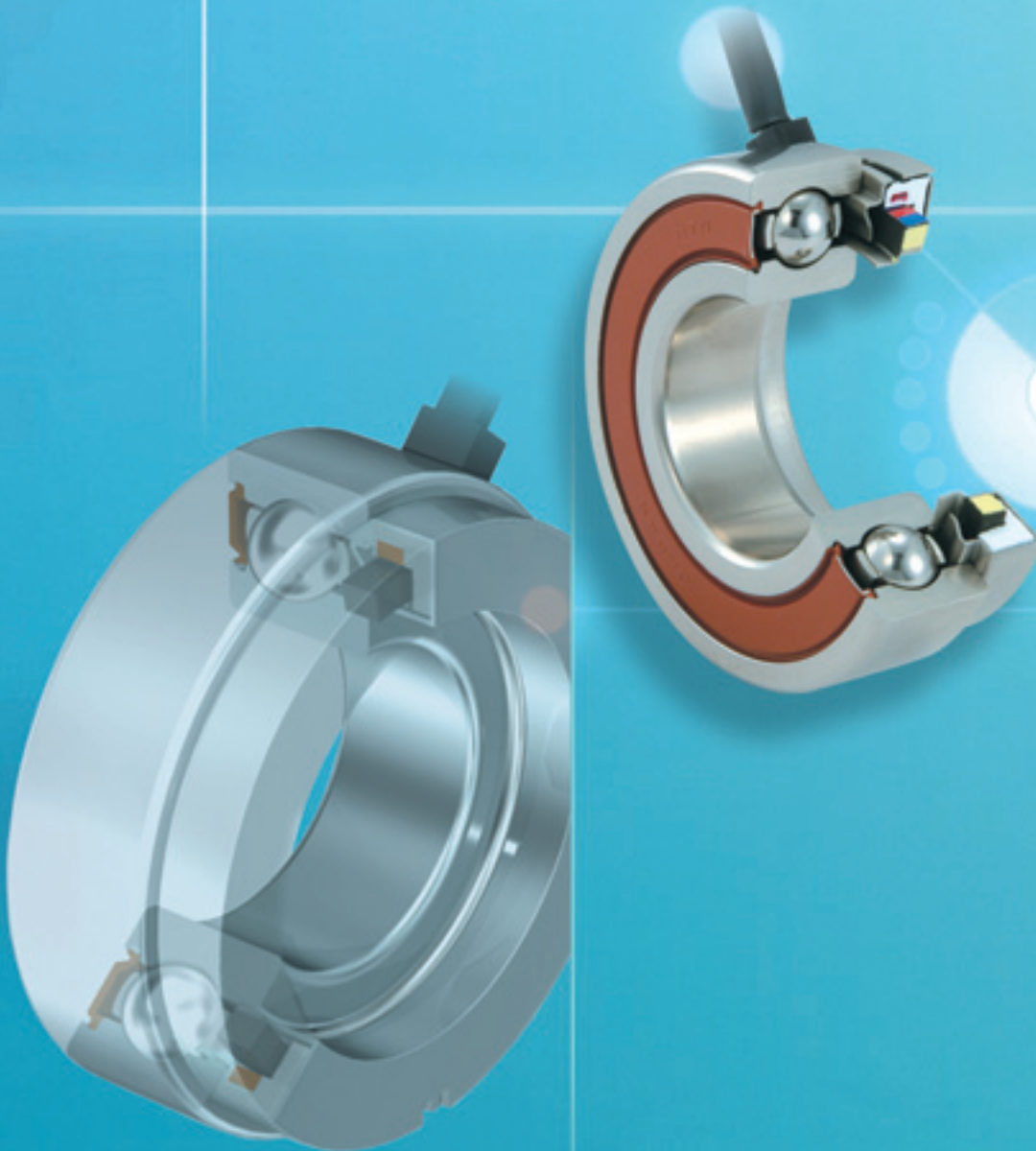


For New Technology Network

**NTN**®

# Integrated Rotation Sensor Bearings



CAT. No. 3032/E

# NTN Integrated Rotation Sensor Bearings



1. This is an integrated product combining a bearing with a rotation sensor that detects the speed and direction of rotation.
2. With a wide variety of models and advanced functions available, these bearings will make your machines more compact and also help in improving their reliability.

