OMRON

Rotary Encoder

E6B2

New General-purpose Incremental-type Rotary Encoder

- A wide operating voltage range of 5 to 24 VDC (open collector model).
- Resolution of 2,000 pulses/revolution in 40-mm housing.
- Phase Z can be adjusted with ease using the origin indicating function.
- A large load of 29.4 N (3 kgf) in the radial direction and 19.6 N (2 kgf) in the thrust direction is permitted.
- The load short-circuit and reversed connection protecting circuit assures highly reliable operation.
- A line driver output model is available. (Cable extends up to 100 m.)

ISO9001and14001 Approved
OMRON Corporation, Ayabe Factory, Sensing Components and Systems

Ordering Information

Supply voltage	Output configuration	Resolution (P/R)	Model
5 to 24 VDC	Open collector output	10/20/30/40/50/60/100/200/300/360/400/500/600/1,000/1,200/1,500/1,800/2,000	E6B2-CWZ6C
5 to 12 VDC	Voltage output		E6B2-CWZ3E
5 VDC	Line driver output		E6B2-CWZ1X

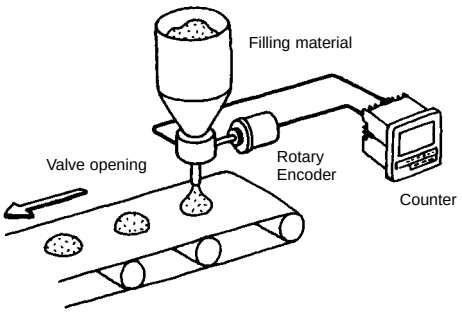
Note: 1. Pre-wired models are also available.
2. When ordering, specify the resolution together with the model number.

■ Accessories (Order Separately)

Name	Model
Coupling	E69-C06B (attachment)
	E69-C68B
	E69-C610B
Flange	E69-FBA
	E69-FBA02
Mounting Bracket	E69-2 (provided with the E69-FBA02)

Application Example

Filling Control



Specifications

■ Ratings/Characteristics

Electrical

Item	E6B2-CWZ3E	E6B2-CWZ6C	E6B2-CWZ1X
Power supply voltage	5 VDC –5% to 12 VDC +10%	5 VDC –5% to 24 VDC +15%	5 VDC±5%
Current consumption (see note 3)	100 mA max.	80 mA max.	160 mA max.
Resolution	10/20/30/40/50/60/100/200/300/360/400/500/600/1,000/1,200/1,500/1,800/2,000 P/R		
Output phases	A, B, and Z (reversible)		A, $\overline{A}$, B, $\overline{B}$, Z, $\overline{Z}$
Output configuration	Voltage	Open collector	Line driver (see note 2)
Output capacity	20 mA max. Residual voltage: 0.4 V max.	30 VDC max. 35 mA max. Residual voltage: 0.4 V max.	AM26LS31 equivalent Output current: High level = I_O = –20 mA Low level = I_S = 20 mA Output voltage: High level = V_O = 2.5 V min. Low level = V_S = 0.5 V max.
Max. response frequency (see note 1)	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. (cord length: 0.5 m; I_{sink}: 10 mA max.)	1 μs max. (control output voltage: 5 V; load resistance: 1 kΩ; cord length: 0.5 m)	0.1 μs max. (cord length: 0.5 m; I_O: –20 mA; I_S: 20 mA)
Insulation resistance	1,000 MΩ min. (at 500 VDC) between carry parts and case		
Dielectric strength	500 VAC, 50/60 Hz for 1 min between carry parts and case		

Note: 1. 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 x 60
This means that the E6B2 Rotary Encoder will not operate electrically if its revolution exceeds the maximum electrical response revolution.

2. The line driver output is a data transmission circuit compatible with the RS-422A and long-distance transmission is possible with a twisted-pair cable.

