 4 W max.</li> <li>ZEN-20C□DT-D-V2 12/24 V DC: 2 W max.</li> </ul> <p>CPU Units with three Expansion I/O Units</p> <ul style="list-style-type: none"> <li>ZEN-10C□DR-D-V2 12/24 V DC: 4 W max.</li> <li>ZEN-10C□DT-D-V2 12/24 V DC: 3 W max.</li> <li>ZEN-20C□DR-D-V2 12/24 V DC: 5 W max.</li> <li>ZEN-20C□DT-D-V2 12/24 V DC: 3 W max.</li> </ul> <p>Expansion I/O Units</p> <ul style="list-style-type: none"> <li>ZEN-8E1DR 12/24 V DC: 2 W max.</li> </ul>
Inrush current	ZEN-10C□AR-A-V2: 4.5 A max. ZEN-20C□AR-A-V2: 4.5 A max. ZEN-8E1AR: 4 A max.	ZEN-10C□D□-D-V2: 30 A max. ZEN-20C□D□-D-V2: 30 A max. ZEN-8E1DR: 15 A max.
Ambient temperature	0 to 55°C (-25 to 55°C for ZEN-□C2□□-□-V2 models)	
Ambient storage temperature	-20 to 75°C (-40 to 75°C for ZEN-□C2□□-□-V2 models)	
Ambient humidity	10% to 90% (with no condensation)	
Ambient conditions	No corrosive gases	
Mounting method	Surface mounting, DIN track mounting (standard (vertical) installation and horizontal installation) (See notes 1 and 2.)	
Terminal block	Solid-line terminal block (use solid wire or fine-stranded wire)	
Terminal screw tightening torque	0.565 to 0.6 N·m (5 to 5.3 in·lb)	
Degree of protection	IP20 (Mounted inside a control panel)	

Note: 1. Can be mounted to 35-mm DIN Track.

2. Standard (Vertical) installation      Horizontal installation





## ■ Characteristics

Item	Specification
Control method	Stored program control
I/O control method	Cyclic scan
Programming language	Ladder diagram
Program capacity	96 lines (3 input conditions and 1 output per line)
Max. No. of control I/O points	44 points (See note 1.) CPU Units with 20 I/O points: 12 inputs and 8 outputs Expansion I/O Units: 4 inputs and 4 outputs each, up to 3 Units.
LCD display (See note 2.)	12 characters × 4 lines, with backlight
Operation buttons (See note 2.)	8 (4 cursor buttons and 4 operation buttons)
User program backup	Internal EEPROM, Memory Cassette (optional)
Power interruption hold	Internal holding bit status, holding timer/counter present values, calendar and clock (year, month, day of month, day of week, time) • Super capacitor backup time: 2 days min. (25°C) • Life of optional battery: 10 years min. (25°C)
Calendar and clock function (See note 2.)	Accuracy: ±15 s/month (at 25°C)
Timer accuracy	0.01 s unit: -0.05% -10 ms max. (rate for set value) min/s unit: -0.05% -1 s max. (rate for set value) h/min unit: -0.05% -1 min max. (rate for set value)
Maximum counting speed	150 Hz: 8-Digit counter (F) set to high-speed operations (CPU Units with DC power supplies only) (The counting speed may be less than 150 Hz depending on the cycle time of the program. See page 21.)
Insulation resistance	20 MΩ (at 500 VDC) min.: Between power supply terminals and all output terminals. Between terminals of different output circuits. Between all terminals of CPU Unit and all terminals of Expansion I/O Unit.
Insulation	<ul style="list-style-type: none"> <li>Reinforced insulation Between power supply or input terminals and output terminals. Between terminals of different output circuits. Between all terminals of CPU Unit and all terminals of Expansion I/O Unit.</li> <li>No separation Between power supply and input terminals of the same unit. Between power supply terminals of CPU Unit and computer connector, Battery Unit connector, or all Expansion Unit connectors (all interfaces are live parts).</li> </ul>
Dielectric strength	2,300 VAC, 50/60 Hz for 1 min (leakage current 1 mA max.): Between power supply terminals and all output terminals. Between terminals of different output circuit. Between all terminals of CPU Unit and all terminals of Expansion I/O Unit.
Vibration resistance	Conforms to IEC60068-2-6, 5 to 9 Hz with 3.5-mm single amplitude, 9 to 150 Hz acceleration 9.8 m/s <sup>2</sup> , 10 sweeps each in X, Y, and Z directions (1 octave/min)
Shock resistance	Conforms to IEC60068-2-27, 147 m/s <sup>2</sup> , 3 times each in X, Y, and Z directions.
Weight	CPU Unit with 10 I/O points: Approx. 300 g max. CPU Unit with 20 I/O points: Approx. 350 g max. Expansion I/O Unit: Approx. 120 g max.

Note: 1. Up to 34 points for CPU Units with 10 I/O points. With Communications-type CPU Units, however, the CPU Unit has 6 inputs and 3 outputs, for a maximum of 33 I/O points.  
2. Not provided for LED-type CPU Unit without display (i.e., ZEN-□C2□□-□-□V2 models).

## ■ Communications Specifications (Communications-type CPU Units)

Item	ZEN-10C4□R-□-□V2
Communications	RS-485 (two-wire, half duplex)
Synchronization method	Start-stop synchronization
Baud rate	4800, 9600, or 19200 bps
Transmission code	ASCII
Data bit length	7 or 8 bits
Stop bit length	1 or 2 bits
Error detection	Vertical parity (none, even, odd), Block check character (BCC)
Flow control	None
Interface	RS-485
Retry function	None
Node number	0 to 99 (default: 1), XX (broadcasting)

## Approved Standards

Item	Specification		
<b>Safety standards</b>	cULus: UL508/CSA C22.2 No.142 (ZEN-PA03024 take Class I Div2) Conforms to EN/IEC 61131-2 clause 11, excluding 11.7.2.2 (Overvoltage category 2 and Pollution degree II conforms to IEC 60664-1)		
<b>EMC</b> (See note.)	Radiation Field Emission	CISPR11	Class A, Group 1
	Noise Terminal Voltage Emission	CISPR11	Class A, Group 1
	Electrostatic Discharge Immunity	IEC61000-4-2	In air: 8 kV, In contact: 6 kV
	Electromagnetic Field Immunity	IEC61000-4-3	10 V/m
	Electrical Fast Transient/Burst Immunity	IEC61000-4-4	Power line AC I/O: 2 kV DC I/O: 1 kV
	Surge Immunity	IEC61000-4-5	Normal Noise AC power supply, AC I/O: 1 kV DC power supply, DC I/O: 0.5 kV Common Noise AC power supply, AC I/O: 2 kV DC power supply: 1 kV DC I/O: 0.5 kV
	Immunity to Conducted Disturbances Induced by Radio-frequency Fields	IEC61000-4-6	3 V
	Momentary Power Interruption Immunity	IEC61131-2	CPU Units with AC Power Supplies: 10 ms max. CPU Units with DC Power Supplies: 2 ms max. (level: PS1)

**Note:** EMC conforms to EN 61131-2 clause 8 except in the following cases.

- When Expansion I/O Units with DC inputs are connected to a CPU Unit with an AC power supply, the burst immunity between power supplies will be 1 kv.
- When the signal wire for transistor outputs exceeds 10 m, the surge immunity of DC output signal lines will not conform.

