Multi-turn Absolute Rotary Encoder

- External diameter of 50 mm.
- Resolution: Single turn: 500 divisions, Multi-turn: -128 to 127 turns
- Easy origin alignment using origin reset function when building into equipment.
- Need for backup power supply eliminated by multi-turn data storage function.
- Product lineup includes both Solid-shaft and Hollow-shaft Models.

⚠ Be sure to read *Safety Precautions* on page 4.

C E

Ordering Information

Encoders [Refer to *Dimensions* on page 5.]

Shaft	Connection method	Model
Shaft model	Pre-wired Model	**E6C-NN5C 2M**
Shaft model	Pre-wired Connector Model	**E6C-NN5C-C 2M**
Hollow shaft	Pre-wired Model	**E6C-NN5CA 2M**
Hollow shaft	Pre-wired Connector Model	**E6C-NN5CA-C 2M**

Accessories (Order Separately)
[Dimensions: Refer to *Accessories* for dimensions.]

| Name	Model	Remarks
Couplings	**E69-C06B**	---
	E69-C68B	Different end diameter
	E69-C610B	Different end diameter
	E69-C06M	Metal construction
Flanges	**E69-FCA**	---
	E69-FCA02	Servo Mounting Bracket E69-2 Servo Mounting Bracket provided.
Servo Mounting Bracket	**E69-2**	Three brackets in a set.

Refer to *Accessories* for details.

Ratings and Specifications

Item	Model	E6C-NN5C E6C-NN5CA	E6C-NN5C-C E6C-NN5CA-C
Power supply voltage		12 VDC −10% to 24 VDC +10%, ripple (p-p): 5% max.	
Current consumption*1		80 mA max.	
Resolution	Single-turn absolute	500 divisions	
	Multi-turn absolute	−128 to 127 turns*2, *3	
Rotational limitation at power failure		±80°*4	
Output	Output code	Binary	
	Alarm output	Counter overflow output*5	
	Output configuration	NPN open-collector output	
	Output capacity	Applied voltage: 30 VDC max. Sink current: 10 mA max. (counter overflow output: 30 mA) Residual voltage: 0.4 V max.	
	Logic	Negative logic	
	Direction	Code increases for CW (when viewed from end of shaft)	
Input	Input signals	Single-turn data reset, multi-turn data reset*6	
	Input current	1 mA max.	
	Input logic	Low active, normally open	
	Input time	100 ms min.	
Maximum response frequency		12.5 kHz	
Rise and fall times of output		1 μs max.*7	
Starting torque		2.9 mN·m max.	
Moment of inertia		1.5×10^{-6} kg·m² max.	
Shaft loading	Radial	30 N	
	Thrust	20 N	
Maximum permissible speed		1,500 r/min	
Ambient temperature range		Operating: −10 to 55°C (with no icing), Storage: −25 to 65°C (with no icing) *8	
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 IP50	
Connection method		Pre-wired Models (Standard cable length: 2 m)	Connector Models (Standard cable length: 2 m)
Material		Case: ABS, Main unit: PPS, Pressboard panel: SUS304, Shaft: SUS420J2	
Weight (packed state)		Approx. 400 g	
Accessories		Instruction manual Note: Coupling, mounting bracket and hex-head spanner are sold separately.	

Note: The data outputs will all turn OFF as soon as the main power supply turns OFF. Data is not saved.
*1. An inrush current of approximately 8 A will flow for approximately 6.5 ms when the power is turned ON.
*2. Negative values for multi-turn absolute values are express as two's complements (see code at right).
*3. Multi-turn data will change approximately 10 μs after single-turn data. Allow for this when reading data.

Single-turn absolute data
Multi-turn absolute data
Approx. 10 μs
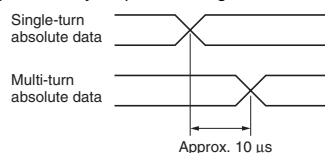
*4. When the power supply is interrupted, multi-turn detection is not performed and multi-turn data is compensated by comparison to the data that existed before the power supply was interrupted. If a rotation operation exceeding ±80° is performed from the position when the main power supply turns OFF, correct multi-turn data will be lost. The application must be set up so that no rotation operations are performed that exceed this stipulation.
*5. Output when the multi-turn counter exceeds the −128 to 127 counting range. This error flag will be reset if the count data returns to within the counting range.
*6. The single-turn data and multi-turn data reset signals can be input independently to reset the single-turn data to address 0 and the multi-turn data to 0 rotations.
*7. Use an Encoder cable length of 10 m max. When using a cable of 10 m or less, read the code 10 μs or more after the LSB (2^0) of the code changes.
*8. The device coupled to the Encoder shaft must also satisfy the ambient temperature condition.
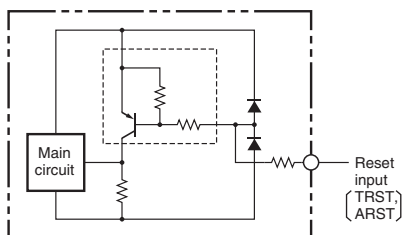
Multi-turn absolute value code

