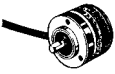# OMRON ®

Absolute Rotary Encoder	E6C2-A

Use the Tough E6C2-A (Rated IP64 for Degree of Protection) Combined with a PLC or Cam Positioner for Optimum Control and Ease-of-Use

- ■ Incorporates a sealed bearing, meeting IP64 for durability

- ■ Compact: 50-mm diameter x 38-mm height

- ■ 8 mm-dia. stainless steel shaft is twice as strong as conventional shafts

- ■ Reliable bearing and metal slit plate ensure shock resistance of 1000 m/s ^{2}

ISO 9001 and 14001 Approved
OMRON Corporation, Ayabe Factory, Sensing Components and Systems

CE

Ordering Information

■ ABSOLUTE ROTARY ENCODERS

Appearance	Connection method	Connecting device	Resolution (p/r)	Part number
	Cable	Programmable Controller	256, 360, 720, 1,024	**E6C2-AG5C 256** **E6C2-AG5C 360** **E6C2-AG5C 720** **E6C2-AG5C 1024**
	Connector	H8PS Cam Positioner	256	**E6C2-AG5C-C 256**

Note: The H8PS can be connected to the E6C2-AG5C-C but not to the E6C2-AG5C.

■ ACCESSORIES (ORDER SEPARATELY)

Refer to *Dimensions* section for details

Item		Part number
Coupling		**E69-C08B**
Flange		**E69-FCA-03**
		E69-FCA-04
Extension cable	5 m	**E69-DF5**
	10 m	**E69-DF10**
	15 m	**E69-DF15**
	20 m	**E69-DF20**

Specifications ——————————————

■ RATINGS/CHARACTERISTICS

Power supply voltage		12 VDC$^{-10\%}$ to 24 VDC$^{+15\%}$, ripple (p-p) 5% max.
Current consumption		70 mA max.
Resolution (See Note 1)		256, 360, 720, 1,024 P/R
Output code (absolute)		Gray code
Output configuration		NPN open collector
Output capacity	Applied voltage	30 VDC max.
	I_{sink}	35 mA max.
	Residual voltage	0.4 V max.
Max. response frequency (See Note 2)		20 kHz
Logic		Negative logic output (H=0, L=1)
Rotational direction		Clockwise, as viewed from the face of the shaft
Rise and fall times of output		1 μs max. (cable length: 2m; I_{sink}: 35 mA max.)
Starting torque		100 gf • cm (0.087 in • lbf) max. at room temperature 150 gf • cm (0.13 in • lbf) max. at low temperature
Moment of inertia		15 g • cm^2 (1.5 x 10^{-6} kg • m^2) or 0.005 lb • in^2 max.
Shaft loading	Radial	8 kgf (78.4N) or 17.6 lbf
	Thrust	5 kgf (49N) or 11.0 lbf
Maximum permissible rotation		5,000 rpm
Ambient temperature	Operating	−10°C to 70°C (14°F to 158°F) with no icing
	Storage	−25°C to 85°C (−13°F to 185°F) with no icing
Ambient humidity	Operating	35% to 85% (with no condensation)
Insulation resistance		20 MΩ min. (at 100 VDC) between carry parts and case
Dielectric strength		500 VAC, 50/60 Hz for 1 min between carry parts and case
Vibration resistance		Destruction: 10 to 500 Hz, 1.0-mm single amplitude or 150 m/s^2 (approx. 15G) for 11 min. 3 times each in X, Y, and Z axes
Shock resistance		Destruction: 1,000 m/s^2 (approx. 100G) 3 times each in X, Y, and Z axes
Degree of protection		IEC IP64
Weight		300 g (0.66 lbs) with 2-m cable

Note: 1. A gray code signal with a remainder of 76 is used for a resolution of 360 per rotation and a gray code signal with a remainder of 152 is used for a resolution of 720 per rotation. Therefore, the code signal for a resolution of 360 per rotation uses addresses 76 through 435 and that for a resolution of 720 per rotation uses addresses 152 through 871.

