MOTION & CONTROL™

NSK

MEGATORQUE MOTOR™

PB Series

RoHS compliant

New Product

Patent pending

New product contribute to reducing cost and improving productivity of machines with its incredible usability and excellent performance.

Features

- A compact size servo motor with large through hole for wiring and piping.
- Positioning using standard Pulse train command.
- Auto Tuning Function for easy start up.

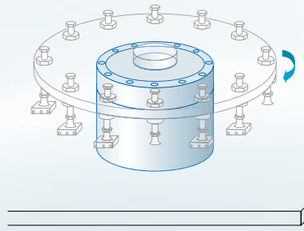
Typical applications

- Replacing Gear reducer and AC servo motor with Direct Drive motor.
- Reducing size and envelope of conventional positioning/transfer system.

Line up

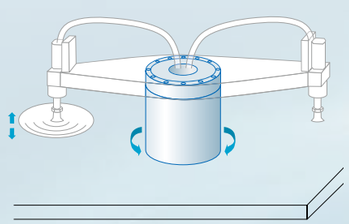
Application

Inspection equipment for electronic parts



- High speed and high accuracy
- Compact ● Clean
- Hollow structure (convenient for wiring/tubing)

High-speed conveyance of lightweight parts



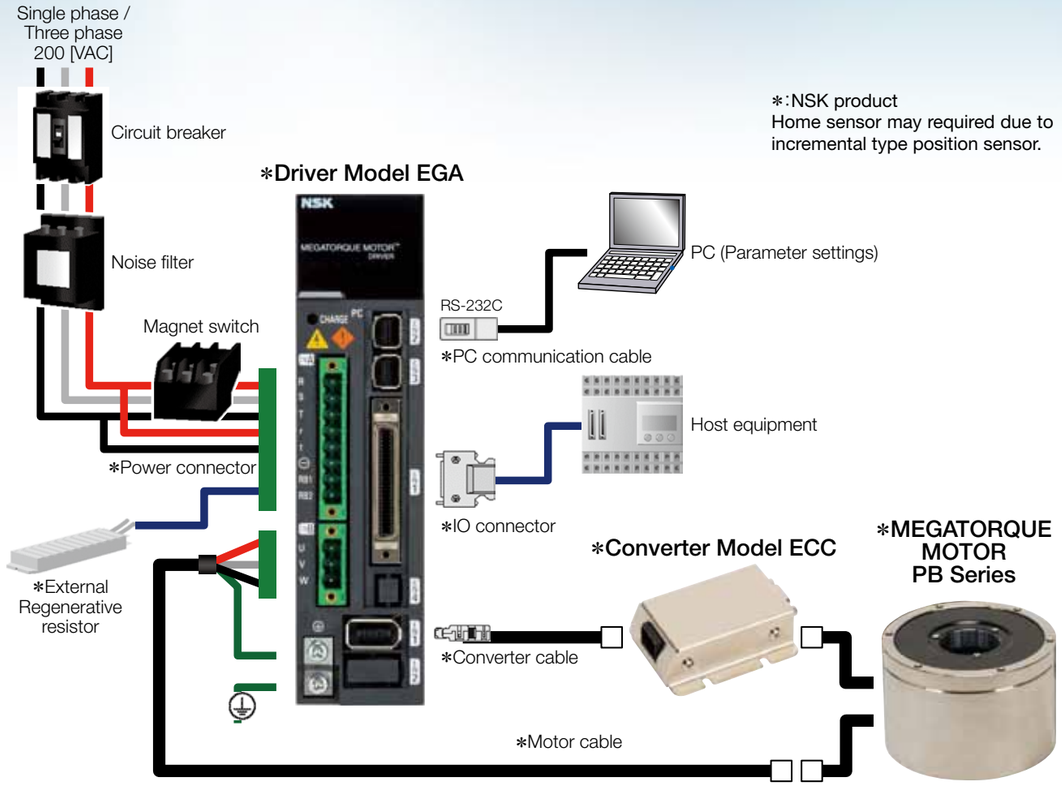
- High speed and high accuracy
- Clean ● Maintenance free
- Hollow structure (convenient for wiring/tubing)

Advantage of Direct Drive Motor

The highly precise positioning which has no backlashes or lost motions is achieved. Because MEGATORQUE MOTOR is directly connected with a load without using reduction gears. Long term maintenance free is achieved by using a grease prelubricated bearing.

Positioning accuracy	Non backlash, high precisions positioning
Positioning time	Short cycle time
Deterioration with age	No performance degradation due to aging
Maintenance	Long term maintenance free
Compact	NSK motor allows users to design compact and lightweight system

1 System configuration



MEGATORQUE MOTOR is a kind of servo motor.

Combination table

Motor Reference No.	Converter Reference No.	Driver Reference No.	Motor cable Reference No.	Converter cable Reference No.
M-PB1006JN001	M-ECC-PB1006GA201	M-EGA-15A2301	M-CA***A101 ***: cable length 002 : 2 [m] 004 : 4 [m] 008 : 8 [m]	M-CC***A101 ***: cable length 002 : 2 [m] 004 : 4 [m] 008 : 8 [m]
M-PB3015JN001	M-ECC-PB3015GA201			
M-PB3030JN001	M-ECC-PB3030GA201			
M-PB3060JN001	M-ECC-PB3060GA201	M-EGA-30A2301		

Accessories

Name	Reference No.	Remarks
Power connector	M-FAE0001	CNA connector
IO connector	M-FAE0002	CN1 connector
Mounting bracket	M-FAE0003	Front mounting bracket for Driver
Regenerative resistor	M-FAE0004	80 [W]
Regenerative resistor	M-FAE0005	220 [W]
PC communication cable	M-FAE0006	Cable length : 2 850 [mm]
Connector set	M-FAE0007	CNA and CN1

2 Motor

2.1. Motor Reference number

Example of Reference number : **M-PB** **1** **006** **JN** **001**

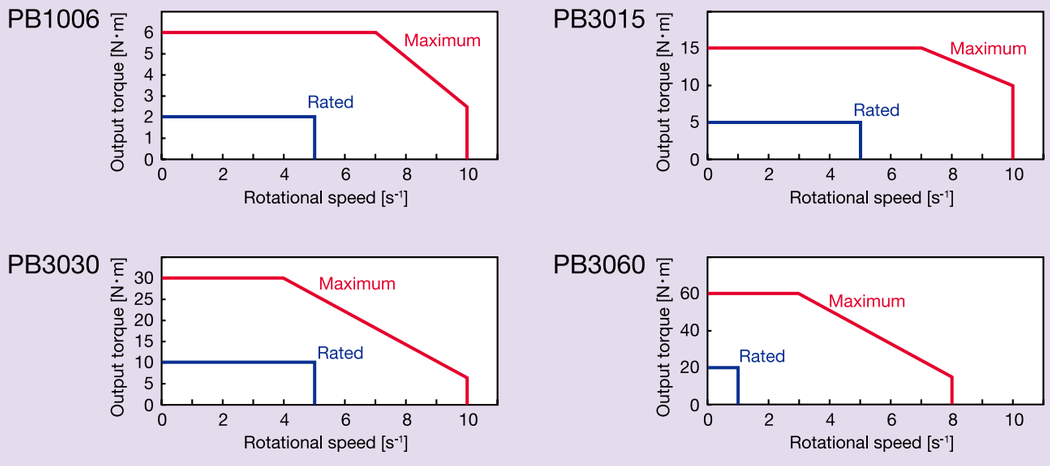
- M-PB : MEGATORQUE MOTOR PB Series
- 1 : Motor size code
- 006 : Maximum output torque [N·m]
- JN : Incremental Resolver
- 001 : Design number 001 : Standard

2.2. Specifications

Functional item	M-PB1006JN001	M-PB3015JN001	M-PB3030JN001	M-PB3060JN001
Motor outer diameter [mm]	ϕ102	ϕ152		
Maximum output torque [N•m]	6	15	30	60
Rated output torque [N•m]	2	5	10	20
Rated wattage *1 [W]	63	157	314	126
Radial run-out [μm]	50			
Axial run-out [μm]	50			
Motor height [mm]	75		92	126
Motor hollow diameter [mm]	ϕ35	ϕ56		
Maximum rotational speed [s^{-1}]	10			8
Rated rotational speed [s^{-1}]	5			1
Resolution of position sensor [count/rev]	524 288			
Absolute positioning accuracy [arc-sec]	112 *2			
Repeatability [arc-sec]	+/-5			
Allowable axial load (Horizontal mounting) *3 [N]	1 000	2 000		
Allowable axial load (Upside down mounting) *3 [N]	120	200		
Allowable radial load *4 [N]	270	540		
Allowable moment load [N•m]	9	20		
Rotor inertia [kg•m^2]	0.0026	0.014	0.016	0.021
Allowable range of inertia [kg•m^2]	0 to 0.26	0 to 1.1	0 to 1.4	0 to 3.1
Mass [kg]	2.6	5.8	7.2	10.2
Environmental conditions	Ambient temperature 0 to 40 [°C]; humidity: 20 to 80 [%]; use indoors. Free from dust, condensation and corrosive gas. IP30 equivalent.			