## Input Specifications

### CPU Units

#### AC Inputs (Not Isolated)

Item	Specifications	Circuit drawing
<b>Input voltage</b>	100 to 240 VAC +10%, -15%, 50/60 Hz	
<b>Input impedance</b>	680 kΩ	
<b>Input current</b>	0.15 mA/100 VAC, 0.35 mA/240 VAC	
<b>ON voltage</b>	80 VAC min.	
<b>OFF voltage</b>	25 VAC max.	
<b>ON response time</b>	50 ms or 70 ms at 100 VAC (See note.)	
<b>OFF response time</b>	100 ms or 120 ms at 240 VAC (See note.)	

**Note:** Can be selected using the filter settings.

#### DC Inputs: I0 to I3 for Units with 10 I/O points, I0 to I9 for Units with 20 I/O Points (Not Isolated)

Item	Specifications	Circuit drawing
<b>Input voltage</b>	12 to 24 VDC +20%, -10%	
<b>Input impedance</b>	5.3 kΩ	
<b>Input current</b>	4.5 mA (typ.)/24 VDC	
<b>ON voltage</b>	8 VDC min.	
<b>OFF voltage</b>	5 VDC max.	
<b>ON response time</b>	15 ms or 50 ms (See note.)	
<b>OFF response time</b>		

**Note:** Can be selected using the input filter settings, except when I0 is being used for an 8-digit counter with a high-speed input.

## DC Inputs: I4 and I5 for Units with 10 I/O points, Ia and Ib for Units with 20 I/O Points (Not Isolated)

Item	Specifications	Circuit drawing	
DC Inputs	Input voltage	12 to 24 VDC +20%, -10%	
	Input impedance	PNP: 5.5 kΩ/14 VDC min. 100 kΩ/14 VDC max. NPN: 5.2 kΩ	
	Input current	PNP: 4.3 mA (typ.)/24 VDC NPN: 4.6 mA (typ.)/24 VDC	
	ON voltage	8 VDC min.	
	OFF voltage	3 VDC max.	
	ON response time	15 ms or 50 ms (See note.)	
	OFF response time		
Analog Inputs	Input range	0 to 10 V	
	External input impedance	100 kΩ min.	
	Resolution	0.1 V (1/100 FS)	
	Accuracy	±1.5% FS (at ambient operating temperature within rated range)	
	AD conversion data	0 to 10.5 V (in increments of 0.1 V)	

Note: Can be selected using the input filter settings.

## Expansion I/O Units

### AC Inputs (Not Isolated)

Item	Specifications	Circuit drawing
Input voltage	100 to 240 VAC +10%, -15%, 50/60 Hz	
Input impedance	680 kΩ	
Input current	0.15 mA/100 VAC, 0.35 mA/240 VAC	
ON voltage	80 VAC min.	
OFF voltage	25 VAC max.	
ON response time	50 ms or 70 ms at 100 VAC (See note.)	
Off response time	100 ms or 120 ms at 240 VAC (See note.)	

Note: Can be selected using the input filter settings.

### DC Inputs (ZEN-8E1DR: Not Isolated, ZEN-8E1DT: Photocoupler Isolated)

Item	Specifications	Circuit drawing
Input voltage	12 to 24 VDC +20%, -10%	
Input impedance	6.5 kΩ	
Input current	3.7 mA (typ.)/24 VDC	
ON voltage	8 VDC min.	
OFF voltage	5 VDC max.	
ON response time	15 ms or 50 ms (See note 1.)	
OFF response time		

Note: 1. Can be selected using the input filter settings.

2. The ZEN-8E1DT has no +/- terminals. There is no need to supply power.

## Output Specifications (CPU Units and Expansion I/O Units)

### Units with Relay Outputs

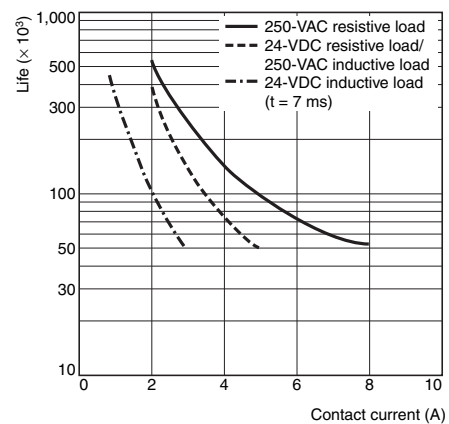
Item	Specifications	Circuit drawing	
<b>Maximum switching capacity</b>	250 VAC/8 A (resistive load: $\cos\phi = 1$ ) 24 VDC/5 A (resistive load) Use the following values for the total of all outputs. CPU Units with 10 I/O points: 20 A max. (15 A max. for Communications-type CPU Units) CPU Units with 20 I/O points: 40 A max. Expansion I/O Units: 20 A max.		
<b>Minimum switching capacity</b>	5 VDC/10 mA (resistive load) (failure level: P, reference value)		
<b>Relay life</b>	<b>Electrical</b>		Resistive load: 50,000 times ( $\cos\phi = 1$ ) Inductive load: 50,000 times ( $\cos\phi = 0.4$ )
	<b>Mechanical</b>		10 million times
<b>ON response time</b>	15 ms max.		
<b>OFF response time</b>	5 ms max.		

The life under the worst conditions, of the output contacts used in ZEN relay outputs is given in the above table. Guidelines for the normal life of the relays are shown in the diagram on the right.

**Note:** The switching capacity, switching durability, and applicable load area when actually using the relay depend on the type of load, environmental conditions, and switching conditions. Therefore, be sure to confirm these conditions for the actual machine before use.

### Life-test Curve (Reference Value)

Usage: 360 times/hour



### Units with Transistor Outputs

Item	Specifications	Circuit drawing
<b>Maximum switching capacity</b>	24 VDC +20%, 500 mA	<p>Each circuit is configured with an independent common circuit</p>
<b>Leakage current</b>	0.1 mA max.	
<b>Residual voltage</b>	1.5 V max.	
<b>ON response time</b>	1 ms max.	
<b>OFF response time</b>	1 ms max.	