2. The electrical maximum response rotation is determined by using the resolution and maximum response frequency in the following formula.

$$\text{Electrical maximum response rotation (rpm)} = \frac{\text{Maximum response frequency}}{\text{Resolution}} \times 60$$

Therefore, a signal cannot follow electrically if the actual rotation exceeds the maximum response rotation.
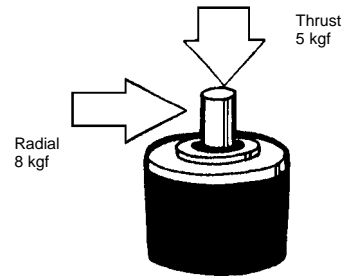
Connections

■ DURABLE DESIGN

The E6C2-A incorporates a high-performance LED, custom-made diode array, high-density printed circuit board, and a compact, watertight, seal bearing that withstands heavy loads, thus ensuring high mechanical durability, watertight performance, and compactness. The O-ring applied to the casing and a watertight packing applied to the cable connector enhance the watertight performance of the E6C2-A.
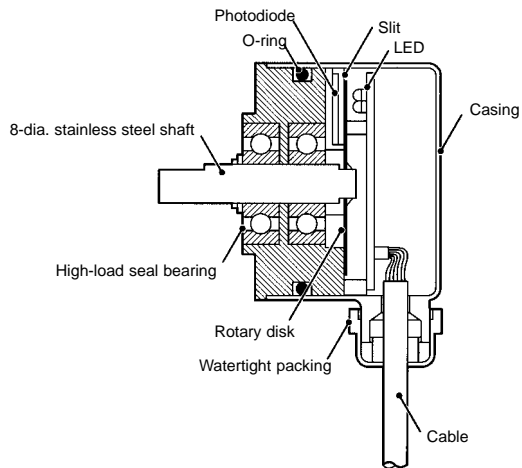
■ SHAFT STRENGTH

The E6C2-A has a stainless steel shaft that is 8 mm in diameter and approximately twice as strong as OMRON's conventional Rotary Encoder shaft. The E6C2-A also has a reliable bearing and metal slit plate, ensuring a shock resistance of 1,000 m/s^2.


Operation

■ CONNECTIONS

Cable Specifications

Wire color	Output signal		
	E6C2-AG5C		
	8-bit (256)	9-bit (360)	10-bit (720, 1,024)
Light blue	NC	NC	2^9
Pink	NC	2^8	2^8
Purple	2^5	2^5	2^5
Orange	2^1	2^1	2^1
Brown	2^0	2^0	2^0
White	2^7	2^7	2^7
Blue	2^4	2^4	2^4
Yellow	2^2	2^2	2^2
Green	2^3	2^3	2^3
Gray	2^6	2^6	2^6
---	Shield (GND)		
Red	12 to 24 VDC		
Black	0 V (Common)		

■ CONNECTOR SPECIFICATIONS

Pin number	Output signal
	E6C2-AG5C-C
	8-bit (256)
1	NC
2	NC
3	2^5
4	2^1
5	2^0
6	2^7
7	2^4
8	2^2
9	2^3
10	2^6
11	Shield (GND)
12	12 to 24 VDC
13	0 V (Common)

