


# E6C3-A

CSM\_E6C3-A\_DS\_E\_5\_1

## 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.

## Ordering Information

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

Power supply voltage	Output configuration	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)	<b>E6C3-AG5C-C (resolution) 1M</b> Example: E6C3-AG5C-C 256P/R 1M
			256, 360, 720, 1,024		<b>E6C3-AG5C (resolution) 1M</b> Example: E6C3-AG5C 256P/R 1M
		Binary	32, 40	Pre-wired Model (1 m) *1	<b>E6C3-AN5C (resolution) 1M</b> Example: E6C3-AN5C 32P/R 1M
	BCD	6, 8, 12	<b>E6C3-AB5C (resolution) 1M</b> Example: E6C3-AB5C 6P/R 1M		
	Open-collector output (PNP)	Gray	256, 360, 720, 1,024		<b>E6C3-AG5B (resolution) 1M</b> Example: E6C3-AG5B 256P/R 1M
		Binary	32, 40	<b>E6C3-AN5B (resolution) 1M</b> Example: E6C3-AN5B 32P/R 1M	
BCD		6, 8, 12	<b>E6C3-AB5B (resolution) 1M</b> Example: E6C3-AB5B 6P/R 1M		
5 VDC	Voltage output	Binary	256	<b>E6C3-AN1E 256P/R 1M</b>	
12 VDC				<b>E6C3-AN2E 256P/R 1M</b>	

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

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	
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	$2.3 \times 10^{-6}$ kg·m <sup>2</sup>									
Shaft loading	Radial		80 N							
	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/s <sup>2</sup> or 2-mm double amplitude for 11 min 3 times each in X, Y, and Z directions									
Shock resistance	Destruction: 1,000 m/s <sup>2</sup> 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									

\*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:

$$\text{Maximum electrical response speed (rpm)} = \frac{\text{Maximum response frequency}}{\text{Resolution}} \times 60$$

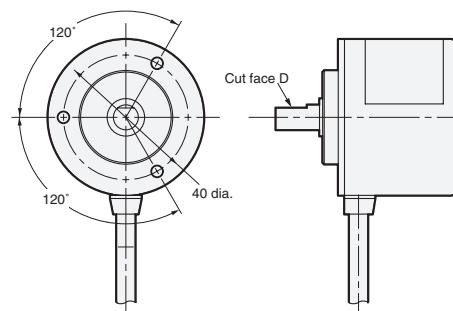
This means that the Rotary Encoder will not operate electrically if its speed exceeds the maximum electrical response speed.

\*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°) 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
<b>Output Circuits</b>	<p>Note: The circuit is the same for all bit outputs. Each E6C3-A Rotary Encoder has one main circuit.</p>	<p>Note: The circuit is the same for all bit outputs. Each E6C3-A Rotary Encoder has one main circuit.</p>	<p>Note: The circuit is the same for all bit outputs. Each E6C3-A Rotary Encoder has one main circuit.</p>	<p>Note: The circuit is the same for all bit outputs. Each E6C3-A Rotary Encoder has one main circuit.</p>
<b>Output mode</b>	<p>Direction of rotation: CW (as viewed from the end of the shaft)</p> <p>Address 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29</p>	<p>Direction of rotation: CW (as viewed from the end of the shaft)</p> <p>Resolution/40</p> <p>Resolution of 32  <math>A = 11.25^\circ</math>  <math>B = 6^\circ</math>  <math>C = 3^\circ</math></p>		

## Connection Specifications

### Connector Models

Model	E6C3-AG5C-C		
	Output signal		
Pin No.	8-bit (256)	9-bit (360)	10-bit (720)
1	} Connected internally	Not connected	$2^9$
2		$2^8$	$2^8$
3		$2^5$	$2^5$
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

