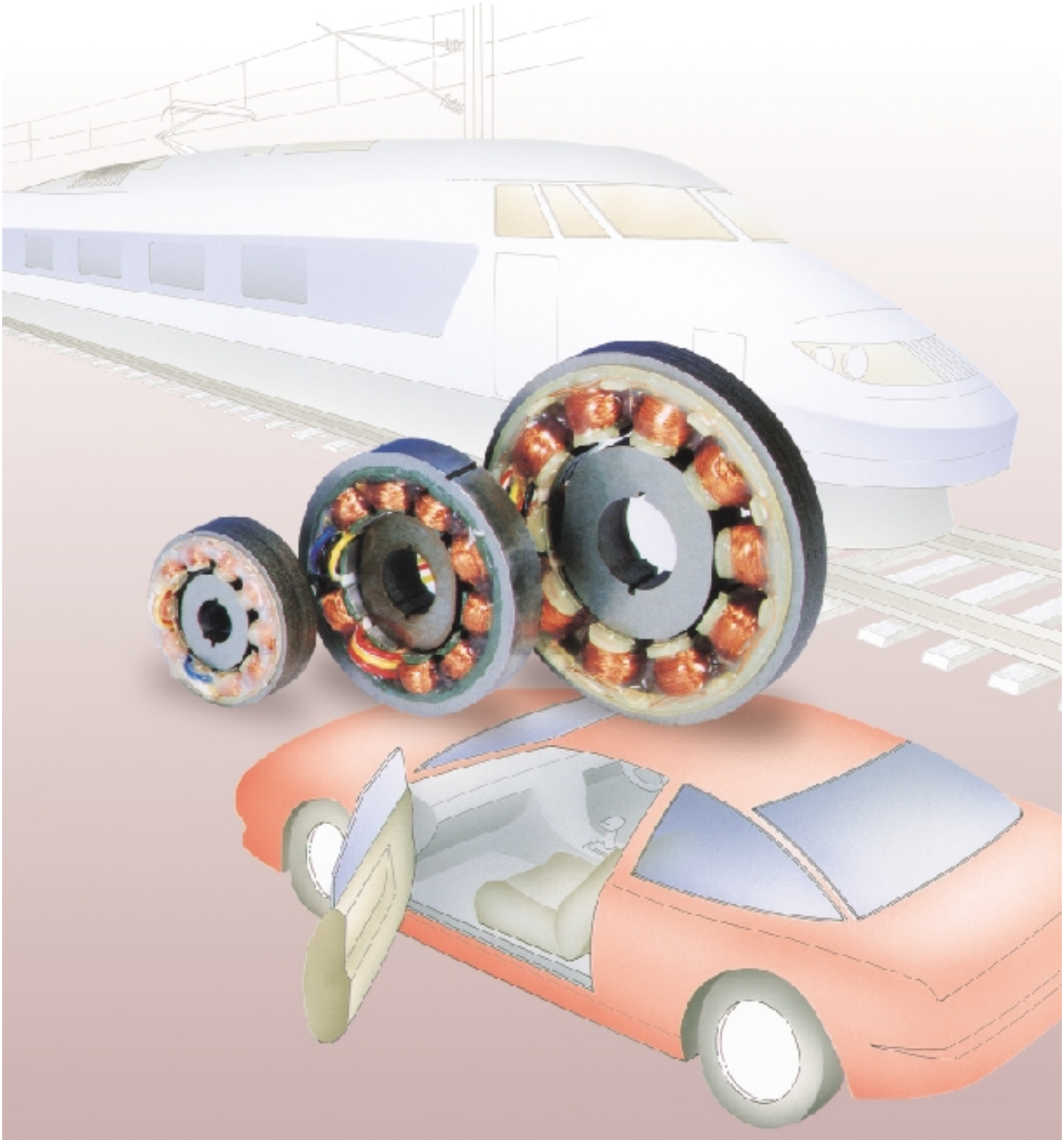
Singlsyn®

(Superior Flat Absolute Angle Sensor)



ENCODER TECHNOLOGY

Singlsyn®

Patent Pending

(Superior Flat Absolute Angle Sensor)

SCOPE

The Singlsyn is the latest type of Absolute Angle Sensor. This is a superior design of sensor with an extremely thin structure, wide usable temperature and humidity range, resistance to other hard environmental conditions, and high reliability.
(Singlsyn is our trade mark for the VR type Resolver.)

