NIKKI DENSO

τ DISC SERVO MOTOR

Manual
Ver. 2.2

Nikki Denso Co., Ltd.

Document number: TI-14231B

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Preface

We wish to thank you for purchasing our **DISC Servo Motor**. Please carefully read this manual, together with another manual for AC Servo Driver/Controller that is combined with the DISC Servo Motor.

[Check points]

1. Receiving check of our products
   Please check the following points when you receive our products.

(1) If the products are exactly the ones you ordered (type, encoder resolution, driver to be combined, appearance, accessories, etc.)
(2) If baggage are not damaged during transporting (package damage, abnormal appearance of the products)
(3) If accessories are packed together

* If packages are broken, please do not unpack them and inform our sales person. And if there is a problem with any of the above points, damage, or the like, please immediately contact our sales person.

2. Precautions before installation (in handling)
   * When transporting the motor, please handle with care to avoid the damage.
   * When lifting or transporting the motor, please use the specific lifting fitting provided on the motor body.

⚠ Caution

- Take care not to stack the products or not to put anything on the product.
- Take care not to drop the product or not to apply a strong impact.
- Do no transport the product while holding cables.
- Do not lift or transport the product using a part other than the specified one provided on the motor body.

3. Cautions in storage
   If our products are not used immediately after receiving, store them under the following conditions in order to prevent deterioration of insulation and rust formation.
   However, unpack the packages soon after receiving, and check any damage and other non-conformances incurred during transportation.

Table 1 Storage conditions of the product

Item		Description
Ambient conditions	Temp.	-10°C to +60°C
	Humidity	85% RH or less (non-condensing)
	Storage location	Store the product in an indoor clean place free from dust and dirt. Do not store in harmful atmosphere such as corrosive gas, grinding fluid, metal powder, oil, etc.
Vibration		Store the product in a place free from vibration.
Altitude		1,000 m or less
Storage direction		With the rotation surface facing upward
Others		For the ND-s/HD-s/DD-s series, and a part of the ND-c series, anti-corrosive treatment is applied during shipment of the table rotor unit without applying surface treatment. Depending on the storage conditions and storage period, rust may form on the product. Rust prevention effective period is within 3 months after the shipment from our factory under the above described ambient conditions. If the storage period is planned for long time, please make rust prevention to the products and inspect them periodically.

4. Precautions in transportation

If you transport our products after receiving, please satisfy following conditions.

Table 2 Transportation conditions of the product

Item		Description
Ambient conditions	Temp.	-10°C to +60°C
	Humidity	85% RH or less (non-condensing)
	Storage location	Do not transport the products in a harmful atmosphere such as corrosive gas, grinding fluid, metal powder, oil, etc.
Vibration		0.5G or less
Transport direction		With the rotation surface facing upward

⚠ Caution

- Storage and transportation at a humidity of 65% RH or less are recommended.
- If the humidity exceeds 65% RH, contact our sales person.

[About this manual]

This manual explains specifications, installation, and precautions in use of the motor.
In order to use this product properly, please fully understand the contents of this manual.
At the time of installation, operation, and in other works, please comply with the conditions and procedures of this manual.
When you use the custom-made product, please refer to this manual together with the specifications of that custom-made product. If there are points overlapped in descriptions and items, the description in the specifications takes priority over that in this manual.

[Warranty period]

Warranty period of the product is one-year from the factory shipment.
However, please note that any failure or abnormality resulting from the following causes is not covered by the warranty.

1) Modification by parties other than NIKKI DENSO.
2) Operation different from rules and regulations stipulated in this manual.
3) Natural disaster or act of gods.
4) Connection with another maker's unit which is not approved by NIKKI DENSO.
5) Change in the size of parts over time, failure due to end-of-life, degradation of consumable parts.

Range of our warranty only covers repair of our products. Any damage, opportunity loss, secondary damage, and accident compensation at the side of the client induced by the failure in the delivered product is excluded from the warranty.

Regardless the warranty period, please inform our sales person whenever you find any failure or abnormality.

⚠ Caution

- Our products have been designed and manufactured for the aim of the general purpose applications in the general industry and the products are not intended to be used in any equipment and system that may involve human life.
  For this reason, we are free from any responsibility if the products are used in any other applications than we intended.
  (Examples: Applications in the equipment and system for the purpose of atomic, aerospace, medical, and passenger vehicles that may greatly involve the human life and assets)
- When installing the product to the facility that may involve serious accidents and loss by excessive exterior noises or failure on the motor, install the back-up and fail-safe functions systematically.
- If used under the conditions where sulfur or sulfide gas is produced, splitting due to corrosion on the chip resistors or poor connection on the contacts can occur.

* NIKKI DENSO retains the right to revise this document at any time and the information in this document is subject to change without notice.
Although the information from NIKKI DENSO is accurate and reliable, NIKKI DENSO will not assume responsibility for whatever results may arise from the use of this information unless specially guaranteed by NIKKI DENSO.

Cautions for Safety

Before installation, wiring, operation, maintenance and inspection, abnormal diagnosis, and countermeasures, read this manual and all other related instruction manuals and documents thoroughly and carefully and use the product correctly.

Use this device only after getting the proper knowledge of this device and understanding all the safety information and precautions.

In this manual cautions for safety are ranked as “Danger” and “Caution”.

And cautions for handling are divided into “Prohibition” and “Compulsion” which are defined as an action not to be done and action to be done, respectively.

Danger : If mis-handling is made, dangerous situation such as death or serious injury of a worker could occur.

Caution : If mis-handing is made, dangerous situation such as medium or light injury and damage of goods could occur.

