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# Incremental Rotary Encoder
# E6C2-C



**<READ AND UNDERSTAND THIS CATALOG>**
Please read and understand this catalog before purchasing the products. Please consult your OMRON representative if you have any questions or comments.

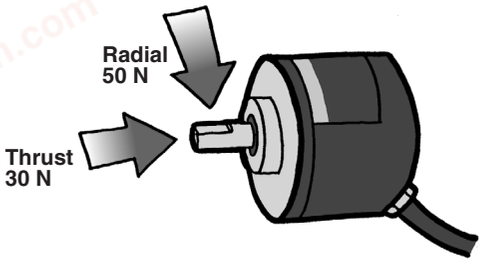
## IP64 Drip-proof Construction

The E6C2-C incorporates a rubber-seal bearing cover of IP64 drip-proof construction thus ensuring ease of use in places with water dripping or sprayed oil.



## Shaft Withstands Heavy Loads

The bearing used by the E6C2-C is larger than that of the conventional E6C-C, thus withstanding heavier loads.




## Protective Circuit for Output Shorting

The E6C2-C incorporates a circuit protecting the E6C2-C from damage resulting from the incorrect wiring of output, thus ensuring ease of use.

## 33% Smaller than E6C-C

The E6C2-C uses a high-performance LED indicator, custom-made receiver element, high-density PCB, and seal bearing thus making the E6C2-C 33% smaller than the conventional E6C-C.

**Conventional Model**

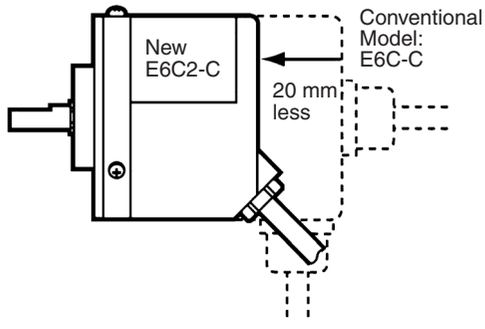


E6C-C
50 dia. × 60 mm

E6C2-C
50 dia. × 40 mm

## Incorporating Cord to Be Pulled Out Aslant Ensuring Ease of Mounting and Wiring

To suit the mounting position, it was necessary to select a conventional E6C-C model with a cord that is pulled out horizontally or a model with a cord that is pulled out backwards. The E6C2-C incorporates a cord that is pulled out aslant, thus ensuring ease of mounting and wiring while saving mounting space.



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# Ordering Information

| Supply voltage | Output configuration | Resolution (P/R) | Model |
|---|---|---|---|
| 5 to 24 VDC | NPN open collector output | 10, 20, 30, 40, 50, 60, 100, 200, 300, 360, 400, 500, 600 | E6C2-CWZ6C |
| | | 720, 800, 1,000, 1,024, 1,200, 1,500, 1,800, 2,000 | |
| 12 to 24 VDC | PNP open collector output | 100, 200, 360, 500, 600 | E6C2-CWZ5B |
| | | 1,000, 2,000 | |
| 5 to 12 VDC | Voltage output | 10, 20, 30, 40, 50, 60, 100, 200, 300, 360, 400, 500, 600 | E6C2-CWZ3E |
| | | 720, 800, 1,000, 1,024, 1,200, 1,500, 1,800, 2,000 | |
| 5 VDC | Line driver output | 10, 20, 30, 40, 50, 60, 100, 200, 300, 360, 400, 500, 600 | E6C2-CWZ1X |
| | | 720, 800, 1,000, 1,024, 1,200, 1,500, 1,800, 2,000 | |

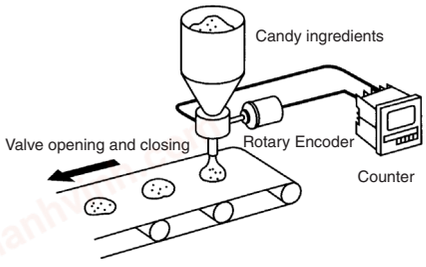
**Note:** When ordering, specify the resolution in addition to the model numbers.

## ■ Accessories (Order Separately)

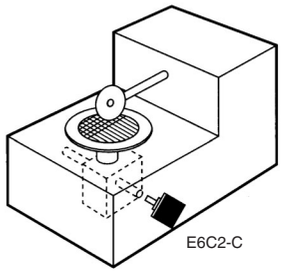
| Name | Model | Remarks |
|---|---|---|
| Coupling | E69-C06B | --- |
| | E69-C68B | Incorporates ends different to each other in diameter. |
| | E69-C06M | Metal construction. |
| Flange | E69-FCA | --- |
| | E69-FCA02 | |
| Servo Mounting Bracket | E69-2 | Provided with the E69-FCA02 Flange. |

