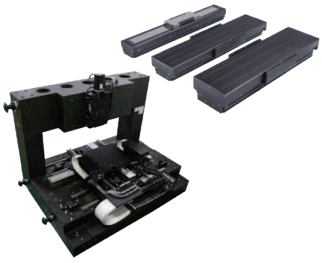
HIWIN® MIKROSYSTEM

Direct Drive Motor

Technical Information

www.hiwinmikro.tw

HIWIN® INDUSTRIE 4.0 Best Partner



Linear Motor Stage

Semiconductor / Precision /
Automated Transport /
Automated Optical Inspection (AOI)

- Planar Servo Motor
- Air Bearing Platform
- X-Y Stage
- Gantry Systems
- Single-Axis Linear Motor Stage

Linear Motor

Machine Tool / Semiconductor /
Touch Panel / Laser Manufacturing
Machine / Glass Cutting Machine

- Iron Core Linear Motor--LMSA, LMSA-Z, LMFA, LMFC, LMFP Series
- Ironless Linear Motor--LMC Series
- Tubular Motor--LMT Series

Torque Motor & Direct Drive Motor

Machine Tools / Semiconductor /
Lithium-ion Battery /
Laser Marking / Wafer Dicing

- Torque Motor--
  TM-2 / IM-2, TMRW Series

Display / Automation / Semiconductor /
Lithium-ion Battery / Robot / Laser Marking /
Automated Optical Inspection (AOI) Industry

- Direct Drive Motor--
  DMS, DMY, DMN, DMT Series

Controller / Drive / AC Servo Motor

PCB / Display / Machine Tools /
Semiconductor / Automated / Food /
Automated Optical Inspection (AOI)
Industry

- Controller--HIMC
- Drive--E1, E2, D1, D2T Series
- AC Servo Motor--
  E1 Series, FR Series, abi Series

Linear Actuator / Servo Actuator

Medical / Automation /
Electric Servo Press /
Barrier-free Equipment Industry

- Servo Actuator--LAA Series
- Linear Actuator--LAM, LAS, LAN, LAC Series

Position Measurement System

PCB / Woodworking / Automation /
Warehouse Automation Programmable
Industry

- High Resolution--PM-A, PM-B, PM-C
- Signal Translator
- High Performance Counter

Semiconductor Subsystem

Semiconductor / LED / Panel

- EFEM
  (Equipment Front End Module)
- Wafer Robot
- Loadport
- Wafer Aligner

Multi-Axis Robot

Pick-and-Place / Assembly /
Array and Packaging / Semiconductor /
Electro-Optical Industry /
Automotive Industry / Food Industry

- Articulated Robot
- SCARA Robot
- Electric Gripper
- Integrated Electric Gripper

Single-Axis Robot

Precision / Semiconductor /
Medical / FPD

- KK, SK
- KS, KA
- KU, KE, KC

Torque Motor Rotary Table

Medical / Automotive Industry /
Machine Tools / Machinery Industry

- RAB Series
- RAS Series
- RCV Series
- RCH Series

Ballscrew

Precision Ground / Rolled

- Super S Series
- Super T Series
- Mini Roller
- Ecological & Economical Lubrication Module E2
- Rotating Nut (R1)
- Energy-Saving & Thermal-Controlling (Cool Type)
- Heavy Load Series (RD)
- Ball Spline

Linear Guideway

Automation / Semiconductor / Medical

- Ball Type--HG, EG, WE, MG, CG
- Quiet Type--QH, QE, QW, QR
- Other--RG, E2, PG, SE, RC

Configurator Chart

Series	External diameter (mm)	Hollow shaft diameter (mm)	Encoder type	Spec page	Dimensions page	Peak torque(Nm)																				Drive	Accessories
						0.96	1.92	4.2	8.4	9	12	18	24	30	40	45	60	75	90	120	141	150	180	225	282	300	450		
DMY	110	35	Absolute	P.11	P.11						DMY44-B		DMY48-B															
	170	45	Absolute	P.12	P.12								DMY63-B			DMY65-B		DMY68-B									E1	P.46
	280	50	Absolute	P.13	P.13													DMYA3-B				DMYA5-B			DMYAA-B			
	110		Incremental																									
	170	45	Incremental	P.14	P.14								DMY63-5			DMY65-5		DMY68-5								E1/D1	P.47/P.54
	280	60	Incremental	P.15	P.15													DMYA3-5				DMYA5-5			DMYAA-5			
DMN	65	12	Absolute	P.22	P.19	DMN21-A	DMN22-A																					
	118	12	Absolute	P.22	P.20			DMN42-A	DMN44-A																			
	160	35	Absolute	P.22	P.21						DMN71-B															E1	P.46
	212	50	Absolute	P.22	P.21										DMN93-B												
	65	12	Incremental	P.26	P.23	DMN21-2	DMN22-2																					
	118	12	Incremental	P.26	P.24			DMN42-2	DMN44-2																			
	160	35	Incremental	P.26	P.25						DMN71-4															E1/D1	P.47/P.54
	212	50	Incremental	P.26	P.25										DMN93-5												

Configurator Chart

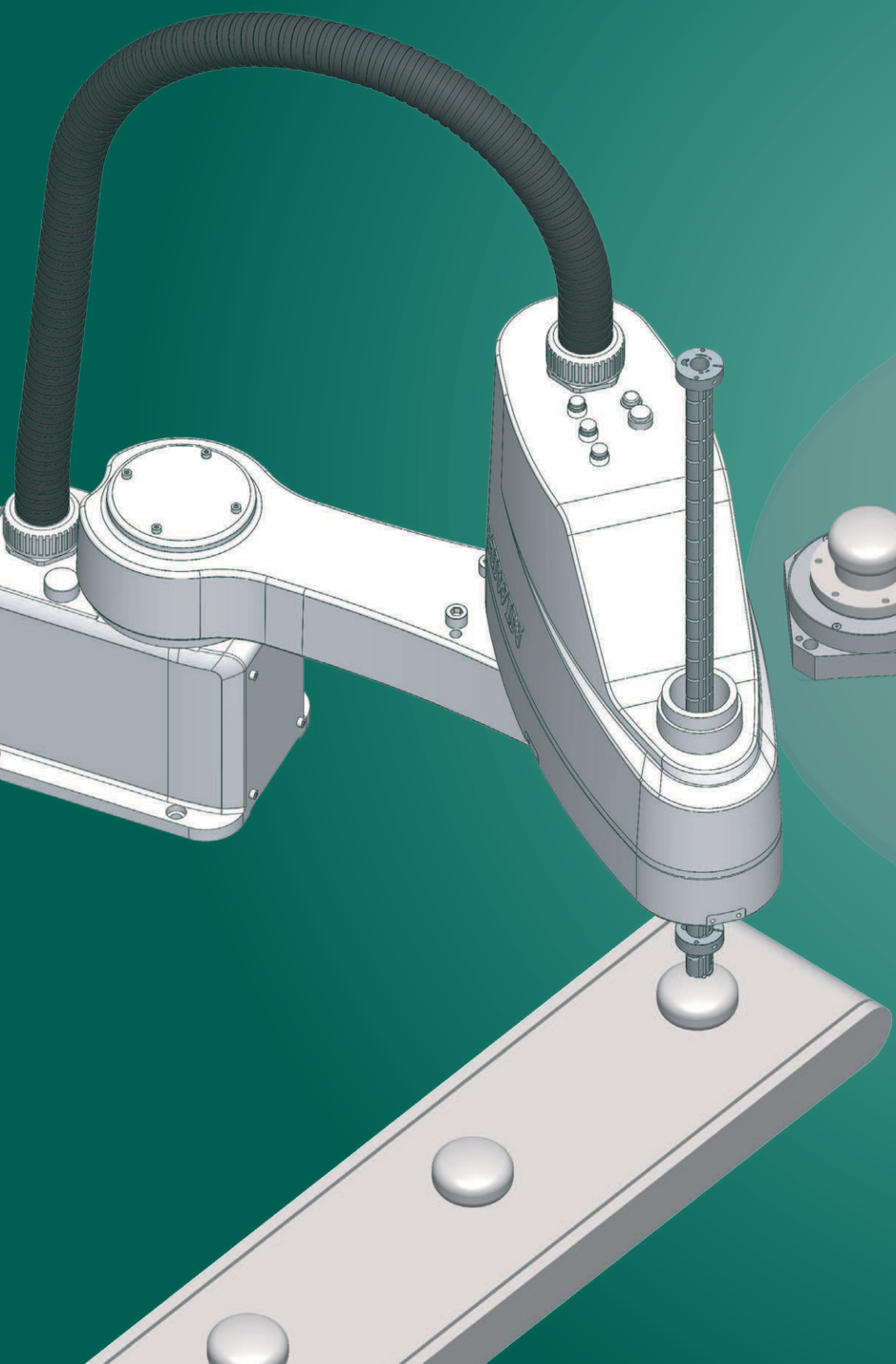
Series	External diameter (mm)	Hollow shaft diameter (mm)	Encoder type	Spec page	Dimensions page	Peak torque(Nm)																				Drive	Accessories
						0.96	1.92	4.2	8.4	9	12	18	24	30	40	45	60	75	90	120	141	150	180	225	282	300	450		
DMS	110	24	Incremental	P.29	P.29					 DMS03-4		 DMS07-4															E1/D1	P.47/P.54
	150	35	Incremental	P.30	P.30							 DMS12-5		 DMS14-5		 DMS16-5	 DMS18-5										
	200	60	Incremental	P.31	P.31												 DMS34-5			 DMS38-5			 DMS3C-5				
	300	104	Incremental	P.32	P.32																	 DMS74-6		 DMS76-6			 DMS7C-6	
DMT	290	140	Incremental	P.35	P.35									 DMTB2-0													E1/D1	-
	390	240	Incremental	P.35	P.35												 DMTF2-1											

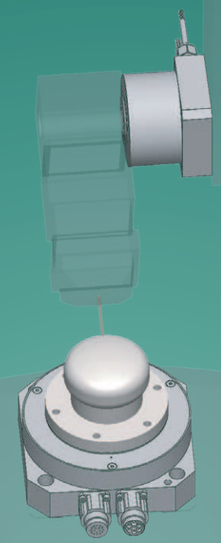
HIWIN® MIKROSYSTEM

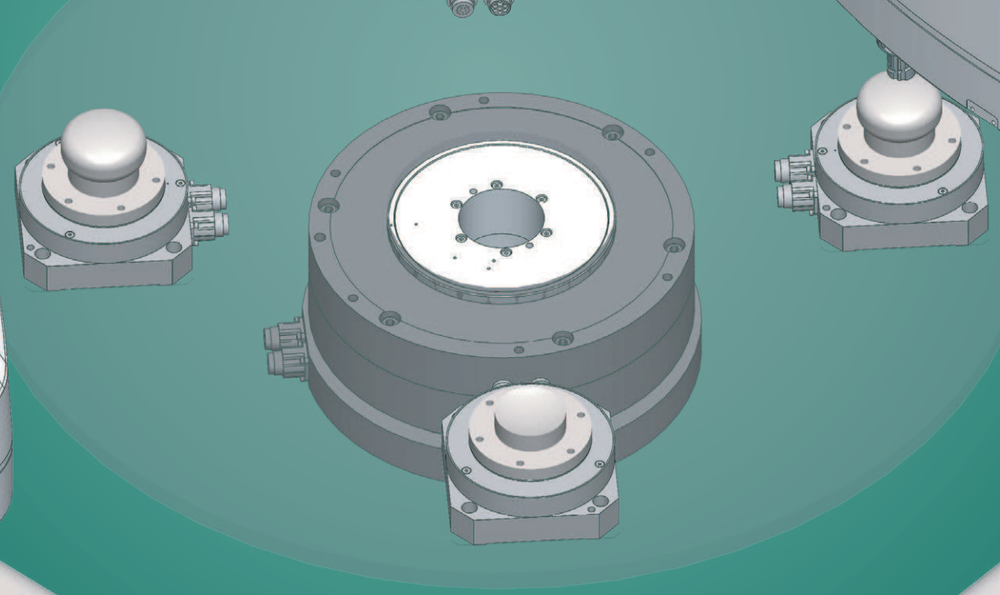
Direct Drive Motor - DM

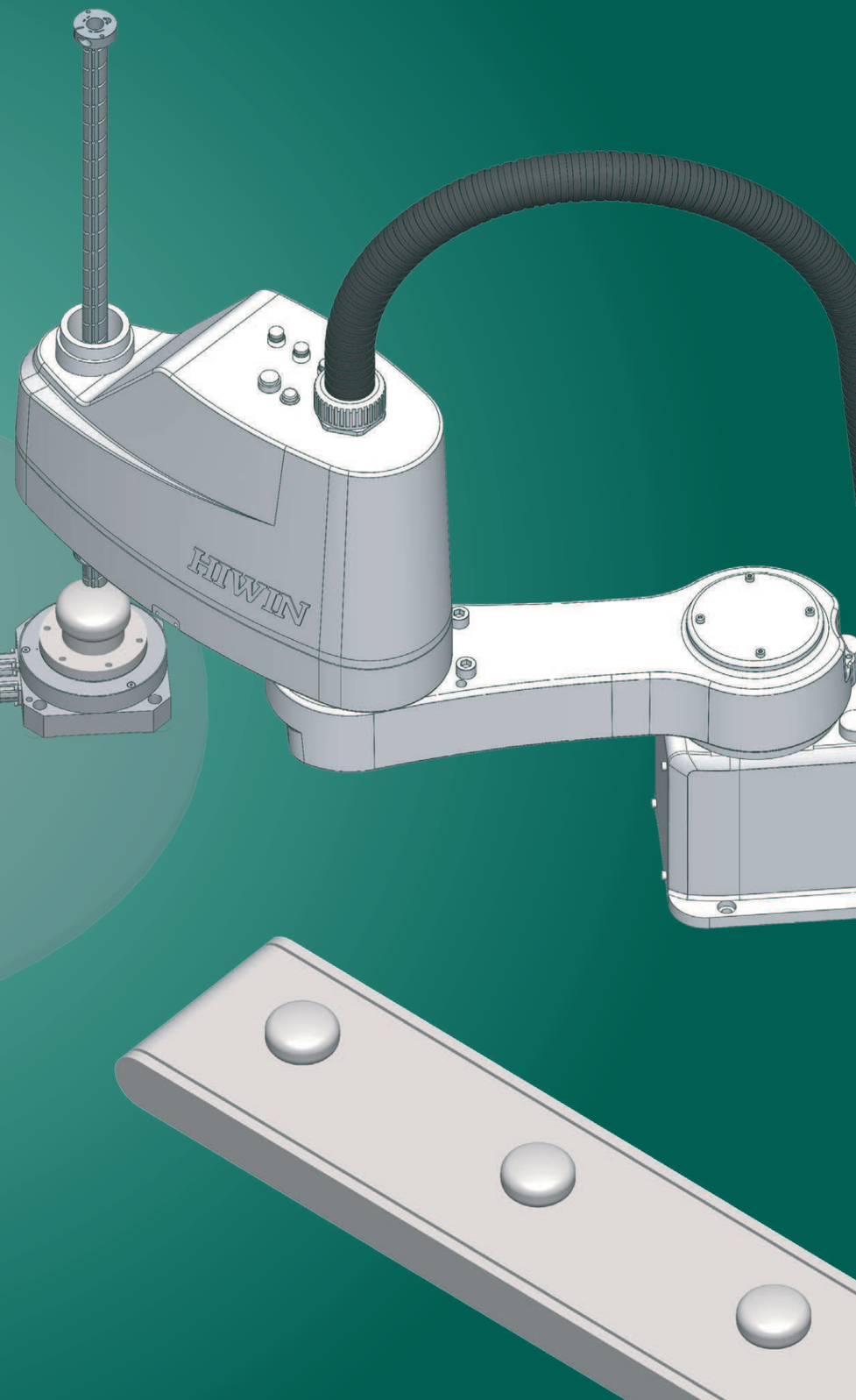
- Large torque output
- High precision performance
- Space saving design
- Free indexing application
- Maintenance free
- Hollow shaft design

Innovation in high-end direct drive technology









Direct Drive Motor - DM

Product Introduction and Application

HIWIN direct drive motors use direct drive design so reducers are not required. There is a highly rigid connection between the motor and load. Working with a servo drive, the motor can operate with outstanding acceleration and motion stability. HIWIN direct drive motors are especially suitable for tasks in automation because of the hollow shaft design. Cable systems and mechanical parts can be fed through without problems.

- No backlash
- Hollow shaft
- Maintenance free
- Compact and ultra-thin options available
- Brush-free drive
- Extremly rigid support with cross-roller brearing
- IP 65 available
- Integrated clamp is available as an option
- Hall sersor is available as an option

Applications

Classification	Application	Priority Performance Requirements					
		Accuracy	Speed	Rigidity	Compactness	Cleanliness	Maintenance Free
Production equipment	CVD, Wafer cleaning, ion Implantation	o			o	o	o
	Semi-conductor transport, Inspection/Processing	o			o	o	o
Assembly machines	Assembly machines for electric components	o	o		o	o	o
	High-speed assembly machines for electronic components	o	o		o	o	o
	Various assembly machines	o	o		o	o	o
Inspection / testing equipment	Machine part inspection	o			o		o
	Inspection of electric components	o			o		o
	Inspection of optical components	o			o		o
	Chemical analysis of liquids		o			o	o
	Various Inspection / testing equipment	o			o		o
Robots	Various assembly robots	o	o	o	o		o
	Various transport robots	o	o		o		o
	Inpsection/Transport robots in clean rooms	o	o		o	o	o

Contents

The best solution to upgrade mechanical transmission to direct drive design

Suitable for high speed moving and high precision application

Outer rotating series

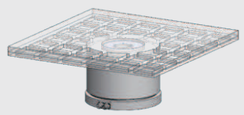
DMY Series

- Outer rotating structure
- Integrated high resolution incremental/absolute feedback system
- High dynamic, torque and precision
- Maximum torque: 12 ~ 300Nm
- Compatiable with special environments

Application
Laser machining and general industrial machinery.

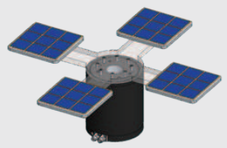
Glass substrate wire cutting and inspection

Large piece applications. Outer rotating structure allows optimization of inertia.



Laser machining, test and sorting

High speed acceleration and deceleration rotation. Outstanding motion profile.

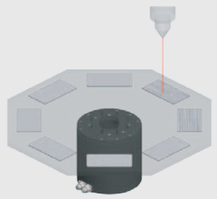


Inner rotating series

DMS Series

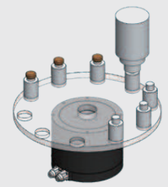
Semiconductor/ 3C electronics and laser application

Index position accuracy <2.5 arc-sec
Axial runout < 5μm



Small part assembly and inspection.

Multi-motion indexing function. Suitable for highly efficient and intensive production.



- Inner rotating structure
- High dynamic, torque and precision
- Maximum torque: 9.3 ~ 450Nm
- Meets IP65 enclosure standards as an option
- Integrated clamp is available as an option
- Hall sensor is available as an option

Application
Laser machining and general industrial machinery.

A low-profile model suitable for high precision micro processing

Suitable for high precision semiconductor manufacturing process

Low center of gravity and low profile series

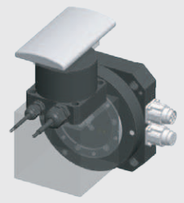
DMN Series

- Inner rotating structure
- Space saving design
- High resolution optical encoder
- Maximum torque: 0.96 ~ 39.6Nm

Application
Laser machining and 3C printing

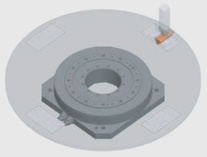
3C electronics and curved surface inspection

Space saving design. A perfect solution for small loading angle adjustment.



3C electronics and coating

Increase productivity and reduce production cycle. Large movement with outstanding accuracy.