In recent years, industrial machines have been using electrical controls that make the machines simpler, allow unmanned operation, and reduce the environment load. In view of this background, many sensors necessary for electrical control are being used, and there is an increased need for bearings with sensors because they simplify installation of sensors and help in making the machines more compact. Therefore, NTN has combined its superior bearing technology and sensor technology to create a series of bearings with rotation sensors.



## 1 Construction and Principles

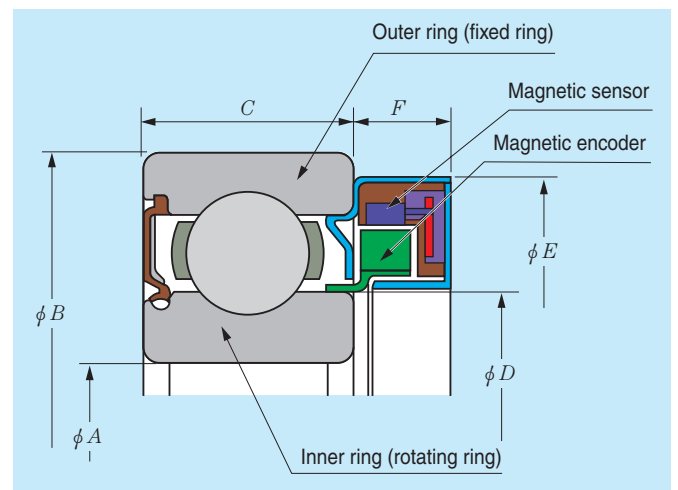
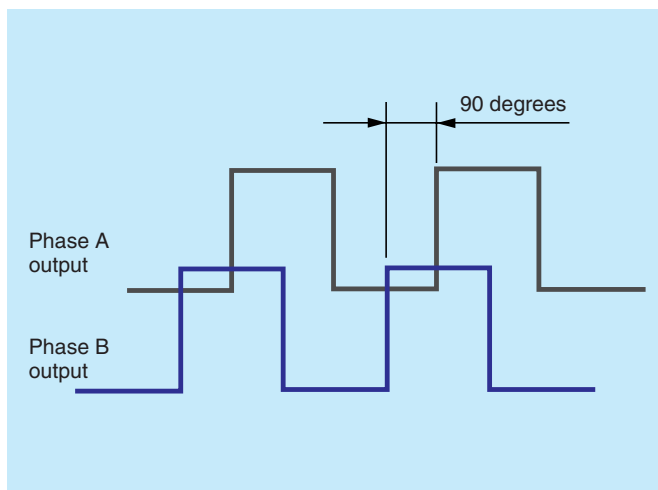
The rotation sensor is made up of a magnetic encoder (a multiple pole magnet) and a magnetic sensor.

The magnetic encoder is fixed to the inner ring (the rotating ring) of the bearing and the magnetic sensor is fixed to the outer ring (the fixed ring).

With the rotation of the shaft (and the inner ring), when the magnetic encoder passes near the magnetic sensor, the magnetic sensor senses changes in the magnetic pole (N pole

and S pole) of the magnetic encoder that is opposite to it and outputs a corresponding electrical signal (with a rectangular waveform).

Through numerical processing of these output signals, the rotational speed can be calculated. In addition, because the phase A output and phase B output signals have a mutual electrical phase shift of 90 degrees, the direction of rotation can also be detected.

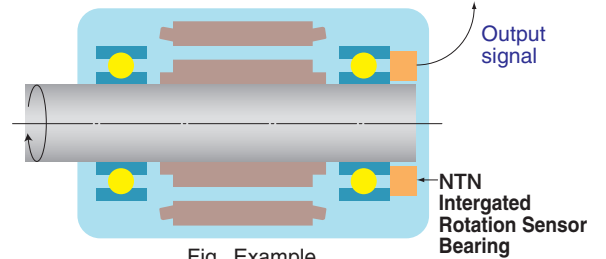




## 2 Applications

AC servo motors, DC servo motors, hydraulic motors, etc.