- *1 Rated power is calculated by rated output torque at rated speed.
- *2 At ambient temperature of 25 +/- 5 [°C]
- Please consult with NSK in case of a simultaneous application of axial load, radial load and moment load to a Motor.
- *3 Under no radial load.
- *4 Under no axial load.
- For an oscillating operation less than 45 [°], turn the motor 90 [°] or more at least once a day.
- Please operate motor within the range of Max. load inertia.

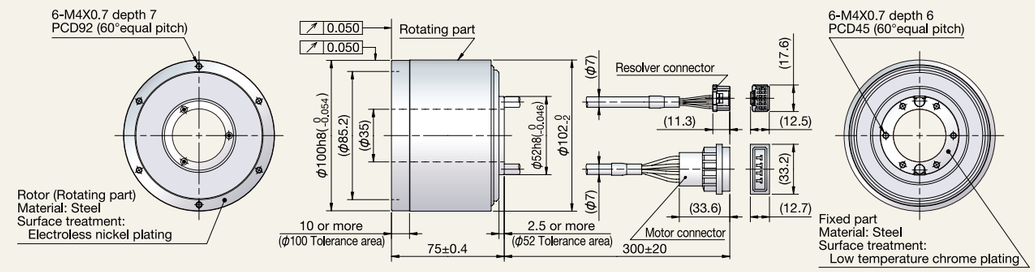
2.3. Speed – Torque curve



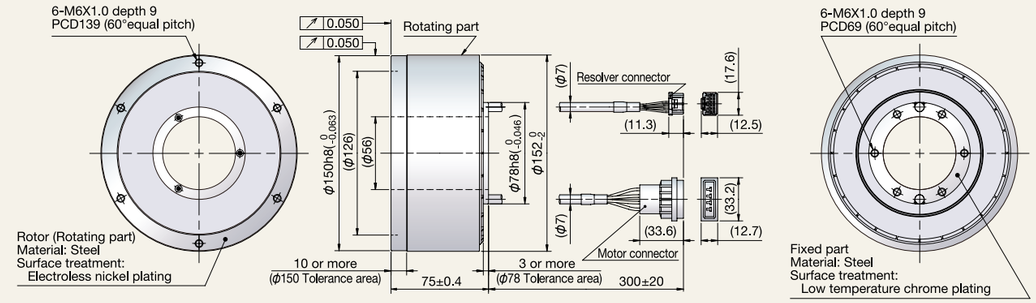
*Speed – Torque curve is typical value measured in 200 [VAC] (PB3060 : 220 [VAC]).

2.4. Dimensions

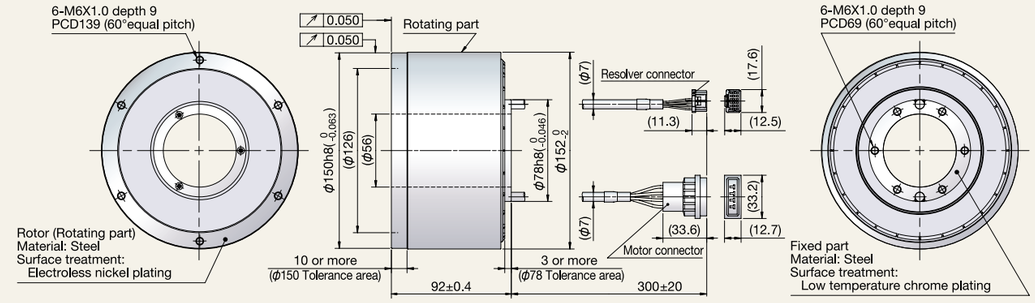
M-PB1006JN001



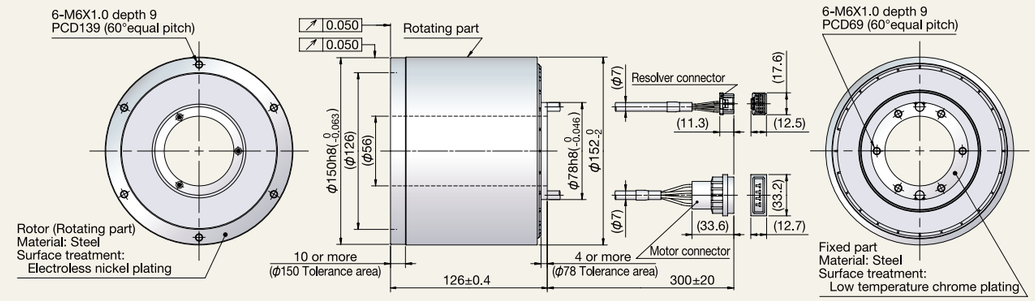
M-PB3015JN001



M-PB3030JN001



M-PB3060JN001



1. The bend radius of the motor cable lead (ϕ7) and the resolver cable lead (ϕ7) should be R30 [mm] or more.
2. Do not use the leads of the motor cable and the resolver cable with flexing motion.
3. Do not add the stress (tension, vibration, etc.) to the joint of the leads and the connector. It causes the disconnection and the loose connection.

3 Driver

3.1. Driver Reference number

Example of Reference number : **M-EGA - 15 A 2 3 01**

- Driver Model EGA
- Maximum output current 15 : 15 [Arms] / 30 : 30 [Arms]
- Power voltage A : 200to230 [VAC] (Single phase/Three phase)
- Position sensor code 2 : Incremental
- Function 3 : Pulse train input
- Design number 01 : Standard

3.2. Specifications

3.3.1. General specifications

Functional item		M-EGA-15A2301	M-EGA-30A2301
Control function		Position control	
Control system		IGBT: PWM control Sinusoidal drive	
Main circuit power	Three phase	200 to 230 [VAC] +10/-15 [%] , 50/60 [Hz]] +/-3 [Hz]	
	Single phase	200 to 230 [VAC] +10/-15 [%] , 50/60 [Hz] +/-3 [Hz]	220 to 230 [VAC] +/-10 [%] , 50/60 [Hz] +/-3 [Hz]
Control power	Single phase	200 to 230 [VAC] +10/-15 [%] , 50/60 [Hz] +/-3 [Hz]	
Power capacity	Main Power (Rated)	M-PB1006JN001 : 0.3 [kVA] M-PB3015JN001 : 0.5 [kVA] M-PB3030JN001 : 1.0 [kVA]	M-PB3060JN001 : 2.0 [kVA]
	Control Power	40 [VA]	
Environment	Operating temperatures	0 to 55 [°C]	
	Storing temperatures	-20 to +65 [°C]	
	Operating/Storing humidity	Below 90 [%RH] (No condensation)	
	Elevation	Below 1,000 [m]	
	Vibration	4.9 [m/s^2]	
	Shock	19.6 [m/s^2]	
Dimensions (H×W×D)		160×40×130 [mm]	160×50×130 [mm]
Mass		0.75 [kg]	0.9 [kg]
Alarms		Over current, Current detection error, Over load, Regeneration error, Driver overheating, External overheating, Over voltage, Main circuit power low voltage, Main circuit power supply open phase, Control power supply low voltage, Encoder error, Over speed, Speed control error, Speed feedback error, Excessive position, Positioning command pulse error, Built-in memory error, Parameter error	
Digital operator		Status display, Monitor display, Alarm display, Parameter setting, Test operation, Adjustment mode	
Dynamic brake circuit		Built-in	
Regeneration process circuit		Built-in *	
Monitors	Speed monitor (VMON)	2.0 [V] +/-10 [%] (at 1,000 [min^{-1}])	
	Torque (TCMON)	2.0 [V] +/-10 [%] (at 100 [%])	