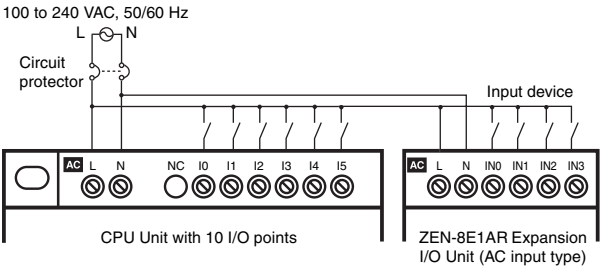
# Connections

## Input Connections

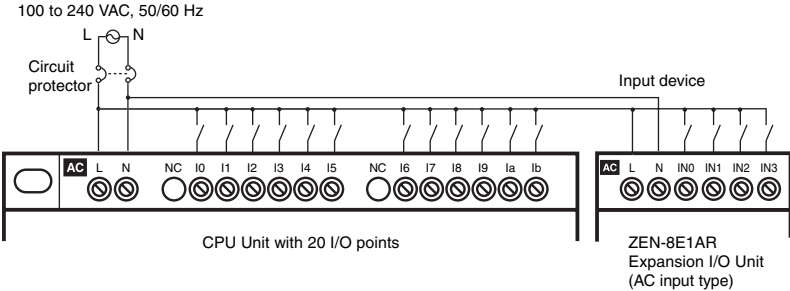
### Units with AC Power Supply

- Note:**
1. Supply power to both the CPU Unit and Expansion I/O Units from the same power supply and turn them ON and OFF at the same time.
  2. The input circuit commons for CPU Units with AC power supply are internally connected to the N terminal of the power supply circuit. Wire the L terminal to the power supply of the input device.
  3. The input circuit commons for Expansion I/O Units with AC power supply are internally connected to the N terminal of the power supply circuit. Wire the L terminal to the power supply of the input device.

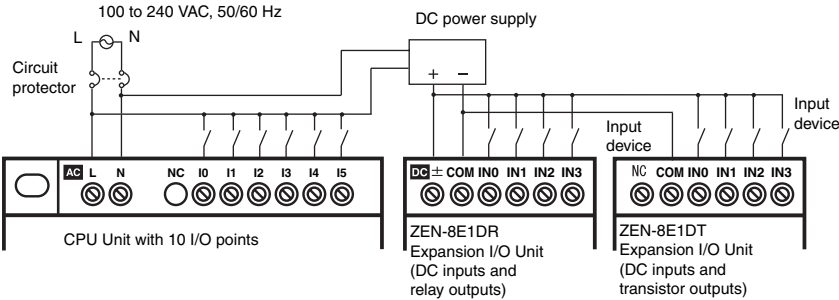
### CPU Units with 10 I/O Points and Expansion I/O Units



### CPU Units with 20 I/O Points and Expansion I/O Units



### Connecting Expansion I/O Units with DC Inputs



**Note:** When connecting Expansion I/O Units with DC inputs to a CPU Unit with an AC power supply, the burst noise immunity will be 1 kV (IEC 61000-4-4).

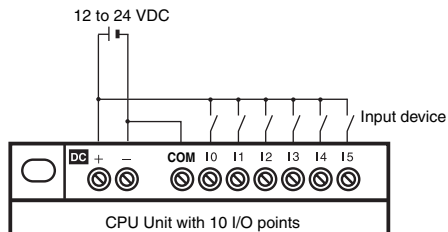


## Units with DC Power Supply

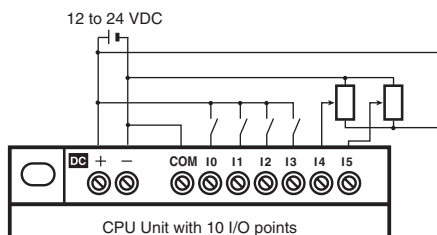
- Note:** 1. Be sure to connect the COM terminal before turning ON the power supply. If the COM terminal is disconnected, or if the wiring is changed after turning ON the power supply, a malfunction may occur.
2. Apply the power supply voltage through a relay or switch in such a way that the voltage reaches the rated value within 4 s. If the voltage is applied gradually, the power may not be reset or unstable output operations may result.

### CPU Units with 10 I/O Points

#### For Connections to Negative (-) Common (PNP Connection)

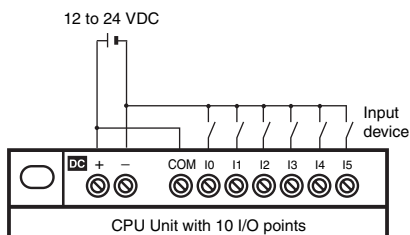


#### For Connecting Analog Input Devices to Input Terminals I4 and I5



**Note:** When connecting an analog input device, always connect the negative side to the COM terminal.

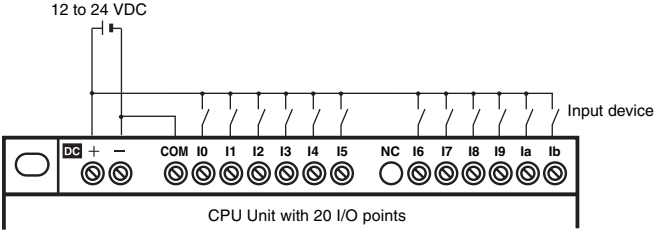
#### For Connections to Positive (+) Common (NPN Connection)



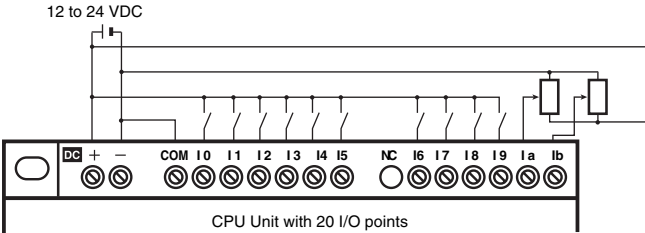
**Note:** When connected to the positive (+) common, I4 and I5 cannot be used as analog inputs.

