# Programmable Logic Controller

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# Course description

**Overview**

CH1 Introduction to PLCs

CH2 CP1 PLC    **2 session    Quiz**

CH3 Instructions    **3 sessions**

CH4 PLC programming    **3 sessions**

# Ch2

## Introduction to CP1

➢Features of CP1

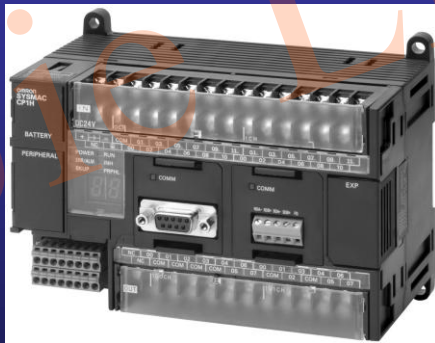➢PLC Addressing

# 2.1 Features of CP1

## 2.1.1 CP1 family

- ➢ 3 models: CP1H, CP1L, CP1E
- • CP1H: High-performance PLC
- • CP1L: Standard PLC
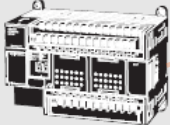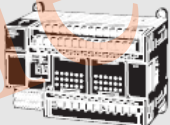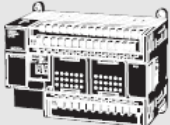- • CP1E: Economy class PLC

**CP1H**

**CP1L**

**CP1E**

# 2.1 Features of CP1

➢ CPU units:

- 10 to 60 I/O points, expandable to 320 I/O points
- Power supply: AC or DC
- Output method: relay, transistor (sinking), transistor (sourcing)

■ CPU Units

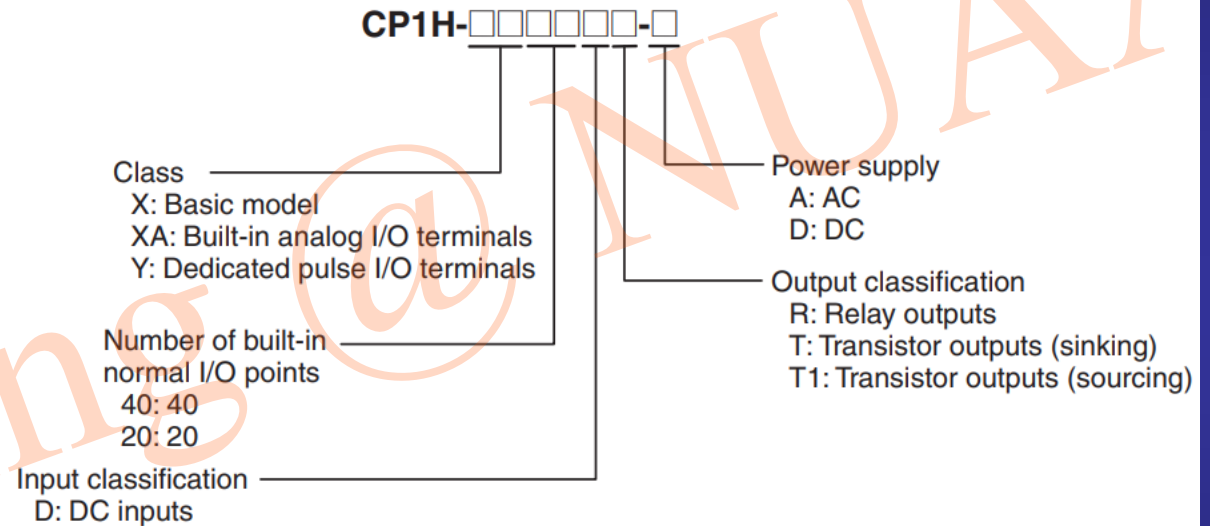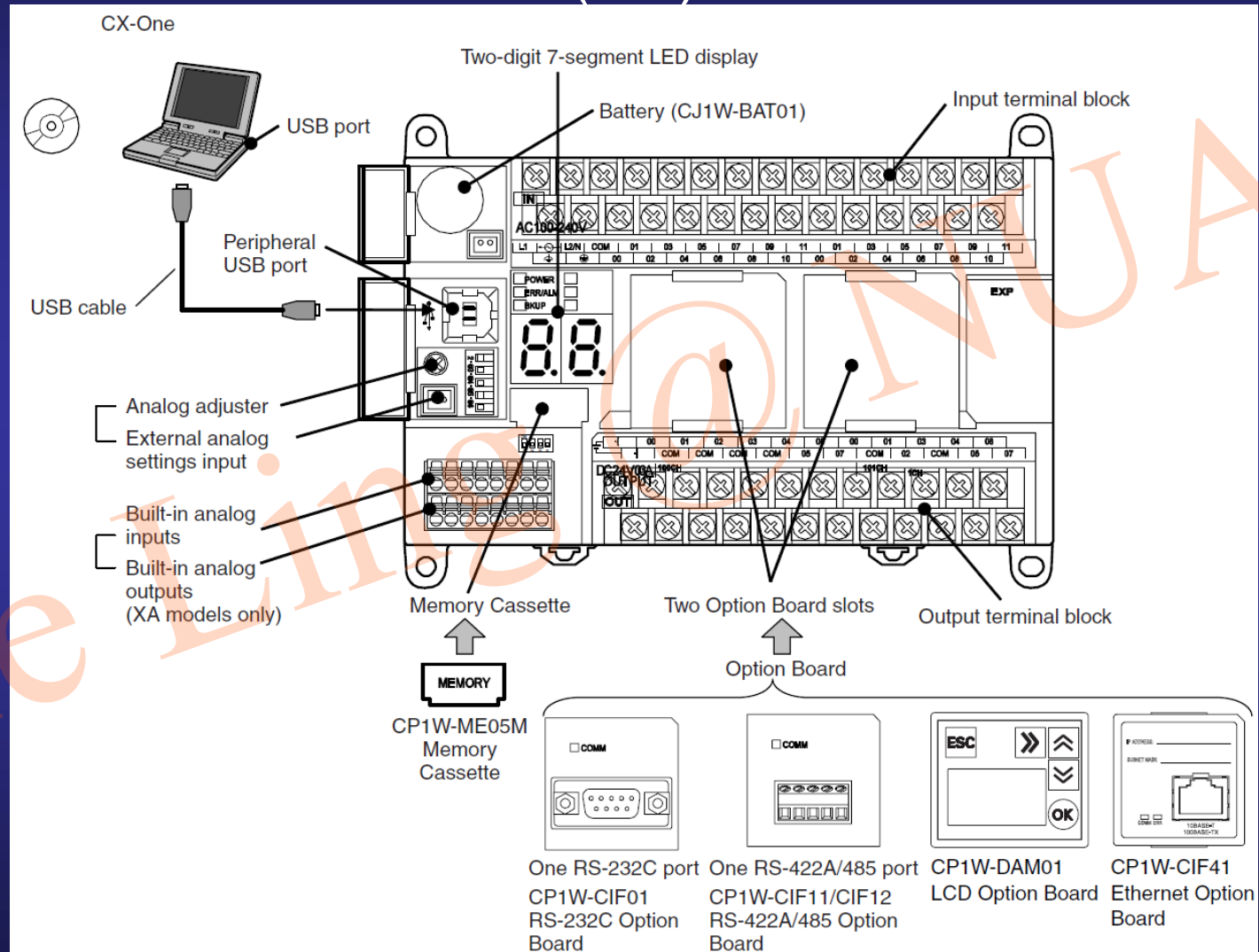| CPU Unit | Specifications | | | | | Model |
| --- | --- | --- | --- | --- | --- | --- |
| | CPU type | Power supply | Output method | Inputs | Outputs | |
| CP1H-X CPU Units | Memory capacity: 20K steps<br>High-speed counters:<br>100 kHz, 4 axes<br>Pulse outputs: 100 kHz, 4 axes<br>(Models with transistor outputs only) | AC power supply | Relay output | 24 | 16 | CP1H-X40DR-A |
| | | DC power supply | Transistor output (sinking) | | | CP1H-X40DT-D |
| | | | Transistor output (sourcing) | | | CP1H-X40DT1-D |
| CP1H-XA CPU Units | Memory capacity: 20K steps<br>High-speed counters:<br>100 kHz, 4 axes<br>Pulse outputs: 100 kHz, 4 axes<br>(Models with transistor outputs only)<br>Analog inputs: 4<br>Analog outputs: 2 | AC power supply | Relay output | 24 | 16 | CP1H-XA40DR-A |
| | | DC power supply | Transistor output (sinking) | | | CP1H-XA40DT-D |
| | | | Transistor output (sourcing) | | | CP1H-XA40DT1-D |
| CP1H-Y CPU Units | Memory capacity: 20K steps<br>High-speed counters:<br>1 MHz, 2 axes<br>100 kHz, 2 axes<br>Pulse outputs:1 MHz, 2 axes<br>100 kHz, 2 axes | DC power supply | Transistor output (sinking) | 12<br>+<br>line-driver input,<br>2 axes | 8<br>+<br>line-driver output,<br>2 axes | CP1H-Y20DT-D |

➢ CPU units:

**Interpreting CP1H CPU Unit Model Numbers**

CP1H-☐☐☐☐☐☐-☐

Class
  X: Basic model
  XA: Built-in analog I/O terminals
  Y: Dedicated pulse I/O terminals

Number of built-in
normal I/O points
  40: 40
  20: 20

Input classification
  D: DC inputs

Power supply
  A: AC
  D: DC

Output classification
  R: Relay outputs
  T: Transistor outputs (sinking)
  T1: Transistor outputs (sourcing)

## Basic CP1H CPU Unit (XA):

# 2.1 Features of CP1

➢ Basic CP1H CPU Unit (XA):

Operation Indicators:
- Show CP1H operation status.