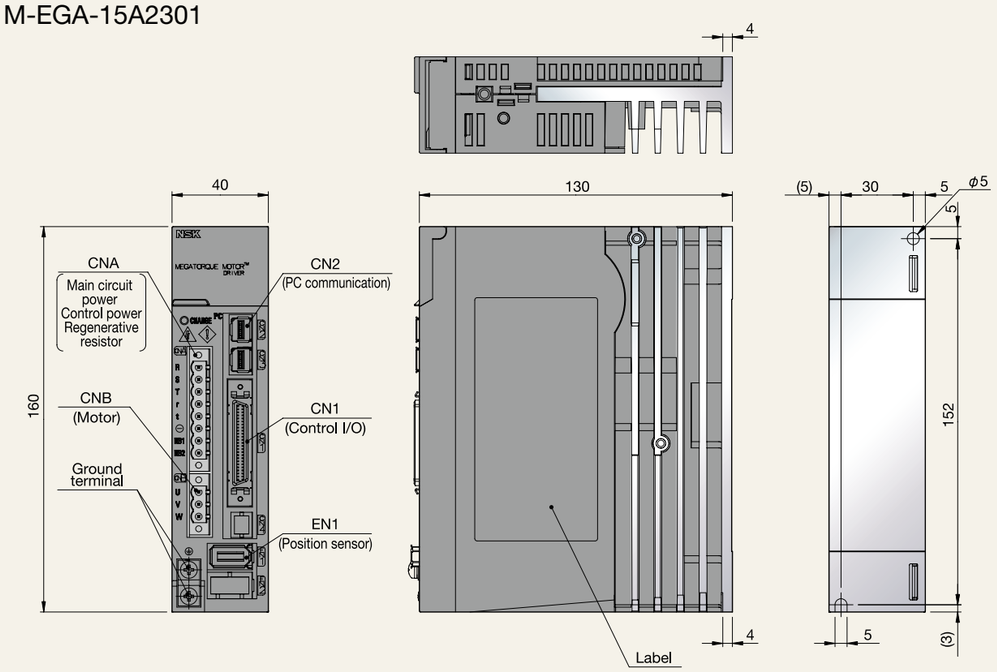
* Please refer 6.Accessories in case of Regenerative reistor is required.

3.3.2. Input command, position feedback signal output, general input, general output

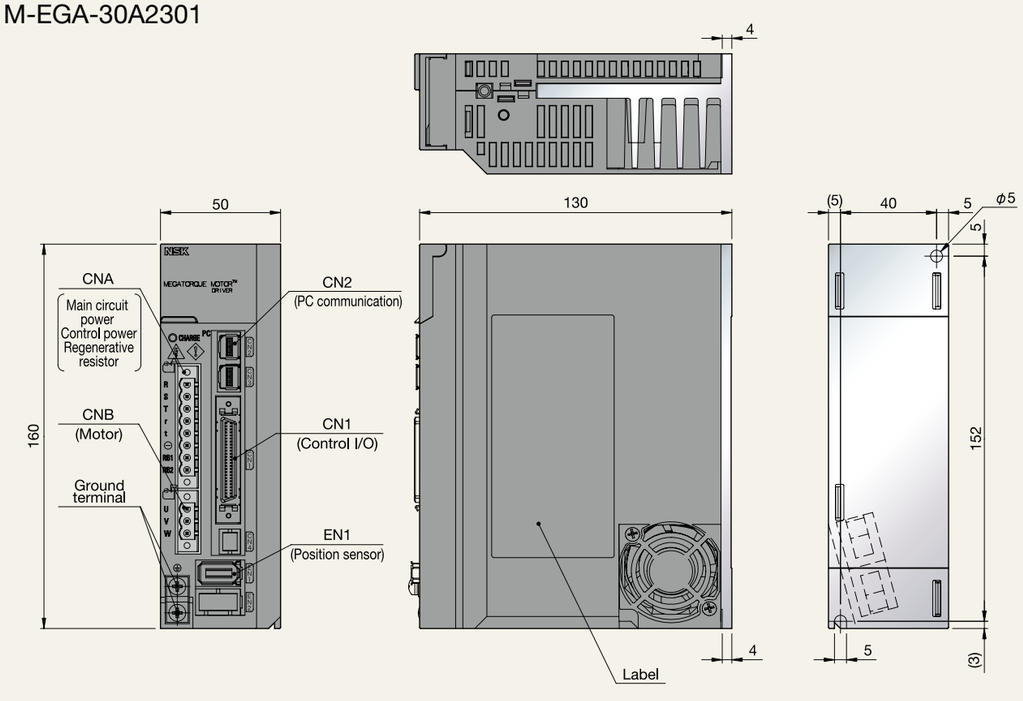
Position command	Maximum input pulse frequency	5 [Mpps] (CW+CCW pulse, Code + Pulse train) 1.25 [Mpps] (90 [°] -phase difference two-phase pulse)
	Input pulse form	CW + CCW command pulse, Code + Pulse train command or 90 [°] -phase difference two-phase pulse train command
	Electronic gear	N/D (N=1 to 2,097,152, D=1 to 2,097,152) however, 1/2,097,152 ≦ N/D ≦ 2,097,152
Position feedback signal		A/B phase pulse output: N/32,768 (N=1 to 32,767), 1/N (N=1 to 64) or 2/N (N=3 to 64) Z phase pulse output : 80 [count / rev]
Sequence input		Interactive photo coupler (sink, source connection): 6 inputs
		Line receiver: 2 inputs
		Input power voltage range: 5 [VDC] +/- 5 [%] / 12 to 24 [VDC] +/- 10 [%], 100[mA] or over
		Servo on, Alarm reset, Torque limit, CW rotation prohibit, CCW rotation prohibit, Command prohibit,Forced discharge, Emergency stop, Gain switching, Internal speed setting, Start of estimation of magnetic pole position, etc.
Sequence output		Open collector output: 8 outputs
		External power supply voltage (OUT-PWR): 5 [VDC] +/- 5 [%] / 12 to 24 [VDC] +/- 10 [%], 20 [mA] or over
		Circuit power for output signal: 5 [VDC] +/- 5 [%] / Max. 10 [mA] (per 1 output) Circuit power for output signal: 12 to 15 [VDC] +/- 10 [%] / Max. 30 [mA] (per 1 output) Circuit power for output signal: 24 [VDC] +/- 10 [%] / Max. 50 [mA] (per 1 output)
		Servo ready, Power on, Servo on, Torque limiting, Speed limiting, Low speed, Velocity attainment, Matching speed, Zero speed, Command acceptable, Status of gain switch, Velocity loop proportional control status, CW Over Travel, CCW Over Travel, Warning, Alarm code (3 bit), Start of estimation of magnetic pole position, etc.

