Rugged Rotary Encoder

• Absolute model.

• External diameter of 50 mm.

• Resolution of up to 1,024 (10-bit).

• IP65 (improved oil-proof protection with sealed bearings)

• Optimum angle control possible in combination with PLC or Cam Positioner.

⚠ Be sure to read *Safety Precautions* on page 7.

CE

Ordering Information

Encoders [Refer to *Dimensions* on page 8.]

Power supply voltage	Output configu-ration	Output code	Resolution (pulses/rotation)	Connection method	Model
12 to 24 VDC	Open-collector output (NPN)	Gray	256, 360, (720) *2	Pre-wired Connector Model (1 m)	**E6C3-AG5C-C (resolution) 1M** Example: E6C3-AG5C-C 256P/R 1M
			256, 360, 720, 1,024	Pre-wired Model (1 m) *1	**E6C3-AG5C (resolution) 1M** Example: E6C3-AG5C 256P/R 1M
		Binary	32, 40		**E6C3-AN5C (resolution) 1M** Example: E6C3-AN5C 32P/R 1M
		BCD	6, 8, 12		**E6C3-AB5C (resolution) 1M** Example: E6C3-AB5C 6P/R 1M
	Open-collector output (PNP)	Gray	256, 360, 720, 1,024		**E6C3-AG5B (resolution) 1M** Example: E6C3-AG5B 256P/R 1M
		Binary	32, 40		**E6C3-AN5B (resolution) 1M** Example: E6C3-AN5B 32P/R 1M
		BCD	6, 8, 12		**E6C3-AB5B (resolution) 1M** Example: E6C3-AB5B 6P/R 1M
5 VDC	Voltage output	Binary	256		**E6C3-AN1E 256P/R 1M**
12 VDC					**E6C3-AN2E 256P/R 1M**

*1. Standard models are also available with 2-m cables. When ordering, specify the cable length at the end of the model number (example: E6C3-AG5C 360P/R 2M).

*2. When connecting to the H8PS, use the E6C3-AG5C-C 256, 360, 720P/R. (Only a 2-m cable is available for the 720P/R Model.)
    For the 360/720 resolutions, 2-m cables are standard in-stock.

Accessories (Order Separately)
 [Dimensions: Refer to *Accessories* on page 8 for Extension Cable dimensions and *Accessories* for the dimensions of other accessories.]

Name	Model	Remarks
Couplings	**E69-C08B**	---
	E69-C68B	Different end diameter (6 to 8 mm)
Flanges	**E69-FCA03**	---
	E69-FCA04	E69-2 Servo Mounting Bracket provided.
Servo Mounting Bracket	**E69-2**	Provided with E69-FCA04 Flange.
Extension Cable	**E69-DF5**	5 m	Applicable to the E6C3-AG5C-C. Models are also available with 15-m and 98-m cables.
	E69-DF10	10 m
	E69-DF20	20 m

Refer to *Accessories* for details.

