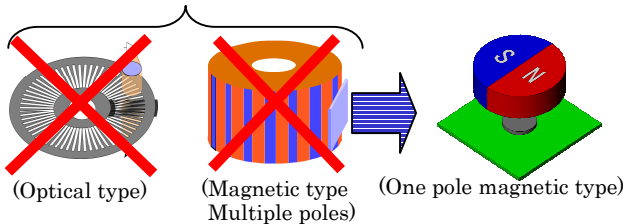# Sankyo
## All for dreams

# Programmable Magnetic Encoder EA Series

EA Series consists of remarkably small rotary encoders which adopt a one pole magnetic type in order to respond downsizing demands from the market.

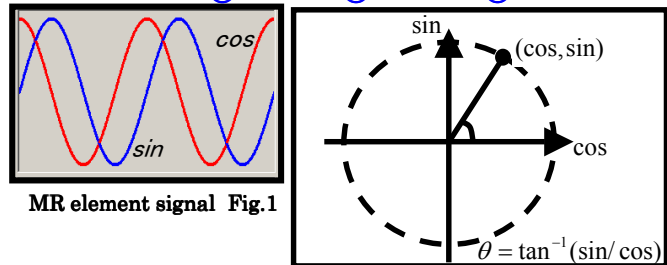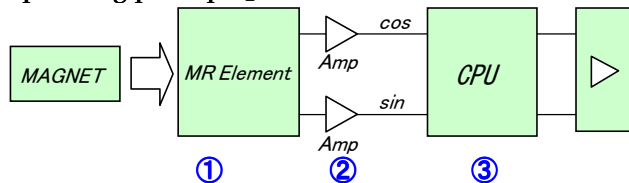**Difficult to downsize in conventional types**    **EA Series**

(Optical type)    (Magnetic type Multiple poles)    (One pole magnetic type)

**Simple structure is indispensable to downsizing.**

## 【Features 】

・**Absolute Encoder**
  Single turn absolute encoder

・**Small & Thin Type**
  Optimum size for □20mm stepping motor

・**Strong for Bad Environments**
  Adaptable for heavy dust and oil mist environments

・**Easy Installation**
  Installation completed in little minute

・**Parameters Allow for Variable Settings**
  **(Patent Pending)**
  Parameters can be set by Windows based software and TTL level UART communication.

  <Example of parameter settings>
  ・Switching of A/B phase /serial communication
  ・Origin adjustment of absolute
  ・Change of resolution
  ・Setting of output

    Example) Setting to Z/U/V/W phase signal

・**Two Types of Interfaces Available**
  Open collector and line driver
  Two types of interfaces available

## 【Operating principle】

MAGNET → MR Element → Amp (cos) → CPU → Amp (sin)

①    ②    ③

MR element signal  Fig.1

$$\theta = \tan^{-1}(\sin/\cos)$$

Fig. 2

<Description of operating principle>

(1) Change of the magnetic flux is detected by MR element.
(2) Sin and cos signals (Fig.1) which are output by MR element are amplified and captured in a CPU by AD converter.
(3) Angle is calculated through ATAN calculation (Fig. 2) by a CPU.

## 【Angle accuracy】

20℃

Master - Error (deg) vs Master encoder (deg)

cw — ccw

# NIDEC SANKYO CORPORATION
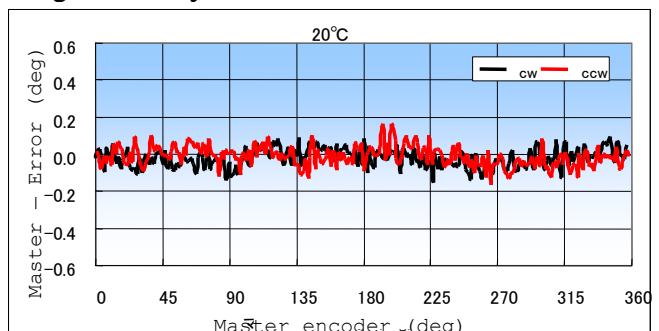
## ◆How to Install

**1. Assembling magnet**
Assemble a magnet to a shaft, insert a height setting jig and fix the magnet with screws.

**2. Placing and assembling spacer**
Place a spacer, insert a centering jig and tighten the screws.

**3. Placing and assembling spacer**
Place an encoder on the spacer and tighten it with bolts.

complete

*Easy installation!*
*Installation completed little minute*

\* Spacer should be prepared by customer depending on shaft protruding dimensions.