3.2. Dimension

M-EGA-15A2301



M-EGA-30A2301



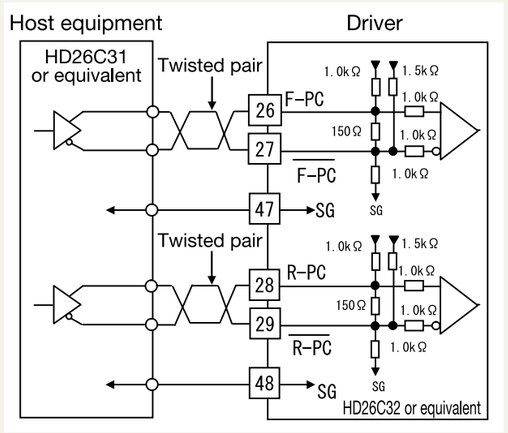
3.4. CN1 Signal and function

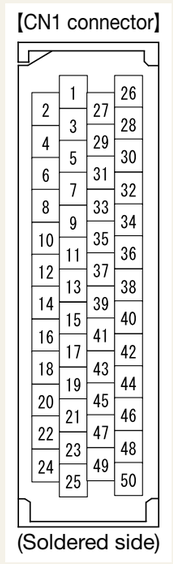
Terminal number	Signal name	Description
1	—	Do notconnect
2	—	Do not connect
3	AO	A phase pulse output
4	$\overline{AO}$	/A phase pulse output
5	BO	B phase pulse output
6	$\overline{BO}$	/B phase pulse output
7	ZO	Z phase pulse output
8	$\overline{ZO}$	/Z phase pulse output
9	PS	Resolver signal output
10	$\overline{PS}$	/Resolver signal output
11	ZOP	Z phase pulse output
12	SG	Common for pins 3 to 11
17	—	Do not connect
18	—	Do not connect
19	—	Do not connect
20	—	Do not connect
21	—	Do not connect
22	T-COMP	Torque compensation input
23	SG	Common for pin 22
26	F-PC	CW command pulse input
27	$\overline{F\text{-}PC}$	CW command pulse input
28	R-PC	CCW command pulse input
29	$\overline{R\text{-}PC}$	CCW command pulse input
47	SG	Common for pins 26 and 27
48	SG	Common for pins 28 and 29
30	MON1	Analog monitor output
31	SG	Common for pin 30

Terminal number	Signal name	Description
13	CONT7	Position command pulse disabled function/shutdown at zero velocity function
14	$\overline{CONT7}$	
15	CONT8	Alarm reset function
16	$\overline{CONT8}$	
38	SG	Common for pins 13 to 16
32	CONT6	CW over travel function
33	CONT5	CCW over travel function
34	CONT4	Deviation clear function
35	CONT3	Magnetic pole position estimation input
36	CONT2	Emergency stop function
37	CONT1	Servo-ON function
50	CONT-COM	General input power supply
39	OUT1	In-Position window
40	OUT2	Magnetic pole position estimation ready
41	OUT3	Operation setup completion
42	OUT4	Magnetic pole position estimation end
43	OUT5	Alarm code bit 5
44	OUT6	Alarm code bit 6
45	OUT7	Alarm code bit 7
46	OUT8	Alarm status
49	OUT-PWR	Power source for general output
24	OUT-COM	General output Common
25	OUT-COM	General output Common

·Terminal number 26 to 29: CW + CCW pulse command, Code + pulse train command or 90 [°] -phase difference two-phase pulse train command can be selected.
·Terminal number 13 to 16, 32 to 37: Shipping set
·Terminal number 39 to 46: Shipping set

3.5. Pulse train input signal specifications





4 Cable

4.1. Motor cable

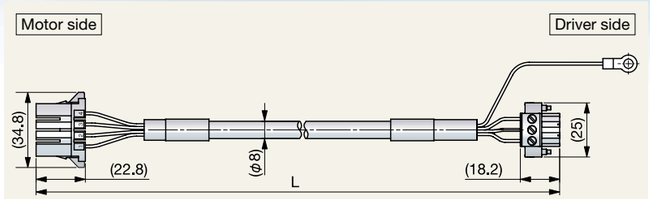
4.1.1. Motor cable Reference number

Example :

M-CA	004	A1	01

Motor cable
Cable length L : [m]
Exp. 004 : 4 [m]
A1 : Standard
Design number
01 : Standard

4.1.2. Dimension



Cable must be installed to stationary part. Cable bending radius: Min. R43

4.2. Converter cable

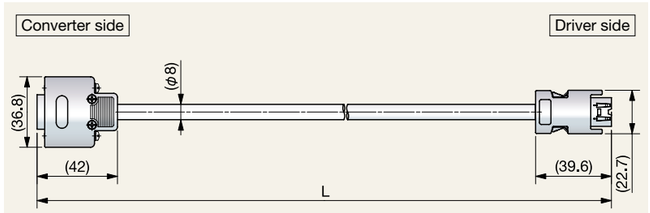
4.2.1. Converter cable Reference number

Example :

M-CC	004	A1	01

Converter cable
Cable length L : [m]
Exp. 004 : 4 [m]
A1 : Standard
Design number
01 : Standard

4.2.2. Dimension



Cable must be installed to stationary part. Cable bending radius: Min. R90

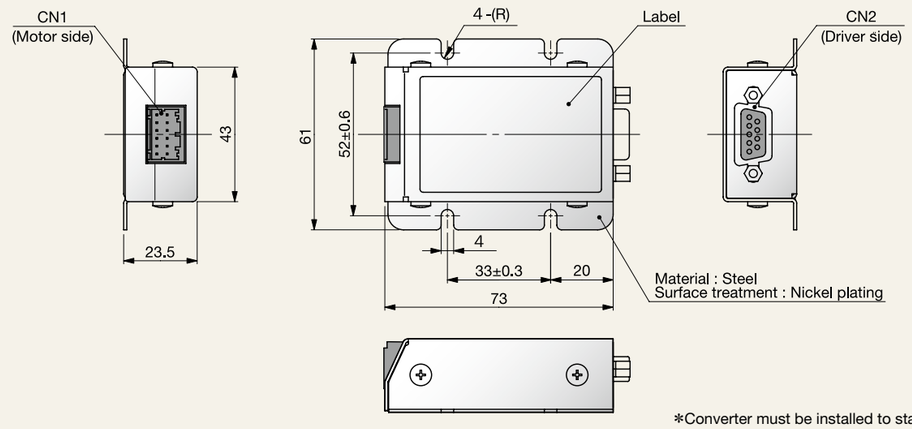
5 Converter

5.1. Converter Reference Number

Example : M-ECC - PB1006 GA 2 01

Converter Model ECC
Motor model
GA : For Driver Model EGA
Position sensor code 2 : Incremental
Design number 01 : Standard

5.2. Dimension



*Converter must be installed to stationary part.

6 Accessories

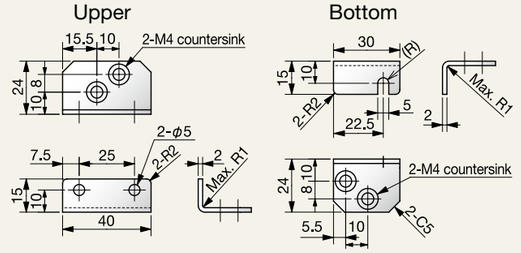
Power connector M-FAE0001

Maker : Phoenix contact
Model number : MSTBT 2, 5/ 8-STF-5, 08LUB

IO connector M-FAE0002

Maker : Sumitomo 3M
Model number : 10150-3000PE
10350-52A0-008

Mounting bracket M-FAE0003



Material : Steel
Surface treatment : Trivalent chrome coating

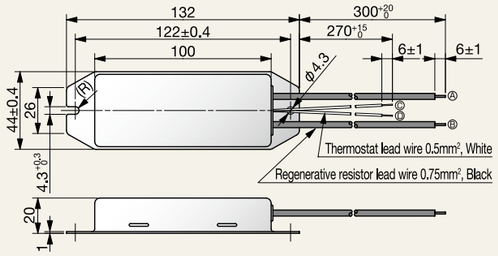
Four screw bolts are attached.