SPECIAL FEATURES

■ **Extremely Thin Dimension**
Singlsyn fits in the smallest spaces because of its extremely thin design as a built-in structure.

■ **Wide Temperature Range**
-55°C ~ +155°C

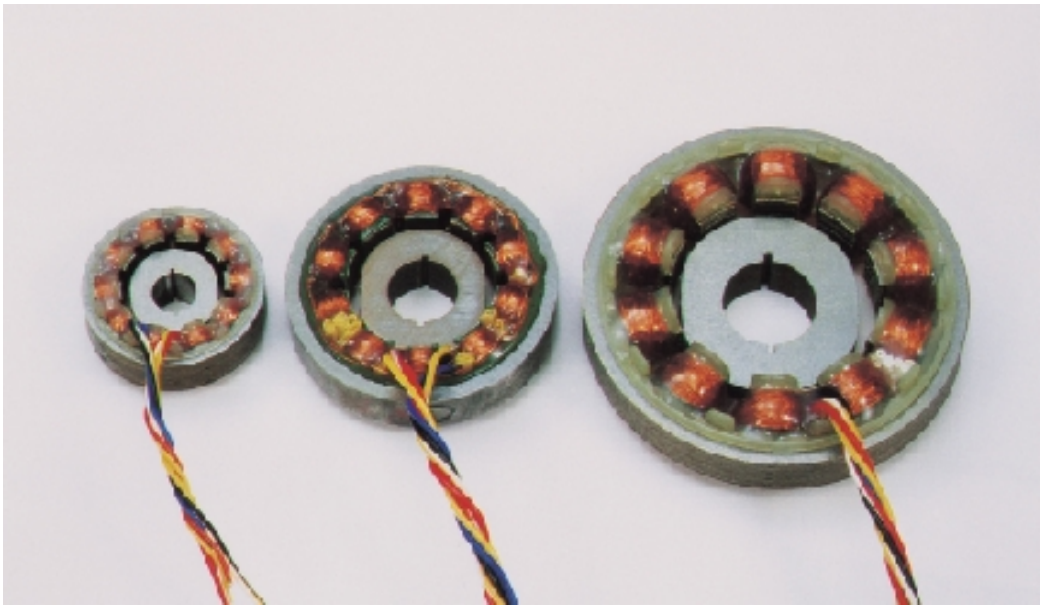
■ **Robust against Hard Environments**
- Vibration : 20 gs
- Shock : 100 gs
- Humidity : Up to 90% RH

■ **High Rotational Speed**
Up to 30,000 min^{-1} (rpm)

■ **High Reliability**
Singlsyn has a similar structure to an electric motor but has high reliability because there is no winding coil on the rotor.

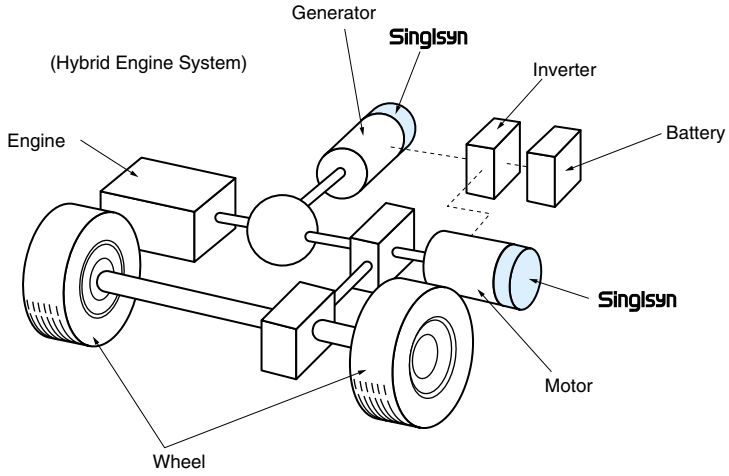
■ **Sensing Absolute Position and Velocity**
By connecting to an R/D converter or **Smartcoder**, it is possible to convert the analog output of the Singlsyn to a digital position (angle) signal . This signal is transmitted as the absolute position within the range of one electrical cycle.