However, since a marked item **Caution** could also cause serious results depending on the actual condition, please comply with the important instructions.

Prohibition : **Action not to be done**
If this caution is ignored, the device does not work properly.

Compulsion : **Action to be done**
If this caution is ignored, the device does not work properly.

[Cautions when using unit]

Danger

*Since electric shock and injury may occur, please be sure to comply with the following suggestions.

(1) Make sure to ground the earth terminal or the earth cable of the product.
The earth cable should have a thickness equal to or larger than that specified in the driver controller manual and should satisfy JIS Class 3 or better grounding.
[Electric shock may occur]

(2) Do not damage cables, pull cables forcibly, apply excessive force to cables, put any heavy thing on cables and nip cables.
[Electric shock may occur]

(3) Never touch the product while it is running.
[Injury may occur]

(4) After the withstand voltage test and insulation-resistance test (Megger test), do not touch the terminal for five minutes.
[Electric shock may occur]

Caution

(1) Use the product and the driver/controller in the specified combination.
[Fire or failure may occur]

(2) Never use the device in the atmosphere such as water splash, corrosive or flammable gas nor place close to combustible goods.
[Fire or failure may occur]

(3) Since temperature of a product, driver/controller and peripherals rises quite high, do not touch them.
[Burn may occur]

(4) In supplying power or for a while after shutting power off, since the product could be very hot, do not touch it.
[Burn may occur]

[Receiving and checking of packages]

Caution

(1) When you receive ordered units, please check the contents. If wrong thing is found or quantity is wrong, please do not use them and inform the status to our sales person.
[Electric shock, injury, damage, fire or failure may occur]

(2) If packages of our products are broken, do not unpack them and inform our sales person.
[Electric shock, injury, damage, fire or failure may occur]

[Storage]

⃠ Prohibition

Do not store units in a place of raining, water dripping, and harmful gas/liquid.
[Failure may occur]

[Storage]

❗ Compulsion

(1) Store the product in a place of no direct sunlight or under the controlled temperature/humidity environment within the range specified in this manual.
[Failure may occur]

(2) When the storage period after purchase exceeds three years, contact our sales person.
[Failure may occur]

[Transportation]

⚠ Caution

Do not hold a cable and a motor shaft during transporting units.
[Injury or failure may occur]

❗ Compulsion

Piling up or overloading the products can induce collapse of cargo; thus, follow instructions.
[Injury or failure may occur]

[Installation]

⚠ Caution

(1) Do not climb or put any heavy thing on this unit.
[Injury or failure may occur]

(2) Prevent foreign particles from entering the device.
[Fire may occur]

(3) Be sure to install this unit to the specified direction.
[Fire or failure may occur]

(4) Never apply heavy shock to this unit.
[This unit may be damaged]

(5) Conduct proper attachment suitable for output or weight of this unit.
[This unit may be damaged]

(6) Attach this unit to a non-flammable thing as metal.
[Fire may occur]

(7) Use the product in the environment where no dust particles exist.

(8) Firmly fix the product on to the installation area where enough hardness is secured.

Duly protect the installed product from being hit by other articles such as dropping items.

[Wiring]

⚠ Caution	
(1)	Be sure to conduct correct wiring. **[Running away or burning of a product, injury or fire may occur]**
(2)	In order to avoid influences by noises, use specific cables (shielded, twisted, and other measures) designated by the driver/controller instruction manual. Further, follow the length specified in this manual. **[Running away of a product, injury or machine damage may occur]**
(3)	To avoid electric shock and noise influence, be sure to make proper grounding (earth). **[Running away of a product, electric shock, injury or machine damage may occur]**

[Operation and Run]

⚠ Caution	
(1)	For safety, protect the motor with an overcurrent protective device, ground fault interrupter, overtemperature control device, and/or emergency stop device. **[Injury or fire may occur]**
(2)	Make sure the proper combination of driver/controller. **[Injury, fire or machine damage may occur]**
(3)	Before conducting test run, separate a product from its load system and fix it to an adequate place and confirm the motion, then connect the load to the product. **[Injury or machine damage may occur]**
(4)	Since excess adjustment may make the operation unstable, avoid this situation. **[Injury or machine damage may occur]**
(5)	When an alarm occurs, be sure to eliminate the cause, reset the alarm and then restart. **[Injury or machine damage may occur]**
(6)	When power recovers from temporary black out status, since sudden re-start may occur, do not approach the machine. (Machine system design shall be considered to maintain safety of workers against re-start.) **[Injury may occur]**
(7)	When any hazardous situation can be imperiled in the stop and breakdown of the product, install an external braking mechanism to maintain the product and to avoid such risks. **[Injury or machine damage may occur]**
(8)	To power on the motor again after power-off, wait 15 seconds or more after the power-off. Otherwise, the motor may operate abnormally. **[Injury or machine damage may occur]**

Prohibition
Do not turn on the power when the product is driven or being vibrated. **[Product runaway, injury, and machine damages can occur]**
Compulsion
Set emergency stop circuit outside in order to stop the operations immediately and stop the power supply. **[Injury or machine damage may occur]**

[Maintenance and inspection]

Prohibition
Overhaul/repair shall be conducted only by us or personnel designated by us. **[Malfunction can occur]**

NIKKI DENSO

Contents

Chapter 1 Outline

1-1. Features

[High performance]

Due to the multi-pole structure and higher magnetic flux density, the motor realizes non-cogging smooth rotating operation even from the low speed area. It is also ideal for applications that require the high mechanical accuracy in such as radial and axial swinging.