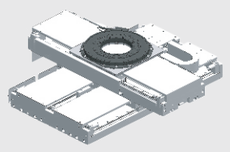


Low center of gravity and ultra-thin series

DMT Series

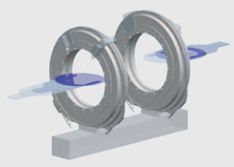
3C electronics and circuit printing

High-temperature endurance.
Hollow shaft>140mm.



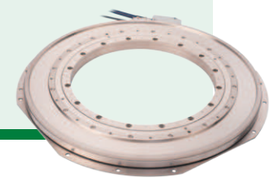
Semiconductor processing and laser application

High precision moving platform.
Axial runout <5μm



- Ultra-thin structure
- High resolution encoder
- No reduction mechanism needed
- Zero backlash
- Extremely rigid support with HIWIN cross-roller bearings
- Excellent positioning accuracy
- Low speed ripple

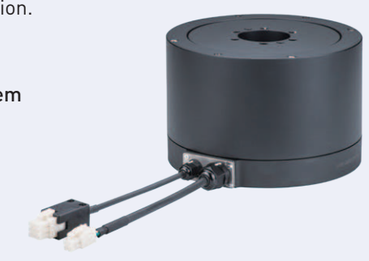
Application
AOI inspection and semiconductor processing.



DMY Series

The DMY series is designed with an integrated, high resolution feedback system which is optimized to achieve high dynamic motion, high torque and high precision. The DMY series is a perfect fit for industries that require high precision.

- Outer rotating structure
- Integrated high resolution incremental/absolute feedback system
- High dynamic, torque and precision
- Maxmum torque: 12 ~ 300Nm



Model Numbers for DMY Series

Motor Specification									Mechanical Specification								
DMY	6	3	-	B	0	S	N	0	0	-	S	0	-	1	S	S	-	0	-	0

Model

Encoder
B：20bits(ABS)
5：3600 lines(INC)

Hall Sensor
0：Without Hall sensor

Winding Code
S：Standard

Temperature Sensor
N：Without temperature sensor
P：PTC sensor

International Protection Standard
0：IP40

Function Code

Axial/Radial Runout
S：30μm/30μm(Standard)
P：5μm/30μm
A：5μm/15μm

Accuracy Compensation
0：Without compensation
1：±10 arc-sec
2：±5 arc-sec

Wire Length
0：No cable (Optical scale standard)
1：0.3m (ABS scale standard)

Connector Type
S：ABS scale standard (AMP joint)
A：Optical scale standard
(Intercontec M17 metallic joint)

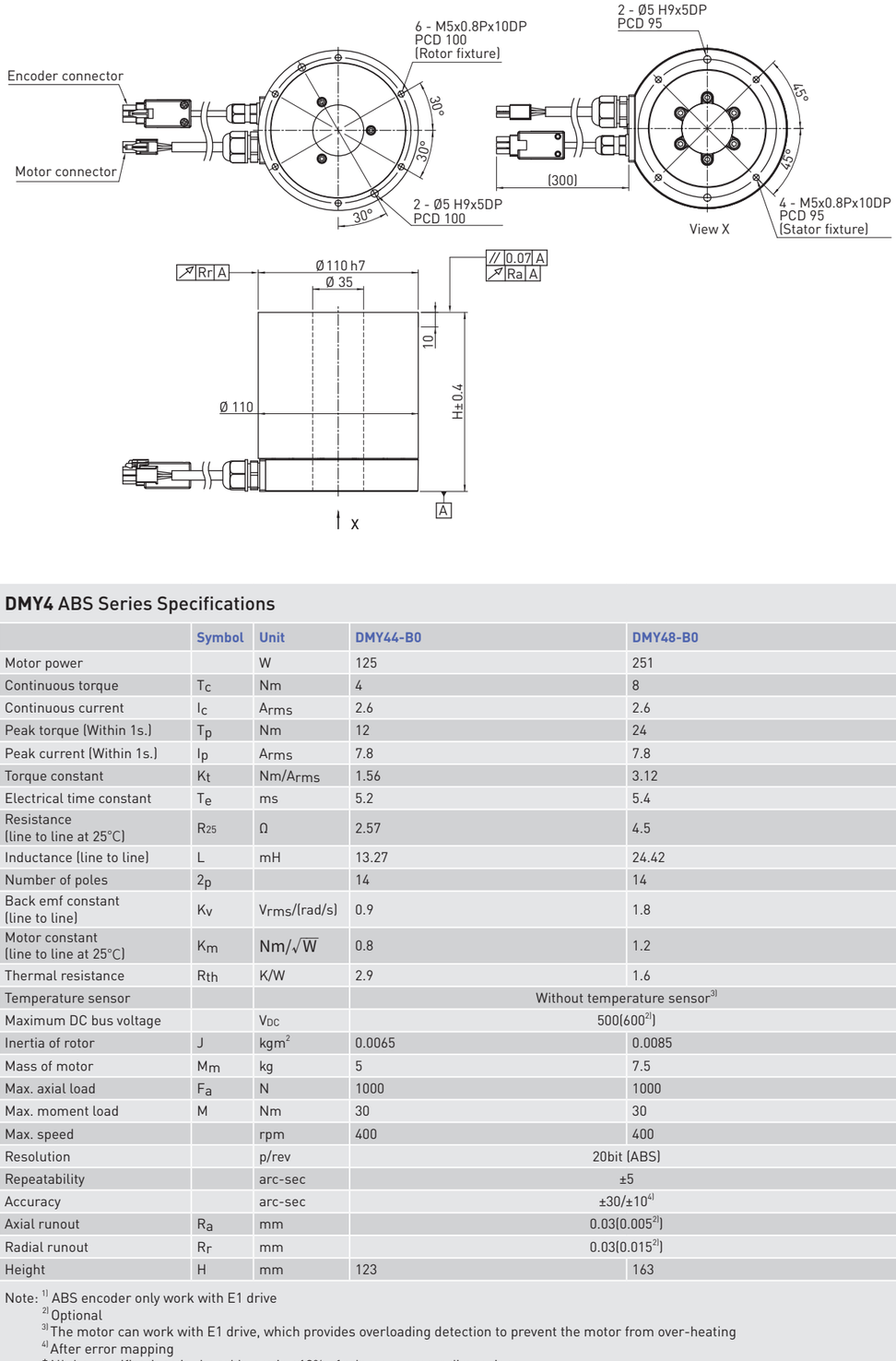
Positioning Pinhole
S：Standard
(According to the drawing)

Clamp
0:Without clamp
(Standard)

Reserved code

*Not suitable for environments with corrosive gas, cutting oils or metal powders.

DMY4 ABS Series Dimensions

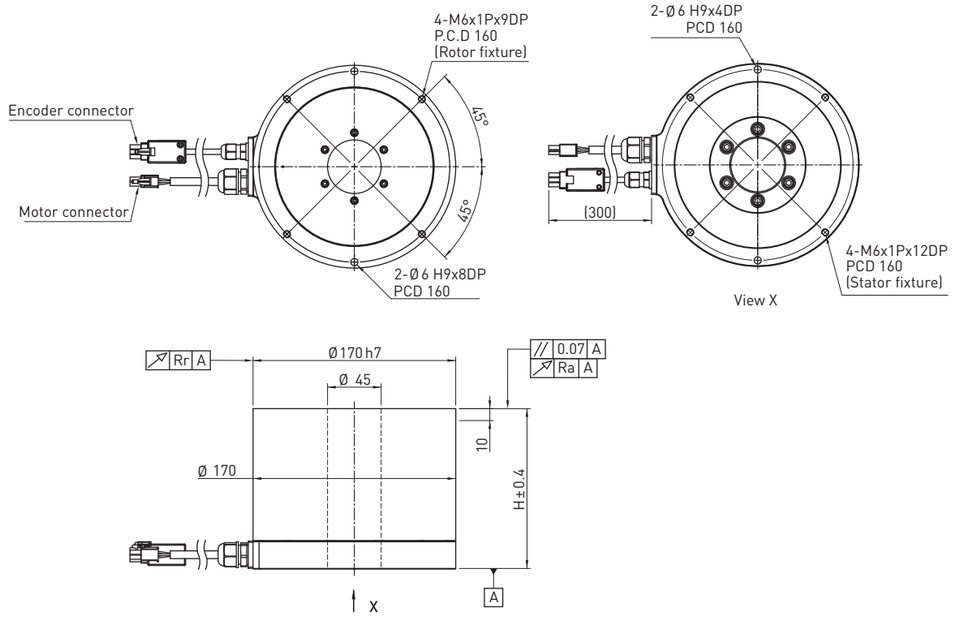


DMY4 ABS Series Specifications

	Symbol	Unit	DMY44-B0	DMY48-B0
Motor power		W	125	251
Continuous torque	T_c	Nm	4	8
Continuous current	I_c	A_{rms}	2.6	2.6
Peak torque (Within 1s.)	T_p	Nm	12	24
Peak current (Within 1s.)	I_p	A_{rms}	7.8	7.8
Torque constant	K_t	Nm/A_{rms}	1.56	3.12
Electrical time constant	T_e	ms	5.2	5.4
Resistance (line to line at 25°C)	R_{25}	Ω	2.57	4.5
Inductance (line to line)	L	mH	13.27	24.42
Number of poles	2_p		14	14
Back emf constant (line to line)	K_v	$V_{rms}/(rad/s)$	0.9	1.8
Motor constant (line to line at 25°C)	K_m	$Nm/\sqrt{W}$	0.8	1.2
Thermal resistance	R_{th}	K/W	2.9	1.6
Temperature sensor			Without temperature sensor[3]	
Maximum DC bus voltage		V_{DC}	500(600[2])	
Inertia of rotor	J	kgm^2	0.0065	0.0085
Mass of motor	M_m	kg	5	7.5
Max. axial load	F_a	N	1000	1000
Max. moment load	M	Nm	30	30
Max. speed		rpm	400	400
Resolution		p/rev	20bit (ABS)	
Repeatability		arc-sec	±5	
Accuracy		arc-sec	±30/±10[4]	
Axial runout	R_a	mm	0.03(0.005[2])	
Radial runout	R_r	mm	0.03(0.015[2])	
Height	H	mm	123	163

Note: [1] ABS encoder only work with E1 drive
[2] Optional
[3] The motor can work with E1 drive, which provides overloading detection to prevent the motor from over-heating
[4] After error mapping
*All the specifications in the table are in ±10% of tolerance except dimensions

DMY6 ABS Series Dimensions

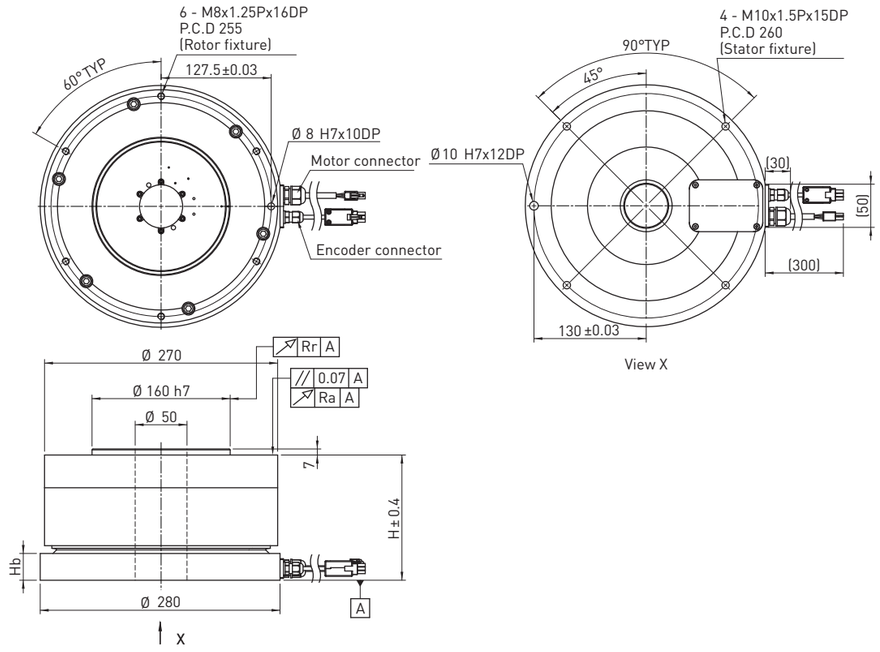


DMY6 ABS Series Specifications

	Symbol	Unit	DMY63-B0	DMY65-B0	DMY68-B0
Motor power		W	418	837	1005
Continuous torque	T_c	Nm	8	16	24
Continuous current	I_c	A_{rms}	3.8	3.8	3.8
Peak torque (Within 1s.)	T_p	Nm	24	48	72
Peak current (Within 1s.)	I_p	A_{rms}	12	12	12
Torque constant	K_t	Nm/A_{rms}	2.13	4.26	6.39
Electrical time constant	T_e	ms	5.7	6.3	6.5
Resistance (line to line at 25°C)	R_{25}	Ω	2	3.1	4.38
Inductance (line to line)	L	mH	11.4	19.4	28.26
Number of poles	2_p		16	16	16
Back emf constant (line to line)	K_v	V_{rms}/(rad/s)	1.2	2.5	3.7
Motor constant (line to line at 25°C)	K_m	$Nm/\sqrt{W}$	1.2	2	2.5
Thermal resistance	R_{th}	K/W	1.7	1.1	0.8
Temperature sensor			Without temperature sensor[3]		
Maximum DC bus voltage		V_{DC}	500(600[2])		
Inertia of rotor	J	kgm^2	0.019	0.026	0.033
Mass of motor	M_m	kg	7.7	10.7	14.7
Max. axial load	F_a	N	3700	3700	3700
Max. moment load	M	Nm	60	60	60
Max. speed		rpm	500	500	400
Resolution		p/rev	20bit (ABS)		
Repeatability		arc-sec	±5		
Accuracy		arc-sec	±25/±10[4]		
Axial runout	R_a	mm	0.03(0.005[2])		
Radial runout	R_r	mm	0.03(0.015[2])		
Height	H	mm	109.5	134.5	159.5

Note: [1] ABS encoder only work with E1 drive
[2] Optional
[3] The motor can work with E1 drive, which provides overloading detection to prevent the motor from over-heating
[4] After error mapping
*All the specifications in the table are in ±10% of tolerance except dimensions

DMYA ABS Series Dimensions

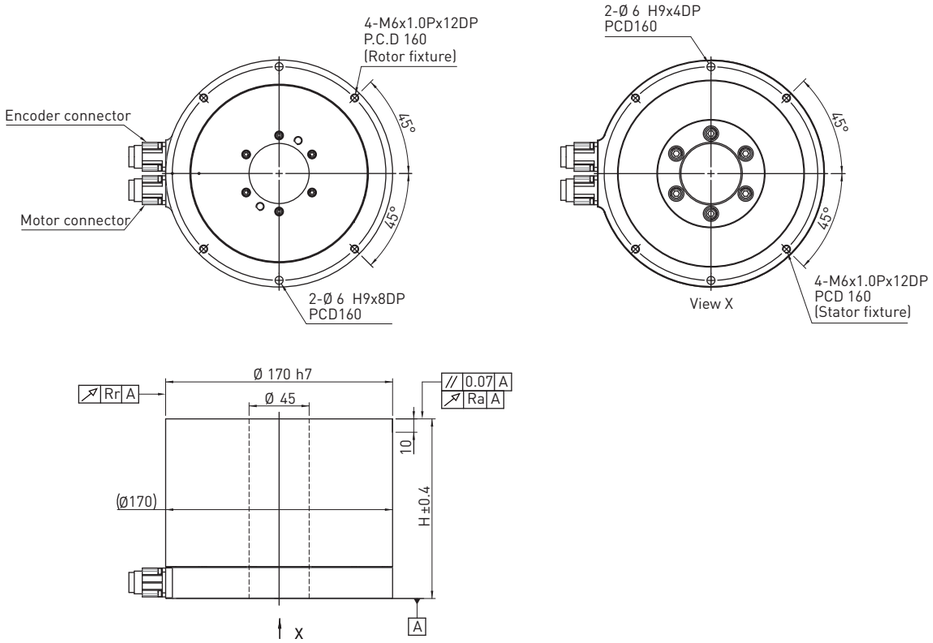


DMYA ABS Series Specifications

	Symbol	Unit	DMYA3-B0	DMYA5-B0	DMYAA-B0
Motor power		W	523	523	1047
Continuous torque	T_c	Nm	25	50	100
Continuous current	I_c	A_{rms}	2.2	2.2	4.4
Peak torque (Within 1s.)	T_p	Nm	75	150	300
Peak current (Within 1s.)	I_p	A_{rms}	6.6	6.6	13.2
Torque constant	K_t	Nm/A_{rms}	11.4	22.5	22.5
Electrical time constant	T_e	ms	11.3	12.8	13.3
Resistance (line to line at 25°C)	R_{25}	Ω	8.6	13.3	5.8
Inductance (line to line)	L	mH	97	170	77
Number of poles	2_p		22	22	22
Back emf constant (line to line)	K_v	V_{rms}/(rad/s)	6.6	13	13
Motor constant (line to line at 25°C)	K_m	$Nm/\sqrt{W}$	3.2	5	7.6
Thermal resistance	R_{th}	K/W	1.2	0.8	0.4
Temperature sensor			Without temperature sensor[3]		
Maximum DC bus voltage		V_{DC}	500(600[2])		
Inertia of rotor	J	kgm^2	0.254	0.32	0.44
Mass of motor	M_m	kg	45	54	71
Max. axial load	F_a	N	8000	8000	8000
Max. moment load	M	Nm	240	240	240
Max. speed		rpm	200	100	100
Resolution		p/rev	20bit (ABS)		
Repeatability		arc-sec	±5		
Accuracy		arc-sec	±25/±10[4]		
Axial runout	R_a	mm	0.03(0.005[2])		
Radial runout	R_r	mm	0.03(0.015[2])		
Height	H	mm	120	145	200
Height of base	H_b	mm	31		

Note: [1] ABS encoder only work with E1 drive
[2] Optional
[3] The motor can work with E1 drive, which provides overloading detection to prevent the motor from over-heating
[4] After error mapping
*All the specifications in the table are in ±10% of tolerance except dimensions