# Application Examples

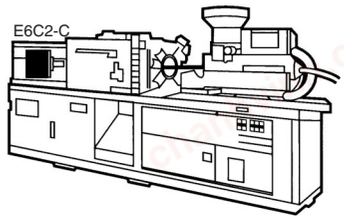
**Filler Control**




**Positioning of Wafer Cutting Machine**




**Metal Mold Positioning of Injection Molding Machine**



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# Specifications

## ■ Ratings/Characteristics

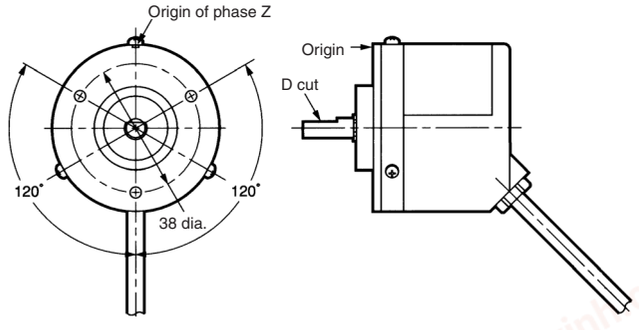
| Item | E6C2-CWZ6C | E6C2-CWZ5B | E6C2-CWZ3E | E6C2-CWZ1X |
|---|---|---|---|---|
| **Power supply voltage** | 5 VDC –5% to 24 VDC +15% | 12 VDC –10% to 24 VDC +15% | 5 VDC –5% to 12 VDC +10% | 5 VDC±5% |
| **Current consumption (see note 1)** | 80 mA max. | 100 mA max. | | 160 mA max. |
| **Resolution** | 10, 20, 30, 40, 50, 60, 100, 200, 300, 360, 400, 500, 600, 720, 800, 1,000, 1,024, 1,200, 1,500, 1,800, 2,000 P/R | 100, 200, 360, 500, 600, 1,000, 2,000 P/R | 10, 20, 30, 40, 50, 60, 100, 200, 300, 360, 400, 500, 600, 720, 800, 1,000, 1,024, 1,200, 1,500, 1,800, 2,000 P/R | |
| **Output phases** | A, B, and Z (reversible) | | | A, $\overline{A}$, B, $\overline{B}$, Z, $\overline{Z}$ |
| **Output configuration** | NPN open collector output | PNP open collector output | Voltage output (NPN output) | Line driver output (see note 2) |
| **Output capacity** | Applied voltage: 30 VDC max.<br>Output current: 35 mA max.<br>Residual voltage: 0.4 V max.<br>(at sink current of 35 mA) | Output current: 35 mA max.<br>Residual voltage: 0.4 V max.<br>(at sink current of 35 mA) | Output resistance: 2 kΩ<br>Output current: 20 mA max.<br>Residual voltage: 0.4 V max.<br>(at sink current of 20 mA) | AM26LS31 equivalent<br>Output current:<br>High level ($I_o$): –20 mA<br>Low level ($I_s$): 20 mA<br>Output voltage:<br>$V_o$: 2.5 V min.<br>$V_s$: 0.5 V max. |
| **Max. response frequency (see note 3)** | 100 kHz | 50 kHz | 100 kHz | |
| **Phase difference on output** | 90°±45° between A and B (1/4T±1/8T) | | | |
| **Rise and fall times of output** | 1 μs max. (control output voltage: 5 V; load resistance: 1 kΩ; cable length: 2 m) | 1 μs max. (cable length: 2 m; $I_{sink}$: 10 mA) | | 0.1 μs max. (cable length: 2 m; $I_o$: –20 mA; $I_s$: 20 mA) |
| **Starting torque** | 10 m N·m max. | | | |
| **Moment of inertia** | 1 x $10^{-6}$ kg·m² max.; 3 x $10^{-7}$ kg·m² max. at 600 P/R max. | | | |
| **Shaft loading** | Radial: 50 N<br>Thrust: 30 N | | | |
| **Max. permissible revolution** | 6,000 rpm | | | |
| **Protection circuits** | Reversed power supply connection protection circuit, output load short-circuit protection circuit | | | --- |
| **Ambient temperature** | Operating: –10°C to 70°C (with no icing)<br>Storage: –25°C to 85°C (with no icing) | | | |
| **Ambient humidity** | Operating: 35% to 85% (with no condensation) | | | |
| **Insulation resistance** | 20 MΩ min. (at 500 VDC) between current carry parts and case | | | |
| **Dielectric strength** | 500 VAC, 50/60 Hz for 1 min between current carry parts and case | | | |
| **Vibration resistance** | Destruction: 10 to 500 Hz, 150 m/s² or 2-mm double amplitude for 11 min 3 times each in X, Y, and Z directions | | | |
| **Shock resistance** | Destruction: 1,000 m/s² (100G) 3 times each in X, Y, and Z directions | | | |
| **Degree of protection** | IEC60529 IP64 | | | |
| **Connection method** | Pre-wired (standard length: 2 m) | | | |
| **Weight** | Approx. 400 g | | | |
| **Others** | Instruction manual | | | |

**Note: 1.** An inrush current of approx. 9 A flows for approx. 0.3 ms right after the E6C2-C is turned on.

**2.** The line driver output of the E6C2-C is used for data transmission circuitry conforming to RS-422A and ensures long-distance transmission over twisted-pair cable, the quality of which is equivalent to AM26LS31.