Model	E6C3-AG5C/E6C3-AG5B		
	Output signal		
Wire color	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
<b>Output circuits</b>	<p>Note: The circuit is the same for all bit outputs.</p>	<p>Note: The circuit is the same for all bit outputs.</p>	<p>Note: The circuit is the same for all bit outputs.</p>	<p>Note: The circuit is the same for all bit outputs.</p>
<b>Output mode</b>	<p>Direction of rotation: CW (as viewed from end of shaft) Resolution/12</p> <p>Resolution of 8 A = 45°, B = 22.5° C = 11.25° Resolution of 6 A = 60°, B = 30° C = 15°</p>	<p>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.</p> <p>Resolution of 8 A = 45°, B = 22.5° C = 11.25° Resolution of 6 A = 60°, B = 30° C = 15°</p>		
			<p><b>Rotation Direction Input Circuit</b></p> <p>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.</p>	

## Connection Specifications

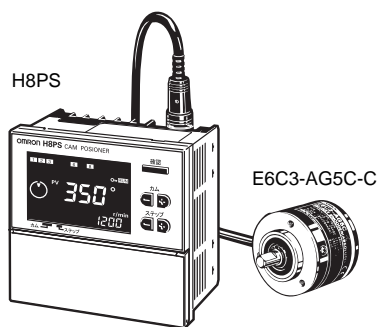
### Pre-wired Models

Wire color	Model	E6C3-AN5C/-AN5B	E6C3-AB5C/-AB5B		E6C3-AN1E/-AN2E
	Output signal	Output signal	Output signal	Output signal	Output signal
	6-bit (32 or 40)	3-bit (6 or 8)	5-bit (12)	8-bit (256)	
Brown	2 <sup>0</sup>	2 <sup>0</sup>	2 <sup>0</sup>	2 <sup>0</sup>	
Orange	2 <sup>1</sup>	2 <sup>1</sup>	2 <sup>1</sup>	2 <sup>1</sup>	
Yellow	2 <sup>2</sup>	2 <sup>2</sup>	2 <sup>2</sup>	2 <sup>2</sup>	
Green	2 <sup>3</sup>	Not connected	2 <sup>3</sup>	2 <sup>3</sup>	
Blue	2 <sup>4</sup>	Not connected	2 <sup>0</sup> × 10	2 <sup>4</sup>	
Purple	2 <sup>5</sup>	Not connected	Not connected	2 <sup>5</sup>	
Gray	Parity	Positioning	Positioning	2 <sup>6</sup>	
White	Strobe	Strobe	Strobe	2 <sup>7</sup>	
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



#### 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

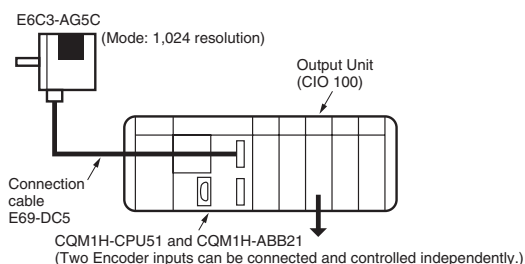
#### Specifications

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	<ul style="list-style-type: none"> <li>• Origin compensation (zeroing)</li> <li>• Rotation direction switching</li> <li>• Angle display switching</li> <li>• Teaching</li> <li>• Pulse output</li> <li>• Angle/number of rotations display switching</li> <li>• Puncture *</li> <li>• Angle advance</li> <li>• Number of rotations alarm output</li> <li>• Setting with support software (order separately) *</li> </ul>

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

### Programmable Controller Connection Example Connections and System Configuration for E6C3-AG5C and the CQM1H (1,024 Resolution)

By combining the CQM1H-CPU51 and CQM1H-ABB21 with the E6C3-AG5C, output angle settings required to achieve 360° conversion, BCD conversion, and cam control can be easily made.

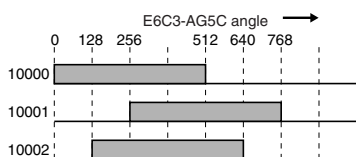


#### CQM1H-CPU51 Settings

Set port 1 to BCD mode and 10-bit resolution.