2-digit 7-segment LED display
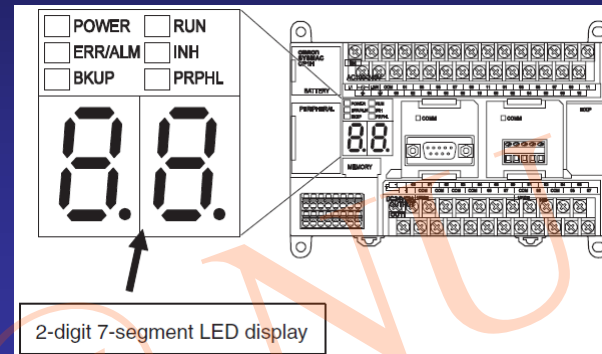
| POWER (Green) | Lit | Power is ON. |
|---|---|---|
| | Not lit | Power is OFF. |
| RUN (Green) | Lit | The CP1H is executing a program in either RUN or MONITOR mode. |
| | Not lit | Operation is stopped in PROGRAM mode or due to a fatal error. |
| ERR/ALM (Red) | Lit | A fatal error (including FALS execution) or a hardware error (WDT error) has occurred. CP1H operation will stop and all outputs will be turned OFF. |
| | Flashing | A non-fatal error has occurred (including FAL execution). CP1H operation will continue. |
| | Not lit | Operation is normal. |
| INH (Yellow) | Lit | The Output OFF Bit (A500.15) has turned ON. All outputs will be turned OFF. |
| | Not lit | Operation is normal. |

| BKUP (Yellow) | Lit | A user program, parameters, or Data Memory are being written or accessed in the built-in flash memory (backup memory). The BKUP indicator also lights while user programs, parameters, and Data Memory are being restored when the PLC power supply is turned ON. Note Do not turn OFF the PLC power supply while this indicator is lit. |
|---|---|---|
| | Not lit | Other than the above. |
| PRPHL (Yellow) | Flashing | Communications (either sending or receiving) are in progress through the peripheral USB port. |
| | Not lit | Other than the above. |

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➢ Expansion units:

• Basic I/O units

**Expansion I/O Units**

**CP1W-8ED**
DC inputs: 8

**CP1W-8ER**
Relay outputs: 8

**CP1W-8ET**
Transistor outputs (sinking): 8

**CP1W-8ET1**
Transistor outputs (sourcing): 8

**CP1W-16ER**
Relay outputs: 16

**CP1W-16ET**
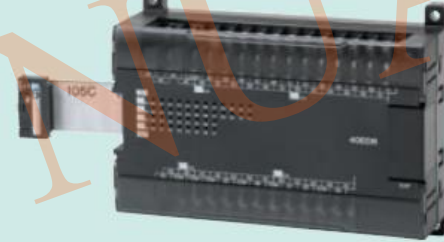Transistor outputs (sinking): 16

**CP1W-16ET1**
Transistor outputs (sourcing): 16

**CP1W-20EDR1**
DC inputs: 12
Relay outputs: 8

**CP1W-20EDT**
DC inputs: 12
Transistor outputs (sinking): 8

**CP1W-20EDT1**
DC inputs: 12
Transistor outputs (sourcing): 8

**CP1W-32ER**
Relay outputs: 32

**CP1W-32ET**
Transistor outputs (sinking): 32

**CP1W-32ET1**
Transistor outputs (sourcing): 32

**CP1W-40EDR**
DC inputs : 24
Relay outputs: 16

**CP1W-40EDT**
DC inputs: 24
Transistor outputs (sinking): 16

**CP1W-40EDT1**
DC inputs: 24
Transistor outputs (sourcing): 16

# 2.1 Features of CP1

➢ Expansion units:

• Analog I/O and temperature sensor units

**Analog I/O Units**

**Analog Input Unit**
CP1W-AD041
Analog inputs: 4
(resolution: 6,000)

CP1W-AD042
Analog inputs: 4
(resolution: 12,000)

**Analog Output Unit**
CP1W-DA021
Analog outputs: 2
(resolution: 6,000)

CP1W-DA041
Analog outputs: 4
(resolution: 6,000)

CP1W-DA042
Analog outputs: 4
(resolution: 12,000)

**Analog I/O Unit**
CP1W-MAD11
Analog inputs: 2 (resolution: 6,000)
Analog outputs: 1 (resolution: 6,000)

CP1W-MAD42
Analog inputs: 4 (resolution: 12,000)
Analog outputs: 2 (resolution: 12,000)

CP1W-MAD44
Analog inputs: 4 (resolution: 12,000)
Analog outputs: 4 (resolution: 12,000)

**Temperature Sensor Unit**

CP1W-TS001
Thermocouple inputs: 2

CP1W-TS002
Thermocouple inputs: 4

CP1W-TS003
Thermocouple inputs: 4
Analog inputs: 2
(instead of 2 thermocouple inputs)
12,000 resolution

CP1W-TS004
Thermocouple inputs: 12

CP1W-TS101
Platinum-resistance
thermometer inputs: 2

CP1W-TS102
Platinum-resistance
thermometer inputs: 4

➢ Expansion units: others

**Optional Boards**

| CP1W-CIF01 | CP1W-CIF11 | CP1W-CIF12-V1 | CP2W-CIFD1 | CP2W-CIFD2 | CP2W-CIFD3 |
|---|---|---|---|---|---|
| RS-232C (15 m max.) | RS-422A/485 (50 m max.) | RS-422A/485 (Isolated-type) (500 m max.) | 2 x RS-232C *1 | RS-232C, RS-485 (Isolated-type) *1 | 2 x RS-485 (Isolated-type) *1 |

| CP1W-CIF41 | CP1W-DAM01 | CP1W-ADB21 | CP1W-DAB21V | CP1W-MAB221 |
|---|---|---|---|---|
| Ethernet *2 | Display 4 rows, 12 characters *2 | 2 analog inputs, 0-10 V, 0-20 mA | 2 analog outputs, 0-10 V | 2 analog inputs 0-10 V, 0-20 mA & 2 outputs 0-10 V |

**Memory Cassette**

CP1W-ME05M *2
512K words
(upload/download program)

**Battery Set**

CP2W-BAT02 (for CP2E)
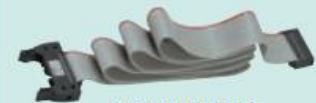
CJ1W-BAT01 (for maintenance of CP1L/CP1H)

**CJ Unit Adapter**

CP1W-EXT01
CJ Unit adapter for use with CP1H. Includes CJ endplate.

**I/O Connecting Cable**

CP1W-CN811
Length: 80 cm

CP1W Expansion Units include I/O Connection Cables (in lengths of approx. 6 cm) for side-by-side connection.

# 2.1 Features of CP1

➢ Expansion units:

• Maximum number of expansion units

■ **Maximum Number of CP1W Expansion Unit and Expansion I/O Units**
● **CP1H CPU Unit**



7 max. (Refer to restrictions below.)
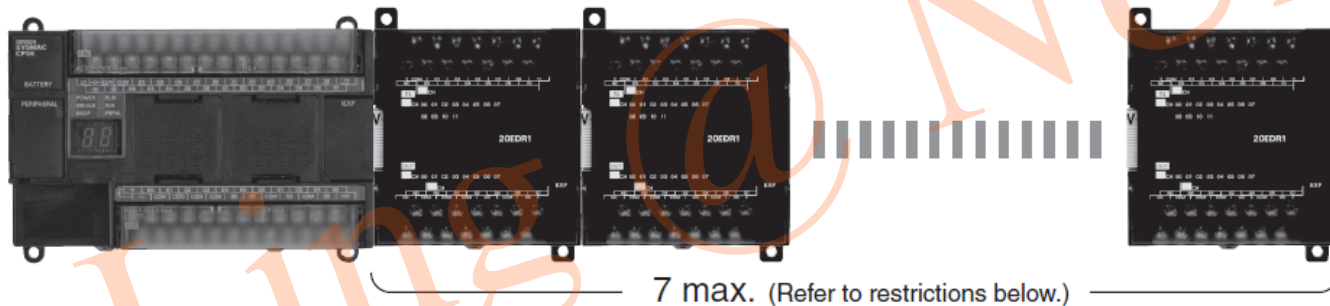
■ **Restrictions on the Number of CP1H Expansion Unit and I/O Unit Connections**
Up to seven Expansion Units and Expansion I/O Units can be connected when a CP1H CPU Unit is used, but the following restrictions apply. Observe these restrictions when using the models in the shaded areas in the following tables. A maximum total of 15 input words is allocated for Expansion Units and a maximum total of 15 output words is allocated for Expansion Units and Expansion I/O Units.

# 2.1 Features of CP1

➢ Input specifications of CP1H:

Input terminals of CP1H(X/XA, AC power supply)

- 24 input points, 2 channels
- Channel 0: 12 bits, 0.00-0.11
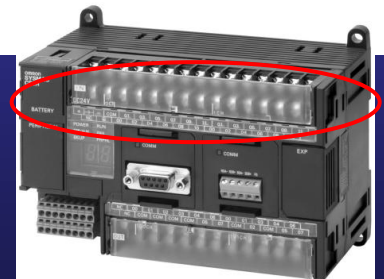- Channel 1: 12 bits, 1.00-1.11

**Terminal Block Arrangement**

Upper Terminal Block (Example: AC Power Supply Models)

| L1 | L2/N | COM | 01 | 03 | 05 | 07 | 09 | 11 | 01 | 03 | 05 | 07 | 09 | 11 |
|----|------|-----|----|----|----|----|----|----|----|----|----|----|----|----|
| ⏚ | ⏚ | 00 | 02 | 04 | 06 | 08 | 10 | | 00 | 02 | 04 | 06 | 08 | 10 |

Inputs (CIO 0)　　　　　Outputs (CIO 1)
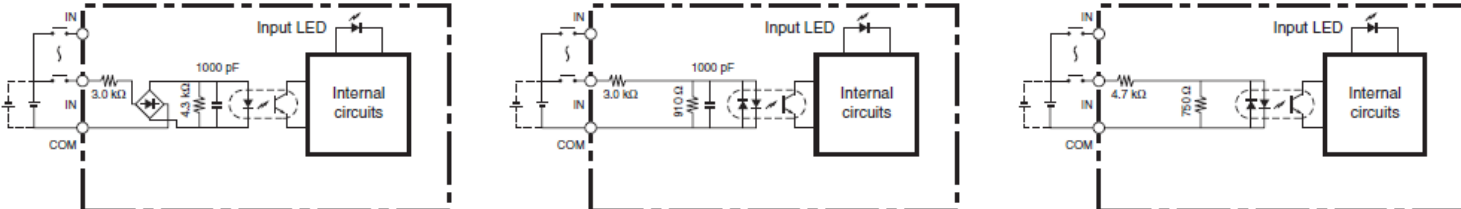
Normal input terminals

# 2.1 Features of CP1

➢ Input specifications:

## ■ Input Specifications

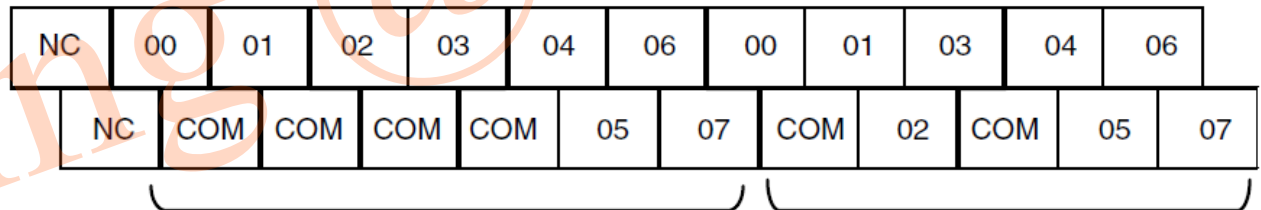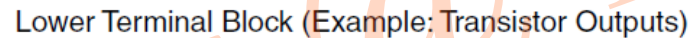| ITEM | | High-speed counter inputs (phases A and B) | Interrupt inputs and quick-response inputs | Normal inputs |
|---|---|---|---|---|
| | | | Specifications | |
| CP1H-XA/X CPU Units | | CIO 0.04 to CIO 0.11 | CIO 0.00 to CIO 0.03 and CIO 1.00 to CIO 1.03 | CIO 1.04 to CIO 1.11 |
| CP1H-Y CPU Units | | CIO 0.04, CIO 0.05, CIO 0.10, CIO 0.11 | CIO 0.00, CIO 0.01 and CIO 1.00 to CIO 1.03 | CIO 1.04, CIO 1.05 |
| Input voltage | | 24 VDC +10%/−15% | | |
| Applicable sensors | | 2-wire sensors or 3-wire sensors | | |
| Input impedance | | 3.0 kΩ | | 4.7 kΩ |
| Input current | | 7.5 mA typical | | 5 mA typical |
| ON voltage | | 17.0 VDC min. | | 14.4 VDC min. |
| OFF voltage/current | | 1 mA max. at 5.0 VDC | | |
| ON delay | | 2.5 µs max. | 50 µs max. | 1 ms max. |
| OFF delay | | 2.5 µs max. | 50 µs max. | 1 ms max. |
| Circuit configuration | |  |  |  |

# 2.1 Features of CP1

➢ Output specifications of CP1H:

Output terminals of CP1H(X/XA, transistor)

- 16 output points, 2 channels
- Channel 100: 8 bits, 100.00-100.07
- Channel 101: 8 bits, 101.00-101.07

**Terminal Block Arrangement**

Lower Terminal Block (Example: Transistor Outputs)

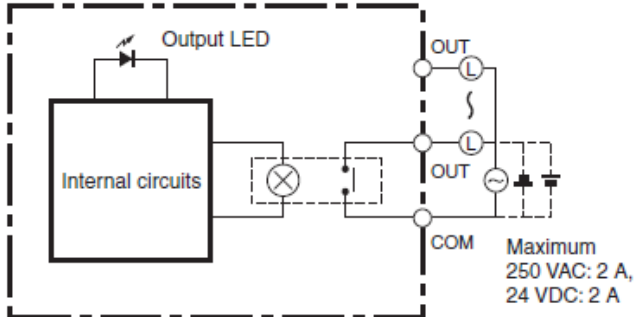| NC | 00 | 01 | 02 | 03 | 04 | 06 | 00 | 01 | 03 | 04 | 06 |
|----|----|----|----|----|----|----|----|----|----|----|----|
| | NC | COM | COM | COM | COM | 05 | 07 | COM | 02 | COM | 05 | 07 |

CIO 100                    CIO 101

Normal output terminals

# 2.1 Features of CP1

➤ Output specifications:
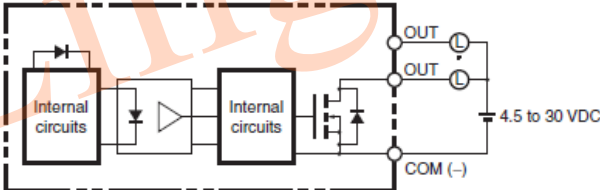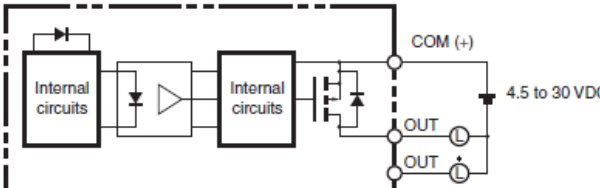
## Output Specifications
## CPU Units with Relay Outputs
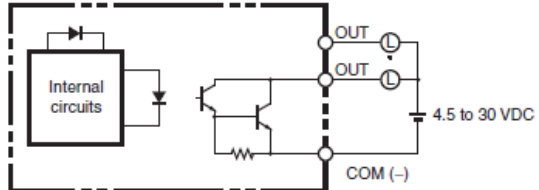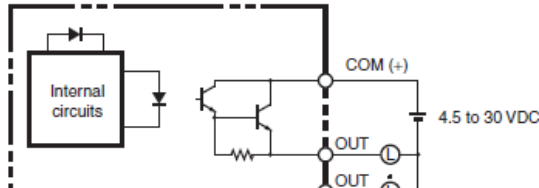
| Item | | | Specifications |
|---|---|---|---|
| Max. switching capacity | | | 2 A, 250 VAC (cosϕ = 1), 2 A, 24 VDC 4 A/common) |
| Min. switching capacity | | | 5 VDC, 10 mA |
| Service life of relay | Electrical | Resistive load | 100,000 operations (24 VDC) |
| | | Inductive load | 48,000 operations (250 VAC, cosϕ = 0.4) |
| | Mechanical | | 20,000,000 operations |
| ON delay | | | 15 ms max. |
| OFF delay | | | 15 ms max. |
| Circuit configuration | | |  |

## Output specifications:

● **CPU Units with Transistor Outputs (Sinking/Sourcing)**

| Item | | Specifications | | |
|---|---|---|---|---|
| CP1H-XA/X CPU Units | | CIO 100.00 to CIO 100.07 | CIO 101.00, CIO 101.01 | CIO 101.02 to CIO 101.07 |
| CP1H-Y CPU Units | | CIO 100.04 to CIO 100.07 | CIO 101.00, CIO 101.01 | CIO 101.02, CIO 101.03 |
| Max. switching capacity | | 4.5 to 30 VDC: 300 mA/point, 0.9 A/common, 3.6 A/Unit *1*2 | | |
| Min. switching capacity | | 4.5 to 30 VDC, 1 mA | | |
| Leakage current | | 0.1 mA max. | | |
| Residual voltage | | 0.6 V max. | 1.5 V max. | |
| ON delay | | 0.1 ms max. | | |
| OFF delay | | 0.1 ms max. | | 1 ms max. |
| Fuse | | 1/common *3 | | |
| Circuit configuration | | Sinking Outputs <br><br> Sourcing Outputs | Sinking Outputs <br><br> Sourcing Outputs | |

➢ External interfaces:
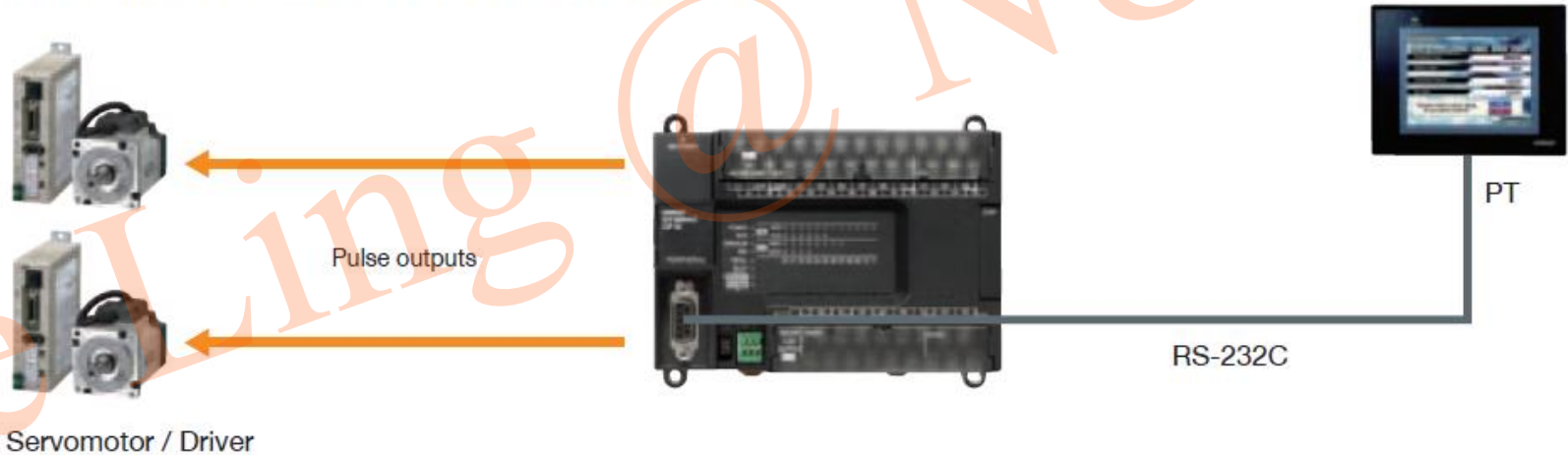
➢ External interfaces:



Pulse Outputs — Models with transistor Output

Two 100kHz pulse outputs for high-precision position control.

Pulse outputs

Servomotor / Driver

PT

RS-232C
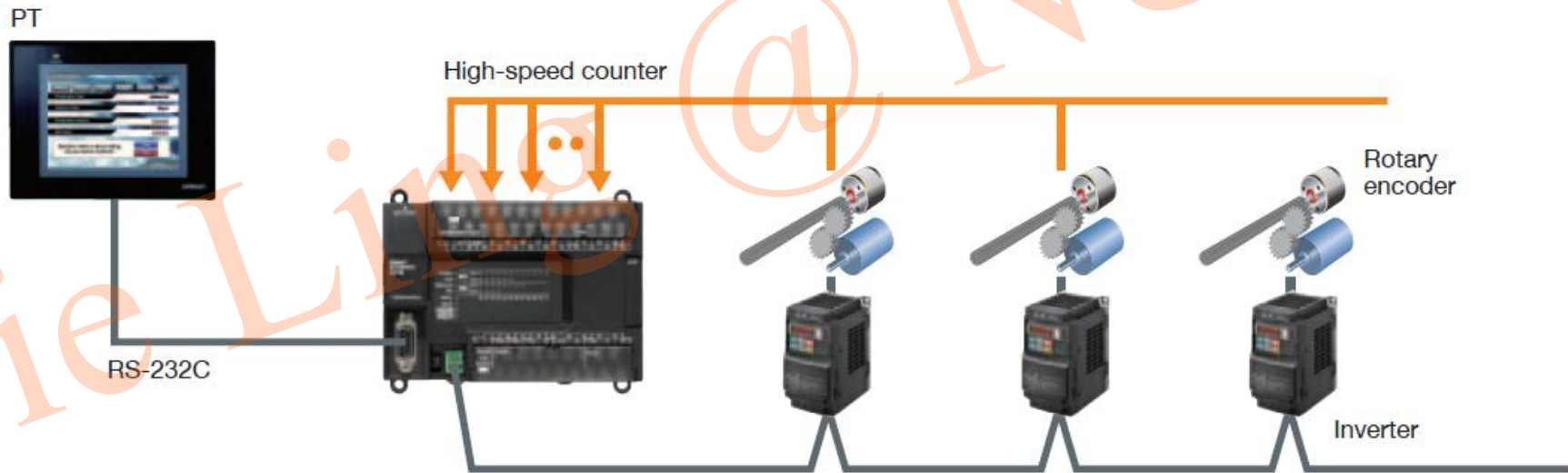
➢ External interfaces:



High-speed Counters*

Control multiple axes with one PLC using the two 100kHz and four 10kHz, single-phase high-speed counters.