Multi-turn absolute value	Code
10	0 0 0 0 1 0 1 0
9	0 0 0 0 1 0 0 1
8	0 0 0 0 1 0 0 0
7	0 0 0 0 0 1 1 1
6	0 0 0 0 0 1 1 0
5	0 0 0 0 0 1 0 1
4	0 0 0 0 0 1 0 0
3	0 0 0 0 0 0 1 1
2	0 0 0 0 0 0 1 0
1	0 0 0 0 0 0 0 1
0	0 0 0 0 0 0 0 0
−1	1 1 1 1 1 1 1 1
−2	1 1 1 1 1 1 1 0
−3	1 1 1 1 1 1 0 1
−4	1 1 1 1 1 1 0 0
−5	1 1 1 1 1 0 1 1
−6	1 1 1 1 1 0 1 0
−7	1 1 1 1 1 0 0 1
−8	1 1 1 1 1 0 0 0
−9	1 1 1 1 0 1 1 1
−10	1 1 1 1 0 1 1 0
−11	1 1 1 1 0 1 0 1

The expressions for negative values given above can be achieved by reversing 1's and 0's and then adding 1.
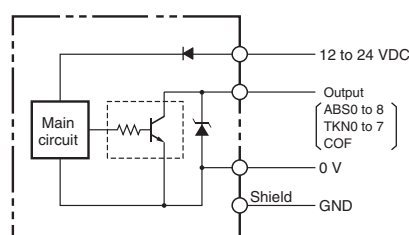
I/O Circuit Diagrams
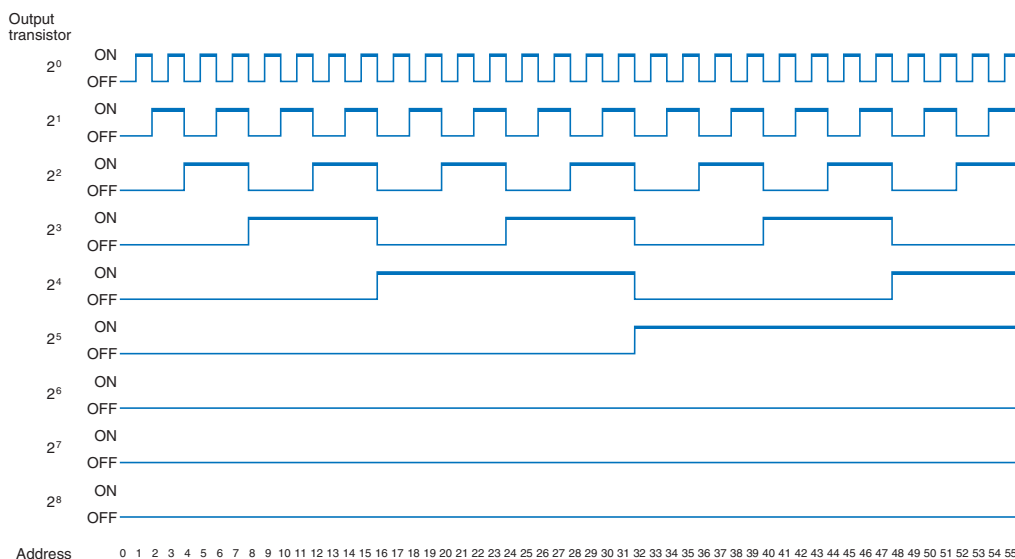
E6C-NN5C, E6C-NN5CA	E6C-NN5C-C, E6C-NN5CA-C

Input Circuit diagram

Main circuit — Reset input $\left\{\begin{array}{l}\text{TRST,}\\\text{ARST}\end{array}\right\}$

Output Circuit Diagram

Main circuit — 12 to 24 VDC / Output $\left\{\begin{array}{l}\text{ABS0 to 8}\\\text{TKN0 to 7}\\\text{COF}\end{array}\right\}$ / 0 V / Shield — GND

Note: The circuit is the same for all bit outputs.
Each Rotary Encoder has one main circuit.