**3.** The maximum electrical response revolution is determined by the resolution and maximum response frequency as follows:
Maximum electrical response frequency (rpm) = Maximum response frequency/resolution × 60
This means that the E6C2-C Rotary Encoder will not operate electrically if its revolution exceeds the maximum electrical response revolution.

**4. Origin Indication**
It is easy to adjust the position of phase Z with the origin indication function. The following illustration (on the left side) shows the relationship between phase Z and the origin. Set cut face D to the origin as shown in the illustration (on the right side).



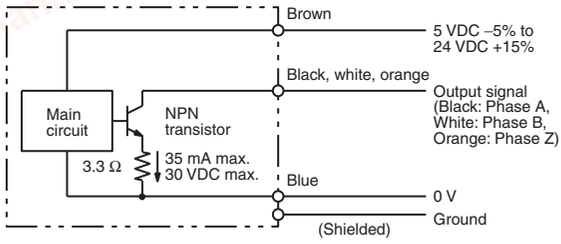
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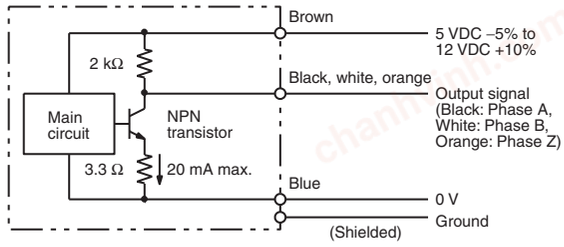
# Operation

## ■ Output Circuit Diagram

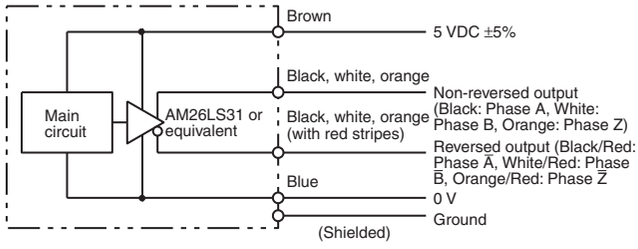
**E6C2-CWZ6C**



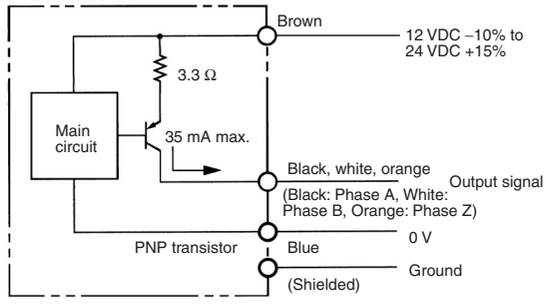

**E6C2-CWZ3E**




**E6C2-CWZ1X**




**E6C2-CWZ5B**




**Note: 1.** The shield is not connected to the internal circuits or casing of the E6C2-C.
**2.** There is no difference in circuit among phases A, B, and Z.
**3.** Connect the GND terminal to 0 V or the ground when the E6C2-C is in normal operation.

## ■ Timing Charts

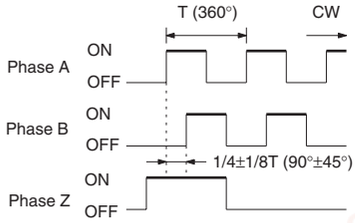
### NPN Open Collector Output

#### E6C2-CWZ6C

### PNP Open Collector Output

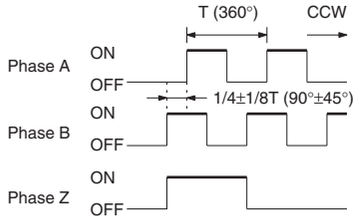
#### E6C2-CWZ5B

Direction or resolution: Clockwise (CW)
(As viewed from the end of the shaft)




**Note:** Phase A is 1/4±1/8T faster than phase B. The ONs in the above timing chart mean that the output transistor is ON and the OFFs mean that the output transistor is OFF.

Direction or resolution: Counterclockwise (CCW)
(As viewed from the end of the shaft)




**Note:** Phase A is 1/4±1/8T slower than phase B.

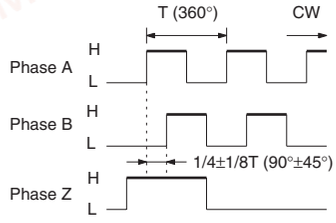
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## Voltage Output

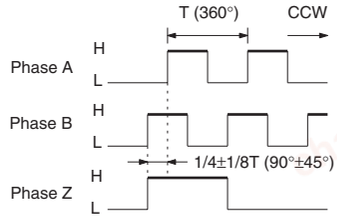
### E6C2-CWZ3E

Direction or resolution: Clockwise (CW)
(As viewed from the end of the shaft)




**Note:** Phase A is 1/4±1/8T faster than phase B.

Direction or resolution: Counterclockwise (CCW)
(As viewed from the end of the shaft)