The adoption of NTN integrated rotation sensor bearings allows detection of the rotational speeds and rotational directions of motors. There is no need to add an encoder outside the motor, which allows the motor to be more compact.



## 3 Specifications

Bearing model number	6202	6204	6206	6208	6209
Bearing tolerance class	JIS : Grade 0 ISO : NORMAL				
Bearing inner diameter (mm) : $\phi A$	15	20	30	40	45
Bearing outer diameter (mm) : $\phi B$	35	47	62	80	85
Bearing width (mm) : $C$	11	14	16	18	19
Sensor unit inner diameter (mm) : $\phi D$	18	29.5	40.6	53	57.3
Sensor unit outer diameter (mm) : $\phi E$	32	46.6	58	75	77
Sensor unit width (mm) : $F$	7.5	7.5	7.5	7.5	7.5
Basic dynamic load ratings (kN)	7.75	12.8	19.5	29.1	32.5
Basic static load ratings (kN)	3.6	6.65	11.3	17.8	20.4
Allowed axial load (static) (kN)	1.48	3.08	5.81	11	9.59
Radial internal clearance: C3 (mm)	0.011~0.025	0.013~0.028	0.013~0.028	0.015~0.033	0.018~0.036
Lubrication	Grease (Multemp SRL)				
Seal type	LU (Contact seal NBR)				
Input voltage (+Vcc DC)	5~24				
Number of output pulses	32	48	64	80	80
Number of signal phases	Two phases (phase A and phase B)				
Sensor output accuracy (See the section on "Calculation of Output Waveform Accuracy.")	Adjacent period error: 5% or less				
	Duty cycle: 50 ±15% (35 to 65%)				
	Phase shift between phase A and phase B: 90 ±45 degrees (45 to 135 degrees)				
Type of waveform	Rectangular output waveform (open collector output, protective resistor 100 Ω)				
Connection of wire	Red line: Input voltage +Vcc				
	White line: Output signal phase A				
	Blue line: Output signal phase B				
	Black line: GND				
Wire size	AWG24 (UL)				
Connector	None/Optional				
Wire bending radius (mm)	Minimum radius: 12				
Wire length (mm)	500				
Ambient operating temperature (°C)	-25 to 120				
Weight (kg) (Reference)	Approx. 0.10	Approx. 0.13	Approx. 0.25	Approx. 0.45	Approx. 0.48

Connect a pull-up resistor between the power supply terminal and the each signal output terminals.  
See the "Electrical Circuit" section for the values of the pull-up resistor, and set it so that the sink current is 20 mA or less.



## 4 Calculation of Output Waveform Accuracy

The accuracy is calculated using the equations below for each output pulse per one rotation.

### 1. Adjacent period error (%)

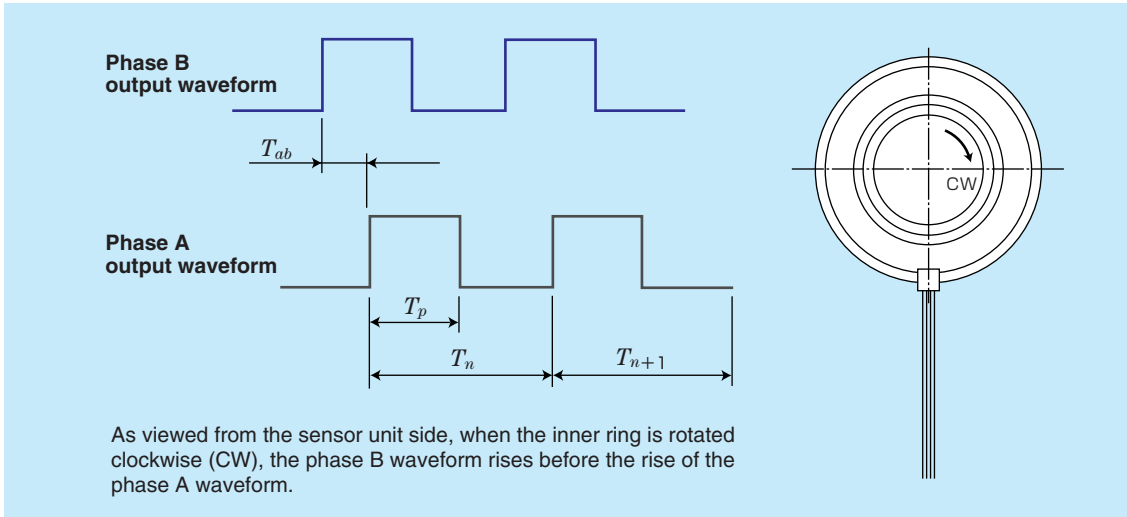
$$= \left\{ \frac{|T_n - T_{n+1}|}{T_n} \right\} \times 100$$