■ **Low Cost**
A significantly lower cost is realized by reducing the number of parts to 1/10 compared with the conventional resolver.

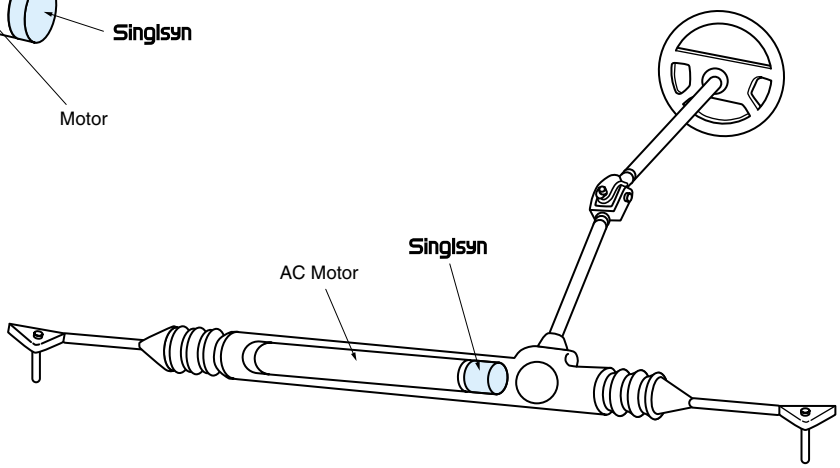


APPLICATIONS

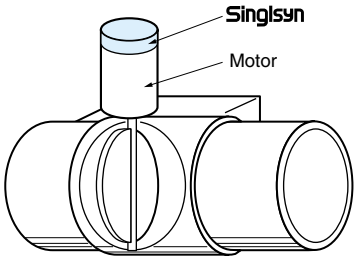
●Detection of Rotational Position of Motor and Generator on Hybrid Vehicle
●Detection of Rotational Position of Motor on Electric Vehicle



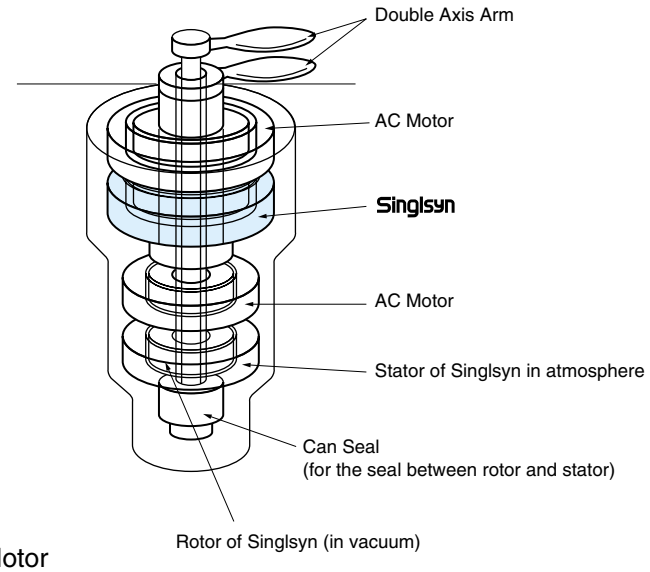
●Angle Detection for Magnetic Pole of Motor in Electrical Power Steering



●Angle Detection for Controlling Fuel Valve (Air Valve)



●Angle Detection for conveyer in Vacuum



●Angle Detection for Control of Switched Reluctance Motor
●Angle Detection for Vector Control of High Efficient Induction Motor
●Angle Detection for Rotational Control of AC Motor (PM Motor)

PRINCIPLE OF OPERATION

The contour of the **Singlsyn** rotor forms a specially curved air gap between its stator and rotor the permeability of which changes as a sinusoidal wave corresponding to the angle of the rotor shaft. One excitation winding and two output windings are placed in the stator. The two output windings detect the change of air gap between the rotor and stator and produce an output voltage with 2-phases proportional to the sine and cosine of the angle of rotor. (Refer Fig. 1 and Fig. 2)

Because the output signals of the **Singlsyn** are the same as that of conventional resolvers and Smartsyns as shown in equation (2) and (3), they can be converted to digital angle data by using conventional resolver to digital (R/D) convertors.