3. An inrush current of approximately 9 A will flow for approximately 0.3 ms when the power is turned ON.

Mechanical

Item	E6B2-CWZ3E	E6B2-CWZ6C	E6B2-CWZ1X
Shaft loading	Radial: 29.4 N (3 kgf) Thrust: 19.6 N (2 kgf)		
Moment of inertia	1 x 10^{-6} kg • m^2 (10 gf • cm^2) max.; 3 x 10^{-7} kg • m^2 (3 gf • cm^2) max. at 600 P/R max.		
Starting torque	980 μN • m (10 gf • cm) max.		
Max. permissible revolution	6,000 rpm		
Vibration resistance	Destruction: 10 to 500 Hz, 150 m/s^2 (15G) or 2-mm double amplitude for 11 min 3 times each in X, Y, and Z directions		
Shock resistance	Destruction: 1,000 m/s^2 (100G) 3 times each in X, Y, and Z directions		
Weight	Approx. 100 g max. (cord length: 0.5 m)		

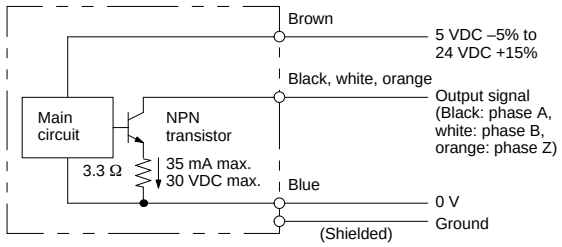
Environmental

Item	E6B2-CWZ3E	E6B2-CWZ6C	E6B2-CWZ1X
Ambient temperature	Operating: –10°C to 70°C (with no icing) Storage: –25°C to 85°C (with no icing)		
Ambient humidity	Operating: 35% to 85% (with no condensation)		
Degree of protection	IEC60529 IP50 (The E6B2 Rotary Encoder is not watertight or oil resistive.)		

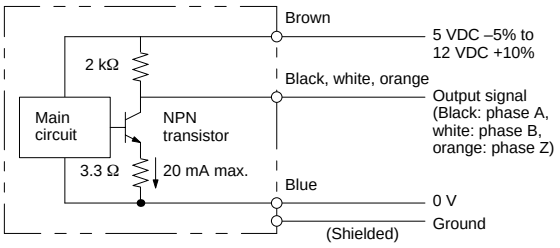
Operation

■ Output Circuits

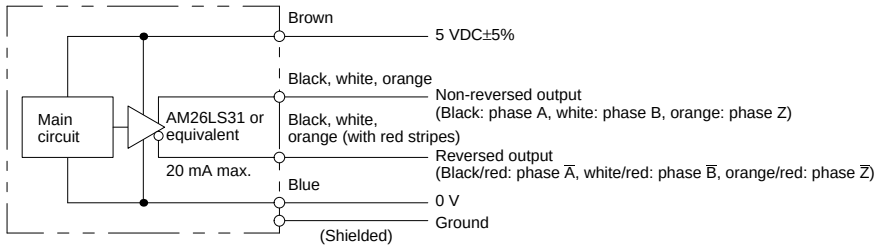
E6B2-CWZ6C



E6B2-CWZ3E



E6B2-CWZ1X

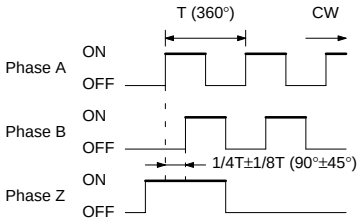


■ Timing Charts

Open Collector Output

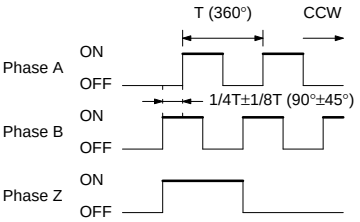
E6B2-CWZ6C

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

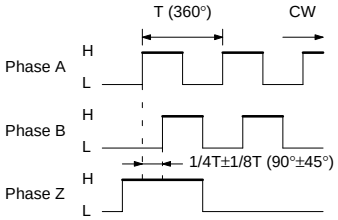


Note: Phase A is 1/4±1/8T slower than phase B.

Voltage Output

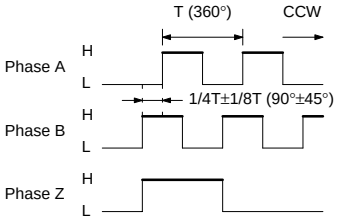
E6B2-CWZ3E

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



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

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

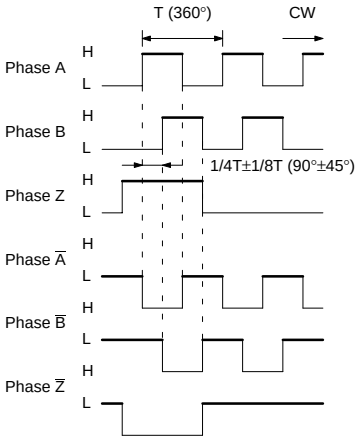


Note: Phase A is 1/4±1/8T slower than phase B.