### 2. Duty cycle (%)

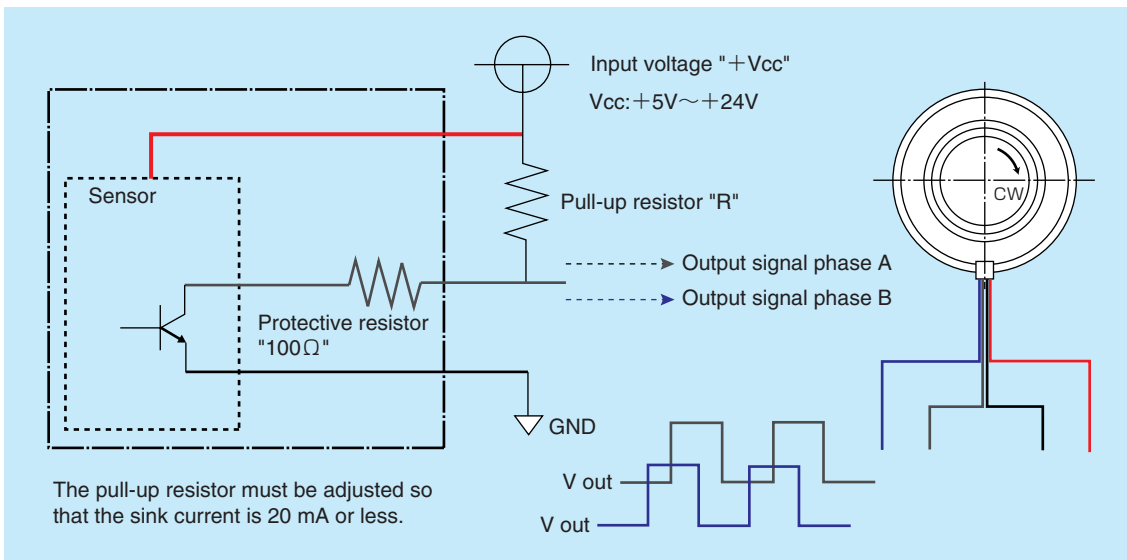
$$= (T_p / T_n) \times 100$$

### 3. Phase shift between phase A and phase B (degrees)

$$= (T_{ab} / T_n) \times 360$$



## 5 Electrical Circuit



### Pull-up Resistor Examples

Input voltage "+Vcc" (DC)	Value of "R"
+5V	270Ω
+9V	470Ω
+12V	680Ω
+24V	1.5kΩ

### Caution:

V out (Low) is the voltage value when the sensor operates. (When the waveform is "Low.") This voltage value can be adjusted with the value of the pull-up resistor "R."

V out (Low) is calculated using the following equation:

$$V_{out} (Low) = V_{cc} \times 100 / (R + 100) + V_{ce}$$

1. Internal protective resistance value: 100 Ω

2. Output saturation voltage for the sensor only. Vce (sat): 0.4 V (max)

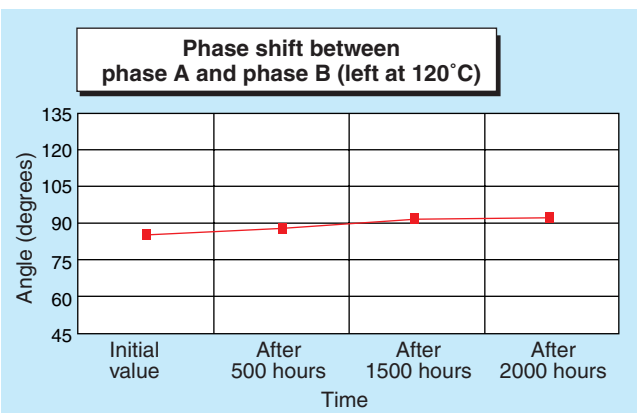
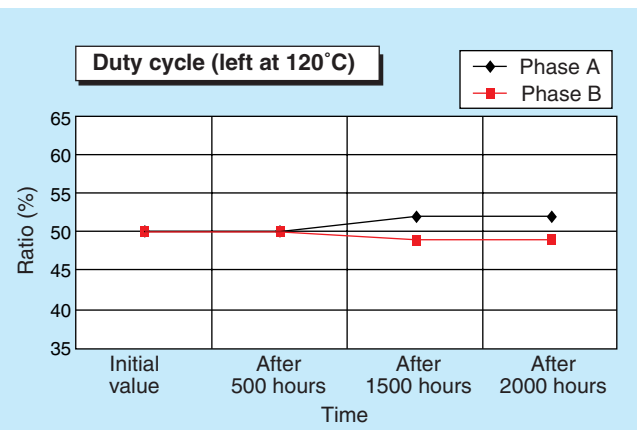
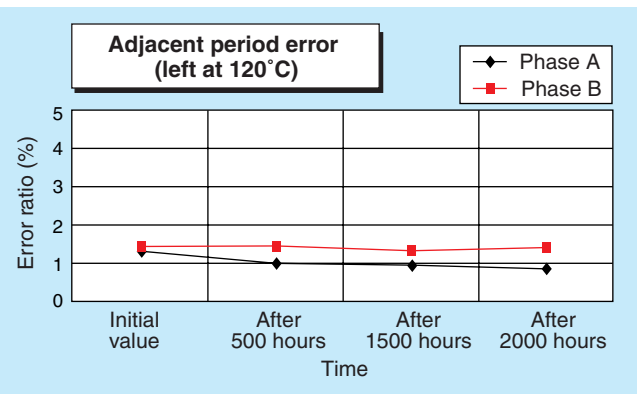
Maximum sink current: 20 mA (both phase A and phase B)

$$I_{sink} = V_{cc} / (R + 100) \leq 20mA$$



## 6 Reliability Test (Reference)

The signal accuracy measurement data for NTN integrated rotation sensor bearings is shown below. Even when kept static for 2,000 hours at 120°C, the NTN integrated rotation sensor bearings have stable signal properties, contributing to improving the reliability of the units in which they are used.



Each measurement is made at room temperature at a speed of 60 min<sup>-1</sup>.



## 7 EMC Standard Test (Reference)

Power supply frequency and magnetic field standard: EN61000-4-8

### Handling Precautions

1. Do not let the ends of the wires come into contact with anything that has accumulated static electricity. It is possible that the static electricity could damage the bearings.
2. Do not build these bearings into machinery that produces electromagnetic waves. Also, do not use them in areas where electromagnetic waves are produced. It is possible that electromagnetic waves could damage the bearings.
3. Do not use these bearings in areas where they may have impact on human life.
4. In the unlikely event of a sensor signal error, be sure to take safety measures, such as a backup system, etc.
5. Do not apply any load to the sensor unit.
6. Do not subject the integrated sensor bearings to any shock.
7. Do not put any load to the wires. Also, do not carry the bearings by the wires.
8. Do not use the integrated sensor bearings in environments where they can come into contact with or be penetrated by water, oil or foreign matter (steel powder, dust).

### Notes

1. These bearings are compatible with RoHS instructions (2002/95/EC).
2. NTN has “high temperature application” models for use in locations where the ambient operating temperature exceeds 120°C. Please contact your NTN branch office or sales office for details.
3. With respect to “Ferromagnetic Field Resistant application” models for use in areas with strong magnetic fields, such as near high output motors, please contact your NTN branch office or sales office for details.
4. If you must use these bearings for purposes other than those specified in this catalog, please contact your nearest NTN sales office.