Connector set M-FAE0007

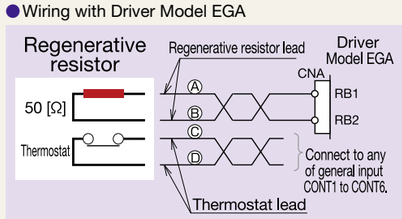
Power connector
M-FAE0001

IO connector
M-FAE0002

Regenerative resistor (80W) M-FAE0004

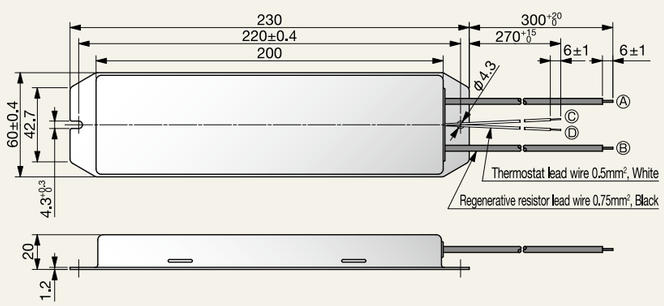


● Wiring with Driver Model EGA

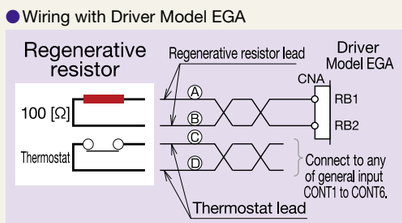


● Specifications
Rated power : 80 [W]
Resistance : 50 [Ω]
Operation temperature of Thermostat : 135 [°C]

Regenerative resistor (220W) M-FAE0005

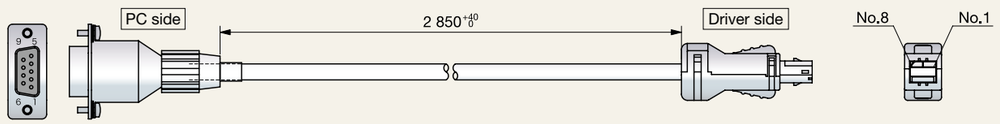


● Wiring with Driver Model EGA



● Specifications
Rated power : 220 [W]
Resistance : 100 [Ω]
Operation temperature of Thermostat : 135 [°C]

PC communication cable M-FAE0006



7 Application software

“MEGATORQUE MOTOR SETUP” software

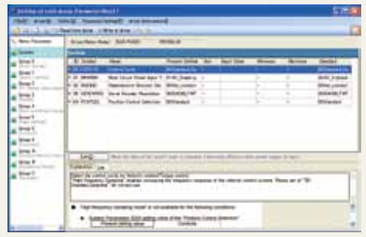
“MEGATORQUE MOTOR SETUP” software for PC provides useful features such as Parameters adjustment, Monitoring, Confirm alarm history, JOG operation and Oscilloscope function.
“MEGATORQUE MOTOR SETUP” software can be downloaded from NSK Web site free of charge. (http://www.nsk.com/)
Optional RS-232C communication cable is available. Reference number : M-FAE0006

● **Please use USB port with commercially available RS-232C to USB converter unit if PC does not have a RS-232C COM port. Recommended RS-232C to USB converter unit is , BUFFALO USB serial cable : model BSUSRC0610BS.**

1. Main menu

2. Parameter edit menu

Read out/Save/Edit parameter setting value.

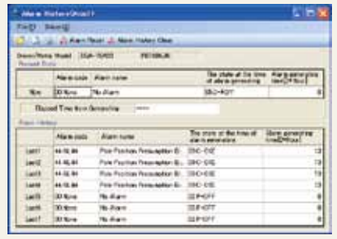


3. Monitor menu

Monitor motor operation and parameters.

4. Alarm history

Confirm current and old alarm history.



5. Jog operation

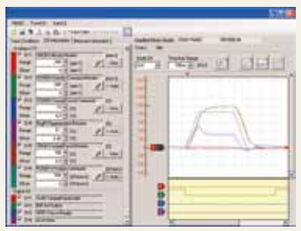
Jog operation for test run.

6. Positioning operation

Positioning by PC for test run.

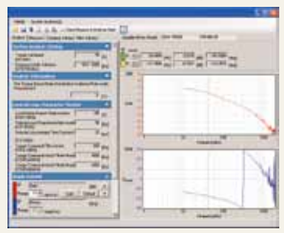
7. Trace operation

Graphic trace for motor internal data.



8. System analysis

Measure system frequency response.



8 Selection of MEGATORQUE MOTOR

To select appropriate MEGATORQUE MOTOR, examine the following data.

8.1 Loads on the Motor

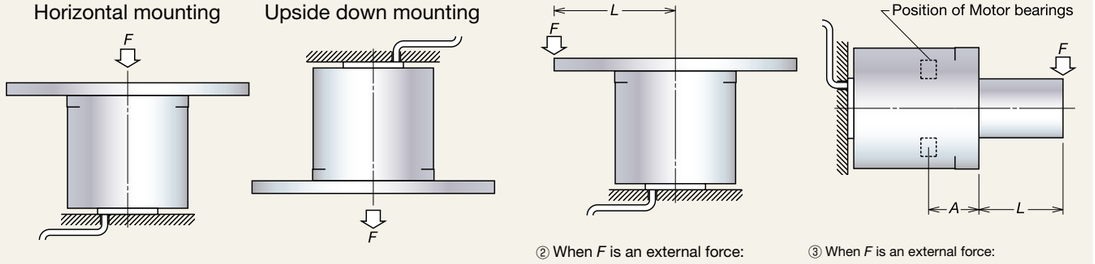
(1) Load moment of inertia *J*

When the MEGATORQUE MOTOR System is used, the moment of inertia of the load mounted to the Motor rotor will significantly affect the acceleration/deceleration characteristics. Thus, calculation of the moment of inertia of the load *J* is required.

(2) Axial load, radial load, and moment load

The relationship between external force and load is represented in the following three patterns.

Ensure the axial load/radial load and the moment load are set within the allowable axial, radial and moment loads. (Refer to "2 Motor" in this catalog for allowable loads. Max. axial load in upside down mounting configuration is significantly different them that of horizontal mounting configuration.)



① When *F* is an external force:
- Axial load: $F_a = F$ + total weight of jigs and works
- Moment load: $M = 0$

② When *F* is an external force:
- Axial load:
  $F_a = F$ + total weight of jigs and works
- Moment load: $M = F \times L$

③ When *F* is an external force:
- Radial load:
  $F_r = F$ + total weight of jigs and works
- Moment load:
  $M = (F + \text{total weight of jigs and works}) \times (L + A)$

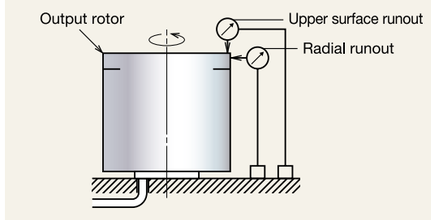
Model	PB1	PB3
Dimension A [mm]	22.2	22.9

(3) Load torque consideration

When motor takes load torque, both load torque and practical effect torque must be considered.

8.2 Runout Accuracy

The measurement method for runout accuracy is shown at right.



8.3 Positioning Accuracy

The positioning accuracy of the MEGATORQUE MOTOR System is considered by two respects as follows:

(1) Absolute positioning accuracy

(2) Repeatability

【Example】 We examine the compatibility of the PB Series motors, assuming required repeatability +/-0.02 [mm] at 300 [mm] distance from the center.

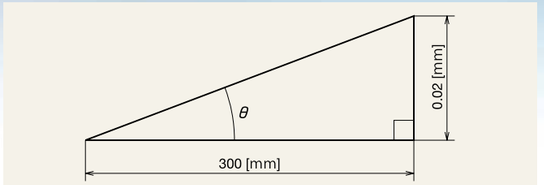
From $\tan\theta = 0.02 \div 300$

$\theta = \tan^{-1}(0.02 \div 300)$

$= 3.8 \times 10^{-3}$ [°]

$= 14$ [arc-sec]

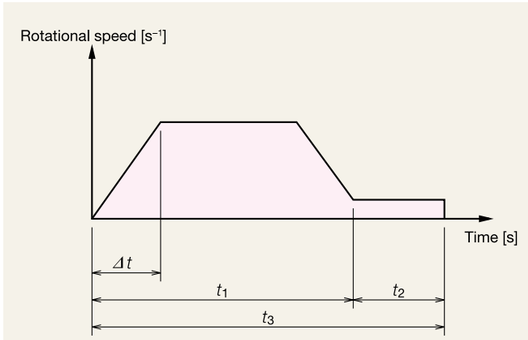
Due to +/-14 > +/-5, both PB1 and PB3 can be used in terms of repeatability.