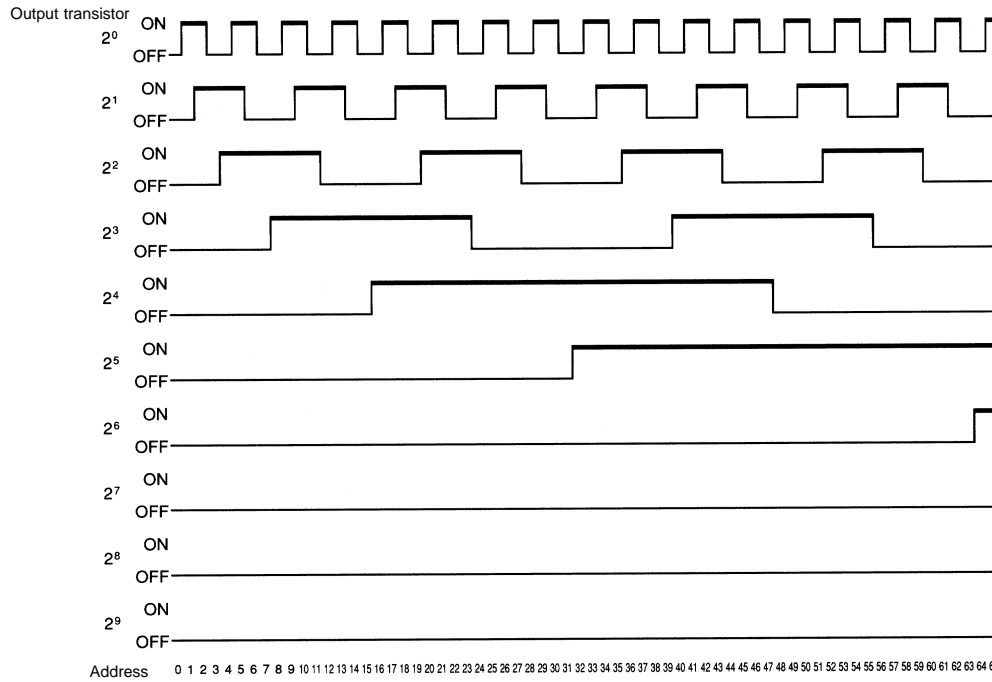## ■ OUTPUT CIRCUIT DIAGRAM
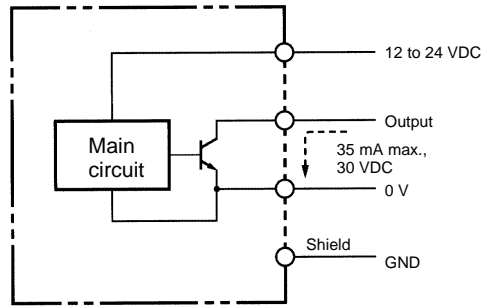
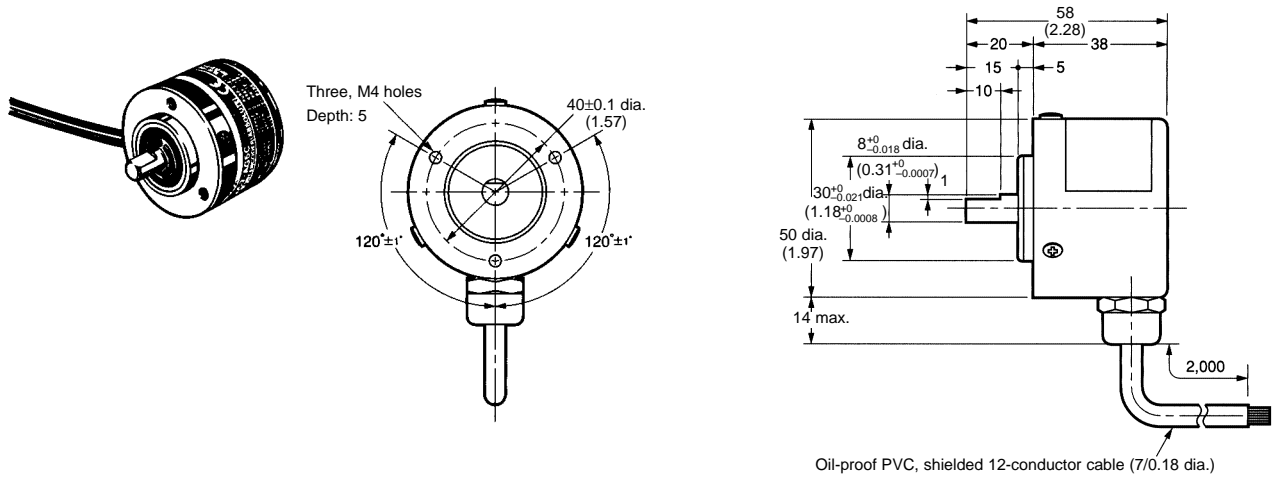Note: Each output bit uses the same circuit.

