Slim Encoder with Diameter of 50 mm

E6C3-A

CSM_E6C3-A_DS_E_3_1

Durable and Easy to Use

- Sealed bearings with IP65 oil resistance.
- Superior shaft loading performance. Radial: 80 N, Thrust: 50 N
- High shock resistance through application of metal slit.
- 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)	**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·m^2								
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/s^2 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 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

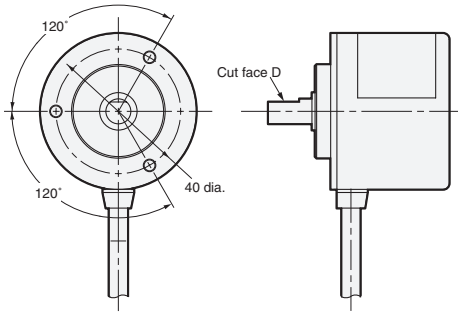
*3. The maximum electrical response speed is determined by the resolution and maximum response frequency as follows:

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

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

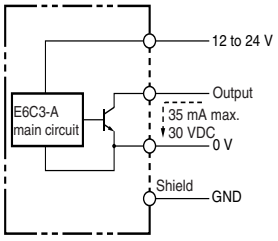
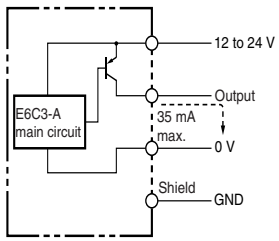
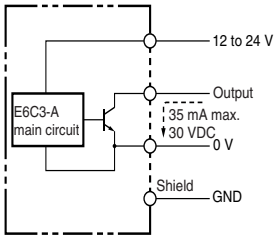
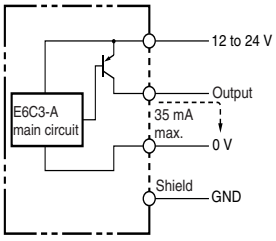
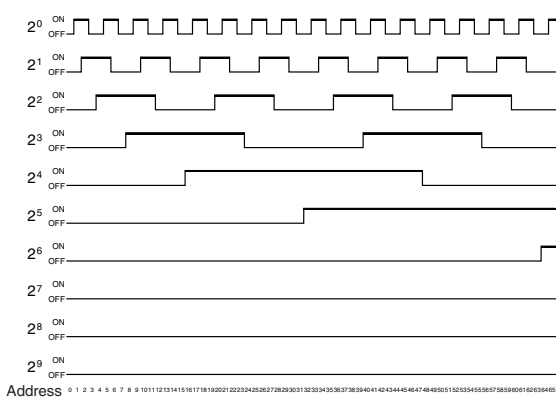
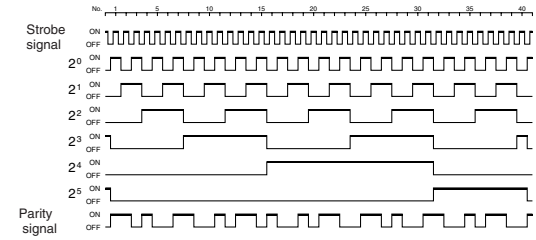
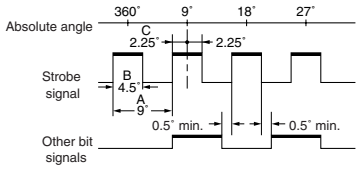
*4. For the E6C3-AN1E and E6C3-AN2E, the rotation direction input (wire color: pink) can be connected to high (Vcc) to increase the output code for CW rotation and connected to low (0 V) to decrease the output code for CW rotation.
E6C3-AN1E: High = 1.5 to 5 V, Low = 0 to 0.8 V
E6C3-AN2E: High = 2.2 to 12 V, Low = 0 to 1.2 V
Read the code 10 μs or more after the LSB (2^0) 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.	 Note: The circuit is the same for all bit outputs.	 Note: The circuit is the same for all bit outputs.	 Note: The circuit is the same for all bit outputs.
Output mode	Direction of rotation: CW (as viewed from the end of the shaft) 		Direction of rotation: CW (as viewed from the end of the shaft) Resolution/40  Resolution of 32 A = 11.25° B = 6° C = 3° 	

Connection Specifications

Connector Models

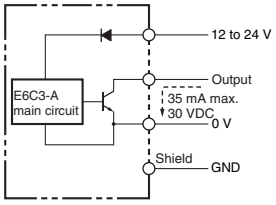
Model	E6C3-AG5C-C		
	Output signal		
Pin No.	8-bit (256)	9-bit (360)	10-bit (720)
1	} Connected internally	Not connected	2^9
2		2^8	2^8
3	2^5	2^5	2^5
4	2^1	2^1	2^1
5	2^0	2^0	2^0
6	2^7	2^7	2^7
7	2^4	2^4	2^4
8	2^2	2^2	2^2
9	2^3	2^3	2^3
10	2^6	2^6	2^6
11	Shield (ground)		
12	12 to 24 VDC		
13	0 V (common)		

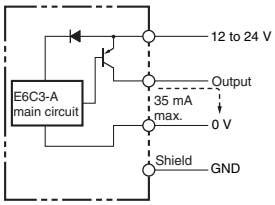
* Connector: RP13A-12PD-13SC (Hirose Electric Co., Ltd.)
Note: Normally connect GND to 0 V or to an external ground.