DMY6 INC Series Dimensions

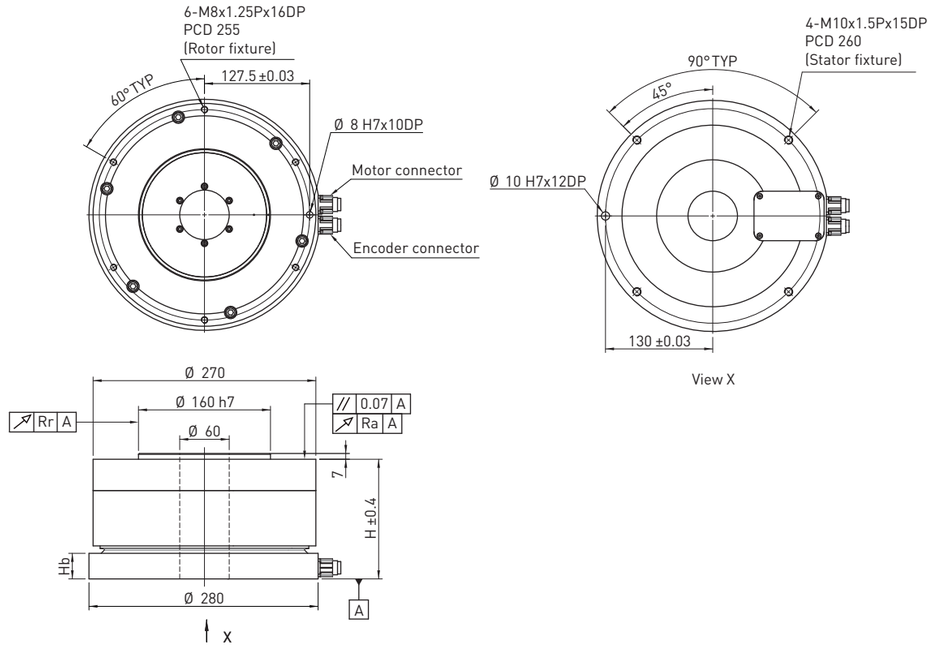


DMY6 INC Series Specifications

	Symbol	Unit	DMY63-50	DMY65-50	DMY68-50
Motor power		W	418	837	1005
Continuous torque	T_c	Nm	8	16	24
Continuous current	I_c	A_{rms}	3.8	3.8	3.8
Peak torque (Within 1s.)	T_p	Nm	24	48	72
Peak current (Within 1s.)	I_p	A_{rms}	12	12	12
Torque constant	K_t	Nm/A_{rms}	2.13	4.26	6.39
Electrical time constant	T_e	ms	5.7	6.3	6.5
Resistance (line to line at 25°C)	R_{25}	Ω	2	3.1	4.38
Inductance (line to line)	L	mH	11.4	19.4	28.26
Number of poles	2_p		16	16	16
Back emf constant (line to line)	K_v	$V_{rms}/(rad/s)$	1.2	2.5	3.7
Motor constant (line to line at 25°C)	K_m	$Nm/\sqrt{W}$	1.2	2	2.5
Thermal resistance	R_{th}	K/W	1.7	1.1	0.8
Temperature sensor			PTC SNM100		
Maximum DC bus voltage		V_{DC}	500(600[2])		
Inertia of rotor	J	kgm^2	0.019	0.026	0.033
Mass of motor	M_m	kg	7.7	10.7	14.7
Max. axial load	F_a	N	3700	3700	3700
Max. moment load	M	Nm	60	60	60
Max. speed		rpm	500	500	400
Resolution		p/rev	4,320,000(INC,sin/cos 1Vpp)		
Repeatability		arc-sec	±2.5		
Accuracy		arc-sec	±15/±10[3]/±5[3]		
Axial runout	R_a	mm	0.03(0.005[2])		
Radial runout	R_r	mm	0.03(0.015[2])		
Height	H	mm	109.5	134.5	159.5

Note:[1]INC encoder able work with E1 or D1 drive
[2]Optional
[3]After error mapping
*All the specifications in the table are in ±10% of tolerance except dimensions

DMYA INC Series Dimensions



DMYA INC Series Specifications

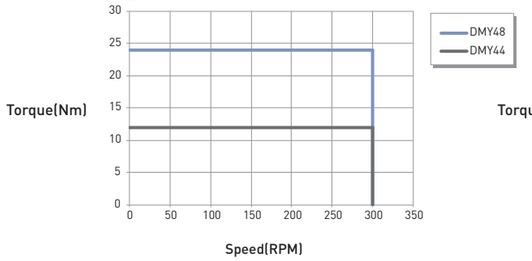
	Symbol	Unit	DMYA3-50	DMYA5-50	DMYAA-50
Motor power		W	523	523	1047
Continuous torque	T_c	Nm	25	50	100
Continuous current	I_c	A_{rms}	2.2	2.2	4.4
Peak torque (Within 1s.)	T_p	Nm	75	150	300
Peak current (Within 1s.)	I_p	A_{rms}	6.6	6.6	13.2
Torque constant	K_t	Nm/A_{rms}	11.4	22.5	22.5
Electrical time constant	T_e	ms	11.3	12.8	13.3
Resistance (line to line at 25°C)	R_{25}	Ω	8.6	13.3	5.8
Inductance (line to line)	L	mH	97	170	77
Number of poles	2_p		22	22	22
Back emf constant (line to line)	K_v	$V_{rms}/(rad/s)$	6.6	13	13
Motor constant (line to line at 25°C)	K_m	$Nm/\sqrt{W}$	3.2	5	7.6
Thermal resistance	R_{th}	K/W	1.2	0.8	0.4
Temperature sensor			PTC SNM100		
Maximum DC bus voltage		V_{DC}	500(600[2])		
Inertia of rotor	J	kgm^2	0.254	0.32	0.44
Mass of motor	M_m	kg	45	54	71
Max. axial load	F_a	N	8000	8000	8000
Max. moment load	M	Nm	240	240	240
Max. speed		rpm	200	100	100
Resolution		p/rev	4,320,000(INC， sin/cos 1Vpp)		
Repeatability		arc-sec	±2.5		
Accuracy		arc-sec	±15/±10[3]/±5[3]		
Axial runout	R_a	mm	0.03(0.005[2])		
Radial runout	R_r	mm	0.03(0.015[2])		
Height	H	mm	120	145	200
Height of base	Hb	mm	31		

Note:[1]INC encoder able work with E1 or D1 drive
[2]Optional
[3]After error mapping
*All the specifications in the table are in ±10% of tolerance except dimensions

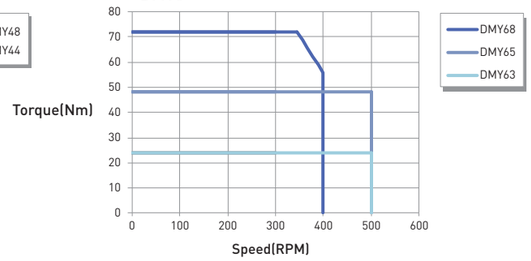
DMY Series T-N Curves

(DC bus voltage=325VDC)

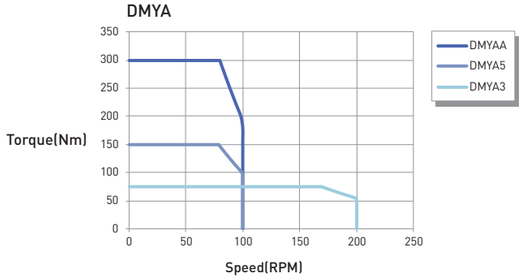
DMY4



DMY6



DMYA



DMN Series

The DMN series is designed with a low profile and high resolution incremental or absolute ecoder optimized to achieve high dynamic motion, high torque and high precision. The DMN series is a perfect fit for industries that require high precision but less force.

- Space saving with low profile design
- High resolution incremental or absolute encoder
- Maximum torque: 0.96~39.6 Nm
- High dynamic, torque and precision

Model Numbers for DMN Series

Motor Specification									Mechanical Specification								
DMN	7	1	-	B	0	S	N	0	0	-	S	0	-	1	S	S	-	0	-	0

Model

Encoder
A：19 bits(ABS)
B：20 bits(ABS)
2：1500 lines(INC)
4：2500 lines(INC)
5：3600 lines(INC)

Hall Sensor
0：Without hall sensor
1：With digital hall sensor

Winding Code
S：Standard

Temperature Sensor
N：Without temperature sensor
P：PTC sensor

International Protection Standard
0：IP40

Function Code

Axial/Radial Runout
S：30μm/30μm (Standard)
P：5μm/30μm
A：5μm/15μm

Accuracy Compensation
0：Without compensation
1：±10 arc-sec
2：±5 arc-sec

Wire Length
0：No cable (Optical scale standard)
1：0.3m (ABS scale standard)
2：0.5m(DMN21 INC encoder only)

Connector Type
S：ABS scale standard (AMP joint)
A：Optical scale standard
(Intercontec M17 metallic joint)

Positioning Pinhole
S：Standard
(According to the drawing)

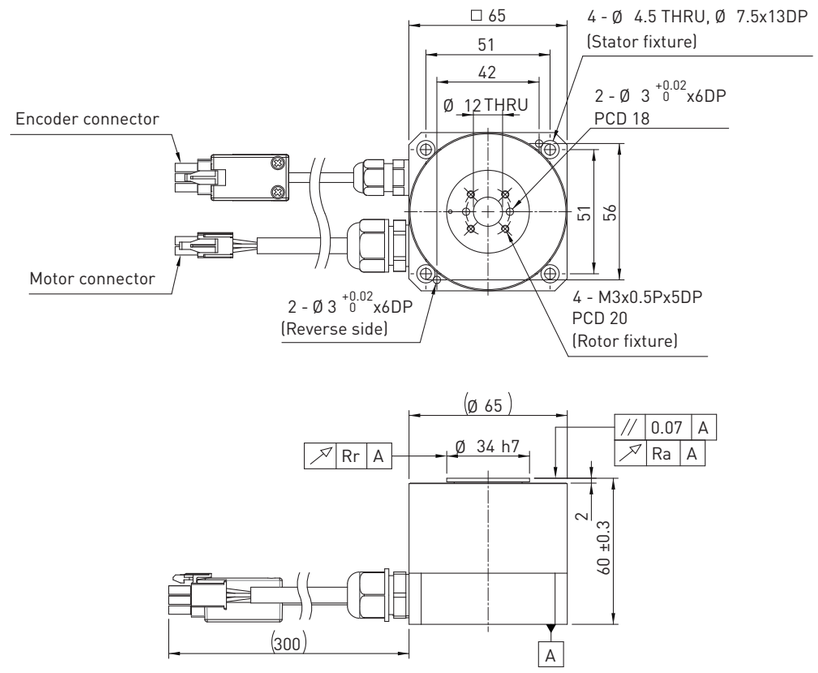
Clamp
0：Without clamp
(Standard)

Reserved code

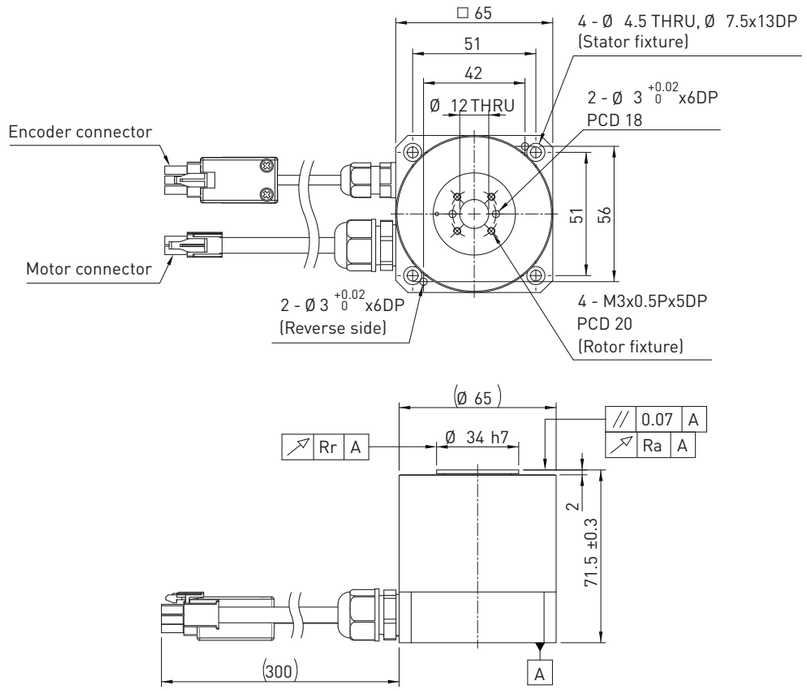
*The product should avoid environment with corrosive gas, cutting oil and metal powder.
*This catalogue only demonstrates absolute encoders. As to incremental encoders, the resolution and connector type may be different. Please consult your local distributor or HIWIN.

DMN ABS Series Dimensions

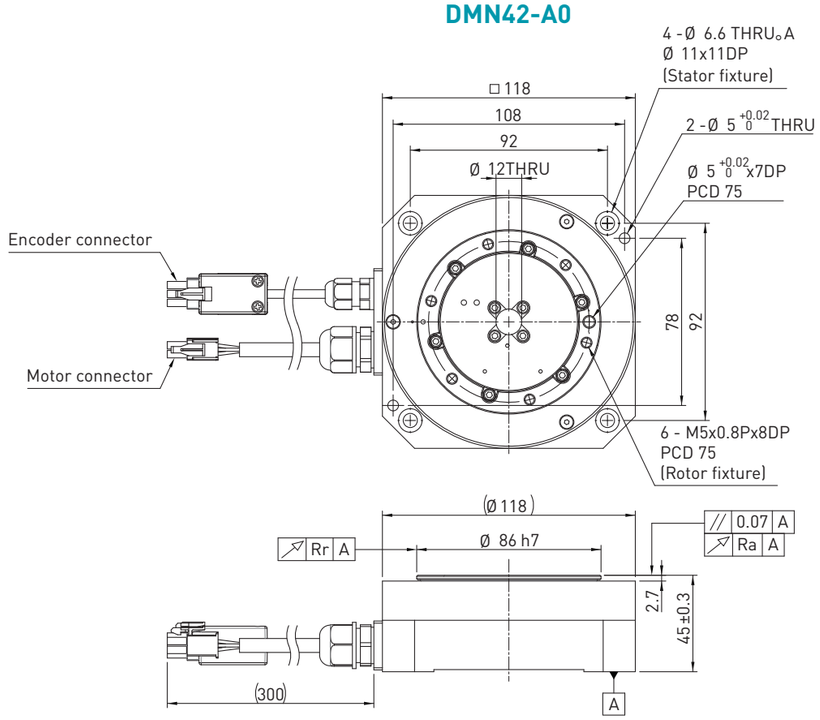
DMN21-A0



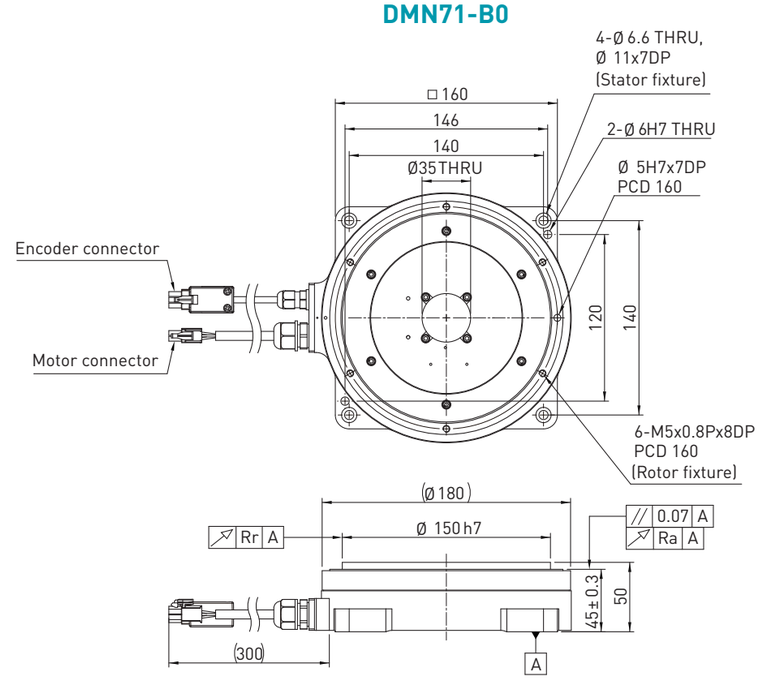
DMN22-A0



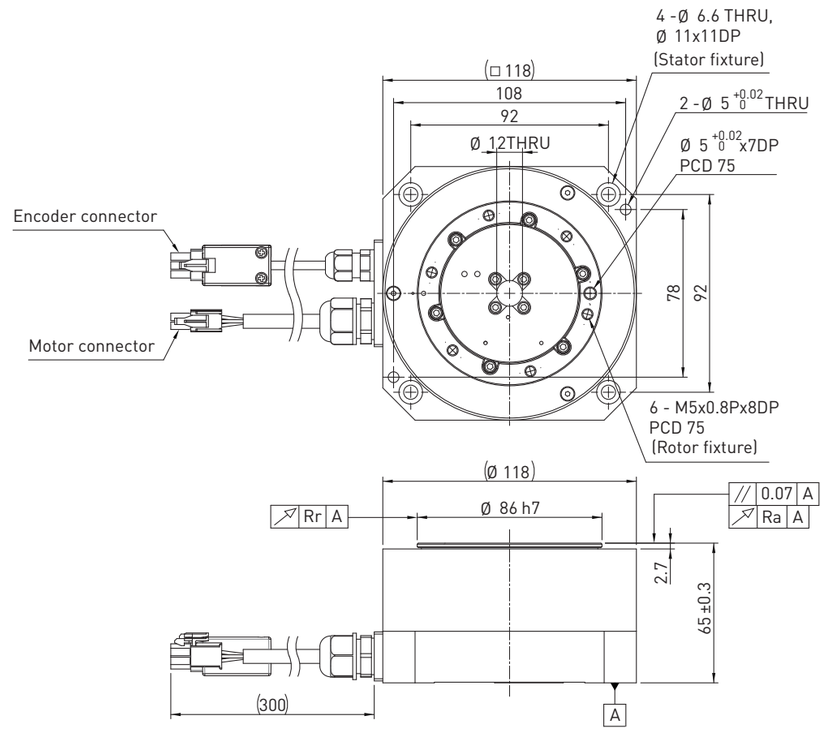
DMN42-A0



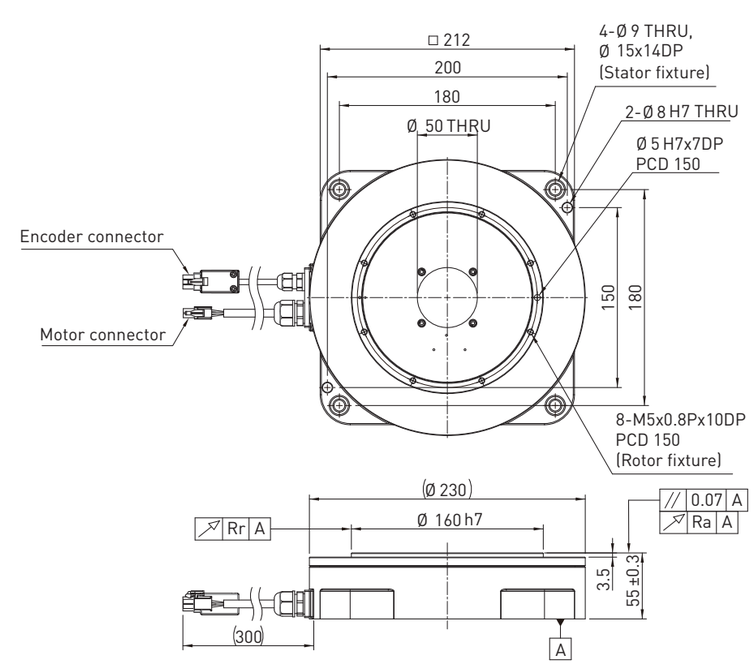
DMN71-B0



DMN44-A0



DMN93-B0



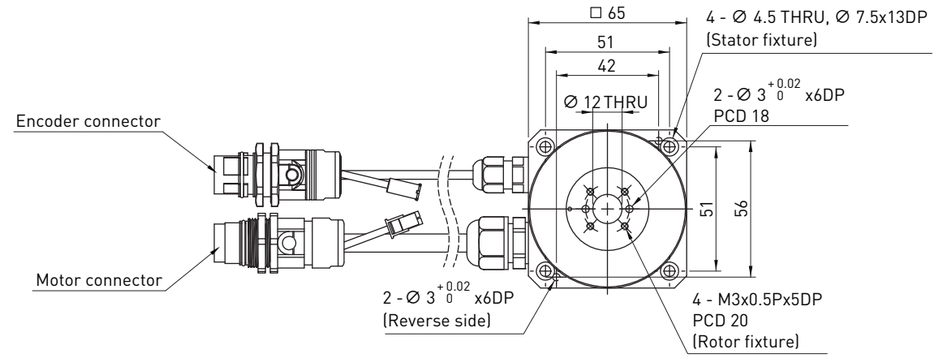
DMN ABS Series Specifications

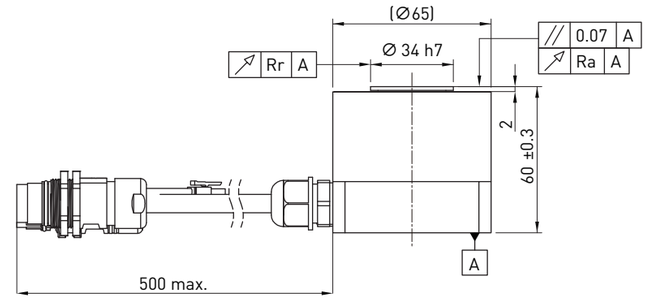
	Symbol	Unit	DMN21-A0	DMN22-A0	DMN42-A0	DMN44-A0	DMN71-B0	DMN93-B0
Motor power		W	50	100	102	205	232	691
Continuous torque	T_c	Nm	0.32	0.64	1.4	2.8	3.7	13.2
Continuous current	I_c	A_{rms}	1.9	1.9	1.5	1.5	3.4	3.4
Peak torque (Within 1s.)	T_p	Nm	0.96	1.92	4.2	8.4	11.1	39.6
Peak current (Within 1s.)	I_p	A_{rms}	5.7	5.7	4.5	4.5	10.2	10.2
Torque constant	K_t	Nm/A_{rms}	0.17	0.17	0.97	1.94	1.09	3.9
Electrical time constant	T_e	ms	0.3	0.2	1.8	2.1	3.5	5.4
Resistance (line to line at 25°C)	R_{25}	Ω	8.4	16.7	4.59	7.3	2.55	4.3
Inductance (line to line)	L	mH	2.55	4.1	8.18	15	9.02	23.2
Number of poles	2_p		10	10	16	16	16	22
Back emf constant (line to line)	K_v	$V_{rms}/(rad/s)$	0.1	0.1	0.56	1.12	0.63	2.25
Motor constant (line to line at 25°C)	K_m	$Nm/\sqrt{W}$	0.05	0.03	0.4	0.6	0.6	1.5
Thermal resistance	R_{th}	K/W	1.65	0.83	4.84	3.04	1.95	1.01
Temperature sensor			Without temperature sensor[3]					
Maximum DC bus voltage		V_{DC}	500(600[2])					
Inertia of rotor	J	kgm^2	0.000025	0.00003	0.0009	0.001	0.008	0.012
Mass of motor	M_m	kg	0.65	0.85	2	3	3.5	7.5
Max. axial load	F_a	N	100	100	600	600	1000	1000
Max. moment load	M	Nm	1.5	1.5	30	30	50	50
Max. speed		rpm	1500	1500	700	700	400	500
Resolution		p/rev	19bitABS	19bitABS	19bitABS	19bitABS	20bitABS	20bitABS
Repeatability		arc-sec	±10				±5	
Accuracy		arc-sec	±45				±30/±10[1]	
Axial runout	R_a	mm	0.03(0.005[2])					
Radial runout	R_r	mm	0.03(0.015[2])					
Size	WxLxH	mm	65x65x60	65x65x71.5	118x118x45	118x118x65	160x160x50	212x212x55