[Low profile type, hollow shaft]

Height is realized in the thinness from 44.5 mm. As it possesses a hollow shaft, simple and new mechanical designing is realized by utilizing the opening.

[Large capacity]

With the maximum torque of 5,800Nm, it is possible to drive a large object with high accuracy and at high speed. More than 60 rpm high-speed rotation is realized at the ultra-high resolution of about 18,430,000 ppr by combining with our “in-house” interpolator. Also, combination with the VCII Series that possesses the higher servo lock capability makes it possible to present large capacity, high-speed rotation, and still preservation.

[High response]

High response type features high resolution of 3,360,000 ppr in maximum and it enabled high speed rotation of 360 rpm.

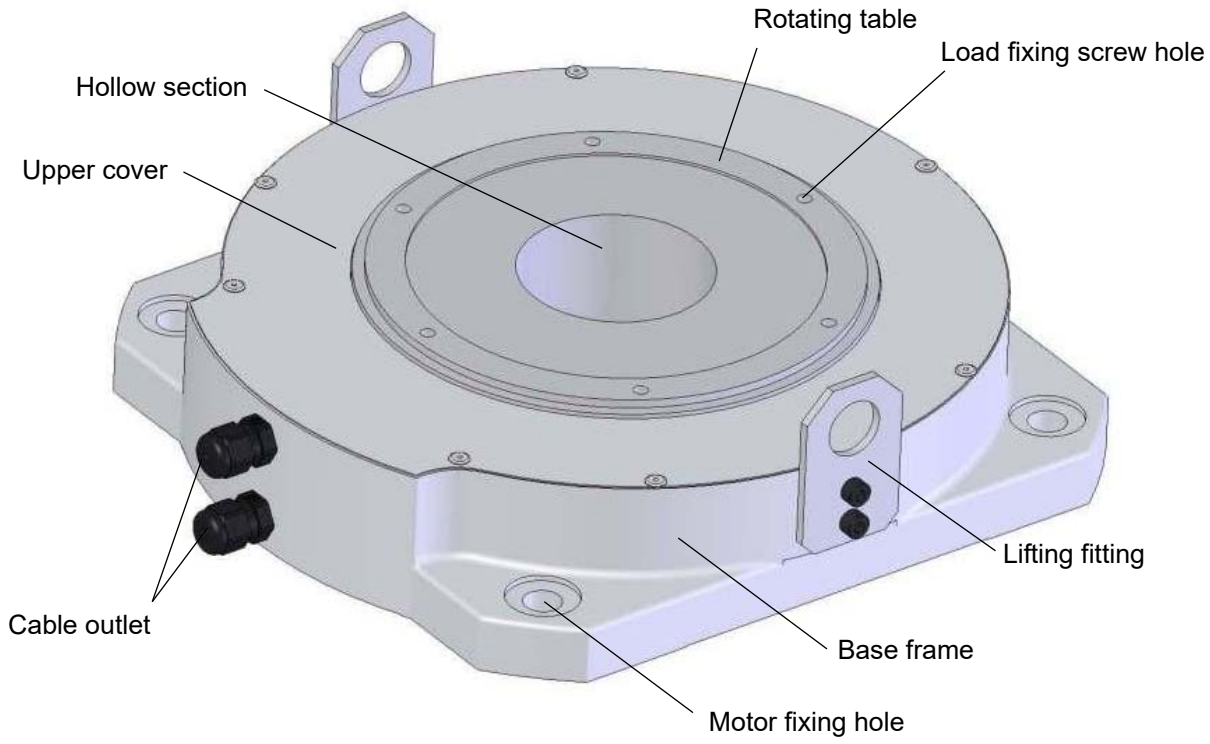


Fig. 1 Example of motor appearance

1-2. Models

Motor model: NMR– F A D B A2 A – 061 A P □ ◇ – $ $ $
(1) (2) (4) (5) (7) (8) (9) (10) (11) (12) (13) (14) (15)

Motor type: D 110– 40 F _ P
(2) (4) (5) (6) (3) (12)

(1)	NMR ··· DISC motor series				
(2)	Series classification	Model	Series name	Type	Series name
		F	D series / HD series / HD-s series	D	D series / HD series
		N	ND series	ND	ND series / ND-c series / ND-s series
		C	ND-c series	HD	HD-s series
		S	ND-s series		
(3)	Series middle classification	None ··· D/HD/ND series, C ··· ND-c series, S ··· ND-s/HD-s series			
(4)	Nominal diameter	Flange		Flange less	
		Code	Nominal size (mm)	Code	Nominal size (mm)
		A	110 (Actual size range 110-119)	P	110 (Actual size range 110-119)
		C	140 (Actual size range 140-149)	R	140 (Actual size range 140-149)
		D	170/180 (Actual size range 170-189)	S	170/180 (Actual size range 170-189)
		E	250 (Actual size range 250-269)	T	250 (Actual size range 250-269)
		F	400 (Actual size range 400-409)	U	400 (Actual size range 400-409)
		G	630 (Actual size range 630-639)	V	630 (Actual size range 630-639)
(5)	Nominal height	D	40 (Actual size range 40-49)	D	40 (Actual size range 40-59)
		M	50/55 (Actual size range 50-59)	M	65/70 (Actual size range 60-69)
		E	60/65 (Actual size range 60-79)	E	60/70/95/100 (Actual size range 70-95)
		U	85 (Actual size range 80-99)	F	95/100/110(Actual size range 96-119)
		F	100 (Actual size range 100-109)	G	125 (Actual size range 120-149)
		G	125 (Actual size range 120-149)	H	160 (Actual size range 150-169)
		H	160 (Actual size range 150-169)	I	175/185(Actual size range 170-199)
		I	185 (Actual size range 170-199)	J	200 (Actual size range 200-219)
				K	225 (Actual size range 220-225)
				N	225 (Actual size range 225-249)
(6)	Flange type	F ··· Flange, L ··· Flange less			
(7)	Encoder type	B	D/HD series Incremental encoder		
		G	ND/ND-c series Incremental encoder with an external IPU		
		H	ND/ND-c series Absolute encoder with an external IPU		
		I	ND-c/ND-s/HD-s series Incremental encoder with a built-in IPU		
		J	ND-s series Absolute encoder with a built-in IPU		
(8)	Power supply	A2	200/220 VAC (A driver configuration allows some motors to cope with 100/110 VAC.)		
(9)	Designing order	A	A → B → C ··· Starts from A.		
(10)	Rated output	061	Examples) 061···06 1 = 6×10^{1} =60W 1: Exponent portion of the power of 10 06: Effective numeral		
(11)	Brake availability	A	Without brake		
(12)	Table rotation accuracy (Option)	Blank ··· Standard spec., P ··· High accuracy spec.			
(13)	Motor construction	Blank ··· Standard spec., B ···Rotor／Stator with positioning pin hole G ···Gas cooling structure L ···Liquid cooling structure			
(14)	Overseas standard	Blank ··· None U ···UL C···CE UC···ULCE			
(15)	Exclusive machine code	Blank ··· Standard spec., Alphabet + serial numeral ··· Exclusive machine spec.			