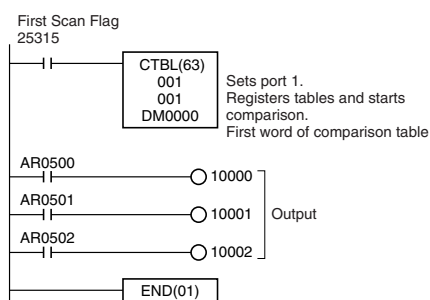
DM6643 0001

#### Output Timing



#### Ladder Program Example

The REGISTER COMPARISON TABLE (CTBL) instruction of the CQM1H-CPU51 is used to register a comparison table of output angle settings. Up to eight comparison can be registered.



#### DM Area Setting Example for Comparison Table

DM0000	0000	Lower limit 1	} Bit AR 0500
0001	0512	Upper limit 1	
0002	0000	Subroutine 1	} Bit AR 0501
0003	0256	Lower limit 2	
0004	0768	Upper limit 2	
0005	0000	Subroutine 2	} Bit AR 0502
0006	0128	Lower limit 3	
0007	0640	Upper limit 3	
0008	0000	Subroutine 3	} Not used in this example.
0009	0000	Lower limit 4	
0022	0000	Upper limit 8	
0023	0000		

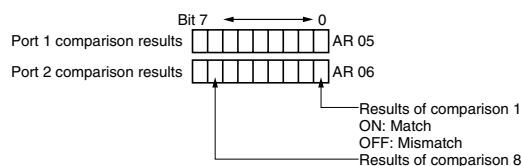
Note: The upper and lower limits are set in increments of 1° in BCD mode and in increments of 5° in 360° mode. Subroutine numbers are set when interrupt processing is required.

#### CQM1H-CPU51 Memory Bits/Words

##### • Range Comparison Results

When the angle of the E6C3-AG5C falls in one of the comparison ranges, the corresponding bit in word AR 05 or AR 06 of the CQM1H-CPU51 turns ON.

The corresponding bit is OFF if there is no match.



##### • Reading the PV

The grey code of the E6C3-AG5C is automatically converted to BCD or 360° and saved in words CIO 232 and CIO 234 in CQM1H-CPU51 memory.

The present value can also be used elsewhere in the ladder program.

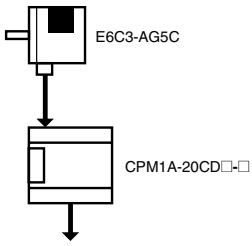
Angle from port 1 \*\*\*\* CIO 232

Angle from port 2 \*\*\*\* CIO 234

Refer to the *CQM1H User's Manual (W363)* for details on the CQM1H-CPU51 Programmable Controller.

## Programmable Controller Connection Example

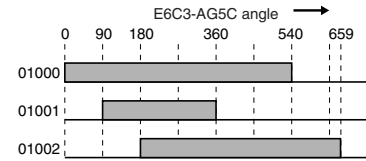
### Connection to the CPM1A (720 Resolution)