Note:[1]After error mapping
[2]Optional
[3]The motor can work with E1 drive, which provides overloading detection to prevent the motor from over-heating
*All the specifications in the table are in ±10% of tolerance except dimensions
*ABS encoder only work with E1 drive

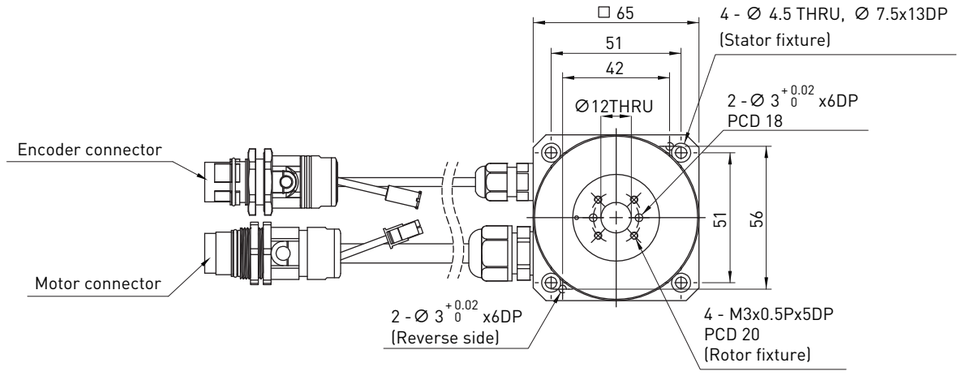
DMN INC Series Dimensions

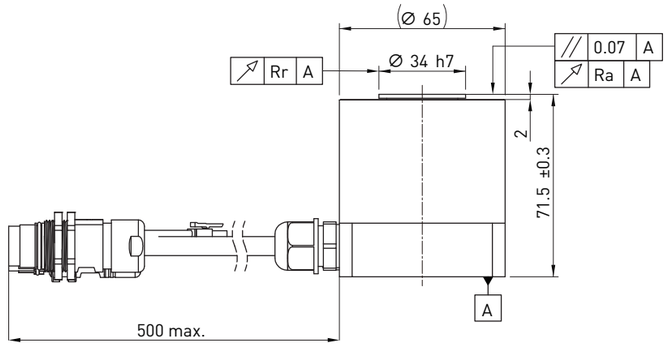
DMN21-20



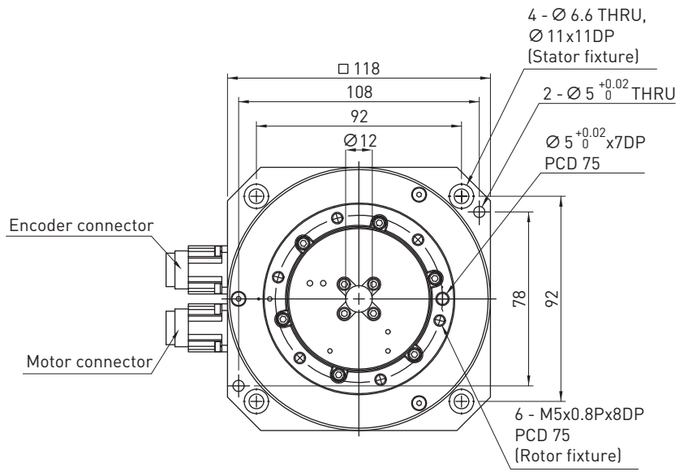


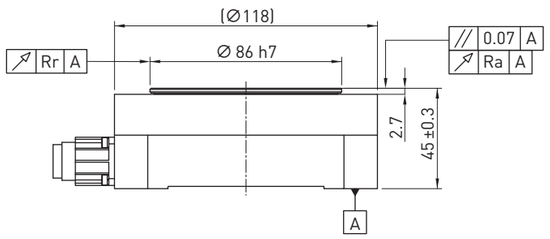
DMN22-20



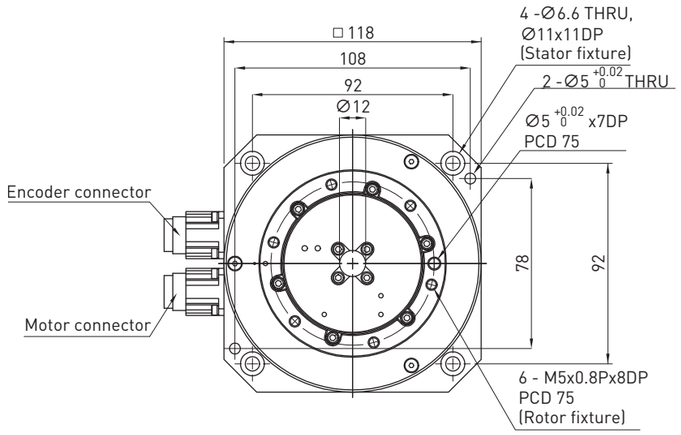


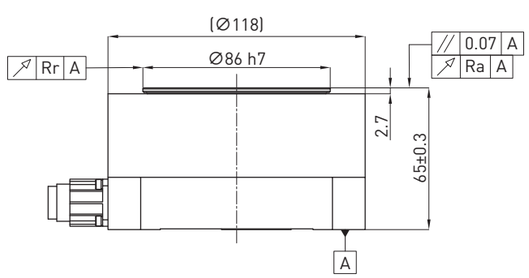
DMN42-20



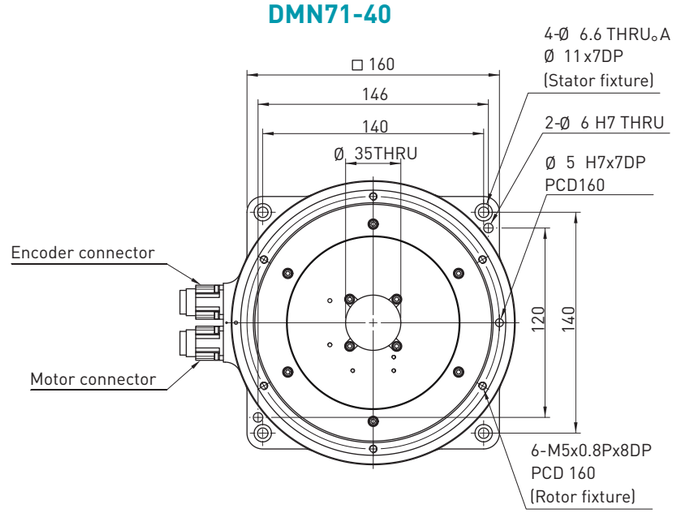


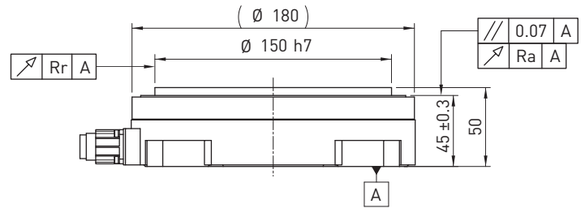
DMN44-20



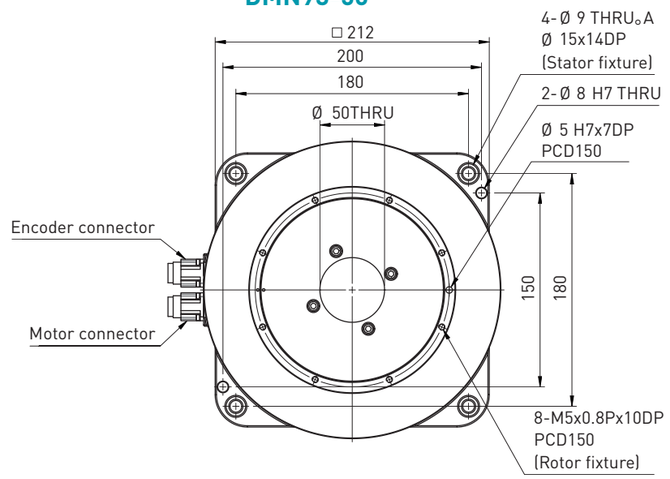


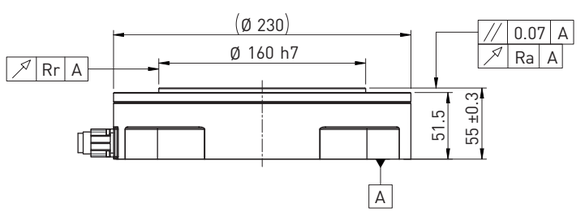
DMN71-40





DMN93-50





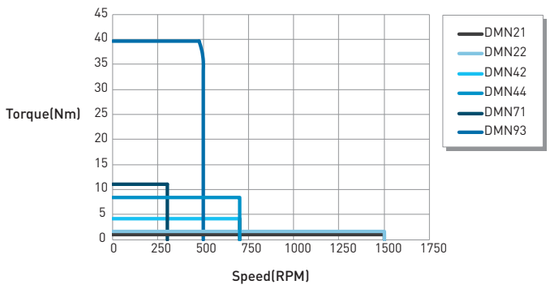
DMN INC Series Specifications

	Symbol	Unit	DMN21-20	DMN22-20	DMN42-20	DMN44-20	DMN71-4□	DMN93-5□
Motor power		W	50	100	102	205	232	691
Continuous torque	T_c	Nm	0.32	0.64	1.4	2.8	3.7	13.2
Continuous current	I_c	A_{rms}	1.9	1.9	1.5	1.5	3.4	3.4
Peak torque (Within 1s.)	T_p	Nm	0.96	1.92	4.2	8.4	11.1	39.6
Peak current (Within 1s.)	I_p	A_{rms}	5.7	5.7	4.5	4.5	10.2	10.2
Torque constant	K_t	Nm/A_{rms}	0.17	0.17	0.97	1.94	1.09	3.9
Electrical time constant	T_e	ms	0.3	0.2	1.8	2.1	3.5	5.4
Resistance (line to line at 25°C)	R_{25}	Ω	8.4	16.7	4.59	7.3	2.55	4.3
Inductance (line to line)	L	mH	2.55	4.1	8.18	15	9.02	23.2
Number of poles	2_p		10	10	16	16	16	22
Back emf constant (line to line)	K_v	V_{rms}/(rad/s)	0.1	0.1	0.56	1.12	0.63	2.25
Motor constant (line to line at 25°C)	K_m	$Nm/\sqrt{W}$	0.05	0.03	0.4	0.6	0.6	1.5
Thermal resistance	R_{th}	K/W	1.65	0.83	4.84	3.04	1.95	1.01
Temperature sensor			PTC SNM100					
Maximum DC bus voltage		V_{DC}	500(600[2])					
Inertia of rotor	J	kgm^2	0.000025	0.00003	0.0009	0.001	0.008	0.012
Mass of motor	M_m	kg	0.65	0.85	2	3	3.5	7.5
Max. axial load	F_a	N	100	100	600	600	1000	1000
Max. moment load	M	Nm	1.5	1.5	30	30	50	50
Max. speed		rpm	1500	1500	700	700	600	500
Resolution		p/rev	4,320,000 (INC,sin/cos 1Vpp)					
Repeatability		arc-sec	±2.5					
Accuracy		arc-sec	±30/±10[1]/±5[1]				±25/±10[1]/±5[1]	±15/±10[1]/±5[1]
Axial runout	R_a	mm	0.03(0.005[2])					
Radial runout	R_r	mm	0.03(0.015[2])					
Size	WxLxH	mm	65x65x60	65x65x71.5	118x118x45	118x118x65	160x160x50	212x212x55

Note: [1]After error mapping
[2]Optional
*All the specifications in the table are in ±10% of tolerance except dimensions

DMN Series T-N Curves

(DC bus voltage=325V_{DC})



DMS Series

The DMS series is designed with an integrated, high resolution feedback system optimized to achieve high dynamic motion, high torque and high precision. The DMS series is a perfect fit for industries that require high precision.

- Inner rotating structure
- Integrated incremental feedback system
- High dynamic,torque and precision
- Maximum torque:9.3~450Nm
- Meets IP65 enclosure standards as an option
- Integrated clamp is available as an option
- Hall sensor is availdable as an option

Model Numbers for DMS Series

Motor Specification								Mechanical Specification										
DMS	3	4	-	5	0	S	P	0	0	-	S	0	-	0	A	S	-	0	-	0

Model

Encoder
4 : 2500 lines(INC)
5 : 3600 lines(INC)
6 : 5400 lines(INC)

Hall Sensor
0 : Without Hall sensor
1 : With digital Hall sensor

Winding Code
S : Standard
L : Low Back emf

Temperature Sensor
N : Without temperature sensor
P : PTC sensor

International Protection Standard
0 : IP40
1 : IP65

Function Code

Axial/Radial Runout
S : 30μm/30μm (Standard)
P : 5μm/30μm
A : 5μm/15μm

Accuracy Compensation
0 : Without compensation
1 : ±10 arc-sec
2 : ±5 arc-sec

Wire Length
0 : No cable (Optical scale standard)

Connector Type
A : Optical scale standard
(Intercontec M17 metallic joint)

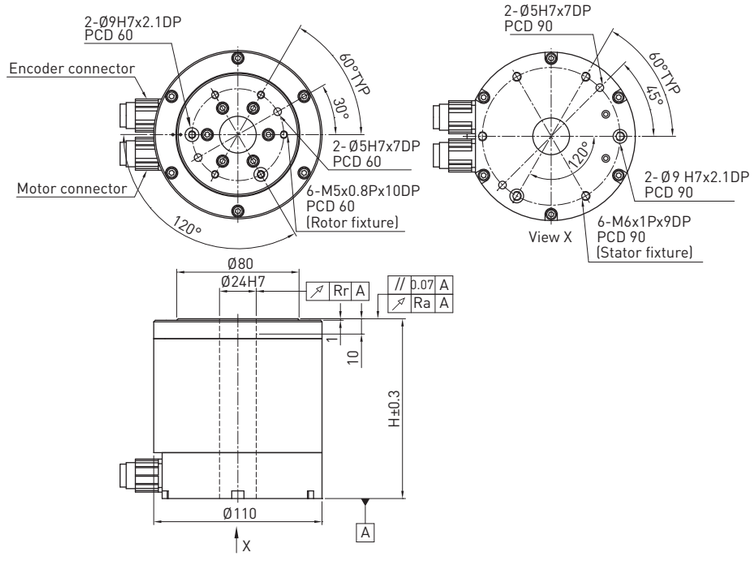
Positioning Pinhole
S : Standard
(According to the drawing)

Clamp
0 : Without clamp
(Standard)
1 : With power-on clamp
2 : With power-off clamp

Reserved Code

*The IP65 option is for environments with cutting oil and metal powder.
*The DMS product offer external clamp option. Please consult your local distributor or HIWIN.

