MOTION & CONTROL™
NSK

Megatorque Motors™

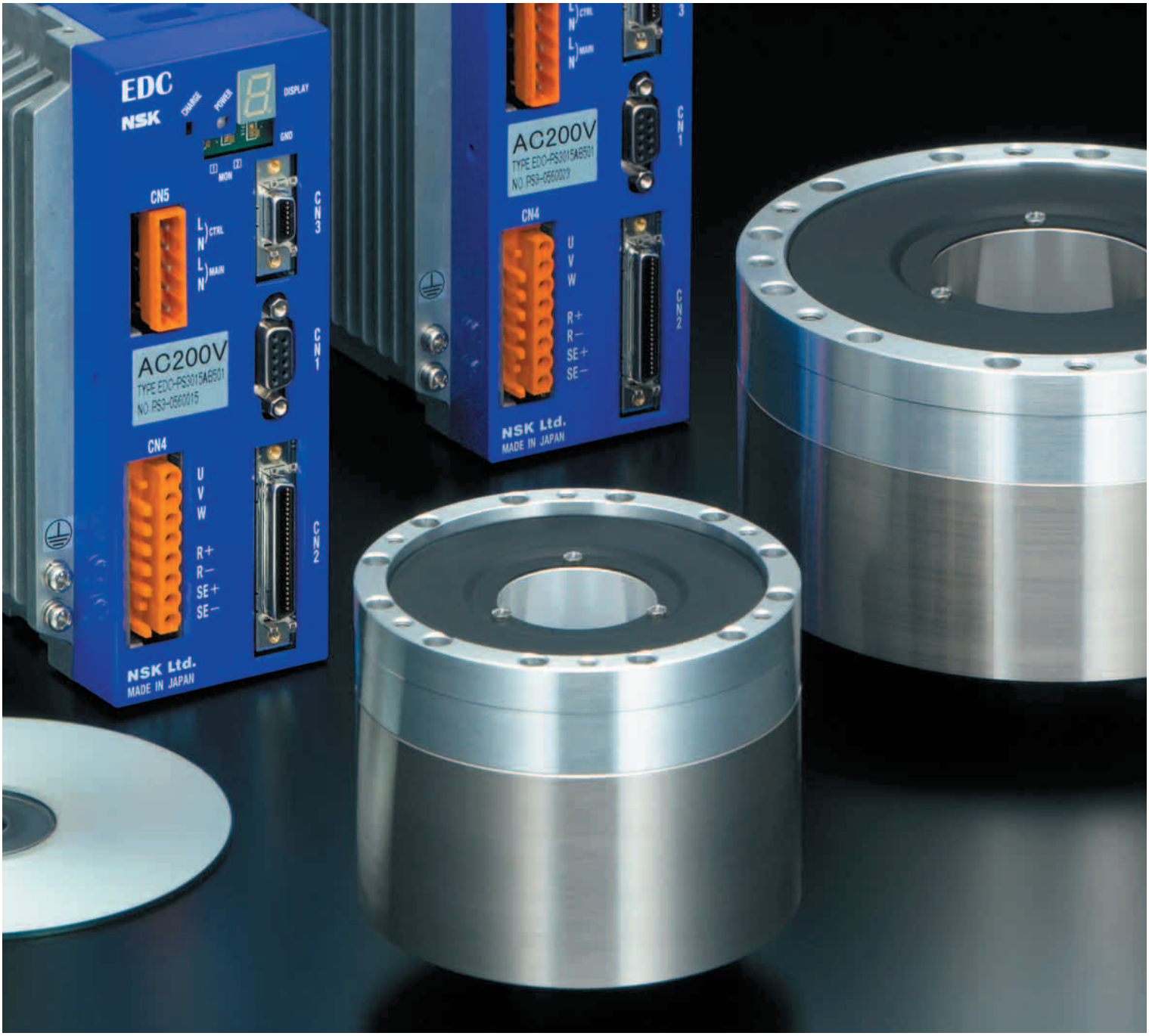
PS Series

UL Standard, CE Marking Conformed

New development
New!

Patent Pending

The PS Series Megatorque Motors delivers unprecedented performance, including a maximum rotational speed of 10 [s^{-1}] and position sensor resolution of 2 621 440 [counts/rev].



Advanced PS Series Megatorque Motors, with high-speed and high-resolution capabilities.

Capable of a maximum rotational speed of 10 [s^{-1}] and position sensor resolution of 2 621 440 [counts/rev] simultaneously, the PS Series offers high accuracy, high torque, light weight, and compactness. These innovative direct drive motors are highly accurate, light and compact, and increase the productivity of various devices such as high-speed robot arms.

1 Shortened Positioning Time

A new servo algorithm shortens the settling time to less than one-fifth of that of conventional NSK motors.

Maximum rotational speed: **10** [S^{-1}] *1)

Settling time: Less than **1/5**

(compared to conventional NSK motors)

2 Compact Motor

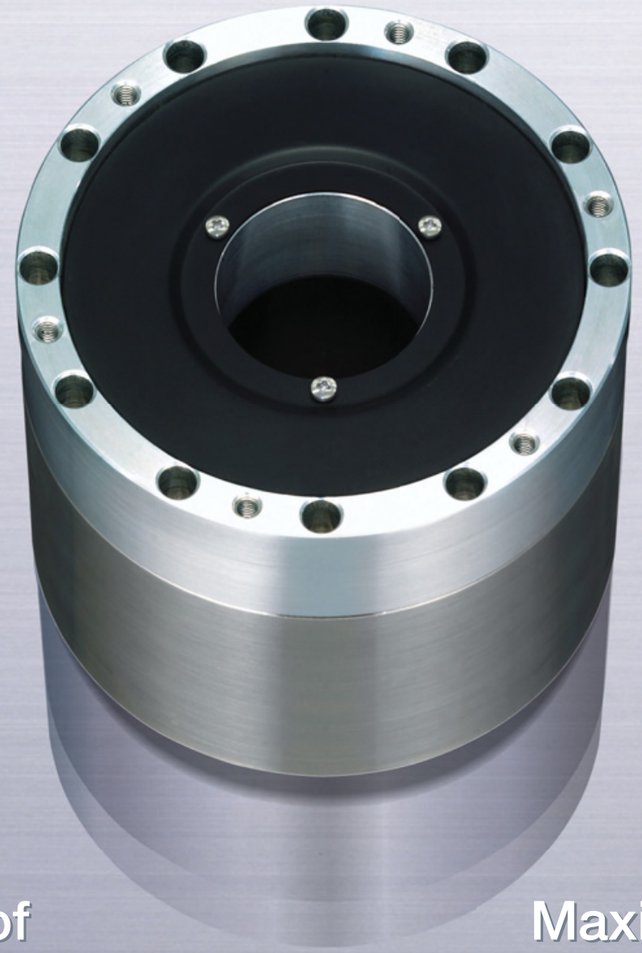
NSK's advanced design technology creates a compact motor with an outer diameter of 100 [mm] (PS1 type) and upgraded functionality. The optimal magnetic field design gives it more than twice as much force density as conventional NSK motors.

Motor outer diameter: **100** [mm]

(PS1 type motor)

Force density: More than **Twice** as much

(compared to conventional NSK motors)



3 Interchangeable, Highly Accurate Absolute Position Sensor

The PS Series incorporates an absolute position sensor with positioning accuracy of 90 arc seconds, requiring no homing operations.
The interchangeable motors and driver units can be combined freely.

Sensor accuracy **90** [arc seconds]

Ambient temperature: 25 ± 5 [°C]

4 Compact Driver Unit

Combined with a special module, the driver unit body is 65% smaller than conventional NSK units.

65 [%] smaller

(compared to conventional NSK driver units)

Position sensor resolution of

2 621 440 [counts/rev]

Maximum rotational speed of

10 [S^{-1}] *1)

*1) Maximum rotational speed varies with motor model.

PS Series Megatorque Motors

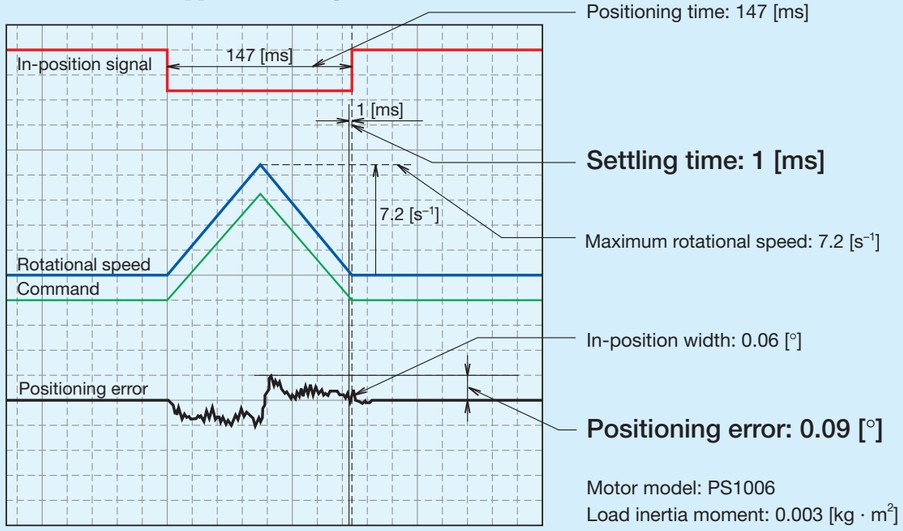
Features of PS Series Megatorque Motors

Control Technology of PS Series Megatorque Motors

- Adopts a **friction compensation control** to reduce the settling time
- Adopts a **high-performance tracking controller** to minimize following errors

High-speed positioning with a settling time of 1 [ms]