A **Singlsyn** which produces twice the angle output signal (2X type) has an elliptical shape of rotor as shown in Fig. 3 (a). The rotor for a 3X type is triangular and is cross shaped for a 4X type as shown in Fig. 3 (b) and 3 (c).

<Excitation Voltage>

$$E_{R1-R2}=E \sin \omega t \quad \text{---------- (1)}$$

<Output Voltage>

$$E_{S1-S3}=K=E \sin \omega t \bullet \cos (X \bullet \theta) \text{ - - - - - - -(2)}$$

$$E_{S2-S4}=KE \sin \omega t \bullet \sin (X \bullet \theta) \text{ ---------- (3)}$$

where

K : Transformation Ratio t : Time (s)

θ : Shaft Angle (deg) f : Excitation Frequency (Hz)

ω : 2 π f E : Excitation Voltage (V)

X : Multiplication Factor of Angle (X = 2, 3 or 4)

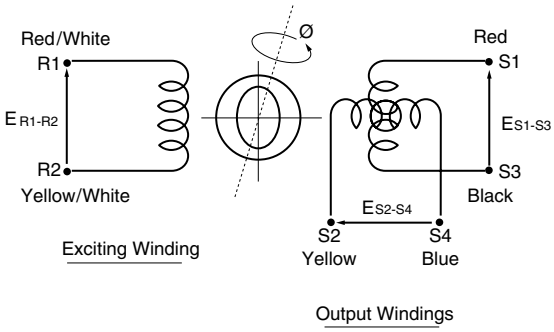


Fig. 1 Wiring Diagram

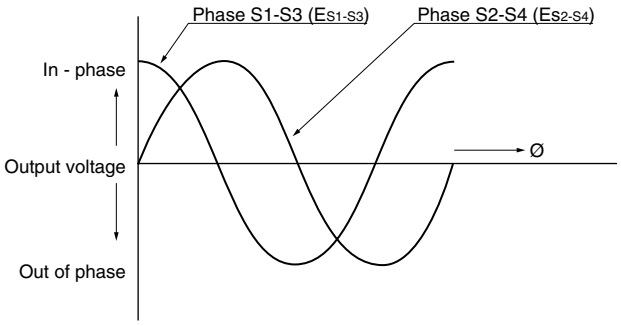


Fig. 2 Output Voltage Characteristics

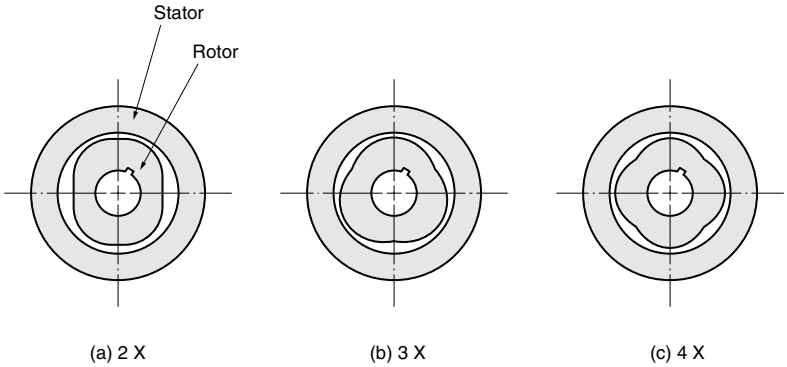


Fig. 3 Shape of Rotor

HISTORY OF DOWN-SIZING AND LESS-PARTS ON RESOLVERS

During more than more than 40 years of development there has been a constant drive to reduce both the size and cost of resolvers.

Originally the military specification for brushed resolvers had two windings on both the rotor and the stator. Later came the brushless type and the built-in type **(Smartsyn)** which still needed four windings for the rotor, stator and rotary transformer (rotor and stator).

Compared with these conventional resolvers, the newly developed VR (Variable Reluctance) type resolver needs a winding in the stator only. This new product has been called the **Singlsyn**.