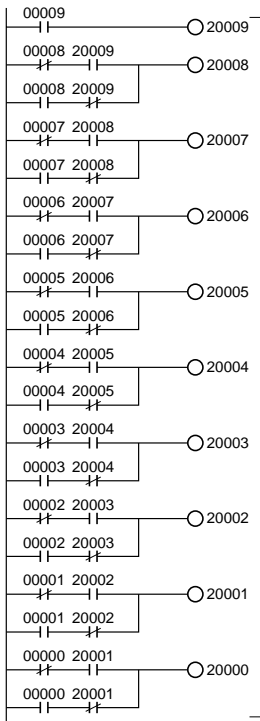
Wiring between the E6C3-AG5C and CPM1A

E6C3-AG5C out-put 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

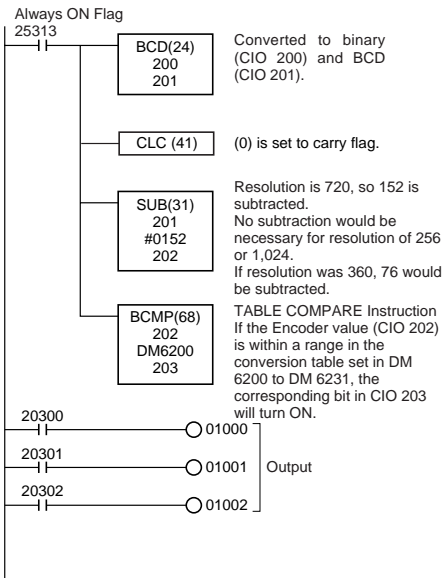
Output Timing



### Ladder Programming Example



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



Converted to binary (CIO 200) and BCD (CIO 201).  
(0) is set to carry flag.  
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.  
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.

### 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).

## Safety Precautions

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Refer to *Warranty and Limitations of Liability*.

 **WARNING**

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



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### Precautions for Correct Use

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<sup>2</sup>

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.

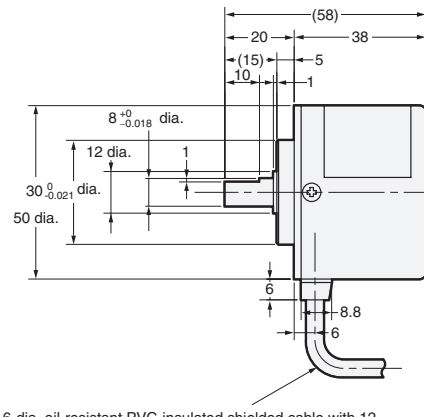
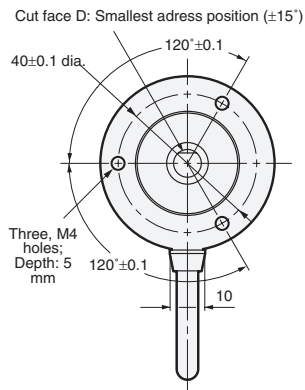
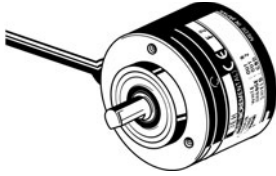
## Dimensions

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

### Encoder

E6C3-A□5□

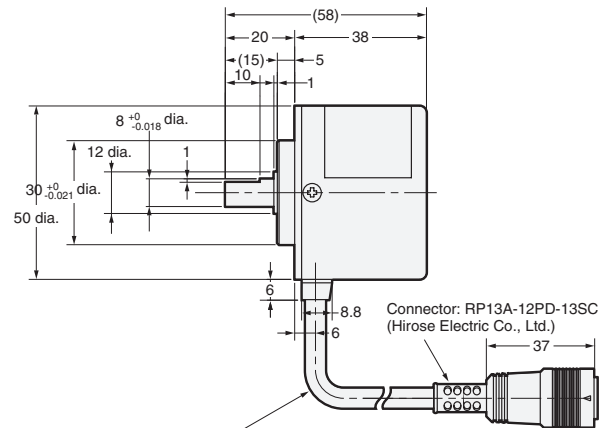
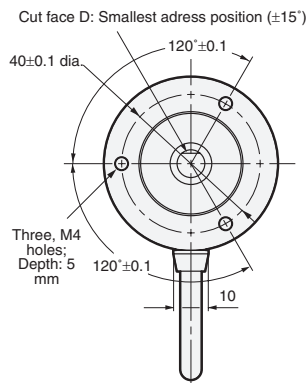
E6C3-AN□E



6-dia. oil-resistant PVC-insulated shielded cable with 12 conductors (Conductor cross section: 0.2 mm<sup>2</sup>, Insulator diameter: 1.1 mm), Standard length: 1 m

Note: The E69-C08B Coupling is sold separately.