8.4. Positioning time (Index time)

Positioning time can be roughly calculated as follows;

J_m:	Load moment of inertia	[kg·m²]
J_r :	Rotor moment of inertia	[kg·m²]
N :	Rotational speed	[s⁻¹]
T :	Output torque at rotational speed N	[N·m]
T_m:	Load torque	[N·m]
t_1 :	Travel time	[s]
t_2 :	Settling time	[s]
t_3 :	Positioning time	[s]
Δt:	Acceleration/Deceleration time	[s]
θ :	Rotational angle	[°]
η :	Safety factor (normally 1.4 to 1.5)	



$$\Delta t = \frac{(J_r + J_m) \times 2\pi N}{(T/\eta - T_m)}$$

$$t_1 = \frac{\theta}{360 \times N} + \Delta t$$

$$t_3 = t_1 + t_2$$

$$\text{Where } \left\{ \begin{array}{l} T/\eta - T_m > 0 \\ 2 \times \Delta t \leq t_1 \end{array} \right\}$$

*t_2 varies with load moment of inertia and motion profile.

Driver Reference number	Capacitor absorption energy [J]
M-EGA-15AXXXX	17
M-EGA-30AXXXX	24

8.5. Selection of External Regenerative resistor

(1) Obtain rotational energy of MEGATORQUE MOTOR during deceleration.

Calculate the rotational energy using the following equation;

Rotational energy $= 1/2 \times J \times \omega^2$ [J]

$= 1/2 \times J \times (2\pi N)^2$ [J]

$J = J_r + J_m$

J_r : Rotor moment of inertia [kg·m²]

J_m: Load moment of inertia [kg·m²]

N : Rotational speed [s⁻¹]

(2) Regenerative energy capacity to internal capacitors.

The regenerative energy capacity of the internal capacitors is different with Driver Reference number.

(3) Calculate energy consumed by external regenerative resistor.

Energy consumed by external regenerative resistor [J] = Rotational energy [J] – Capacitor absorption energy [J]

When the difference is zero or less, no external regenerative resistor is necessary.

When difference is greater than zero, use the following procedure to obtain the required capacity for an external regenerative resistor.

(4) Calculate required external regenerative resistor.

Required capacity for an external regenerative resistor [W]

= Energy consumed by external regenerative resistor [J] / (Operation cycle [s] × 0.25)

0.25 : Load ratio of external regenerative resistor use

When the quotient is 80 or less, use regenerative resistor : M-FAE0004

When the quotient is 220 or less, use regenerative resistor : M-FAE0005

8.6. Effective torque calculations

When selecting a MEGATORQUE MOTOR, it is necessary to consider the Max. required torque and the required effective torque for the actual operation which must be lower than rated torque.
Determine whether 45 [°] can be positioned in 0.3 [s], assuming the load moment of inertia is 0.12 [kg·m^2].
Also calculate the effective torque when an operation cycle is 2.0 [s].

Conditions: J_m (Load moment of inertia) = 0.12 [kg·m^2]
J_r (Rotor moment of inertia) = 0.014 [kg·m^2] (PB3015)
N (Max. rotational speed) = 1.25 [s^{-1}]
T (Torque at speed N) = 15 [N·m] (PB3015 : 1.25 [s^{-1}])
T_m (Load torque) = 0 [N·m]　　η : Safety factor = 1.4
θ (Rotational angle) = 45 [°]　　t_4 (Cycle time) = 2.0 [s]
Repeatability = +/-100 [arc-sec]　　t_2 (Settling time) = 0.04 [s]
Δt : Acceleration time [s]　　t_1 : Travel time [s]

- Calculate positioning time using the following equation,

Acceleration time $\Delta t = \dfrac{(J_r + J_m) \times 2\pi N}{(T/\eta - T_m)}$ = ((0.12 + 0.014) × 2π × 1.25) / (15 / 1.4 - 0) = 0.1 [s]

Travel time $t_1 = \dfrac{\theta}{360 \times N} + \Delta t$ = 45 / (360 × 1.25) + 0.1 = 0.2 [s]

Positioning time $t_1 + t_2$ = 0.2 + 0.04 = 0.24 [s]

- The effective torque required for the actual operational pattern in use (see following diagram) needs to be examined.
Also determine whether the PB3015 meets the operational conditions.

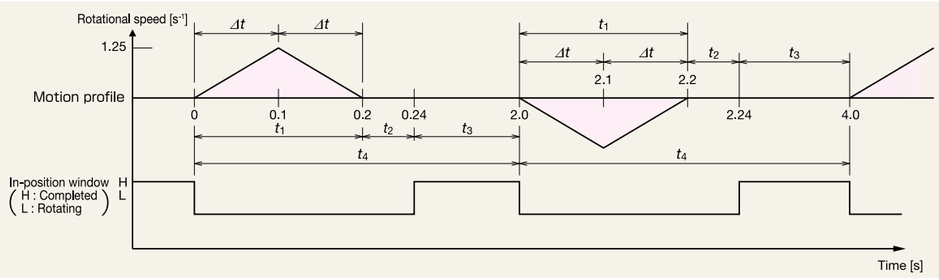
t_4 : Cycle time = 2.0 [s]

Required effective torque $= \sqrt{\dfrac{(T/\eta)^2 \times \Delta t \times 2}{t_4}}$ = 3.4 [N·m]

Rotational energy = 1/2 × (J_r + J_m) × (2πN)^2 = 1/2 × (0.12 + 0.014) × (2π × 1.25)^2 = 4.1 [J]

An effective torque 4.4 [N·m] is determined by multiplying the equation above by a temperature coefficient of 1.3, which is less than the PB3015's rated output torque of 5.0 [N·m]. Therefore, the PB3015 sufficiently meets the operational conditions and no external regenerative resistor.

- In case results do not meet rated torque ≧effective torque, recalculation with revised conditions is required.