* The Basic Models are equipped with six 10kHz, single-phase high-speed counters.
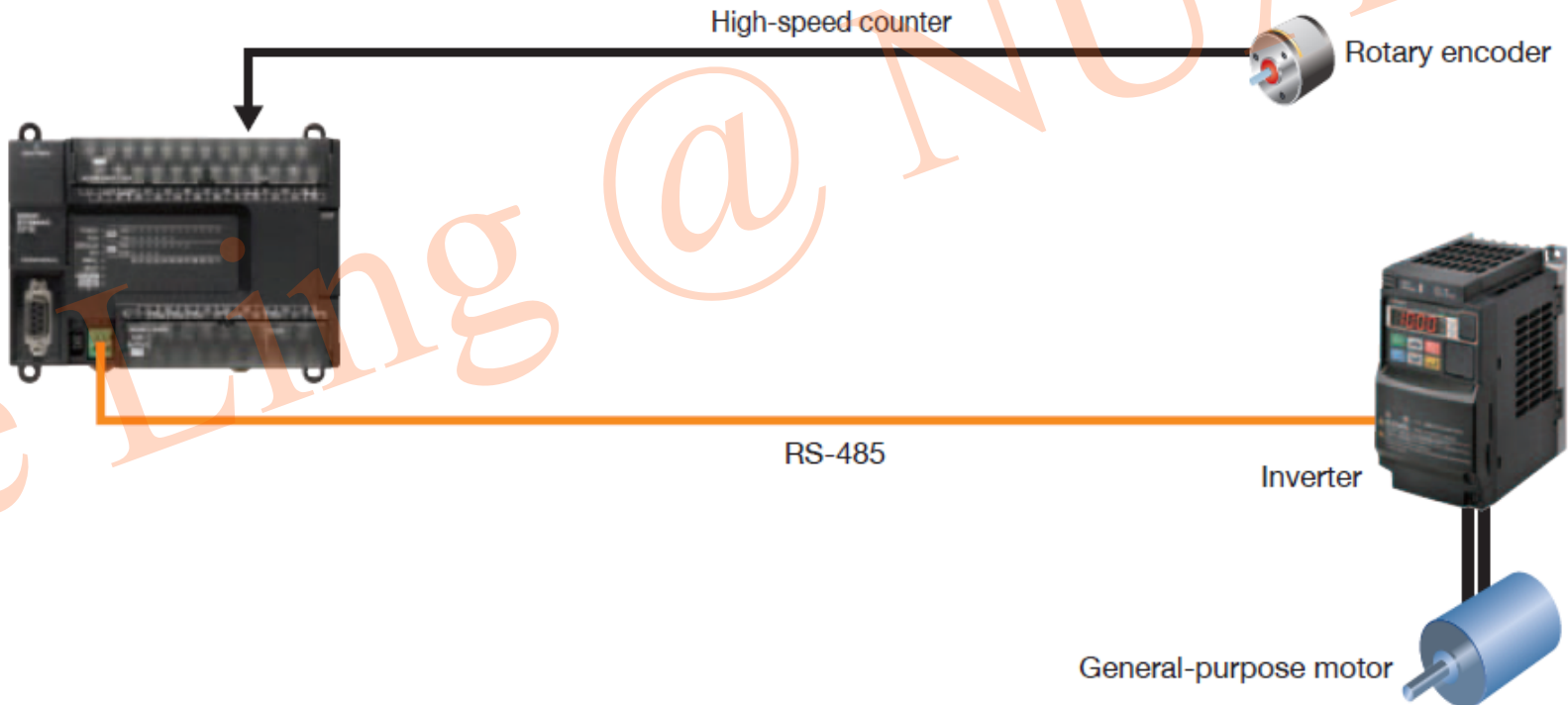
PT

High-speed counter

Rotary encoder

RS-232C

Inverter

# 2.1 Features of CP1

➢ External interfaces:



Modbus-RTU easy master

Specify Inverter speeds via RS-485
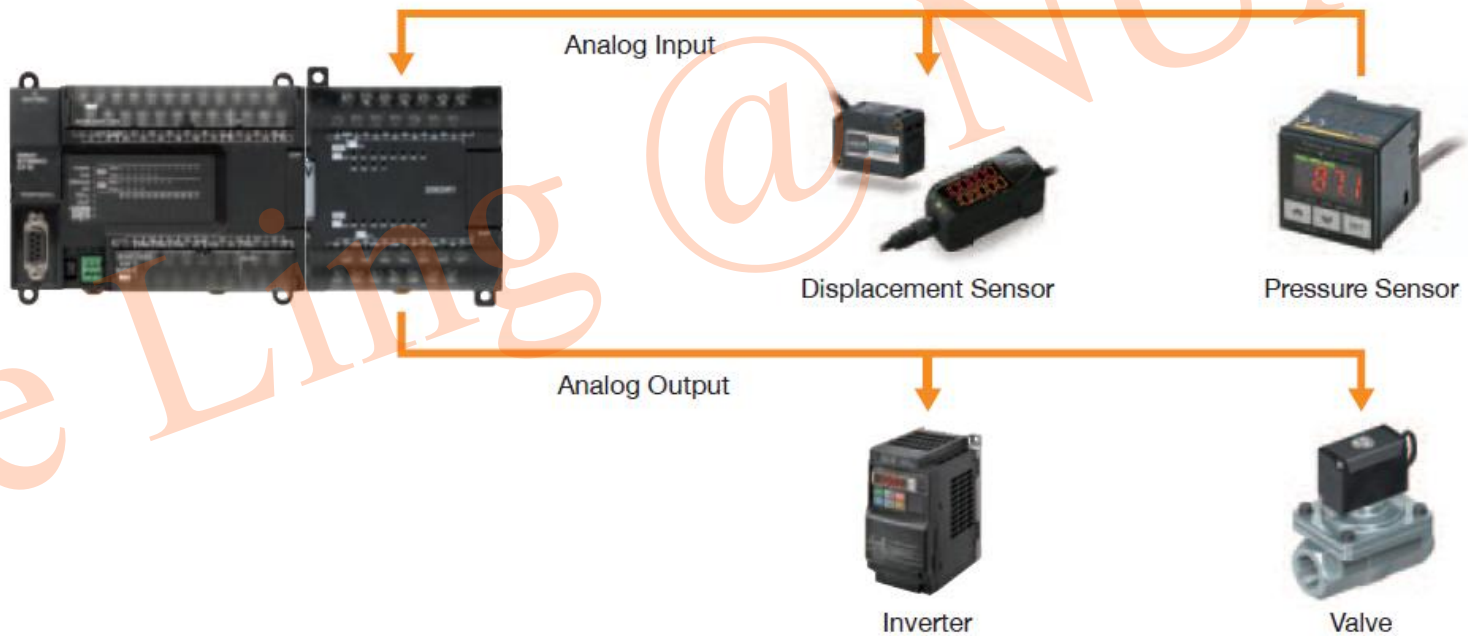
High-speed counter — Rotary encoder

RS-485 — Inverter

General-purpose motor

➢ External interfaces:



## Analog I/O Control

High-accuracy analog I/O control with a resolution 1/12,000.
You can add up to 4 analog I/O by mounting an Analog Option Board and up to 24 analog I/O by connecting Expansion Units.
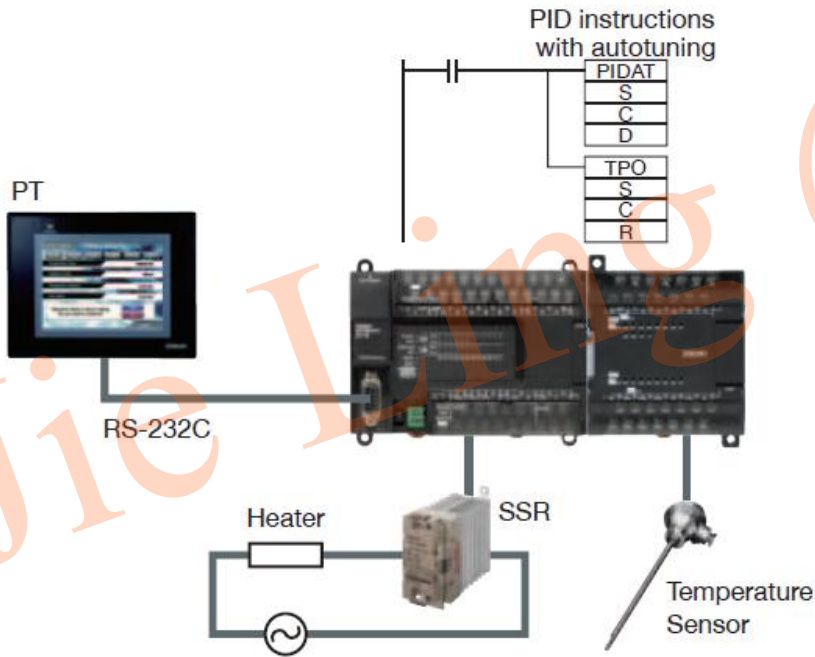
Analog Input

Displacement Sensor
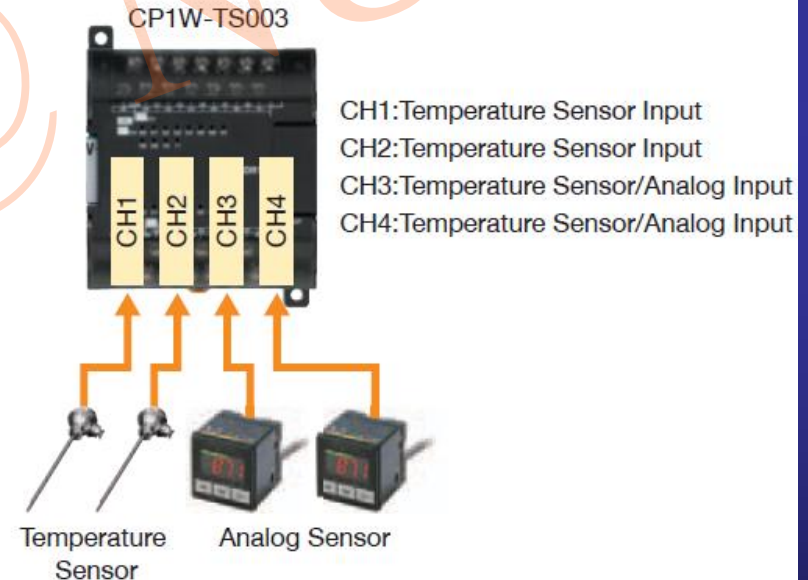
Pressure Sensor

Analog Output

Inverter

Valve

> ## External interfaces:



## Temperature Control

The combination of the Temperature Input Unit with the PID instructions enables temperature control.
Up to 12 thermocouple inputs per Unit for CP1W-TS004.