Models (DD-s series)

Motor model

DD	16	-	251	L	04	C	N	N		-P		-	1
(1)	(3)		(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)		(14)

Motor type

DD	160	-	96	-	L	S	P5
(1)	(3)		(4)		(6)	(2)	(12)

(1)	Product classification (1)	DD … tDISC DD-s series
(2)	Product classification (2)	S … tDISC DD-s series
(3)	Outer diameter	Motor model: 16 (ϕ160) 25 (ϕ265) 40 (ϕ420)
		Motor type: 160 (ϕ160) 250 (ϕ265) 400 (ϕ420)
(4)	Height	Example) 96 … 96mm
(5)	Rated output	Examples) 251 … 25 1 =25×10^1 =250W Exponent portion of the power of 10 Effective numeral
(6)	Motor flange	F … Flange type L … Flange-less type
(7)	Rated speed	Rated speed (in rps, rounded down to the nearest whole number) Example) 04 … 4rps
(8)	Encoder type	C … Absolute encoder (detecting an absolute position within one turn) A … Incremental encoder
(9)	Cooling method	N … Natural cooling A … Gas cooling W … Liquid cooling
(10)	Overseas standard	N … None U … UL C … CE W … ULCE
(11)	Exclusive machine code	Blank …Standard spec., Alphabet + serial numeral …Exclusive machine spec.
(12)	High accuracy machining (radial/axial runout)	Motor model: None … Standard spec. -P … High accuracy 5μm spec. (option) -P3 … High accuracy 3μm spec. (option)
		Motor type: None … Standard spec. P5 … High accuracy 5μm spec. (option) P3 … High accuracy 3μm spec. (option)
(13)	Parallelism machining	None … Standard spec. H … Parallelism machining spec. (option)
(14)	Absolute position compensation option	None … Absolute position compensation option not provided 0 … Compensation data installed on the VPH driver by the customer 1 … Japanese version of compensation data installed on the VCII driver by the customer 2 … English version of compensation data installed on the VCII driver by the customer 3 … Japanese version of compensation data installed on the VPS driver by the customer 4 … English version of compensation data installed on the VPS driver by the customer 5 … Compensation data installed on the VPH driver by Nikki Denso 6 … Japanese version of compensation data installed on the VCII driver by Nikki Denso 7 … English version of compensation data installed on the VCII driver by Nikki Denso 8 … Japanese version of compensation data installed on the VPS driver by Nikki Denso 9 … English version of compensation data installed on the VPS driver by Nikki Denso

1-3. Specifications

[Common general specifications]

Item		Contents
Ambient conditions	Temperature	0 - 40°C
	Humidity	85% RH or less, non-condensing
	Setting place	Indoor use: Do not install in such harmful environments as corrosive gas, grinding fluid, metal powder, oil, etc.
Cooling method		Natural cooling (a model that partially adopts forced air cooling is also present.)
Fixing direction		With the rotation surface facing upward
Decoration color		Refer to the specifications in the catalog and outline drawings.
Insulation class		Class F
Insulation withstand voltage		1,500 VAC, for 1 minute
Insulation resistance		500 VDC, 100MΩ or greater
Protection class		IP40 to IP51 (refer to the specifications in the catalog and outline drawings.)
Altitude		1,000 m or less
Vibration proof		1G (3-direction, each 2 h)
Shock proof		30G (3-direction, each 2 times)
Connection method		Direct connection

*: As for specifications and outline dimensions for each motor, refer to the specifications in the catalog and outline drawings.

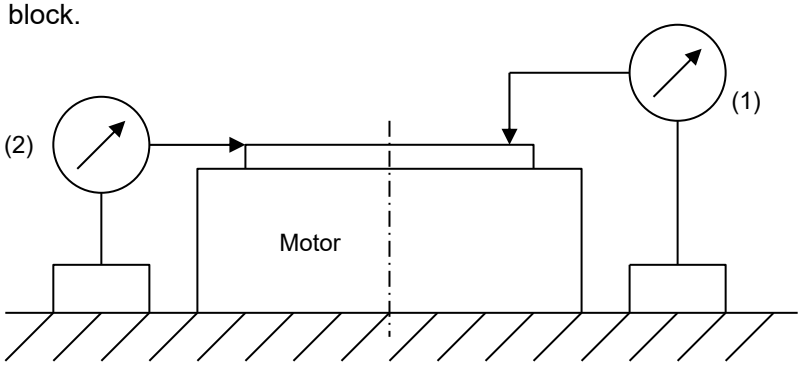
*: Operation in the fine angle mode may shorten the life of the bearing.