9 Operating precautions

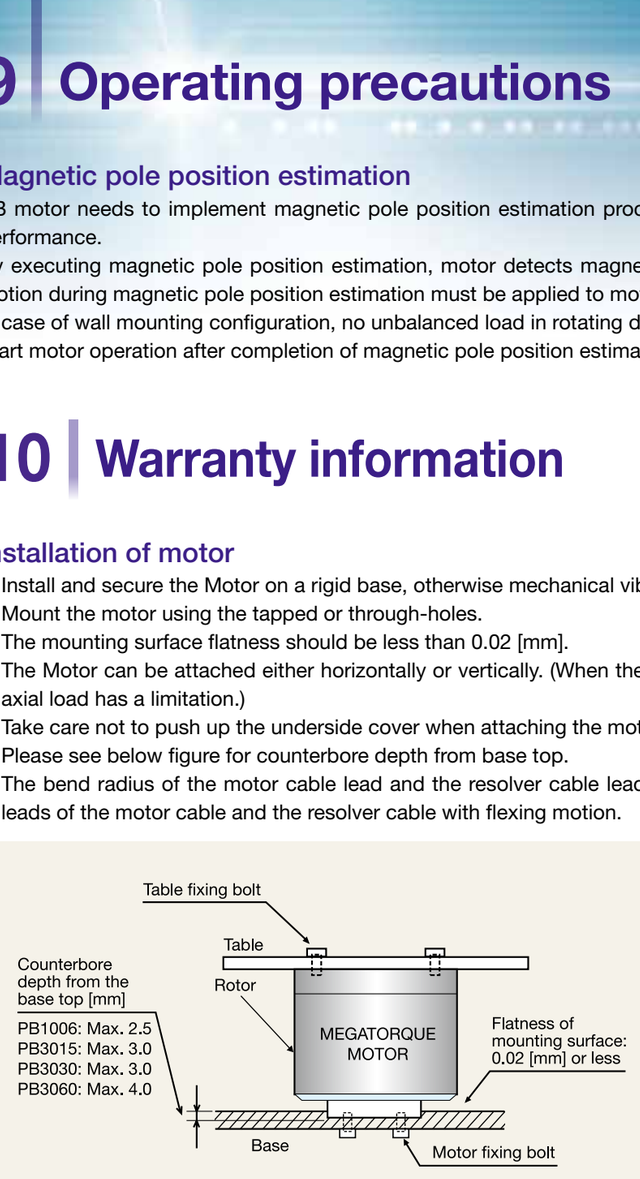
Magnetic pole position estimation

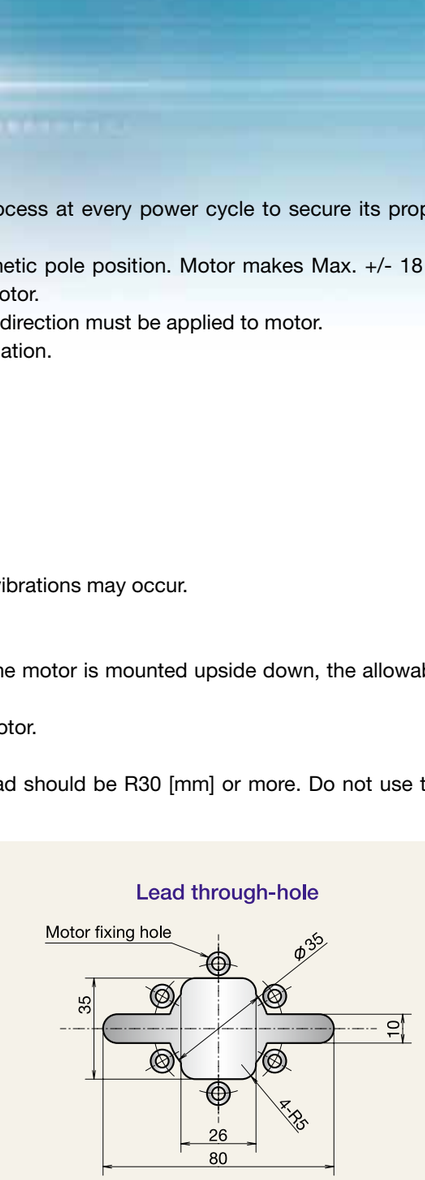
PB motor needs to implement magnetic pole position estimation process at every power cycle to secure its proper performance.
By executing magnetic pole position estimation, motor detects magnetic pole position. Motor makes Max. +/- 18 [°] motion during magnetic pole position estimation must be applied to motor.
In case of wall mounting configuration, no unbalanced load in rotating direction must be applied to motor.
Start motor operation after completion of magnetic pole position estimation.

10 Warranty information

Installation of motor

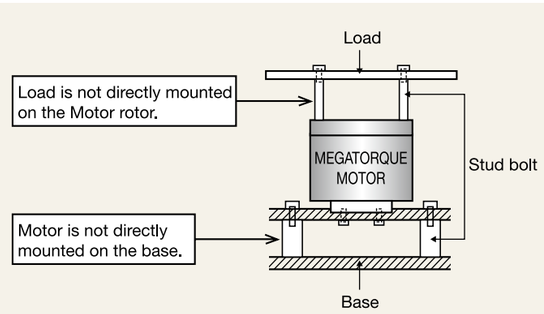
- Install and secure the Motor on a rigid base, otherwise mechanical vibrations may occur.
- Mount the motor using the tapped or through-holes.
- The mounting surface flatness should be less than 0.02 [mm].
- The Motor can be attached either horizontally or vertically. (When the motor is mounted upside down, the allowable axial load has a limitation.)
- Take care not to push up the underside cover when attaching the motor.
- Please see below figure for counterbore depth from base top.
- The bend radius of the motor cable lead and the resolver cable lead should be R30 [mm] or more. Do not use the leads of the motor cable and the resolver cable with flexing motion.





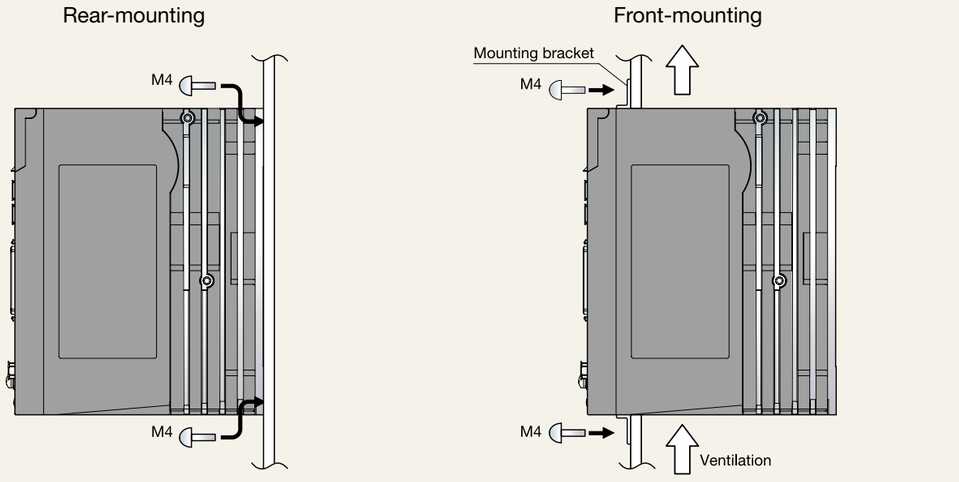
When inserting connector through the bottom of the base, making a larger hole than is shown in this figure Is recommended.

(Note) Since the installation condition shown below can cause mechanical resonant vibration or failure of estimation of magnetic pole due to low rigidity of the mounting base and the load, installation of motor to mounting base and load to motor have to be secure and rigid.



9.2. Installation of driver

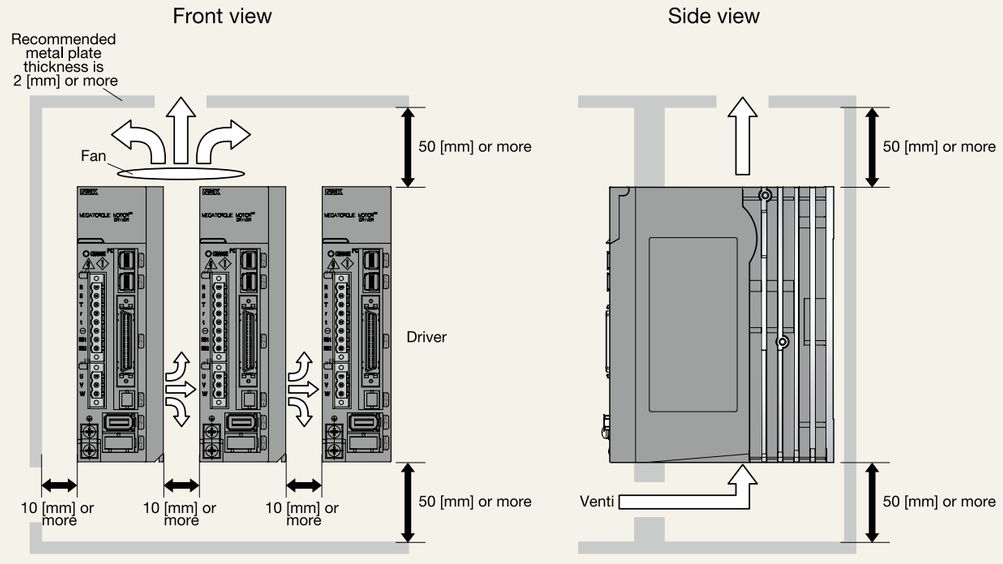
Mounting configuration and mounting location



*Please refer 6. Accessories for mounting bracket.

Control arrangement within the machine

- Leave at least 50 [mm] space above and below the driver to ensure unobstructed airflow from the inside of the driver and the radiator. If heat gets trapped around the driver, use a cooling fan to create airflow.
- Make sure the temperature around the driver does not exceed 55 [°C]. For longevity and reliability purposes it is recommended to keep the temperature below 40 [°C].
- Leave at least 10 [mm] space on both sides of the driver to ensure unobstructed airflow from the heat sinks on the side and from the inside of the driver.
- If the driver is installed on its side, make sure that the ambient temperature does not exceed 50 [°C], and mount the bask panel to a metal plate.



11 Warranty information

Warranty Period

- The warranty period is either one year from delivery or 2 400 hours of operation, whichever comes first.

Limited warranty

- The warranty is limited to the products supplied by NSK Ltd.
- The defective products will be repaired free of charge within the applicable warranty period.
- Repairs after expiration of the applicable warranty period will be subject to payment.

Immunities

- The products is not warranted in one of the following cases even within the warranty period.
  - Failure of the unit due to installation and operation not in accordance with the instruction manual specified by the supplier.
  - Failure of the unit due to improper handling and use, modification and careless handling by the user.
  - Failure of the unit due to the causes other than those attributable to the supplier.
  - Failure of the unit due to modification or repair that is conducted by a person(s) or party(ies) other than the supplier.
  - Other types of failure due to natural disasters and accidents (causes not attributable to the responsibility of the supplier).
- Damages induced by a failure if the supplied unit are not covered.

