

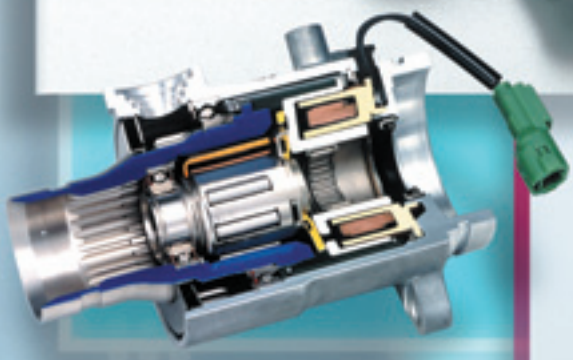
For New Technology Network



# CLUTCHES



*One-way Clutch*



*Two-way Clutch*



*Torque Diode*

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**NTN**

**CLUTCHES**

# One-way Clutch

## 1-1 Features

### 〈One-way clutch〉

The one-way clutch only drives in one direction and is idle in the other direction. The drive and idle directions can be switched. NTN has a wide variety of one-way clutches to meet various needs.



#### **Stable idle rotation**

Because the force of the spring that holds the roller is adjusted accurately, roller movement is slight when idle, so that the idling torque is stable.

Please contact NTN if the required idle rotation is fast.

#### **Cross section height is small and the unit is compact**

The HF and HFL types have thin external rings made of steel plate that has been made by precision extrusion. This has allowed these shell type one-way clutches to have a low cross section height and compact design.

#### **Simple handling**

The one-way clutch series has the clutches press fit tightly into the housing inner diameter, so that there is no need for a fixing device in the axial direction. In addition, torque can be transmitted with this fit alone, thus making handling simple.

#### **No need for a radial load bearing**

Because radial load bearings are built into both sides of the clutch unit (HFL type: needle roller with cage; NHF type: oil-impregnated bearing; NCM type: ball bearing), external radial load bearings are not needed.

**Use the HF type together with a radial load bearing.**

#### **Excellent clutch accuracy**

Each roller is precisely supported by a spring and they are fabricated with high precision so that they always engage together, thereby achieving excellent clutch accuracy. The delay angle that exists until rotational torque is completely transmitted includes both the sliding angle and the displacement angle that is created by the elastic deformation of the contact section between the rollers, shaft and external ring.

This value will differ depending on the size of the clutch and load torque, but the average value of the delay angle up to the torque capacity (listed in the Dimensions Table) is 3 degrees or less. (Based on NTN measurements.)



# One-way Clutch

## <One-way clutch unit>



NCU type



NCZ type

### Compact design possible by using units

This product is comprised of a unit that includes external parts and the one-way clutch. The NCZC type and NCUX type have an even smaller width and allow effective use of space, so that the overall design can be made even more compact.

### Resin external parts that can be made to the designated shape

The gears, pulleys, rubber roller receptacles and other external parts are made of resin, and can be made in various shapes and dimensions per your requirements.

### High degree of freedom concerning the selection of shafts used

The clutch functions satisfactorily even if the shaft tolerance is large. In addition, shafts can be made from a wide variety of steels. (However, if a softer material is used, the torque capacity will decrease.)

### Enhanced torque capacity and improved clutch accuracy

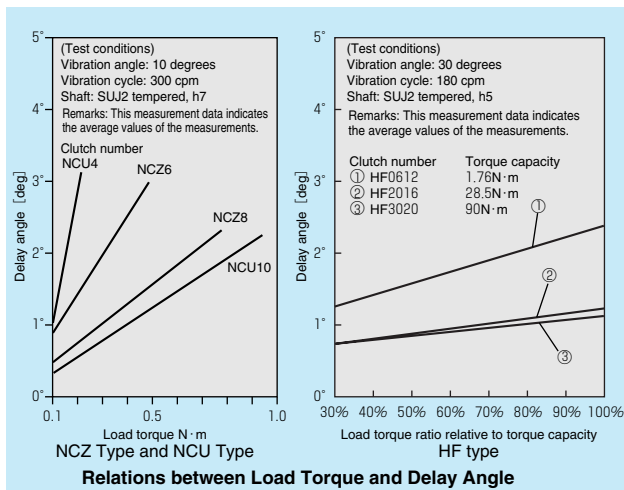
Through incorporation of a metal spring, the NCZ and NCU types boast improved locking functions and idling torque compared with conventional types.

### Can be used at high temperatures

The NCZ type does not use any resin parts in the clutch interior. Therefore, it can be used in high temperature conditions (140°C or less). (However, please consult with NTN if the part is to be used at 100°C or more.)

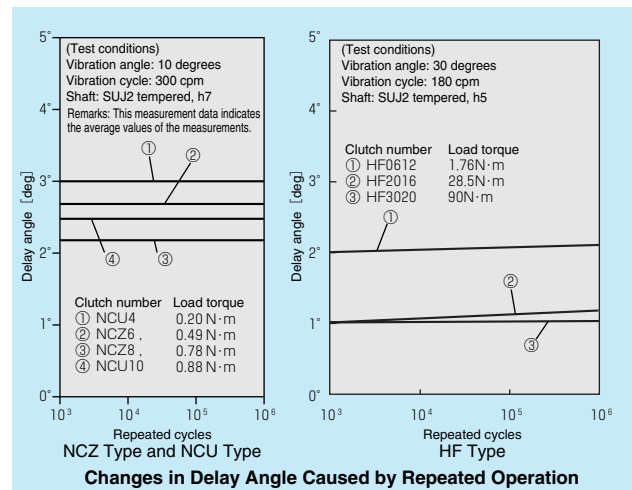
## Delay angle

The delay angle refers to the difference ( $\theta_i - \theta_o$ ) between the input shaft rotational angle ( $\theta_i$ ) and output shaft rotational angle ( $\theta_o$ ). The delay angles of NTN one-way clutch units differ depending on the type and the torque that is applied to the one-way clutches. The figure below shows the general trend. (Based on NTN measurements.)



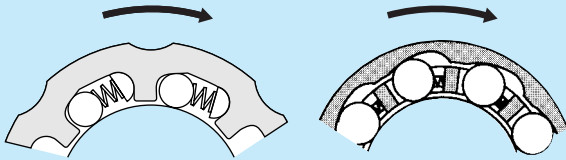
## Service life

Even when torque is applied at the torque capacity in NTN one-way clutch units and the units are engaged over one million times, we have confirmed that there is little change in the delay angle. (Based on NTN measurements.)



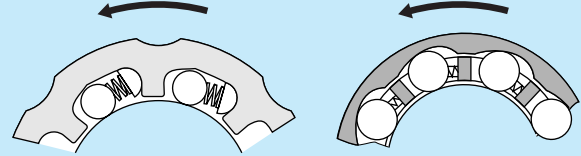
# One-way Clutch

## 1-2 Operating mechanism



### Clutch engaged

When the outer ring tries to turn clockwise with respect to the shaft, the spring is activated and the rollers advance to the engagement position of the outer ring cam surface, then the wedge action between the outer ring cam surface and shaft drives the shaft.



### Clutch idle

When the outer ring turns counterclockwise with respect to the shaft, the shaft turns clockwise with respect to the outer ring, so that the rollers are released from the outer ring cam surface and the outer ring is disengaged from the shaft.

## 1-3 Types and construction

### NTN one-way clutches

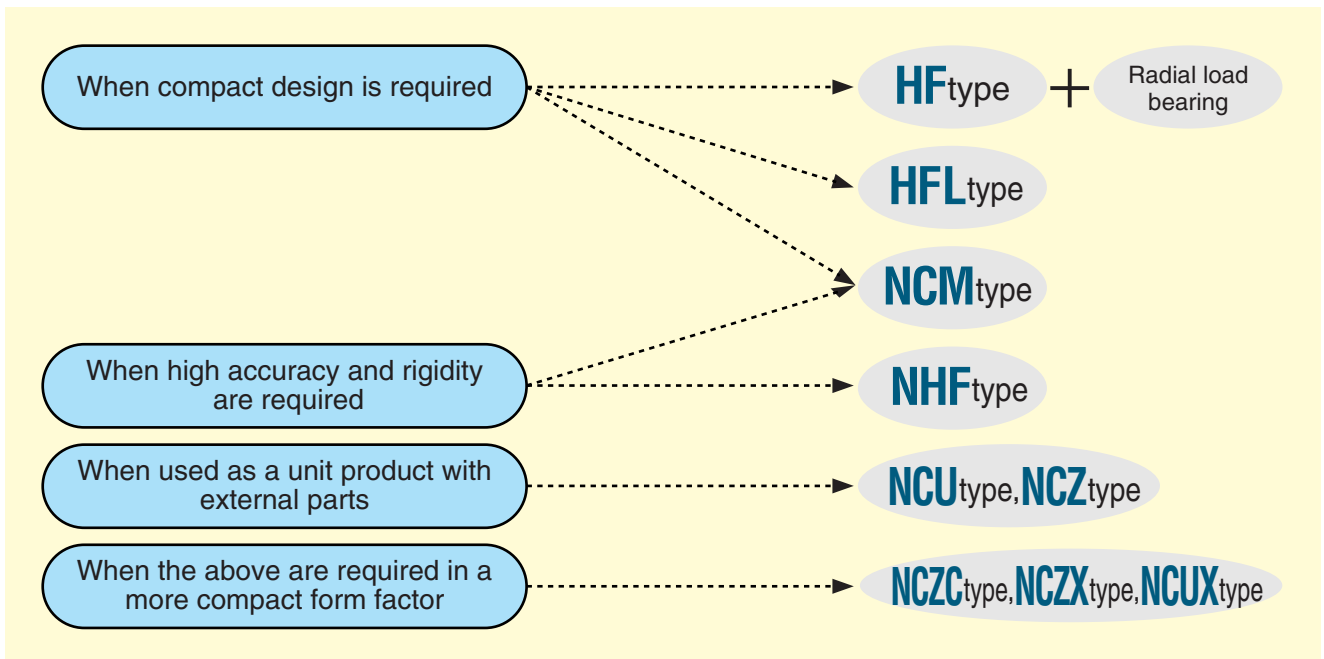
#### One-way clutches

#### One-way clutch units

HF type Partially INA products	HFL type INA products	NHF type	NCM type	NCU type	NCZ type	NCZC type	NCZX type NCUX type
The clutch unit is made up of a needle roller, cage and spring. The outer ring is a shell shape that is made by precision extrusion of thin steel plate. As a radial load, use NTN BEARPHITE oil-impregnated bearings or shell-type needle roller bearings.	The HF type has needle rollers with cages built into both sides for radial loads.	The clutch unit is made up of a needle roller, cage and spring. The outer ring is a solid unit with NTN BEARPHITE oil-impregnated bearings built into both sides for radial loads.	The NCM type is a ball bearing-shaped one-way clutch that has a built-in locking sprag and load-carrying balls. The color coding with the right and left seals allows the user to identify the locking direction.	The main unit is made up of an outer ring, lid, roller, cage and spring. The outside has resin external parts including a gear, pulley and roller receptacle to make up the unit.	The main unit is made up of an outer ring with cage, lid, roller and steel single piece ring spring. The outside has resin external parts including a gear, pulley and roller receptacle to make up the unit.	The outer diameter dimension has been made as small as possible to reduce the amount of space needed in the outer diameter direction. The outside has resin external parts including a gear, pulley and roller receptacle to make up the unit.	The width has been made as small as possible in order to cope with the need for smaller units. The outside has resin external parts including a gear, pulley and roller receptacle to make up the unit.

# One-way Clutch

## 1-4 Selection guidelines



### ■ Lubrication

Oil lubrication is best for these one-way clutches, but, in general, grease lubrication is usually used. NTN one-way clutches are filled with suitable grease, so that they can be installed immediately. In general use there is no need to resupply grease; however, if grease is resupplied, note that too much grease can interfere with clutch operation. Please consult with NTN for the type of lubricant to use.