*: Surface treatment of this device complies with RoHS. Thus, it can induce some deviations on the surface that gives no problems at all in the practical use.

[Measuring method of mechanical accuracy]

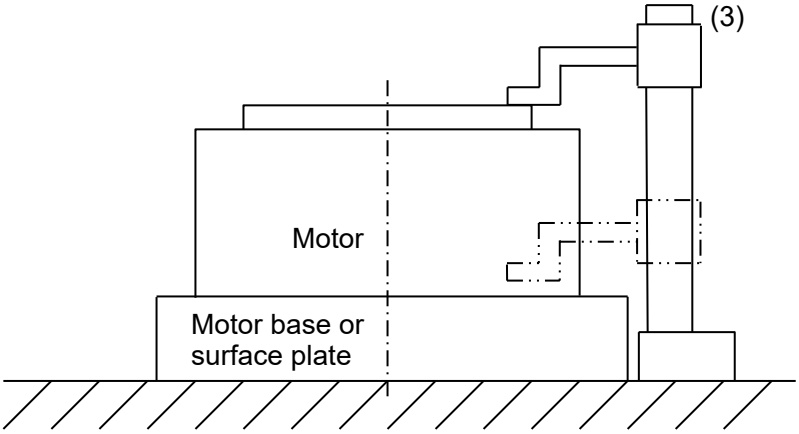
(1) Output axis rotating table plane vibration (axial swinging)
When turning the output axis rotating table for one turn, the maximum axial swinging width of the outer circumference of the output axis rotating table is measured with a dial gauge that is fixed to the fitting block.

(2) Output axis rotating table axis vibration (radial swinging)
When turning the output axis rotating table for one turn, the maximum radial swinging width of the output axis rotating table is measured with the dial gauge that is fixed to the fitting block.



(3) Parallelism of the output axis

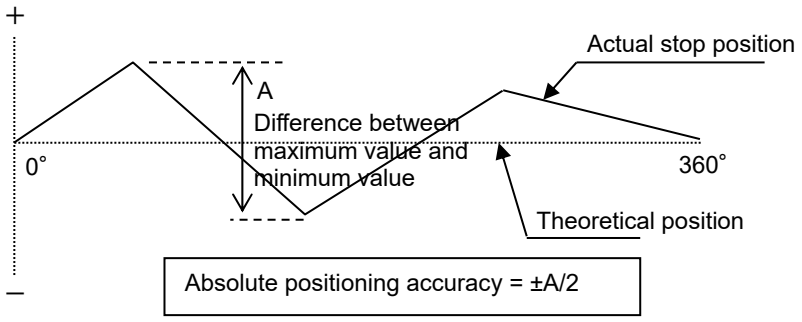
In the status in which the output axis rotating table is stopped at the zero point position, measure the height from the motor base or surface plate to the rotating table at the positions of four points at 0, 90, 180, and 270 degrees with a height gauge. Calculate the difference between the maximum and minimum values as the parallelism.



[About positioning accuracy]

(1) What is the absolute positioning accuracy?

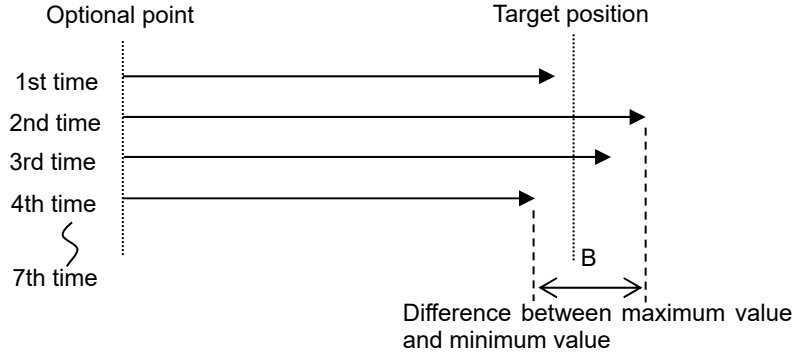
Turn the output axis one turn originating the zero point position and measure both the actual value and the theoretical value at each of the positioning point. Half of the difference between the maximum value and the minimum value is preceded by ± to obtain the absolute positioning accuracy.



Absolute positioning accuracy = ±A/2

(2) What is the repeated positioning accuracy?

Perform positioning by making movement for a certain angle in the same direction from an optional point to the target position and measure the stop position. Repeat this measurement for seven times. The repeated positioning accuracy is obtained by adding ± to half of the difference between the maximum value and the minimum value of the measured value.



Repeated positioning accuracy = ±B/2

Chapter 2 Installation

2-1. Motor installation

In order to fully exercise the performance of the τDISC motor series, and to prevent accidents, install the product by following the precautions below:

- Take care not to stack the motors together or not to put anything on the motor.
- Take care not to drop the motor or not to apply a strong impact.
- Make sure that the lift-up tool mounting hole of the motor should be used only to transport the motor.
- Make sure that the motor is installed on an installation surface with sufficient rigidity and a wide dispersion area in such a manner that they make full contact with each other with no space present between them to secure accuracy and good heat dispersion of the motor.
  (Take care to keep the installation surface from rattling and foreign matter from being pinched.)
- Check the accuracy of the rotating table and installation of the motor with reference to the outline drawing of each motor.
- Make sure that the load is installed on the rotating table surface of the motor tightly in such a manner that they make full contact with each other with no space present between them. The accuracy of the motor installation surface is shown below.