## ◆Input/Output Interface

### 【Connector Pin Location】

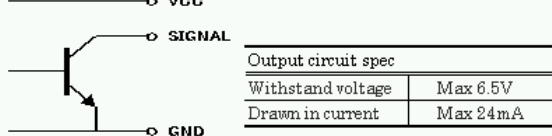| Pin No. | < Open collector > A/B phase Terminal name | I/O | Content | Serial communication Terminal name | I/O | Content | <Line driver > A/B phase Terminal name | I/O | Content | Serial communication Terminal name | I/O | Content |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | VCC | – | Voltage | VCC | – | Voltage | VCC | – | Voltage | VCC | – | Voltage |
| 2 | GND | – | GND | GND | – | GND | GND | – | GND | GND | – | GND |
| 3 | NC | IN | No Connection | REQ | IN | Signal | NC | IN | No Connection | REQ | IN | Signal |
| 4 | A | OUT | A phase | NC | OUT | No Connection | -OUT:0 | OUT | -Z phase or -OUTterminal0 | -SPI_SDO | OUT | -Communication data |
| 5 | OUT:0 | OUT | Z phase or OUTterminal0 | SPI_SDO | OUT | Communication data | +OUT:0 | OUT | +Z phase or +OUTterminal0 | +SPI_SDO | OUT | +Communication data |
| 6 | OUT:1 | OUT | U phase or OUTterminal1 | SPI_CLK | OUT | Communication clock | +B | OUT | +Bphase | +SPI_CLK | OUT | +Communication clock |
| 7 | B | OUT | B phase | NC | OUT | No Connection | -B | OUT | -Bphase | -SPI_CLK | OUT | -Communication clock |
| 8 | OUT:2 | OUT | V phase or OUTterminal2 | OUT:2 | OUT | V phase or OUTterminal2 | -A | OUT | -Aphase | NC | OUT | No Connection |
| 9 | OUT:3 | OUT | W phase or OUTterminal3 or error output | OUT:3 | OUT | W phase or OUTterminal3 | +A | OUT | +Aphase | NC | OUT | No Connection |

Encoder connector model No.  : 501568-0907 manufactured by molex
Corresponding connector model No. : Housing 501330-0900 manufactured by molex
Contact 501334-0000 manufactured by molex

※USB cable of not longer than 3m

### 【Interface Circuit】

●Output circuit
NPN open collector (SN74LV07 or equivalent) is adopted.

VCC
SIGNAL
GND

| Output circuit spec | |
|---|---|
| Withstand voltage | Max 6.5V |
| Drawn in current | Max 24mA |

※Because the output frequency is 2 MHz in serial communication, set the recommended pull-up resistance value of SPI_SDO and SPI_CLK to approximately 390Ω.
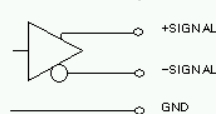
●Input circuit
SN74LVC or equivalent is adopted.

| Input voltage range | |
|---|---|
| High level | 3.5V MIN |
| Low level | 0.8V MAX |

●Output circuit
RS422A Line driver (AM26C31 or equivalent) is adopted

VCC
+SIGNAL
–SIGNAL
GND

●Input circuit
SN74LVC or equivalent is adopted

| Input voltage range | |
|---|---|
| High level | 3.5V MIN |
| Low level | 0.8V MAX |

### 【Serial Communication Specifications】

| Name | Content |
|---|---|
| Control method | ONDEMAND scheme (request input/angle output) |
| Communication scheme | Synchronous serial communication (SPI communication) |
| Clock | 2MHz |
| Data | 16bit |
| Transmission data direction | MSB first  (settable to LSB) |

64us
0.5～30us
REQ
40～45us
0.5us
SPI CLK
SPI_SDO   15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
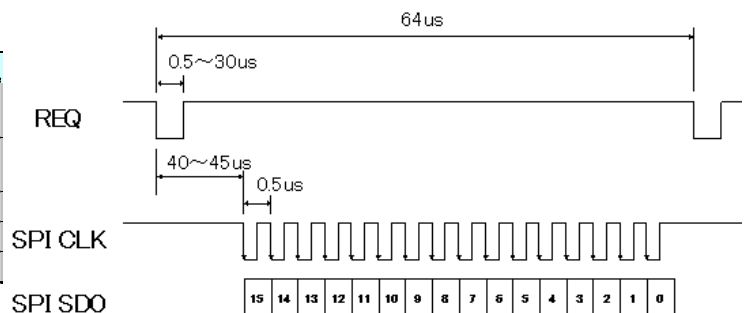
## ◆Parameter Change Function

Parameters in the encoder can be changed by Windows based software.