### ■ Allowable operating temperature

HF <sub>type</sub> , HFL <sub>type</sub> .....	Oil lubricant	: -10~120°C
	Grease lubricant	: -10~ 70°C
NHF <sub>type</sub> .....		-10~100°C
NCU <sub>type</sub> , NCUX <sub>type</sub> .....		-10~100°C
NCZ <sub>type</sub> , NCZC <sub>type</sub> , NCZX <sub>type</sub> .....		-10~140°C
NCM <sub>type</sub> .....		-10~ 70°C

Please consult with NTN when using these units outside their allowable operating temperatures or when using the NCZ type at over 100°C.

### ■ Engagement direction

#### ● HF<sub>type</sub>, HFL<sub>type</sub>, NHF<sub>type</sub>

The NHF type has an arrow (→) on the outer diameter surface or oil-impregnated bearing edge, and the HF type and HFL type have arrows on the outer ring sides. Turning the outer ring in the direction of the arrow will engage the clutch.

#### ● NCU<sub>type</sub>, NCZ<sub>type</sub>, NCZC<sub>type</sub>, NCZX<sub>type</sub>, NCUX<sub>type</sub>

Turning the external resin part in the direction of the arrow (→) on the side of the external resin part will engage the clutch.

#### ● NCM<sub>type</sub>

The right and left seals being incorporated into the clutch are each uniquely color-coded, allowing the user to be sure of the locking direction of the clutch.

### ■ Selection precautions



NTN checks the functions of its one-way clutches under many different test conditions. However, the service life may be reduced if they are used with heavy load torques, high oscillation cycles or minute oscillations, if the shaft is not hard, and if a large radial load acts on the one-way clutch unit. In addition, if the idling rotational speed is high or the clutch is used often in idle, there is a possibility that lock problems might occur.

Please consult with NTN when using these units under these special conditions.

# One-way Clutch

## ■ Shaft and housing (HF<sub>type</sub>, HFL<sub>type</sub>, NHF<sub>type</sub>) / external resin parts (NCU<sub>type</sub>, NCZ<sub>type</sub>, NCZC<sub>type</sub>, NCZX<sub>type</sub>, NCUX<sub>type</sub>) specifications

Type		One-way clutch			One-way clutch unit		
		HF <sub>type</sub>	HFL <sub>type</sub>	NHF <sub>type</sub>	NCU <sub>type</sub>	NCZ <sub>type</sub> , NCZC <sub>type</sub>	NCZX <sub>type</sub> , NCUX <sub>type</sub>
Shaft	Material	Tempered steel, case hardened steel (Hardness HRC58–64; effective depth 0.4 mm or greater for carburizing)			Carbon steel, stainless steel, tempered steel, case hardened steel (Surface hardness if tempered: HRC50 or greater)		
	Dimensions Tolerance	h5 (h6)		h7	NCU4···h9 NCU10···h10	NCZ6,8 }···h9 NCZC6,8 }	NCZX6,8···h9 NCUX4···h8
	Cylindricity	One-half of tolerance		One-half of tolerance	One-half of tolerance		
	Roughness	0.2a (Ra)		0.4a (Ra)	0.3~1.6a (Ra)		
Housing (HF, HFL, NHF type) External resin part (NCU, NCUX, NCZ, NCZC, NCZX type)	Material	Steel, light metal alloys			Standard: Polyacetal resin (They can also be made of oil-impregnated polyacetal resin and PBT resin.)		
	Bore Tolerance	Steel : N6 (N7) light metal alloys : R6 (R7)			————		
	Cylindricity	One-half of tolerance		One-half of tolerance	————		
	Roughness	1.6a		1.6a	————		
	Wall- thickness	Steel: 0.75 ( <i>D-FW</i> ) or greater Light metal alloy: 1.5 ( <i>D-FW</i> ) or greater (See the dimensions table for the <i>D-FW</i> dimension)			————		
Remarks		————			Gear accuracy: Grade 6 is the standard for JGMA engagement accuracy.		

Remark 1) Round off the tip of the shaft to facilitate insertion into the one-way clutch. (Minimum 0.3 mm)

- 2) The requirements for the shaft and housing for the NCM type one-way clutch can vary depending on the operating conditions.  
Contact NTN Engineering for technical assistance.



# One-way Clutch

## 1-5 Installation precautions

Use of a press-fitting mandrel as shown in the figure is convenient for installing a one-way clutch. When installing an HF type or HFL type, be sure that the side with the mark comes into contact with the mandrel when press fitting. In addition, when installing the NHF type, be sure to press fit the outer ring and use a jig to avoid pressing the oil-impregnated bearing section. Precautions for assembly include not twisting the outer ring, not directly striking the outer ring with a hammer, and using an appropriate jig on the outer ring side when press fitting. When assembling in a press for mass production, using a mandrel with an O-ring as shown in the figure will prevent the one-way clutch from falling off and facilitate insertion.

The dimensions of the mandrel are shown below.

$$A = D - (0.2 \text{ to } 0.3) \text{ mm (in the case of NHF, } A \text{ is greater than } D)$$

$$B = d \text{ or } F_w - (0 \text{ to } 0.025) \text{ mm}$$

$D$ : Outer diameter of the one-way clutch, mm

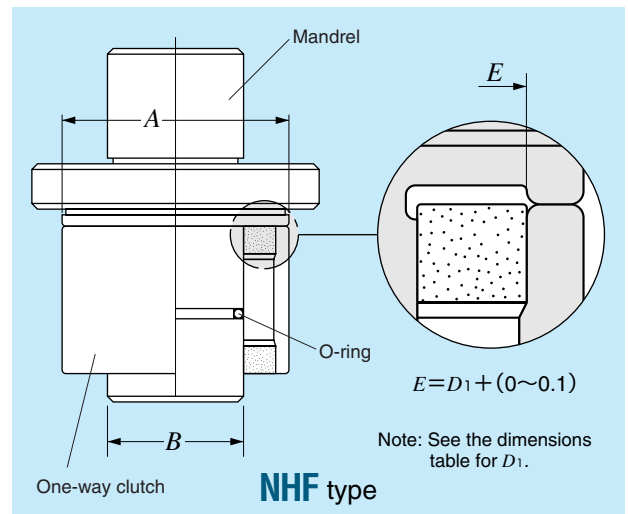
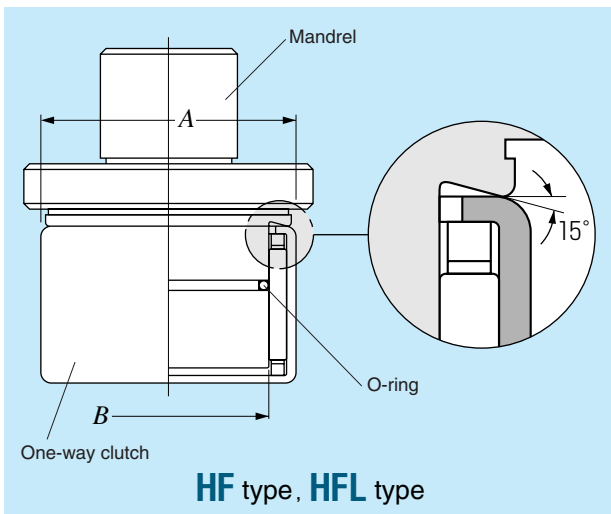
$d$ : Bore of the oil-impregnated bearing, mm

$F_w$ : Inscribed circle diameter of the roller, mm

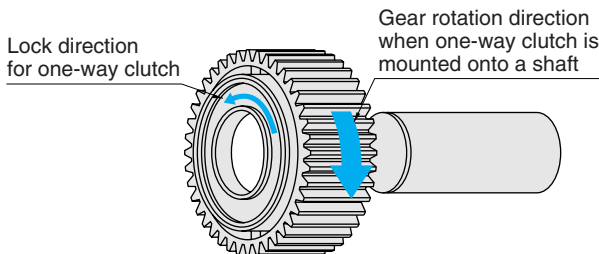
(See the dimensions table)

Shaft assembly can be facilitated by turning the shaft in the direction that the clutch is disengaged.

If the shaft cannot be turned during installation, installation can be facilitated by attaching a tapered guide (chamfered) to the end of the shaft.



When installing or removing the one-way clutch or one-way clutch unit, turn the gear in the direction of the arrow in the figure (idle direction) to prevent damaging the shaft.



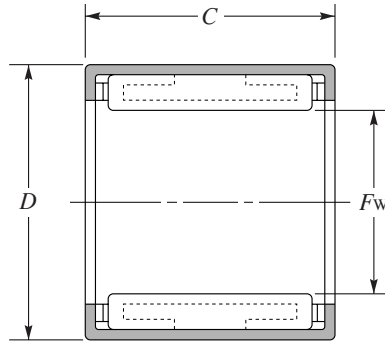
### Handling precautions

Be very careful not to subject the one-way clutch to a severe impact such as a shock resulting from falling.

# One-way Clutch

## 1-6 Dimensions table <One-way clutch>

HF<sub>type</sub>

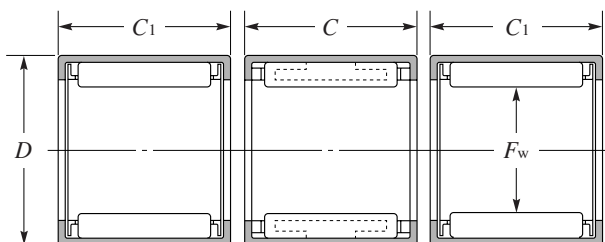


Shaft diameter mm	Clutch number	Dimensions mm			Torque capacity N·m [kgf·cm]	Mass g (Reference)
		$F_w$	$D$	$C_{-0.25}^0$		
6	HF0612	6	10	12	1.76 { 18 }	3
8	HF0812	8	12	12	3.15 { 32 }	3.5
10	HF1012	10	14	12	5.30 { 54 }	4.0
12	HF1216	12	18	16	12.2 { 124 }	11.6
14	HF1416	14	20	16	17.3 { 176 }	13
16	HF1616	16	22	16	20.5 { 209 }	14
18	HF1816	18	24	16	24.1 { 246 }	15.5
20	HF2016	20	26	16	28.5 { 291 }	17
25	HF2520	25	32	20	66 { 673 }	30.9
30	HF3020	30	37	20	90 { 918 }	36
35	HF3520	35	42	20	121 { 1230 }	40

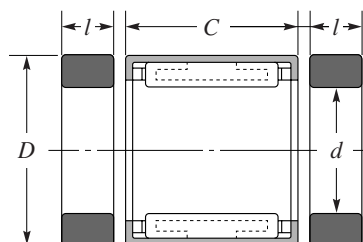
# One-way Clutch

## HF type radial load bearing

Select by referring to the bearings in the table below.



NTN shell-type needle roller bearing (HK type)



NTN BEARPHITE oil-impregnated bearing

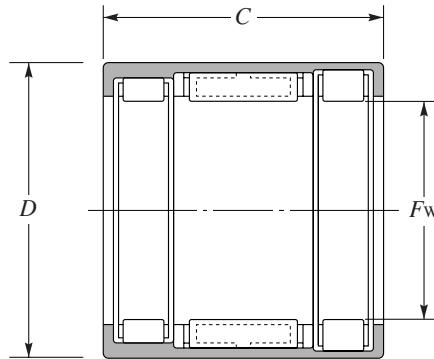
Shaft diameter mm	One-way clutch number	NTN shell-shaped needle roller bearing (HK type) <sup>①</sup>					NTN BEARPHITE <sup>②</sup> oil-impregnated bearing				
		Bearing number	Dimensions mm		Basic rated load N  kgf		Bearing number	Dimensions mm			
			$F_w$	$D$	$C_1$	$C_r$	$C_{or}$		$d$	$D$	$l$
6	HF0612	HK0609T2	6	10	9	2 660   272	2 280   233	B-S6-22	6	10	5
8	HF0812	HK0810C	8	12	10	3 850   395	3 950   400	B-S8-25	8	12	5
10	HF1012	HK1010 HK1012	10	14	10 12	4 500   460  5 900   605	5 100   520  7 250   735	B-S10-21	10	14	5
12	HF1216	HK1212	12	18	12	6 600   675	7 300   745	B-S12-32	12	18	5
14	HF1416	HK1412 HK1416	14	20	12 16	7 200   735  10 700   1090	8 500   865  14 000   1430	B-S14-13	14	20	5
16	HF1616	HK1612 HK1616	16	22	12 16	7 750   795  11 100   1130	9 700   990  15 300   1560	B-S16-13	16	22	8
18	HF1816	HK1812 HK1816	18	24	12 16	8 300   845  11 800   1210	10 900   1110  17 300   1760	B-S18-8	18	24	8
20	HF2016	HK2012C HK2016 HK2020C	20	26	12 16 20	9 250   945  13 000   1320  16 400   1670	13 000   1330  20 100   2050  27 100   2760	B-S20-19	20	26	10
25	HF2520	HK2512 HK2516 HK2520	25	32	12 16 20	11 800   1200  15 900   1620  20 300   2070	16 300   1660  24 000   2450  33 000   3350	B-S25-11	25	32	10
30	HF3020	HK3012 HK3016 HK3020	30	37	12 16 20	13 000   1320  18 100   1850  22 300   2280	19 500   1990  30 000   3050  39 500   4000	B-S30-19	30	37	10
35	HF3520	HK3512 HK3516 HK3520	35	42	12 16 20	14 000   1430  19 700   2000  24 800   2530	22 800   2320  35 000   3600  47 500   4850	B-S35-7	35	42	10

<sup>①</sup>NTN shell-shaped needle roller bearings include the closed end type (BK type) in addition to the open end type (HK type) listed above.  
In addition, there are HK and BK types with seals (single seal or double seal).  
Refer to the special catalog "Needle Roller Bearings" for the features and assembly guidelines for shell-type needle roller bearings.