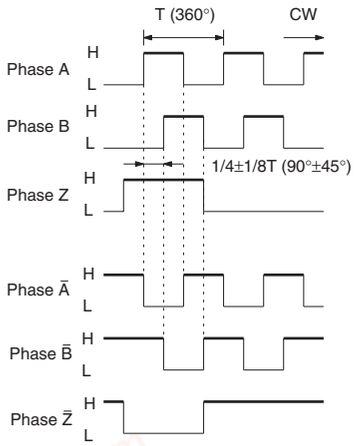



**Note:** Phase A is 1/4±1/8T slower than phase B.

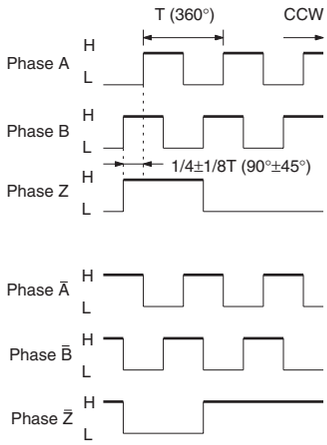
## Line Driver Output

### E6C2-CWZ1X

Direction or resolution: Clockwise (CW)
(As viewed from the end of the shaft)




Direction or resolution: Counterclockwise (CCW)
(As viewed from the end of the shaft)

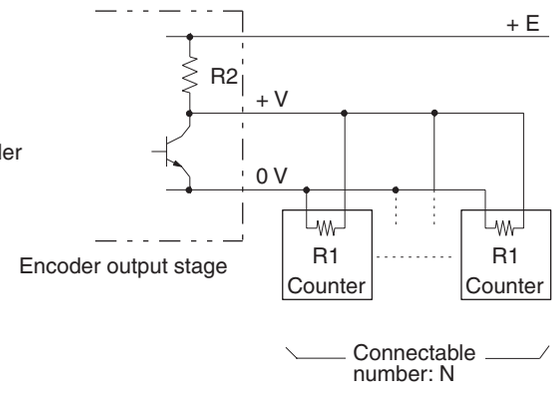



## ■ Input to More than One Counter from Encoder (with Voltage Output)

Use the following formula to obtain the number of counters to be connected to a single E6C2-C Rotary Encoder.

$$\text{Number of counters (N)} = \frac{R1\ (E-V)}{V \times R2}$$

E: Voltage supplied to Rotary Encoder
V: Minimum input voltage of the counter
R2: Output resistance of the Rotary Encoder
R1: Input resistance of the Counter



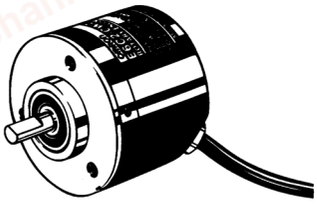
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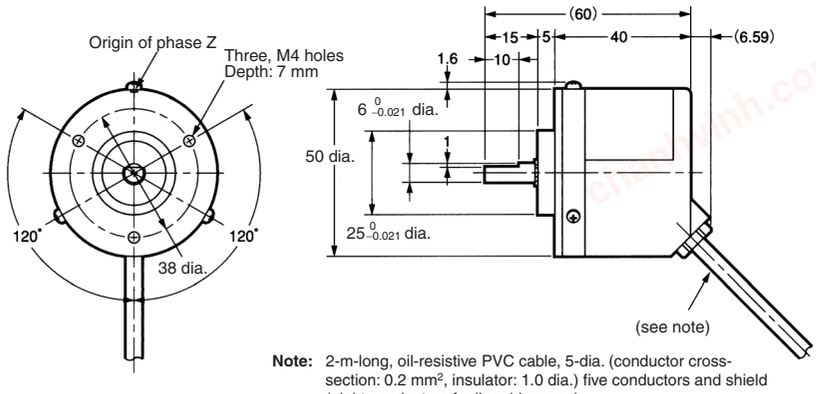
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# Dimensions

**Note:** All units are in millimeters unless otherwise indicated.

**E6C2-CWZ□□**



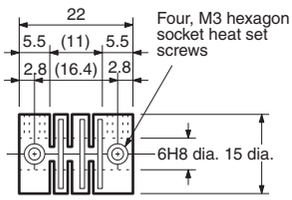



**Note:** 2-m-long, oil-resistive PVC cable, 5-dia. (conductor cross-section: 0.2 mm$^2$, insulator: 1.0 dia.) five conductors and shield (eight conductors for line driver use)