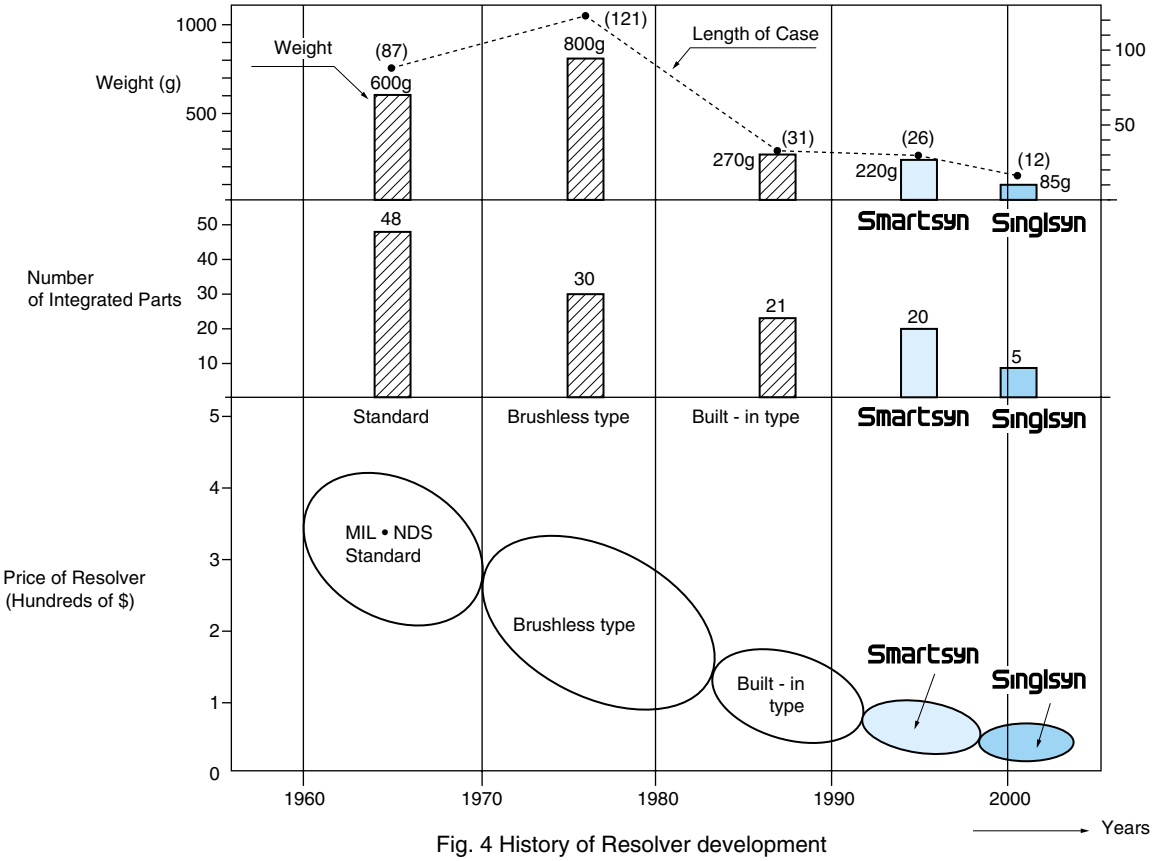


Fig. 4 History of Resolver development

■ Structural Comparison of Smartsyn and Singlsyn

The structural differences between the conventional winding type brushless resolver **(Smartsyn)** and the new developed **Singlsyn** are shown in Fig. 5.