## CPU Units with 20 I/O Points

### For Connections to a Negative Common (PNP Connection)

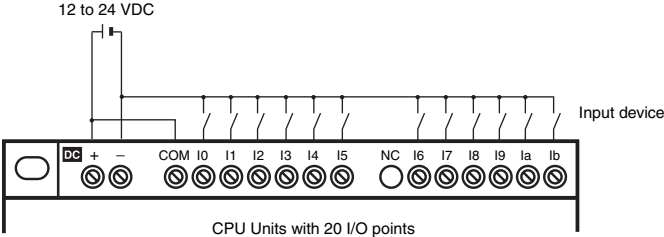


### For Connecting Analog Input Devices to Input Terminals 1a and 1b



**Note:** When connecting an analog input device, always connect the negative side to the COM terminal.

### For Connections to Positive (+) Common (NPN Connection)

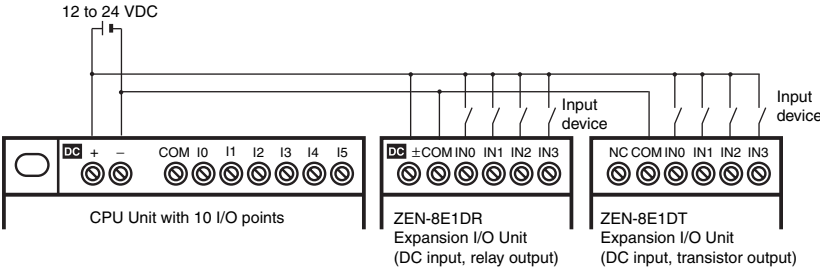


**Note:** When connected to the positive (+) common, 1a and 1b cannot be used as analog inputs.

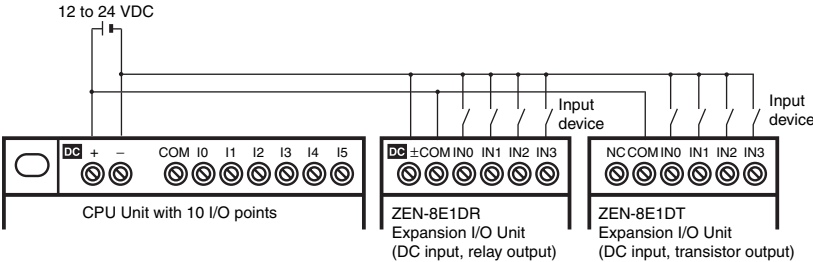
## Expansion I/O Units

- Note:**
1. Supply power to both the CPU Unit and Expansion I/O Units from the same power supply and turn them ON and OFF at the same time.
  2. ZEN-8E1AR Expansion I/O Units with AC inputs cannot be connected to CPU Units with DC power supply.
  3. The input circuit commons for ZEN-8E1DR Expansion I/O Units with relay outputs are each internally connected to one side of the power supply circuit (COM terminal).
  4. ZEN-8E1DT Expansion I/O Units with transistor outputs do not need to be connected to a power supply.

### For Connections to Negative (-) Common



### For Connections to Positive (+) Common

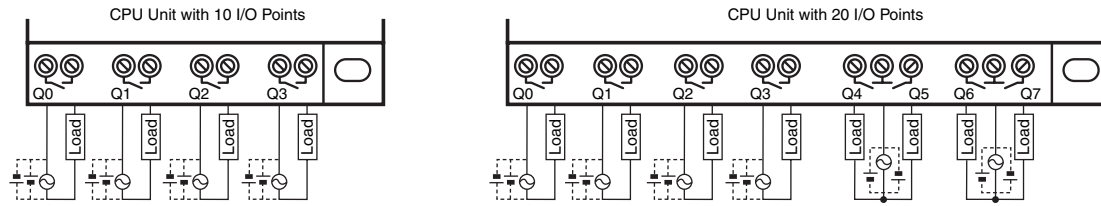


## Output Connections

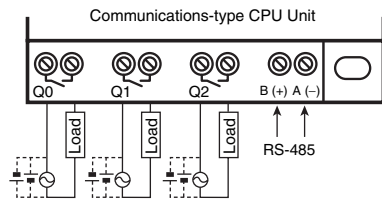
### Units with Relay Outputs

All four relay output circuits in both CPU Units with 10 I/O points and Expansion I/O Units have independent contacts. CPU Units with 20 I/O points have 4 independent contacts (Q0 to Q3) and the remaining four (Q4 to Q7) have 2 points/common. There are no restrictions for polarity.

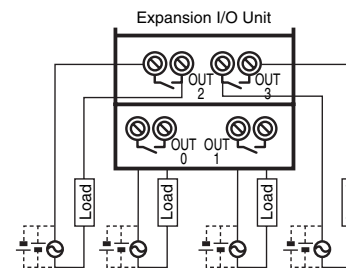
### Standard LCD-type CPU Units, LED-type CPU Units, and Economy-type CPU Units



### Communications-type CPU Units



### Expansion I/O Units



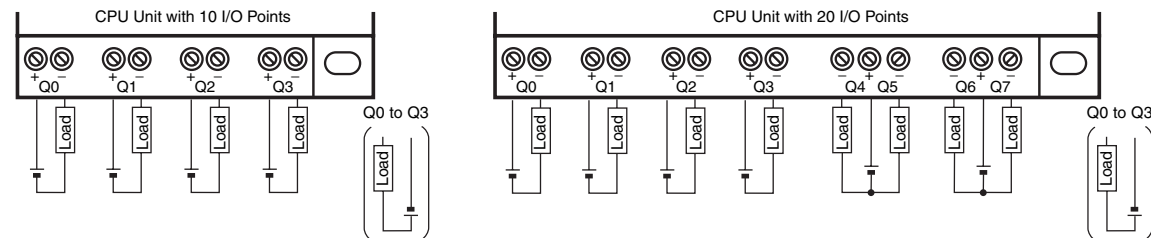
### Units with Transistor Outputs

For CPU Units with 10 I/O points and Expansion I/O Units, all 4 outputs in the transistor output circuits have independent circuits. The terminals of output have polarity given on the terminal block, but no problem will result from reversing the connection positions of the power supply and load.

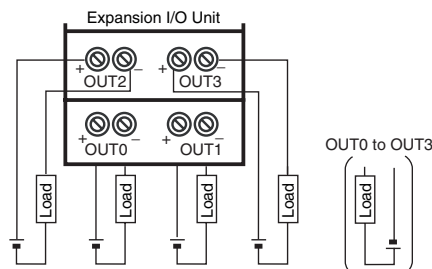
For CPU Units with 20 I/O points, outputs Q0 to Q3 in the transistor output circuits have independent circuits and outputs Q4 to Q7 have 2 points per common. The terminals of output Q0 to Q3 have polarity given on the terminal block, but no problem will result from reversing the connection positions of the power supply and load.