Ratings and Specifications

Item \ Model	E6C3-AG5C-C	E6C3-AG5C	E6C3-AN5C	E6C3-AB5C	E6C3-AG5B	E6C3-AN5B	E6C3-AB5B	E6C3-AN1E	E6C3-AN2E
Power supply voltage	12 VDC −10% to 24 VDC +15%, ripple (p-p): 5% max.							5 VDC ±5%	12 VDC ±10%
Current consumption*1	70 mA max.								
Resolution*2 (pulses/rotation)	256, 360, 720	256, 360, 720, 1,024	32, 40	6, 8, 12	256, 360, 720, 1,024	32, 40	6, 8, 12	256	
Output code	Gray code		Binary	BCD	Gray code	Binary	BCD	Binary	
Output configuration	NPN open-collector output				PNP open-collector output			Voltage output	
Output capacity	Applied voltage: 30 VDC max. Sink current: 35 mA max. Residual voltage: 0.4 V max. (at sink current of 35 mA)				Source current: 35 mA max. Residual voltage: 0.4 V max. (at source current of 35 mA)			Output resistance: 2.4 kΩ	Output resistance: 8.2 kΩ
								Sink current: 35 mA max. Residual voltage: 0.4 V max. (at sink current of 35 mA)	
Rise and fall times of output	1 μs max. (Cable length: 2 m, Sink current: 35 mA)							Rise: 3 μs max., Fall: 1 μs max.	Rise: 10 μs max., Fall: 1 μs max.
Maximum response frequency*3	20 kHz							10 kHz	
Logic	Negative logic (high = 0, low = 1)				Positive logic (high = 1, low = 0)				
Direction of rotation*4	Output code increases for CW (as viewed from end of shaft).							Switched using rotation direction input.	
Strobe signal	None		Supported		None	Supported		None	
Positioning signal	None			Supported	None		Supported	None	
Parity signal	None			Supported (even)	None	Supported (even)	None		
Starting torque	10 mN·m max. at room temperature, 30 mN·m max. at low temperature								
Moment of inertia	2.3×10^{-6} kg·m²								
Shaft loading — Radial	80 N								
Shaft loading — Thrust	50 N								
Maximum permissible speed	5,000 r/min								
Ambient temperature range	Operating: −10 to 70°C (with no icing), Storage: −25 to 85°C (with no icing)								
Ambient humidity range	Operating/Storage: 35% to 85% (with no condensation)								
Insulation resistance	20 MΩ min. (at 500 VDC) between current-carrying parts and case								
Dielectric strength	500 VAC, 50/60 Hz for 1 min between current-carrying 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 3 times each in X, Y, and Z directions								
Degree of protection	IEC 60529 IP65, in-house standards: oilproof								
Connection method	Connector Models *6	Pre-wired Models (Standard cable length: 1 m)							
Material	Case: Aluminum, Main unit: Aluminum, Shaft: SUS303								
Weight (packed state)	Approx. 300 g								
Accessories	Instruction manual Note: Coupling, mounting bracket and hex-head spanner are sold separately.								

*1. An inrush current of approximately 6 A will flow for approximately 0.8 ms when the power is turned ON.

*2. The code is as follows:

Output code	Resolution	Code No.
Binary	32	1 to 32
	40	1 to 40
	256	0 to 255
BCD	6	0 to 5
	8	0 to 7
	12	0 to 11
Gray	256	0 to 255
	360	76 to 435 (gray after 76)
	720	152 to 871 (gray after 152)
	1,024	0 to 1,023

*3. The maximum electrical response speed is determined by the resolution and maximum response frequency as follows:
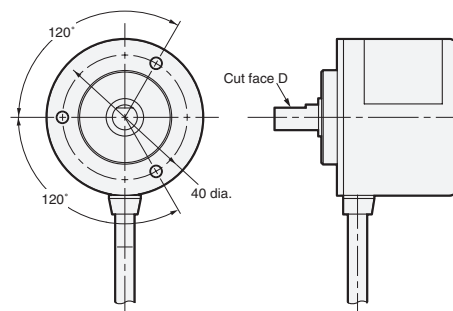
$$\text{Maximum electrical response speed (rpm)} = \frac{\text{Maximum response frequency}}{\text{Resolution}} \times 60$$

This means that the Rotary Encoder will not operate electrically if its speed exceeds the maximum electrical response speed.
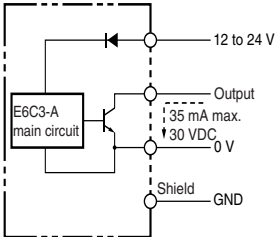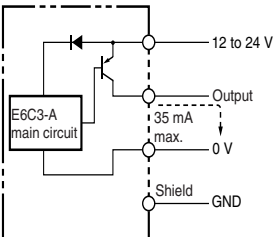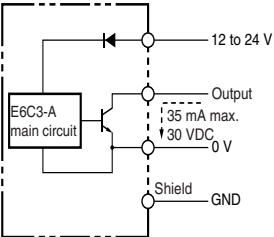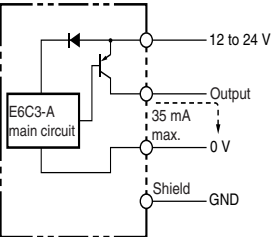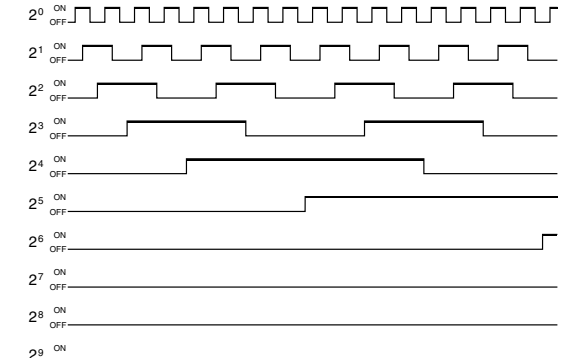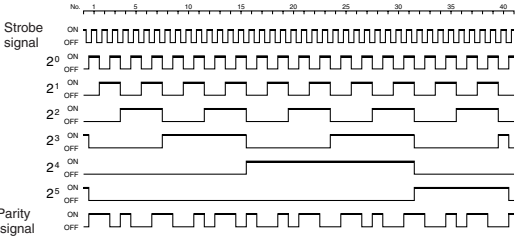
*4. For the E6C3-AN1E and E6C3-AN2E, the rotation direction input (wire color: pink) can be connected to high (Vcc) to increase the output code for CW rotation and connected to low (0 V) to decrease the output code for CW rotation.
E6C3-AN1E: High = 1.5 to 5 V, Low = 0 to 0.8 V
E6C3-AN2E: High = 2.2 to 12 V, Low = 0 to 1.2 V
Read the code 10 μs or more after the LSB (2^0) of the code changes for the E6C3-AN1E or E6C3-AN2E.