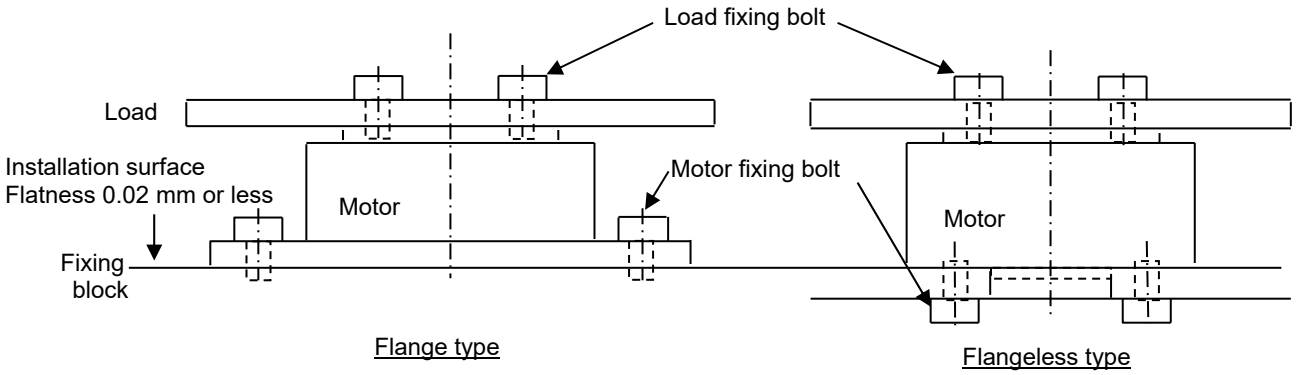


Fig. 2 Accuracy of installation surface

- Securely tighten all motor fixing bolts.
  If the motor is not fixed securely, it may be removed during operation, possibly causing an accident.
  The tightening torques of the motor fixing bolts are shown below. Application of too much tightening torque may lead to breakage. (The following values assume that the screwing length is equal to or more than the nominal diameter.)

Table 3 Tightening torque of motor fixing bolts

Bolt size	M5	M6	M8	M10	M12	M16
Tightening torque	4Nm	7Nm	16Nm	32Nm	76Nm	190Nm

(M5 - M10: when the material of motor fixing block is aluminum and helisert is used.)
* Use motor fixing bolts with a strength class of 10.9 or larger.

Note on selecting the length of a fixing bolt

For the bolt that fixes parts to the motor rotating block and the bolt that fixes the motor to the device, the depths at which the bolts are screwed into the female screws on the motor side must be equal to or less than the screw depths indicated in the outline drawing of the motor. Do not use a bolt with a screwing depth larger than the screw depth indicated in the outline drawing. Otherwise, a severe failure may occur.

- After fixing the motor, turn the motor rotating table manually to check if there is no abnormal sliding resistance, no abnormal sound, or no interference with peripheral devices.

2-2. Other setting precautions

- Operators are requested to wear protective equipment and carry out the installation work paying due attention to the safety.
- Do not install the product in a place of high temperature and high humidity or in places where excessive dust particles, metal powder, and oily smoke exist, and in an environment where corrosive gas exists. The motor is not waterproof and does not have the splash-proof capabilities. Install it away from watery splashes. Use in the environment of IEC60664-1, Pollution Degree 1 or 2, is recommended.
- Peel off the dust prevention seals at the top and bottom of the motor just before installation. After removal, carry out the job paying attention not allowing dust particles to go inside the motor.
- According to your necessity, prepare your own rotating area keep-off mechanism or protective fence to ensure the safeness of the operators.
- When lifting up the motor, use the attached lift-up metal tool.
- Strictly prohibited is to lift up using the screw that was processed at the motor rotating block.
- During the motor installation, do not give damages to the cables and connectors of the motor and never pull them.
- Please make sure to correctly and assuredly connect the power line (grounding wire) and signal cables to the servo driver.
- Carefully wire to eliminate the influence of the exterior noises on the motor.
- Be sure to ground the grounding wire.
- Since the wires running from the motor are not robot cables (bending resistance cables), they do not have bending resistance. Fix the wires adequately to avoid movements and exterior tensions.
- During connection or disconnection of a connector, be sure to hold the body of the connector instead of the cable.
- It is recommended that the motor be placed in an orientation in which the identification plate of the motor can be easily seen from the outside. If the identification plate of the motor cannot be seen from the outside, record the serial number of the motor on the device side.
- It is recommended that power lines be routed separately from signal lines to prevent generation of noise.
- The interpolation unit (IPU) is not waterproof or dustproof. Do not install the IPU in a place of water dripping or in a dusty environment. Since IPU software may be upgraded, install the IPU in a maintainable place, fix the housing with screws, and ground the housing.

⚠ Caution

(1) Shaft core deviation in the connection with the load can enlarge stress to the motor, and it can cause heat on the motor output shaft and damages on the bearing. Thus, pay attention at the time of connection.

(2) As the motor produces heat, control the cooling system not to exceed the permissible surrounding temperature range.

(3) When installing the motor to the facility that may involve serious accidents and loss by a failure of the motor, install the back-up and fail-safe functions systematically.