**Note:** Do not exceed a cable length of 10 m when connecting transistor outputs.

### Standard LCD-type CPU Units and LED-type CPU Units without Display



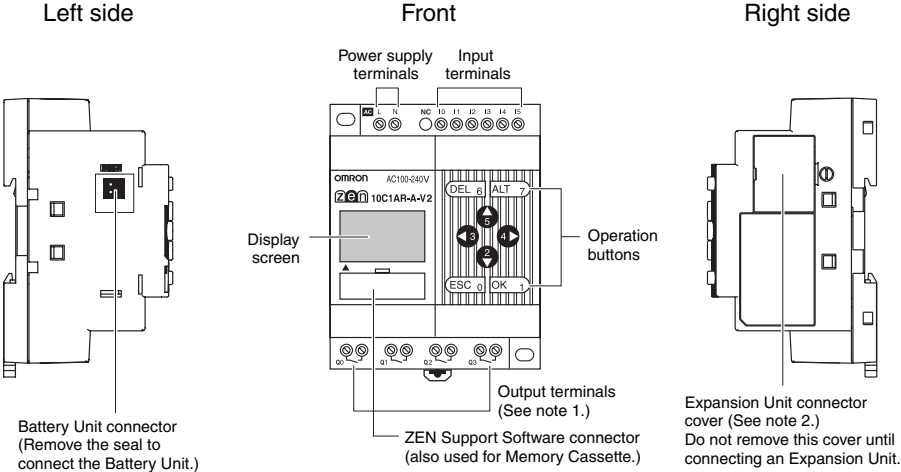
### Expansion I/O Units



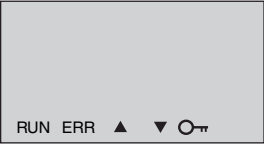
# Nomenclature

## Standard LCD-type, Economy-type, and Communications-type CPU Units (Except for ZEN-□C2□□-□-V2 Models)

### CPU Units with 10 I/O Points



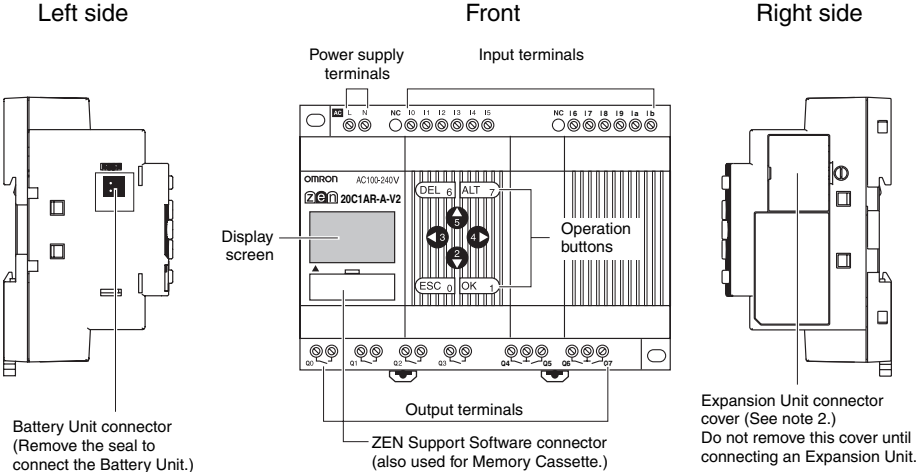
### Display Screen



### Icon Meanings

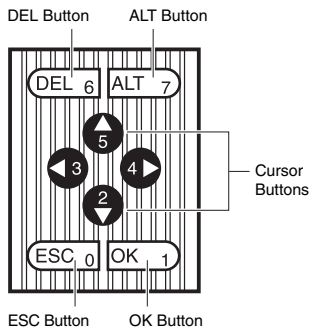
Icon	Meaning
RUN	Display while in RUN mode.
ERR	Indicates an error.
▲	Displayed when there is a higher-level menu or ladder program line than the one currently displayed.
▼	Displayed when there is a lower-level menu or ladder program line than the one currently displayed.
◯	Displayed when a password had been set.

### CPU Units with 20 I/O Points











- Note:** 1. With Communications-type CPU Units, the Q3 terminal is used as the RS-485 terminal. For details, refer to *Output Connections* on page 15.
2. Economy-type CPU Units are not provided with an Expansion Unit connector. Do not remove the cover.

## Operation Buttons



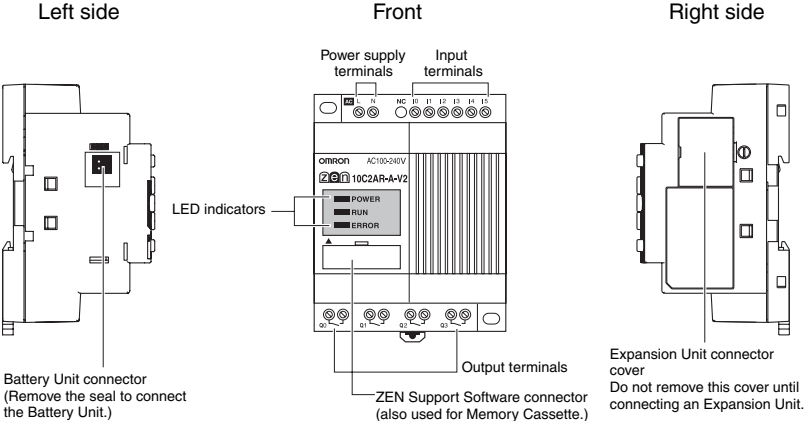
## Operation Button Names and Operations

Button	Function			
	Menus	Writing ladder program	Setting parameters	Button input bit (See page 24.)
DEL 	---	Deletes inputs, outputs, connection lines, and blank lines.	---	B6 ON
ALT 	---	<ul style="list-style-type: none"> <li>• Switches between normally open and normally closed conditions.</li> <li>• Changes to connection line write mode.</li> <li>• Inserts a line.</li> </ul>	---	B7 ON
Up 	Moves the cursor up and down.	<ul style="list-style-type: none"> <li>• Moves the cursor up and down.</li> <li>• Selects bit types and functions.</li> </ul>	<ul style="list-style-type: none"> <li>• Moves the cursor up and down.</li> <li>• Changes numerals and parameters.</li> </ul>	B5 ON
Down 				B2 ON
Left 	---	Moves the cursor right and left.	Moves the cursor right and left.	B3 ON
Right 				B4 ON
ESC 	Returns to the previous screen.	Cancels the setting and returns to the previous operation.	Cancels the setting and returns to the previous operation.	B0 ON
OK 	Selects the menu item at the cursor position.	Confirms the setting.	Confirms the setting.	B1 ON



■ LED-type CPU Units without Display (ZEN-□C2□□-□-V2)

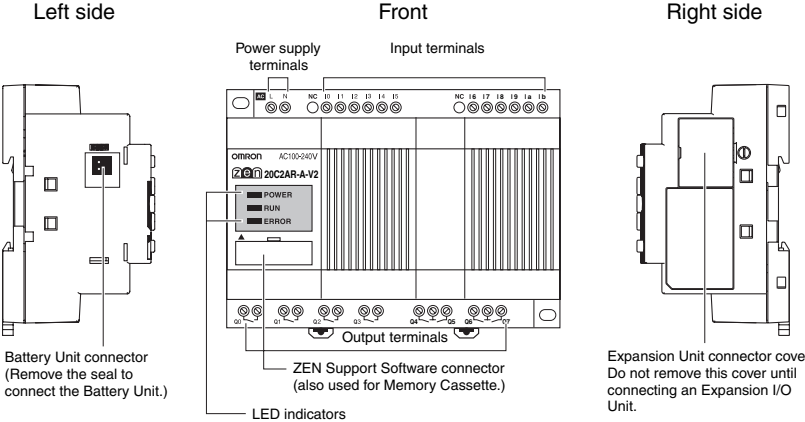
CPU Units with 10 I/O Points



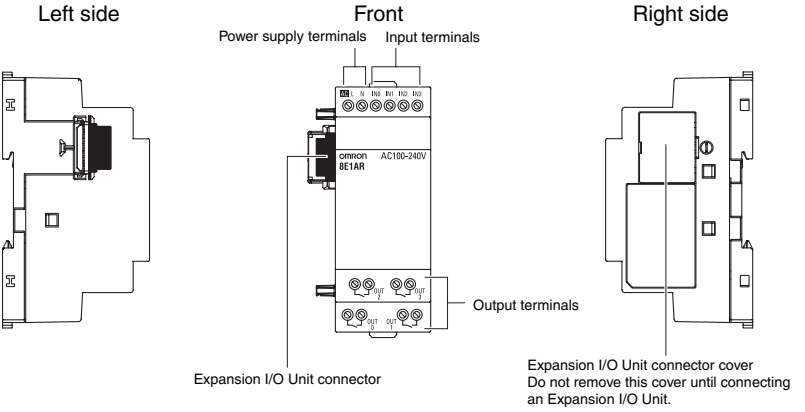
LED Indicators

Name	LED	Status	
POWER	Green	Lit	Power is ON.
		Not lit	Power is OFF.
RUN	Green	Lit	Operating (RUN)
		Not lit	Stopped (STOP)
ERROR	Red	Lit	Error occurred.
		Not lit	Normal

CPU Units with 20 I/O Points

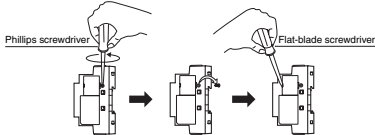


■ Expansion I/O Units (ZEN-8E1□□)



Precaution when Using Expansion I/O Units:

Up to three Expansion I/O Units can be connected.  
When removing the Expansion Unit connector cover from the side of the CPU Unit, use a Phillips screwdriver to remove the cover screw, and then insert a flat-blade screw driver in the cover gap to remove the cover, as shown at the right.