<sup>②</sup>NTN BEARPHITE oil-impregnated bearings are designed for an ideal radial clearance with the housing and shaft tolerances recommended on page 6.  
If the width  $l$  of the NTN BEARPHITE oil-impregnated bearing is a problem due to the available space, please consult with NTN.  
Refer to the special catalog "NTN BEARPHITE Oil-impregnated Bearings" for the features, loads, rotational speeds and installation dimensions of oil-impregnated bearing.

## One-way Clutch

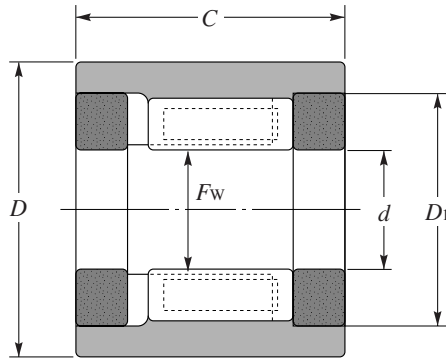
## 1-6 Dimensions table &lt;One-way clutch&gt;

HFL<sub>type</sub>

Shaft diameter mm	Clutch number	Dimensions mm			Torque capacity N·m  kgf·cm	Basic rated load N  kgf		Mass g (Reference)
		$F_w$	$D$	$C_{-0.25}^0$		$C_r$	$C_{or}$	
8	HFL0822	8	12	22	3.15   32	4 050   413	4 150   423	6.3
10	HFL1022	10	14	22	5.30   54	4 300   438	4 650   474	7.4
12	HFL1226	12	18	26	12.2   124	6 300   642	6 500   663	18
14	HFL1426	14	20	26	17.3   176	7 100   724	7 700   785	20
16	HFL1626	16	22	26	20.5   209	7 300   744	8 400   857	22
18	HFL1826	18	24	26	24.1   246	8 300   846	10 300  1050	24
20	HFL2026	20	26	26	28.5   291	8 200   836	10 400  1060	27
25	HFL2530	25	32	30	66.0   673	10 900  1110	14 100  1440	44
30	HFL3030	30	37	30	90.0   918	12 600  1280	17 600  1790	51
35	HFL3530	35	42	30	121.00  1230	13 000  1330	19 300  1970	58

# One-way Clutch

## NHF<sub>type</sub>

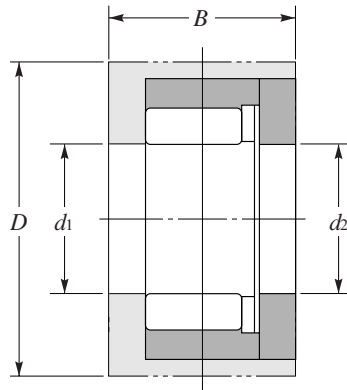


Shaft diameter mm $F_w$	Clutch number	Dimensions mm				Torque capacity N·m [kgf·cm]	Mass g (Reference)
		$d$	$D \begin{smallmatrix} +0.020 \\ 0 \end{smallmatrix}$	$(D_1)$	$C \begin{smallmatrix} 0 \\ -0.200 \end{smallmatrix}$		
4	NHF04	$4 \begin{smallmatrix} +0.050 \\ +0.020 \end{smallmatrix}$	10	8.4	9	0.29 { 3 }	3.4
6	NHF06	$6 \begin{smallmatrix} +0.055 \\ +0.020 \end{smallmatrix}$	12	10.4	10	0.69 { 7 }	4.7
8	NHF08	$8 \begin{smallmatrix} +0.055 \\ +0.020 \end{smallmatrix}$	16	13.5	13	2.06 { 21 }	11
10	NHF10	$10 \begin{smallmatrix} +0.060 \\ +0.020 \end{smallmatrix}$	18	15.5	14	3.14 { 32 }	14
12	NHF12	$12 \begin{smallmatrix} +0.065 \\ +0.020 \end{smallmatrix}$	20	17.5	15	4.61 { 47 }	18

# One-way Clutch

## 1-7 Dimensions table <One-way clutch units>

**NCU**<sub>type</sub>, **NCZ**<sub>type</sub>, **NCZC**<sub>type</sub> (Standard Width Models)

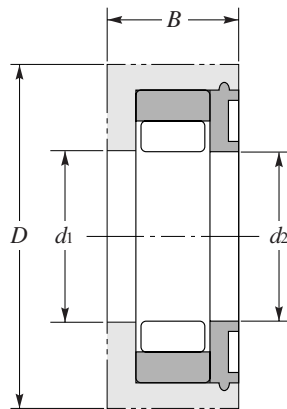


Shaft diameter mm	Clutch number	Dimensions mm				Torque capacity <sup>①</sup> N·m  kgf·cm	Idling torque <sup>②</sup> mN·m  gf·cm
		$d_1$	$d_2$	$D$	$B$		
4	<b>NCU 4</b>	4 <sup>+0.10</sup> / <sub>+0.02</sub>	4 <sup>+0.10</sup> / <sub>+0.02</sub>	12 min.	9min.	0.20 {2}	2.94 {30}
6	<b>NCZ 6</b>	6 <sup>+0.10</sup> / <sub>+0.02</sub>	6 <sup>+0.12</sup> / <sub>+0.02</sub>	13.5min.	8min.	0.49 {5}	3.43 {35}
	<b>NCZC 6</b>			13 min.	8min.	0.20 {2}	3.43 {35}
8	<b>NCZ 8</b>	8 <sup>+0.10</sup> / <sub>+0.02</sub>	8 <sup>+0.10</sup> / <sub>+0.02</sub>	16 min.	8min.	0.78 {8}	4.90 {50}
10	<b>NCU10</b>	10 <sup>+0.10</sup> / <sub>+0.02</sub>	10 <sup>+0.10</sup> / <sub>+0.02</sub>	20 min.	10min.	0.88 {9}	4.90 {50}

①The torque capacity is based on the NTN standard test conditions.  
②Idling torque is the value when radial torque is not applied.

Oscillation angle: 10 degrees  
Oscillation cycle: 300 cpm, 10<sup>6</sup> times  
Shaft used: SUJ2, tempered  
Dimension tolerance: h7

## One-way Clutch

NCZX<sub>type</sub>, NCUX<sub>type</sub> (Narrow Width Products)

Shaft diameter mm	Clutch number	Dimensions mm				Torque capacity <sup>①</sup> N·m {kgf·cm}	Idling torque <sup>②</sup> mN·m {gf·cm}
		$d_1$	$d_2$	$D$	$B$		
4	NCUX 4	4 <sup>+0.10</sup> / <sub>+0.02</sub>	4 <sup>+0.10</sup> / <sub>+0.02</sub>	11.5min.	5min.	0.10 {1}	2.94 {30}
6	NCZX 6	6 <sup>+0.10</sup> / <sub>+0.02</sub>	6 <sup>+0.12</sup> / <sub>+0.02</sub>	13.5min.	5min.	0.20 {2}	3.43 {35}
8	NCZX 8	8 <sup>+0.10</sup> / <sub>+0.02</sub>	8 <sup>+0.10</sup> / <sub>+0.20</sub>	16 min.	5min.	0.34 {3.5}	3.92 {40}

① The torque capacity is based on the NTN standard test conditions.

② Idling torque is the value when radial torque is not applied.

Oscillation angle: 10 degrees

Oscillation cycle: 300 cpm, 10<sup>6</sup> times

Shaft used: SUJ2, tempered

Dimension tolerance: h7

# One-way Clutch

## 1-8 Product applications

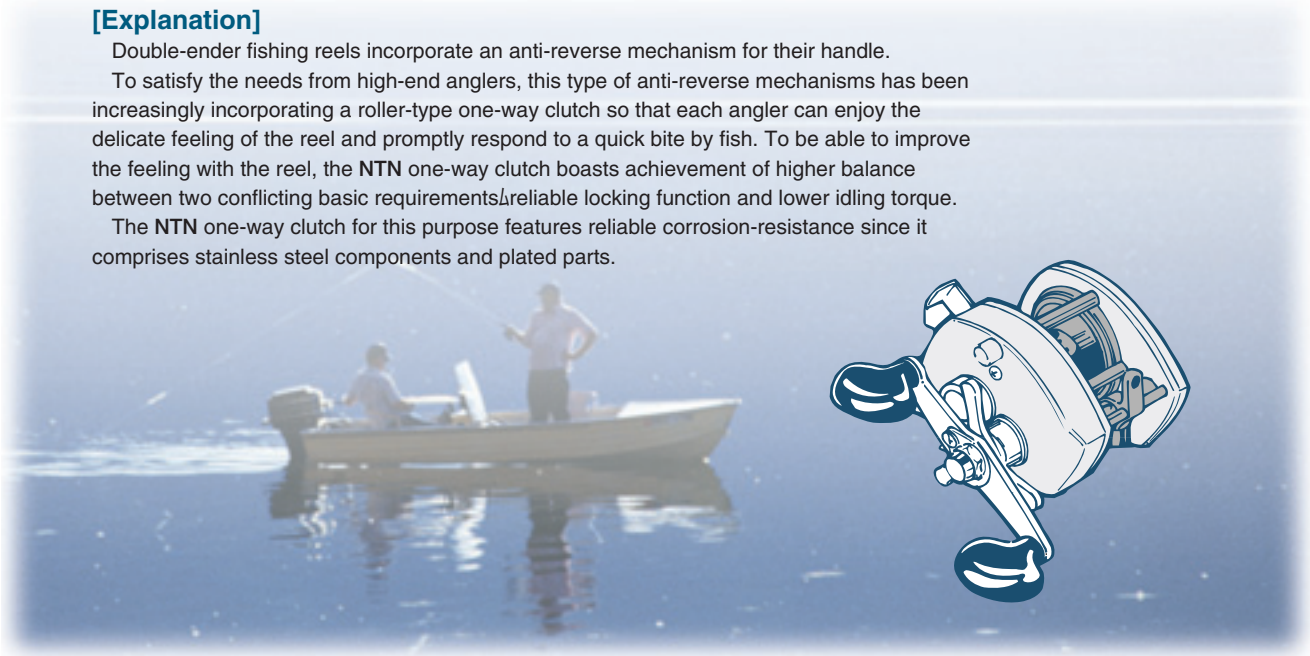
### 1-8-1 One-way clutch for fishing reels

#### [Explanation]

Double-ender fishing reels incorporate an anti-reverse mechanism for their handle.

To satisfy the needs from high-end anglers, this type of anti-reverse mechanisms has been increasingly incorporating a roller-type one-way clutch so that each angler can enjoy the delicate feeling of the reel and promptly respond to a quick bite by fish. To be able to improve the feeling with the reel, the NTN one-way clutch boasts achievement of higher balance between two conflicting basic requirements—reliable locking function and lower idling torque.

The NTN one-way clutch for this purpose features reliable corrosion-resistance since it comprises stainless steel components and plated parts.