■ OUTPUT MODE

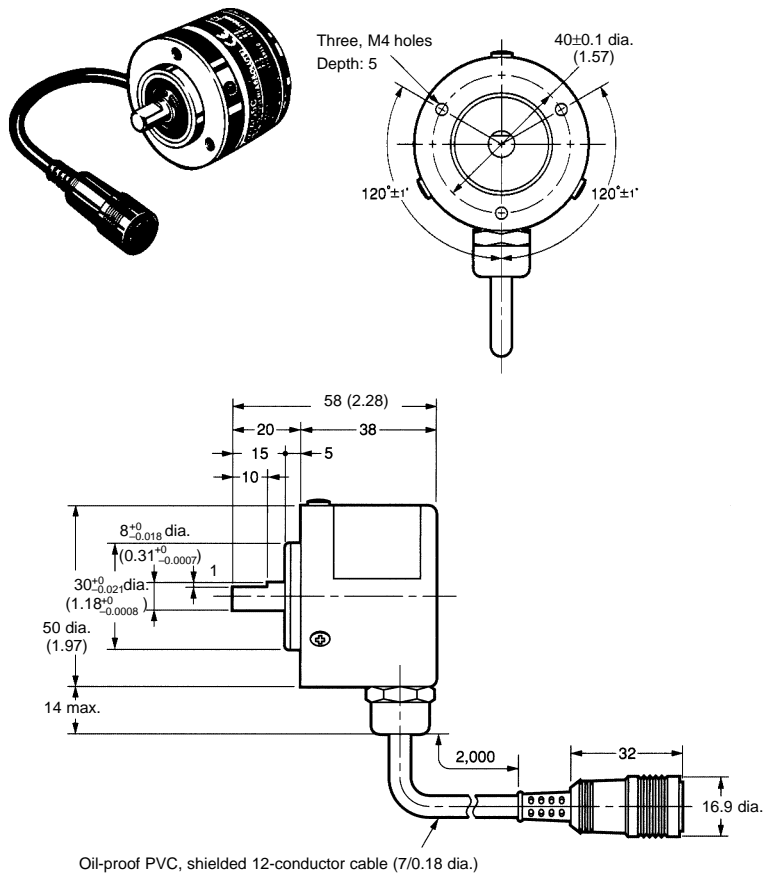Rotating direction: CW, as viewed from the face of the shaft.
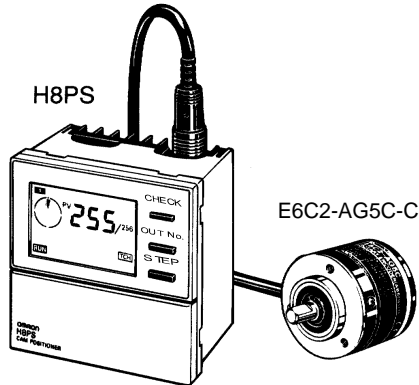

4

Dimensions

Unit: mm (inch)

■ **E6C2-AG5C**

Three, M4 holes
Depth: 5

40±0.1 dia.
(1.57)

120°±1°   120°±1°

58
(2.28)

20   38

15   5

10

$8^{+0}_{-0.018}$ dia.

$(0.31^{+0}_{-0.0007})$ 1

$30^{+0}_{-0.021}$ dia.

$(1.18^{+0}_{-0.0008})$

50 dia.
(1.97)

14 max.

2,000

Oil-proof PVC, shielded 12-conductor cable (7/0.18 dia.)

■ **E6C2-AG5C-C**

Three, M4 holes
Depth: 5

40±0.1 dia.
(1.57)

120°±1°   120°±1°

58 (2.28)

20   38

15   5

10

$8^{+0}_{-0.018}$ dia.

$(0.31^{+0}_{-0.0007})$ 1

$30^{+0}_{-0.021}$ dia.

$(1.18^{+0}_{-0.0008})$

50 dia.
(1.97)

14 max.

2,000   32

16.9 dia.

Oil-proof PVC, shielded 12-conductor cable (7/0.18 dia.)