Results of 180 [°] Positioning of the PS Series



Positioning time: 147 [ms]

Settling time: 1 [ms]

Maximum rotational speed: 7.2 [s^{-1}]

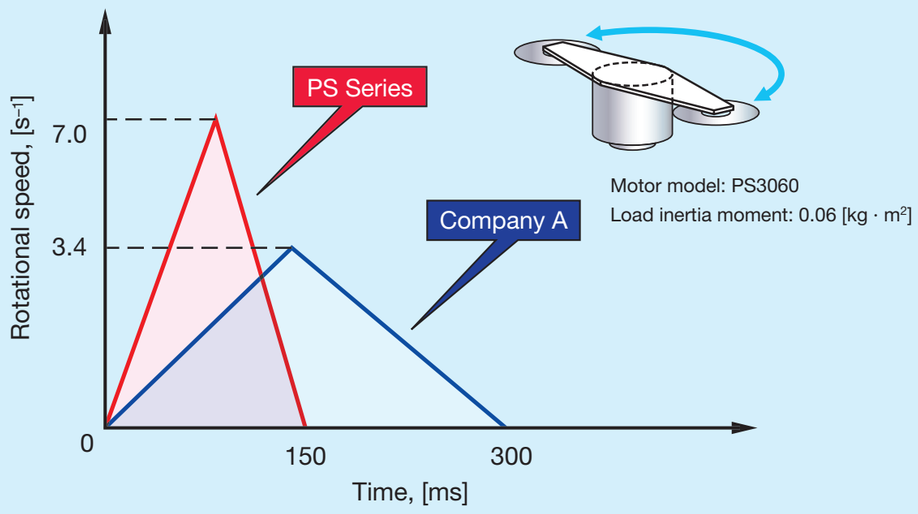
In-position width: 0.06 [°]

Positioning error: 0.09 [°]

Motor model: PS1006
Load inertia moment: 0.003 [kg · m^2]

When a high rigid load is mounted

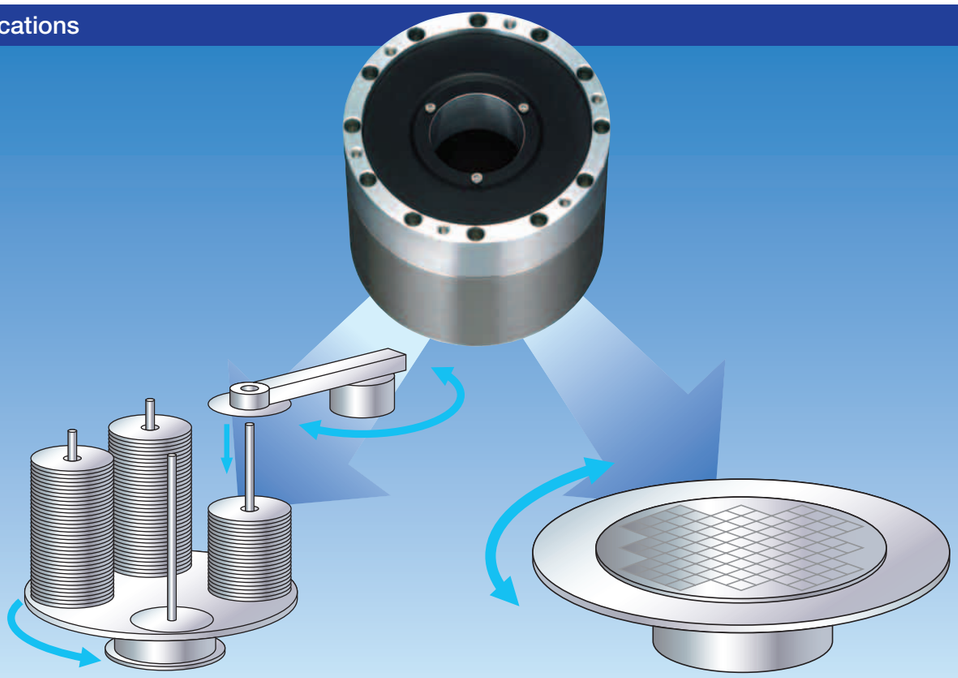
180° positioning of the PS Series compared against a competitor



Motor model: PS3060
Load inertia moment: 0.06 [kg · m^2]

Applications and System Configuration

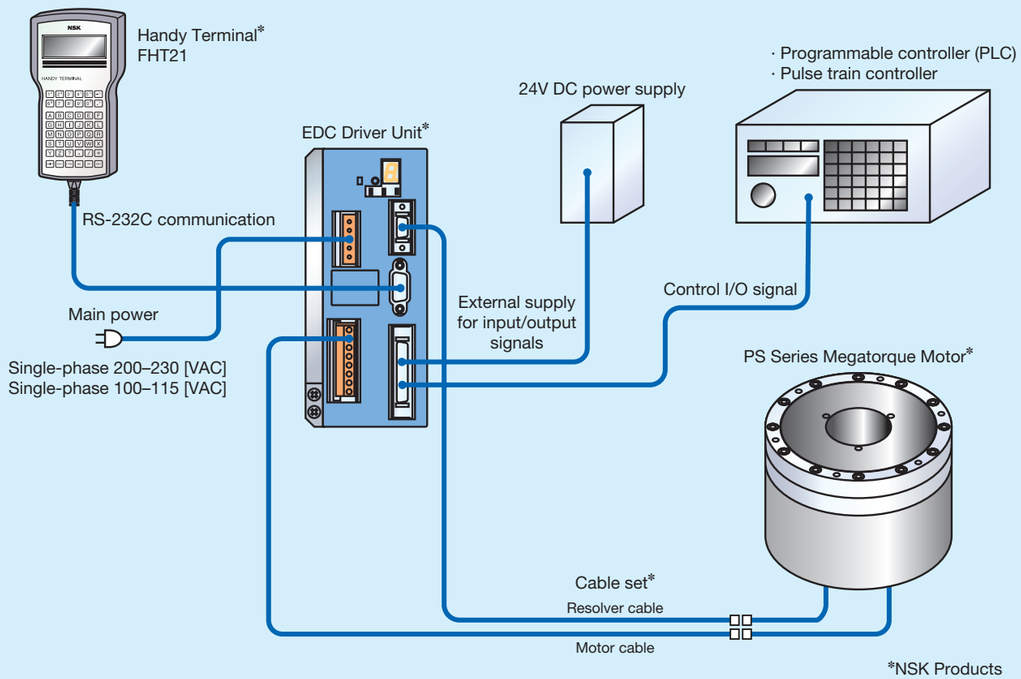
Applications



High-speed robot arms for CD media

High-resolution positioning table

System Configuration



*NSK Products

1. Motor Specifications

PS1 Type Motor

1.1 Coding for Motor Reference Number

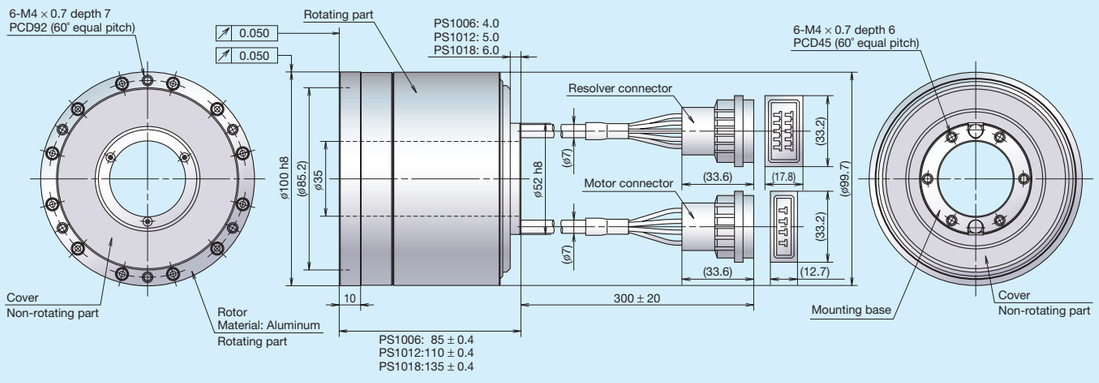
Example of Reference Number: **M-PS 1 006 KN 002**

- M-PS: PS Series Megatorque Motor
- 1: Motor size code
- 006: Maximum output torque [N·m]
- KN: Standard
- 002: Design serial number
  002: Standard
  003: High-precision products (made to order)

1.2 PS 1 Type Motor Specifications

Functional item \ Reference number	M-PS1006KN002	M-PS1012KN002	M-PS1018KN002
Motor outer diameter [mm]		ϕ100	
Maximum output torque [N·m]	6	12	18
Rated output torque [N·m]	2	4	6
Motor height [mm]	85	110	135
Motor hollow diameter [mm]		ϕ35	
Maximum rotational speed [s^{-1}]		10	
Rated rotational speed [s^{-1}]		5	
Resolution of position sensor [count/rev]		2 621 440	
Absolute accuracy [arc sec] *1		90 (interchangeable type, ambient temperature: 25 ± 5 [°C])	
Repeatability [arc sec]		±2	
Allowable axial load [N]		1 000 (under no radial load)	
Allowable radial load [N]		820 (under no axial load)	
Allowable moment load [N·m]		28	
Rotor inertia moment [kg·m^2]	0.0024	0.0031	0.0038
Applied load inertia moment [kg·m^2]	0.015–0.24	0.03–0.31	0.03–0.38
Mass [kg]	2.4	3.5	4.5
Environmental conditions	Ambient temperature 0–40 [°C]; humidity: 20–80%; use indoors, free from dust, condensation and corrosive gas. IP30 equivalent.		