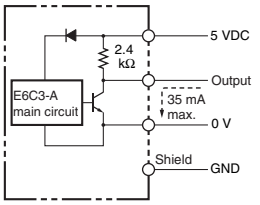
Pre-wired Models

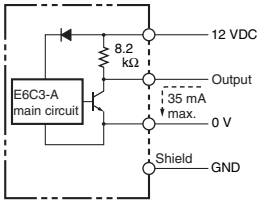
Model	E6C3-AG5C/E6C3-AG5B		
	Output signal		
Wire color	8-bit (256)	9-bit (360)	10-bit (720 or 1,024)
Brown	2^0	2^0	2^0
Orange	2^1	2^1	2^1
Yellow	2^2	2^2	2^2
Green	2^3	2^3	2^3
Blue	2^4	2^4	2^4
Purple	2^5	2^5	2^5
Gray	2^6	2^6	2^6
White	2^7	2^7	2^7
Pink	Not connected	2^8	2^8
Light blue	Not connected	Not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

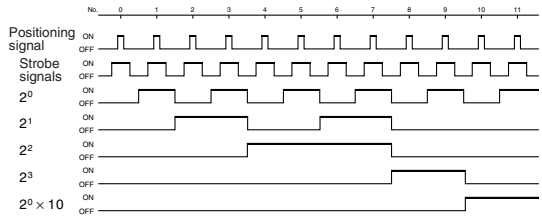
I/O Circuit Diagrams

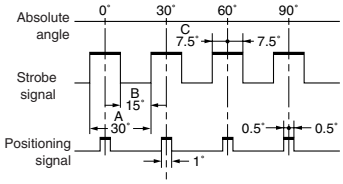
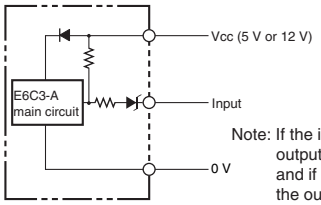
<table>
<tr><th>Model</th><th>E6C3-AB5C</th><th>E6C3-AB5B</th><th>E6C3-AN1E</th><th>E6C3-AN2E</th></tr>
<tr><td>Output circuits</td>
<td> 

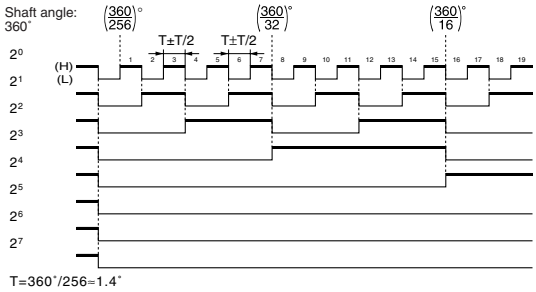
Note: The circuit is the same for all bit outputs.</td>
<td> 

Note: The circuit is the same for all bit outputs.</td>
<td> 

Note: The circuit is the same for all bit outputs.</td>
<td> 

Note: The circuit is the same for all bit outputs.</td></tr>
<tr><td>Output mode</td>
<td colspan="2">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°
 
</td>
<td colspan="2">Rotation Direction Input Circuit
 

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.
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.
 
</td></tr>
</table>

Connection Specifications

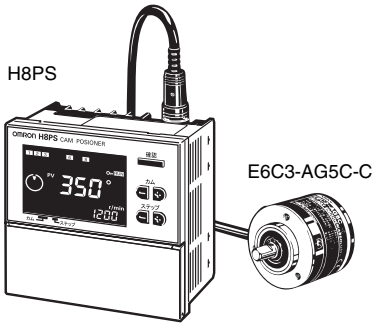
Pre-wired Models

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



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

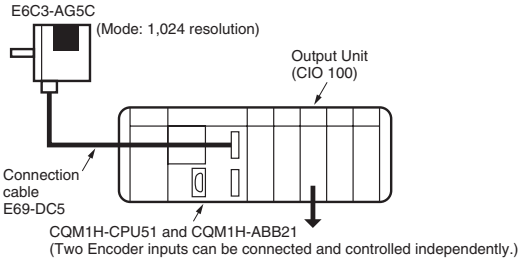
Rated voltage	24 VDC
Cam precision	0.5° (for 720 resolution), 1° (for 256/360 resolution)
No. of output points	8-point output type: 8 cam outputs, 1 RUN output, 1 pulse output 16-point output type: 16 cam outputs, 1 RUN output, 1 pulse output 32-point output type: 32 cam outputs, 1 RUN output, 1 pulse 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

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.