Installation ━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━━

■ **CONNECTING E6C2-AG5C-C TO H8PS CAM POSITIONER**

H8PS

E6C2-AG5C-C

Model	Mounting method	Output configuration
H8PS-8B	Flush	NPN transistor output
H8PS-8BP		PNP transistor output
H8PS-8BF	Surface/Track	NPN transistor output
H8PS-8BFP		PNP transistor output

Specifications

Rated voltage	24 VDC
Cam resolution	1.4° (a resolution of 256 per rotation)
Outputs	Open-collector transistor output NPN: H8PS-8B(F) PNP: H8PS-8B(F)P Cam outputs: 8 lines (Output No. 1 to 8) 30 VDC max., 100 mA max. (residual voltage: 2 V max.) RUN OUT: Turns ON in Run and Test modes, OFF in Program mode in case of error 30 VDC max., 100 mA max. (residual voltage: 2 V max.) TACHOMETER: 60-ppr signal output for rpm meter 30 VDC max., 30 mA max. (residual voltage: 0.5 V max. for NPN models, 2 V max. for PNP models)
Encoder response	330 rpm
Functions	Origin compensation (zero shift) Rotating direction selection Angle display selection Teaching

■ CONNECTING E6C2-AG5C TO PROGRAMMABLE CONTROLLER

Example of Connection to CQM1-CPU44-E High-capacity CPU Unit with Absolute Interface and RS-232C Port
Position data can be directly input as 8, 10, or 12-bit gray code signals from Absolute Encoders to the CQM1-CPU44-E. The position data input is backed up during power failures. Therefore, the origin return operation is not required after the power supply resumes. Furthermore, the origin compensation function of the E6C2-AG5C makes it possible to use any position for the origin.

The rotating angle is detected and the turntable is controlled.

No. of I/O:	192 points max.
User memory:	7.2 Kwords
Data memory:	6 Kwords
Number of instructions:	118
Operating mode:	BCD or 360° mode (selectable)
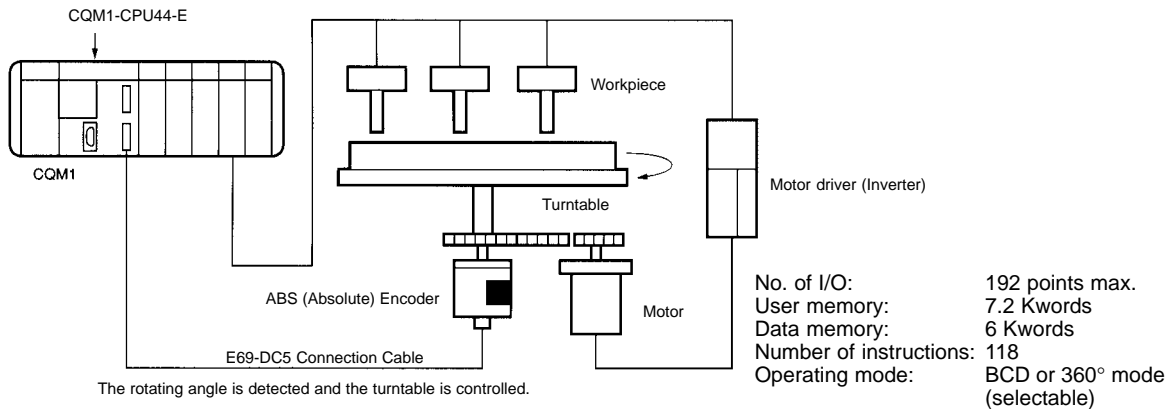
Input Specifications

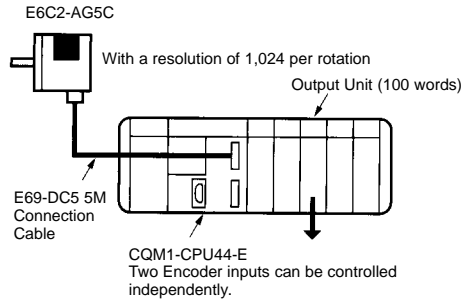| Input voltage	24 VDC$^{+10\%}/_{-15\%}$
Input impedance	5.4 kΩ
Input current	4 mA (TYP.)
ON voltage	16.8 VDC min.
OFF voltage	3.0 VDC max.
Counting speed	4 kHz max.
Input code	Gray code (8, 10, or 12 bits)