# Operation

## ■ Bits

Name	Symbol	Bit addresses	No. of points	Operation		Details (See note 1.)	
Input bits	I	I0 to Ib (See note 2.)	12	Reflect the ON/OFF status of the input devices connected to the input terminals on the CPU Unit.		---	
Expansion input bits	X	X0 to Xb	12	Reflect the ON/OFF status of the input devices connected to the input terminals on the Expansion I/O Units.			
Output bits	Q	Q0 to Q7 (See note 2.)	8	The ON/OFF status of these output bits is used to control the output devices connected to the output terminals on the CPU Unit.		1	
Expansion output bits	Y	Y0 to Yb	12	The ON/OFF status of these output bits is used to control the output devices connected to the output terminals on the Expansion I/O Units.			
Work bits	M	M0 to Mf	16	Work bits can be used only within the ZEN program. I/Os for external devices cannot be made (i.e., all I/O is internal).			
Holding bits	H	H0 to Hf	16	Used the same as the work bits. However, if the power to the ZEN is turned OFF, these bits also maintain the previous ON/OFF status.			
Timers	T	T0 to Tf	16	X: ON-delay timer ■: OFF-delay timer O: One-shot pulse timer F: Flashing pulse timer W: Twin timer	Functions are selected from the screen when parameter settings are made.	Time units can be selected from the following: 0.01-s unit: 0.01 to 99.99 s min/s unit: 00 min 01 s to 99 min 59 s h/s unit: 00 h 01 min to 99 h 59 min	2
Holding timers	#	#0 to #7	8	Hold the present value being counted even if the trigger input or power supply is turned OFF and continue timing when the trigger input or power is restored.		3	
Counters	C	C0 to Cf	16	Reversible 4-digit counters that can be incremented and decremented.		4	
8-digit counter	F	F0	1	Reversible 8-digit counters that can be incremented and decremented. CPU Units with DC power supply support a high-speed counter up to 150 Hz. For details, refer to <i>8-digit Counter Operation</i> on page 21.		5	
Weekly timers (See note 3.)	@	@0 to @f	16	Turn ON and OFF during specified times on specified days.		6	
Calendar timers (See note 3.)	*	*0 to *f	16	Turn ON and OFF between specified dates.		7	
Display bits (See note 3.)	D	D0 to Df	16	Display user-specified messages, times, timer/counter present values, or analog-converted values.		8	
Analog comparator bits	A	A0 to A3	4	Used as program input conditions to output analog comparator comparison results. These bits can be used only for CPU Units with DC power supply.		9	
Timer/counter comparator bits	P	P0 to Pf	16	Compare the present values of timers (T), holding timers (#), and counters (C). Comparison can be made between the same two counters or timers, or with constants.		10	
8-digit counter comparator bits	G	G0 to G3	4	Used to compare the present values of 8-digit counters (F) and output the comparison results.		11	
Button input bits (See note 3.)	B	B0 to B7	8	Used as program input conditions and turn ON when operation buttons are pressed in RUN Mode.		12	

**Note:** 1. For details, refer to the indicated item numbers on the following pages.

- CPU Units with 10 I/O points have 6 input bits (I0 to I5) and 4 output bits (Q0 to Q3). Output bit Q3 of Communications-type CPU Units, however, cannot be output externally. It can be used as a work bit.
- These input bits are not supported by LED-type CPU Units without display.

### 1. Additional Bit Output Functions

[: Normal	Set/Reset operation		A: Alternate
	S: Set	R: Reset	
Q0 will turn ON or OFF depending on the ON/OFF status of the execution condition I0.	Q1 will stay ON once the execution condition I1 has turned ON once. A reset is used to turn Q1 OFF.	Q1 is forced OFF when the execution condition I2 is turned ON.	Q2 alternates between turning ON and OFF when the execution condition I3 turns ON.

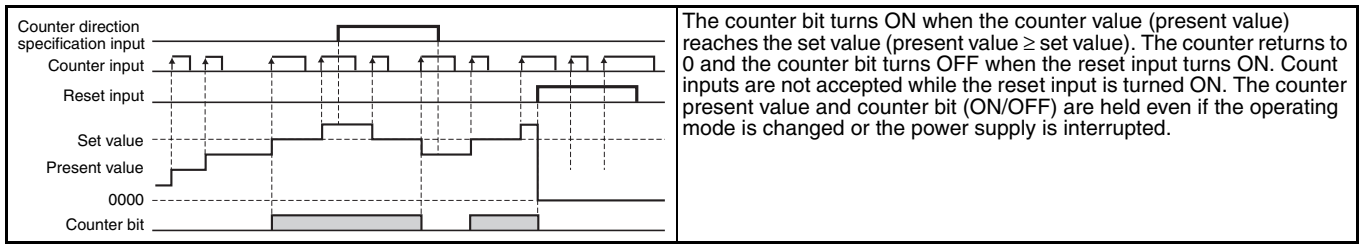
## 2. Using Timers and Holding Timers

<p><b>X: ON-delay timer</b></p>	<p>Turns ON after set delay after the trigger input turns ON.  <b>Basic Operation</b></p> <p><b>Main Applications</b>                  When delayed operation or a time lag is required.</p>
<p><b>■: OFF-delay timer</b></p>	<p>Stays ON while the trigger input is ON and turns OFF after a set delay after the trigger input has turned OFF.  <b>Basic Operation</b></p> <p><b>Main Applications</b>                  Useful for OFF delay circuits for lights or fans</p>
<p><b>O: One-shot pulse timer</b></p>	<p>Turns ON for a set period after the trigger input turns ON and regardless of how long the trigger input remains ON.  <b>Basic Operation</b></p> <p><b>Main Applications</b>                  Useful for set operations where operation is always required during a regular period only.</p>
<p><b>F: Flashing pulse timer</b></p>	<p>Repeatedly turns ON and OFF in a set cycle while the trigger input is ON.  <b>Basic Operation</b></p> <p><b>Main Applications</b>                  Useful for flashing emergency lights or sounding buzzers as the output for an alarm circuit.</p>
<p><b>W: Twin timer</b></p>	<p>Repeatedly turns ON and OFF in a set cycle while the trigger input is ON. Independent ON- and OFF-time settings are possible.  <b>Basic Operation</b></p> <p><b>Main Applications</b>                  Useful for intermittent (ON/OFF) operation, such as that used for fans.</p>