- Please refer to「Installation Conditions for EMC approval」in「Installation Manual」

for the CE marking compliant.
Note) By deciding the setting model (conditions) of the driver and motor, the related standard to the EMC Directives will be achieved by that model. Therefore, it is necessary for the finally configured product to confirm and measure if the EMC compliance is applicable.

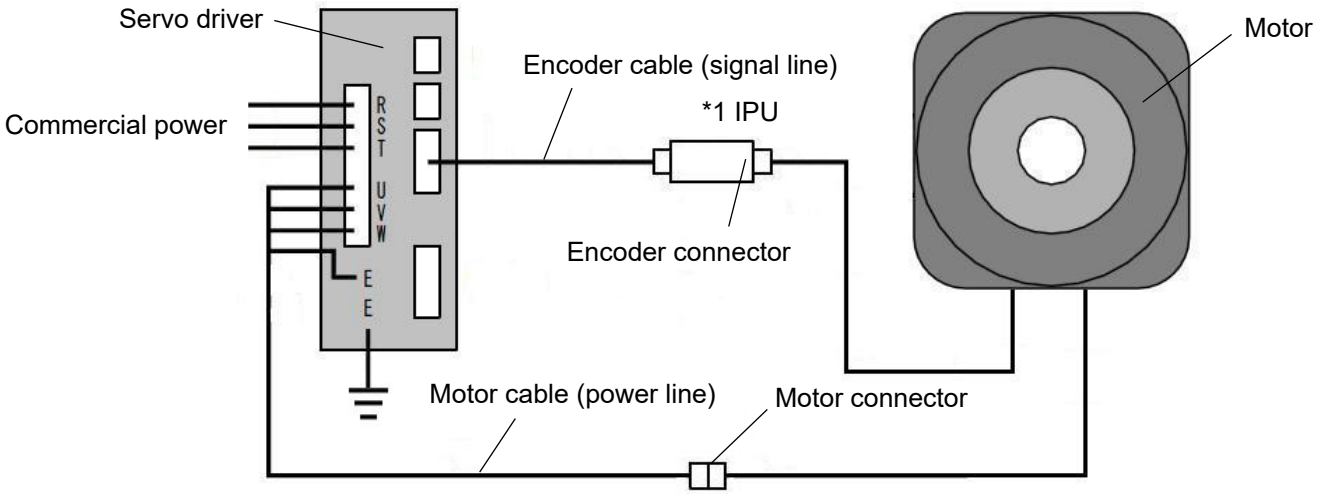


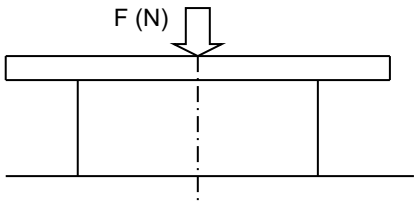
Fig. 3 General structure

*1 Two types of IPUs (interpolation units) are present depending on the model: motor built-in type and external type.

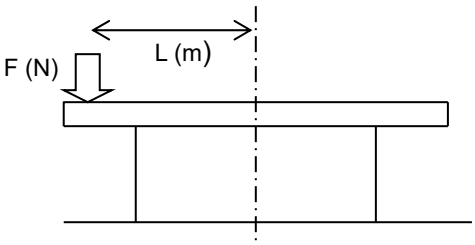
2-3. Allowable loads

The following figures show typical patterns of the load applied when the motor is installed so that its rotating surface faces upward. Design the axial load (Radial load is the same value as the axial load.), and the moment load allowing a plenty of spare capacities so as not to exceed the catalog specifications.

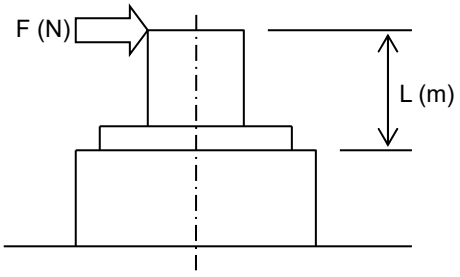
1) If F is an external force, then
   Axial load : Fa(N) = F + Load mass
   Moment load : M(N·m) = 0



2) If F is an external force, then
   Axial load : Fa(N) = F + Load mass
   Moment load : M(N·m) = F x L



3) If F is an external force, then
   Radial load : Fr(N) = F
   Moment load : M(N·m) = F x L



*: For the load that pulls up the rotating part comes out, in installation in the horizontal downward direction or vertical wall-plane installation, contact our sales department.

- Excessive unbalanced loads may cause deformation of the rotor and damages on the bearing.
- In normal work, the motor should be used under a load sufficiently smaller than the allowable load in consideration of its service life.
- The motor is a precision instrument, and it is equipped with precision electronic components; therefore, do not hit the motor and never give any shock during installation.
- After installation, be sure to protect the motor from being hit by other articles such as dropping items. Exercise special care because the upper surface (cover) and lower surface (encoder cover) are metal plates.

2-4. Notes on detecting magnetic poles

- The τ DISC motor series products are synchronous motors. Note that the output torque may become smaller than the specification value if magnetic pole detection does not complete normally.
- In the motor with an incremental encoder, the magnetic sensor performs coarse detection during power-on and movement (rotation) by the angle set for each model is performed to normally complete magnetic pole detection.
- When magnetic pole detection by a magnetic sensor is set in the motor with an incremental encoder, magnetic pole detection may not complete normally unless movement (rotation) is performed by the maximum operation angle shown in Table 4 from the rotor (motor rotating block) position during power-on.