Note: Please consult with NSK in case the axial load, radial load, and moment load are all applied on the motor simultaneously.
For repeated operations within a range of 45 [°], turn the motor at least 90 [°] about once a day.
*1: Absolute accuracy of high-precision products (made to order) is 30 [arc sec] (interchangeable type, ambient temperature: 25 ± 5 [°C]).



Note: Please pay special attention to interference with the connectors when using the resolver hollow to insert a component.

PS3 Type Motor

1.3 Coding for Motor Reference Number

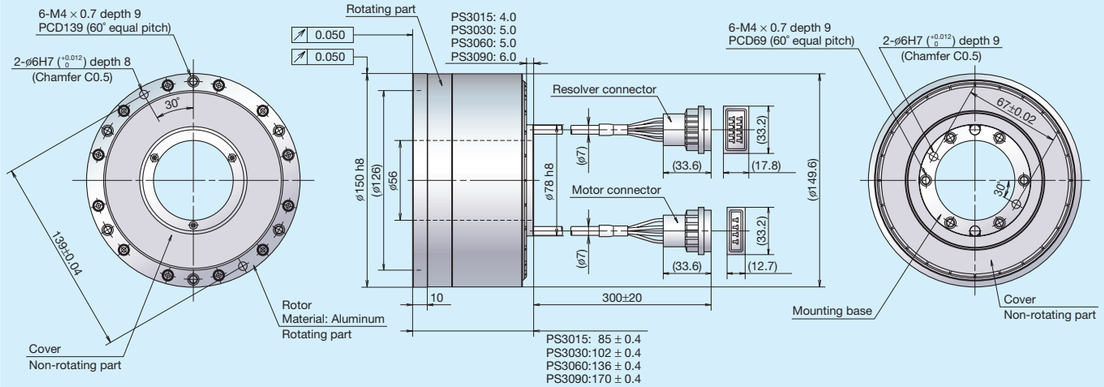
Example of Reference Number: **M-PS 3 015 KN 002**

- M-PS: PS Series Megatorque Motor
- 3: Motor size code
- 015: Maximum output torque [N·m]
- KN: Standard
- 002: Design serial number
  002: Standard
  003: High-precision products (made to order)

1.4 PS 3 Type Motor Specifications

Functional item \ Reference number	M-PS3015KN002	M-PS3030KN002	M-PS3060KN002	M-PS3090KN002
Motor outer diameter [mm]		ϕ150		
Maximum output torque [N·m]	15	30	60	90
Rated output torque [N·m]	5	10	20	30
Motor height [mm]	85	102	136	170
Motor hollow diameter [mm]		ϕ56		
Maximum rotational speed [s^{-1}]	10		8	5
Rated rotational speed [s^{-1}]	5		1	1
Resolution of position sensor [count/rev]		2 621 440		
Absolute accuracy [arc sec] *1		90 (interchangeable type, ambient temperature: 25 ± 5 [°C])		
Repeatability [arc sec]		±2		
Allowable axial load [N]		2 000 (under no radial load)		
Allowable radial load [N]		1 700 (under no axial load)		
Allowable moment load [N·m]		42		
Rotor inertia moment [kg·m^2]	0.011	0.014	0.019	0.024
Applied load inertia moment [kg·m^2]	0–1.1	0–1.4	0.12–1.9	0.12–2.4
Mass [kg]	5.5	6.9	11.0	13.8
Environmental conditions	Ambient temperature 0–40 [°C]; humidity: 20–80%; use indoors, free from dust, condensation and corrosive gas. IP30 equivalent.			

Note: Please consult with NSK in case the axial load, radial load, and moment load are all applied on the motor simultaneously.
For repeated operations within a range of 45 [°], turn the motor at least 90 [°] about once a day.
*1: Absolute accuracy of high-precision products (made to order) is 30 [arc sec] (interchangeable type, ambient temperature: 25 ± 5 [°C]).

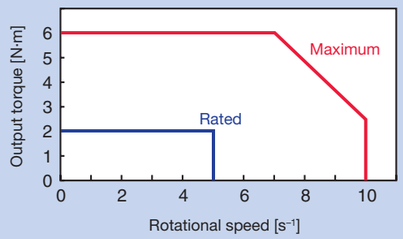


2. EDC Driver Units

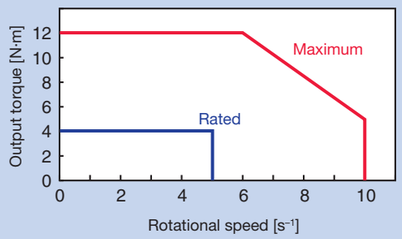
1.5 Rotational Speed and Output Torque Characteristics

PS1 Type

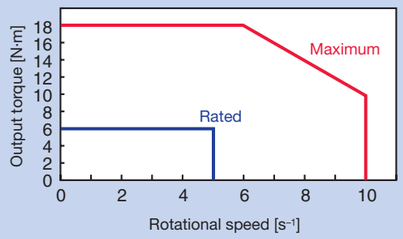
PS1006



PS1012

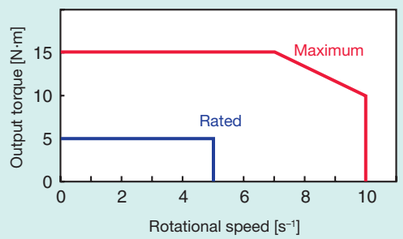


PS1018

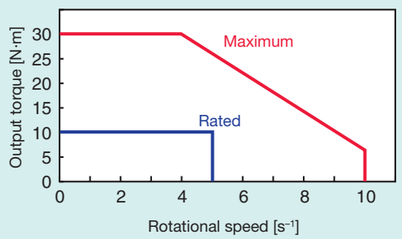


PS3 Type

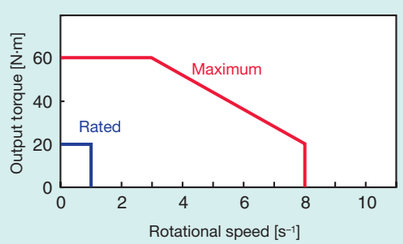
PS3015



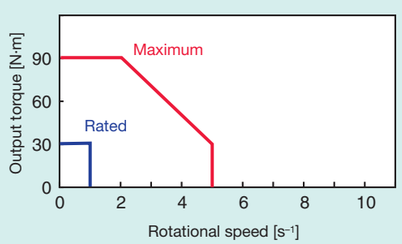
PS3030



PS3060



PS3090



2.1 Coding for Driver Unit Reference Number

Example of Reference Number: **M-EDC - PS1006 A B 5 02 -01**

- M-EDC: EDC Driver Unit
- PS1006: Motor model
- A: Main power voltage — A: 200–230 [VAC] (single-phase); C: 100–115 [VAC] (single-phase)
- B: Specification of position sensor — B: Incorporates absolute position sensor
- 5: Function — 5: Standard; C: CC-Link (made to order)
- 02: Design serial number — 02: Standard; 03: High-precision products (made to order)
- -01: No code: no accessories included; -01: connector, mounting bracket, Japanese manual; -02: connector, mounting bracket, English manual

2.2 Dimensions of Driver Unit

Accessories

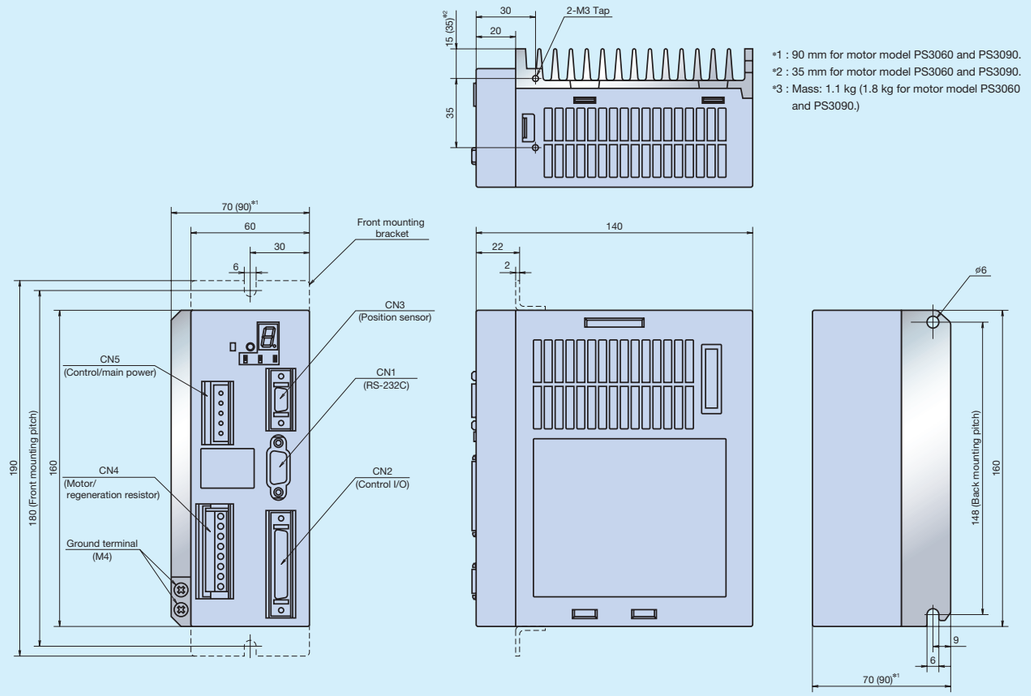
Accessories vary depending on the requested functions. For example, “5: Standard” type comes standard with the following:

① CN2 connector (user side)
Connector: 54306-5011 (Molex)
Connector shell: 54331-0501 (Molex)

② CN5 connector (user side)
Connector: 231-305/026-000 (WAGO)
Wiring lever: 231-131(WAGO)

③ Driver Unit mounting bracket

④ Manual

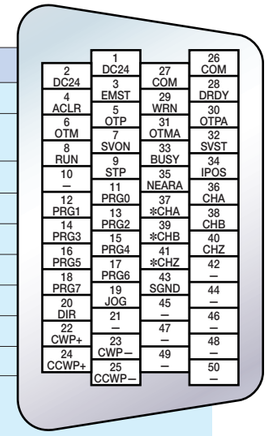


*1 : 90 mm for motor model PS3060 and PS3090.
*2 : 35 mm for motor model PS3060 and PS3090.
*3 : Mass: 1.1 kg (1.8 kg for motor model PS3060 and PS3090.)