E69-DC5 5M Connection Cable for CQM1-CPU44-E (Order Separately)
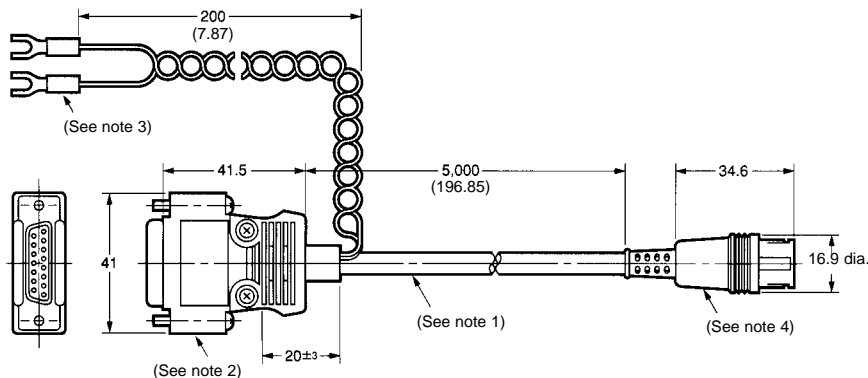
Note: 1. 6-dia. oil-proof PVC, shielded 12-conductor cable (7/0.18 dia.);
        standard length: 5 m
      2. Connected to CQM1-CPU44-E.
      3. 12 to 24 VDC
      4. Connected to Encoder.

7

System Configuration Using a Resolution of 1,024 per Rotation

A combination of the CQM1-CPU4-4E and E6C2-AG5C ensures easy output angle setting for cam control in 360° or BCD mode.
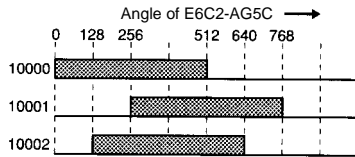
E6C2-AG5C

With a resolution of 1,024 per rotation

Output Unit (100 words)

E69-DC5 5M Connection Cable

CQM1-CPU44-E
Two Encoder inputs can be controlled independently.

Mode Setting of CQM1-CPU44-E

Set port 1 to BCD mode and 10 bits

DM 6643 | 0001

Output Timing

Angle of E6C2-AG5C ⟶

0 128 256   512 640 768

10000

10001

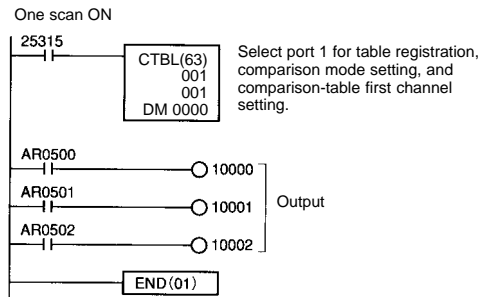10002

Ladder Program Example

Use the CTBL instruction of the CQM1-CPU44-E to register a maximum of eight comparison tables for output angle setting.
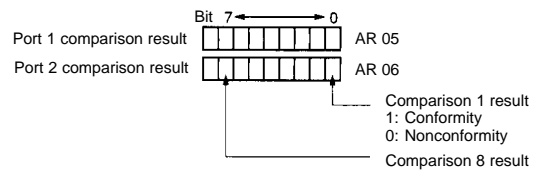
One scan ON

25315

CTBL(63)
001
001
DM 0000

Select port 1 for table registration, comparison mode setting, and comparison-table first channel setting.

AR0500 ——————————○ 10000

AR0501 ——————————○ 10001 ⎤ Output

AR0502 ——————————○ 10002 ⎦

END(01)

Example of DM Setting for Comparison Table

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

Note: An upper or lower limit can be set with integers in BCD mode and 5° increments in 360° mode. Subroutine numbers are set for interrupt processing.

Internal Bits of CQM1-CPU44-E

• Range Comparison Result

Each bit of the CQM1-CPU44-E CPU Unit's words AR 05 and AR 06 turns ON only when the comparison range coincides with the angle of E6C2-AG5C.