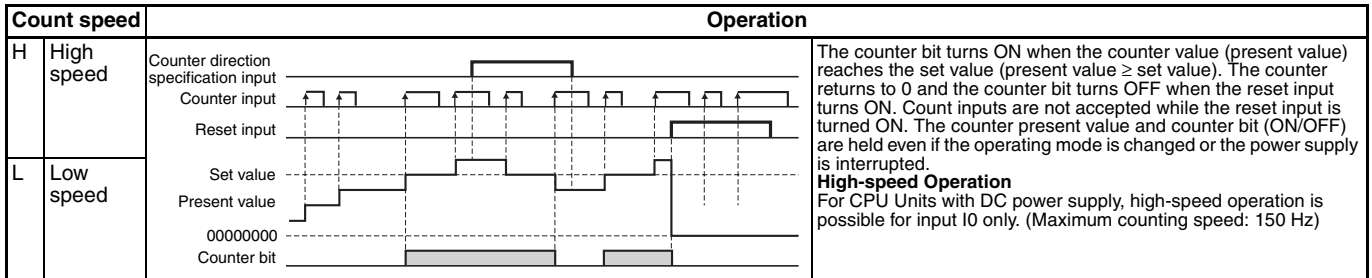
## 3. Using Holding Timers

<p><b>X: ON-delay timer</b></p>	<p>Turns ON after set delay after the trigger input turns ON. The present value is held while the trigger input is OFF.  <b>Main Applications</b>                  To continue operation after momentary power loss or power interruptions. Also can be used when delayed operation or a time lag is required.</p>
---------------------------------	--

### 4. Counter Operation



### 5. 8-digit Counter Operation



### Counting Speed of the 8-digit Counter

The maximum counting speed of the 8-digit counter is 150 Hz. When the ladder program volume is large, however, this speed will be less than 150 Hz. Calculate the cycle time and confirm the maximum counting speed using the following formula. The calculation serves as a guide only, so allow a suitable margin in the actual machine.

$$\text{Maximum counting speed} = 1,000,000 \text{ Hz} / \text{Cycle time } (\mu\text{s}) \times 2.2 \text{ Hz}$$

**Note:** Even if the calculated maximum counting speed exceeds 150 Hz using this formula, the maximum counting speed will be 150 Hz.

#### Cycle Time Calculation Method

$$\text{Cycle time } (\mu\text{s}) = \text{Common processing time} + \text{Processing time taken when Expansion I/O Units are connected} + \text{Ladder program execution time} + \text{Communications processing time (only for CPU Units with communications)}$$

Refer to the following table for ZEN execution times. The execution times are provided as a guide. External factors, button operations, execution of ZEN Support Software operations, and timing of the processing affects the actual processing times.

#### Common Processing Time

Unit type	Common processing time
Standard LCD-type CPU Units, Economy-type CPU Units, and Communications-type CPU Units	850 μs
LED-type CPU Units	200 μs

#### Expansion I/O Unit Processing Time

Unit type	Expansion I/O Unit processing time
Expansion I/O Units	160 μs per Unit

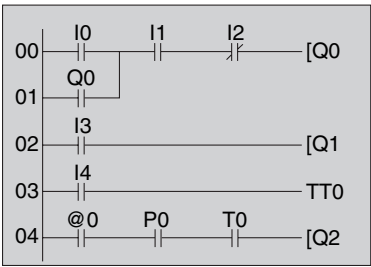
#### Communications Processing Time (only for CPU Units with Communications)

Reading information	170 μs
Writing set values	Twin timer: 11,000 μs Others: 6,000 μs
Writing time information	820 μs

#### Ladder Program Execution Time

Per line	30 μs: Line containing program 7 μs: Empty lines	*1	
Per output	CPU Unit output bits (Q)	4 μs	*2
	Expansion I/O Unit output bits (Y)		
	Work bits (M)		
	Holding bits (H)		
	Timers (T)/Holding timers (#)	15 μs	*3
	Counters (C)/8-Digit Counters (F)	13 μs	
	Display bits (D)	Hour and minute (CLK)/Year and month (DAT)/Month and day (DAT1): 21 μs Timers (T)/Holding timers (#)/Counters (C)/Analog comparators: 28 μs Characters (CHR)/8-Digit Counters (F): 38 μs	
	Weekly timers (@)	4 μs	*4
	Calendar timers (*)	1 μs	
	Analog comparators (A)	3 μs	
	Comparators (P)	7 μs	*5
	8-Digit Comparators (G)	4 μs	

## Example Calculation of Ladder Program Execution Time



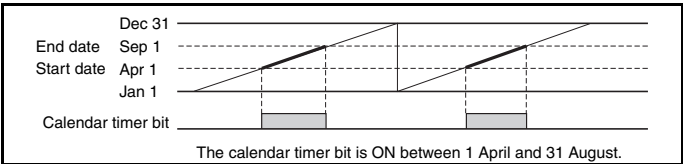
Ladder program execution time =  $(30 \times 5) + (4 \times 3) + 15 + 4 + 7 = 188 \text{ (}\mu\text{s)}$

- \*1: For 5 lines
- \*2: Q (outputs) for 3 points
- \*3: T0 (output)
- \*4: @0
- \*5: P0

## 6. Weekly Timer Operation (Only for Standard LCD-type, Economy-type, and Communications-type CPU Units)

Weekly timer mode	Operation	
N Normal operation	<b>Typical Timer Operation</b> 	Between Tuesday and Friday every week, the weekly timer bit turns ON from 08:15 until 17:30.
	<b>Timer Operation Extending Past Midnight</b> 	Between Tuesday and Friday every week, the weekly timer bit turns ON from 23:00 until 05:00 the following day.
D Multiple-day operation		The weekly timer bit turns ON from Tuesday 08:15 until Friday 17:30 every week.
P Pulse-output operation		Every week, from Tuesday through Friday, the weekly timer bit turns ON for 15 minutes and thirty seconds from 08:15.