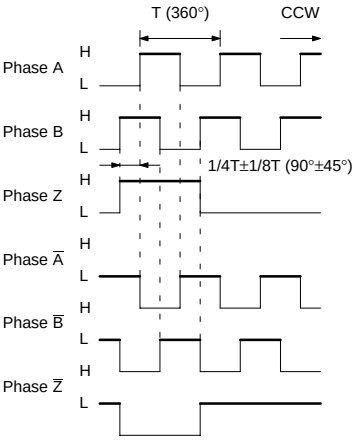
Line Driver Output

E6B2-CWZ1X

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



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



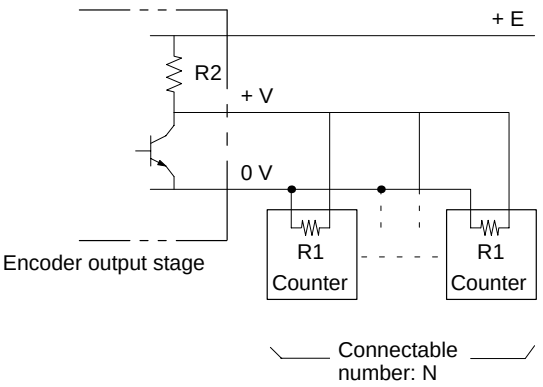
Note: The line driver output circuit is an RS-422A data transmission circuit consisting of two balanced output lines. The relationship between the two output lines is on an equal status. This means that if the level of the signal on a line is H, the level of the signal on the other line is L. The noise-resistive line driver output circuit assures high-speed data transmission.

■ 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 E6B2 Rotary Encoder.

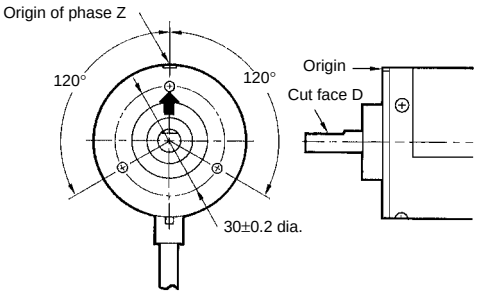
$$\text{Number of counters (N)} = \frac{R1\ (E-V)}{V \times R2}$$

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



■ Origin Indication

It is easy to adjust the position of phase Z with the origin indication function. The following illustration (on the left-hand 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-hand side).



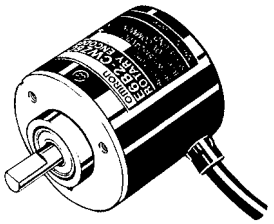
■ Output Protection Circuit

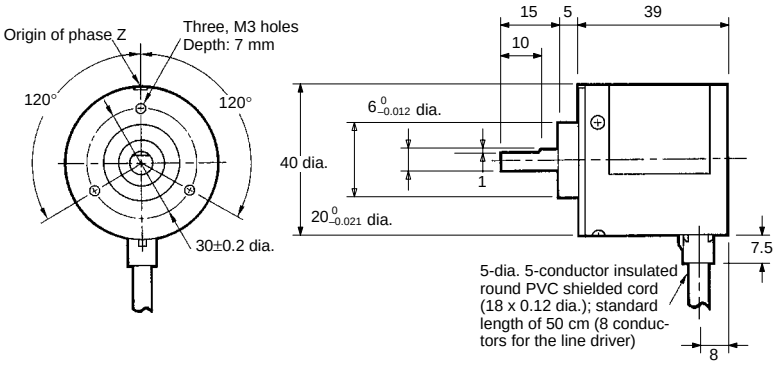
The E6B2 (open collector model with voltage output) incorporates a circuit preventing the E6B2 from damage due to a short-circuited load and reversed connection.