Table 4 Minimum movement (rotation) angle required for the completion of magnetic pole detection

Motor type	D/ ND110	D/HD/ ND140/ DD160	D170/ HD/ ND180	D/ND DD250	D/ ND400	D630
Operation angle (°)	9	9	6	3.6	3	1.8

- When the automatic magnetic pole detection function has been set in the motor with an incremental encoder, magnetic pole detection is automatically performed for a short time during the first servo-on after power-on.
  Note that the rotor may swing at the maximum operation angle shown in Table 5 during magnetic pole detection.

Table 5 Maximum swing angle during automatic magnetic pole detection

Motor type	D/ ND110	D/HD/ ND140/ DD160	D170/ HD/ ND180	D/ND DD250	D/ ND400	D630
Operation angle (°)	±36	±36	±24	±14.4	±12	±7.2

- In the automatic magnetic pole detection and magnetic pole detection by a magnetic sensor, the magnetic pole completion state is retained until the driver is powered off.
- In the motor with a magnetic sensor, set magnetic pole detection by the magnetic sensor using parameters unless there is a special reason. For details, see the instruction manual of the servo driver. Particularly for motor type 250 or greater, be sure to perform magnetic pole detection by the magnetic sensor because the installed object is large.
- An automatic magnetic pole detection error may occur depending on the settings of parameters for automatic magnetic pole detection. If an automatic magnetic pole detection error occurs, the motor may not be controlled. Therefore, motion by the inertia may pose a significant risk if the moment of inertia of an installed load is large.
- For these reasons, even when the motor with an incremental encoder is used for fine-angle operation or usage without movement from the power-on position, reserve the operation range that allows magnetic pole detection to be complete normally.
- In the motor with an absolute encoder, it is not necessary to operate the rotor from the power-on position because magnetic pole detection is performed on the basis of the absolute position.

Chapter 3 Operation

<Inspection before operation>

Upon completion of installation and wiring, inspect the following before operation.

1) Wiring is correct.
2) A shortcut due to wire chips etc. does not occur.
3) Improper force is not applied to wiring.
4) Screws, terminals, and so on are not loosened. Connectors are inserted securely.
5) The power voltage is correct.
6) There is no short circuit or ground fault in the external sequence circuit.
7) The grounding method is correct.
8) Motor fixing bolts are not loosened.

* Never operate the motor if it is not fixed.
* To maximize the performance of the motor, set the parameters of the driver.

Check the following settings before starting operation. For details, refer to "Parameters" in the manual of each driver.

Set the motor type data in motor setting parameter P000.
For a special motor, set "999" in motor setting parameter P000 and set motor-related parameters in P020 to P059 with reference to the [Setting Option] specification of the driver manual.

For operation and trial operation, check the operation with reference to "Operation Procedure" in "Operation" in the manual of each driver.

⚠ Caution

- An error in the setting of the motor number can induce a reckless runaway or malfunctions and is very dangerous. Thus, never make a mistake in its setting.
- For prevention of accidents, initial setting should be made so that emergency stop can be pressed at any time.
  An unanticipated behavior may occur in the initial operation after adjustment of parameters.

- Depending on the use condition, it is necessary to set the protection function for preventing the motor from malfunctioning.
  Refer to the "Protection Function" in the manual of the driver in use.
  For if there are any questions about the protection function, contact our sales person.
- Before the line power operation, rotate the motor at the very slow speed with the human power and make sure that there are no noises from the motor and no interferences with peripheral devices.
- At the power-on, make sure there is no one in the machine working range.
- A trial run for energization should be done in a state where no load is applied to the motor.
- In the case of a device that runs in the fine angle mode, periodically rotate the motor rotating table by more than 90 degrees so as to prevent unbalanced abrasions due to a lack of grease in the bearing and to maintain the accuracy.
- The counterclockwise (CCW) direction viewed from the motor rotating table is the forward rotation direction.
  (In forward rotation, the indication value of driver status display ST01 increases.)

⚠ Caution

Never connect the servo motor to the commercial power line directly. Otherwise, the servo motor does not operate normally, causing a malfunction.

Chapter 4 Maintenance and inspection

In order to prevent breakdown by the change in the use conditions, periodically inspect the motor.
Disassembling or repairing of the motor is allowed only for us or our contractors.
If there is a need for disassembly or repair, contact our sales person.

⚠ Caution
(1) Before work, be sure to switch off the power to the driver in use. The worker himself must ensure power ON/OFF switching of the driver in use. Conduct the work according to the precautions for the driver maintenance that is described in the instruction manual of the driver in use. (2) When measuring the insulation of the motor, completely cut off the wire connection (U, V, W) between the motor and the driver.

4-1. Daily inspection

Conduct the following daily inspection before and after operation.

[Daily inspection items]

1) If the motor runs normally.
2) If there is no anomaly in the environment of the installed place. (Power, temperature, humidity, dusts, etc.)
3) If there is no anomaly in the cooling system. (Articles that block the airflow, and the like.)
4) If there is no loosening on the terminals and connectors.
5) If there is no abnormal sound or vibration.
6) If there is no abnormal heating or discoloration.

4-2. Periodic inspection

Perform the following periodic inspection at the interval of the designated operating time or at a fixed interval (for such as a half year or one year).

[Periodic inspection items]

1) If there is no loosening at the connecting part with other devices and if there is no abnormal sound in the motor bearing.
2) If there is no anomaly in the environment of the installed place. (Power, temperature, humidity, dusts, etc.)
3) If there is no anomaly in the cooling system. (Articles that block the airflow, and the like.)
4) If there is no loosening on the terminals and connectors.
5) If there is no abnormal sound or vibration.
6) If there is no abnormal heating or discoloration.
7) If there are no scratches and wear on the cables.
8) Motors with a greasing mechanism should be greased according to the greasing procedure manual of each motor.