Bit 7 ⟵——⟶ 0

Port 1 comparison result   AR 05

Port 2 comparison result   AR 06

Comparison 1 result
1: Conformity
0: Nonconformity

Comparison 8 result

• Present Value Read

The gray code signals of the E6C2-AG5C are automatically converted into BCD or 360° code signals and read through the CQM1-CPU44-E CPU Unit's words AR 232 and AR 234. The present value can be used for ladder programs.
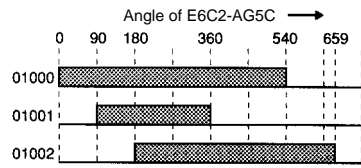
Port 1 angle | ∗∗∗∗ | Word 232

Port 2 angle | ∗∗∗∗ | Word 234
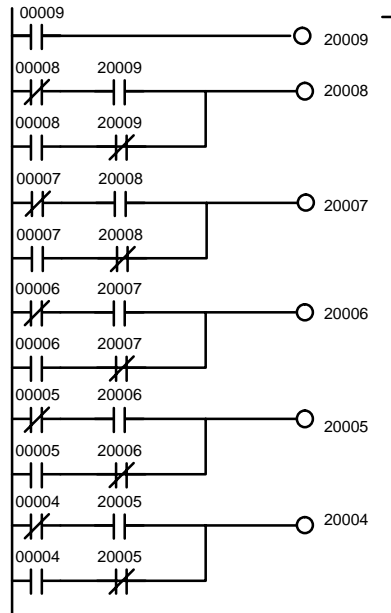
■ CONNECTING TO CPM1A USING A RESOLUTION OF 720 PER ROTATION

E6C2-AG5C

CPM1A-20CDR-□
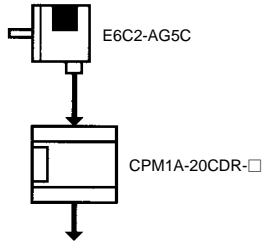
Wiring Between E6C2-AG5C and CPM1A

Output signal from E6C2-AG5C	Input signal to CPM1A
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

Angle of E6C2-AG5C →

0 90 180 360 540 659

01000
01001
01002

Ladder Program

00009 — 20009

00008 / 20009, 00008 20009 — 20008

00007 / 20008, 00007 20008 — 20007

00006 / 20007, 00006 20007 — 20006

00005 / 20006, 00005 20006 — 20005

00004 / 20005, 00004 20005 — 20004

Converts a gray code signal into a BIN code signal (word 200).

00003 / 20004, 00003 20004 — 20003

00002 / 20003, 00002 20003 — 20002

00001 / 20002, 00001 20002 — 20001

00000 / 20001, 00000 20001 — 20000

Converts a gray code signal into a BIN code signal (word 200).

(Always ON)
25313
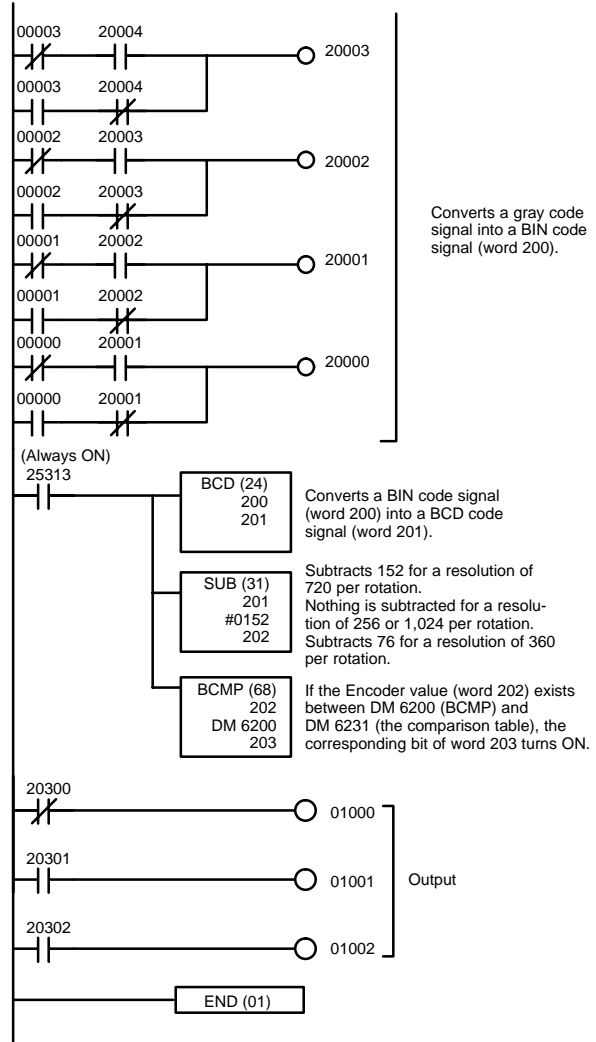
BCD (24) 200 201 — Converts a BIN code signal (word 200) into a BCD code signal (word 201).