#### [Features of one-way clutch for finishing reel]

##### 1. Excellent rust-resistance quality

Fishing reels are often stored without removing seawater on them. As a result, rust can quickly occur on them, leading to a malfunctioning clutch.

With the NTN one-way clutches for fishing reel, their outer ring is plated, the rollers and springs are made of stainless steel and the cage is composed of a resin. Thus, they offer excellent rust-resistance quality, and maintain reliable clutch function even under very severe operating conditions such as an environment filled with saltwater mist.

##### 2. Reliable clutch function

The NTN one-way clutch for fishing reel employs a stainless steel spring. This feature allows the one-way clutch to be reliably locked even in a cold climate (no problem has occurred at -20°C: bench test by NTN, see \*1).

##### 3. Low idling torque

Use of a specially shaped spring ensures a low idling torque (approx. 50% compared with conventional one-way clutch). This feature leads to realization of higher balance between two conflicting basic requirements—reliable locking function and lower idling torque.

##### 4. Compact size & high load-carrying capacity

Because being held by the hand of angler for a prolonged time, a fishing reel has to be very light and compact. So that a compact fishing reel, when locked, can maintain a sufficiently great torque capacity, it needs to employ a highly rigid one-way clutch.

The outer ring of the NTN one-way clutch for fishing reel is manufactured through a drawing process rather than a conventional press process, and, therefore, the one-way clutch boasts a compact construction and higher rigidity.

##### 5. Easy assembly

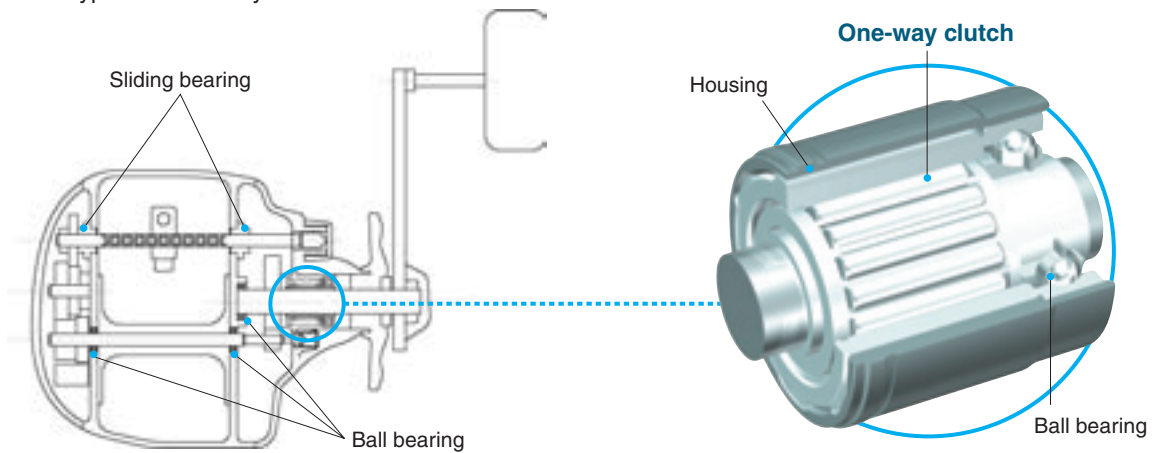
The outer circumference of the outer ring can be formed into a special shape. Then, by simply inserting the one-way clutch into the housing whose inner surface conforms to the outer surface of the outer ring, the one-way clutch is fixed into position to prevent undesirable rotation.



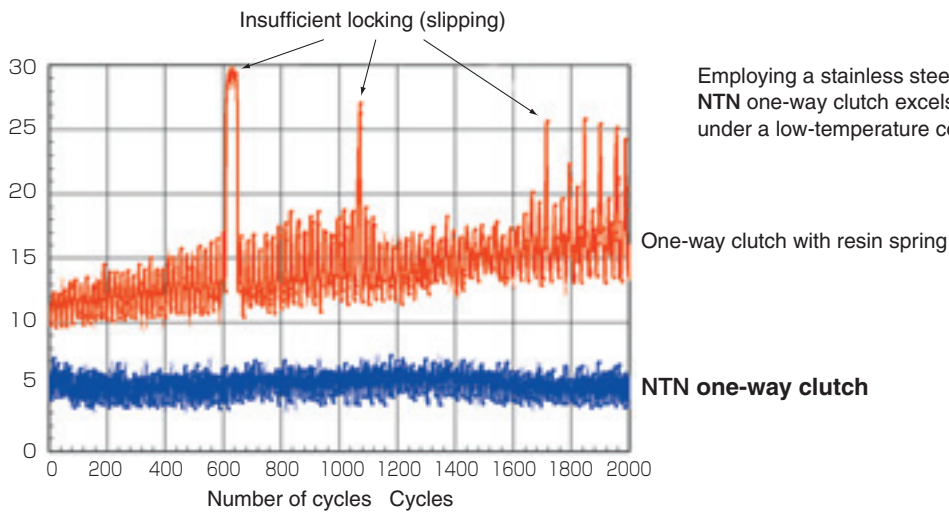
# One-way Clutch

## [Example of fishing reel construction]

Double-ender type with one-way clutch

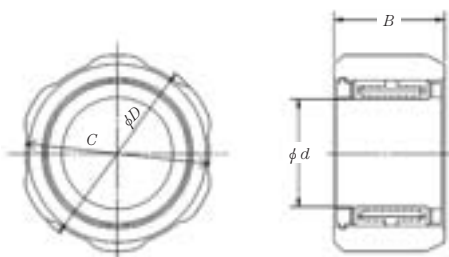


## [Experimental data] \*1 Comparison in locking performance under simulated cold climate (-20°C)



Employing a stainless steel spring rather than a resin spring, the NTN one-way clutch excels in locking performance, in particular, under a low-temperature condition.

## [Dimensions table for NTN one-way clutches]

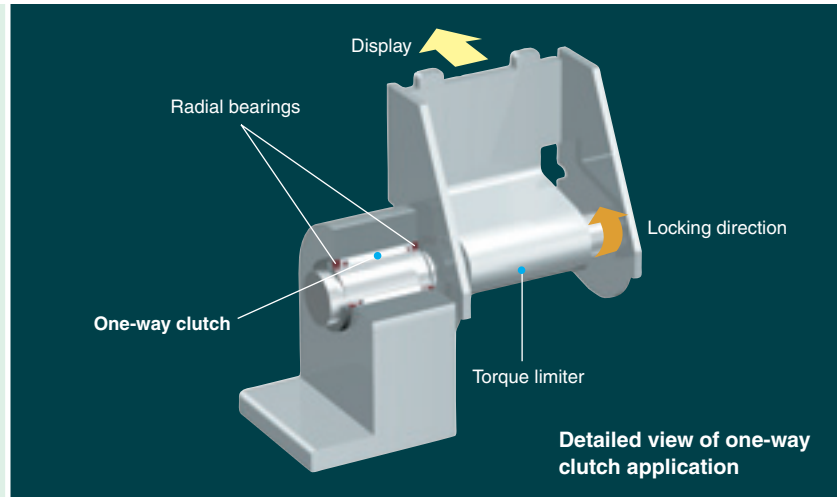
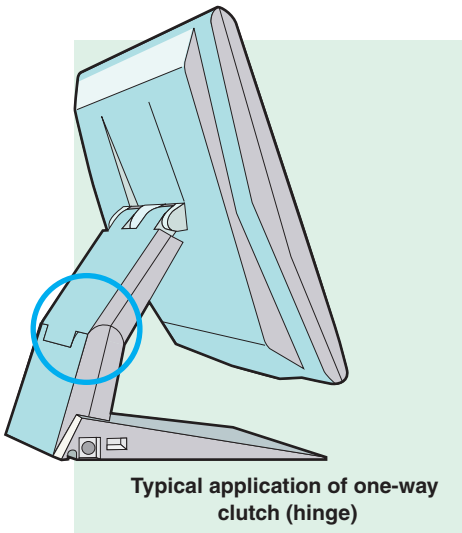


Product name	Dimensions				Torque capacity (N·m)	Idling <sup>*2</sup> torque (N·m)
	d	D	C	B		
HFX10X17.1X8-2/0G	10	17.1	16	8	3.0	2.5×10 <sup>-3</sup> max.
HFX10X17.1X12/0G	10	17.1	16	12	5.3	2.5×10 <sup>-3</sup> max.

\*2 The idling torque values are obtained from use of the NTN recommended shaft diameter  $\phi 9.955 \pm 0.005$ .

## One-way Clutch

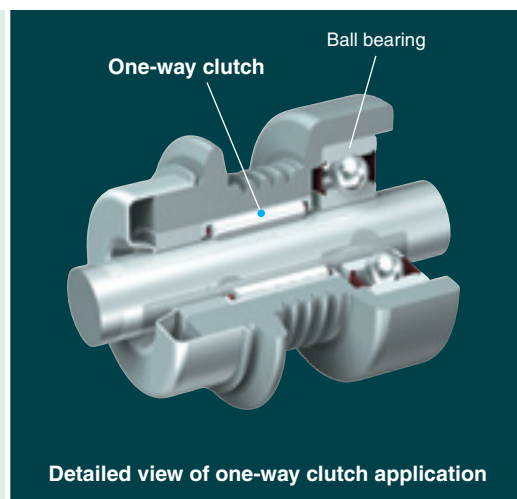
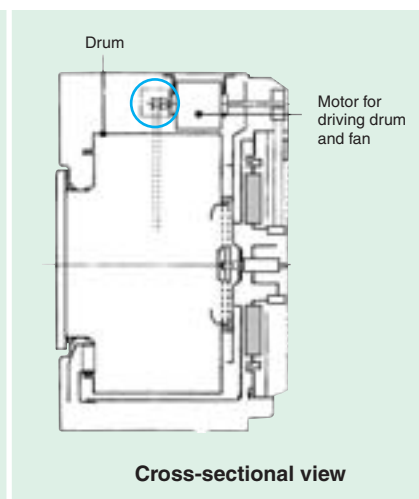
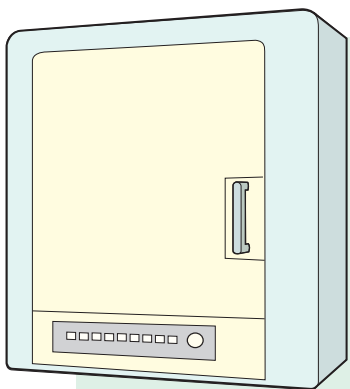
### 1-8-2 Personal computer and LCD panel (for hinge)



#### [Operation of one-way clutch]

- In a normal operating condition, the one-way clutch remains in the locked mode and the weight of the display is stably supported.
- When intending to swing down the display, the user will exert a torque (force) greater than the allowable torque on the torque limiter (though the clutch remains locked), and, as a result, the torque limiter will slip, causing the display to lower.
- When the user attempts to swing up the display, the clutch will idle, allowing the user to smoothly swing up the display with a very light force.

### 1-8-3 Clothes dryer (drum rotation mechanism)



The one-way clutch is built into the pulley for drum drive belt.

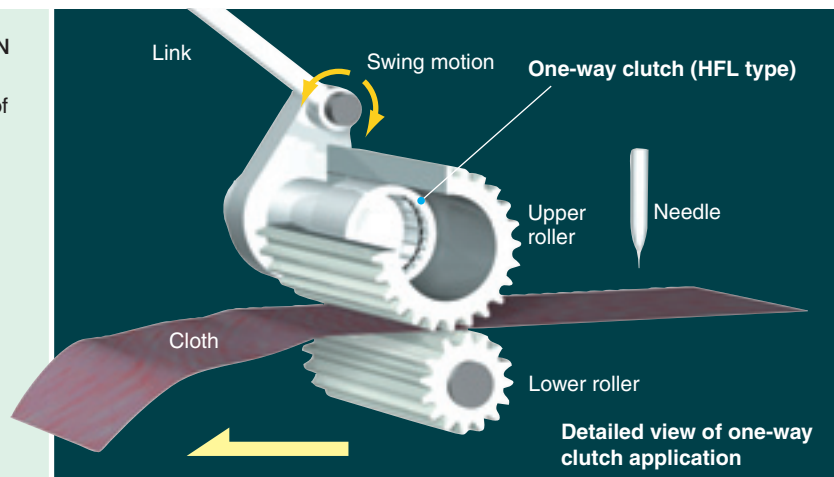
#### [Operation of one-way clutch]

- When the drum and fan are running: the clutch is locked to drive the drum.
- When the fan alone is running (the drum is at a standstill): the clutch idles and does not transmit power to the drum.