## 7. Calendar Timer Operation (Only for Standard LCD-type, Economy-type, and Communications-type CPU Units)



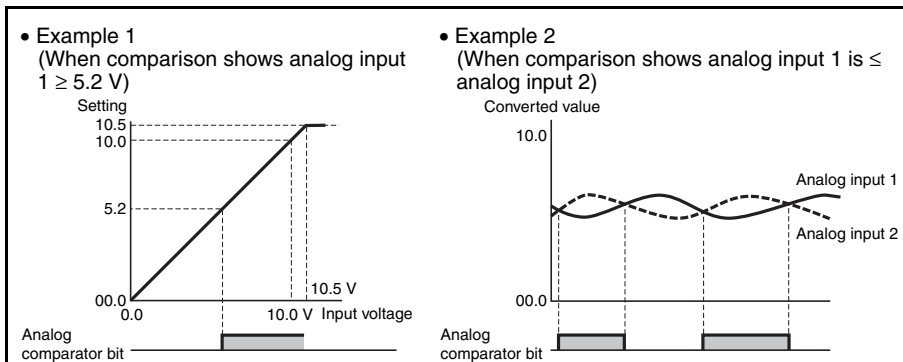


## 8. Display Settings (Only for Standard LCD-type, Economy-type, and Communications-type CPU Units)

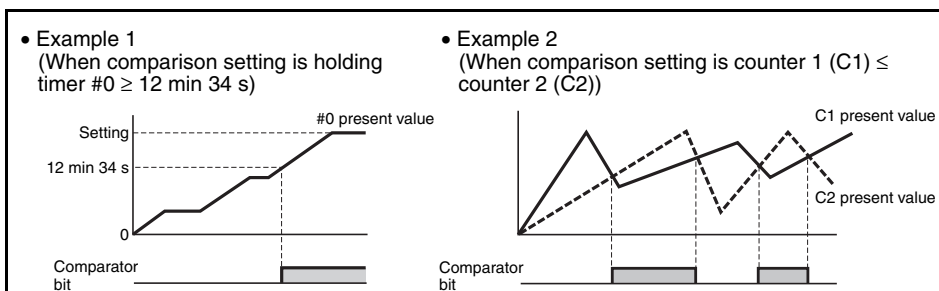
<b>Backlight/display function screen switching</b>	L0: No backlight; No switching to display function screen (See note 1.) L1: Backlight; No switching to display function screen (See note 1.) L2: No backlight; Switching to display function screen (See note 2.) L3: Backlight; Switching to display function screen (See note 2.)	
<b>Display start position</b>	X (digit): 00 to 11 Y (line): 0 to 3	
<b>Display object</b>	CHR	Characters (Up to 12 characters - English, numerals, symbols)
	DAT	Month/day (5 digits □□/□□)
	CLK	hour/minute (5 digits □□:□□)
	I4 to I5	Analog-converted value (4 digits □□:□)
	T0 to Tf	Timer present value (5 digits □□.□□)
	#0 to #7	Holding timer present value (5 digits □□.□□)
	C0 to Cf	Counter present value (4 digits □□□□)
	F0	8-digit counter present value(8 digits □□□□□□□□)
<b>Monitoring</b>	A: Can read settings during operation. D: Cannot read settings during operation.	

- Note:** 1. When L0 or L1 are selected to disable the display function screen, the display function screen will not be displayed automatically. Use operation buttons to move to the display function screen.  
2. When L2 or L3 are selected, the ZEN switches to the display function screen if the display function is enabled and the specified data is displayed. The Main Screen will no longer be displayed. To display the Main Screen, change the CPU Unit to STOP mode.

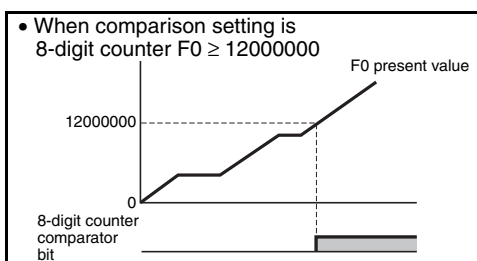
## 9. Analog Comparator Operation



## 10. Timer/Counter Comparator Operation

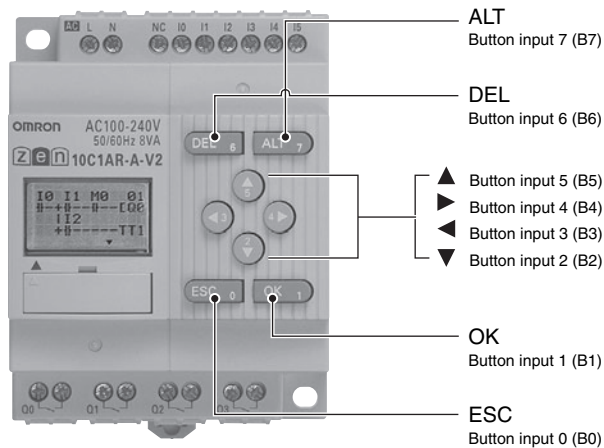


## 11. 8-digit Counter Comparator Operation



## 12. Specifications for Button Input Bits (Only for Standard LCD-type, Economy-type, and Communications-type CPU Units)

The operation buttons are used to perform operations for input bits. They are useful when checking program operations or forcefully resetting holding timers or counters.



## ■ Password Function (Only for Standard LCD-type, Economy-type, and Communications-type CPU Units)

The ZEN has a password function to prevent incorrect manipulation of ladder programs or settings data by other operators. When the password (0000 to 9999) is set, the following operations will not be possible unless the password is input correctly.

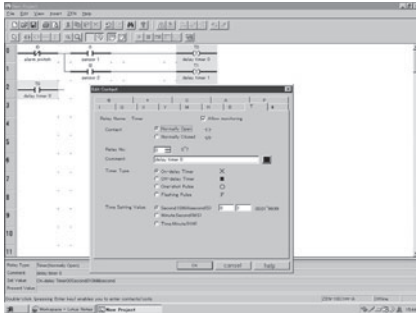
- Editing ladder program
- Program all clear
- Monitoring ladder programs
- Changing/clearing password
- Changing backlight OFF time
- Setting input filter
- Setting RS-485 communications

## ■ ZEN Support Software Functions

**Note:** Always use ZEN-SOFT01-V4 as the Support Software for the V2 CPU Unit.

### Creating Ladder Programs

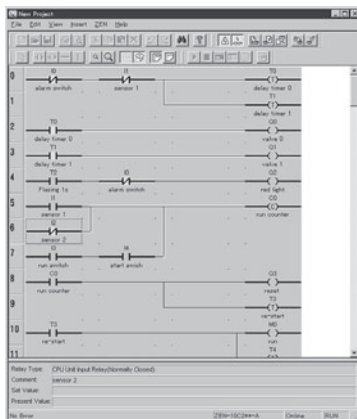
ZEN ladder programs can be created with ease.



**Note:** The Edit Input Dialog Box is displayed when an input bit is inserted. Timer, counter, and other parameter settings are also set in the Edit Input Dialog Box. They cannot be set in the Edit Output Dialog Box.

### Monitoring Ladder Programs

The operating status can be monitored from the Support Software by connecting to the ZEN using a Connecting Cable (ZEN-CIF01).



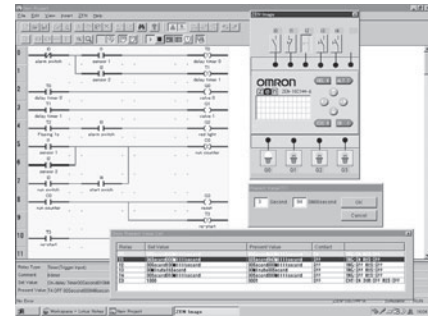
**Note:** Both RS-485 communications and the ZEN monitoring function cannot be used at the same time with Communications-type CPU Units.

### The Support Software can also be used to save files and edit comments.

Refer to the *ZEN Support Software Operation Manual* (Cat. No. Z184-E1-03) for details.

### Simulating Ladder Programs

The simulation function makes it possible to check whether correct operation is performed without connecting to the ZEN.



### Printing Ladder Programs

Ladder programs and I/O comments, as well as timer, counter and other parameter settings can be printed.