## ■ Accessories (Order Separately)

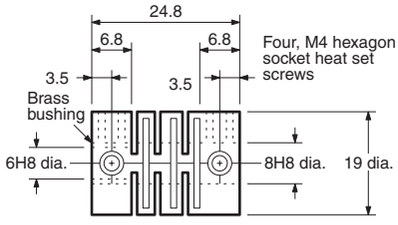
### Couplings

**E69-C06B**



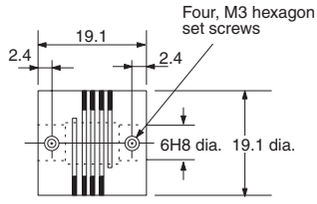

**Note:** The coupling is made of glass-reinforced PBT.

**E69-C68B (With Ends of Different Diameter)**




**Note:** The coupling is made of glass-reinforced PBT.

**E69-C06M (Metal Construction)**



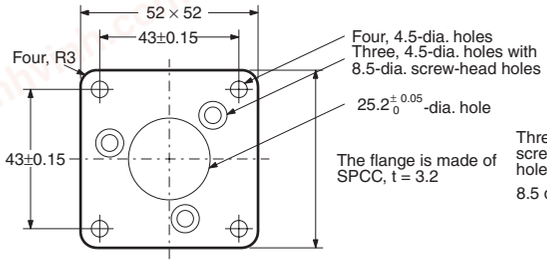

**Note:** Material: Super duralumin

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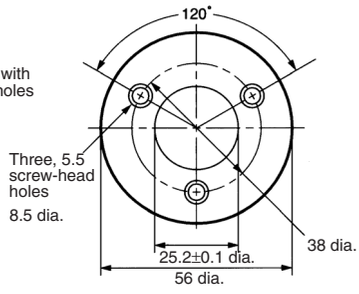


# Flanges

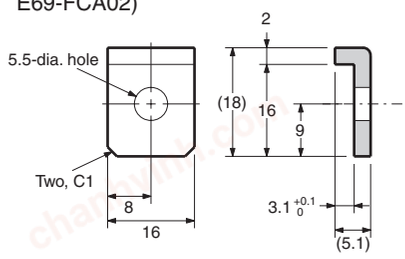
### E69-FCA




### E69-FCA02

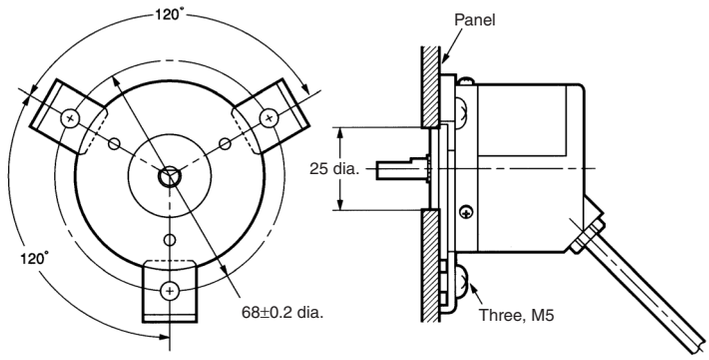



Mounting Bracket:
(A set of three Brackets provided with the E69-FCA02)



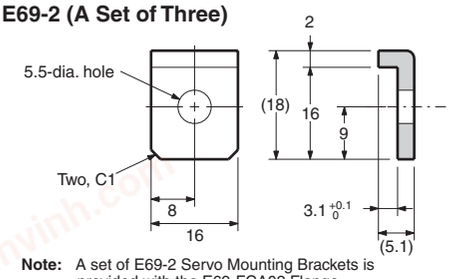

**Note:** Material: SPCC, t=3.2

Mounting Dimensions




# Servo Mounting Bracket

### E69-2 (A Set of Three)




**Note:** A set of E69-2 Servo Mounting Brackets is provided with the E69-FCA02 Flange.

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# Installation

## ■ Connection

### E6C2-CWZ6C/-CWZ3E/-CWZ5B

| Color | Terminal |
|---|---|
| Brown | Power supply (+$V_{CC}$) |
| Black | Output phase A |
| White | Output phase B |
| Orange | Output phase Z |
| Blue | 0 V (common) |

### E6C2-CWZ1X

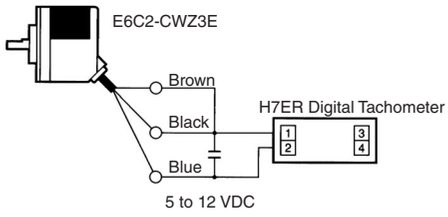
| Color | Terminal |
|---|---|
| Brown | Power supply (+$V_{CC}$) |
| Black | Output phase A |
| White | Output phase B |
| Orange | Output phase Z |
| Black/Red stripes | Output phase $\overline{A}$ |
| White/Red stripes | Output phase $\overline{B}$ |
| Orange/Red stripes | Output phase $\overline{Z}$ |
| Blue | 0 V (common) |

**Note:** Receiver: AM26LS32 equivalent

## ■ Connection Examples

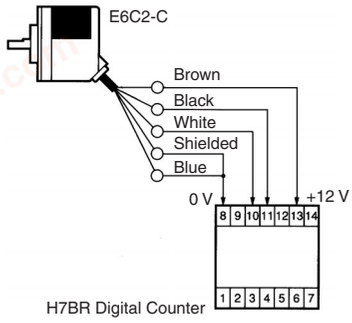
### H7ER Self-powered Tachometer

Applicable Model: E6C2-CWZ3E (with a resolution of 10 or 60 P/R)