## One-way Clutch

### 1-8-4 Industrial sewing machine (cloth feeding section)

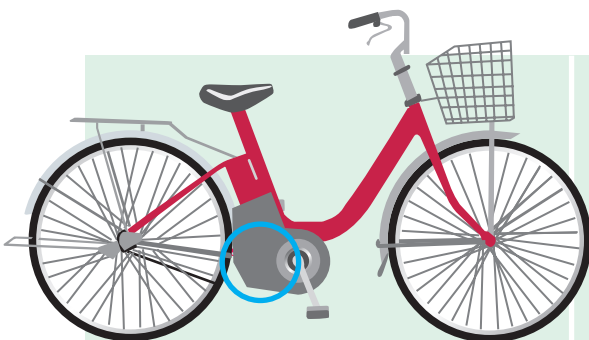
On industrial sewing machines, an NTN one-way clutch is incorporated into a roller that intermittently feeds a piece of cloth, being timed with the upward / downward motion of the needle.



#### [Operation of one-way clutch]

- The clutch shaft swings via the link. The installed clutch is oriented such that when the clutch shaft is turned clockwise, the clutch is locked; when the shaft is turned counterclockwise, the clutch idles.
- When the shaft is turned clockwise, the clutch is locked, and the upper roller rotates in conjunction with the shaft, thereby the cloth is fed along the arrow direction.
- When the shaft is turned counterclockwise, the clutch idles, and the upper roller remains at a standstill. As a result, the cloth is not fed.
- The shaft repeatedly swings and the above-mentioned cycle is repeated, thereby the cloth is fed intermittently.

### 1-8-5 Power-assisted bicycle (drive unit)

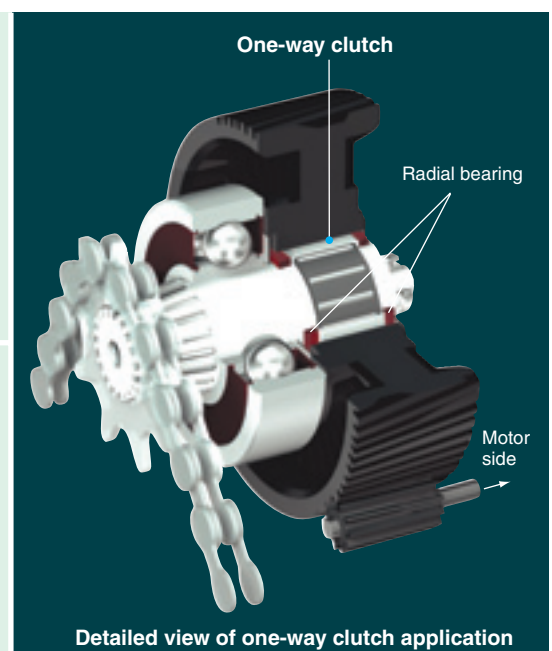


Section incorporating one-way clutch

The driving power from the motor is transmitted to the chain via the one-way clutch. As a result, the rider's power required for the pedals is reduced.

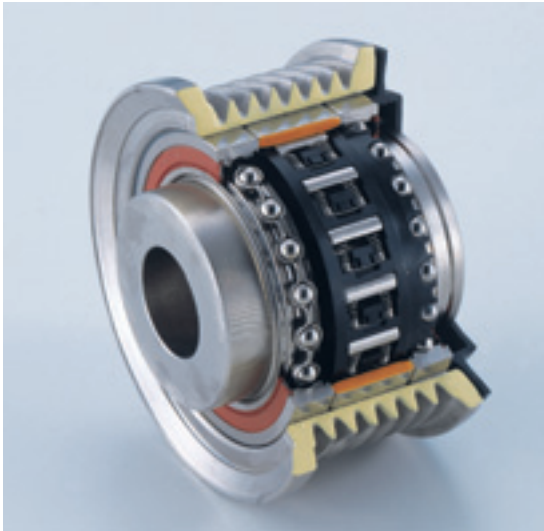
#### [Operation of one-way clutch]

- **When the motor is running (assist function is ON):**  
The rotary output from the motor acts on the one-way clutch via the reduction gearing, causing the clutch to engage. As a result of this engagement, the drive force is transmitted from the clutch shaft, the sprocket and then to the chain.
- **When the motor is not running (assist function is OFF):**  
The clutch, which drives the chain, remains disengaged, while the clutch shaft receives the driving force from the chain.



# One-way Clutch

## 1-8-6 Clutch incorporated pulley (CIP)



### [Product overview]

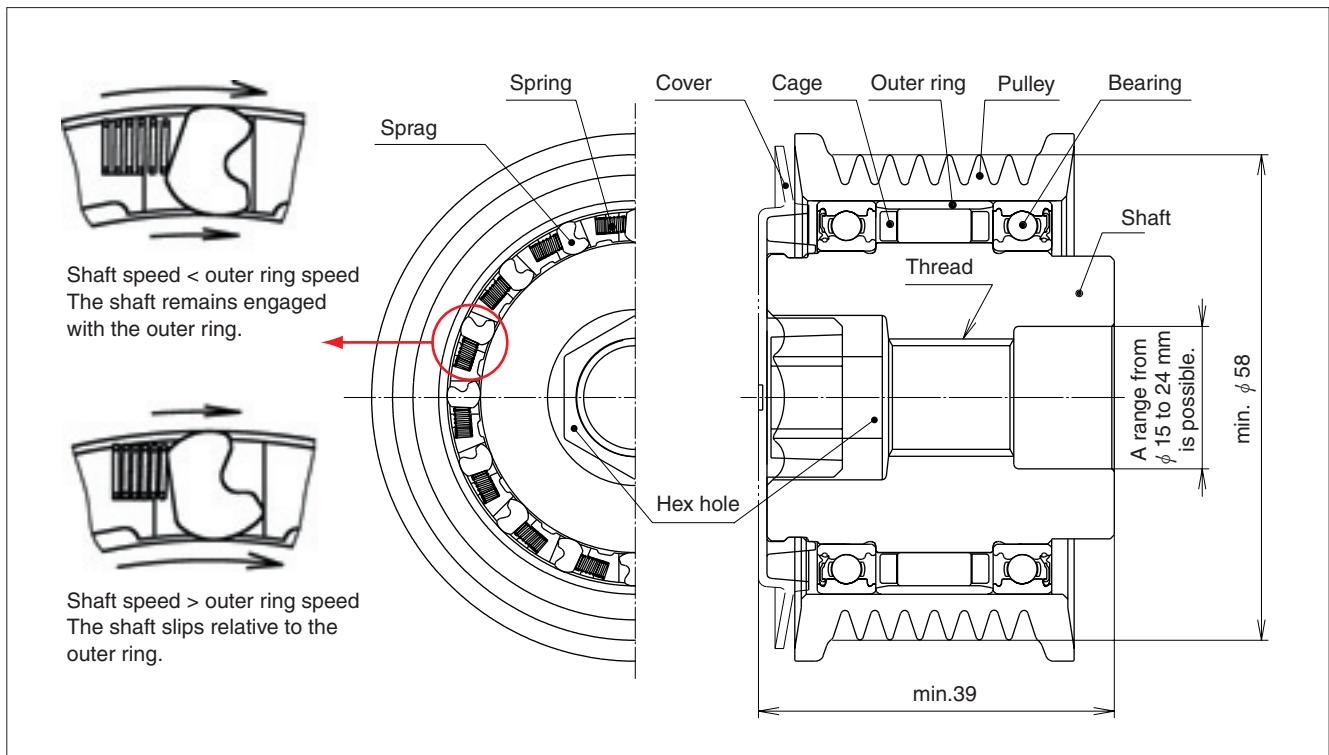
The pulley of an auxiliary device of a greater rotating inertia may incorporate a one-way clutch to mitigate the variation in belt tension and/or suppress the belt slip noise. This type of pulley is known as "clutch incorporated pulley".

- Longer life for drive belt
  - Prevention of vibration on drive belt
  - Suppression of belt slip noise
- (Reduction of belt tension variation)

### [Features]

- Benefits with sprag-type one-way clutch
    - Compact design
    - Greater torque capacity
  - Benefits with a construction comprising two rows of deep groove ball bearings
    - Increased radial load capacity
    - Increased moment load capacity
- Joint development work in cooperation with Bando Chemical Industries, Ltd.

### [Construction]



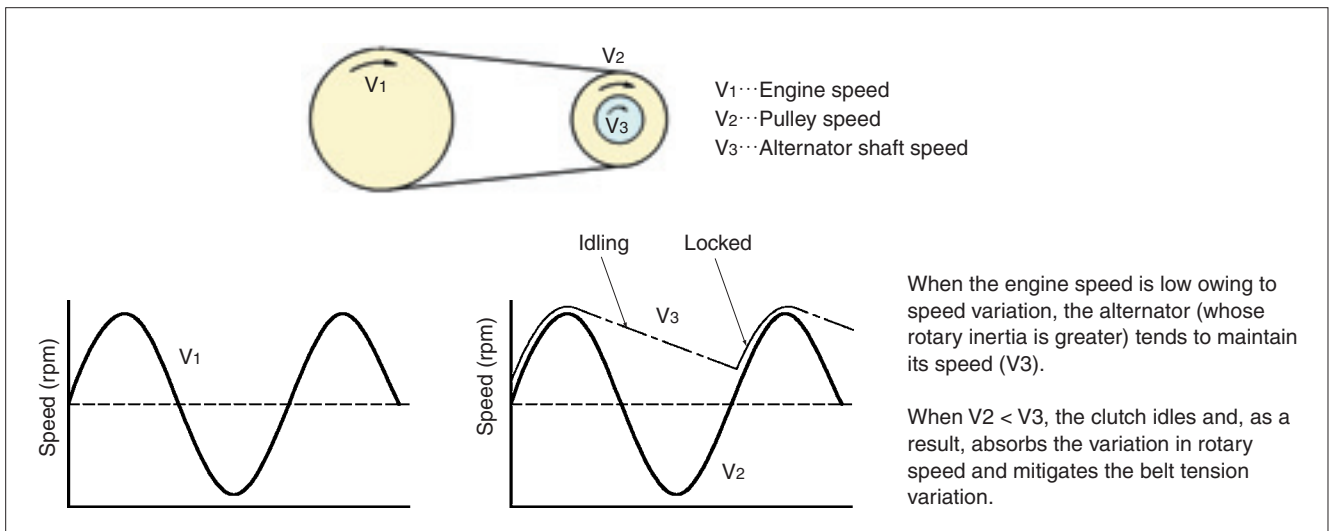
# One-way Clutch

## [Operating principle]

If an engine with greater speed variation drives a mechanism of a greater rotary inertia (alternator, etc.), greater tension variation occurs on the drive belt, possibly rendering the service life of the drive belt shorter.

To address this problem, NTN has attempted to incorporate a one-way clutch into a pulley to absorb speed variation and reduce belt tension variation in order to achieve a longer belt life.