DMS0 INC Series Dimensions

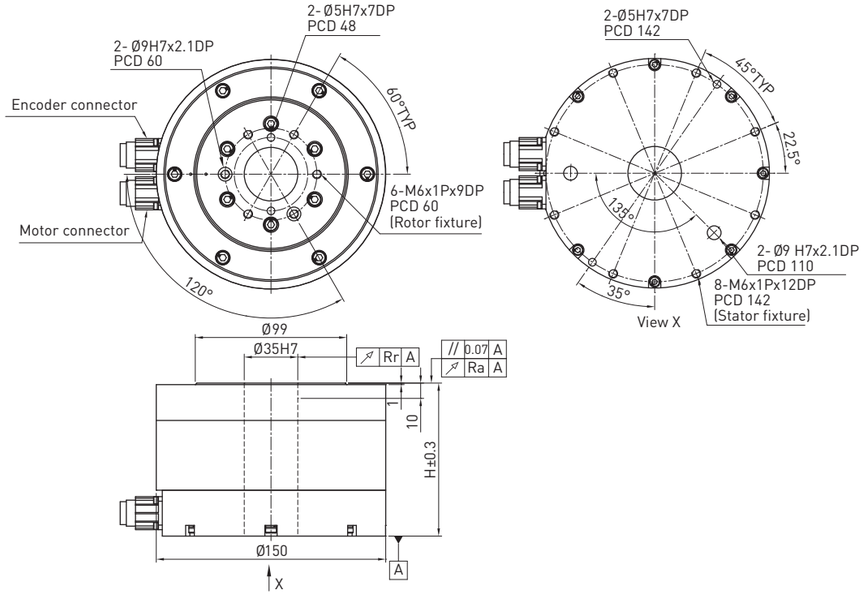


DMS0 INC Series Specifications

	Symbol	Unit	DMS03-40	DMS07-40
Motor power		W	227	454
Continuous torque	T_c	Nm	3.1	6.2
Continuous current	I_c	A_{rms}	2	2
Peak torque (Within 1s.)	T_p	Nm	9.3	18.6
Peak current (Within 1s.)	I_p	A_{rms}	6	6
Torque constant	K_t	Nm/A_{rms}	1.55	3.1
Electrical time constant	T_e	ms	1.9	2.1
Resistance (line to line at 25°C)	R_{25}	Ω	7.1	11.1
Inductance (line to line)	L	mH	13.8	23
Number of poles	2_p		10	10
Back emf constant (line to line)	K_v	$V_{rms}/(rad/s)$	0.82	1.7
Motor constant (line to line at 25°C)	K_m	$Nm/\sqrt{W}$	0.5	0.8
Thermal resistance	R_{th}	K/W	1.76	1.13
Temperature sensor			PTC SNM100	
Maximum DC bus voltage		V_{DC}	500(600[2])	
Inertia of rotor	J	kgm^2	0.003	0.006
Mass of motor	M_m	kg	4	7
Max. axial load	F_a	N	3700	3700
Max. moment load	M	Nm	40	40
Max. speed		rpm	700	700
Resolution		p/rev	4,320,000 (INC,sin/cos 1Vpp)	
Repeatability		arc-sec	±2.5	
Accuracy		arc-sec	±15/±10[1]/±5[1]	
Axial runout	R_a	mm	0.03(0.005[2])	
Radial runout	R_r	mm	0.03(0.015[2])	
Height	H	mm	117.5	150

Note:[1]After error mapping
[2]Optional
*All the specifications in the table are in ±10% of tolerance except dimensions

DMS1 INC Series Dimensions

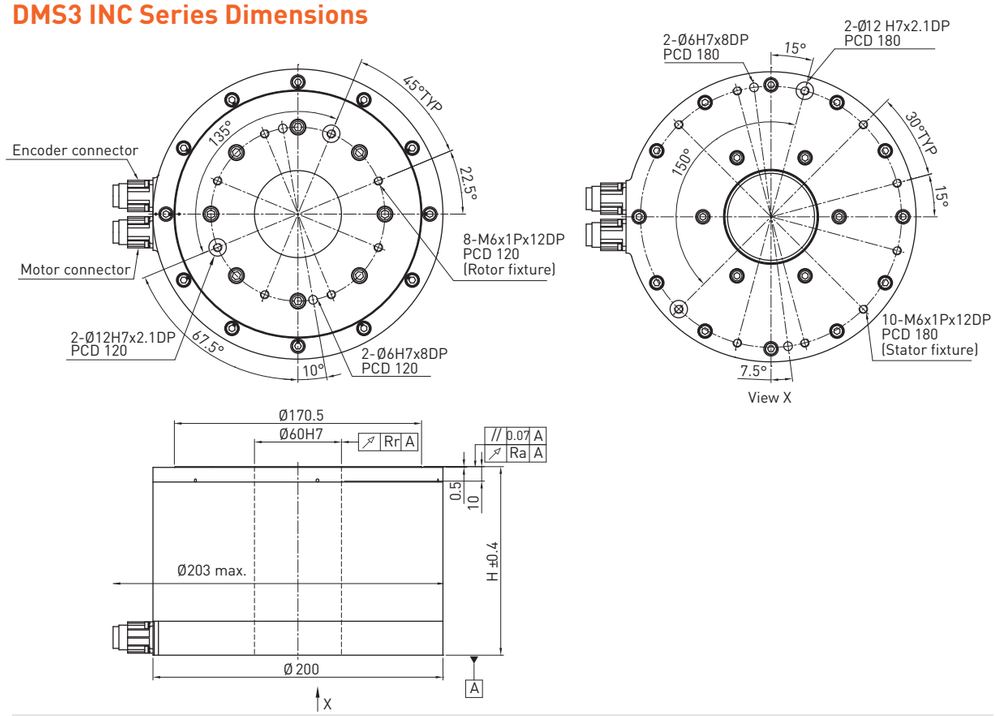


DMS1 INC Series Specifications

	Symbol	Unit	DMS12-5□	DMS14-5□	DMS16-5□	DMS18-5□
Motor power		W	314	628	942	1047
Continuous torque	T_C	Nm	5	10	15	20
Continuous current	I_C	A_{rms}	4	4	4	4
Peak torque (Within 1s.)	T_P	Nm	15	30	45	60
Peak current (Within 1s.)	I_P	A_{rms}	12	12	12	12
Torque constant	K_t	Nm/A_{rms}	1.25	2.5	3.75	5
Electrical time constant	T_e	ms	3.2	3.6	3.8	4
Resistance (line to line at 25°C)	R_{25}	Ω	2.6	3.9	5.2	6.5
Inductance (line to line)	L	mH	8.2	14	20	26
Number of poles	2_p		22	22	22	22
Back emf constant (line to line)	K_V	V_{rms}/(rad/s)	0.6	1.2	1.8	2.4
Motor constant (line to line at 25°C)	K_m	$Nm/\sqrt{W}$	0.6	1	1.3	1.6
Thermal resistance	R_{th}	K/W	1.2	0.8	0.6	0.48
Temperature sensor			PTC SNM100			
Maximum DC bus voltage		V_{DC}	500(600[2])			
Inertia of rotor	J	kgm^2	0.006	0.0065	0.007	0.0075
Mass of motor	M_m	kg	5.7	7	8.3	9.5
Max. axial load	F_a	N	3700	3700	3700	3700
Max. moment load	M	Nm	60	60	60	60
Max. speed		rpm	600	600	600	500
Resolution		p/rev	4,320,000 (INC,sin/cos 1Vpp)			
Repeatability		arc-sec	±2.5			
Accuracy		arc-sec	±15/±10[1]/±5[1]			
Axial runout	R_a	mm	0.03(0.005[2])			
Radial runout	R_r	mm	0.03(0.015[2])			
Height	H	mm	100	120	140	160

Note: [1]After error mapping
[2]Optional
*All the specifications in the table are in ±10% of tolerance except dimensions

DMS3 INC Series Dimensions

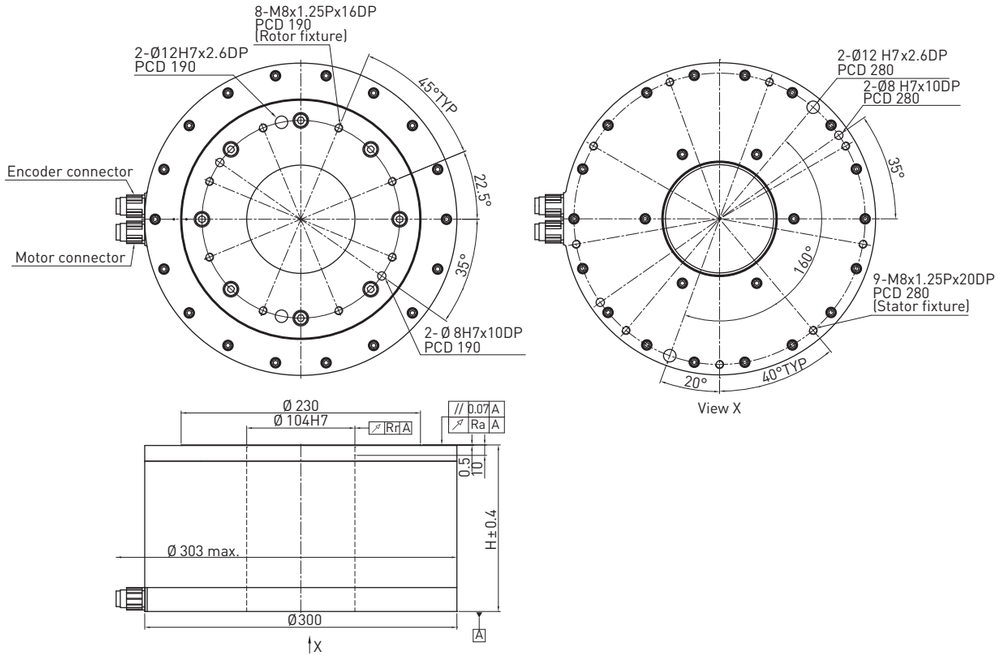


DMS3 INC Series Specifications

	Symbol	Unit	DMS34-5□	DMS34-5□L	DMS38-5□	DMS38-5□L	DMS3C-5□	DMS3C-5□L
Motor power		W	837	1256	837	1884	753	1884
Continuous torque	T_C	Nm	20	20	40	40	60	60
Continuous current	I_C	A_{rms}	3	6	3	6	3	6
Peak torque (Within 1s.)	T_P	Nm	60	60	120	120	180	180
Peak current (Within 1s.)	I_P	A_{rms}	9	18	9	18	9	18
Torque constant	K_t	Nm/A_{rms}	6.6	3.3	13.3	6.65	20	10
Electrical time constant	T_e	ms	4.8	4.4	5.3	4.5	5.1	5
Resistance (line to line at 25°C)	R_{25}	Ω	8.4	1.7	13.6	2.9	18.8	3.9
Inductance (line to line)	L	mH	40	7.5	71.5	13	95	19.5
Number of poles	2_p		22	22	22	22	22	22
Back emf constant (line to line)	K_V	V_{rms}/(rad/s)	3.2	1.6	6.4	3.2	9.6	4.8
Motor constant (line to line at 25°C)	K_m	$Nm/\sqrt{W}$	1.9	2.1	2.9	3.2	3.8	4.1
Thermal resistance	R_{th}	K/W	0.66	0.82	0.41	0.48	0.3	0.36
Temperature sensor			PTC SNM100					
Maximum DC bus voltage		V_{DC}	500(600[2])					
Inertia of rotor	J	kgm^2	0.02	0.02	0.026	0.026	0.035	0.035
Mass of motor	M_m	kg	17	17	22.5	22.5	28.5	28.5
Max. axial load	F_a	N	8000	8000	8000	8000	8000	8000
Max. moment load	M	Nm	240	240	240	240	240	240
Max. speed		rpm	400	600	200	450	120	300
Resolution		p/rev	4,320,000 (INC,sin/cos 1Vpp)					
Repeatability		arc-sec	±2.5					
Accuracy		arc-sec	±15/±10[1]/±5[1]					
Axial runout	R_a	mm	0.03(0.005[2])					
Radial runout	R_r	mm	0.03(0.015[2])					
Height	H	mm	150	150	190	190	230	230

Note: [1]After error mapping
[2]Optional
*All the specifications in the table are in ±10% of tolerance except dimensions

DMS7 INC Series Dimensions



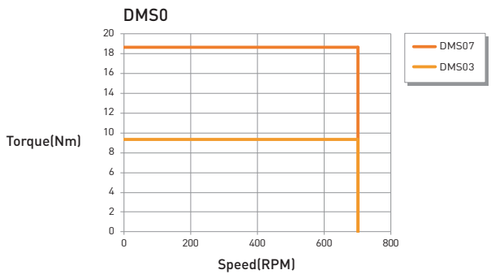
DMS7 INC Series Specifications

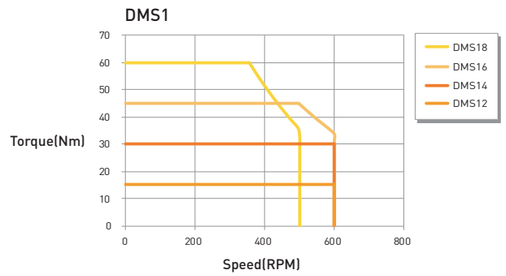
	Symbol	Unit	DMS74-6□	DMS74-6□L	DMS76-6□	DMS76-6□L	DMS7C-6□	DMS7C-6□L
Motor power		W	628	1308	565	1334	376	1256
Continuous torque	T_c	Nm	50	50	75	75	150	150
Continuous current	I_c	A_{rms}	3	6	3	6	3	6
Peak torque (Within 1s.)	T_p	Nm	150	150	225	225	450	450
Peak current (Within 1s.)	I_p	A_{rms}	9	18	9	18	9	18
Torque constant	K_t	Nm/A_{rms}	16.7	8.35	25	12.5	50	25
Electrical time constant	T_e	ms	4.6	5	5.1	5	5.4	6
Resistance (line to line at 25°C)	R_{25}	Ω	14	3.5	19	4.8	32.5	8.5
Inductance (line to line)	L	mH	64	17.5	96.5	27	176	50.6
Number of poles	2_p		44	44	44	44	44	44
Back emf constant (line to line)	K_v	V_{rms}/(rad/s)	10.8	5.4	16.2	8.1	32.4	16.2
Motor constant (line to line at 25°C)	K_m	$Nm/\sqrt{W}$	3.6	3.6	4.7	4.7	7.2	7.0
Thermal resistance	R_{th}	K/W	0.4	0.4	0.29	0.29	0.17	0.16
Temperature sensor			PTC SNM100					
Maximum DC bus voltage		V_{DC}	500(600[2])					
Inertia of rotor	J	kgm^2	0.152	0.152	0.174	0.174	0.241	0.241
Mass of motor	M_m	kg	36	36	41	41	57	57
Max. axial load	F_a	N	8000	8000	8000	8000	8000	8000
Max. moment load	M	Nm	360	360	360	360	360	360
Max. speed		rpm	120	250	72	170	24	80
Resolution		p/rev	4,320,000 (INC,sin/cos 1Vpp)					
Repeatability		arc-sec	±2.5					
Accuracy		arc-sec	±15/±10[1]/±5[1]					
Axial runout	R_a	mm	0.03(0.005[2])					
Radial runout	R_r	mm	0.03(0.015[2])					
Height	H	mm	160	160	180	180	240	240

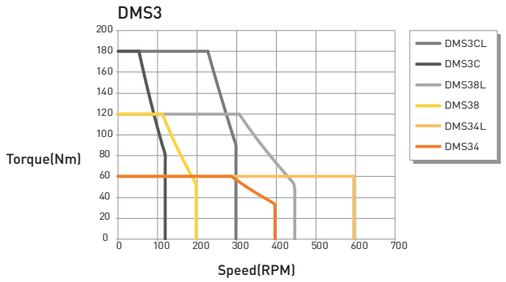
Note: [1]After error mapping
[2]Optional
*All the specifications in the table are in ±10% of tolerance except dimensions

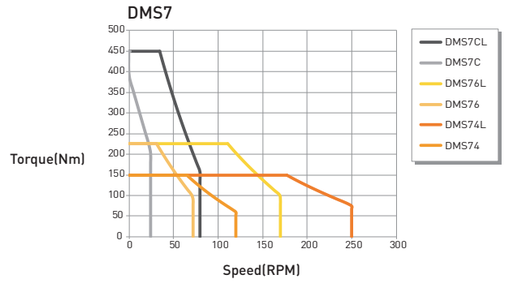
DMS Series T-N Curves

(DC bus voltage=325V_{DC})





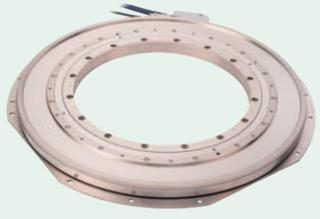




DMT Series

DMT series is one of the lowest profile direct drive motors in the market. The compact design significantly decreases the height of the machine. Cables and air tubes can go through the large hollow shaft easily. With high resolution encoder and superior dynamic features, DMT series is suitable for applications of various product inspection and processing.

- Extra large hollow center
- Excellent positioning accuracy. Low speed ripple
- No reduction mechanism needed. Zero backlash
- Highly rigid design



Model Numbers for DMT Series

Motor Specification								Mechanical Specification							
DMT	B	2	-	0	0	S	P	0	0	-	S	0	-	3	G	S	-	0	-	0

Model

Encoder
0：900 lines
1：1216 lines

Hall Sensor
0：Without hall sensor

Winding Code
S：Standard

Temperature Sensor
N：Without temperature sensor
P：PTC sensor

International Protection Standard
0：IP40

Function Code

Reserved Code

Clamp
0：Without clamp (Standard)

Positioning Pinhole
S：Standard (According to the drawing)

Connector Type
G：D-SUB 15P(Encoder) + Free wire(Motor power cable)

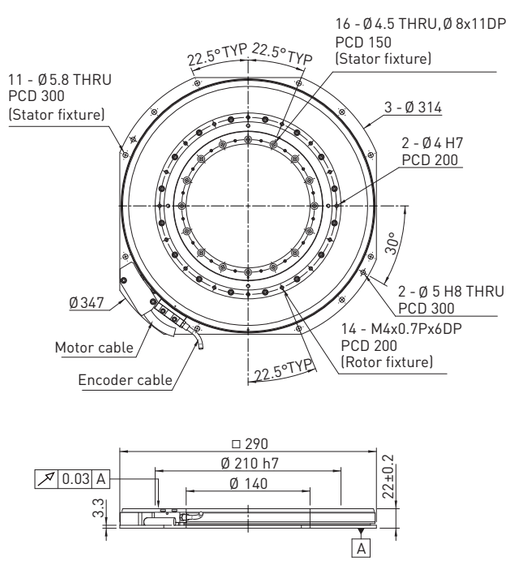
Wire Length
3：3m(DMT series standard)

Accuracy Compensation
0：Without compensation
1：±10 arc-sec
2：±5 arc-sec

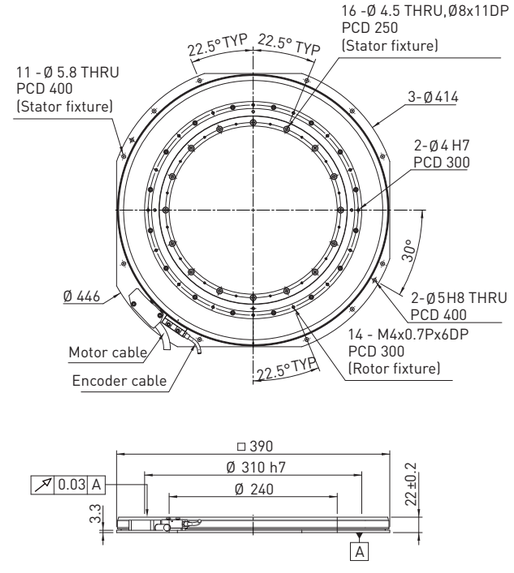
Axial/Radial Runout
S：30μm/30μm(Standard)
P：5μm/30μm

DMT INC Series Dimensions

DMTB2



DMTF2

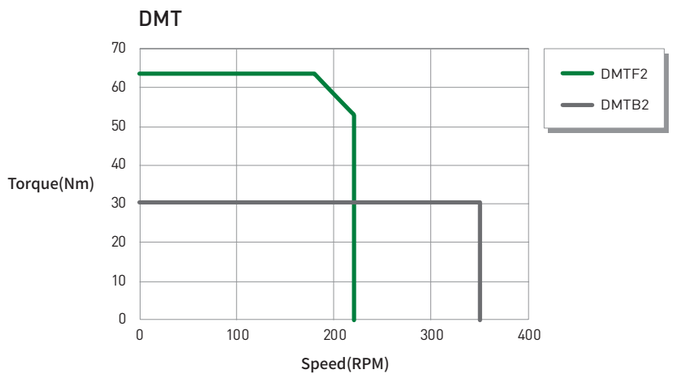


DMT INC Series Specifications

	Symbol	Unit	DMTB2-0	DMTF2-1
Motor power		W	334	438
Continuous torque	T_c	Nm	9.1	19
Continuous current	I_c	A_{rms}	2.6	2.6
Peak torque (Within 1s.)	T_p	Nm	30.4	63.6
Peak current (Within 1s.)	I_p	A_{rms}	8.7	8.7
Torque constant	K_t	Nm/A_{rms}	3.5	7.3
Electrical time constant	T_e	ms	0.7	0.7
Resistance (line to line at 25°C)	R_{25}	Ω	11.7	17.2
Inductance (line to line)	L	mH	8.6	12.3
Number of poles	2_p		32	48
Back emf constant (line to line)	K_v	$V_{rms}/(rad/s)$	2	4.2
Motor constant (line to line at 25°C)	K_m	$Nm/\sqrt{W}$	0.8	1.4
Thermal resistance	R_{th}	K/W	0.63	0.43
Temperature sensor			PTC SNM100	
Maximum DC bus voltage		V_{DC}	500(600[2])	
Inertia of rotor	J	kgm^2	0.04	0.13
Mass of motor	M_m	kg	6.5	9.3
Max. axial load	F_a	N	500	750
Max. moment load	M	Nm	50	75
Max. speed		rpm	350	220
Resolution		p/rev	3,686,400	4,319,232
Repeatability		arc-sec	±2	±1.5
Accuracy		arc-sec	±20/±10[1]/±5[1]	±15/±10[1]/±5[1]
Axial runout	R_a	mm	0.03	0.03
Radial runout	R_r	mm	0.03	0.03
Height	H	mm	22	22