*5. The minimum address of the absolute code is output when cut face D on the shaft and the cable connection direction are as shown in the diagram at the right (output position range: ±15°).

*6. Resolution of 360 or 720: Standard cable length: 2 m
Resolution of 256: Standard cable length: 1 m

I/O Circuit Diagrams

Model	E6C3-AG5C/-AG5C-C	E6C3-AG5B	E6C3-AN5C	E6C3-AN5B
Output Circuits	 Note: The circuit is the same for all bit outputs. Each E6C3-A Rotary Encoder has one main circuit.	 Note: The circuit is the same for all bit outputs. Each E6C3-A Rotary Encoder has one main circuit.	 Note: The circuit is the same for all bit outputs. Each E6C3-A Rotary Encoder has one main circuit.	 Note: The circuit is the same for all bit outputs. Each E6C3-A Rotary Encoder has one main circuit.
Output mode	Direction of rotation: CW (as viewed from the end of the shaft) Resolution of 32 $A = 11.25°$ $B = 6°$ $C = 3°$		Direction of rotation: CW (as viewed from the end of the shaft) Resolution/40 	

Connection Specifications

Connector Models

Pin No.	E6C3-AG5C-C		
	Output signal		
	8-bit (256)	9-bit (360)	10-bit (720)
1	Connected internally	Not connected	2^9
2		2^8	2^8
3	2^5	2^5	2^5
4	2^1	2^1	2^1
5	2^0	2^0	2^0
6	2^7	2^7	2^7
7	2^4	2^4	2^4
8	2^2	2^2	2^2
9	2^3	2^3	2^3
10	2^6	2^6	2^6
11	Shield (ground)		
12	12 to 24 VDC		
13	0 V (common)		

* Connector: RP13A-12PD-13SC (Hirose Electric Co., Ltd.)
Note: Normally connect GND to 0 V or to an external ground.

Pre-wired Models

Wire color	E6C3-AG5C/E6C3-AG5B		
	Output signal		
	8-bit (256)	9-bit (360)	10-bit (720 or 1,024)
Brown	2^0	2^0	2^0
Orange	2^1	2^1	2^1
Yellow	2^2	2^2	2^2
Green	2^3	2^3	2^3
Blue	2^4	2^4	2^4
Purple	2^5	2^5	2^5
Gray	2^6	2^6	2^6
White	2^7	2^7	2^7
Pink	Not connected	2^8	2^8
Light blue	Not connected	Not connected	2^9
---	Shield (ground)		
Red	12 to 24 VDC		
Black	0 V (common)		

I/O Circuit Diagrams

Model	E6C3-AB5C	E6C3-AB5B	E6C3-AN1E	E6C3-AN2E
Output circuits	12 to 24 V, Output, 35 mA max. 30 VDC, 0 V, Shield, GND. Note: The circuit is the same for all bit outputs.	12 to 24 V, Output, 35 mA max., 0 V, Shield, GND. Note: The circuit is the same for all bit outputs.	2.4 kΩ, 5 VDC, Output, 35 mA max., 0 V, Shield, GND. Note: The circuit is the same for all bit outputs.	8.2 kΩ, 12 VDC, Output, 35 mA max., 0 V, Shield, GND. Note: The circuit is the same for all bit outputs.