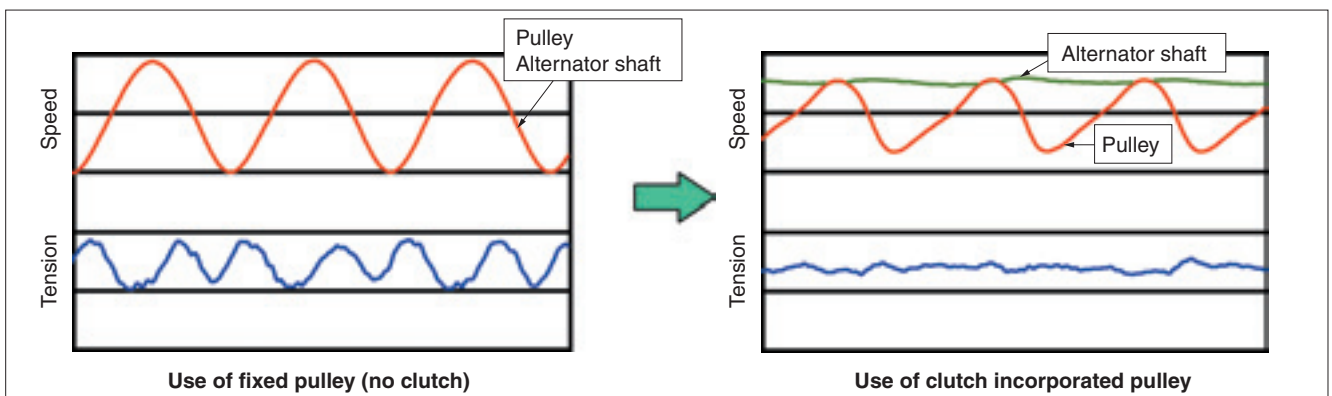
(Bando Chemical Industries, Ltd.: Japanese Patent No. 216602, No. 2779331)



## [Recommended applications]

- Automotive auxiliary devices (alternator, etc.)
- Idling stop mechanism

## [Engineering data]



## Two-way Clutch

### 2-1 Features

In contrast to one-way clutches which can drive in one direction only, any two-way clutch is capable of switchover between drive and idle modes in both directions.

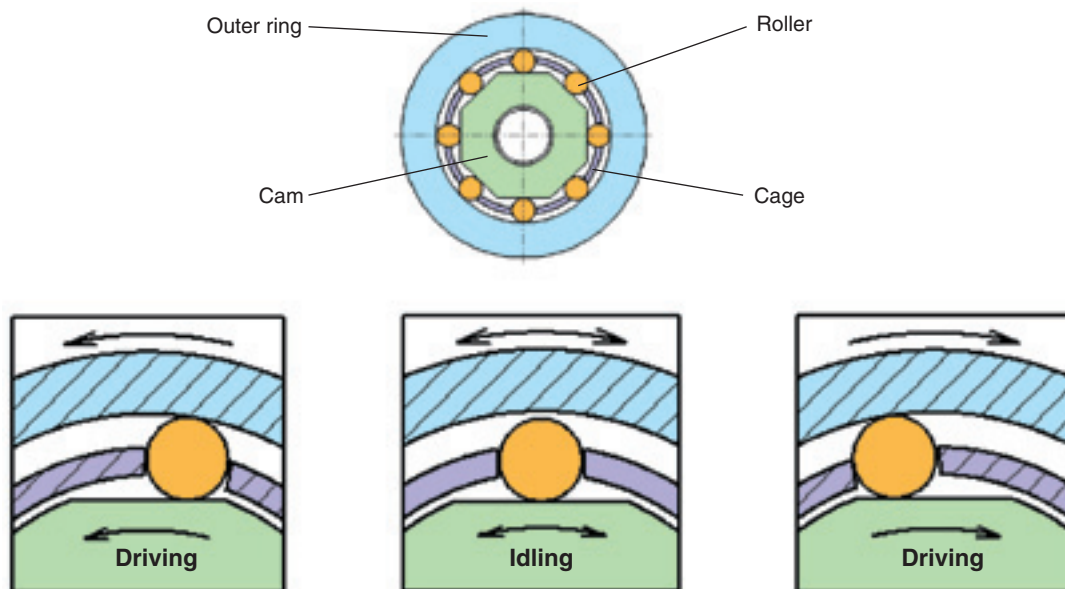
For a situation where the user wants to transmit a torque in both forward and reverse directions, a two-way clutch may be employed. Consequently, use of a combination of complicated switching mechanisms is no longer necessary; and this advantage leads to simplification and compact size of a transmission mechanism, as well as to a lower cost.

### 2-2 Operating mechanism

The NTN two-way clutch comprises, as illustrated below, a regular polygon cam that is capable of driving in both directions, wherein each cam face aligns with a roller. By switching the phase of the cage relative to the phase of the cam face, the clutch can be arbitrarily switched to the neutral-idling state, forward-driving state and reverse-driving state.

### 2-3 Provision of multiple functions with a variety of switchover schemes

The NTN two-way clutch line of products address specific needs of customer, and the examples include a roller two-way clutch (friction switchover type) with which the driving direction is automatically selected to cope with the running direction of the input shaft; and a mechanical clutch unit (MCU) with which the operating mode is electrically selected from an external controller.



## 2-4 Applications

### 2-4-1 Roller two-way clutch (friction switchover type)



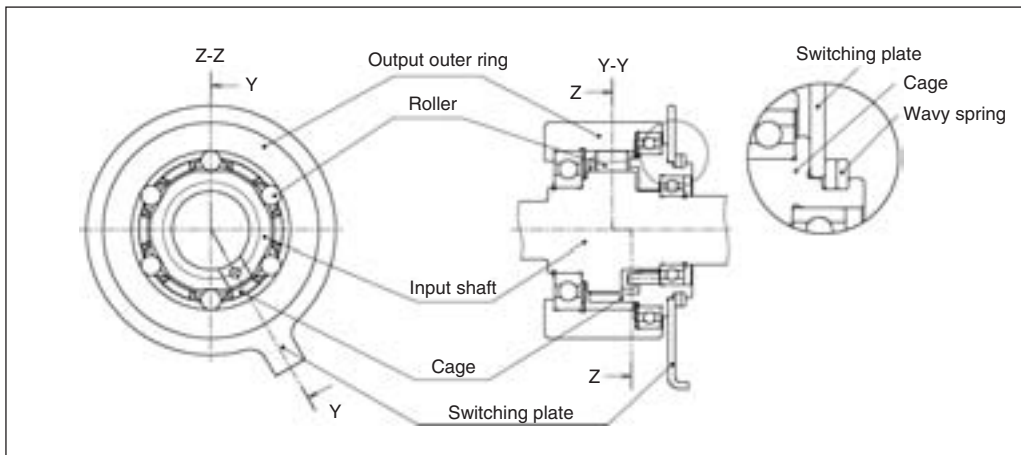
**[Explanation]**

The operating direction of this type of clutch is automatically selected based on the rotating direction on the input side.

**[Features]**

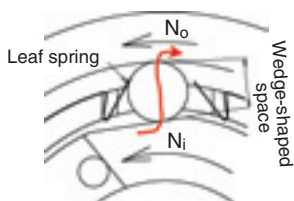
- ① Lower idling torque
- ② Greater torque capacity and compact size
- ③ Pure-mechanical switchover system that does not need a special control device

**[Construction]**

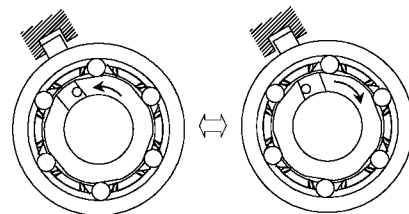


**[Operating principle]**

- ① One end of the switching plate is fixed to the static system while the switching plate is held to the cage by the force of wavy spring. As a result, a resistance opposite to the rotating direction of the input shaft is exerted to the cage.
- ② When revolution is transmitted to the input shaft, there will occur a speed difference between the input shaft and cage.
- ③ Consequently, within the two-way clutch, the rollers come into contact with the input shaft and output outer ring by the force of the leaf springs installed in the cage pockets, thereby the two-way clutch is ready for driving operation.
- ④ When the input shaft speed  $N_i >$  output outer ring speed  $N_o$ , the rollers are forced into the wedge-shaped spaces formed between the input shaft and the output outer ring, allowing the torque from the input shaft to be transmitted to the output outer ring. (See Fig. 1.)
- ⑤ When the input shaft speed  $N_i <$  output outer ring speed  $N_o$ , the rollers leave the wedge shaped spaces, allowing the output outer ring to idle.
- ⑥ When the input shaft rotates in the reverse direction, the operation described above occurs in the opposite direction because the clutch is axisymmetric.



**Fig.1 Torque transmission**  
(red arrow indicates the torque flow)



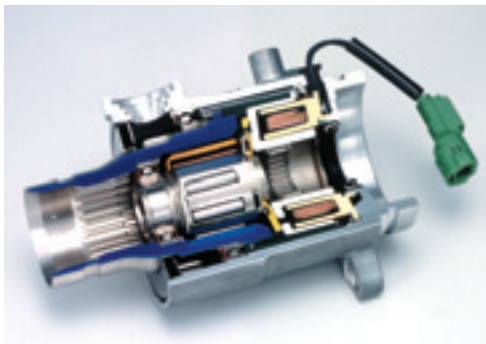
**Fig.2 Variation in clutch interior configuration depending on input shaft rotating direction**

**[Recommended application]**

- Switchover of power transmission on drive system

## Two-way Clutch

### 2-4-2 Mechanical clutch unit (MCU)



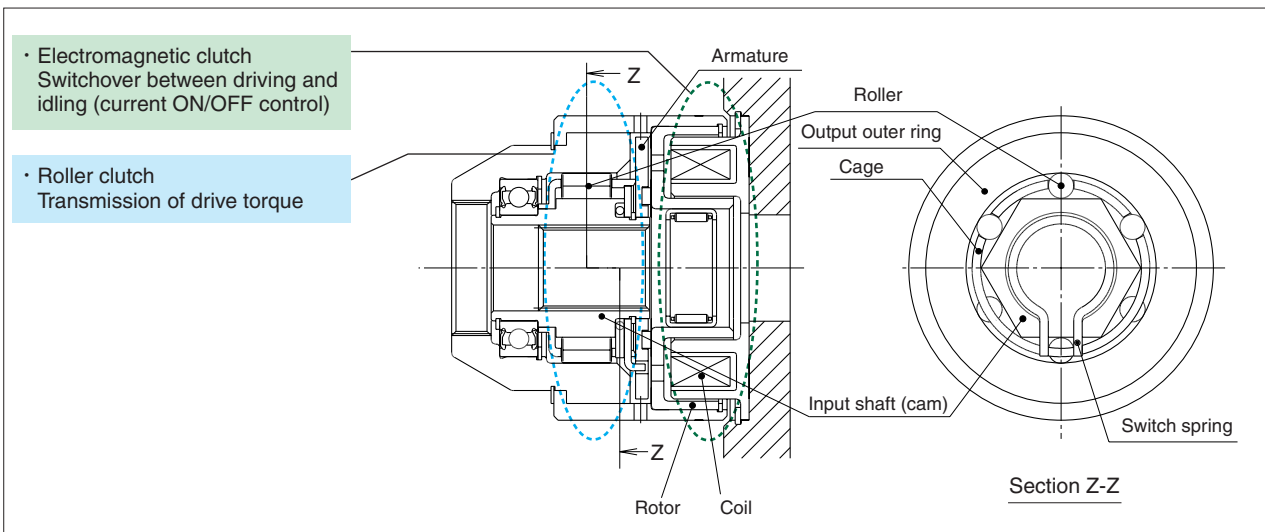
**[Explanation]**

The NTN mechanical clutch unit consists of a mechanical roller clutch and an electromagnet clutch to realize both greater transmission torque capacity and easy control.

**[Features]**

- ① Lower idling torque
- ② Greater torque capacity and compact size
- ③ Excellent response owing to electrical control
- ④ No slippage transmitting torque: longer life
- ⑤ Simple construction that incorporates both roller 2WC and electromagnetic clutch

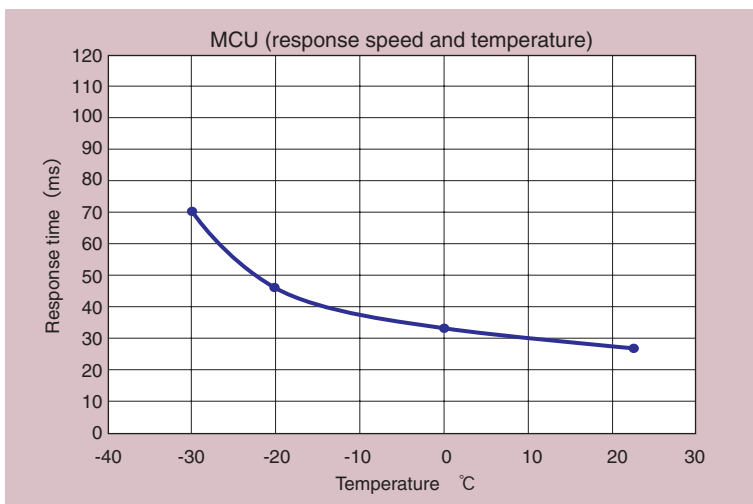
**[Construction]**



**[Engineering data]**

The response speed varies somewhat depending on the operating temperature. However, the response time always remains not greater than 100 ms, which means excellent response speed<sup>1)</sup> (see the chart in the right: under oil lubrication).