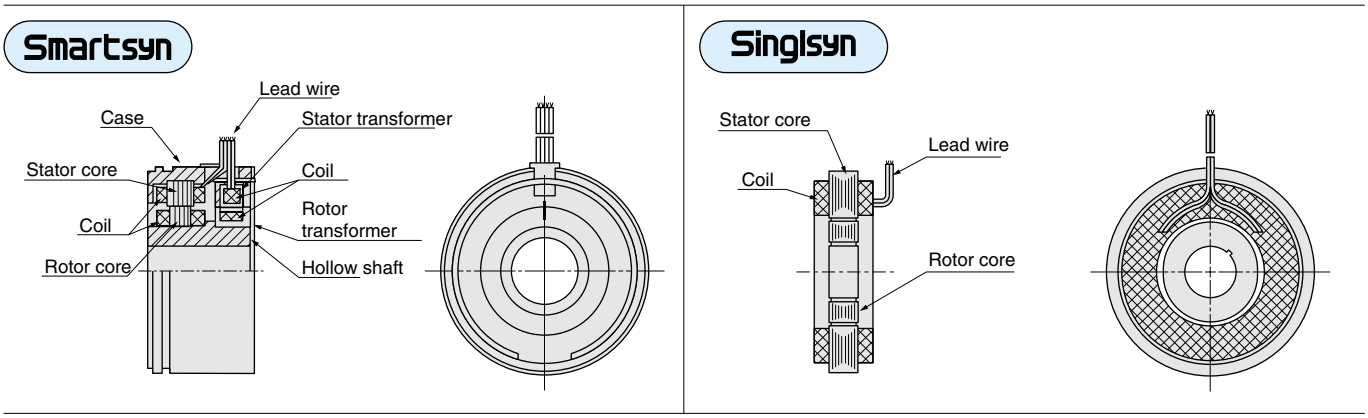


Fig. 5 Structural Comparison of **Smartsyn** and **Singlsyn**

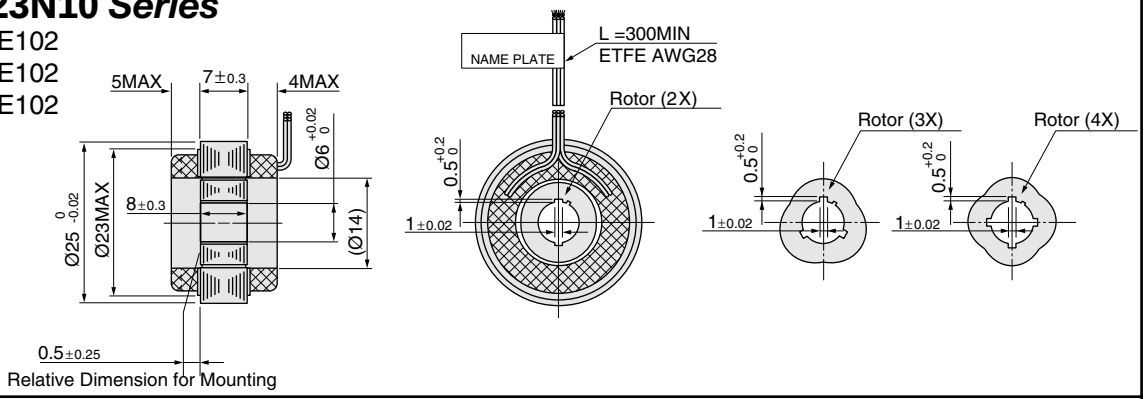
SPECIFICATION

F U N C T I O N	2X-BRX			3X-BRX			4X-BRX		
Frame Size	S10	S15	S21	S10	S15	S21	S10	S15	S21
Model Number	TS2223N12E102	TS2224N12E102	TS2225N12E102	TS2223N13E102	TS2224N13E102	TS2225N13E102	TS2223N14E102	TS2224N14E102	TS2225N14E102
Excitation Input	AC7Vrms 10kHz			AC7Vrms 10kHz			AC7Vrms 10kHz		
Primary Side	R1 - R2			R1 - R2			R1 - R2		
Transformation Ratio	0.286 ± 10%			0.286 ± 10%			0.286 ±10%		
Electrical Error	±60'MAX			±45'MAX			±30'MAX		
Input Impedance: Zro	120 Ω ± 20%			120 Ω ± 20%			120 Ω ±20%		
Output Impedance: Zss	350 Ω NOM	250 Ω NOM	270 Ω NOM	330 Ω NOM	260 Ω NOM	290 Ω NOM	430 Ω NOM	340 Ω NOM	335 Ω NOM
Phase Shift	+ 15° TYP	+ 10°TYP	0 ° TYP	+ 25° TYP	+ 5 °TYP	0° TYP	+10° TYP	0° TYP	-10° TYP
Weight	0.023kg	0.050kg	0.090kg	0.023kg	0.050kg	0.090kg	0.023kg	0.050kg	0.090kg