2.3 General Specifications of Driver Unit

Item		Size code	PS1006	PS1012	PS1018	PS3015	PS3030	PS3060	PS3090
Input power	Rated power capacity [VA]		230	380	500	470	770	1 300	1 700
	Maximum power capacity [VA]		670	1 200	1 500	1 400	2 400	3 900	5 900
	Control power specification		Single-phase 100–115 [VAC], single-phase 200–230 [VAC]						
	Main power specification								
Resolution of position sensor [count/rev]			2 621 440						
Position command mode			Programmable indexer positioning command (up to 265 channels, positioning commands and parameter settings are programmable), pulse train command and RS-232C communication command, jog operation command, and homing operation command						
Input signal	Pulse train input		Opto-coupler input Maximum pulse train frequency: 1 [MHz] Input pulse format: CW/CCW; pulse and directional; ϕA/ϕB Resolution changer for free multiplication is available (1 000–5 242 880 [count/rev])						
	Control input		Opto-coupler input (usable as either ± common) × 17 inputs; Power voltage: 24 [V]						
Output signal	Position feedback signal		Signal format: ϕA/ϕB/ϕZ line driver Resolution of phase A and B: Shipping set: 20 480 [count/rev] (81 920 [count/rev] after quadrupled) Maximum: 1 310 720 [count/rev] (5 242 880 [count/rev] after quadrupled) *The resolution limits the Motor maximum speed because the processing frequency is limited to 781K [kHZ]. Maximum speed [s^{-1}] = 781K [kHZ]/Resolution of Phase A (B) Resolution of phase Z: 80 [count/rev]						
	Control output		Opto-coupler output (usable as either ± common) × 8 outputs; Maximum switching capacity: 24 [VDC] /50 [mA]						
Alarms			RAM error, ROM error, system error, interface error, ADC error, emergency stop, CPU error, position sensor error, absolute position error, motor disconnection, excessive velocity, resolver excitation amp alarm, commutation error, overheat, main-supply overvoltage, overcurrent, control-supply voltage drop, power module alarm, excess position error, program error, auto-tuning error, excessive position command and position feedback error, software thermal, main-supply low voltage, travel limit over						
Monitoring function			Analog monitor × 2, RS-232C communication monitor						
Communication			RS-232C (Start-stop synchronism type 9 600 [bps])						
Other			Automatic tuning Capable of allocating functions to control input/output Acceleration profiling (modified sine, modified trapezoid, cycloid and half sine)						
Option			Field bus (CC-Link)						
Operating conditions	Operating/storage temperatures		0 to 50 [°C] /–20 to +70 [°C]						
	Operating/storage humidity		90% or less [no condensation]						
	Vibration resistance		4.9 [m/s^2]						
Incorporated functions	Regeneration		External dump resistor (M-E014DCKR1-100, sold separately). Connect to R+ and R–. Do not short circuit.						
	Dynamic brake		Functions at power-off, servo-off and an occurrence of alarm						
Safety standards	UL		UL508C						
	CE	LVD	EN50178						
		EMC	EMI: EN55011, EMS: EN61000-6-2						
Connector	RS-232C	CN1	D-sub 9 pins						
	Control I/O	CN2	Standard type: 50 pins half-pitch connector (user side connector) CC-Link type: 10 pins half-pitch connector (user side connector)						
	Position sensor	CN3	14 pins half-pitch connector						
	Motor	CN4	Plastic connector (UL and CE approved)						
	External regeneration resistor								
	Control/main power	CN5	Plastic connector (UL and CE approved) (user side connector)						
	CC-Link (option)	CN6	Connector MSTB2, 5/5-STF-5, 08AU (Phoenix Contact)						

2.4 Signal Specifications of CN2 (Control I/O)



Pin-out

Input/ Output	Signal Code	Pin No.	Signal Name	Function
Input signal	DC24	1, 2	External power supply 24 [V]	Power supply for input signals
	EMST	3	Emergency stop	Interrupts and stops operation with the dynamic brake.
	ACLR	4	Alarm clear	Releases warning.*1
	OTP	5	Travel limit switch (+)	Limits clockwise rotation.*1
	OTM	6	Travel limit switch (–)	Limits counterclockwise rotation.*1
	SVON	7	Servo on	Enables the servo.*1
	RUN	8	Positioning start	Activates the program selected by PRG input.*1
	STP	9	Stop	Stops operation and program.*1
	—	10	(Do not connect.)	—
	PRG0	11	Internal program·channel selection 0	A combination of ON and OFF of these 0–7 signals selects a channel (0–225) to execute its internal programs.*1
	PRG1	12	Internal program·channel selection 1	
	PRG2	13	Internal program·channel selection 2	
	PRG3	14	Internal program·channel selection 3	
	PRG4	15	Internal program·channel selection 4	
	PRG5	16	Internal program·channel selection 5	
	PRG6	17	Internal program·channel selection 6	
	PRG7	18	Internal program·channel selection 7	
	JOG	19	Jog operation	Activates/stops jog operations.*1
	DIR	20	Jog direction	Sets the direction of jog operation.
	—	21	(Do not connect.)	—
	CWP+	22	CW pulse train (+)	The motor rotates in the plus direction by the pulse train input. (This part can be a direction or ϕB by switching.)
	CWP–	23	CW pulse train (–)	
	CCWP+	24	CCW pulse train (+)	The motor rotates in the minus direction by the pulse train input. (This part can be a pulse train or ϕA by switching.)
	CCWP–	25	CCW pulse train (–)	
Output signal	COM	26, 27	Output signal, common	Output signal, common
	DRDY	28	Driver Unit ready	This signal notifies that the Driver Unit is ready for operation. (This signal opens when the Driver Unit is not ready or an alarm is given.)
	WRN	29	Warning	Reports a warning.*2
	OTPA	30	Over travel limit (+)	Detection and output of plus-direction limit (software/hardware)*2
	OTMA	31	Over travel limit (–)	Detection and output of minus-direction limit (software/hardware)*2
	SVST	32	Servo state	Reports the servo state.*2
	BUSY	33	In operation	Reports operating status.*2
	IPOS	34	Positioning completed	Reports the position error/positioning states.*2
	NEARA	35	Target proximity A	Reports the motor is approaching the target position.*2
	CHA	36	Positioning completed ϕA	Pulse signals indicate a rotational speed of the motor. Output format is line driver.
	*CHA	37	Positioning completed *ϕA	
	CHB	38	Positioning completed ϕB	
	*CHB	39	Positioning completed *ϕB	
	CHZ	40	Positioning completed ϕZ	
	*CHZ	41	Positioning completed *ϕZ	
	—	42	(Do not connect.)	—
	SGND	43	Signal ground	Ground connection for position feedback signal
	—	44–50	(Do not connect.)	—

Selection and optional allocation of control input/output functions
- You may set functions to control input/output ports by the parameters.

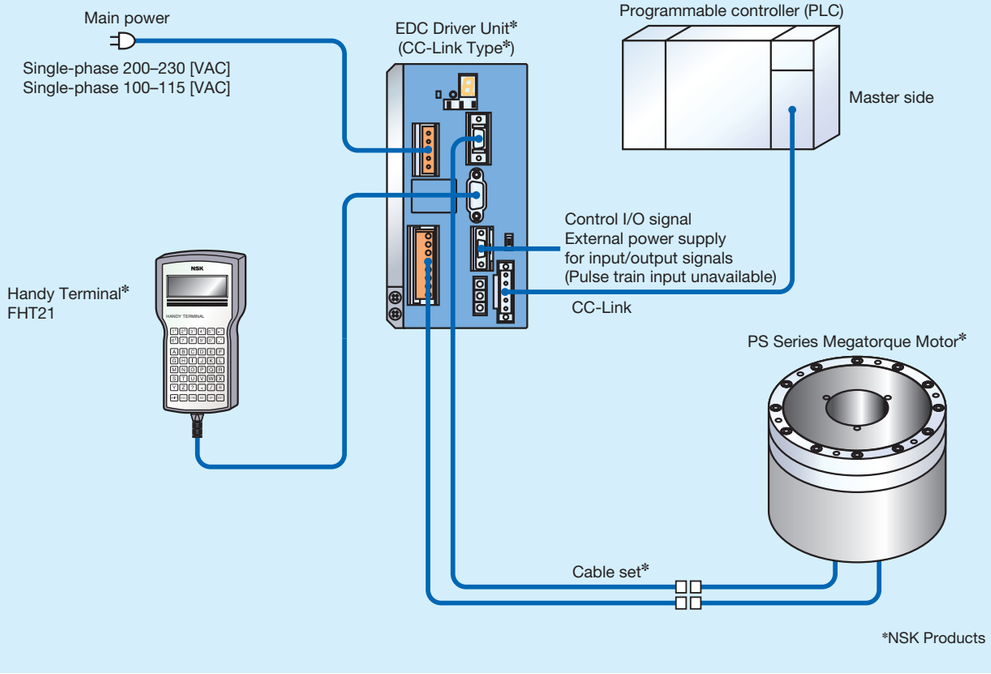
*1. Input signal
- Select 16 of the 22 functions listed in the above table and then allocate them to pin numbers 4 to 9 and 11 to 20 (in addition to the input signals listed above, you may select any of the following: hold; velocity override; integration control OFF; home position return start-up; or home position limit).
- Pin No. 3 is fixed to the 'emergency stop' signal (signal polarity is variable).