SUB (31) 201 #0152 202 — Subtracts 152 for a resolution of 720 per rotation. Nothing is subtracted for a resolution of 256 or 1,024 per rotation. Subtracts 76 for a resolution of 360 per rotation.

BCMP (68) 202 DM 6200 203 — If the Encoder value (word 202) exists between DM 6200 (BCMP) and DM 6231 (the comparison table), the corresponding bit of word 203 turns ON.

20300 — 01000
20301 — 01001   Output
20302 — 01002

END (01)

Example of DM Setting for Comparison Table

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

■ GRAY-TO-BINARY CONVERSION CIRCUIT REFERENCE

Note: This circuit example is for 10-bit signals. For 9-bit signals, input Vin into the XOR of 2^8, and for 8-bit signals, input Vin into the XOR of 2^7.
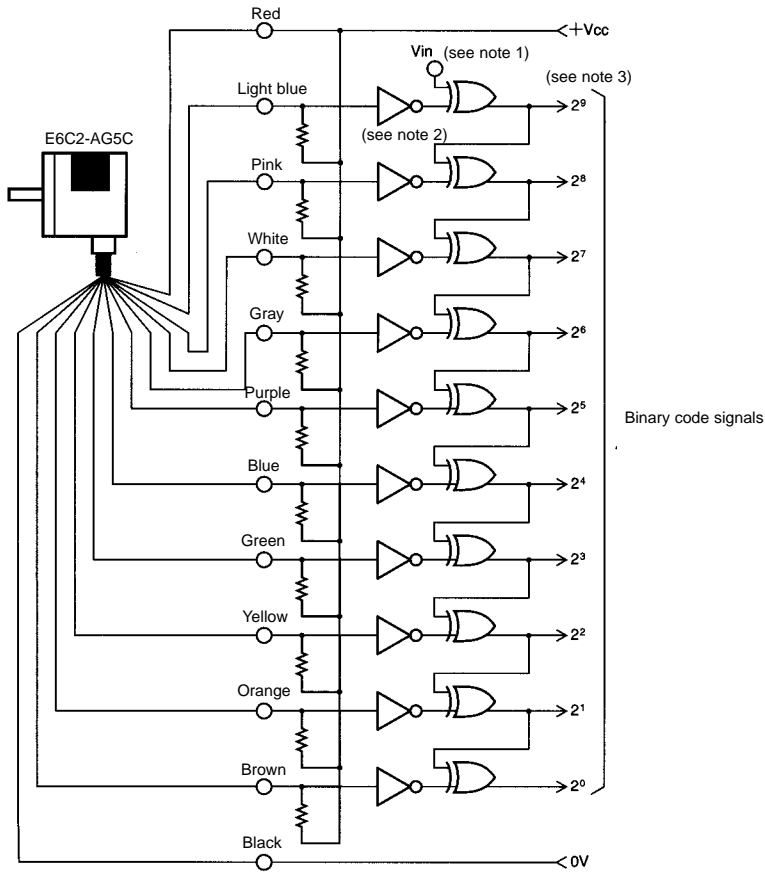
Note: 1. Signal can be converted into positive-logic binary code signals if 0 V is connected to Vin.
2. Inverter
3. Exclusive OR (EOR)

NOTE: DIMENSIONS SHOWN ARE IN MILLIMETERS. To convert millimeters to inches divide by 25.4.