OUTLINE DIMENSIONS

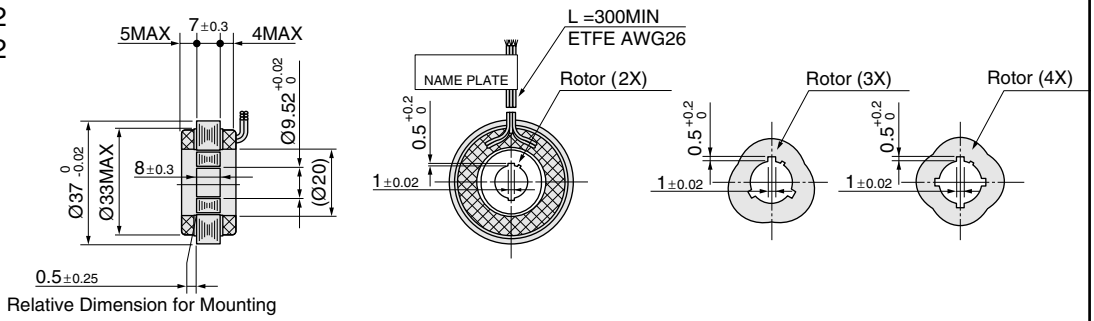
S10// TS2223N10 *Series*

2X : TS2223N12E102
3X : TS2223N13E102
4X : TS2223N14E102



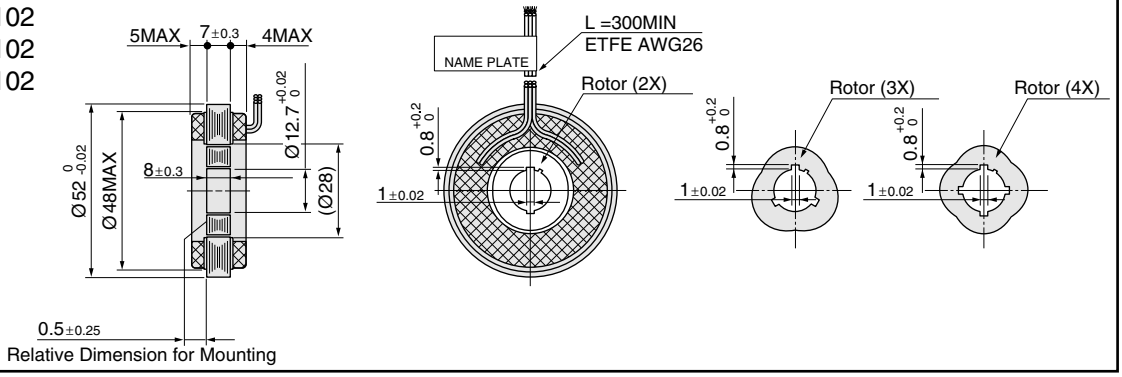
S15// TS2224N10 *Series*

2X : TS2224N12E102
3X : TS2224N13E102
4X : TS2224N14E102



S21// TS2225N10 *Series*

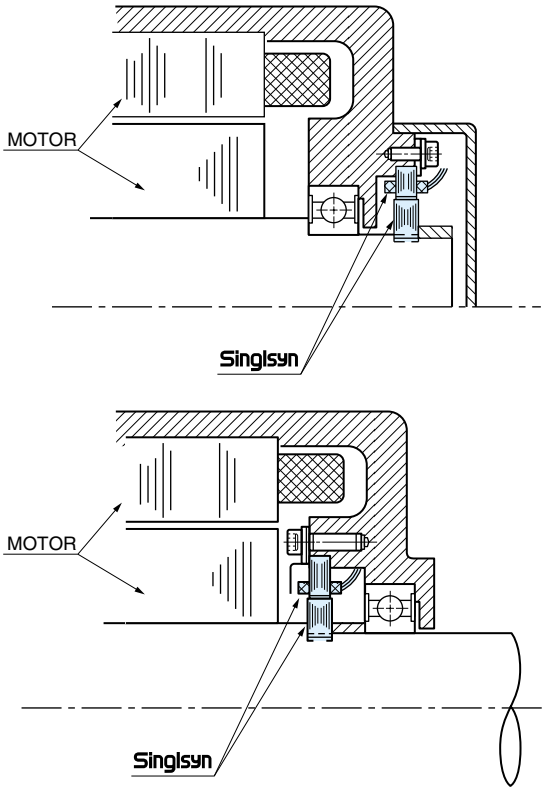
2X : TS2225N12E102
3X : TS2225N13E102
4X : TS2225N14E102