*2. Output signal
- Select 7 of the 23 functions listed in the above table and then allocate them to pin numbers 29 to 35 (in addition to output signals listed above, you may select any of the following: target proximity B; target area A/B/C; travel limit detection (±); normal; position deviation (under/over); velocity error (under/over); torque command (under/over); thermal loading (under/over); home-position return completion; or home-position determination).
- 'Driver Unit ready' allocated to Pin No. 28 can only be replaced with 'normal.' (Signal polarity cannot be changed.)

3. Option

3.1 CC-Link

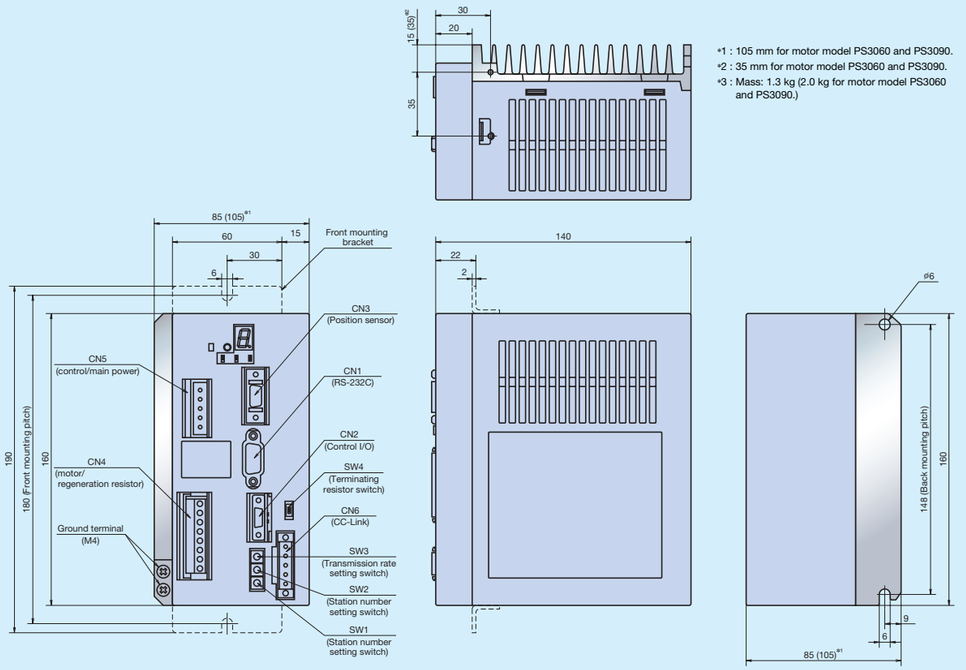
CC-Link System Configuration



*NSK Products

- EDC Driver Unit for PS Series Megatorque Motors provides the field bus (CC-Link) compatibility.
- You can set station numbers and the baud rate with the switches provided on the Driver Unit's front panel.
- Monitoring communication status by LED and terminating resister can be switched on/off.
- The EDC Units are fully compatible with CC-Link Ver. 1.10.

3.2 Dimensions of CC-Link Type Driver Unit



Accessories for CC-Link Type

Accessories vary depending on the functions. For example, "C: CC-Link Type" comes standard with the following:

① CN2 connector (user side)
Connector: DHA-PDA10-3-A01 (DDK)

② CN5 connector (user side)
Connector: 231-305/026-000 (WAGO)
Wiring lever: 231-131 (WAGO)

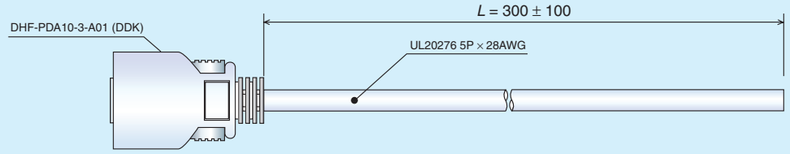
③ CN6 connector (user side)
Connector: MSTB, 5/5-STF-5.08AU
(Phoenix contact)

④ Driver Unit mounting bracket

⑤ Manual (English version)

⑥ Manual for CC-Link
(English version)

Cable with CN2 connector (sold separately)
Reference number: M-E011DCCN1-001



Pin-out

1 DC24V	6 OTM
2 –	7 –
3 EMST	8 DRDY
4 ACLR	9 –
5 OTP	10 COM

3.3 I/O Signal Specifications of CC-Link CN2

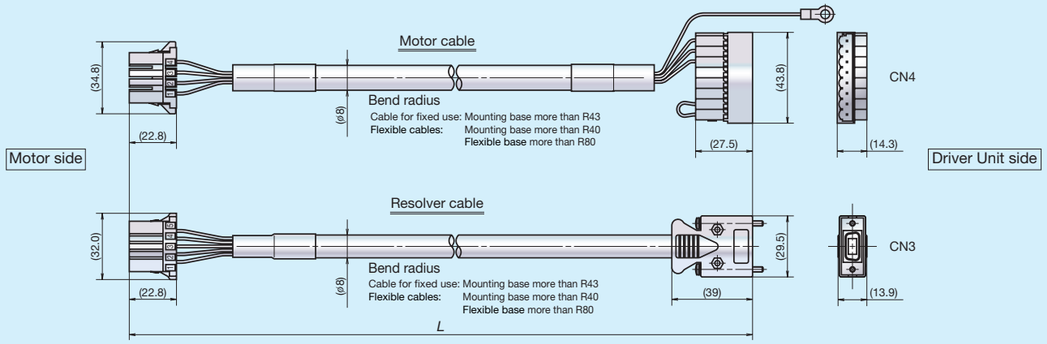
Input/ Output	Signal Code	Pin No.	Signal Name	Function
Input signal	DC24	1	External power supply 24 [V]	Power supply for input signals
	—	2	(Do not connect.)	—
	EMST	3	Emergency stop	Interrupts and stops operation with the dynamic brake.
	ACLR	4	Alarm clear	Releases warning.
	OTP	5	Travel limit switch (+)	Limits rotation in the plus direction.
	OTM	6	Travel limit switch (–)	Limits rotation in the minus direction.
	—	7	(Do not connect.)	—
Output signal	DRDY	8	Driver Unit ready	This signal notifies that the Driver Unit is ready for operation. (This signal opens when the Driver Unit is not ready or an alarm is given.)
	—	9	(Do not connect.)	—
	COM	10	Output signal, common	Output signal, common

3.4 Cable Set

Example of Reference Number: **M-C** **004** **SCP** **03**

- M-C: Cable set
- 004: Cable length — Example: 004: 4m
- SCP: EDC Driver Unit
- 03: Cable (for fixed use) / 13: Flexible cables

For an appropriate length, refer to “9.1 PS Series Combinations.”



Cable bend radius (for both motor cable and resolver cable)

	Bend radius for fixed base	Bend radius for flexible base
Fixed cable	R43 or more	—
Flexible cable	R40 or more	R80 or more

3.5 Handy Terminal

Example of Reference Number: **M-FHT** **21**

- M-FHT: Handy Terminal
- 21: Serial number

Handy Terminal FHT21 is an easy-to-handle RS-232C communication terminal for inputting parameters and programs to the EDC Driver Unit. You just need to connect it to the CN1 connector of the driver unit.

- LCD screen: 20 letters × 4 lines, no external power source required, cable length: 3m

Conventional models M-FHT01 and M-FHT11 are also supported by the EDC Driver unit.

To select appropriate Megatorque Motors, examine the following data.

4.1 Loads on the Motor

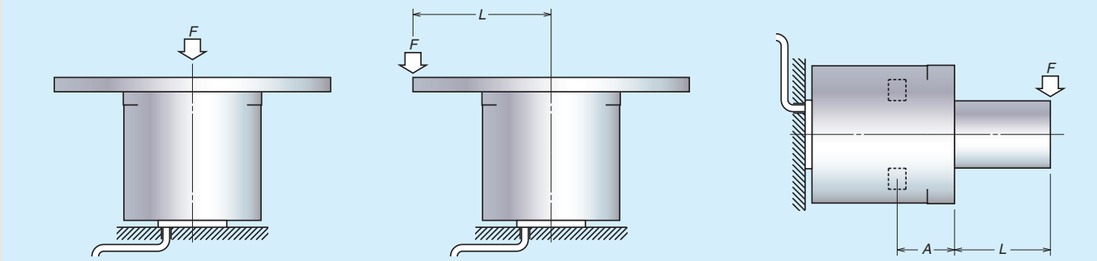
(① Load moment of inertia; ② Axial load, radial load, moment load; ③ Holding torque required during halts)

① Load moment of inertia *J*

When the Megatorque Motors System is used, the size of the load moment of inertia mounted to the motor body will significantly affect the acceleration/deceleration characteristics. Thus, calculation of the load moment of inertia *J* is required.

② Axial load, radial load, moment load

Calculate the load on the motor. The relationship between external force and load is represented in the following patterns. Ensure the axial load/radial load and the moment load are set within the limiting axial, radial and limiting moment loads. (Refer to the limiting values listed in “1. Motor Specifications for PS Series” on pages 5–6 of this catalog.)