Note:[1]After error mapping
[2]Optional
*All the specifications in the table are in ±10% of tolerance except dimensions

DMT Series T-N Curves



Drive

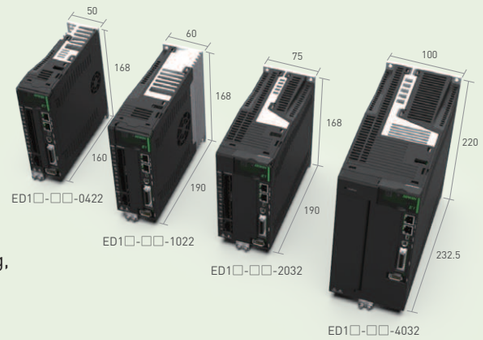
Combinations to work with servo drive

Drive		E1 servo drive	D1 servo drive
		Communication interface	
		EtherCAT®	EtherCAT®
		mega-ulink	mega-ulink
		MECHATRONLINK III	-
DM series		Model	
DMS series	DMS03	ED1□-□□-04	D1-36-S2
	DMS07	ED1□-□□-04	D1-36-S2
	DMS12	ED1□-□□-10	D1-36-S2
	DMS14	ED1□-□□-10	D1-36-S2
	DMS16	ED1□-□□-10	D1-36-S2
	DMS18	ED1□-□□-10	D1-36-S2
	DMS34	ED1□-□□-10	D1-36-S2
	DMS34-5□L	ED1□-□□-20	D1-36-S2
	DSM38	ED1□-□□-10	D1-36-S2
	DMS38-5□L	ED1□-□□-20	D1-36-S2
	DMS3C	ED1□-□□-10	D1-36-S2
	DMS3C-5□L	ED1□-□□-20	D1-36-S2
	DMS74	ED1□-□□-10	D1-36-S2
	DMS74-6□L	ED1□-□□-20	D1-36-S2
	DMS76	ED1□-□□-10	D1-36-S2
	DMS76-6□L	ED1□-□□-20	D1-36-S2
	DMS7C	ED1□-□□-10	D1-36-S2
	DMS7C-6□L	ED1□-□□-20	D1-36-S2
DMY series	DMY44	ED1□-□□-04	-
	DMY48	ED1□-□□-04	-
	DMY63	ED1□-□□-10	D1-36-S2
	DMY65	ED1□-□□-10	D1-36-S2
	DMY68	ED1□-□□-10	D1-36-S2
	DMYA3	ED1□-□□-04	D1-36-S2
	DMYA5	ED1□-□□-04	D1-36-S2
	DMYAA	ED1□-□□-10	D1-36-S2
DMN series	DMN21	ED1□-□□-04	D1-36-S2
	DMN22	ED1□-□□-04	D1-36-S2
	DMN42	ED1□-□□-04	D1-36-S2
	DMN44	ED1□-□□-04	D1-36-S2
	DMN71	ED1□-□□-10	D1-36-S2
	DMN93	ED1□-□□-10	D1-36-S2
DMT series	DMTB2	ED1□-□□-04	D1-36-S2
	DMTF2	ED1□-□□-04	D1-36-S2

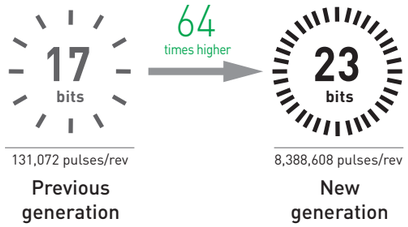
*D1 series can only work with incremental encoder direct drive motor.
*E1 series can work with absolute/ incremental encoder direct drive motor.
ESC (Excellent Smart Cube) is requested for incremental encoders.

E1 Drive

- 3.2 kHz speed response
- Tuneless function
- Advanced auto tuning
- Ripple compensation
- Unique gantry control function
- Network with industrial communication devices
- Supports various motor types
- Built-in STO function
- Supports various types of encoders, such as Digital, Analog, Tamagawa, EnDat and Biss-C

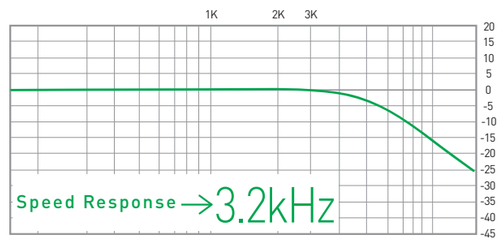


1 Higher Accuracy



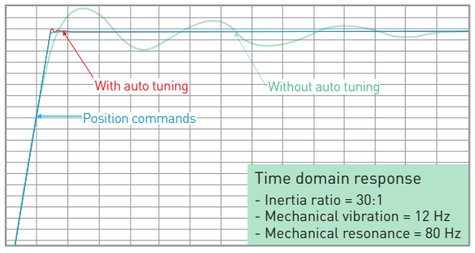
2 3.2kHz Speed Response

Higher speed reponse, faster settling and higher throughput.



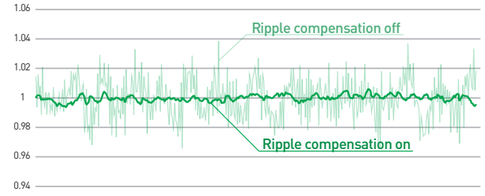
3 Advanced Auto Tuning

This function supports automatic loop gains, tuning and filters adjustment to suppress mechanical vibration and resonance, which optimizes machine performance.



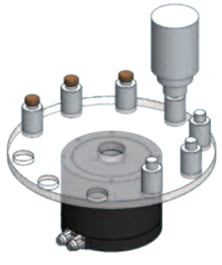
4 Ripple Compensation

Effectively suppresses the speed ripple caused by motor cogging. This function is especially useful for mechanism in which high control gains are not allowed.



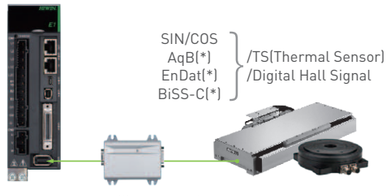
5 Unique Multi-motion Function

Applications, such as Indexing, multi-motion and absolute motion, can be realized easily with E1 multi-motion function.



6 Compatible Encoder Types

Built-in interface to receive digital encoder signals. Tamagawa serial encoder interface is also supported. With an ESC(Excellent Smart Cube), E1 can support other types of encoders, such as analog (SIN/COS), EnDat® and BiSS®-C.



Note(*): Supported in ESC-SS

E1 Model Explanation

ED1 S – V G – 0 4 2 2 – 0 1 - 0 0

Type
S : Standard
F : Fieldbus

Control Interface
V : Voltage command and Pulse
E : EtherCAT*1
H : mega-ulink
L : MECHATROLINK-III*1
P : PROFINET*1

Special Function
G : Gantry
N : Without special function

Rated Output
04 : 400W
10 : 1kW
20 : 2kW
40 : 4kW

AC Phase
2 : Single/Three phase(400W or 1kW Drive)
3 : Three phase(2kW or above Drive)

AC Voltage
2 : 100 Vac ~ 240 Vac

Motor Type
A : AC Servo motor
0 : General (AC、LM、DM、TM)

Safety Certification
1 : STO safety function

Reserved
Reserved

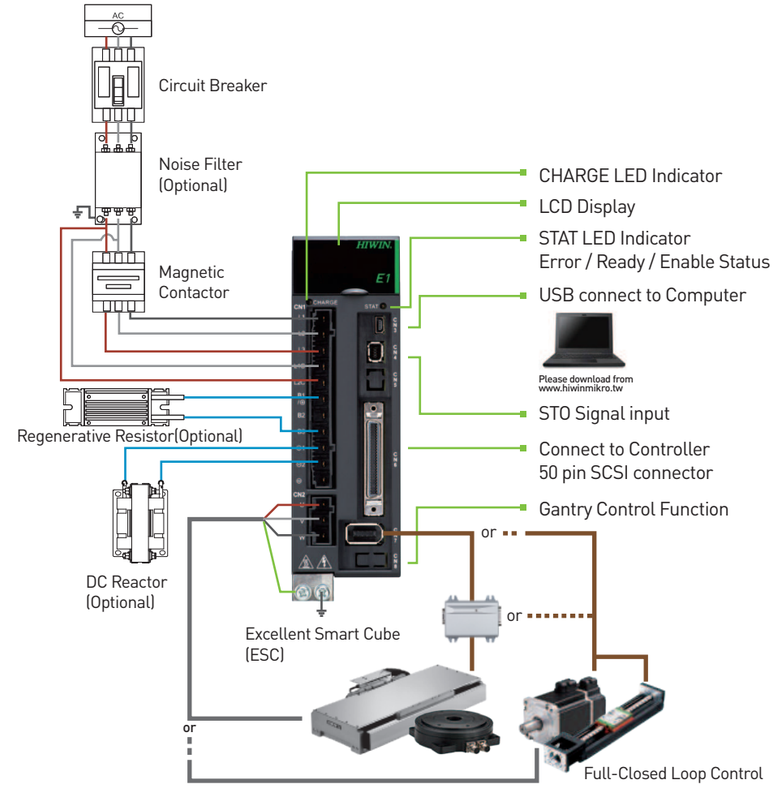
ESC – S S – S 0 1

Type
AN : SIN/COS
SS : SIN/ COS,A/B,BiSS-C*2,EnDat*2
Note1 : AN type only support S01.
Note2 : SS type please refer to E1 manual for details.

Reserved
S01 : Full Function Type
S02 : General Type

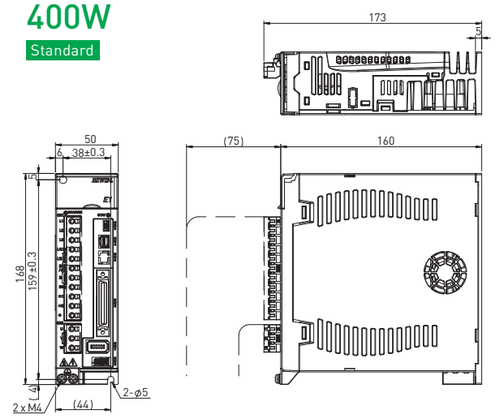
Note:
*1
EtherCAT® is a registered trademark of Beckhoff Automation Co., Ltd.
MECHATROLINK is a registered trademark of MECHATROLINK Members Association.
PROFINET® is a registered trademark of PROFIBUS & PROFINET International (PI).
*2
EnDat® is a registered trademark of HEIDENHAIN GmbH.
BiSS® is a registered trademark of iC-Haus GmbH.

E1 Wiring Diagrams

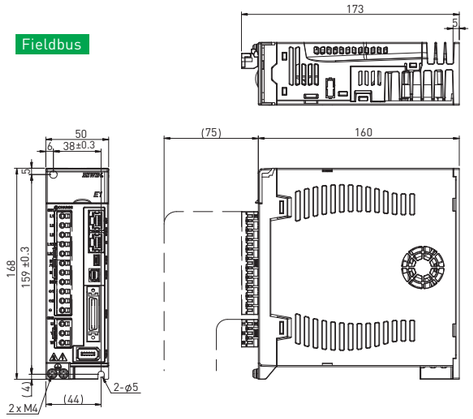


400W

Standard

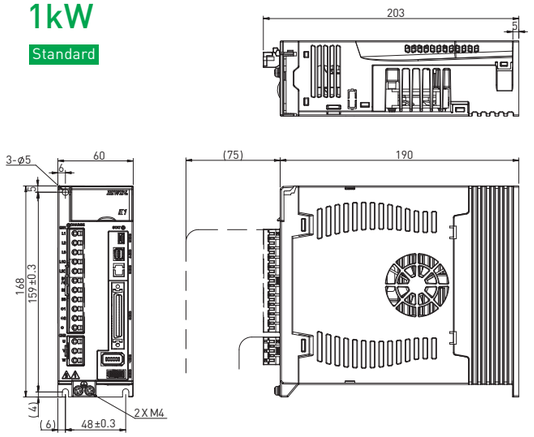


Fieldbus

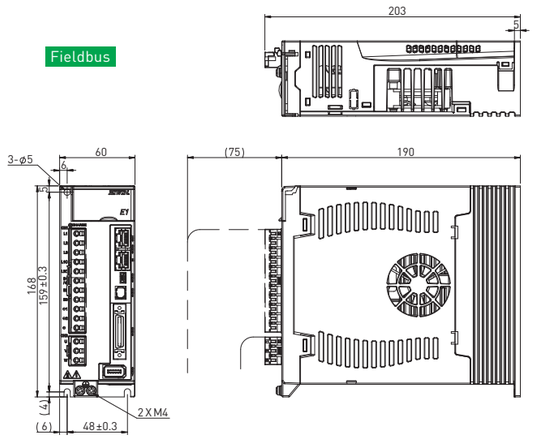


1kW

Standard

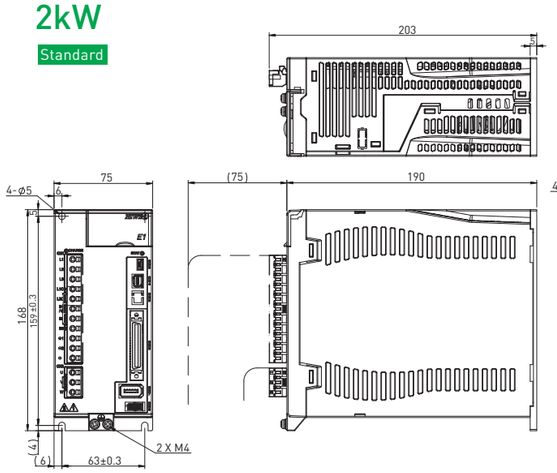


Fieldbus

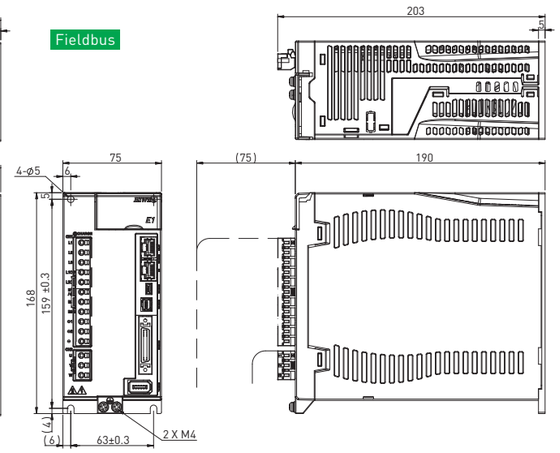


2kW

Standard



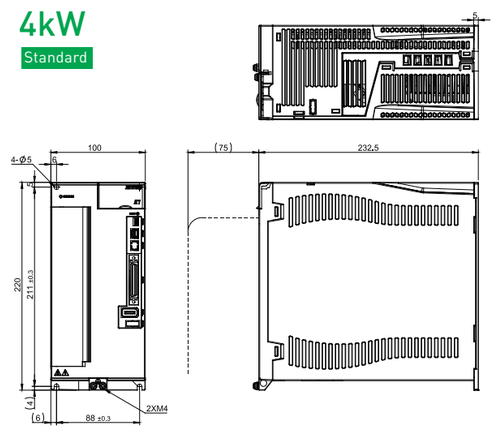
Fieldbus



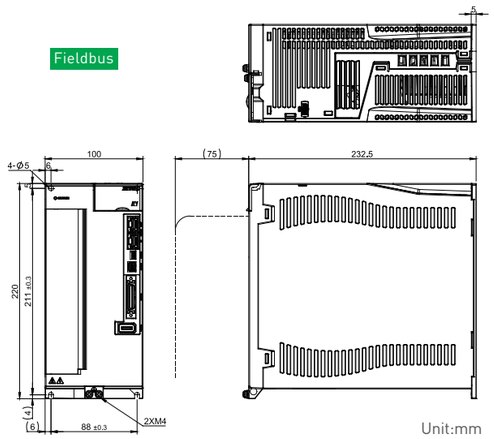
Unit: mm

4kW

Standard



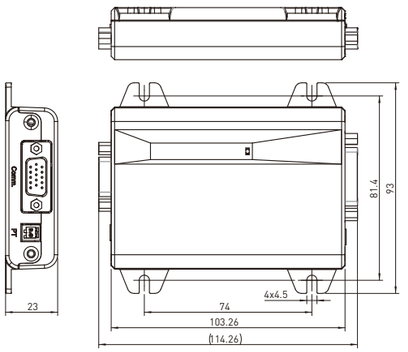
Fieldbus



Unit:mm

ESC Hardware

Excellent Smart Cube (ESC)

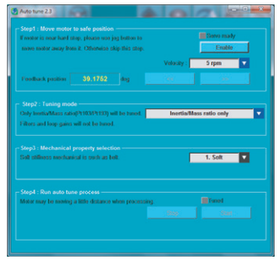


Item	Specification					
Max. Output Voltage	+5.0 V ±5%					
Max. Output Current	650mA					
Encoder Type	Digital Hall Sensor	Incremental Sign		Absolute Type		
	Hall U / V / W	SIN / COS / Reference	A / B / Index	BiSS-C	Tamagawa	EnDat 2.1 / 2.2
Signal Bandwidth	2kHz	1 MHz (multiplier factor : 4096 times)	4MHz	5MHz		4MHz
Max. Resolution	-	-	-	32 bit		64 bit
Input Signal Format	5V CMOS / TTL	Differential (RS422)		Differential (RS485)		
Over-Temperature Protection	PTC					
Ambient Temperature	0°C ~ + 45°C					
Storage Temperature	-20°C ~ + 65°C					
IP Rating	IP20					

E1 Servo Drive System Support Tools

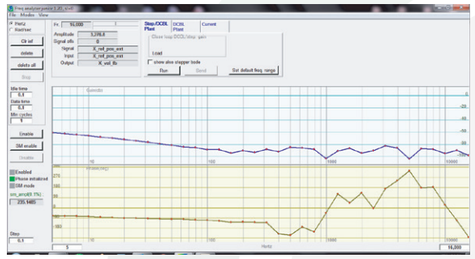
1 Auto-Tuning

1. Gain:velocity loop gain, position loop gain and moment of inertia ratio.
2. Filter:torque command filter and notch filter.



2 Analyze Function

Scope
1. Scope can support up to 8 channels at the same time.
2. User-defined time length. Easy to check the results of before and after adjustments.
3. Monitor up to 21 physical quantities.
4. Monitor 38 servo signal status.

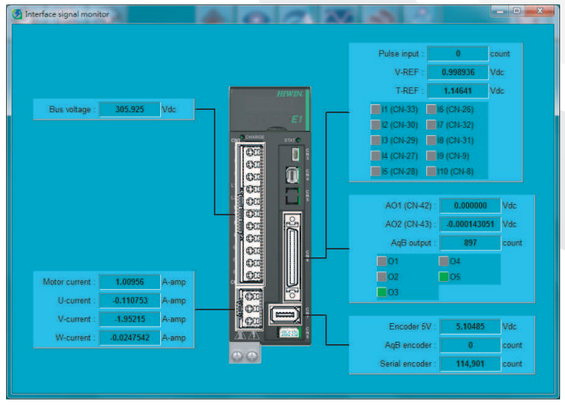


Spectrum analyzer
1. Quick inertia ration measurement.
2. Identify mechanical resonance point.