Rotation Direction Input Circuit

Vcc (5 V or 12 V), Input, 0 V

Note: If the input is connected to Vcc, the output will increase for CW rotation and if the input is connected to 0 V, the output code will decrease for CW rotation.

Output mode

Direction of rotation: CW (as viewed from end of shaft) Resolution/12

Resolution of 8
A = 45°, B = 22.5°
C = 11.25°
Resolution of 6
A = 60°, B = 30°
C = 15°

Direction of rotation: CW (as viewed from end of shaft) if rotation direction input is high and CCW (as viewed from end of shaft) if rotation direction input is low.

$T = 360° / 256 = 1.4°$
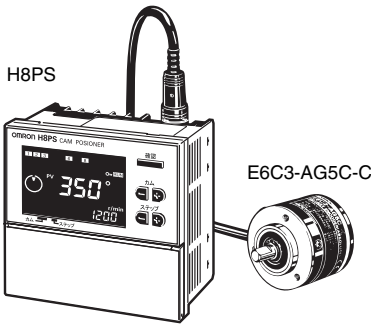
Connection Specifications

Pre-wired Models

Model	E6C3-AN5C/-AN5B	E6C3-AB5C/-AB5B		E6C3-AN1E/-AN2E
	Output signal	Output signal		Output signal
Wire color	6-bit (32 or 40)	3-bit (6 or 8)	5-bit (12)	8-bit (256)
Brown	2^0	2^0	2^0	2^0
Orange	2^1	2^1	2^1	2^1
Yellow	2^2	2^2	2^2	2^2
Green	2^3	Not connected	2^3	2^3
Blue	2^4	Not connected	$2^0 \times 10$	2^4
Purple	2^5	Not connected	Not connected	2^5
Gray	Parity	Positioning	Positioning	2^6
White	Strobe	Strobe	Strobe	2^7
Pink	Not connected	Not connected	Not connected	Rotation Direction Input
Light blue	Not connected	Not connected	Not connected	Not connected
---	Shield (ground)			
Red	12 to 24 VDC			5 or 12 VDC
Black	0 V (common)			

Note: Normally connect GND to 0 V or to an external ground.

Connection Example

H8PS Cam Positioner Connection Example

H8PS

E6C3-AG5C-C

Ordering Information

Model
H8PS-8A
H8PS-8AP
H8PS-8AF
H8PS-8AFP
H8PS-16A
H8PS-16AP
H8PS-16AF
H8PS-16AFP
H8PS-32A
H8PS-32AP
H8PS-32AF
H8PS-32AFP

Specifications

Rated voltage	24 VDC
Cam precision	0.5° (for 720 resolution), 1° (for 256/360 resolution)
No. of output points	8-point output type: 8 cam outputs, 1 RUN output, 1 pulse output 16-point output type: 16 cam outputs, 1 RUN output, 1 pulse output 32-point output type: 32 cam outputs, 1 RUN output, 1 pulse output
Encoder response	RUN mode, test mode: 256/360 resolution ..... 1,600 r/min max. (1,200 r/min when advance compensation is set for four cams or more) 720 resolution .... 800 r/min max. (600 r/min when advance compensation is set for four cams or more)
Additional functions	● Origin compensation (zeroing) ● Rotation direction switching ● Angle display switching ● Teaching ● Pulse output ● Angle/number of rotations display switching ● Puncture * ● Angle advance ● Number of rotations alarm output ● Setting with support software (order separately) *

* For 16-point and 32-point output types only

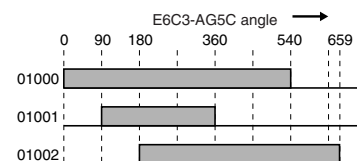## Programmable Controller Connection Example
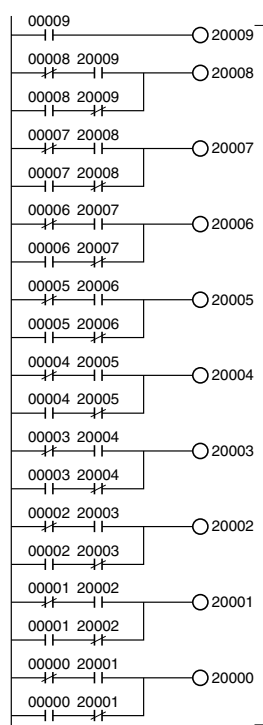
Connection to the CPM1A
(720 Resolution)