Dimensions

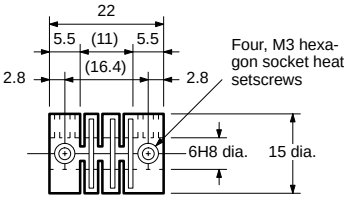
Note: All units are in millimeters unless otherwise indicated.

E6B2

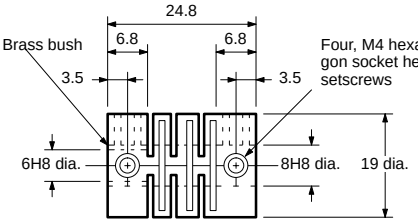




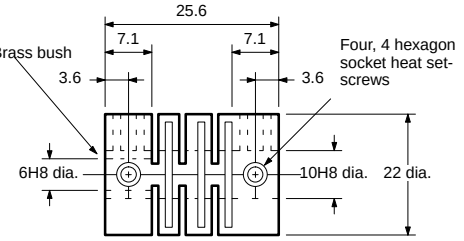
Coupling
E69-C06B
(Included)



E69-C68B
(Sold Separately, Different Diameter)

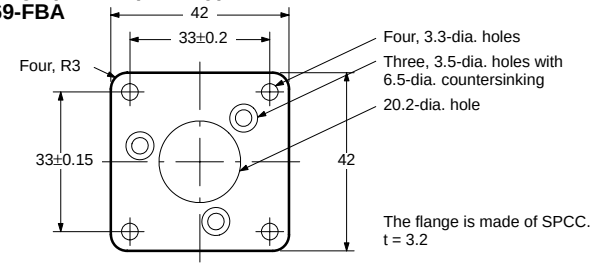


E69-C610B
(Sold Separately, Different Diameter)

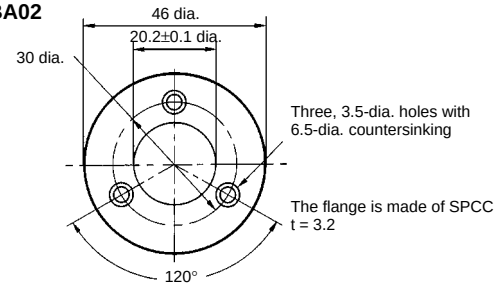


Note: The coupling is made of glass-reinforced PBT.

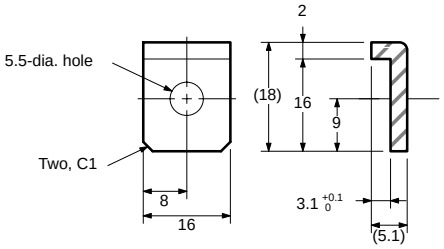
Flange (Sold Separately)
E69-FBA

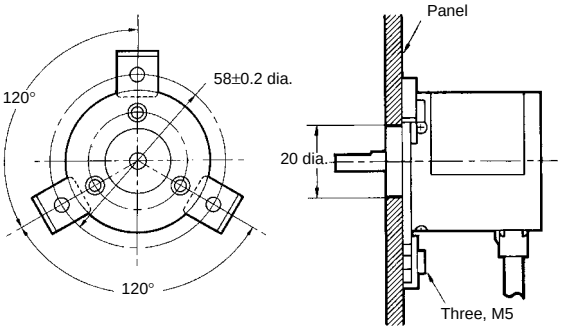


E69-FBA02



Mounting Bracket (Three Pieces as a Set)
E69-2 (One Set Provided with the E69-FBA02)





Installation

■ Connection

Be sure to connect the external terminals correctly or the E6B2 Rotary Encoder may be damaged.

E6B2-CWZ6C/-CWZ3E

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

E6B2-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

Note: 1. The external conductor (shield) of the shielded cord is not connected to the internal conductors nor to the case.
2. All the phases A, B, and Z are in the same circuit.
3. Connect the GND to the 0-V line or to the ground terminal.

■ Conversion from E6B to E6B2

Refer to the following table for conversion from the E6B to the E6B2.