Output Mode

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

Output transistor

2^0, 2^1, 2^2, 2^3, 2^4, 2^5, 2^6, 2^7, 2^8 (ON/OFF)

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 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55

Connections
E6C-NN5C(A)

Wire color: grey			Wire color: Black	
Signal	**Meaning**	**Color**	**Signal**	**Meaning**
ABS0		2^0 Brown	TKN0		2^0
ABS1		2^1 Orange	TKN1		2^1
ABS2		2^2 Yellow	TKN2		2^2
ABS3	Single-turn absolute data	2^3 Green	TKN3	Multi-turn absolute data	2^3
ABS4		2^4 Blue	TKN4		2^4
ABS5		2^5 Purple	TKN5		2^5
ABS6		2^6 Gray	TKN6		2^6
ABS7		2^7 White	TKN7		2^7
ABS8		2^8 Pink	COF	Counter overflow alarm	
ARST	Single-turn data reset	Light blue	TRST	Multi-turn data reset	
GND	0 V*	Black	GND	0 V*	
Vcc	12 to 24 VDC*	Red	Vcc	12 to 24 VDC*	
SHIELD	Shield	—	SHIELD	Shield	

Connections
E6C-NN5C(A)-C

Pin No.	Signal	Meaning	Pin No.	Signal	Meaning
A1	ABS0		2^0	B1	TKN0		2^0
A2	ABS1		2^1	B2	TKN1		2^1
A3	ABS2		2^2	B3	TKN2		2^2
A4	ABS3	Single-turn absolute data	2^3	B4	TKN3	Multi-turn absolute data	2^3
A5	ABS4		2^4	B5	TKN4		2^4
A6	ABS5		2^5	B6	TKN5		2^5
A7	ABS6		2^6	B7	TKN6		2^6
A8	ABS7		2^7	B8	TKN7		2^7
A9	ABS8		2^8	B9	COF	Counter overflow alarm	
A10	ARST	Single-turn data reset	B10	TRST	Multi-turn data reset	
A11	GND	0 V*	B11	GND	0 V*	
A12	Vcc	12 to 24 VDC*	B12	Vcc	12 to 24 VDC*	
A13	SHIELD	Shield	B13	SHIELD	Shield	

* We recommend connecting both Vcc and GND.
Note: Connector Model
PS-D4C26
(Hood: PS-HD26)
(Japan Aviation Electronics Industry, Ltd.)
Connector:
PS-26PE-D4T☐-M☐
(Straight Model)
PS-26PE-D4LT☐-M☐
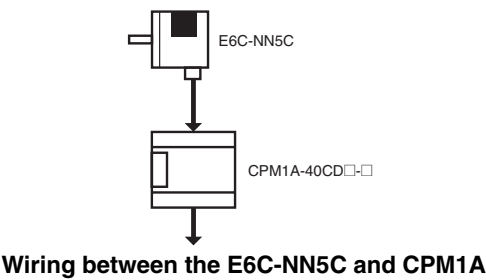(Angle Model)
(Japan Aviation Electronics Industry, Ltd.)

Pin Arrangement

A13 B13
A12 B12
A11 B11
A10 B10
A9 B9
A8 B8
A7 B7
A6 B6
A5 B5
A4 B4
A3 B3
A2 B2
A1 B1
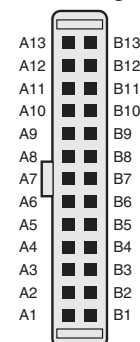
Note: Normally connect GND to 0 V or to an external ground.