E6C3-AG5C

CPM1A-20CD☐-☐
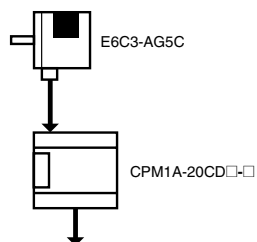
Wiring between the E6C3-AG5C and CPM1A

E6C3-AG5C output signal	CPM1A input signal
Brown (2^0)	00000
Orange (2^1)	00001
Yellow (2^2)	00002
Green (2^3)	00003
Blue (2^4)	00004
Purple (2^5)	00005
Gray (2^6)	00006
White (2^7)	00007
Pink (2^8)	00008
Light blue (2^9)	00009

Output Timing

E6C3-AG5C angle →

0 90 180 360 540 659

01000
01001
01002

Ladder Programming Example

00009 — 20009

00008 20009 — 20008
00008 20009

00007 20008 — 20007
00007 20008

00006 20007 — 20006
00006 20007

00005 20006 — 20005
00005 20006

00004 20005 — 20004
00004 20005

00003 20004 — 20003
00003 20004

00002 20003 — 20002
00002 20003

00001 20002 — 20001
00001 20002

00000 20001 — 20000
00000 20001

Converts gray code to binary (CIO 200). Sets the unused bits (10 to 15 bits) of CIO 200 to unused (always 0).

Always ON Flag
25313
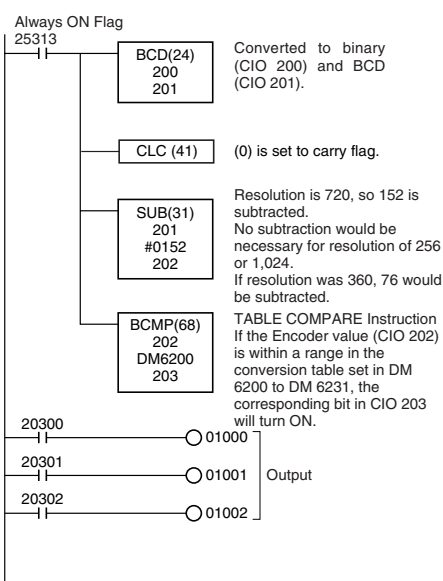
BCD(24)
200
201
Converted to binary (CIO 200) and BCD (CIO 201).

CLC (41)
(0) is set to carry flag.

SUB(31)
201
#0152
202
Resolution is 720, so 152 is subtracted.
No subtraction would be necessary for resolution of 256 or 1,024.
If resolution was 360, 76 would be subtracted.

BCMP(68)
202
DM6200
203
TABLE COMPARE Instruction
If the Encoder value (CIO 202) is within a range in the conversion table set in DM 6200 to DM 6231, the corresponding bit in CIO 203 will turn ON.

20300 — 01000
20301 — 01001   Output
20302 — 01002

DM Area Setting Example for Comparison Table

DM6200	0000	Lower limit 1	Bit CIO 20300
6201	0540	Upper limit 1	
6202	0090	Lower limit 2	Bit CIO 20301
6203	0360	Upper limit 2	
6204	0180	Lower limit 3	Bit CIO 20302
6205	0659	Upper limit 3	
6206	0000	Lower limit 4	Not used in this example.
...	...		
6231	0000	Upper limit 16	

CPM1A	For details, refer to the *SYSMAC C200HX/HG/HE/C200H/C200HS/CQM1/CPM1A/SRM1 Command Reference Manual* (SCCC-304).

OMRON

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Safety Precautions

Refer to *Warranty and Limitations of Liability*.

<table>
<tr><td>⚠ WARNING</td></tr>
</table>

**This product is not designed or rated for ensuring safety of persons either directly or indirectly.
Do not use it for such purposes.**

<table>
<tr><td>Precautions for Correct Use</td></tr>
</table>

Do not use the Encoder under ambient conditions that exceed the ratings.

● **Wiring**

Connections

Cable Extension Characteristics
- Conditions will change according to frequency, noise, and other factors. As a guideline, use a cable length of 10 m* or less.