E6B	E6b2
Resolution: 10 to 600 P/R	Resolution: 10 to 2,000 P/R
E6B-CWZ3C	E6B2-CWZ6C
E6B-CWZ3E	E6B2-CWZ3E
---	E6B2-CWZ1X (line driver output type)

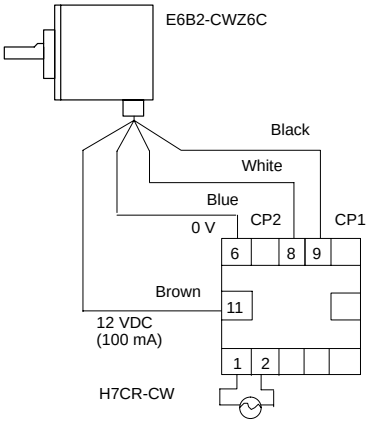
■ Connection with Peripheral Devices

Model	E6B2-CWZ3E	E6B2-CWZ6C	E6B2-CWZ1X
TTL, LSTTL	A	A	C
CMOS	A	A	C
Sensor Controller (S3D8)	B	A	C
Sensor Controller (S3D2)	A	A	C
Direction Sensor Unit (E63-WF-5C)	A	A	C
Digital counter (H7BR, H7CR)	A	A	C
Digital Tachometer (H7ER)	A	A	C
Intelligent Signal Processor (K3NR-NB□□□/K3NP-NB□□□)	B	A	C
Line receiver IC	C	C	A
SYSMAC High-speed Counter Unit	A	A	A
Position Control Unit	B	B	A

Note: A: Possible to connect directly in most cases.
B: Possible to connect, but an independent power supply or pull-up resistor will be required.
C: Impossible to connect.

Connection Examples

Connection to H7CR-CW Counter

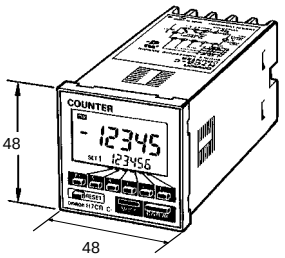


Features of H7CR

DIN-sized (DIN 48) counter incorporating a prescale function converting the measured value to the actual value.

Synchronized output and ± indication are available (± area models).

Models with a general-purpose six-digit display and four-digit display are available.

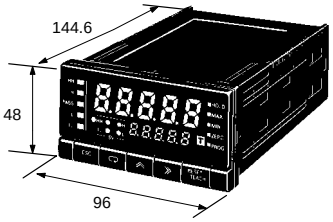


Connection to K3NR-NB□□□/K3NP-NB□□□ Rotary Intelligent Signal Processor

Features of K3NR/K3NP

Each model incorporates a prescale function with an input range of 50 kHz and the measurement accuracy is 0.006%.

A variety of outputs including relay, transistor, BCD, linear, and communications outputs are available.



Precautions

Mounting

Be careful not to spray water or oil onto the E6B2 Rotary Encoder.

The E6B2 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 cord of the E6B2 Rotary Encoder after the E6B2 Rotary Encoder is mounted to a panel. Do not apply any shock to the hollow shaft or the body.

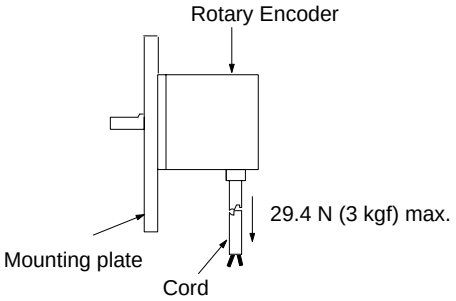
When the E6B2 Rotary Encoder is used in reversed operation, pay utmost attention to the mounting direction of the E6B2 Rotary Encoder and the directions of increment and decrement rotation.

To match phase Z of the E6B2 Rotary Encoder and the origin of the device to be connected to the E6B2 Rotary Encoder, conform the phase Z output 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 490 mN • m (5 kgf • m).

If the Rotary Encoder is mounted to a panel, do not pull the cord with more than a force of 29.4 N (3 kgf).



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.

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

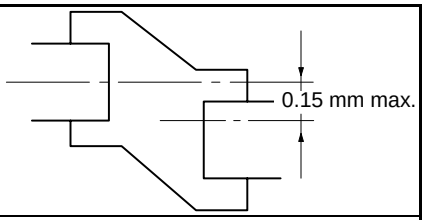
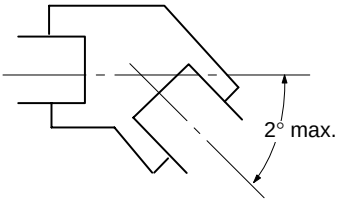
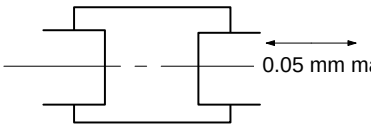
3. Secure the coupling.