Programmable Controller Connection Example

Connection to the CPM1A

E6C-NN5C

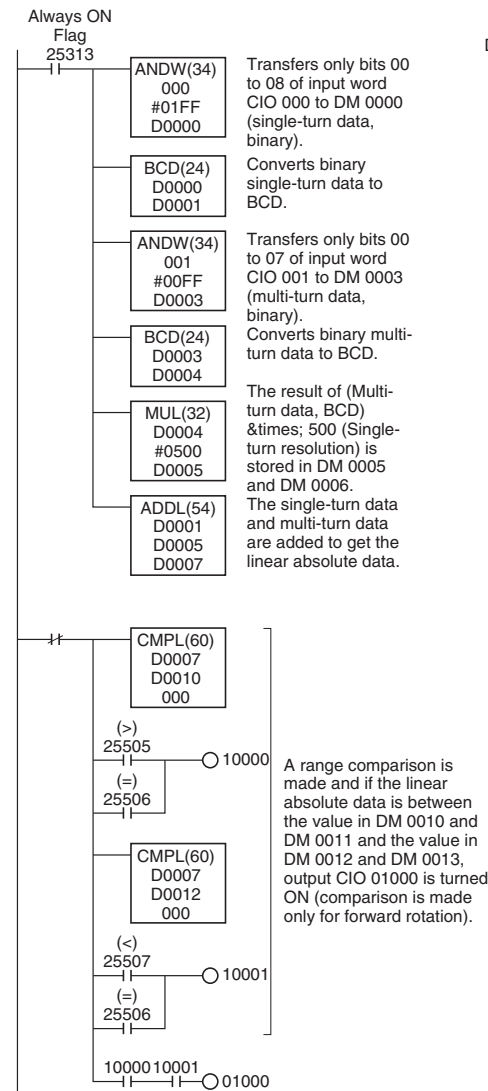CPM1A-40CD□-□

Wiring between the E6C-NN5C and CPM1A

E6C-NN5C output signal			CPM1A input signal
Single-turn data	Code Cable color: Gray	Brown (2^0)	0 0 0 0 0
		Orange (2^1)	0 0 0 0 1
		Yellow (2^2)	0 0 0 0 2
		Green (2^3)	0 0 0 0 3
		Blue (2^4)	0 0 0 0 4
		Purple (2^5)	0 0 0 0 5
		Gray (2^6)	0 0 0 0 6
		White (2^7)	0 0 0 0 7
		Pink (2^8)	0 0 0 0 8
Multi-turn data	Code Cable color: Black	Brown (2^0)	0 0 1 0 0
		Orange (2^1)	0 0 1 0 1
		Yellow (2^2)	0 0 1 0 2
		Green (2^3)	0 0 1 0 3
		Blue (2^4)	0 0 1 0 4
		Purple (2^5)	0 0 1 0 5
		Gray (2^6)	0 0 1 0 6
Sign + = 0 − = 1		White (2^7)	0 0 1 0 7

Output Timing

E6C-NN5C absolute data ⟷

1 turn 2 turns   127 turns
0   500 1000   9000 10500   63500

                                   → 63999
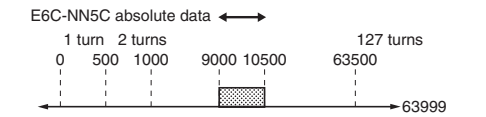
Ladder Programming Example

Always ON Flag 25313

ANDW(34) 000 #01FF D0000	Transfers only bits 00 to 08 of input word CIO 000 to DM 0000 (single-turn data, binary).
BCD(24) D0000 D0001	Converts binary single-turn data to BCD.
ANDW(34) 001 #00FF D0003	Transfers only bits 00 to 07 of input word CIO 001 to DM 0003 (multi-turn data, binary).
BCD(24) D0003 D0004	Converts binary multi-turn data to BCD.
MUL(32) D0004 #0500 D0005	The result of (Multi-turn data, BCD) × 500 (Single-turn resolution) is stored in DM 0005 and DM 0006.
ADDL(54) D0001 D0005 D0007	The single-turn data and multi-turn data are added to get the linear absolute data.

CMPL(60) D0007 D0010 000

(>) 25505 ——○ 10000
(=) 25506

A range comparison is made and if the linear absolute data is between the value in DM 0010 and DM 0011 and the value in DM 0012 and DM 0013, output CIO 01000 is turned ON (comparison is made only for forward rotation).

CMPL(60) D0007 D0012 000

(<) 25507 ——○ 10001
(=) 25506

10000 10001 ——○ 01000

Note: The above ladder programming is only for reference. Data may not always be input properly depending on the data read timing of the Programmable Controller. If data is missed and there is a large difference, e.g., 100 or more, between the current data and the previous data, discard the data the add ladder programmed to re-read the data. (If both the single-turn data and multi-turn data are read at the same time when the multi-turn data changed, the data will be incorrect. Refer to "*3" under *Ratings and Specifications*.

DM Area Settings

DM0000	
0001	
0002	0000
0003	
0004	
0005	
0006	
0007	
0008	
0009	
0010	9000
0011	0000
0012	0500
0013	0001

Work area for data programming

Linear absolute data

Comparison data

Upper limit setting

Lower limit setting

| **CPM1A** | For details, refer to the *SYSMAC CPM1/CPM1A/CPM2A/CPM2C/SRM1(-V2) Programming Manual* (W353). |

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

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.
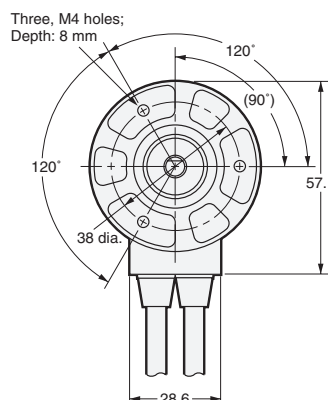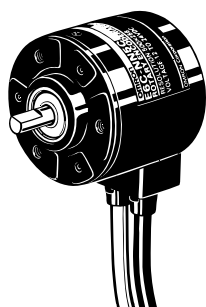
Dimensions

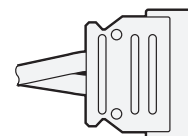Tolerance class IT16 applies to dimensions in this datasheet unless otherwise specified.