* Recommended Cable
  Conductor cross section: 0.2 mm^2
  Spiral shield
  Conductor resistance: 92 Ω/km max. (20°C)
  Insulation resistance: 5 Ω/km min. (20°C)

- The output waveform startup time changes not only according to the length of the cable, but also according to the load resistance and the cable type.
- Extending the cable length not only changes the startup time, but also increases the output residual voltage.

● **Connection**

Spurious pulses may be generated when power is turned ON and OFF. Wait at least 0.1 s after turning ON the power to the Encoder before using the connected device, and stop using the connected device at least 0.1 s before turning OFF the power to the Encoder. Also, turn ON the power to the load only after turning ON the power to the Encoder.

Dimensions

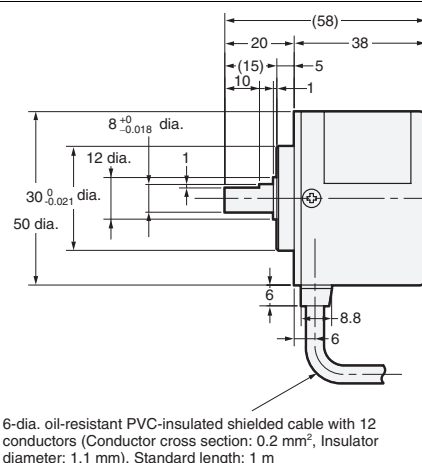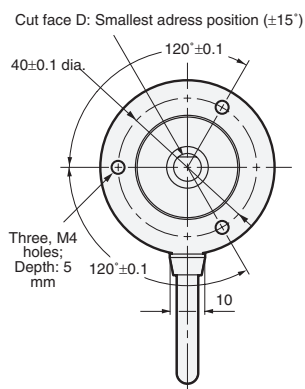Tolerance class IT16 applies to dimensions in this datasheet unless otherwise specified.

Encoder

E6C3-A☐5☐
E6C3-AN☐E

Cut face D: Smallest adress position (±15˚)

120˚±0.1
40±0.1 dia.

Three, M4 holes; Depth: 5 mm
120˚±0.1
10

(58)
20
38
(15)
5
10
1
$8^{+0}_{-0.018}$ dia.
12 dia.
1
$30^{0}_{-0.021}$ dia.
50 dia.
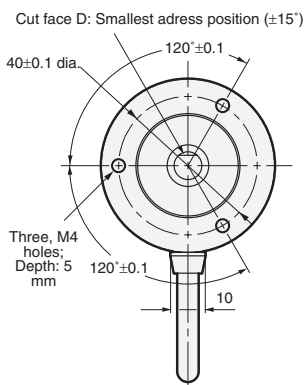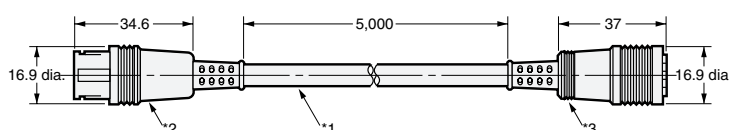6
8.8
6

Note: The E69-C08B Coupling is sold separately.

6-dia. oil-resistant PVC-insulated shielded cable with 12 conductors (Conductor cross section: 0.2 mm², Insulator diameter: 1.1 mm), Standard length: 1 m

E6C3-AG5C-C
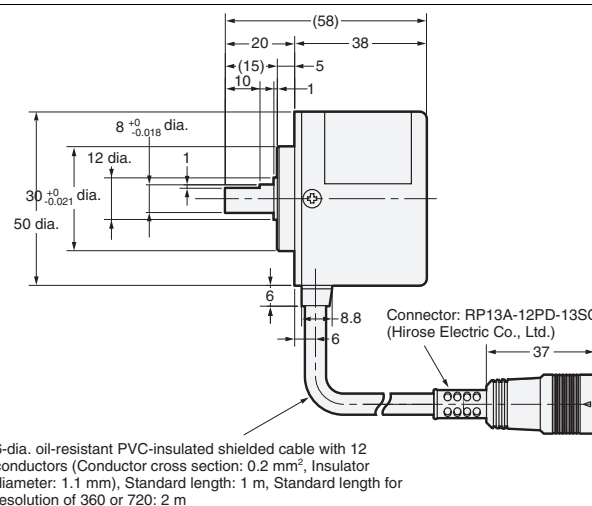
Cut face D: Smallest adress position (±15˚)

120˚±0.1
40±0.1 dia.