### E6C3-AG5C-C



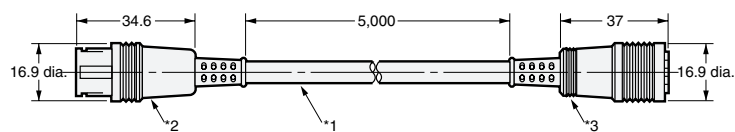
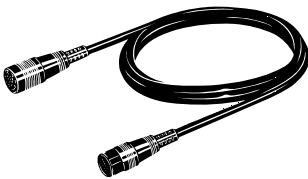
6-dia. oil-resistant PVC-insulated shielded cable with 12 conductors (Conductor cross section: 0.2 mm<sup>2</sup>, Insulator diameter: 1.1 mm), Standard length for resolution of 360 or 720: 2 m

Note: The E69-C08B Coupling is sold separately.

## Accessories (Order Separately)

### Extension Cable

E69-DF5



\*1. 6-dia. oil-resistant PVC-insulated shielded cable with 12 conductors (Conductor cross section: 0.2 mm<sup>2</sup>, 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



# Terms and Conditions of Sale

1. **Offer; Acceptance.** These terms and conditions (these "Terms") are deemed part of all quotes, agreements, purchase orders, acknowledgments, price lists, catalogs, manuals, brochures and other documents, whether electronic or in writing, relating to the sale of products or services (collectively, the "Products") by Omron Electronics LLC and its subsidiary companies ("Omron"). Omron objects to any terms or conditions proposed in Buyer's purchase order or other documents which are inconsistent with, or in addition to, these Terms.
2. **Prices; Payment Terms.** All prices stated are current, subject to change without notice by Omron. Omron reserves the right to increase or decrease prices on any unshipped portions of outstanding orders. Payments for Products are due net 30 days unless otherwise stated in the invoice.
3. **Discounts.** Cash discounts, if any, will apply only on the net amount of invoices sent to Buyer after deducting transportation charges, taxes and duties, and will be allowed only if (i) the invoice is paid according to Omron's payment terms and (ii) Buyer has no past due amounts.
4. **Interest.** Omron, at its option, may charge Buyer 1-1/2% interest per month or the maximum legal rate, whichever is less, on any balance not paid within the stated terms.
5. **Orders.** Omron will accept no order less than \$200 net billing.
6. **Governmental Approvals.** Buyer shall be responsible for, and shall bear all costs involved in, obtaining any government approvals required for the importation or sale of the Products.
7. **Taxes.** All taxes, duties and other governmental charges (other than general real property and income taxes), including any interest or penalties thereon, imposed directly or indirectly on Omron or required to be collected directly or indirectly by Omron for the manufacture, production, sale, delivery, importation, consumption or use of the Products sold hereunder (including customs duties and sales, excise, use, turnover and license taxes) shall be charged to and remitted by Buyer to Omron.
8. **Financial.** If the financial position of Buyer at any time becomes unsatisfactory to Omron, Omron reserves the right to stop shipments or require satisfactory security or payment in advance. If Buyer fails to make payment or otherwise comply with these Terms or any related agreement, Omron may (without liability and in addition to other remedies) cancel any unshipped portion of Products sold hereunder and stop any Products in transit until Buyer pays all amounts, including amounts payable hereunder, whether or not then due, which are owing to it by Buyer. Buyer shall in any event remain liable for all unpaid accounts.
9. **Cancellation; Etc.** Orders are not subject to rescheduling or cancellation unless Buyer indemnifies Omron against all related costs or expenses.
10. **Force Majeure.** Omron shall not be liable for any delay or failure in delivery resulting from causes beyond its control, including earthquakes, fires, floods, strikes or other labor disputes, shortage of labor or materials, accidents to machinery, acts of sabotage, riots, delay in or lack of transportation or the requirements of any government authority.
11. **Shipping; Delivery.** Unless otherwise expressly agreed in writing by Omron:
  - a. Shipments shall be by a carrier selected by Omron; Omron will not drop ship except in "break down" situations.
  - b. Such carrier shall act as the agent of Buyer and delivery to such carrier shall constitute delivery to Buyer;
  - c. All sales and shipments of Products shall be FOB shipping point (unless otherwise stated in writing by Omron), at which point title and risk of loss shall pass from Omron to Buyer; provided that Omron shall retain a security interest in the Products until the full purchase price is paid;
  - d. Delivery and shipping dates are estimates only; and
  - e. Omron will package Products as it deems proper for protection against normal handling and extra charges apply to special conditions.
12. **Claims.** Any claim by Buyer against Omron for shortage or damage to the Products occurring before delivery to the carrier must be presented in writing to Omron within 30 days of receipt of shipment and include the original transportation bill signed by the carrier noting that the carrier received the Products from Omron in the condition claimed.