NOTE 1) Response speed is expressed as response time from a timing where electricity is supplied to the electromagnet to a timing where the MCU being to transmit the torque.



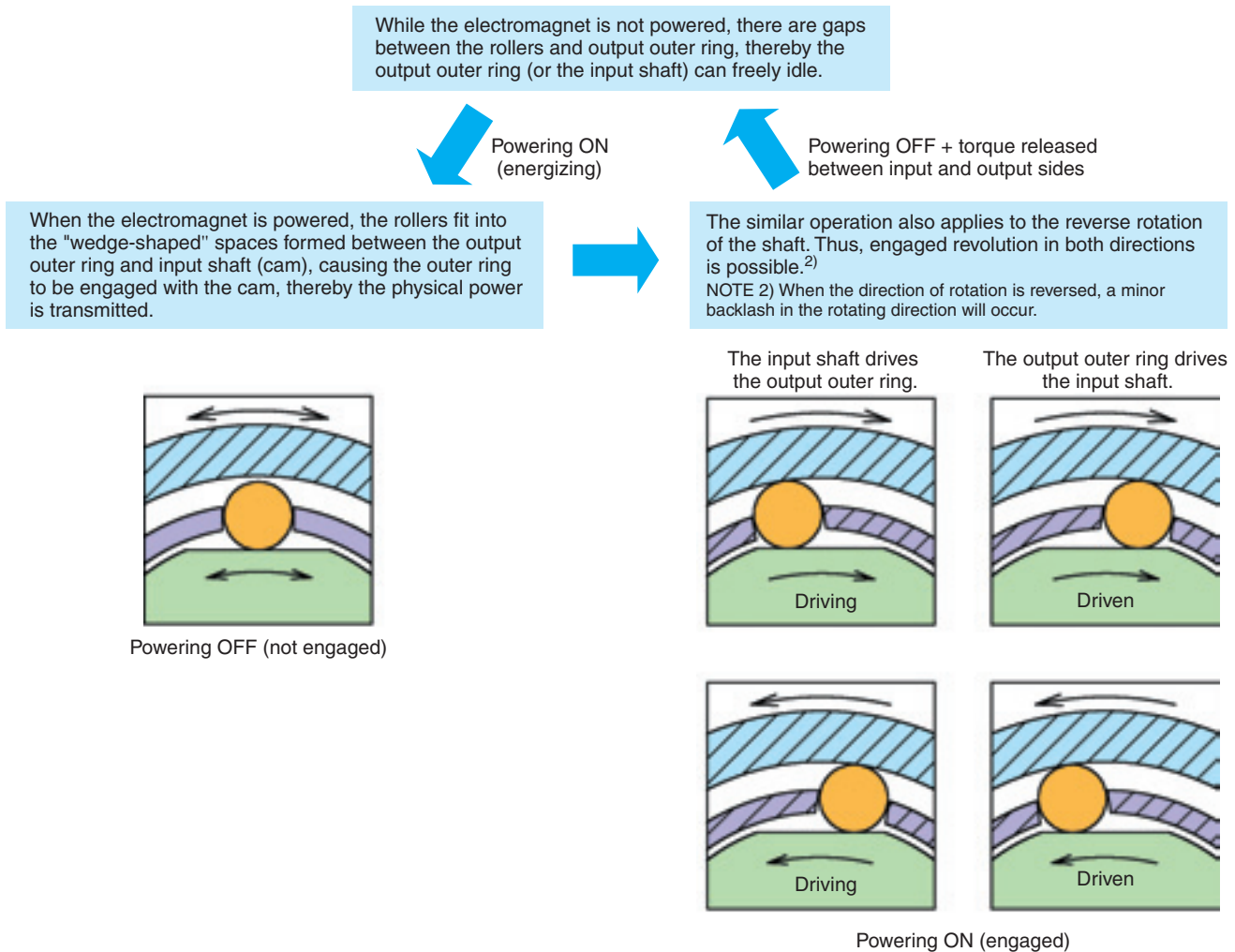
Response speed of MCU relative to temperature change



## Two-way Clutch

### [Operating principle]

The electromagnet is powered ON/OFF to change the phase relation between the rollers and input shaft (cam) so as to engage/disengage the roller clutch, thereby switchover between the drive mode and idle mode is achieved.



### [Specification]

The engineering data for the prototypes already fabricated are summarized in the right.

NOTE 3) The prototypes summarized in this table have been developed per specifications of particular customers. NTN will develop and supply a newly designed product per the specification of each customer.

No.	Boundary dimensions (outer dia. × entire length)	Rating torque <sup>4)</sup> (N · m)	Current consumption (A) (@12 V)
1	φ 73 × 65	150	1.4
2	φ 82 × 100	530	2.4
3	φ 104 × 100	1020	4.2

NOTE 4) Rating torque: Torque under which the clutch can withstand 10<sup>6</sup> loadings.

### [Recommended application]

- Switchover between 2WD and 4WD modes for 4WD cars
- Switchover between power sources for hybrid cars
- The NTN two-way clutches can be widely applied for other power transmission/interruption for input/output based on current control by an external control device.

# Torque Diode

## 3-1 Features

Precaution: When considering an application that uses a torque diode, contact NTN Engineering for technical assistance.

- If the input shaft is rotated, the output shaft also rotates.
- The output shaft cannot cause the input shaft to rotate.

The following is a description of the lock type, free type, swing type, their features and their operating principles.

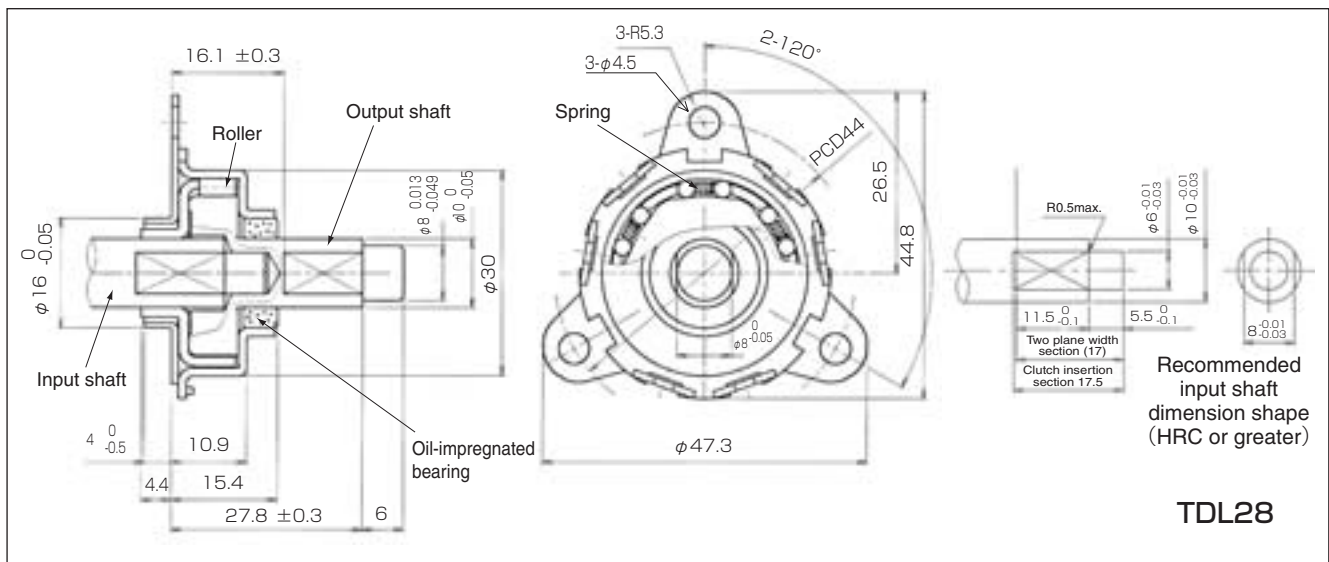
## 3-2 Lock type torque diode (TDL)



### [Features]

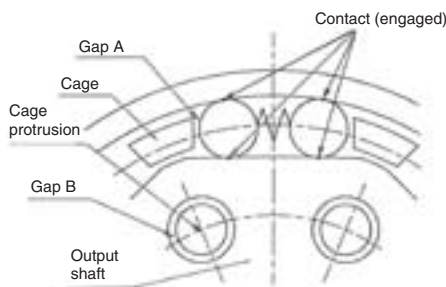
- When the input shaft is rotated, the output shaft also rotates.
- When the output shaft is rotated, the output side is locked and movement is not transmitted to the input shaft.

### [Construction]



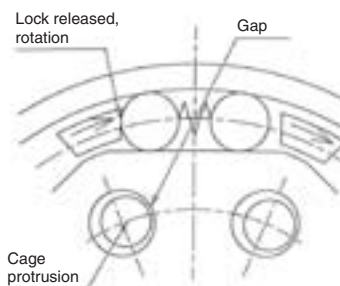
### [Operating principle]

\* Dimensions and/or shape may somewhat vary from those of an actual product.



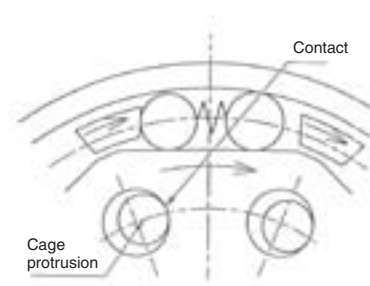
**Fig. 1 Initial State (Forward/Reverse Locked)**

Unless there is drive from the input shaft, the roller locks the output shaft in both forward and reverse.



**Fig. 2 Cage Rotation (Engagement Released)**

When the input shaft (connected to the cage) is turned, the cage kicks out the roller from the cam side and releases the lock.



**Fig. 3 Output Shaft Rotation**

The cage rotates further, and the cage protrusion comes into contact with the output shaft hole, thereby turning the output shaft.

### [Engineering data]

TDL28 specification Allowed load torque: 4.9 N·m

### [Uses]

Devices to prevent reverse input, drop-off preventing mechanism, geared motors, etc.

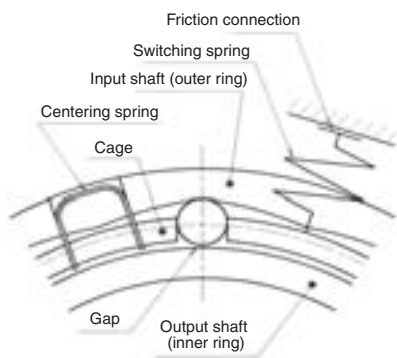
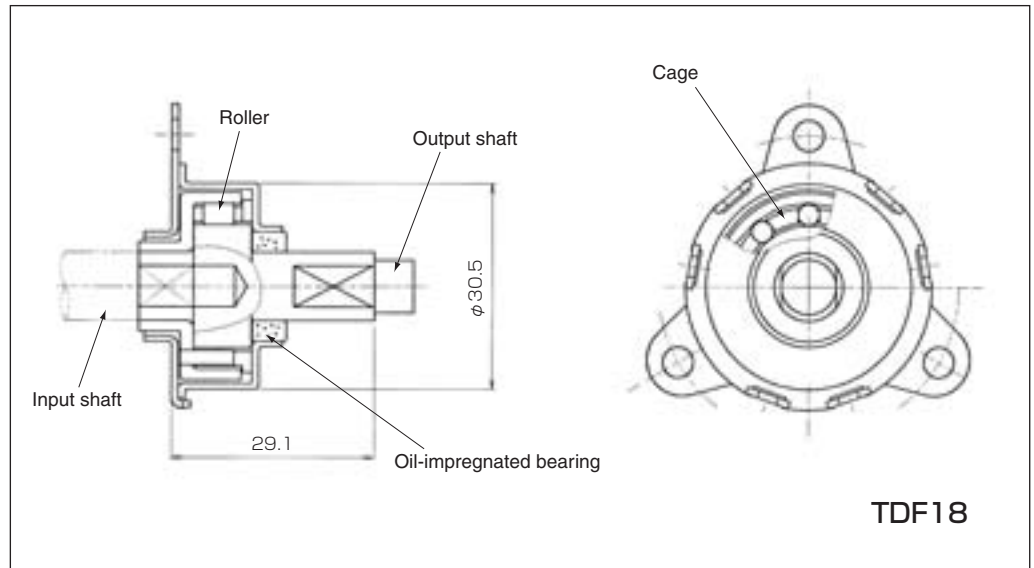
3-3 Free type torque diode (TDF)



[Features]

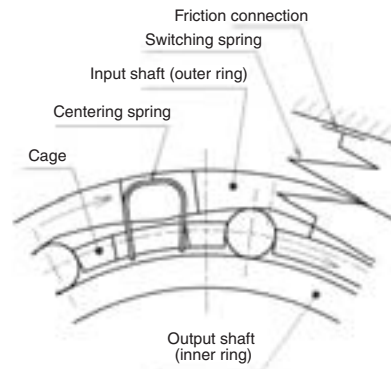
- When the input shaft is rotated, the output shaft also rotates.
- When the output shaft is rotated, it will rotate freely, but the movement is not transmitted to the input shaft.