The CP1W-TS003 has two inputs that can be used for temperature sensor or analog inputs.
Both temperature sensor and analog inputs can be achieved with only one Unit.

PID instructions with autotuning
PIDAT
S
C
D
TPO
S
C
R

PT

RS-232C

Heater          SSR

Temperature Sensor

CP1W-TS003

CH1:Temperature Sensor Input
CH2:Temperature Sensor Input
CH3:Temperature Sensor/Analog Input
CH4:Temperature Sensor/Analog Input

CH1 CH2 CH3 CH4

Temperature Sensor          Analog Sensor
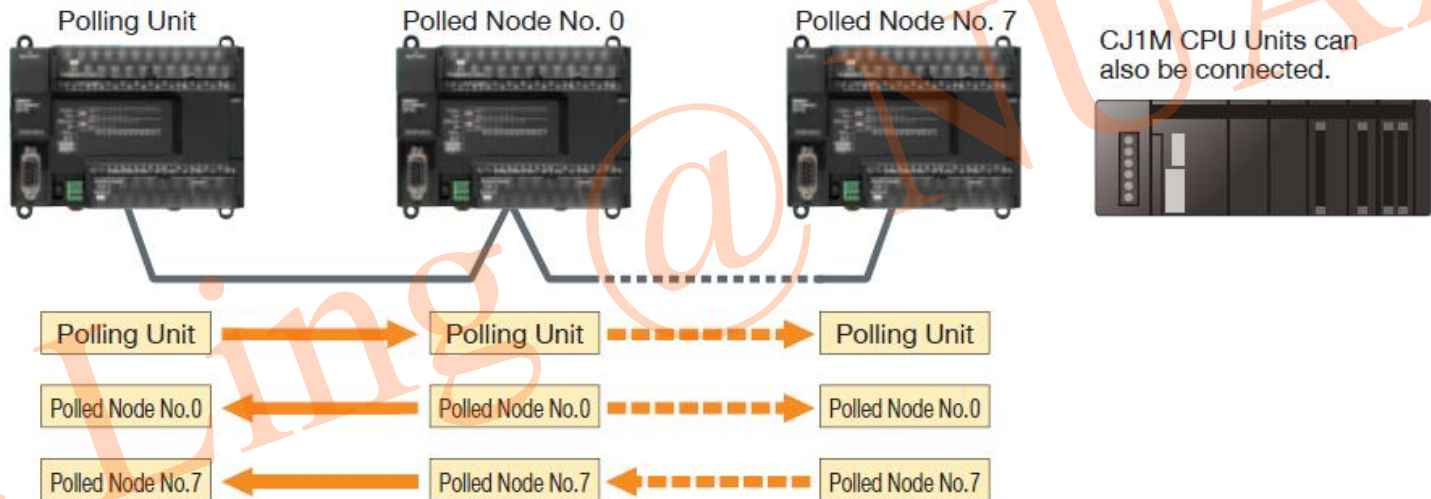
➢ External interfaces:

## Serial PLC Links

Link data with up to 10 words between up to nine CP1E-N CPU Units when controlling a device with multiple CP1E-N PLCs.

Polling Unit    Polled Node No. 0    Polled Node No. 7

CJ1M CPU Units can also be connected.

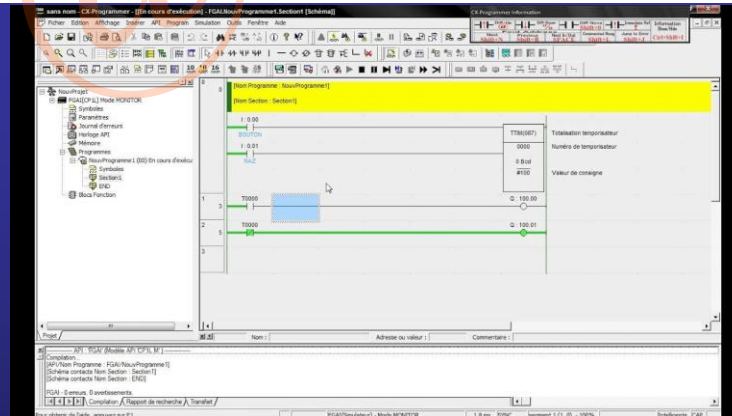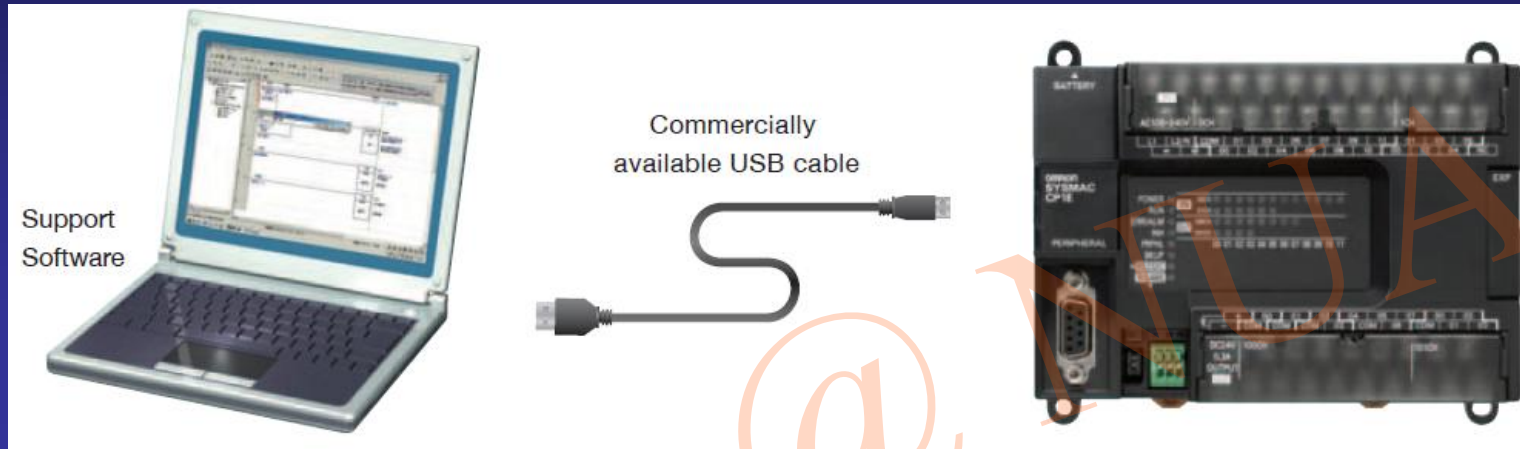| Polling Unit | → | Polling Unit | ⇢ | Polling Unit |
| Polled Node No.0 | ← | Polled Node No.0 | ⇢ | Polled Node No.0 |
| Polled Node No.7 | ← | Polled Node No.7 | ⇠ | Polled Node No.7 |

➢ External interfaces:

## Ethernet Communications

Mount a CP1W-CIF41 Ethernet Option Board to an option board slot on the CP1E-N/NA type CPU Unit.
Perform monitoring and programming with CX-Programmer, or communicate with a host computer via Ethernet.(server function only)

Computer
(server function only)

FINS-UDP
FINS-TCP
protocol

Industrial switching hub
W4S1

CP1E

CP1H / CP1L
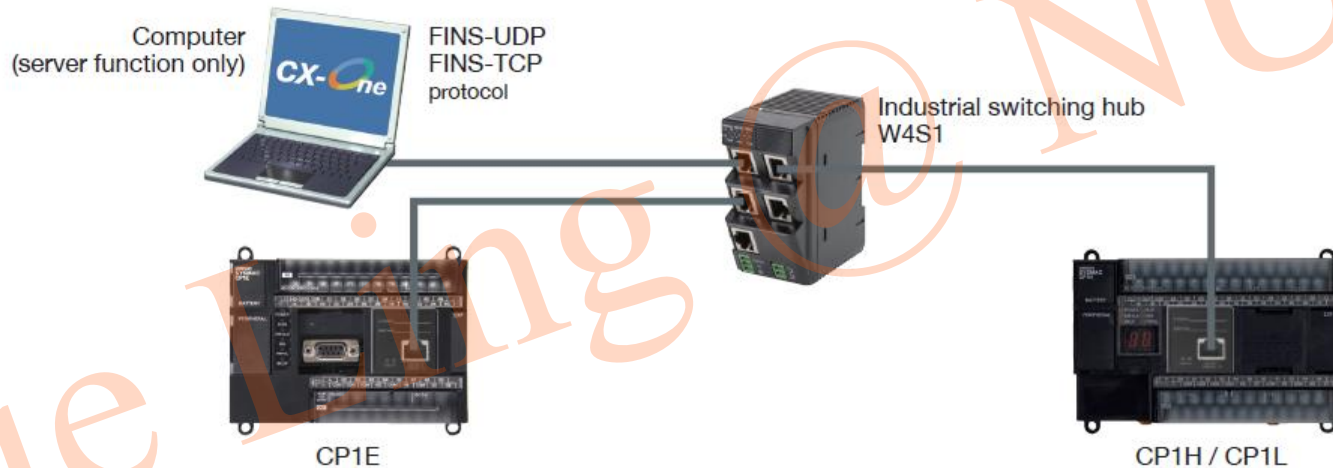
# 2.1 Features of CP1

➢ **Programming tool:**



| Operating system | Windows 98, Me, 2000, or XP |
|---|---|
| Support Software | CX-Programmer Ver. 6.1 (CX-One Ver. 1.1) |
| USB driver | Included with above Support Software. |
| USB cable | USB 1.1(or 2.0) cable (A connector-B connector), 5 m max. |