13. **Warranties.** (a) **Exclusive Warranty.** Omron's exclusive warranty is that the Products will be free from defects in materials and workmanship for a period of twelve months from the date of sale by Omron (or such other period expressed in writing by Omron). Omron disclaims all other warranties, express or implied. (b) **Limitations.** OMRON MAKES NO WARRANTY OR REPRESENTATION, EXPRESS OR IMPLIED, ABOUT NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OF THE PRODUCTS. BUYER ACKNOWLEDGES THAT IT ALONE HAS DETERMINED THAT THE PRODUCTS WILL SUITABLY MEET THE REQUIREMENTS OF THEIR INTENDED USE. Omron further disclaims all warranties and responsibility of any type for claims or expenses based on infringement by the Products or otherwise of any intellectual property right. (c) **Buyer Remedy.** Omron's sole obligation hereunder shall be, at Omron's election, to (i) replace (in the form originally shipped with Buyer responsible for labor charges for removal or replacement thereof) the non-complying Product, (ii) repair the non-complying Product, or (iii) repay or credit Buyer an amount equal to the purchase price of the non-complying Product; provided that in no event shall Omron be responsible for warranty, repair, indemnity or any other claims or expenses regarding the Products unless Omron's analysis confirms that the Products were properly handled, stored, installed and maintained and not subject to contamination, abuse, misuse or inappropriate modification. Return of any Products by Buyer must be approved in writing by Omron before shipment. Omron Companies shall not be liable for the suitability or unsuitability or the results from the use of Products in combination with any electrical or electronic components, circuits, system assemblies or any other materials or substances or environments. Any advice, recommendations or information given orally or in writing, are not to be construed as an amendment or addition to the above warranty. See <http://www.omron247.com> or contact your Omron representative for published information.
14. **Limitation on Liability; Etc.** OMRON COMPANIES SHALL NOT BE LIABLE FOR SPECIAL, INDIRECT, INCIDENTAL, OR CONSEQUENTIAL DAMAGES, LOSS OF PROFITS OR PRODUCTION OR COMMERCIAL LOSS IN ANY WAY CONNECTED WITH THE PRODUCTS, WHETHER SUCH CLAIM IS BASED IN CONTRACT, WARRANTY, NEGLIGENCE OR STRICT LIABILITY. Further, in no event shall liability of Omron Companies exceed the individual price of the Product on which liability is asserted.
15. **Indemnities.** Buyer shall indemnify and hold harmless Omron Companies and their employees from and against all liabilities, losses, claims, costs and expenses (including attorney's fees and expenses) related to any claim, investigation, litigation or proceeding (whether or not Omron is a party) which arises or is alleged to arise from Buyer's acts or omissions under these Terms or in any way with respect to the Products. Without limiting the foregoing, Buyer (at its own expense) shall indemnify and hold harmless Omron and defend or settle any action brought against such Companies to the extent based on a claim that any Product made to Buyer specifications infringed intellectual property rights of another party.
16. **Property; Confidentiality.** Any intellectual property in the Products is the exclusive property of Omron Companies and Buyer shall not attempt to duplicate it in any way without the written permission of Omron. Notwithstanding any charges to Buyer for engineering or tooling, all engineering and tooling shall remain the exclusive property of Omron. All information and materials supplied by Omron to Buyer relating to the Products are confidential and proprietary, and Buyer shall limit distribution thereof to its trusted employees and strictly prevent disclosure to any third party.
17. **Export Controls.** Buyer shall comply with all applicable laws, regulations and licenses regarding (i) export of products or information; (ii) sale of products to "forbidden" or other proscribed persons; and (iii) disclosure to non-citizens of regulated technology or information.
18. **Miscellaneous.** (a) **Waiver.** No failure or delay by Omron in exercising any right and no course of dealing between Buyer and Omron shall operate as a waiver of rights by Omron. (b) **Assignment.** Buyer may not assign its rights hereunder without Omron's written consent. (c) **Law.** These Terms are governed by the law of the jurisdiction of the home office of the Omron company from which Buyer is purchasing the Products (without regard to conflict of law principles). (d) **Amendment.** These Terms constitute the entire agreement between Buyer and Omron relating to the Products, and no provision may be changed or waived unless in writing signed by the parties. (e) **Severability.** If any provision hereof is rendered ineffective or invalid, such provision shall not invalidate any other provision. (f) **Setoff.** Buyer shall have no right to set off any amounts against the amount owing in respect of this invoice. (g) **Definitions.** As used herein, "including" means "including without limitation"; and "Omron Companies" (or similar words) mean Omron Corporation and any direct or indirect subsidiary or affiliate thereof.