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: $M = (F$ + total weight of jigs and works$) \times (L + A)$

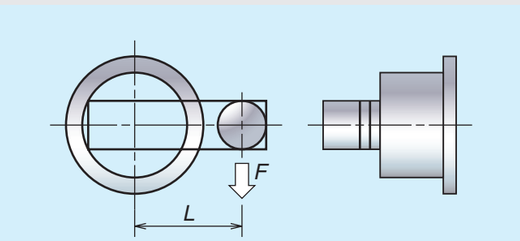
Motor size code	PS1006 PS1012 PS1018	PS3015 PS3030 PS3060 PS3090
A dimension [mm]	30.2	32.9

③ Holding torque size required during halts

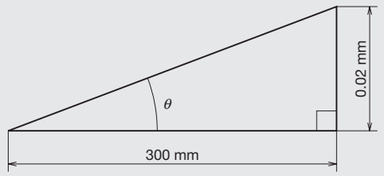
When the arm is halted at the following position, the torque, equal to $F \times L$, will be applied on the motor as a load torque. Therefore, the rated torque of the motor, equal to or greater than the load torque, is required.

4.2 Positioning Accuracy

The positioning accuracy of the Megatorque Motors System is classified into the following types:
① Absolute accuracy: 90 [arc sec] (interchangeable combination)
② Repeatability: ±2 [arc sec]



[Example 1]
We examine the compatibility of PS1 type and PS3 type, assuming a required repeatability of ±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]
Therefore, ±14 > ±2.
Both PS1 and PS3 types can be used in terms of the positioning accuracy.



4.3 Positioning Time (Index Time)

When a Megatorque Motor is used to index an angle, index times 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 of the motor	[s⁻¹]
T	: Output torque at the rotational speed N	[N · m]
T_m	: Load torque	[N · m]
t_1	: Command time	[s]
t_2	: Settling time	[s]
t_3	: Positioning time	[s]
Δt	: Accelerating/decelerating time	[s]
θ	: Rotational angle	[°]
η	: Safety coefficient (normally 1.5)	

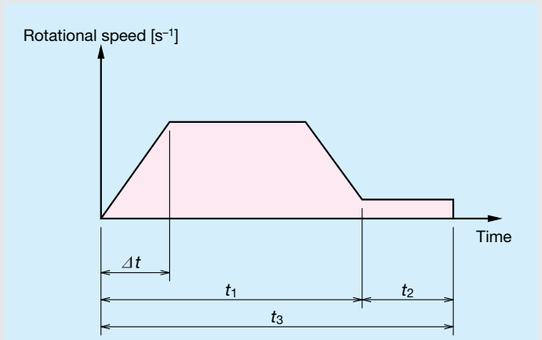
In accordance with the list above,

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

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

$$t_3 = t_1 + t_2$$

Where $T - T_m > 0$, and $2 \times \Delta t \leq t_1$



Please refer to the following table for the settling time. Since the settling time will also be affected by factors such as the magnitude of the load moment of inertia and rigidity of the whole structure, the settling time is not absolute.

Required repeatability [arc sec]	Settling time t_2 [s]
±2 to ±10	0.1
±10 to ±100	0.04
±100 and above	0.001

4.4 Selection of Regenerative Resistance

① The rotational energy of a Megatorque Motor during deceleration is obtained.
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 by the internal capacitors
The regeneration energy that can be disposed of by the internal capacitors is 28 [J] (200 [VAC]).

③ Calculate energy consumed by external regenerative resistance:
Energy consumed by external regenerative resistance [J] = Rotational energy [J] – 28 [J] capacitor absorption energy.
When the difference is zero or less, no external regenerative resistance is necessary.
When the difference is greater than zero, use the following procedure to obtain the required capacity for an external regenerative resistor.

④ Calculate required capacity for an external regenerative resistor:
Required capacity for an external regenerative resistor [W] = Energy consumed by external regenerative resistance [J] / (Operation cycle [s] × 0.25).
0.25: Load ratio of regenerative resistance use
When the quotient is 1.75 or less, use external regenerative resistor (M-E014DCKR1-100, sold separately).
When the quotient is 30 or less, use external regenerative resistor (M-E014DCKR1-101, sold separately).

4.5 Effective Torque Calculations

When selecting a PS Series Megatorque Motor, it is necessary to consider the maximum required torque and the effective torque required for the actual operation.
Here, we examine a motor that can rotate 90° in 0.2 [s], assuming that the load moment of inertia is 0.05 [kg · m²]. We will also calculate the effective torque when a standard operation cycle is 0.6 [s].

Conditions: Maximum rotational speed = 2.5 [s⁻¹]
Rotational acceleration = 25 [s⁻²]
Repeatability = ± 2 arc sec
Stopping time = 0.09 [s]
J_m (load moment of inertia) = 0.05 [kg · m²]
J_r (moment of inertia of the rotor) = 0.019 [kg · m²] (for PS3060)

- Since the rotational acceleration is 25 [s⁻²], we calculate the approximate required torque using the following equation.
  Required torque* = (load moment of inertia + moment of inertia of the rotor) × angular acceleration
  $= (0.05 + 0.019)\ 2\pi \times 25$
  $= 10.8$ [N · m]
  Therefore, the candidate selection is a motor with a maximum output torque of 10.8 [N · m] or larger.
  The PS1 type (excluding PS1006) or PS3 type can be selected.
  *Since the moment of inertia of the rotor of the motor varies depending on the motor, the required torque needs to be recalculated for each motor.

- The effective torque required for the actual operational pattern in use (see the following diagram) needs to be examined. Here, we will determine whether the PS3060 meets the operational conditions.

Equations:
$T1$: Torque at accelerating [N · m]
$T2$: Dynamic friction torque [N · m]
$T3$: Torque at decelerating [N · m]
J_m: (Load moment of inertia) = 0.05 [kg · m²]
J_r: (Rotor moment of inertia) = 0.019 [kg · m²]
α: Rotational acceleration [s⁻²] = 25 [s⁻²]
η: Safety coefficient = 1.3

Dynamic friction torque [N · m]

PS1 type	PS3 type
0.7	2.0

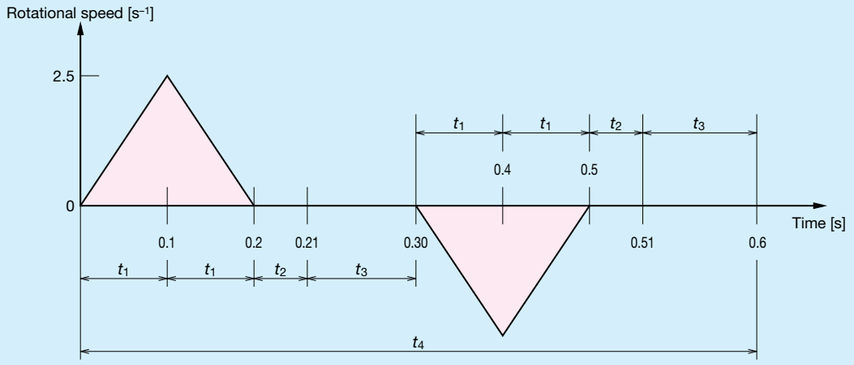
Torque at accelerating $T1 = \eta\,(J_m + J_r) \times \alpha + T2 = 1.3 \times (0.05 + 0.019) \times 2\pi \times 25 + 2.0 = 16.1$ [N · m]
Torque at decelerating $T3 = \eta\,(J_m + J_r) \times \alpha - T2 = 1.3 \times (0.05 + 0.019) \times 2\pi \times 25 - 2.0 = 12.1$ [N · m]

t_1 = accelerating/decelerating time = 0.1 [s], t_2 = settling time = 0.01 [s],
t_3 = stopping time = 0.09 [s], t_4 = cycle time $t_1 \times 4 + t_2 \times 2 + t_3 \times 2 = 0.6$ [s]

$$\text{Effective torque} = \sqrt{\frac{\{(T1)^2 \times t_1 + (T3)^2 \times t_1\} \times 2}{t_4}} = 11.6 \text{ [N·m]}$$

Rotational energy = $1/2 \times J \times (2\pi N)^2 = 1/2 \times (0.05 + 0.019) \times (2\pi \times 2.5)^2 = 8.5$ [J]

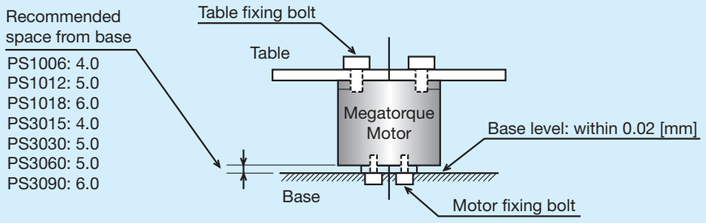
The effective torque is 11.6 [N · m], which is less than the PS3060's rated output torque of 20 [N · m].
Therefore, the PS3060 sufficiently meets the operational conditions. External regenerative resistance is not necessary.



5. Installation

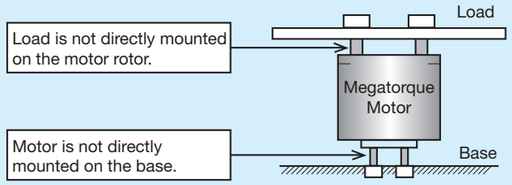
5.1 Installation of Motor

- Install and secure the motor on a solid base otherwise, mechanical vibrations will be produced.
- Attach the motor on the base using the tapped mounting holes on the underside of the motor.
- The mounting surface should be level within 0.02 [mm].
- The motor can be attached either horizontally or vertically.
- Take care not to push up the underside cover when attaching the motor.
- Refer to the figure below for recommended space.
- Do not use the leads of a motor cable or a resolver cable when transferring motor. The bend radius of leads should be at least R30 [mm].