Service Fee

- Prices of goods do not include any applicable service charges, such as the dispatching of engineers.
- Startup or maintenance services that require the dispatching of engineers are subject to payment even during the applicable warranty period.

Discontinuation of Production and Maintenance Service Period

- Any discontinuation of production will be announced one year in advance. The maintenance service period is five (5) years after discontinuation of production. Announcement will be released by the supplier or published on the NSK Web site.

Special – purpose Applications

- This product is intended for general industrial applications and is not designed or manufactured for use under dangerous conditions.
- Contact NSK before using this product for any special-purpose applications, including nuclear power equipment and systems or aerospace, medical, and safety devices.
- While this product is manufactured under strict quality controls, NSK recommends that an appropriate safety device be installed when used with equipment that could cause serious accidents or damage in the event of product failure.

12 Form for Requesting MEGATORQUE MOTOR Selection

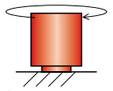
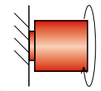
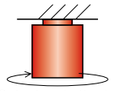
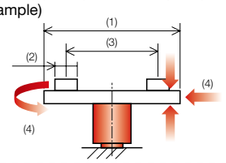
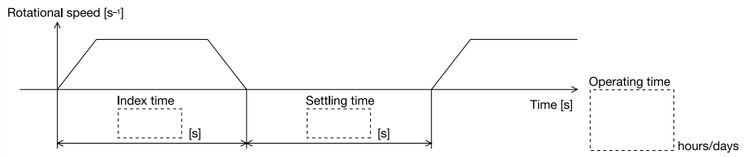
NSK will assist in selecting the optimal MEGATORQUE MOTOR.
Please fill in the necessary items on the below form and send it by fax to the local NSK office.
Items marked with ◎ represent the important information required for selection. Please provide as much detail as possible.

To be completed by customer

To _____ Date (DD/MM/YYYY): / /

◎Company Name: _____ ◎Section: _____

◎Name: _____ ◎Contact:
TEL _____ FAX _____

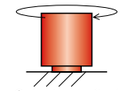
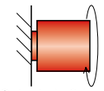
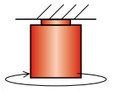
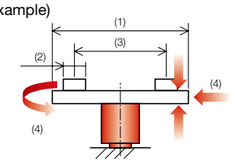
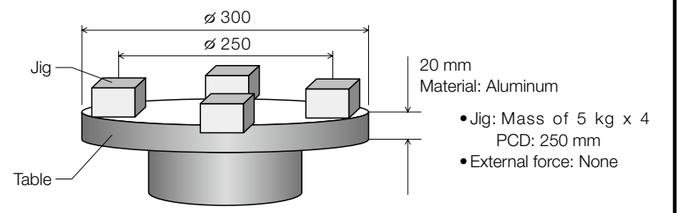
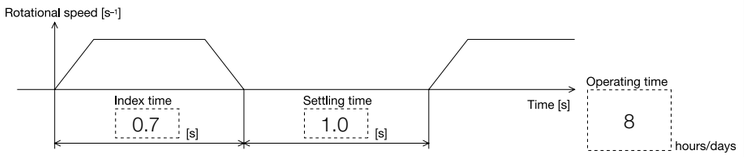
◎**Application and equipment used** (specify with as much detail as possible)	
◎**Motor installation position** (check in ☐)	☐ Horizontal mounting  Output shaft in a vertical direction ☐ Wall mounting  Output shaft in a horizontal direction ☐ Upside down mounting  Output shaft in a downward direction ☐ Others
◎**Load conditions** (1) Geometry, dimensions, thickness, material (or mass) of table (2) Dimensions, mass, quantity of loads/ jigs (3) PCD (distance between the jigs/ loads) (example of description) (Example) 	Schematic drawing (an attached illustration showing outside dimensions is acceptable) • Please provide information on outside dimensions, dimensions from the center, material, etc. Attachment: ☐ Yes ☐ No
(4) External force (pressure/impact load, sliding friction, etc.)	_____ N ☐ None ☐ Always ☐ At settling ☐ During rotating ☐ Some impact ☐ Rotational direction ☐ Sliding friction *Specify position, direction, etc. in the schematic drawing.
Motor size requested	
Positioning command system	☐ Internal program system ☐ Pulse train input operation ☐ RS-232C operation ☐ CC-Link
◎**Index angle / Number of points**	Settle at °, Number of points:
◎**Repeatability (+/-)**	+/- [s] (+/- [mm] at [mm] from the motor center)
◎**Cycle pattern** (desired positioning time) *Specify settling time.	
◎**Input power voltage**	☐ 100 to 115 [VAC] ☐ 200 to 230 [VAC] ☐ Others ([VAC])
Environmental conditions	Operating environment ☐ General environment (equivalent to IP30) ☐ Oil, water and chemical ☐ Chips and dust ☐ Clean Operating temperature ☐ 0 to 40 [°C] ☐ Below 0 [°C] ☐ Above 40 [°C] ☐ Other ([°C]) Contact NSK for details.
◎**Cable specification and length**	☐ Stationary cable ☐ Flexible cable Length: [m] Select “Movable” when cable is repeatedly bent anywhere along the wiring route.
Other request items	

Example of completed form

To Mr. XXX XXX , in charge of Precision Machinery & Parts, NSK Date (DD/MM/YYYY): 12 / 01 / 20XX

◎Company Name: YYY Corporation ◎Section: Engineering Dept., Engineering Section #1

◎Name: YYY YYY ◎Contact:
TEL 03-1234-5678 FAX 03-1234-5678

◎**Application and equipment used** (specify with as much detail as possible)	Semiconductor inspection machine
◎**Motor installation position** (check in ☐)	☑ Horizontal mounting  Output shaft in a vertical direction ☐ Wall mounting  Output shaft in a horizontal direction ☐ Upside down mounting  Output shaft in a downward direction ☐ Others
◎**Load conditions** (1) Geometry, dimensions, thickness, material (or mass) of table (2) Dimensions, mass, quantity of loads/ jigs (3) PCD (distance between the jigs/ loads) (example of description) (Example) 	Schematic drawing (an attached illustration showing outside dimensions is acceptable) • Please provide information on outside dimensions, dimensions from the center, material, etc.  Attachment: ☐ Yes ☐ No
(4) External force (pressure/impact load, sliding friction, etc.)	_____ N ☑ None ☐ Always ☐ At settling ☐ During rotating ☐ Some impact ☐ Rotational direction ☐ Sliding friction *Specify position, direction, etc. in the schematic drawing.
Motor size requested	M-PB3015JN001
Positioning command system	☐ Internal program system ☑ Pulse train input operation ☐ RS-232C operation ☐ CC-Link
◎**Index angle / Number of points**	Settle at 90 °, Number of points: 4
◎**Repeatability (+/-)**	+/- 20.6 [s] (+/- 0.01 [mm] at 100 [mm] from the motor center)
◎**Cycle pattern** (desired positioning time) *Specify settling time.	
◎**Input power voltage**	☐ 100 to 115 [VAC] ☑ 200 to 230 [VAC] ☐ Others ([VAC])
Environmental conditions	Operating environment ☑ General environment (equivalent to IP30) ☐ Oil, water and chemical ☐ Chips and dust ☐ Clean Operating temperature ☑ 0 to 40 [°C] ☐ Below 0 [°C] ☐ Above 40 [°C] ☐ Other ([°C]) Contact NSK for details.
◎**Cable specification and length**	☑ Stationary cable ☐ Flexible cable Length: 4 [m] Select “Movable” when cable is repeatedly bent anywhere along the wiring route.
Other request items	Please reply by January 12, 20XX. (example)

MOTION & CONTROL™

NSK

Worldwide Sales Offices

P: Phone ☆: Head Office

NSK LTD. HEADQUARTERS, TOKYO JAPAN
INDUSTRIAL MACHINERY BUSINESS DIVISION-HEADQUARTERS P: +81-3-3779-7227
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NSK REPRESENTATIVE OFFICE
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Mexico:
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MEXICO CITY ☆ P: +52-55-3682-2900
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