# Application Example

**Cutting Metal Sheets to Specified Lengths**

The proximity sensor detects the edge of a metal plate to operate the cutter. Metal sheets can be cut continuously to the specified lengths at a high speed.
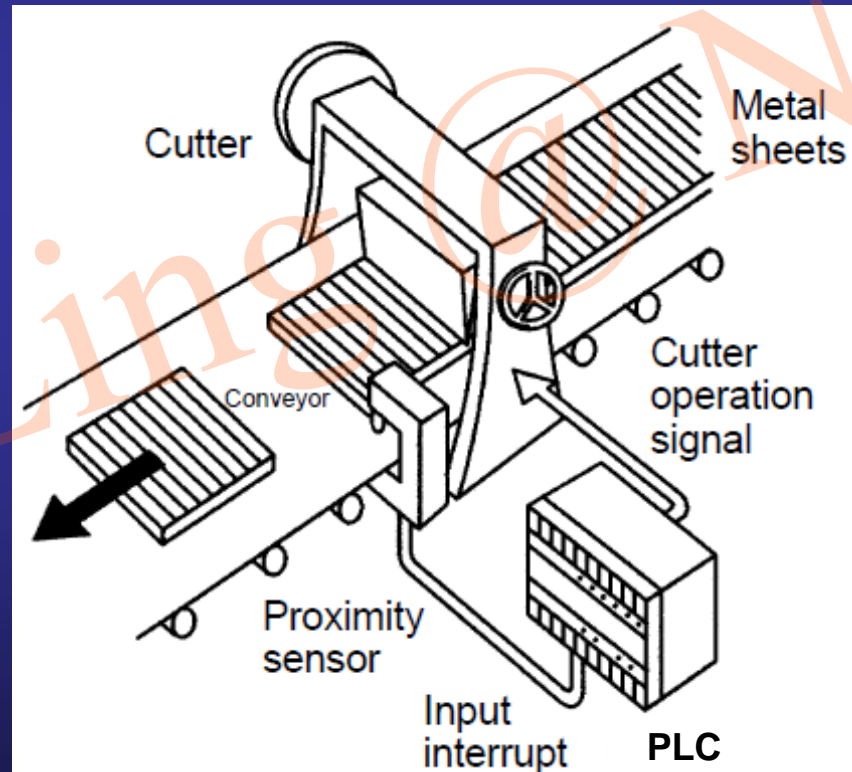
# Application Example

## Calculating the Number of Chips

The metal sensor counts the number of parts that have passed. Steady counting can be achieved even when the input-ON time is short.
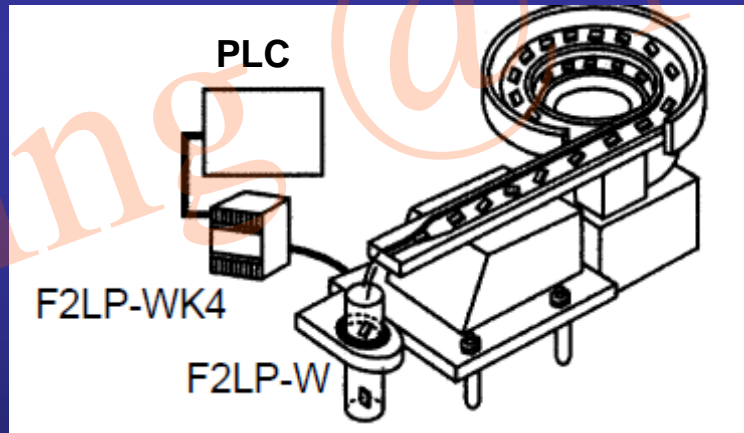
# Application Example

**Computing the Sheet Speed**

The number of pulse inputs is computed in the interrupt mode at a fixed time to calculate the speed.

# 2.2 PLC Addressing
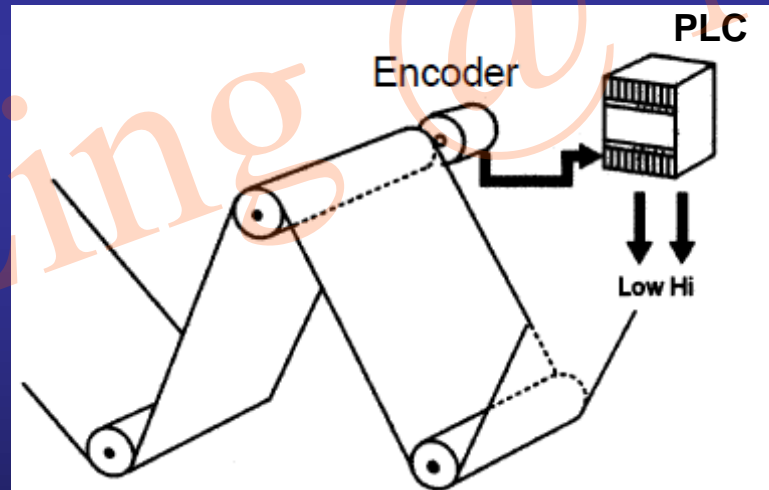
## 2.2.1 I/O memory area

**This region of memory contains the data areas that can be accessed as <span style="color:red">instruction operands</span>, including:**

- **CIO Area (CIO)**
- **Work Area (W)**
- **Holding Area (H)**
- **Auxiliary Area (A)**
- **Temporary Relay Area (TR)**
- **Data Memory Area (D)**
- **Timer Area (T)**

- **Counter Area (C)**
- **Task Flag Area (TK)**
- **Data Registers (DR)**
- **Index Registers (IR)**
- **Condition Flag Area**
- **Clock Pulse Area**
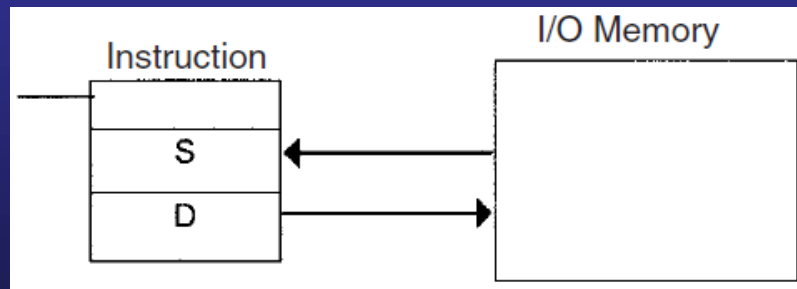
# 2.2 PLC Addressing

## 2.2.1 I/O memory area
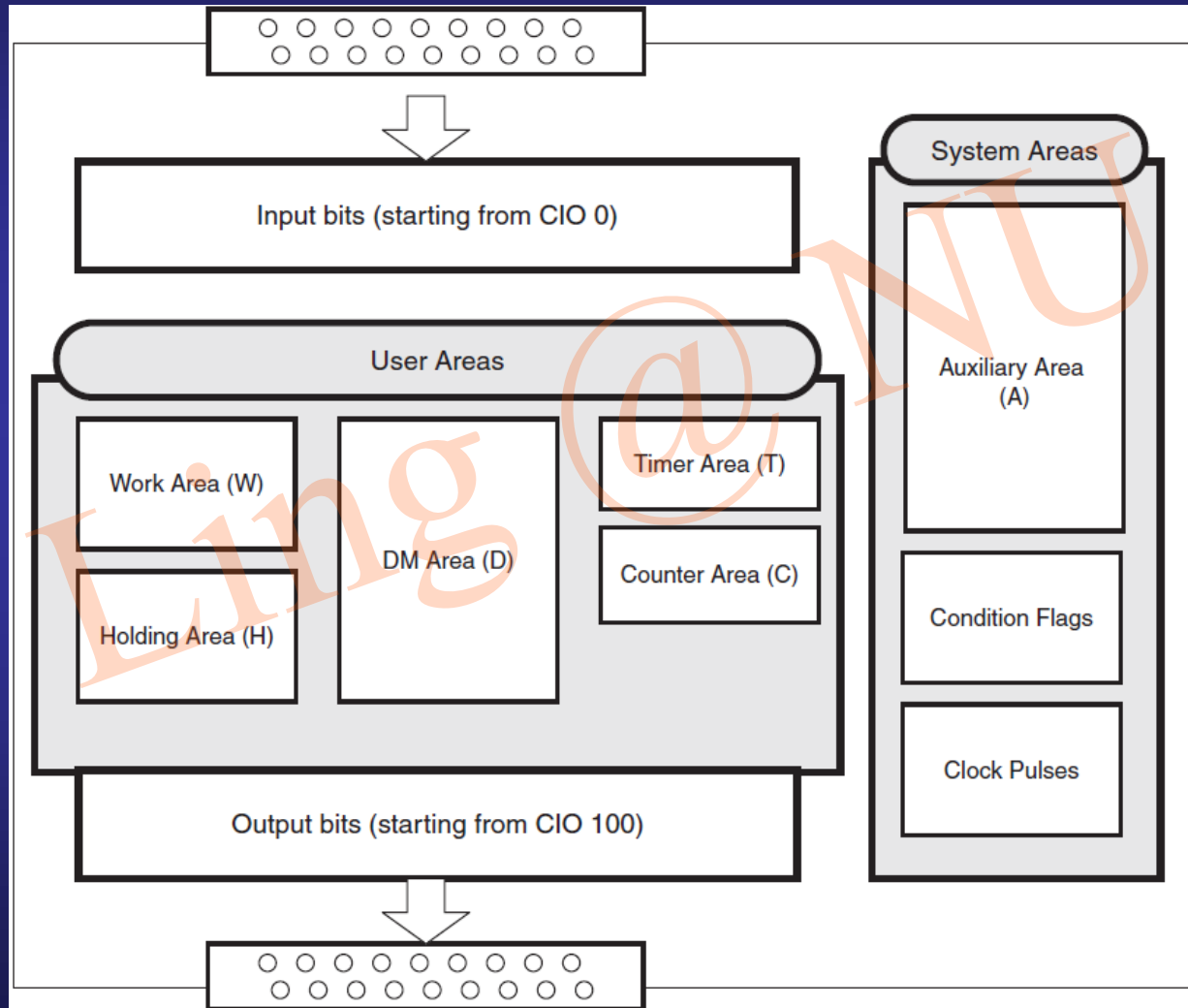
# 2.2 PLC Addressing

## 2.2.2 Address of relay

Method:  (Word address) .  (bit address)

Represented by 4 numbers, each word has 16 bits, also called "channel"

Represented by 2 numbers, i.e. 00-15

E.g:  address of a relay is **3800.04**

Word address

Bit address

# 2.2 PLC Addressing

| | Area | | Size | Range |
|---|---|---|---|---|
| CIO Area | I/O Area | Input Area | 272 bits (17 words) | CIO 0 to CIO 16 |
| | | Output Area | 272 bits (17 words) | CIO 100 to CIO 116 |
| | Built-in analog I/O Areas (XA CPU Units only) | Built-in Analog Input Area | 4 words | CIO 200 to CIO 203 |
| | | Built-in Analog Output Area | 2 words | CIO 210 to 211 |
| | Data Link Area | | 3,200 bits (200 words) | CIO 1000 to CIO 1199 |
| | CPU Bus Unit Area | | 6,400 bits (400 words) | CIO 1500 to CIO 1899 |
| | Special I/O Unit Area | | 15,360 bits (960 words) | CIO 2000 to CIO 2959 |
| | Serial PLC Link Area | | 1,440 bits (90 words) | CIO 3100 to CIO 3189 |
| | DeviceNet Area | | 9,600 bits (600 words) | CIO 3200 to CIO 3799 |
| | Work Area | | 4,800 bits (300 words) 37,504 bits (2344 words) | CIO 1200 to CIO 1499 CIO 3800 to CIO 6143 |

| Area | Size | Range |
|---|---|---|
| Work Area | 8,192 bits (512 words) | W000 to W511 |
| Holding Area | 8,192 bits (512 words) | H000 to H511 (Note 1) |
| Auxiliary Area | 15,360 bits (960 words) | A000 to A959 |

| Area | Size | Range |
|---|---|---|
| TR Area | 16 bits | TR0 to TR15 |
| Data Memory Area | 32,768 words | D00000 to D32767 |
| Timer Completion Flags | 4,096 bits | T0000 to T4095 |
| Counter Completion Flags | 4,096 bits | C0000 to C4095 |
| Timer PVs | 4,096 words | T0000 to T4095 |
| Counter PVs | 4,096 words | C0000 to C4095 |
| Task Flag Area | 32 bits | TK0 to TK31 |
| Index Registers | 16 registers | IR0 to IR15 |
| Data Registers | 16 registers | DR0 to DR15 |