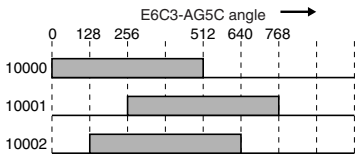


CQM1H-CPU51 Settings

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

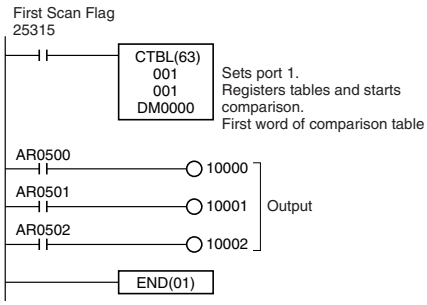
DM6643	0001

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

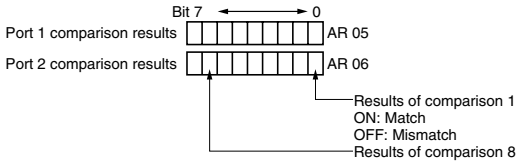
DM0000	0000	Lower limit 1	Bit AR 0500
0001	0512	Upper limit 1	
0002	0000	Subroutine 1	
0003	0256	Lower limit 2	Bit AR 0501
0004	0768	Upper limit 2	
0005	0000	Subroutine 2	
0006	0128	Lower limit 3	Bit AR 0502
0007	0640	Upper limit 3	
0008	0000	Subroutine 3	
0009	0000	Lower limit 4	Not used in this example.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

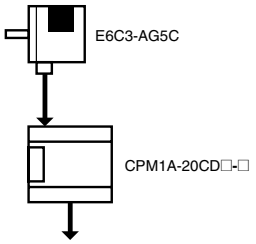
  The grey code of the E6C3-AG5C is automatically converted to BCD or 360° and saved in words CIO 232 and CIO 234 in CQM1H-CPU51 memory.
  The present value can also be used elsewhere in the ladder program.

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

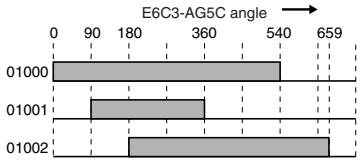
Connection to the CPM1A (720 Resolution)