[Construction]



**Fig. 1 Initial State  
(Free Forward/Reverse Rotation)**

If there is no drive from the input shaft, the centering spring causes the roller to position itself at the center of the outer ring cam surface. Because there is a gap between the roller and inner ring, they are not locked and the output shaft is free to rotate.



**Fig. 2 Input/Output Shafts Locked**

When the input shaft is rotated, the resistance from the switching spring causes the roller to lock with the inner and outer rings, and rotation is transmitted to the output shaft.

[Engineering data]

TDF18 specification Allowed load torque: 4.9 N·m

[Uses]

Devices to prevent reverse input, automatic/manual switching mechanisms, geared motors, etc.



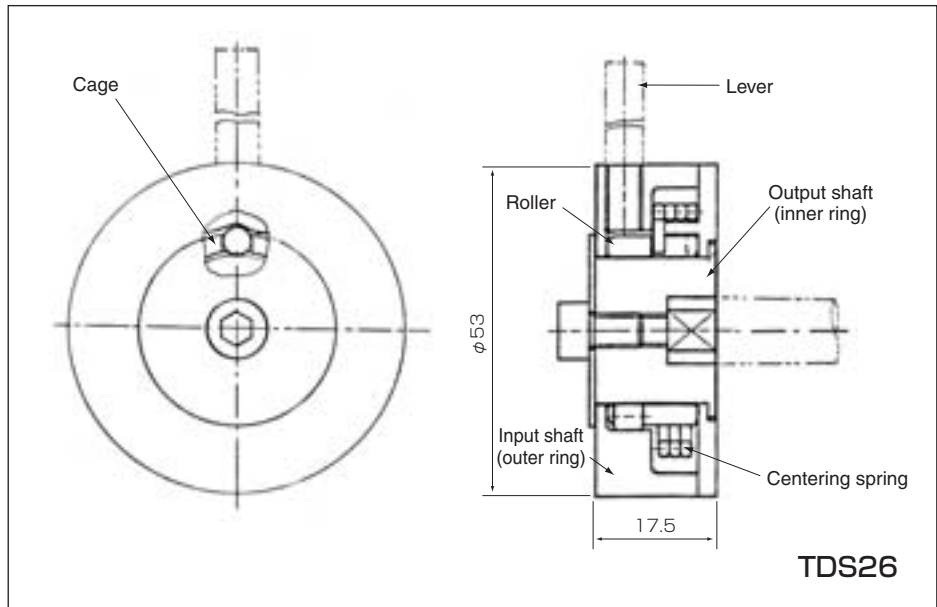
### 3-4 Swing type torque diode (TDS)



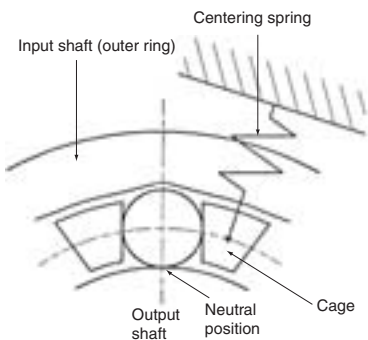
**[Features]**

- By moving the input shaft from the neutral position to the swinging rotation mode, the output shaft will rotate.
- When the output shaft is rotated, it will rotate freely, but the movement is not transmitted to the input shaft.

**[Construction]**



**[Operating principle]**



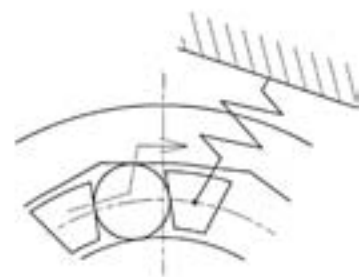
**Fig. 1 Initial State**

If there is no drive from the input shaft, the centering spring causes the roller to position itself at the center of the outer ring cam surface. Because there is a gap between the roller and inner ring, they are not locked and the output shaft is free to rotate.



**Fig. 2 Output Shaft Rotation**

When the input shaft (outer ring) is turned, the rollers come into contact with the corresponding cam faces to lock the output shaft, causing the output shaft to rotate.



**Fig. 3 Returning to the neutral state**

When the input shaft (outer ring) is not turned any more, the rollers and input shaft (outer ring) will return to their neutral state owing to the restoring force of the centering spring.

**[Engineering data]**

TDS26 specification Allowed load torque: 29.4 N·m

**[Uses]**

Input mechanisms on lock-type and free-type torque diode systems.

## Torque Diode

3-5

### Torque diode incorporated product: **Seat lifter clutch (TDLU)**



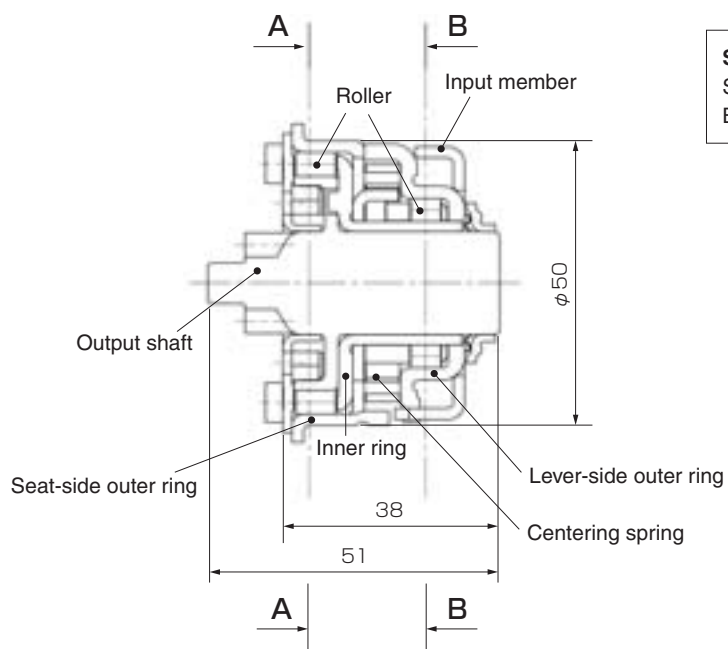
**[Explanation]**

The NTN seat lifter clutch incorporates both a lock-type torque diode (see page 24) and a swing-type torque diode (see page 26).

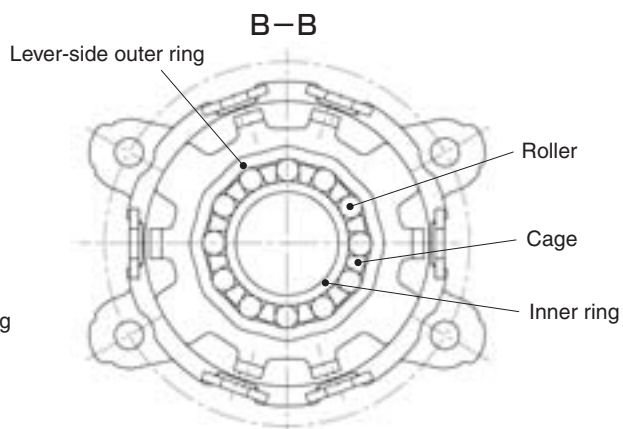
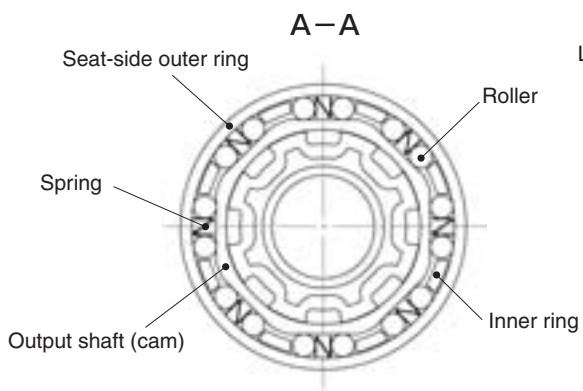
**[Features]**

- ① Compact size
- ② Invariable seat height adjustment
- ③ Smaller lever actuation force
- ④ Quiet operation

**[Construction]**



**Specification**  
 Size: OD  $\phi 50 \times 51$ W  
 Braking force: 80 Nm

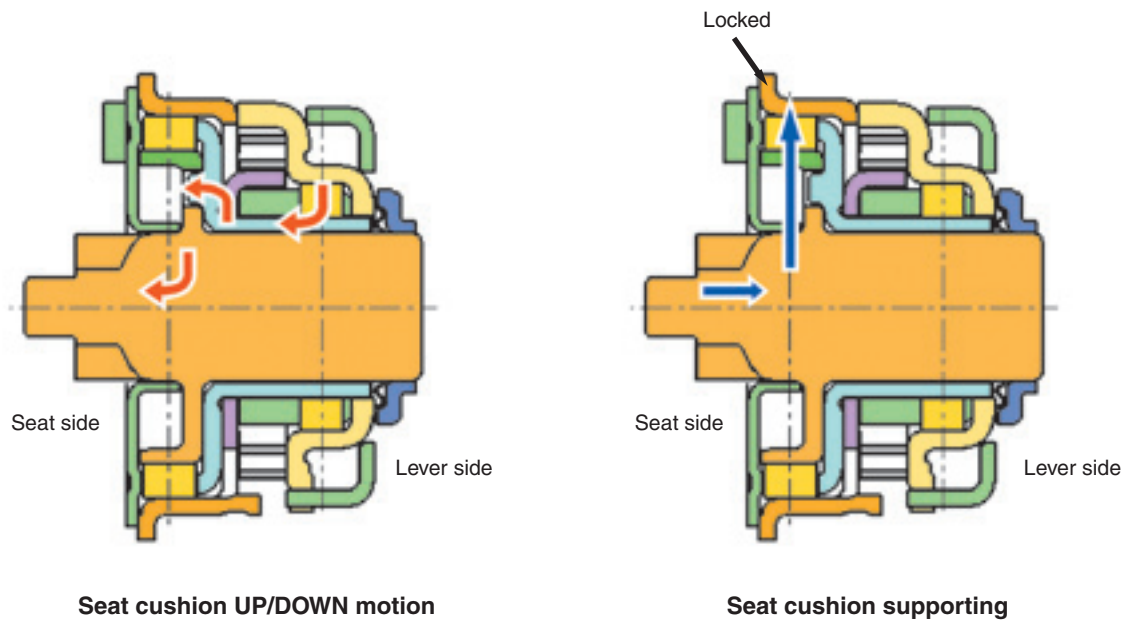


## Torque Diode

### [Operating principle]

The seat lifter mechanism allows the cushion of automotive seat to lift up/down and supports the load on the cushion.

- The diagram on the left summarizes the flow of power when the cushion is lifted up/down.
- The diagram on the right shows the flow of power when the load on the cushion is supported.



### [Applicable section]

The clutch is fixed to the seat skeleton on the side of seat cushion, while a lever is provided on the input section of the clutch. This lever is actuated to lift up/down the seat cushion.