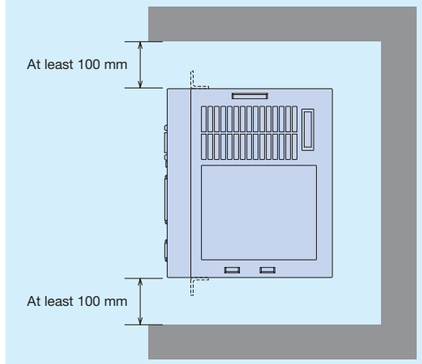
Note: If a motor is installed as indicated in the figure below, mechanical vibrations will be produced and the velocity loop proportional gain (VG) of the motor cannot be improved. Therefore, the ability to secure the motor at a stop position is weakened, resulting in overshoot. Since smooth motor operation cannot be expected under this configuration, the following countermeasures must be taken.

- Directly mount load on the motor rotor (or add dummy inertia).
- Directly mount motor on the base.



5.2 Installation of Driver Unit

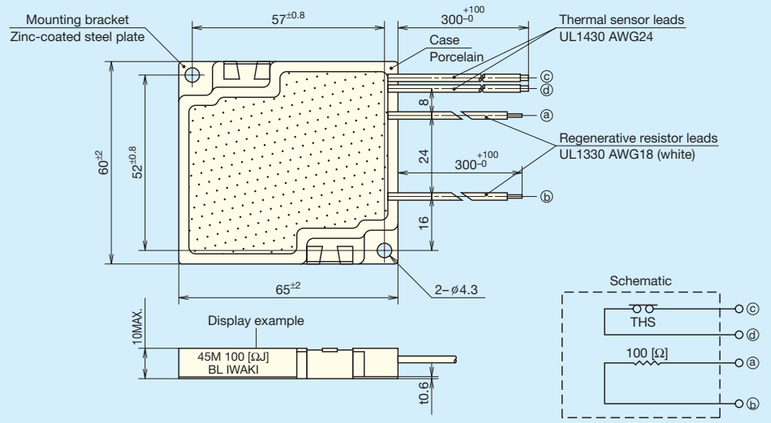
- Make sure that EDC Driver Unit is installed in a vertical position. EDC Driver Unit is naturally air cooled, so the fin should be in a vertical position.
- Ambient temperatures should be in a range from 0 to 50 [°C]. EDC Driver Unit cannot be used in high temperatures in excess of 50 [°C]. A sufficient space of at least 100 [mm] should be provided both above and below the driver unit on a control board.
  Operate the driver unit in an environment in which internally generated heat can be dissipated. If heat is trapped above the driver unit, open the space above the driver unit to permit the heat to dissipate (in this case, also take steps to prevent the entry of dust) or provide a forced-air cooling system.
- Use EDC Driver Unit on control boards of level IP54 or higher. Protect the driver unit from exposure to oil mist, cutting water, cutting dust, coating gas, etc., to prevent their entry into the driver unit through ventilation openings, which may cause circuit failure.
- When two or more driver units are arranged in a row, as in the case of multi-axis combinations, adjacent driver units must be separated by a space of at least 10 [mm].
- EDC Driver Unit can be attached to a panel using mounding hardware (sold separately).
- The EDC Driver Unit draws a maximum of 55 [W].



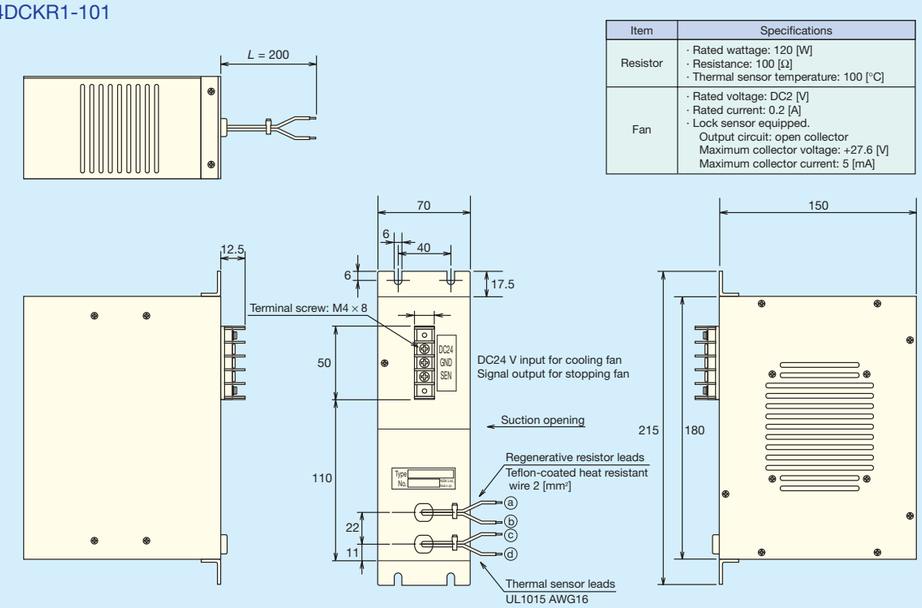
6. Regenerative Resistance (M-E014DCKR1-100·101)

6.1 Dimensions and Schematics

M-E014DCKR1-100



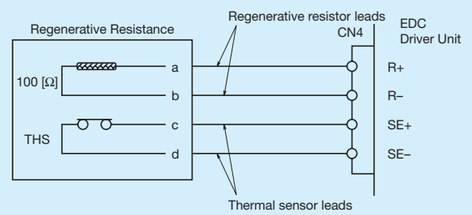
M-E014DCKR1-101



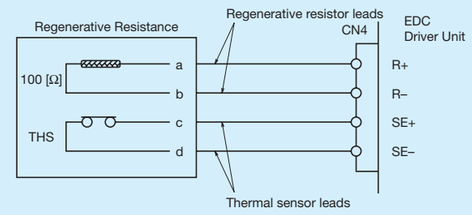
Item	Specifications
Resistor	· Rated wattage: 120 [W] · Resistance: 100 [Ω] · Thermal sensor temperature: 100 [°C]
Fan	· Rated voltage: DC2 [V] · Rated current: 0.2 [A] · Lock sensor equipped. Output circuit: open collector Maximum collector voltage: +27.6 [V] Maximum collector current: 5 [mA]

6.2 Connection to EDC Driver Unit

M-E014DCKR1-100



M-E014DCKR1-101

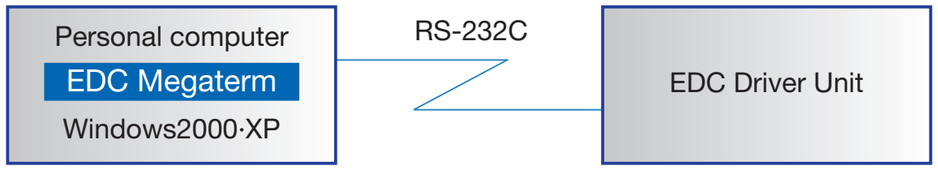


7. EDC Megaterm Application Software

Once installed into your personal computer, this software allows the editing, preparation and control of EDC Driver Unit programs and parameters. The software also facilitates the allocation and monitoring of control input/output. Its oscilloscope function permits motor operation to be easily confirmed.

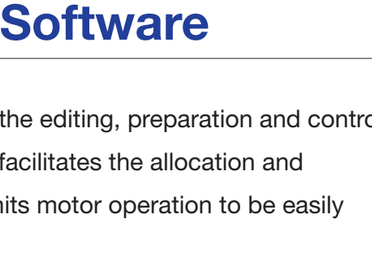
EDC Megaterm can be obtained as a free download from the NSK Web site.
(http://www.jp.nsk.com/tech-support/seiki/appli/003_medc.html) (in Japanese)

RS-232C communication cable is available as an option.
Type: M-C003RS03 (cable length: 3 [m])



Functions

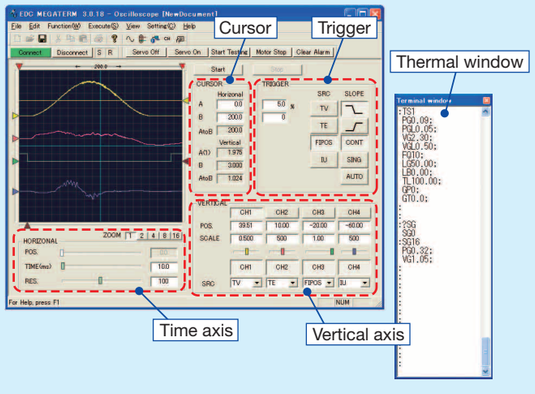
1. Oscilloscope function
2. Allocation and monitoring of control input/output
3. Parameter edits
4. Channel edits
5. Others:
   - Upload/download parameter and channel data
   - Terminal



Main functions

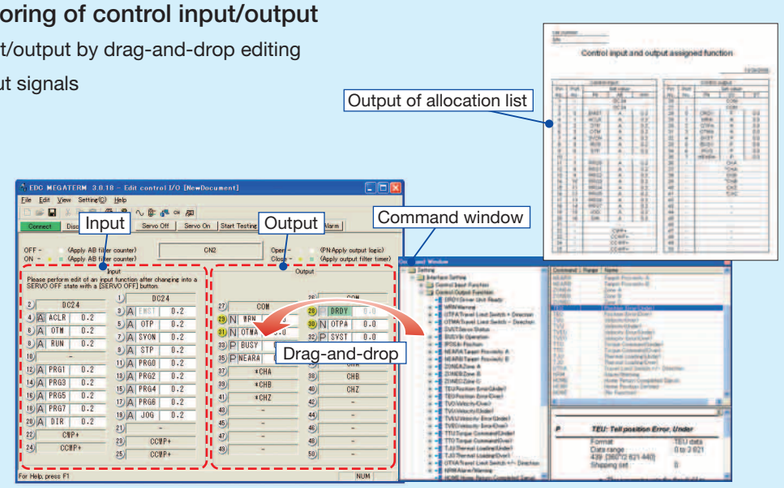
1. Oscilloscope function

- 4-channel oscilloscope, 10 [k sampling/s] maximum
- Anything that can be monitored using the handy terminal can be displayed on the oscilloscope
- Monitor scale is adjustable
- Measured waveforms are output as bitmaps in CSV format