### 1. Output mode
Two types of output modes of A/B phase and serial communication (SPI communication method) can be selected.

### 2. Resolution  [Count/Turn]
Any division number up to 8192 [C/T] for A/B phase and up to 32768 [C/T] for serial communication can be set.

### 3. Encoder count-up direction
Direction of encoder count-up and count-down to the rotating direction can be set.


**Parameter setting software sample (Note 1)**

### 4. Setting output phase
In addition to A/B phase, open collector type has four outputs and line driver type has one output .
These outputs can be switched to HI level or LO level at any position in one rotation by parameter setting.
ex) in the case of four outputs: U-phase, V-phase, W-phase and Z-phase outputs can be set.

### 5. Origin adjustment
Origin of absolute for one rotation can be changed with the encoder installed on the customer's mechanism part.

### 6. Write to memory
Memory area (64 Byte) open to a customer is prepared in the encoder. Customer's Specific information can be recorded in this area.
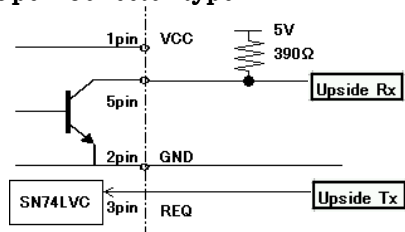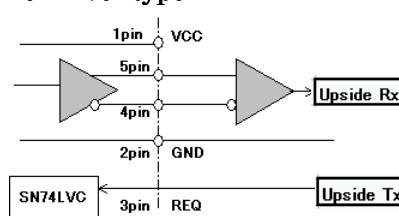ex) Serial number, motor specific information etc.
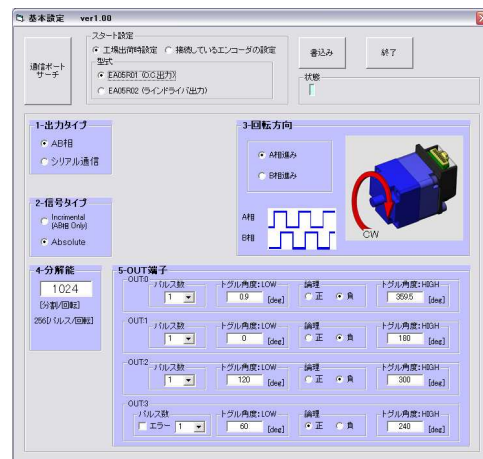
### 【How to connect 】

REQ signal terminal and SPI_SDO signal terminal are used as UART (5V-TTL level) in parameter setting communication.Connect the Rx and Tx signals on the upper level side as shown in the following diagram.

**Open Collector type**



**Line Driver type**



### 【Communication format 】

| Synchronization method | Start-stop synchronous communication |
|---|---|
| Control method | Command / Response method |
| Transmission method | Full-duplex communication method |
| Communication setting | 9600 bps, data 8 bit, no parity, STOP bit: 1 Bit |

### 【Factory shipping setting 】

| Parameter setting item | Setting content |
|---|---|
| Output mode | A/B phase |
| Resolution | 1024 [C/T] (256 [P/T]) |
| A/B phase direction | A-phase advance (in CW rotation) |
| OUT terminal setting | Z, U, V, W phase [1 P/T] |
| A/B phase mode | Absolute |
| Error signal | Output in combination of U, V and W phases |

**(Note 1) Parameter setting software sample**
For the communication method, its source is published as sample software. Read / write of the memory can be utilized online by mounting into a customer's control device. Sample software for each function such as (1) Encoder mode / parameter setting mode switching, (2) Basic function setting, (3) Edit of memory and (4) Origin adjustment can be downloaded from the following URL.
http://www.nidec-sankyo.co.jp/pro/parts/01.htm

| type | EA05R01 | EA05R03 |
|---|---|---|
| Output interface | Open Collector | Line Driver type(RS422-Abase) (Output driver AM26C31corresponding) |
| Output phase | 4 output (example : Z、U、V、W phase) | 1 output (example : Z phase) |