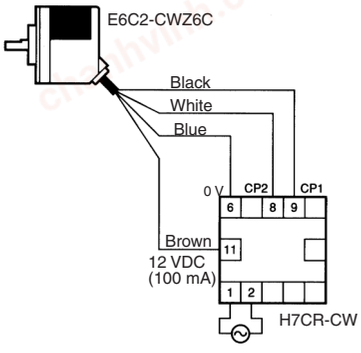

### H7BR Digital Counter

Applicable Model: E6C2-CWZ3E



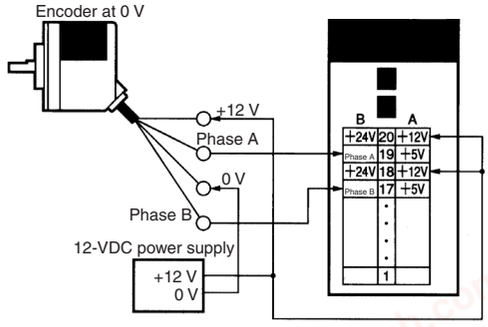

### H7CR-CW Digital Counter

Applicable Model: E6C2-CWZ6C



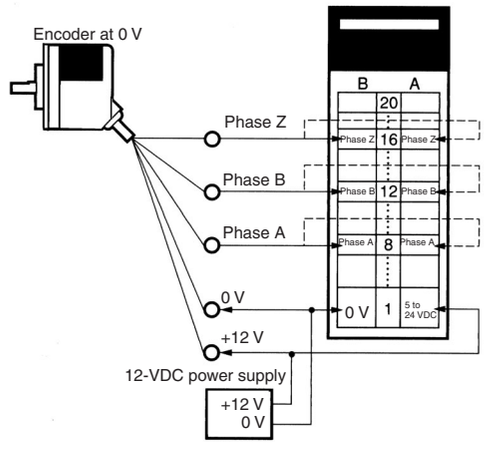

### C200H-CT□□ High-speed Counter Unit

Applicable model: E6C2-CWZ6C
Typical model: C200H-CT001-V1




**Note:** Apply the following connections if the power supply to the E6C2-C is 5 or 24 V.
Phase A and Power Supply: 5 V to A19 and 24 V to B20
Phase B and Power Supply: 5 V to A17 and 24 V to B18

Applicable model: E6C2-CWZ5B
Typical model: C200H-CT021



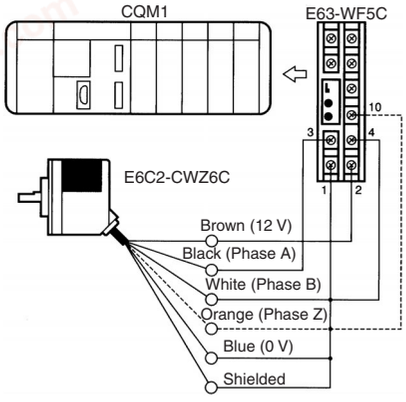

**Note:** Apply the following connections if the power supply to the E6C2-C is 12 or 24 V.
Phase A and Power Supply: 12 V to A8/B8 and 24 V to A9/B9
Phase B and Power Supply: 12 V to A12/B12 and 24 V to A13/B13
Phase Z and Power Supply: 12 V to A16/B16 and 24 V to A17/B17

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## CQM1 Programmable Controller

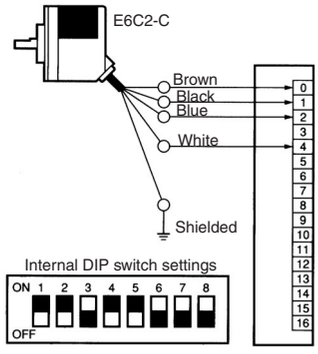
Applicable Model: E6C2-CWZ6C




## C500-CT001/CT012 High-speed Counter Unit

CW and CCW detection (increment/decrement counting)

Applicable Model: E6C2-CWZ6C




## CQM1-CPU43-EV1 (as Built-in High-speed Counter)

The pulse output of the E6C2-C can be directly input into IN04, IN05, and IN06 of the CPU Unit to use these three points as a built-in high-speed counter.

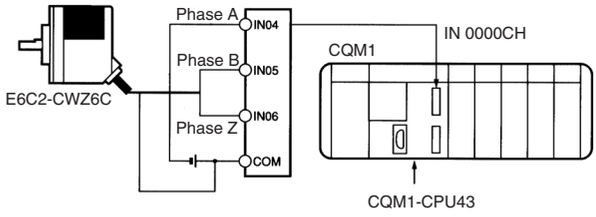
The single-phase response speed is 5 kHz and the two-phase response speed is 2.5 kHz. The count value is within a range between 0 and 65,535 in increment mode and –32,767 and 32,767 in decrement mode.

The operating mode of the high-speed counter is set with the PC Setup in the DM area.