## 2.2.3 Input/output relay
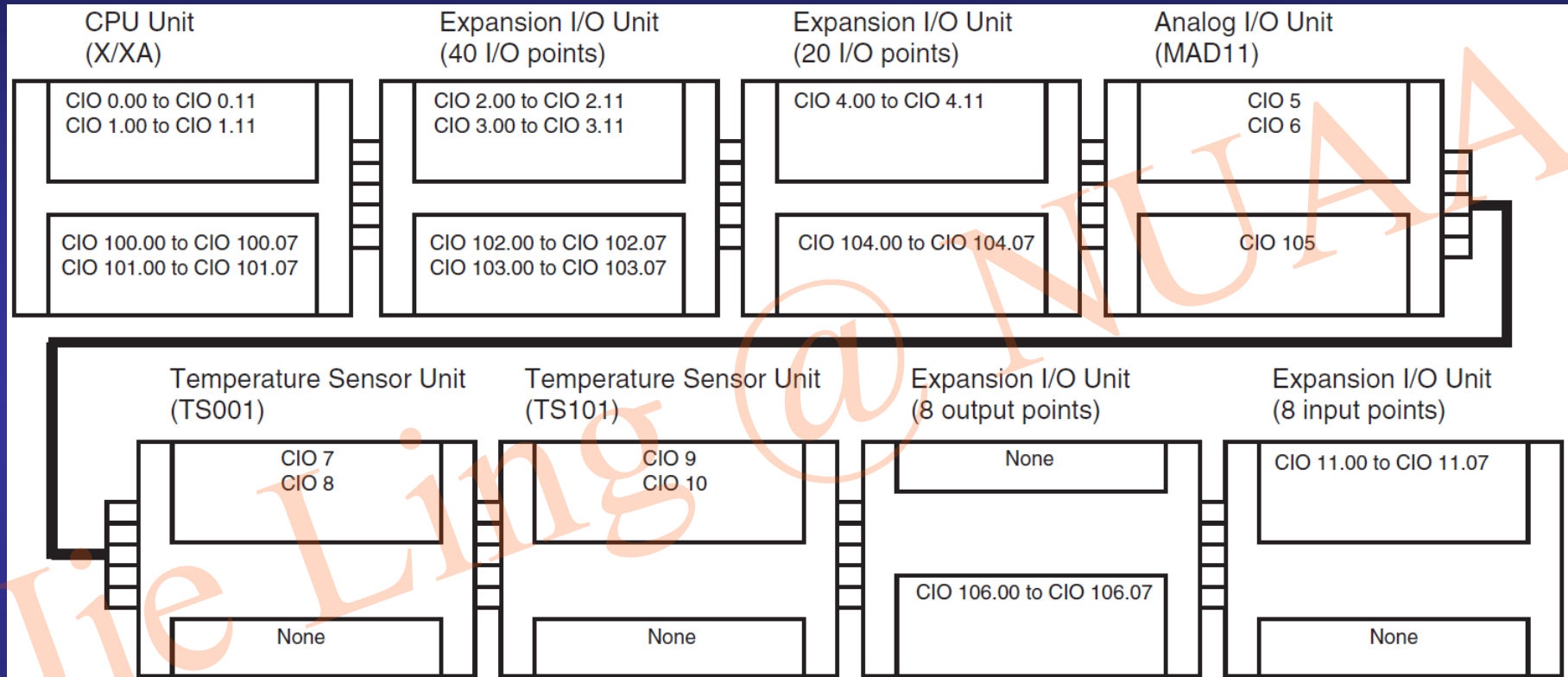
**Input Bits:** CIO 0.00 to CIO 16.15 (17 words)
**Output Bits:** CIO 100.00 to CIO 116.15 (17 words)

- It is not necessary to use the "CIO" acronym when specifying an address in the CIO Area
- Input bits in CIO 0 and CIO 1 and output bits in CIO 100 and CIO 101 are automatically allocated to the built-in I/O
- Expansion Units are automatically allocated input bits in words starting from CIO 2 and output bits in words starting from CIO 102.

# 2.2.4 I/O expansion

| CPU Unit (X/XA) | Expansion I/O Unit (40 I/O points) | Expansion I/O Unit (20 I/O points) | Analog I/O Unit (MAD11) |
|---|---|---|---|
| CIO 0.00 to CIO 0.11<br>CIO 1.00 to CIO 1.11 | CIO 2.00 to CIO 2.11<br>CIO 3.00 to CIO 3.11 | CIO 4.00 to CIO 4.11 | CIO 5<br>CIO 6 |
| CIO 100.00 to CIO 100.07<br>CIO 101.00 to CIO 101.07 | CIO 102.00 to CIO 102.07<br>CIO 103.00 to CIO 103.07 | CIO 104.00 to CIO 104.07 | CIO 105 |

| Temperature Sensor Unit (TS001) | Temperature Sensor Unit (TS101) | Expansion I/O Unit (8 output points) | Expansion I/O Unit (8 input points) |
|---|---|---|---|
| CIO 7<br>CIO 8 | CIO 9<br>CIO 10 | None | CIO 11.00 to CIO 11.07 |
| None | None | CIO 106.00 to CIO 106.07 | None |

**I/O Allocation Examples**

**Restrictions:**
1. A maximum of up to 7 Units can be connected.
2. A maximum of 15 input and output words can be allocated.

## 2.2.5 Internal I/O (Work) Area (W)

**Contains 512 words, addresses: W0 to W511, used in programming as work words.**

✓Unused words in the CIO area may also be used as work words and work bits in the program.

## 2.2.6 Holding Area (H)

**Contains 512 words, addresses: H0 to H511 (bits H0.00 to H511.15), used in programming.**

✓Data in the Holding Area is not cleared when the power is cycled.

✓When a self-maintaining bit is programmed with a Holding Area bit, the self-maintaining bit won't be cleared even when the power is reset.
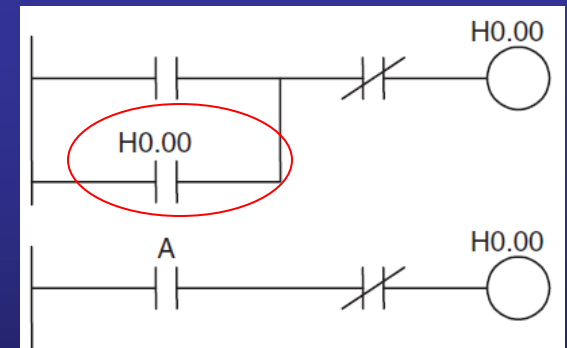
## 2.2.7 Auxiliary Area (A)

**Contains 960 words, addresses: A0 to A959, preassigned as flags and control bits to monitor and control operation.**

- ✓ A0 through A447 are read-only
- ✓ A448 through A959 can be read or written from the program or the CX-Programmer.

## 2.2.8 TR (Temporary Relay) Area

**Contains 16 bits, addresses: TR0 to TR15, temporarily store the ON/OFF status of an instruction block for branching and are used only with mnemonics.**

✓The TR bits can be used as many times as required and in any order required as long as the same TR bit is not used twice in the same instruction block.

## 2.2.9 Timer Area (T)

- **4096 timer numbers, T0000 to T4095**

✓shared by the TIM, TIMX, TIMH, TIMHX, TMHH, TIMHHX, TTIM, TTIMX, TIMW, TIMWX, TMHW, and TIMHWX instructions.

✓Do not use the same timer number in two timer instructions.

✓Timer Completion Flags and present values (PVs) for these instructions are accessed with the timer numbers.

✓When used in an operand that requires bit data, the timer number accesses the Completion Flag of the timer.

✓When used in an operand that requires word data, the timer number accesses the PV of the timer.

## 2.2.10 Counter Area (C)

- **4096 counter numbers, C0000 to C4095**

✓shared by the CNT, CNTX, CNTR, CNTRX, CNTW, and CNTWX instructions.

✓Do not use the same counter number in two counter instructions.

✓Counter Completion Flags and present values (PVs) for these

✓instructions are accessed with the counter numbers.

✓When used in an operand that requires bit data, the counter number accesses the Completion Flag of the counter.

✓When used in an operand that requires word data, the counter number accesses the PV of the counter.

> **Changing the BCD or Binary Mode for Counters and Timers**
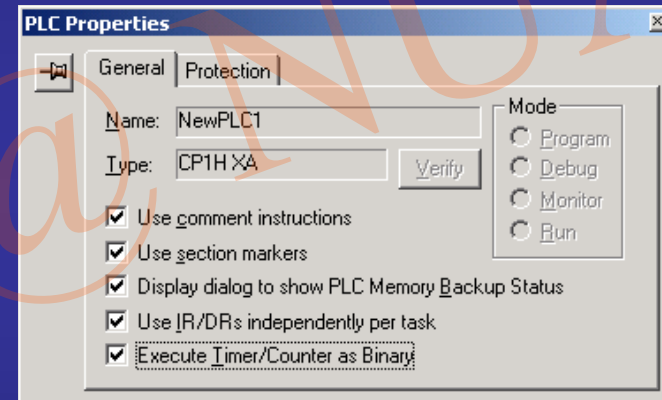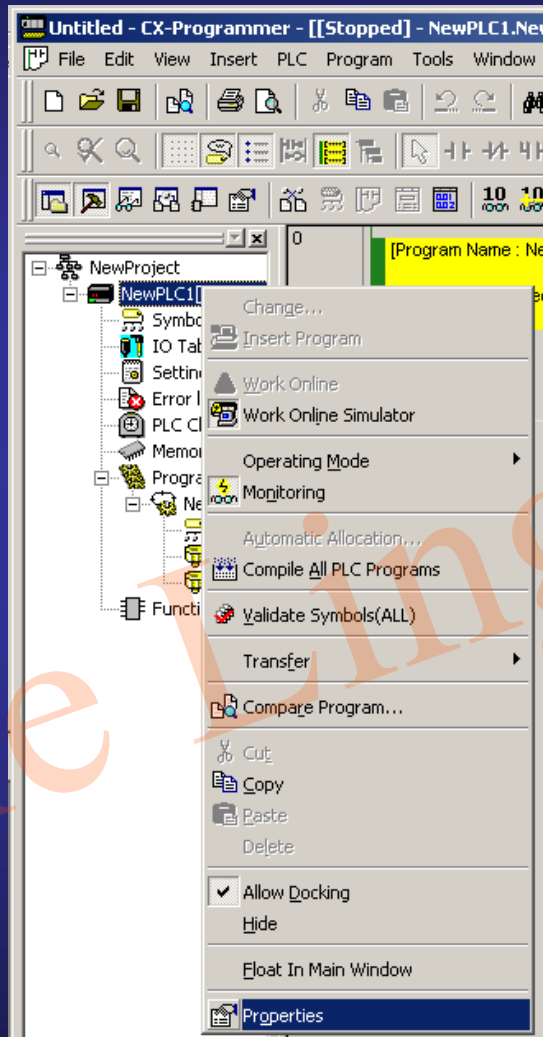
## 2.2.11 Data Memory Area (D)

- **contains 32,768 words, addresses: D0 to D32767, used for general data storage and manipulation, accessible only by word.**

✓Data in the DM Area is retained when the PLC's power is cycled.