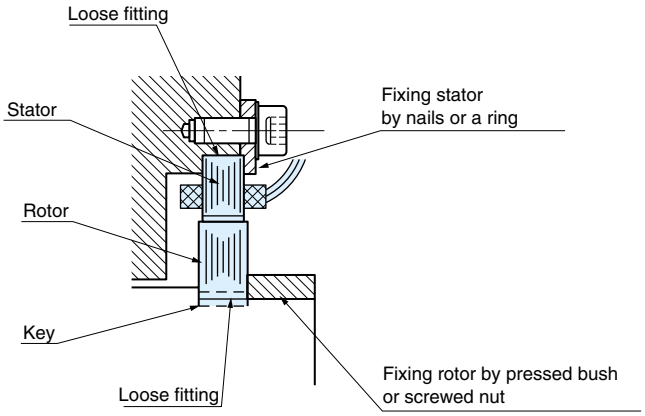


All dimensions are in mm.

MOUNTING METHOD AND ACCURACY

●Mounting Method (Built-in type)





Detail Drawing for mounting **Singlsyn**

●Mounting Accuracy

If a **Singlsyn** is inaccurately mounted the performance will not be optimised.

The eccentricity between the rotor and stator affects its electrical accuracy as shown in the right table.

●Allowable Axial Deflection

The deflection in the axial direction between the stator and rotor should be within ± 0.25 mm.

●Electrical error caused by the Stator
Eccentricity error of 0.05 mm

Function		2X-BRX	3X-BRX	4X-BRX
Size	S10	45'	10'	5'
	S15	35'	3'	2'
	S21	10'	2'	1'

●Electrical error caused by the Rotor
Eccentricity error of 0.05 mm

Function		2X-BRX	3X-BRX	4X-BRX
Size	S10	30'	3'	3'
	S15	10'	2'	1'
	S21	3'	1'	1'

Cautions for Use

●The excitation input voltage in the specification sheet is described as the rated value. There is no problem for use in the range from 3 V to 1.2 times of the rated voltage, but the frequency should be ± 5% of the rated value. Otherwise degradation of the accuracy may result.

●If a significant electrical noise source is nearby or a long transmission line is used, twisted pair lines with individual shields around each pair are necessary. A differential amplifier should also be used as the receiver if any noise is induced in output signal.

●If the **Singlsyn** is mounted out of eccentricity, tilt or run-out for the shaft of measured object, some significant electrical error may occur in the output signal. Therefore the user should take special care with the mechanical mounting of the Singlsyn as described in the above Mounting Method.

●If the Singlsyn is connected to an unequal load for each output of the 2-phases, the two output voltages become unequal and may result in some electric error. Therefore the load for the 2-phases should be the same.

●In the presence of strong external magnetic fields around the **Singlsyn**, the magnetic flux in the Singlsyn can be affected and may result in some electrical error. Some shielding for the Singlsyn is recommended in this case.

●If the **Singlsyn** is used where the relative humidity is near 100% for long periods, the electrical insulation may gradually worsen. In this case some form of protective cover is recommended.

ENCODER TECHNOLOGY LIMITED

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WARRANTY

Encoder Technology warrants that this product is free from defects in material or workmanship under normal use and service for a period of one year from the date of shipment from its factory. This warranty, however, excludes incidental and consequential damages caused by careless use of the product by the user. Even after the warranty period, Encoder Technology offers repair service, with charge, in order to maintain the quality of the product. The MTBF (mean time between failures) of our product is quite long; yet, the predictable failure rate is not zero. The user is advised, therefore, that multiple safety means be incorporated in your system or product so as to prevent any consequential troubles resulting from the failure of our product.

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URL http://www.encoder-technology.com