Model	Tightening torque
E69-C06B	250 mN • m (2.5 kgf • cm)

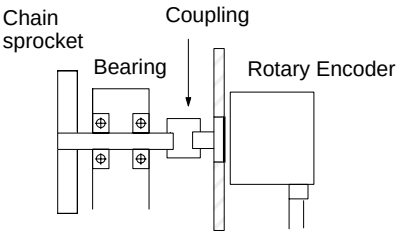
4. Connect the power and I/O lines.

   Be sure to turn off the Rotary Encoder when connecting the lines.
5. Turn on the Rotary Encoder and check the output.

Refer to the following illustrations when using a standard coupling.

Decentering tolerance	
Declination tolerance	
Displacement tolerance in the shaft direction	

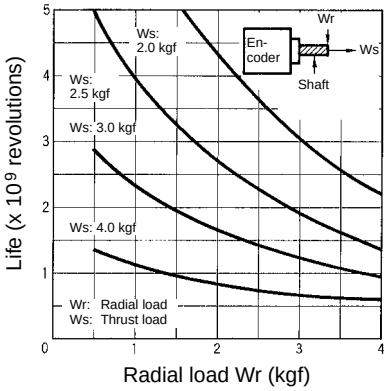
When connecting the shaft of the Rotary Encoder with a chain timing belt or gear, connect the chain timing belt or gear with the shaft via the bearing and coupling as shown in the following illustration.



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.



Wiring

Turn off the Rotary Encoder when wiring. The output circuit may be damaged if the output line contacts with the power source while the Rotary Encoder is turned on.

Do not wire power lines or high-tension lines along with the power supply lines of the E6B2 Rotary Encoder or the E6B2 Rotary Encoder may be damaged or malfunction.

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.

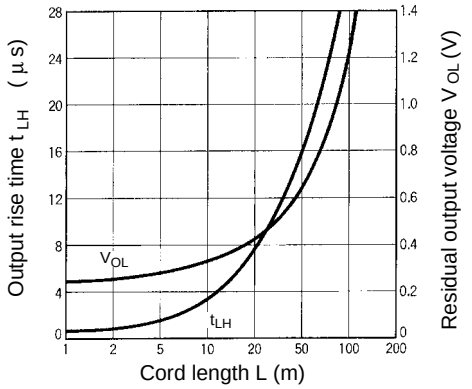
Insert a surge absorber between the power supply terminals if there is any surge.

A wrong pulse may be generated when the E6B2 Rotary Encoder is turned on or off. Do not use the connected device for 0.1 s after the E6B2 Rotary Encoder is turned on and for 0.1 s before the E6B2 Rotary Encoder is turned off.

Make sure the E6B2 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.

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 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:	E6B2-CWZ6C (2,000 pulses/revolution)
Load voltage:	5 VDC
Load resistance:	1 kΩ (The residual output voltages were measured with a load current of 35 mA.)
Frequency:	100 kHz
Cord:	Dedicated cord

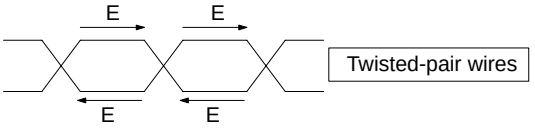
Preventing Miscounting

If the operation of the E6B2 Rotary Encoder is stopped near a signal rising or falling edge, a wrong pulse may be generated, in which case the E6B2 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.



ALL DIMENSIONS SHOWN ARE IN MILLIMETERS.
To convert millimeters into inches, multiply by 0.03937. To convert grams into ounces, multiply by 0.03527.

Cat. No. Q085-E1-1B **In the interest of product improvement, specifications are subject to change without notice.**

OMRON Corporation
Industrial Sensors Division
Sensing Devices and Components Division H.Q.
28th Fl., Crystal Tower Bldg.,
1-2-27, Shiromi, Chuo-ku,
Osaka 540-6028 Japan
Phone: (81)6-949-6012 Fax: (81)6-949-6021

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