✓Although bits in the DM Area cannot be accessed directly, the status of these bits can be accessed with the BIT TEST instructions, TST and TSTN.

## 2.2.12 Index Registers (IR)

- **16 Index Registers (IR0 to IR15), used for indirect addressing.**

✓Each IR can hold a single PLC memory address, which is the absolute memory address of a word in I/O memory.

✓Use MOVR to convert a regular data area address to its equivalent PLC memory address and write that value to the specified IR.
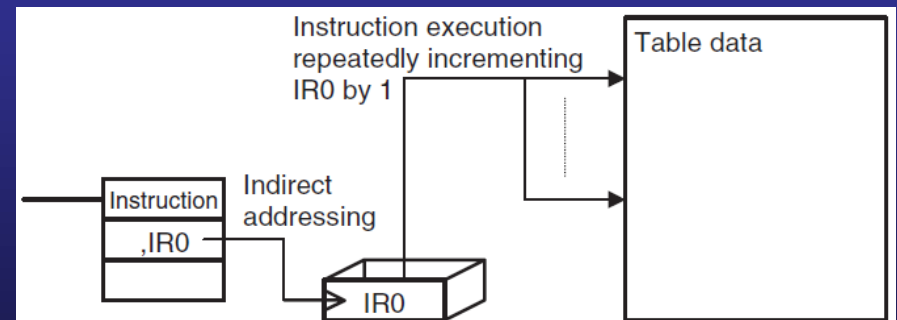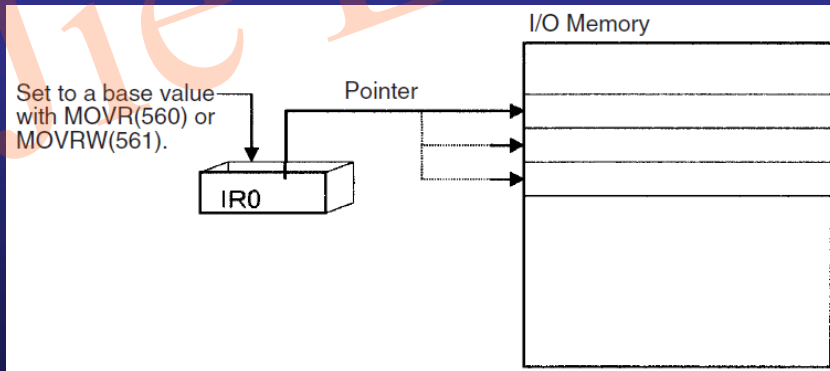
## 2.2.13 Data Registers (DR)

- **16 Data Registers (DR0 to DR15) are used to offset the PLC memory addresses in IR when addressing words indirectly.**
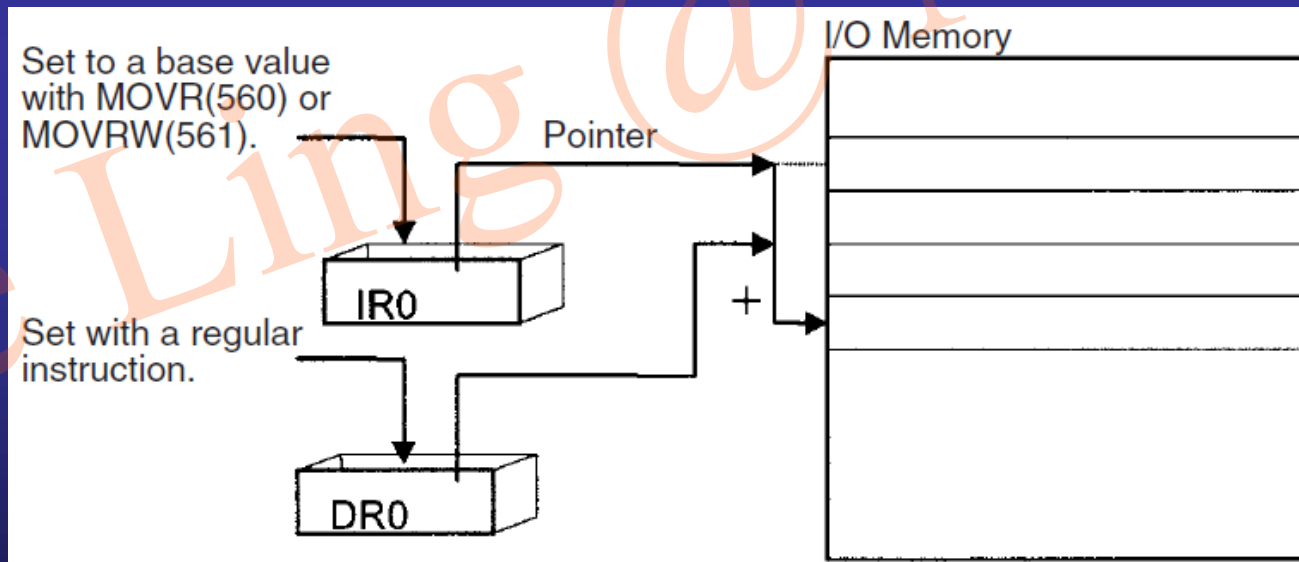
## 2.2.14 Task Flags (TK)

- **32 Task Flags range from TK00 to TK31 and correspond to cyclic tasks 0 to 31.**

  ✓will be ON when the corresponding cyclic task is in executable (RUN) status and OFF when the cyclic task hasn't been executed (INI) or is in standby (WAIT) status.

## 2.2.15 Condition Flags

- **specified with <span style="color:red">symbols</span>, such as P_CY and P_ER, rather than addresses.**
- **indicate the results of instruction execution.**
- **read-only.**

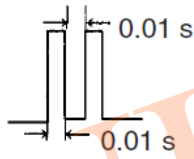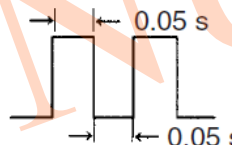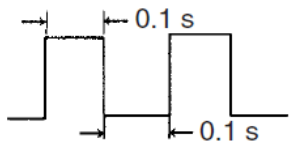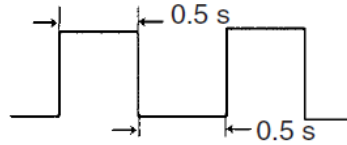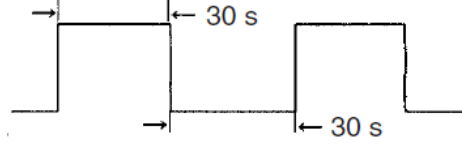| Name | Symbol | Function |
|---|---|---|
| Error Flag | P_ER | Turned ON when the operand data in an instruction is incorrect (an instruction processing error) to indicate that an instruction ended because of an error. |
| | | When the PLC Setup is set to stop operation for an instruction error (Instruction Error Operation), program execution will be stopped and the Instruction Processing Error Flag (A29508) will be turned ON when the Error Flag is turned ON. |
| Access Error Flag | P_AER | Turned ON when an Illegal Access Error occurs. The Illegal Access Error indicates that an instruction attempted to access an area of memory that should not be accessed. |
| | | When the PLC Setup is set to stop operation for an instruction error (Instruction Error Operation), program execution will be stopped and the Instruction Processing Error Flag (A429510) will be turned ON when the Access Error Flag is turned ON. |

# 2.2.15 Condition Flags

| Name | Symbol | Function |
|---|---|---|
| Carry Flag | P_CY | Turned ON when there is a carry in the result of an arithmetic operation or a "1" is shifted to the Carry Flag by a Data Shift instruction.<br>The Carry Flag is part of the result of some Data Shift and Symbol Math instructions. |
| Greater Than Flag | P_GT | Turned ON when the first operand of a Comparison Instruction is greater than the second or a value exceeds a specified range. |
| Equals Flag | P_EQ | Turned ON when the two operands of a Comparison Instruction are equal the result of a calculation is 0. |
| Less Than Flag | P_LT | Turned ON when the first operand of a Comparison Instruction is less than the second or a value is below a specified range. |
| Negative Flag | P_N | Turned ON when the most significant bit (sign bit) of a result is ON. |
| Overflow Flag | P_OF | Turned ON when the result of calculation overflows the capacity of the result word(s). |
| Underflow Flag | P_UF | Turned ON when the result of calculation underflows the capacity of the result word(s). |
| Greater Than or Equals Flag | P_GE | Turned ON when the first operand of a Comparison Instruction is greater than or equal to the second. |
| Not Equal Flag | P_NE | Turned ON when the two operands of a Comparison Instruction are not equal. |
| Less Than or Equals Flag | P_LE | Turned ON when the first operand of a Comparison Instruction is less than or equal to the second. |
| Always ON Flag | P_On | Always ON. (Always 1.) |
| Always OFF Flag | P_Off | Always OFF. (Always 0.) |

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## 2.2.16 Clock Pulses

- **flags that are turned ON and OFF at regular intervals by the system.**
- **specified with symbols rather than addresses.**

| Name | Symbol | Operation | |
|---|---|---|---|
| 0.02 s Clock Pulse | P_0_02_s | 0.01 s / 0.01 s | ON for 0.01 s OFF for 0.01 s |
| 0.1 s Clock Pulse | P_0_1s | 0.05 s / 0.05 s | ON for 0.05 s OFF for 0.05 s |
| 0.2 s Clock Pulse | P_0_2s | 0.1 s / 0.1 s | ON for 0.1 s OFF for 0.1 s |
| 1 s Clock Pulse | P_1s | 0.5 s / 0.5 s | ON for 0.5 s OFF for 0.5 s |
| 1 min Clock Pulse | P_1min | 30 s / 30 s | ON for 30 s OFF for 30 s |

# References

- **CP1H CPU Unit Operation Manual, OMRON, 2014**