### Count Mode

| | |
|---|---|
| Up/Down mode | Increment/Decrement counter uses phases A and B. |
| Incrementing mode | Increment counter uses phase A only. |
| Normal mode | IN04 through IN06 are used for normal input. |

Applicable Model: E6C2-CWZ6C




### Reset

The present count value can be reset with the soft-reset function or the AND of soft reset and phase Z input.

### Output

| | |
|---|---|
| Target value | When the count value reaches the target value, the specified subroutine is executed. A maximum of 16 target values can be set. |
| Range comparison | When the count value is within the range, the specified subroutine is executed. A maximum of 8 ranges can be set with upper and lower limits. |

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# Precautions

**⚠ WARNING**

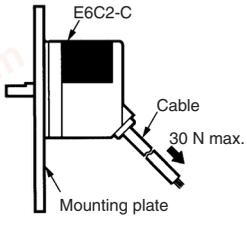
This products is not designed or rated for ensuring safety of persons.
Do not use it for such purpose.

1. Do not impose voltage exceeding the rated voltage range on the E6C2-C, otherwise the E6C2-C may be damaged.
2. Be sure that the wiring of power supply to the E6C2-C is correct, otherwise the E6C2-C may be damaged.
3. Turn off the Rotary Encoder when wiring.
4. Do not wire power lines or high-tension lines along with the power supply lines of the E6C2-C Rotary Encoder or the E6C2-C Rotary Encoder may be damaged or malfunction.

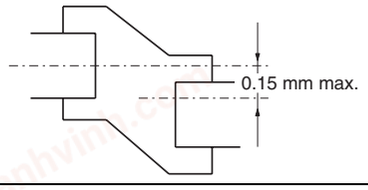
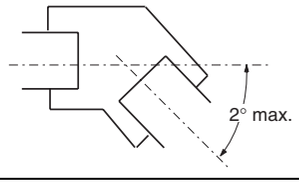
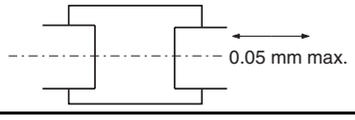
## ■ Precautions for Safe Use

### Mounting

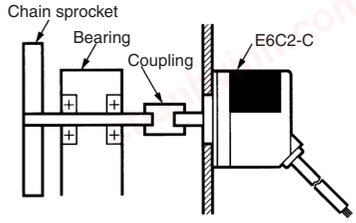
Be careful not to spray water or oil onto the E6C2-C Rotary Encoder.
The E6C2-C Rotary Encoder consists of high-precision components. Handle with utmost care and do not drop the Rotary Encoder, otherwise malfunctioning may result.
Do not pull the cable of the E6C2-C Rotary Encoder after the E6C2-C Rotary Encoder is mounted to a panel. Do not apply any shock to the hollow shaft or the body.
When the E6C2-C Rotary Encoder is used in reversed operation, pay utmost attention to the mounting direction of the E6C2-C Rotary Encoder and the directions of increment and decrement rotation.
To match phase Z of the E6C2-C Rotary Encoder and the origin of the device to be connected to the E6C2-C Rotary Encoder, conform the phase Z outputs while connecting the device.
Be careful enough not to impose an excessive load on the shaft if the shaft connects to a gear.
If the Rotary Encoder is mounted with screws, the tightening torque must be approximately 0.5 N·m.
If the Rotary Encoder is mounted to a panel, do not pull the cable with more than a force of 30 N.




No shock must be given to the shaft or coupling. Therefore, do not hit the shaft or coupling with a hammer when inserting the shaft into the coupling.
Refer to the following illustrations when using a standard coupling.

| | |
|---|---|
| **Decentering tolerance** |   |
| **Declination tolerance** |   |
| **Displacement tolerance in the shaft direction** |   |

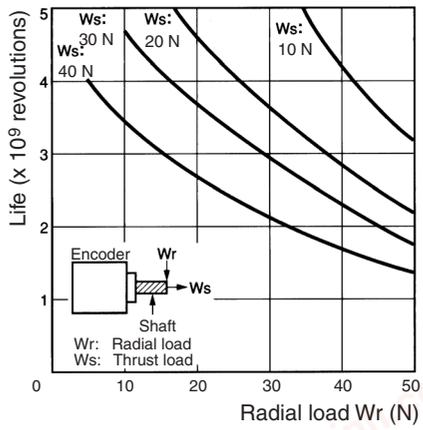
When connecting or disconnecting the coupling, do not impose an excessive bending, pressing, or pulling force on the E6C2-C.
When connecting the shaft of the Rotary Encoder with a chain timing belt or gear, connect the chain timing belt or gear with the shaft via the bearing and coupling as shown in the following illustration.




If the decentering or declination value exceeds the tolerance, an excessive load imposed on the shaft may damage the Rotary Encoder or shorten the life of the Rotary Encoder.