Three, M4 holes; Depth: 5 mm
120˚±0.1
10

(58)
20
38
(15)
5
10
1
$8^{+0}_{-0.018}$ dia.
12 dia.
1
$30^{+0}_{-0.021}$ dia.
50 dia.
6
8.8
6

Connector: RP13A-12PD-13SC (Hirose Electric Co., Ltd.)
37

Note: The E69-C08B Coupling is sold separately.

6-dia. oil-resistant PVC-insulated shielded cable with 12 conductors (Conductor cross section: 0.2 mm², Insulator diameter: 1.1 mm), Standard length: 1 m, Standard length for resolution of 360 or 720: 2 m

Accessories (Order Separately)

Extension Cable

E69-DF5

34.6
5,000
37
16.9 dia.
16.9 dia.
*2
*1
*3

*1. 6-dia. oil-resistant PVC-insulated shielded cable with 12 conductors (Conductor cross section: 0.2 mm², Insulator diameter: 1.1 mm), Standard length: 5 m
*2. Connects to connector on E6C3-AG5C-C.
*3. Connects to H8PS Cam Positioner.

Note: 1. The E69-DF5 (5 m) is also available with the following cable lengths: 10 m, 15 m, 20 m, and 98 m.
2. Cable can be extended to 100 m when the H8PS Cam Positioner is connected.

Couplings
E69-C08B
E69-C68B
Refer to *Accessories* for details.

Flanges
E69-FCA03
E69-FCA04

Servo Mounting Bracket
E69-2

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.

Warranty and Limitations of Liability

WARRANTY
OMRON's exclusive warranty is that the products are free from defects in materials and workmanship for a period of one year (or other period if specified) from date of sale by OMRON.

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Application Considerations

SUITABILITY FOR USE
OMRON shall not be responsible for conformity with any standards, codes, or regulations that apply to the combination of products in the customer's application or use of the products.

At the customer's request, OMRON will provide applicable third party certification documents identifying ratings and limitations of use that apply to the products. This information by itself is not sufficient for a complete determination of the suitability of the products in combination with the end product, machine, system, or other application or use.

The following are some examples of applications for which particular attention must be given. This is not intended to be an exhaustive list of all possible uses of the products, nor is it intended to imply that the uses listed may be suitable for the products:

- Outdoor use, uses involving potential chemical contamination or electrical interference, or conditions or uses not described in this catalog.

- Nuclear energy control systems, combustion systems, railroad systems, aviation systems, medical equipment, amusement machines, vehicles, safety equipment, and installations subject to separate industry or government regulations.

- Systems, machines, and equipment that could present a risk to life or property.

Please know and observe all prohibitions of use applicable to the products.

NEVER USE THE PRODUCTS FOR AN APPLICATION INVOLVING SERIOUS RISK TO LIFE OR PROPERTY WITHOUT ENSURING THAT THE SYSTEM AS A WHOLE HAS BEEN DESIGNED TO ADDRESS THE RISKS, AND THAT THE OMRON PRODUCTS ARE PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.

PROGRAMMABLE PRODUCTS
OMRON shall not be responsible for the user's programming of a programmable product, or any consequence thereof.

Disclaimers

CHANGE IN SPECIFICATIONS
Product specifications and accessories may be changed at any time based on improvements and other reasons.

It is our practice to change model numbers when published ratings or features are changed, or when significant construction changes are made. However, some specifications of the products may be changed without any notice. When in doubt, special model numbers may be assigned to fix or establish key specifications for your application on your request. Please consult with your OMRON representative at any time to confirm actual specifications of purchased products.

DIMENSIONS AND WEIGHTS
Dimensions and weights are nominal and are not to be used for manufacturing purposes, even when tolerances are shown.

PERFORMANCE DATA
Performance data given in this catalog is provided as a guide for the user in determining suitability and does not constitute a warranty. It may represent the result of OMRON's test conditions, and the users must correlate it to actual application requirements. Actual performance is subject to the OMRON Warranty and Limitations of Liability.

ERRORS AND OMISSIONS
The information in this document has been carefully checked and is believed to be accurate; however, no responsibility is assumed for clerical, typographical, or proofreading errors, or omissions.

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

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