3 Status Monitor

Internal status
1. Bus voltage
2. Serial encoder
3. AqB encoder
4. Encoder 5V
5. Motor current
6. U, V, W-current

I/O signal status
1. Pulse input
2. AqB output
3. V-REF
4. T-REF
5. Digital input signal (I1~I10)
6. Digital output signal (O1~O5)
7. AO1, AO2

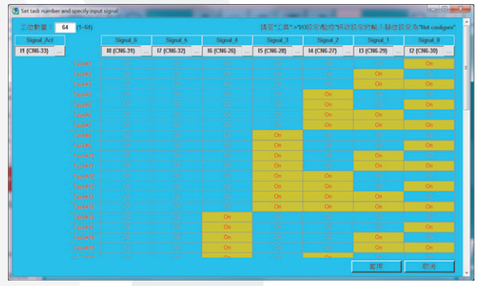


Multi-indexing function

4 Convenient and Useful

1. Absolute Movement
2. Relative Movement
3. JOG
4. Homing
5. Indexing movement-1 (Reset method: next motion)
6. Indexing movement-2 (Reset method: nearest motion)

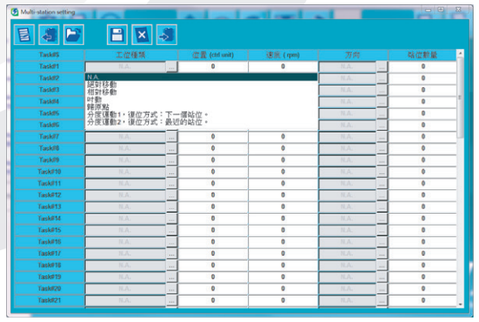
Up to 64 selections!



5 Rich Combinations to Choose

1. 1~64 selections
2. Binary options
3. Save the number of controller I/O

Easy programming with a drop-down list



6 Easy Operation

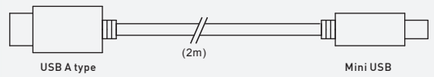
1. Free from complicated programming
2. User Experience design
3. Foolproof design

E1 Drive Specification

Rated Output			400W	1kW	2kW	4kW
Input Power	Single Phase Main Power	Rated Voltage (Line to Line)	AC 100 ~ 120 Vrms , 50~60 Hz AC 200 ~ 240 Vrms , 50~60 Hz		-	
		Rated Current (Arms)	2.9	6.5	-	-
	Three Phase Main Power	Rated Voltage (Line to Line)	AC 200 ~ 240 Vrms , 50~60 Hz			
		Rated Current (Arms)	1.46	3.3	11.3	17.0
	Control Power		1 Ø/AC 100 ~ 120 Vrms , 50~60 Hz		-	
			1 Ø/AC 200 ~240 Vrms , 50~60 Hz			
Output Power	Phase Voltage		3 Ø/AC 240 Vrms max.			
	Max Rated Power (W)		400	1k	2k	4k
	Peak Current (Arms)		10	23.3	42	75
	Rated Current (Arms)		2.5	5.6	12	25
	Cooling Method		Fan cooling			
	Control Method		IGBT PWM space vector control			
	PWM Modulation Frequency		16 kHz		8 kHz	
	Applicable Motor		AC/DM/LM			
	STAT LED Indicator		Blinking red: Error/Blinking green: Ready			
	CHARGE LED Indicator		Red: The main power is supplied./No light: The main power is not supplied.			
	Dynamic Brake		Built-in dynamic brake circuit/Delay time of relay: 20 ms			
	Built-in Resistor for Dynamic Brake		-	10 Ohm / 10 W		27 Ohm / 40 W
	Analog Output		Channel: 2/Resolution: 12 bit/Output voltage range: ±10 V/Accuracy: ±2%/ Maximum output current: ± 10 mA			
Control Function	Position Mode	Command Source	Pulse command from controller			
		Signal Type	Pulse / Direction, CW / CCW, AqB			
		Isolated Circuit	High-speed optical coupler			
		Input Signal	Differential input or single-ended input			
		Maximum Input Bandwidth	Differential: 5 Mpps / Single-ended: 200 kpps			
		Electronic Gear	Gear ratio: Pulses / Counts Pulses: 1~1,073,741,824 Counts: 1~1,073,741,824			
	Velocity Mode	Command Source	DC voltage command from controller			
		Impedance	14 kOhm			
		Signal Format	±10 Vdc			
		Maximum Input Bandwidth	100 Hz			
		Specification	16 bit A/D input (V-REF+/-)			
	Torque Mode	Command Source	DC voltage command from controller			
		Impedance	14 kOhm			
		Signal Format	±10 Vdc			
		Maximum Input Bandwidth	100 Hz			
		Specification	16 bit A/D input (T-REF+/-)			

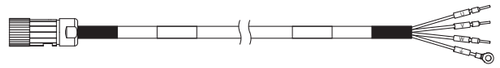
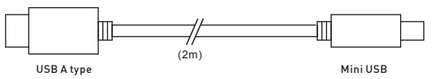
Rated Output			400W	1kW	2kW	4kW
	Control Mode		Position mode Velocity mode Torque mode Full-closed loop mode (Dual loop mode)			
Encoder	Power Supply		+5.1 Vdc±5%, 700 mA			
	Signal Format	Serial Signal	Resolution: 23 bit (Single-turn/multi-turn absolute encoder) Bandwidth: 5 MHz			
		Incremental Signal	AqB and Z-phase signals (Digital differential TTL signal) The maximum input bandwidth of each phase is 5 MHz			
	Safety Functions		Encoder power malfunction detection/Short circuit protection/Undervoltage protection /Overvoltage protection			
	Position Counting Range		-2,147,483,648~2,147,483,647 (32 bit)			
	Maximum Differential Input Bandwidth		Internal quadruple frequency 20 M counts/s			
	Linear Motor/Direct Drive Motor		Depending on encoder type, Excellent Smart Cube (ESC) may be required.			
Encoder Feedback	Emulated Encoder Output (Fieldbus servo drive does not support)	Z Phase	1. Serial encoder and incremental encoder (AqB、sin/cos) are supported. 2. The width of output signal can be adjusted by parameter. 3. Digital differential signal output 4. Z-phase open collector output is supported. 5. Two output methods can be selected. (a.) Only outputs one Z-phase signal for total travel distance. (b.) Outputs one Z-phase signal per one revolution.			
		A/B Phase	1. Serial encoder and digital encoder (AqB) are supported. 2. Differential signal output. The maximum output bandwidth is 18 Mcount/s. 3. The scaling of output can be adjusted. For instance, ten encoder counts = one emulated encoder count.			
Computer Communication	Standard USB2.0 (Mini USB type)		Connect the servo drive with your computer to set parameters, monitor physical quantities and operate manually via Thunder.			
General-purpose I/O	Input		The functions of general-purpose inputs (Optical couplers) can be defined by the user. E1 series servo drive provides ten general-purpose inputs (I1 to I10). Fieldbus servo drive only provides eight general-purpose inputs (I1 to I8) 24 V/5 mA (Each input pin)			
	Output		The functions of general-purpose outputs (Optical couplers) can be defined by users. E1 series servo drive provides five general-purpose outputs (O1 to O5) 24 V/0.1 A (Each output pin)			
	Position Trigger (PT)		Outputs are differential signals. The timing for the outputs and condition to trigger should be set with parameters.			
Regenerative Energy Protection	Regenerative Resistor		**400 W :** Without built-in regenerative resistor Connect to external regenerative resistor if needed. **1 kW/2 kW/4 kW :** With built-in regenerative resistor. Connect to external regenerative resistor to increase regenerative capacity.			
	Built-in Regenerative Resistor		-	40 Ohm / 40 W	12 Ohm / 60 W	13 Ohm / 120 W
	Protection of Regenerative Resistor Enabled		+HV > 370 Vdc			
	Protection of Regenerative Resistor Disabled		+HV < 360 Vdc			
	Overvoltage Protection		390 Vdc			
	Optional Function		Gantry synchronization control function			
Environment	Operating Temperature		0~45°C			
	Storage Temperature		-20°C~65°C			
	Humidity		Operating and storage temperature: 20 to 85% RH (Non-condensing)			
	Altitude		Altitude 1,000 M or lower above sea level			
	Vibrating		Less than 0.5 G, Frequency 10 to 500 Hz, (No continuous use under resonance frequency)			
	IP Rating		IP20			

E1 Dirive and Accessories-ABS

Part name	Model	Connector	Description
1 Drive	E1 Series	-	
2 Motor Power Cable	HVPS04AB□□MB	CN2	
3 Encoder Cable	HVE23IAB□□MB	CN7	
4 USB Communication Cable	051700800366	CN3	
5 Control Signal Cable	HE00EJ6DA300 (Standard 50 pins)	CN6	Connect servo drive (standard) to controller via CN6 to receive or send pulse command, voltage command, I/O signal, analog monitoring output signal, encoder output signal, etc. The cable (3m) is with open ends.
	HE00EJ6DC300 (Fieldbus 36 pins)		Send or receive I/O signal, analog monitoring output signal, encoder output signal, etc. via CN6 on Fieldbus servo drive. The cable (3 m) is with open ends.
6 EMC Accessory	051800200044 Filter (Single-phase power supply)	-	Single-phase filter FN2090-10-06, for 400 W ~ 1 kW models (rated current: 10 A, leakage current: 0.67 mA)
	051800200071 Filter (Three-phase power supply)	-	Three-phase filter FN3025HL-20-71, for 400 W ~ 4 kW model (rated current: 20 A, leakage current: 0.4 mA)

□□	03	05	07	10
Cable Length(m)	3	5	7	10

E1 Dirive and Accessories-INC

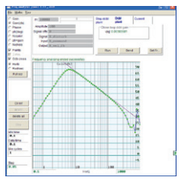
Part name	Model	Connector	Description
1 Drive	E1 Series	-	
2 Motor Power Cable	LMACS-□□0FE	CN2	
3 Excellent Smart Cube	ESC-SS-S01	-	Excellent Smart Cube (ESC) converts signals, such as encoder signal, signal of thermal sensor, Hall signal, etc. from the motor side into serial communication format for E1 series servo drive. For model explanation of Excellent Smart Cube (ESC), please refer to table below.
4 ESC Encoder Extension Cable	HE00EJWDA□00	-	 ESC to HIWIN direct drive motor with incremental feedback system (analog encoder)Internal digital Hall signal and thermal signal supported
5 ESC Encoder Communication Cable	HE00EJUDA□00	CN7	 For connecting ESC to CN7 on the servo drive
6 USB Communication Cable	051700800366	CN3	
7 Control Signal Cable	HE00EJ6DA300 (Standard 50 pins)	CN6	Connect servo drive (standard) to controller via CN6 to receive or send pulse command, voltage command, I/O signal, analog monitoring output signal, encoder output signal, etc. The cable (3 m) is with open ends.
	HE00EJ6DC300 (Fieldbus 36 pins)		Send or receive I/O signal, analog monitoring output signal, encoder output signal, etc. via CN6 on Fieldbus servo drive. The cable (3 m) is with open ends.
8 EMC Accessory	051800200044 Filter (Single-phase power supply)	-	Single-phase filter FN2090-10-06, for 400 W ~ 1 kW models (rated current: 10 A, leakage current: 0.67 mA)
	051800200071 Filter (Three-phase power supply)		Three-phase filter FN3025HL-20-71, for 400 W ~ 4 kW model (rated current: 20 A, leakage current: 0.4 mA)

□□	03	05	07	10
Cable Length(m)	3	5	7	10

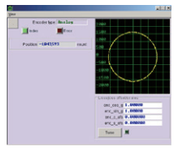
□	3	5	7	A
Cable Length(m)	3	5	7	10

D1 Drive

- 100-240 VAC power input
- Supports STP/DIR, CW/CCW, A/B pulse formats (differential/single-ended interface)
- Supports ±10V voltage or digital commands for velocity or force / torque modes
- Built-in function of error compensation, vibration suppression

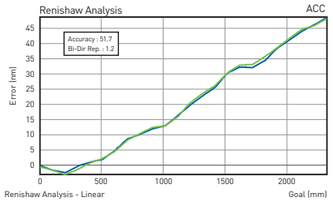


Optimization Tool
D1 provides powerful and easy-to-use optimization tools. A user can use the closed-loop frequency response function and a real-time response graph will be displayed on the PC. The best gain values of the system can be set easily ccording to the response graph.

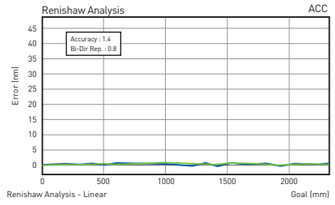


Analog Encoder Can Work with Resolution Units Smaller than Nanometer
When using an analog encoder, a user is allowed to set the resolution to very small units. D1 is able to realize precise control based on units smaller than a nanometer.

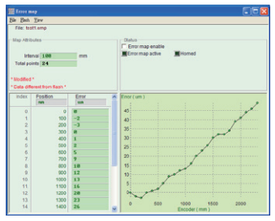
Error Mapping
D1 drive supports error mapping to encoder feedback and compensation table building, which contains up to 16,000 points. With this function, the positioning accuracy of the system can be optimized in any control mode.



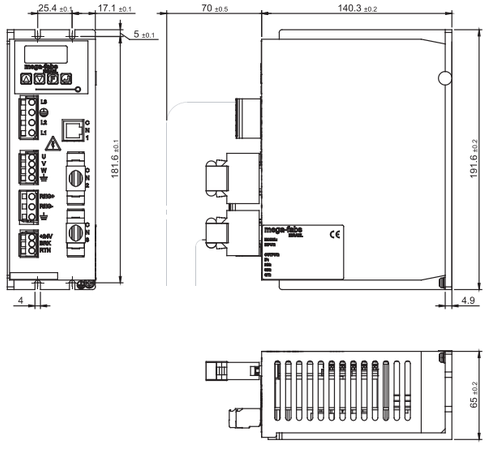
Before Error Mapping



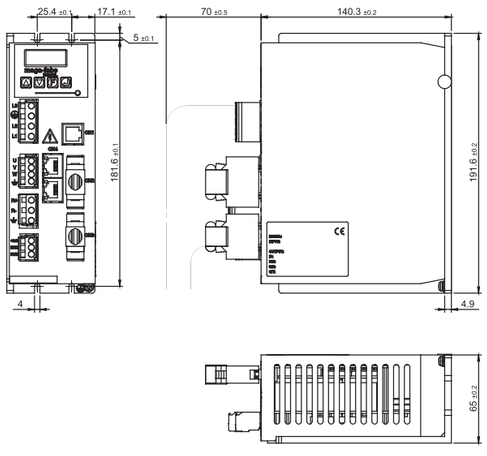
After Error Mapping



Standard



Fieldbus



D1 Model Description

D1-36-S2-2-0-00

Rated Output
36:36App

Communication Interface
S:Standard format RS232
(No fieldbus interface)
E:EtherCAT (CoE)
F: mega-ulink (mega-ulink)

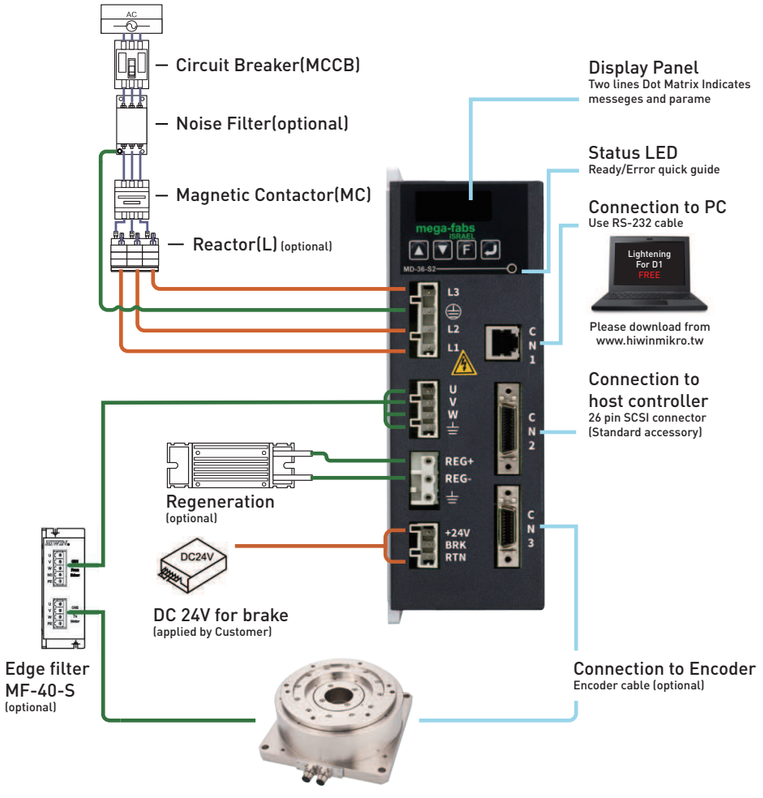
Encoder Type
2: Analog
3: Digital
4: Resolver

Input Voltage
2: Single/Three-Phase 220Vac

Heat Sink
0: Without heat sink
1: High profile (H1)

Reserved Code
00: Standard

D1 Wiring Diagram



D1 Basic Specifications

D1				D1-36
Input Power	Voltage			100-240 Vac ±10%
	Frequency			47 to 63 Hz
	Phase			1 Ø or 3 Ø
	Control Voltage			+24 Vdc ±10%
	Control Current			1A minimum
Output Power	Continuous Current			12 A_amp [8.5 A_rms] (Note: with external heat sink)
	Instantaneous Current			36 A_amp [25.4 A_rms]
	Allowable Continuous Time for Instantaneous Current			1 second maximum
Servo Drive Startup Time				1~2 seconds
Servo Drive Reset Time				3~4 seconds
Main Circuit Control				IGBT PWM space vector control
Control Motor Type				• 13 bit AC servo motor • Linear motor • Torque motor
Status LED Indicator	Servo Drive Status			Red: Error ; Green: Servo ready
Control Mode	Position Mode	Input Pin		[I9, I9M], [I10, I10M] differential inputs or I9, I10 single-ended inputs
		Pulse Command Type		• Pulse/Direction • CW/CCW • AqB
		The Maximum Input Pulse Frequency	Differential Signal	Pulse input (2 M pulses/s max.); Quad A/B (8 M counts/s max.)
			Singleended Signal	Pulse input (500 K pulses/s max.); Quad A/B (2 M counts/s max.)
		Command Source		Pulse from controller
		Electronic Gear		Electronic gear ratio: pulses/counts Pulses: 1~2147483647; Counts: 1~2147483647
	Velocity Mode	Analog Input Command	Input Impedance	10 KΩ
			Voltage Range	±10 Vdc
			Time Constant	2.2 us
			Resolution	12 bits
		Digital Input Command	PWM 100%	I9: PWM = 0% - 100% ; I10: Direction = 1/0
			PWM 50%	I9: PWM = 50% ± 50% ; I10: No function
			Frequency Range	36.5 KHz minimum, 100 KHz maximum
			Pulse Width Limit	220 ns minimum
		Command Source		Voltage or PWM from controller

D1				D1-36
Force/torque Mode	Analog Input Command			The specification is the same as the one in velocity mode
	Digital Input Command			The specification is the same as the one in velocity mode
	Command Source			Voltage or PWM from controller
Encoder Type	Operating Voltage			+5 Vdc ± 5% @400 mA
	Digital		Input Signal	A, /A, B, /B, Z, /Z, RS422 differential signal
			Bandwidth	5 MHz line frequency, x 4 frequency: 20 M counts/s
	Analog		Input Amplitude	1 Vpp (sin/cos), differential signal
			Bandwidth	1 MHz maximum line (cycle) frequency
			Resolution	Maximum 65528 counts/cycle
	Resolver			Sin/Cos, differential signal Reference 3 KHz, 6 Vpp, 100 mA
Encoder Counting Range				-2147483648~2147483647 (32 bits) The motor commutation is normal and is not affected by encoder counting range.
Buffered Encoder Output	Digital Encoder			• Without being processed by the servo drive, A/B phase signals are directly sent to the controller. (Maximum 18 M counts/s, digital AqB output, differential signal output) • Without being processed by the servo drive, Z phase signals are directly sent to the controller. (Differential signal) • The delay time between the time the servo drive receives encoder signal from the encoder and the time the servo drive outputs signal from output pin is less than 100 nanosecond (ns).
	Digital Encoder			• Maximum 18 M counts/s, digital AqB output, differential signal output • The resolution is the grating period of analog encoder/4. (If grating period = 40 µm, the resolution of buffered encoder output = 10 µm/count) • The delay time between the time the servo drive receives encoder signal from the encoder and the time the servo drive outputs signal from output pin is less than 100 nanosecond (ns).
Emulated Encoder Output				• Maximum 18 M counts/s, digital AqB output, differential signal output • The ratio of encoder input to emulated encoder output can be adjusted. The width of emulated index signal output can be adjusted. • Linear motor: (1)Outputs one index (Z phase) signal per travel distance Rotary motor: (1)Outputs one index (Z phase) signal per travel distance (2)Outputs one index (Z phase) signal per motor revolution • The maximum delay time between the time the servo drive receives encoder signal from the encoder and the time the servo drive outputs signal from output pin is 66.67 us.
Digital Hall Signal				Digital single-ended signal with 120 degrees phase difference HA, HB, HC
Communication	Interface			Connect to PC via RS232
	Protocol			• Full-duplex • Baud rate: 9,600 ~ 115,200 bps • Binary
Programmable I/O Interface	Digital Input			74HC14 Schmitt trigger input. Inputs [I1~I6] [I11, I12] [I9, I10]10 digital inputs are provided. Note: When I9 and I10 are set for digital inputs, they cannot be programmed as general inputs.