## Certain Precautions on Specifications and Use

1. **Suitability of Use.** Omron Companies shall not be responsible for conformity with any standards, codes or regulations which apply to the combination of the Product in the Buyer's application or use of the Product. At Buyer's request, Omron will provide applicable third party certification documents identifying ratings and limitations of use which apply to the Product. This information by itself is not sufficient for a complete determination of the suitability of the Product in combination with the end product, machine, system, or other application or use. Buyer shall be solely responsible for determining appropriateness of the particular Product with respect to Buyer's application, product or system. Buyer shall take application responsibility in all cases but the following is a non-exhaustive list of applications for which particular attention must be given:
  - (i) Outdoor use, uses involving potential chemical contamination or electrical interference, or conditions or uses not described in this document.
  - (ii) Use in consumer products or any use in significant quantities.
  - (iii) 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.
  - (iv) Systems, machines and equipment that could present a risk to life or property. Please know and observe all prohibitions of use applicable to this Product.
 NEVER USE THE PRODUCT FOR AN APPLICATION INVOLVING SERIOUS RISK TO LIFE OR PROPERTY OR IN LARGE QUANTITIES WITHOUT ENSURING THAT THE SYSTEM AS A WHOLE HAS BEEN DESIGNED TO ADDRESS THE RISKS, AND THAT THE OMRON'S PRODUCT IS PROPERLY RATED AND INSTALLED FOR THE INTENDED USE WITHIN THE OVERALL EQUIPMENT OR SYSTEM.
2. **Programmable Products.** Omron Companies shall not be responsible for the user's programming of a programmable Product, or any consequence thereof.
3. **Performance Data.** Data presented in Omron Company websites, catalogs and other materials 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 user must correlate it to actual application requirements. Actual performance is subject to the Omron's Warranty and Limitations of Liability.
4. **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 part numbers when published ratings or features are changed, or when significant construction changes are made. However, some specifications of the Product may be changed without any notice. When in doubt, special part numbers may be assigned to fix or establish key specifications for your application. Please consult with your Omron's representative at any time to confirm actual specifications of purchased Product.
5. **Errors and Omissions.** Information presented by Omron Companies has been checked and is believed to be accurate; however, no responsibility is assumed for clerical, typographical or proofreading errors or omissions.



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