**Absolute maximum rating**

| Spec item | | Content |
|---|---|---|
| Voltage | VCC | DC -0.3V ～ +5.5 V |
| Input voltage | Vin | 0 ～ VCC V |
| Operating ambient temp | | -10℃ ～ +85℃ |
| Operating ambient humidity | | 20 ～ 80%RH (No codensation) |
| Storage temp | | -10℃ ～ +90℃ |

**Mechanical spec**

| Spec item | | Content |
|---|---|---|
| External disturbance magnetic field | | Within ±2m |
| Mass | Sensor part | 6.0g or less |
| | Magnetic part | 5.5g or less |
| Magnet inertia moment | | 0.85 g・cm² |

**Electical spec**

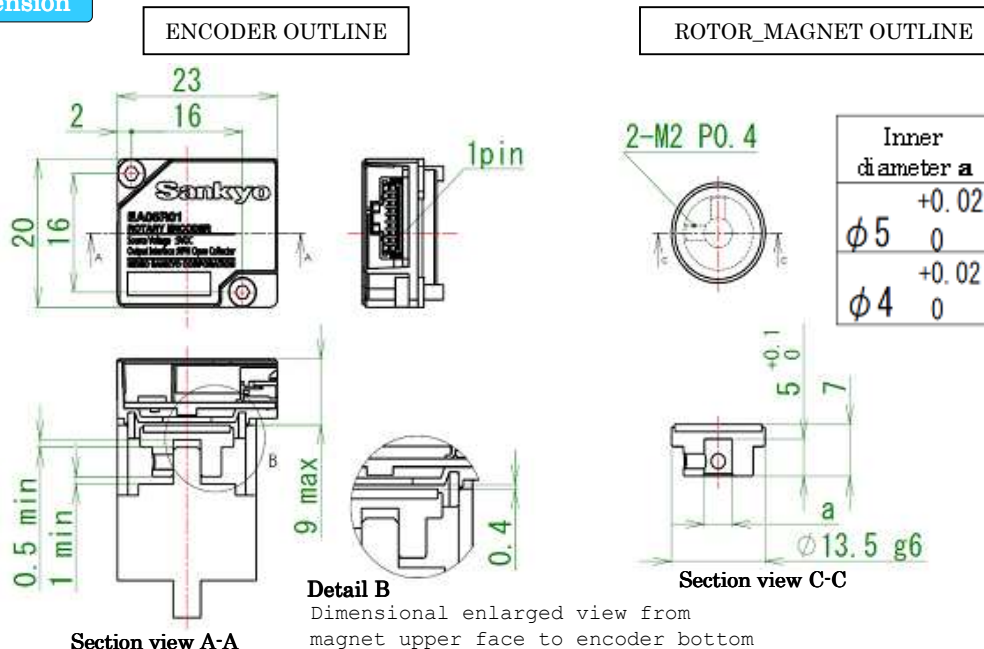| Spec item | A/B phase | Serial communication |
|---|---|---|
| Recommended power supply | DC 5V ± 10% | |
| Comsumption current | 20mA or less | |
| Output method | A/B phase | Binary (Serial) |
| Maximum response frequency (Response pulse number) | 60 KHz | — |
| Allowable maximum rotating speed (Electical) | Note 1 | Note 2 |
| Maximum resolution | 8192 [C／T] (2048 [P／T]) | 32768 [C／T] |

Note1)Allowable maximum rotating speed in A/B phase mode Maximum rotation speed is specified from resolution [C/T] (after multiplying by four ) and maximum response frequency [Hz].

Note2) Allowable maximum rotating speed in serial communication mode Maximum rotation speed is specified from request frequency [sec].

$$\text{Maximum rotation speed[rev/min]} = \frac{\text{Maximum response frequency}\ (60[\text{KHz}])}{\text{Resolution}} = \times 60 \times 4$$

$$\text{Maximum rotation speed [rev/min]} = \frac{30}{\text{request frequency}}$$

◆Outline Dimension

ENCODER OUTLINE

ROTOR_MAGNET OUTLINE



Section view A-A

**Detail B**
Dimensional enlarged view from magnet upper face to encoder bottom

Section view C-C

| Inner diameter a | |
|---|---|
| φ5 | +0.02 / 0 |
| φ4 | +0.02 / 0 |

Note) The above contents may be subject to change without prior notice.