Encoder

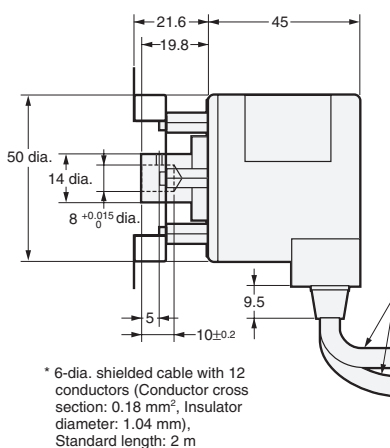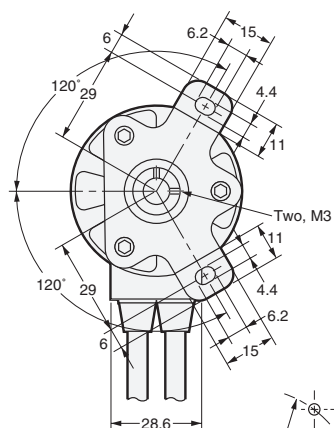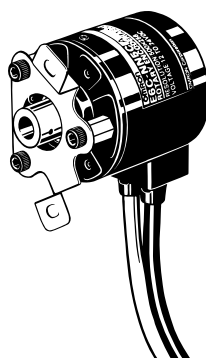**E6C-NN5C (Pre-wired Model)**
E6C-NN5C-C (Connector Model)

Three, M4 holes;
Depth: 8 mm

120°
(90°)
120°
120°
57.1
38 dia.
28.6

(65)
(20)
45
15
5
20.2
10
$6_{-0.012}^{0.005}$ dia.
1
$25_{-0.15}^{0}$ dia.
50 dia.
9.5

* 6-dia. shielded cable with 12 conductors (Conductor cross section: 0.18 mm², Insulator diameter: 1.04 mm), Standard length: 2 m
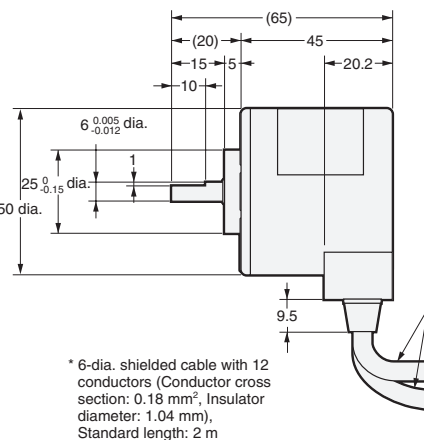
For the E6C-NN5C-C

Connector Model
(Japan Aviation Electronics Industry, Ltd.)
PS-D4C26
(Hood: PS-HD26)

E6C-NN5CA (Pre-wired Model)
E6C-NN5CA-C (Connector Model)

6 6.2 15
120° 29
4.4
11
Two, M3
11
120° 29
4.4
6.2
6 15
28.6

21.6
19.8
45
50 dia.
14 dia.
$8_{0}^{+0.015}$ dia.
9.5
5
10±0.2

* 6-dia. shielded cable with 12 conductors (Conductor cross section: 0.18 mm², Insulator diameter: 1.04 mm), Standard length: 2 m

For the E6C-NN5CA-C
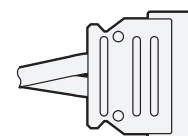
Connector Model
(Japan Aviation Electronics Industry, Ltd.)
PS-D4C26
(Hood: PS-HD26)

Mounting Hole Dimensions (View from Hollow Shaft Side)

R29±0.1
50.2±0.1
Rotational shaft center
R29±0.1
Two, M4
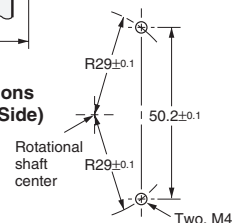
Accessories (Order Separately)

Couplings
E69-C06B
E69-C68B
E69-C610B
E69-C06M
Refer to *Accessories* for details.

Flanges
E69-FCA
E69-FCA02

Servo Mounting Bracket
E69-2

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