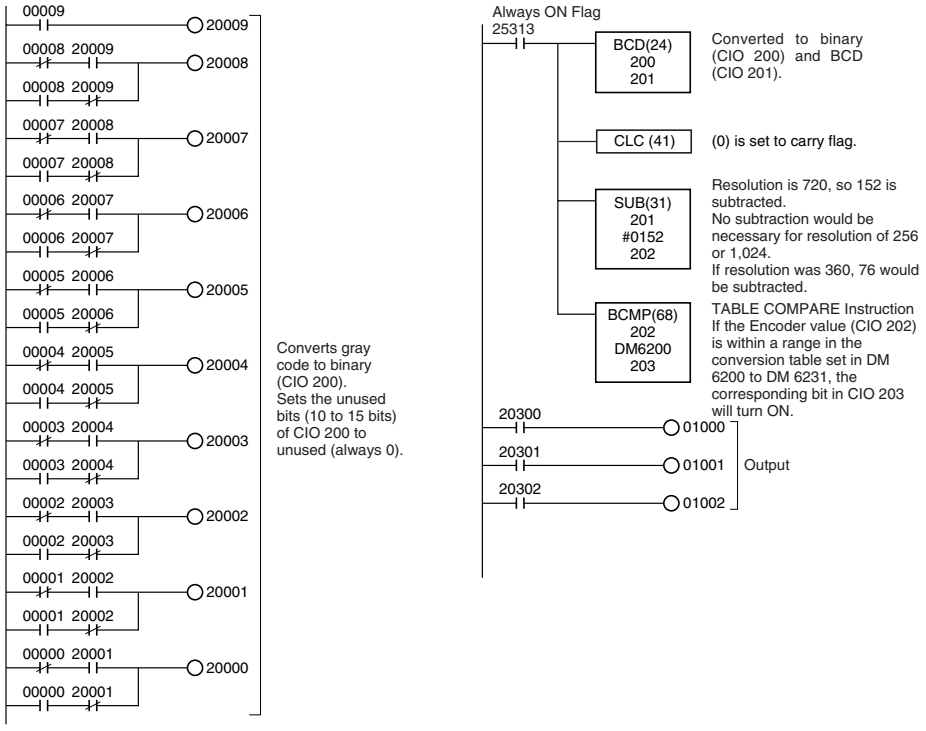
Wiring between the E6C3-AG5C and CPM1A

E6C3-AG5C 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

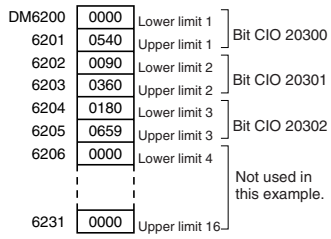
Output Timing



Ladder Programming Example



DM Area Setting Example for Comparison Table



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

Safety Precautions

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.

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^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.

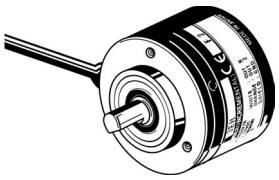
(Unit: mm)

Dimensions

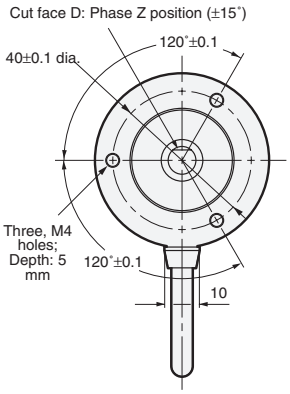
Tolerance class IT16 applies to dimensions in this datasheet unless otherwise specified.

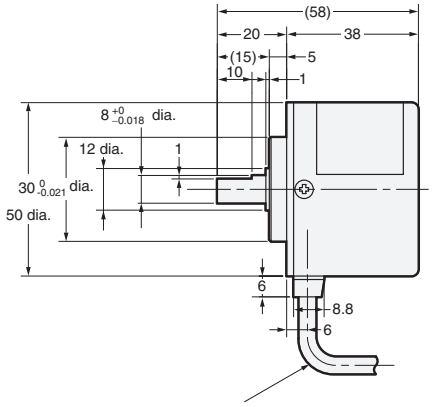
Encoder

E6C3-A□5□
E6C3-AN□E



Note: The E69-C08B Coupling is sold separately.

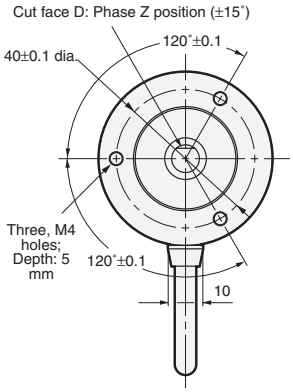


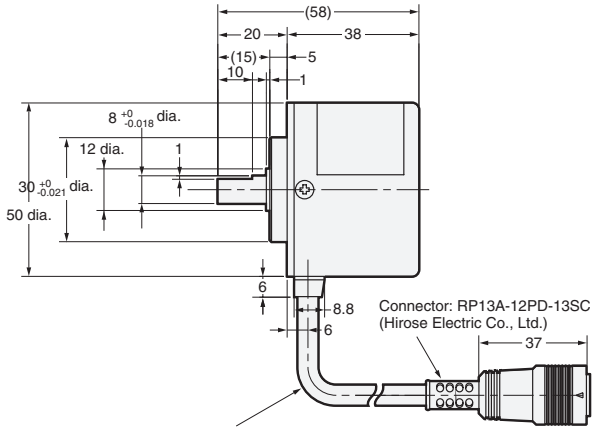


6-dia. oil-resistant PVC-insulated shielded cable with 12 conductors (Conductor cross section: 0.2 mm², Insulator diameter: 1.1 mm), Standard length: 1 m

E6C3-AG5C-C

Note: The E69-C08B Coupling is sold separately.



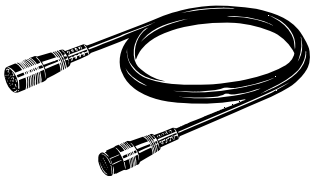


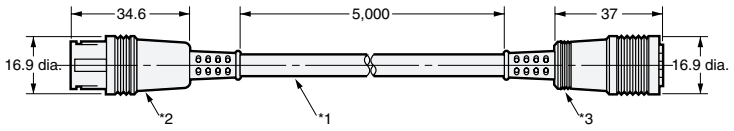
6-dia. oil-resistant PVC-insulated shielded cable with 12 conductors (Conductor cross section: 0.2 mm², Insulator diameter: 1.1 mm), Standard length: 1 m, Standard length for resolution of 360 or 720: 2 m

Accessories (Order Separately)

Extension Cable

E69-DF5





*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

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

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Disclaimers

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2008.11

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