### Life of Bearing

The following graph shows the life expectancy of the bearing with radial and thrust loads imposed on the bearing. (Theoretical)




### Mounting Procedure

1. Insert the shaft into the coupling.
   Do not secure the coupling and shaft with screws at this stage.
2. Secure the Rotary Encoder.
   Refer to the following table for the maximum insertion length of the shaft into the coupling.

| Model | Maximum insertion length |
|---|---|
| E69-C06B | 5.5 mm |
| E69-C06M | 8.5 mm |

3. Secure the coupling.

| Model | Tightening torque |
|---|---|
| E69-C06B | 0.25 N·m |
| E69-C06M | 0.7 N·m |

4. Connect the power and I/O lines.
   Be sure to turn off the Rotary Encoder when connecting the lines.
5. Turn on the Rotary Encoder and check the output.

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## Connecting

When extending the cord, select the kind of cord with care by taking the response frequency into consideration because the longer the cord is, the more the residual voltage increases due to the resistance of the cord and the capacitance between the wires. As a result, the waveform will be distorted.

We recommend the line driver output type model if the cord needs to be extended.

In order to reduce inductive noise, the cord must be as short as possible, especially when the signal is input to an IC.

Insert a surge absorber between the power supply terminals if there is any surge.

A wrong pulse may be generated when the E6C2-C Rotary Encoder is turned on or off. Do not use the connected device for 0.1 s after the E6C2-C Rotary Encoder is turned on and for 0.1 s before the E6C2-C Rotary Encoder is turned off.

### Cord Extension

The rise time of each output waveform will increase when the cord is extended. This affects the phase difference characteristics of phases A and B.

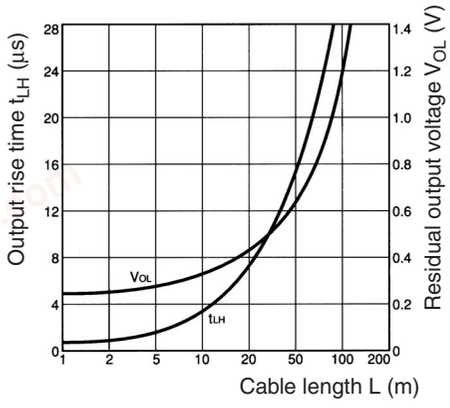
The available length of cord varies with the response frequency and noise. It is safer to limit the length of cord to 10 m maximum. If a longer cord of up to 100 m is required, use line driver output.

**Note:** Recommended Cord:

| | |
|---|---|
| Cross section: | 0.2 mm$^2$ with spiral shield |
| Conductor resistance: | 92 Ω/km max. at 20°C |
| Insulation resistance: | 5 MΩ/km min. at 20°C |

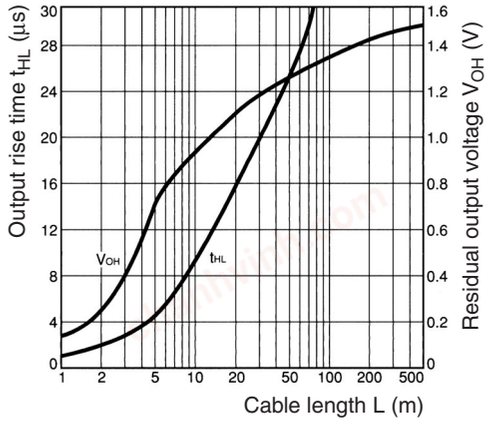
The rise time varies with the resistance of the cord and the kind of cord as well as the length of the cord.

The residual output voltage will increase according to the length of the cord.




**Conditions**

| | |
|---|---|
| Rotary Encoder: | E6C2-CWZ6C |
| Load voltage: | 5 VDC |
| Load resistance: | 1 kΩ (The residual output voltages were measured with a load current of 35 mA.) |
| Cord: | Dedicated cord |




**Conditions**

| | |
|---|---|
| Rotary Encoder: | E6C2-CWZ5B |
| Load voltage: | 12 VDC |
| Load current: | 5 mA (The residual output voltages were measured with a load current of 35 mA.) |
| Cord: | Dedicated cord |

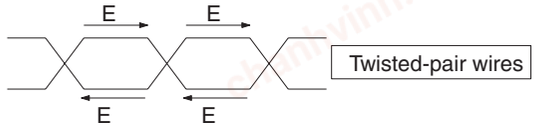
## Preventing Miscounting

If the operation of the E6C2-C Rotary Encoder is stopped near a signal rising or falling edge, a wrong pulse may be generated, in which case the E6C2-C Rotary Encoder will miscount. In such a case, use an increment-decrement counter to prevent miscounting.

## Extension of Line Driver Output

Be sure to use a twisted-pair cable to extend a line driver cord. Use an RS-422A Receiver for the receiver side.

The twisted-pair wires as shown in the following illustration are suitable for RS-422A signal transmission. Normal mode noise can be eliminated by twisting the wires because the generated electrical forces on the lines cancel each other.




Be sure the E6C2-C Rotary Encoder is supplied with 5 VDC when a line driver output is used. There will be an approximately 1-V voltage drop if the cable length is 100 m.

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Cat. No. Q109-E1-05

**In the interest of product improvement, specifications are subject to change without notice.**


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Printed in Japan
0805-0.5C (0997) (M)