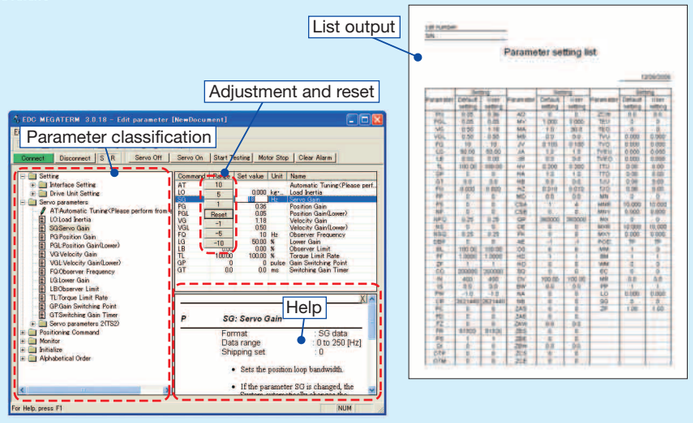
2. Allocation and monitoring of control input/output

- Allocation of control input/output by drag-and-drop editing
- Monitoring of input/output signals
- Output of allocation lists



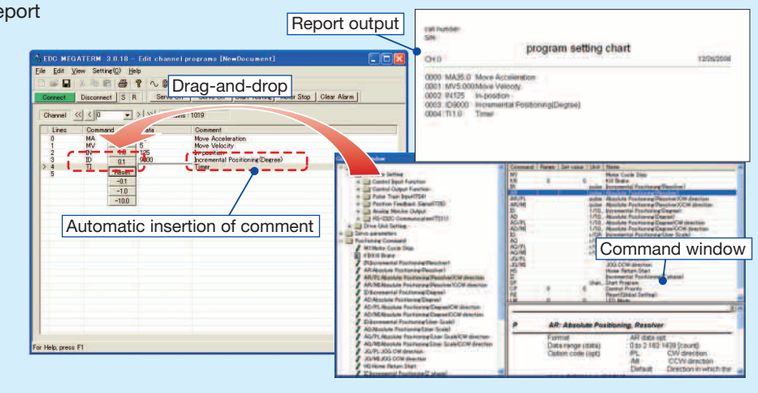
3. Parameter edits

- Parameter edits take effect in real time (Off-line editing is supported)
- Parameter-by-parameter reset to default
- Help function for parameters
- Output of parameter settings



4. Channel edits

- Drag-and-drop edits from command window
- Direct input capability also supported (automatic insertion of comments)
- Output of program setting report



8. International Safety Standards and Warranty Information

CE Marking

- **Low voltage command (applicable standard: EN50178)**
  PS Series Megatorque Motors are incorporated into machinery as components. NSK set low voltage standards to ensure the PS Series Megatorque Motors fully comply with the EC Directive. The standards have been certified by TÜV, a third-party testing and certification organization.
- **EMC command (applicable standards: EMI EN55011 and EMS EN61000-6-2)**
  NSK defined installation models (conditions) for PS Series Megatorque Motors, including installation space and wiring between driver units and motors, and set EMC command standards based on 4m cable models, which have been certified by TÜV, a third-party testing and certification organization.
  When PS Series Megatorque Motors are incorporated into machinery, real-world installation and/or wiring conditions may differ from those of established models. Therefore, it is necessary to check for EMC command compliance (especially radiation and conduction noise) in the machinery incorporating the PS Series Megatorque Motors.

Compliance with UL Standards

- **Motor**
  Compliant with UL1004 (File No.: E216970)
- **Driver unit**
  Compliant with UL508C (File No.: E216221)
- **Cable set**
  UL-compliant cables are used

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 the expiration of the applicable warranty period will be subject to payment.**

Exemption Clause

- **The warranty will not apply to any of the following cases:**
  · Failure due to work and operation performed not in accordance with the instruction manual designated by the supplier
  · Failure due to improper handling, misuse, modification or careless operation performed by the user
  · Failure resulting from causes not attributable to the supplier
  · Failure caused by modification or repair made by anyone other than the supplier
  · Failure resulting from causes beyond the reasonable control of the supplier, including natural disasters or other accidents
- **The warranty is limited to delivered units and the supplier shall not be liable for any incidental or consequential damage which may be caused by the failure of delivered units.**

Services Charges

- **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.**
- **Service charges will be invoiced in accordance with the supplier's standard service charge list.**

Announcement of production discontinuation and maintenance service period after discontinuation

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

9. Combinations

9.1 PS Series Combinations

Motor Outer Diameter	Motor Reference Number	Driver Unit Reference Number Refer to "2.1 Coding for Driver Unit Reference Number"	Power Voltage	Cable Reference Number	Main Specifications
ϕ100	M-PS1006KN002	M-EDC-PS1006AB502✻✻✻	AC200–AC230 [V]	M-C0✻✻SCP03 (Fixed cable) M-C0✻✻SCP13 (Flexible cable) ✻✻indicates cable length 01: 1 [m] 02: 2 [m] 03: 3 [m] 04: 4 [m] 05: 5 [m] 06: 6 [m] 08: 8 [m] 10: 10 [m] 15: 15 [m] 20: 20 [m] 30: 30 [m]	Internal program 256 channels Pulse train input (Opto-coupler)
		M-EDC-PS1006CB502✻✻✻	AC100–AC115 [V]		
	M-PS1012KN002	M-EDC-PS1012AB502✻✻✻	AC200–AC230 [V]		
		M-EDC-PS1012CB502✻✻✻	AC100–AC115 [V]		
	M-PS1018KN002	M-EDC-PS1018AB502✻✻✻	AC200–AC230 [V]		
		M-EDC-PS1018CB502✻✻✻	AC100–AC115 [V]		
ϕ150	M-PS3015KN002	M-EDC-PS3015AB502✻✻✻	AC200–AC230 [V]		
		M-EDC-PS3015CB502✻✻✻	AC100–AC115 [V]		
	M-PS3030KN002	M-EDC-PS3030AB502✻✻✻	AC200–AC230 [V]		
		M-EDC-PS3030CB502✻✻✻	AC100–AC115 [V]		
	M-PS3060KN002	M-EDC-PS3060AB502✻✻✻	AC200–AC230 [V]		
		M-EDC-PS3060CB502✻✻✻	AC100–AC115 [V]		
	M-PS3090KN002	M-EDC-PS3090AB502✻✻✻	AC200–AC230 [V]		
		M-EDC-PS3090CB502✻✻✻	AC100–AC115 [V]		
ϕ100	M-PS1006KN002	M-EDC-PS1006ABC02✻✻✻	AC200–AC230 [V]		CC-Link compatible Internal program 256 channels
		M-EDC-PS1006CBC02✻✻✻	AC100–AC115 [V]		
	M-PS1012KN002	M-EDC-PS1012ABC02✻✻✻	AC200–AC230 [V]		
		M-EDC-PS1012CBC02✻✻✻	AC100–AC115 [V]		
	M-PS1018KN002	M-EDC-PS1018ABC02✻✻✻	AC200–AC230 [V]		
		M-EDC-PS1018CBC02✻✻✻	AC100–AC115 [V]		
ϕ150	M-PS3015KN002	M-EDC-PS3015ABC02✻✻✻	AC200–AC230 [V]		
		M-EDC-PS3015CBC02✻✻✻	AC100–AC115 [V]		
	M-PS3030KN002	M-EDC-PS3030ABC02✻✻✻	AC200–AC230 [V]		
		M-EDC-PS3030CBC02✻✻✻	AC100–AC115 [V]		
	M-PS3060KN002	M-EDC-PS3060ABC02✻✻✻	AC200–AC230 [V]		
		M-EDC-PS3060CBC02✻✻✻	AC100–AC115 [V]		
	M-PS3090KN002	M-EDC-PS3090ABC02✻✻✻	AC200–AC230 [V]		
		M-EDC-PS3090CBC02✻✻✻	AC100–AC115 [V]		

9.2 Accessories (sold separately)

Item	Reference number	Contents		
Connector	M-E014DCFS1-001	CN2 connector (user side) for standard type	Connector: Connector shell:	54306-5011 (Molex) 54331-0501 (Molex)
	M-E014DCFS1-006	CN2 connector (user side) for CC-Link type	Connector:	DHA-PDA10-3-A01 (DDK)
	M-E014DCFS1-002	CN5 connector (user side)	Connector: Wiring lever:	231-305/026-000 (WAGO) 231-131 (WAGO)
	M-E014DCFS1-003	CN6 connector (user side)	Connector:	MSTB2, 5/5-STF-5, 08AU (Phoenix Contact)
	M-E011DCCN1-001	Cable with CN2 connector for CC-Link type		
Mounting bracket	M-E050DCKA1-001	Driver unit mounting bracket		
Manual*	M-E099DC0C2-155	Manual in Japanese		
	M-E099DC0C2-158	Manual in English		
	M-E099DC0C2-156	Manual in Japanese (CC-Link Type)		
External dump resistor	M-E014DCKR1-100	External regenerative resistor		
	M-E014DCKR1-101	External regenerative resistor (large capacity)		

*Manuals can be downloaded from the NSK Web site.
http://www.jp.nsk.com/tech-support/seiki/manual/index.html (in Japanese)

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