D1		D1-36
Digital Output		0.3 Adc max, +40 Vdc max (Open drain) [01~03]
Brake Output		Brake [04], 1 Adc max.
PDL Editor	The Maximum Storage for Codes	32K Bytes
	Storage for Variables	800 Bytes
	Supported Variable Type	Float: 32 bits ; Integer: 16 bits and 32 bits (Array and pointer are supported.)
	Execution Cycle	66.67 us
	Multitasking	Four tasks can be run at the same time.
	Control Commands for Program Flow	Supports commands such as "if", "else", "while loop", "for loop", "goto", "till", etc.
	Operator	Includes arithmetic operators, logic operators and comparison operators.
	Task Synchronization	Supports Lock and Unlock commands to perform task synchronization.
	Length Limit for User-defined Name	• Variable: 17 characters • Label: 24 characters • Proc: 24 characters
Regenerative Resistor	Resistor	External connection
	Voltage Threshold for Activation	+HV > 390 Vdc
	Voltage Threshold for Deactivation	+HV < 380 Vdc
	Hysteresis	10 V ± 0.5 Vdc
	DC Link Capacity	1880 uF
Protection Function		Short circuit, Overvoltage (> 400 Vdc ± 5%), Position error too big, Encoder error, Motor cable lost connection, Drive over temperature (IGBT > 80 oC± 3 oC), Motor over temperature, Undervoltage (< 60 Vdc), I2T current limit protection
Error Compensation	Applicable Motor	Linear motor
	Compensation Method	Creates error map table to compensate encoder error by means of linear interpolation.
	Storage Point	Maximum 5,000 points
	Storage Location	Flash ROM, disk file
	Unit	μm, count
	Enabling Method	• Enabled after internal homing completes. • Enabled by external input signal.
Frequency Suppression Range for Vibration Suppression Filter (VSF)		0.1 Hz~200 Hz
Environment	Operating Temperature	0~50 °C (If temperature is above 55 oC, forced ventilation will be required.)
	Storage Temperature	-20 °C ~65 °C
	Humidity	0 to 90%RH (No condensation)
	Altitude	Altitude 1000 M or lower
	Vibration	1G (10 to 500 Hz)
	IP Rating	IP20

D1	D1-36
Cooling	Natural cooling or external heat sinks
Weight	1,250 g (min.)
Dimensions	191.6 mm X 139.8 mm X 64.8 mm
Case	Complies with CE U.L. Spec 94 V-0 Flammability Rating

D1 Drive and Accessories

Part Name	Model	Connector	Description
1 Drive	D1-36-S2		For Incremental feedback types 
2 Motor Power Cable	LMACS□□F	Motor Connects (U,V,W)	For Direct Drive motors  Free leads Intercontec Model : BSTA880FR0886201A000
3 Position Signal Cable	LMACE□□AM	CN3	For incremental feedback types with hall sensor  Intercontec Model : ASTA876FR1085200A000 — Drive Connector(3M) Model : 10120-3000VE
4 RS-232 Cable	LMACR21D		To PC (about 2m long for mega-fabs drive)  D-SUB 9 Female — Drive RS-232 RJ-11
5 Controller Pulse Cable	LMACK30R	CN2	To motion controller (about 3m long)  Drive Connector(3M) Model : 10126-3000VE
6 Regen Resistor	050100700001		Rated 100W, Peak 500W
7 D1 Drive Accessory	D1-CK1		All Connector (Not Include CN3)
	D1-CK2		All Connector (Include CN3)
8 EMC Accessory	D1-EMC1		Used in Single Phase AC Power
	D1-EMC2		Used in Three Phase AC Power
9 Heat Sink	D1-H1		Standard
	D1-H2		Low Profile

□□	03	04	05	06	07	08	09	10
Cable Length (m)	3	4	5	6	7	8	9	10

Note: User must prepare one 24 V_{DC} power supply for each drive.

Pin Assignment

LMACE□□AM

Function	8-10-0090 (Female)	Signal	Color (051400300069)	SCSI 20 (Male)
Power	4	5V	Blue	3
	5	5V	Blue	-
	6	0V	White	2
Incremental Signal	2	U_2^-	Red	19
	3	U_1^-	Brown	17
	9	U_2^+	Black	18
	10	U_1^+	Green	16
Reference Mark	1	U_0^-	Pink	9
	8	U_0^+	Grey	8
	Case	Shield	Outer Shield	1
Temperature Switch	11	T+	Purple	14
	12	T-	Yellow	15
Hall Sensor	13	Vcc	Blue	3
	14	Hall A	Brown/Green	11
	15	Hall B	White/Yellow	12
	16	Hall C	White/Green	13
	17	GND	White	10

Appendix

Appendix A : Motor Sizing

Start Motor Sizing

The following contents describe how to choose a proper motor according to speed, moving distance, and loading inertia. The basic process for sizing a motor is:

Requirements

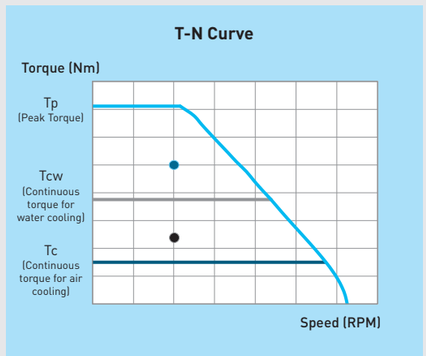
- Operating environment
- Installation (horizontal or vertical)
- Driving method
- Load conditions (loading inertia, friction and cutting force)
- Speed condition (maximum acceleration and velocity)
- Duty cycle

Torque Calculation

- Calculate the torque corresponding to the speed under each operation condition
- Calculate equivalent torque

Motor Sizing and T-N Curve Confirmation

- Select the appropriate motor from the HIWIN's catalogue in accordance with calculated maximum torque, equivalent torque and speed.
- Ensure the speed and the corresponding torque under all operating conditions are within the range of torque-speed curve of the motor.
- Confirm the equivalent torque is within the continuous torque of the motor.



Symbol :

θ: Angular displacement (rad)
t: Moving time(sec)
α: Angular acceleration(rad/s^2)
ω: Angular velocity (rad/s)
J: Load inertia(kgm^2)
J_m: Rotor inertia (kgm^2)
T_p: Peak torque (Nm)
T_c: Continuous torque (Nm)
T_i: Inertia torque(Nm)
K_t: Torque constant(Nm/Arms)
I_p: Peak current(Arms)
I_e: Equivalent current (Arms)
I_c: Continuous current(Arms)
ω0: Initial angular velocity(rad/s)
m:Loading Mass(kg)
R:External diameter of loading Mass(m)
r: Internal diameter of loading Mass(m)
a、b: Side length of loading Mass(m)
S:Distance from gravity center to rotary center(m)

STEP1 Requirements

In order to select the motor that meet user's needs, the following formula of load inertia motion must be understood prior to the selection.

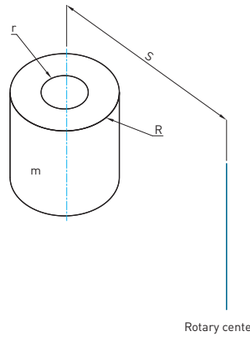
Calculation of loading inertia

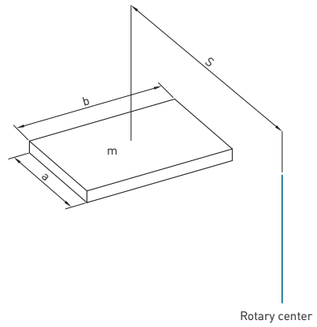
Loading inertia can be determined by 3D drawing software or according to the formula. The basic loading formula is as follows:
Moment of inertia of a hollow cylinder

$$J = m\left(\frac{R^2 + r^2}{2} + S^2\right)$$

Moment of inertia of a rectangular

$$J = m\left(\frac{a^2 + b^2}{12} + S^2\right)$$





Determine the motion speed and parameters

Basic kinematics equations are described as follows:

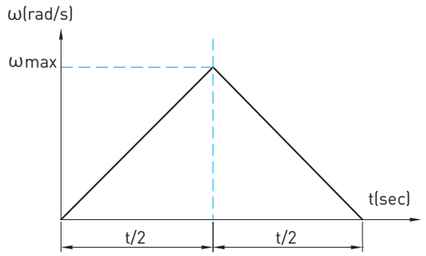
$$\omega = \omega_0 + \alpha t$$

$$\theta = \omega_0 t + \frac{1}{2}\alpha t^2$$

Where ω is angular velocity, α is angular acceleration, t is moving time and θ is angular displacement. Choose two of the four parameters (ω, α, t andθ) as user's designed parameters, then the left two parameters can be calculated by above equations.

Motion Velocity Profile

The motion profiles for direct drive motors are usually classified as "Trapezoid Profile" and "Triangle Profile", where the Trapezoid Profile is frequently used for scanning. The motion profiles are divided as acceleration, constant velocity and deceleration. The maximum angular acceleration can be determined by the basic kinematics equations above-mentioned; the Trapezoid Profile is usually used in point-to-point application. The motion profiles are divided as acceleration and deceleration, where the motion profile and formula can be simplified as follows:



$$\omega_{max} = 2 \times \frac{\theta}{t} \quad \text{or} \quad \omega_{max} = \sqrt{\alpha \times \theta}$$

$$\alpha_{max} = \frac{4\theta}{t^2}$$

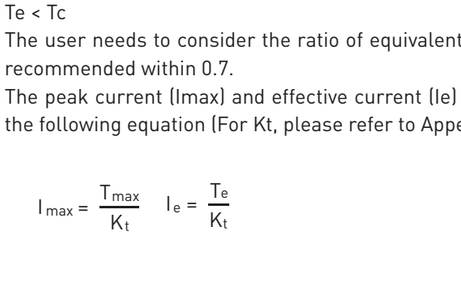
STEP 2 Torque Calculation

The maximum torque can be calculated by the following equation

$$T_{max} = (J + J_m) \times \alpha_{max} + T_f = T_i + T_f$$

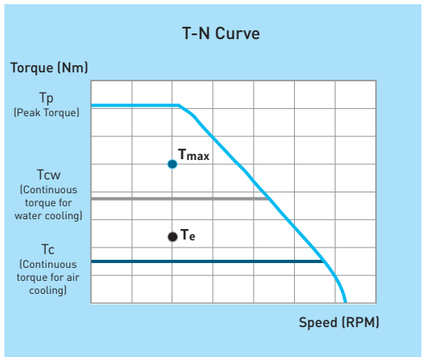
Where Ti is inertia torque, Tf is the torque which is caused by friction, cutting force or external force.In most cases, the motions are cyclic point-to-point movements. Assuming a cyclic motion shown in the following profile with a dwell time of t4 second, the effective force can be calculated as follows:

$$T_e = \sqrt{\frac{(T_i + T_f)^2 \times t_1 + T_f^2 \times t_2 + (T_i - T_f)^2 \times t_3}{t_1 + t_2 + t_3 + t_4}}$$



STEP 3 Motor Sizing and T-N curve Confirmation

With the help of HIWIN's motor specification, users can select the appropriate motor from peak torque and equivalent torque, and ensure the speed and torque under all operating conditions are within the range of the T-N curve for the motor.



The motor sizing is determined as follows:
Tmax <Tp
Te < Tc
The user needs to consider the ratio of equivalent torque and continuous torque. Usually the ratio (Te/Tc)is recommended within 0.7.
The peak current (Imax) and effective current (Ie) can be calculated by bringing motor torque constant into the following equation (For Kt, please refer to Appendix B)

$$I_{max} = \frac{T_{max}}{K_t} \quad I_e = \frac{T_e}{K_t}$$

Example of motor sizing

Loading requirement: An aluminum disc with ϕ500mm and 15mm thick without offset and weight is 12kg. There are eight jigs with 100x50x50mm on the aluminum disc at an interval of 45°. Each jig weighs 1 kg. The distance from the jig gravity center to the rotary center is 150mm, and the mechanical friction force is 2Nm.
Speed requirement: Each position 45° is completed in 0.3 seconds, and rests for 1 second.

STEP1 Requirement Confirmation

Calculation of loading inertia
Inertia of disc

$$J_1 = m\left(\frac{R^2 + r^2}{2} + S^2\right) = 12\left(\frac{0.25^2 + 0^2}{2} + 0^2\right) = 0.375\,kgm^2$$

Inertia of jig

$$J_2 = m\left(\frac{a^2 + b^2}{12} + S^2\right) = 1\left(\frac{0.1^2 + 0.05^2}{12} + 0.15^2\right) = 0.0235\,kgm^2$$

Total inertia

$$J = J_1 + 8 \times J_2 = 0.375 + 8 \times 0.0235 = 0.563\,kgm^2$$

Motion profile
It is a point-to-point application. The maximum angular velocity and the maximum angular acceleration are calculated as follows:

$$\theta = 45° = \frac{45 \times \pi}{180} = 0.7854\,rad$$

$$\omega_{max} = 2 \times \frac{\theta}{t} = 2 \times \frac{0.7854}{0.3} = 5.236\,rad/s = 50rpm$$

$$\alpha_{max} = \frac{4\theta}{t^2} = \frac{4 \times 0.7854}{0.3^2} = 34.91\,rad/s^2$$

STEP 2 Torque Calculation

It is recommended that the ratio loading inertia (J) over motor rotator inertia (Jm) be less than 150[1]. It can be roughly estimated 30 in motor sizing. Since J/30=0.563/30=0.019kgm², user can select the DMS34 (Jm=0.02 kgm²)

$$T_{max} = (J + J_m) \times \alpha_{max} + T_f = T_i + T_f = (0.563 + 0.02) \times 34.91 + 2 = 20.4 + 2 = 22.1Nm$$

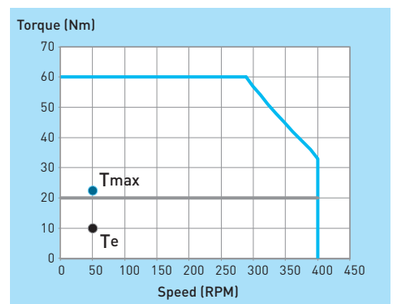
Where Ti=20.4Nm, Tf=2Nm

$$T_e = \sqrt{\frac{(T_i + T_f)^2 \times t_1 + T_f^2 \times t_2 + (T_i - T_f)^2 \times t_3}{t_1 + t_2 + t_3 + t_4}} = \sqrt{\frac{(20.4 + 2)^2 \times 0.15 + 2^2 \times 0 + (20.4 - 2)^2 \times 0.15}{0.15 + 0 + 0.15 + 1}} = 9.9Nm$$

Note:
* D1 series drives are recommended the inertia ratio less than 100, if over than 50 ,we recommended the motor with hall sensor.
* E1 series drives are recommended the inertia ration less than 150.

STEP 3 Motor Sizing and T-N curve Confirmation

Finally, DMS34 can be selected according to the Tmax and Te. The peak torque Tp=60Nm, the continuous torque Tc=20Nm, the torque constant Kt=6.6 Nm/Arms, and the speed/torque, Te, under all operating conditions are within the range of T-N curve for DMS34.



Appendix B : Glossary

1. Back EMF constant (Line to Line): $K_V \left(\frac{V_{rms}}{rad/s}\right)$

The back EMF constant, Kv, is the ratio of the back emf voltage (Vrms) to the motor rotational speed(rad/s) when the magnet is at 25°C. It is created at the movement of the coil in the magnetic field of permanent magnets.

2. Continuous current: I_c (A_{rms})

The continuous current, Ic, is the current that can be continuously supplied to the motor coils at the ambient temperature 25°C, and the final temperature of coil can't exceed 100°C. Under this condition, the motor reaches the rating continuous torque Tc; in relation with the continuous current and coil temperature.

3. Continuous torque: Tc (Nm)

The continuous torque, T_c, is the maximum torque the motor is able to generate continuously at the ambient temperature 25°C and the final temperature of coil can't exceed 100°C. This continuous torque corresponds to Ic supplied to the motor; in relation with the continuous current and coil temperature.

4. Inductance (line-to-line): L (mH)

Inductance is measured between lines when the motor operates in continuous current I_c/I_{cw}.

5. Resistance at 25°C (line-to-line): R_{25} (Ω)

Resistance is measured between lines when the motor operates at the coil temperature 25°C.

6. Motor constant: $K_m \left(\frac{Nm}{\sqrt{W}}\right)$

The motor constant, K_m, is defined as the ratio of the square root of motor output torque to consumption power when the coils and magnets are at 25°C. The larger motor constant represents the lower power loss when the motor outputs at the specific torque.

7. Number of poles: 2p

2p represents the number of poles of the rotor, where p is the number of pole pairs.

8. Peak current: I_p (Arms)

The peak current, Ip, is the current corresponding to maximum torque output of the motor, and the motor temperature reached by the current that will not demagnetize the magnet. Generally speaking, peak current can be granted to supply 1 second when the motor is operating in the normal condition, and then needs to ensure it reaches the normal temperature to supply peak current.

9. Peak torque: T_p (Nm)

The peak torque,Tp, is the maximum torque that the motor can output for less than 1 second. Peak current corresponding to the torque that will not demagnetize the magnet.

10. Rotor inertia: J (kgm^2)

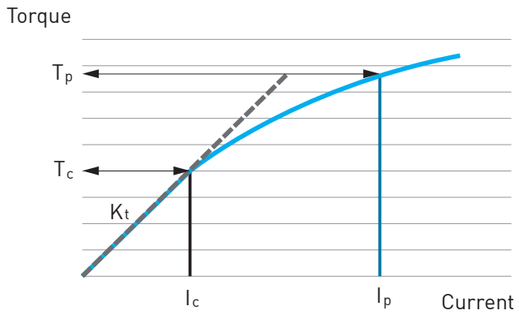
The rotor inertia, J, is the rotary component resistance any change in its state of motion, including changes to its speed and direction.It is related with the shape and mass.

11. Thermal resistance: Rth/Rthw (K/W)

The thermal resistance, R_{th}, is defined as the resistance heat suffered from motor coil by the heat dissipated into the environment. (Consider the natural convection and radiation for air cooling when ambient air is at 25°C, and the water cooling for water cooling when the water is at 25°C); Higher thermal resistance represents the larger temperature difference between the coil and environment under the same heat source.

12. Torque constant: K_t (Nm/Arms)

The torque constant, K_t, is the ratio between as the motor's output torque per RMS current.



13. Maximum speed (RPM)

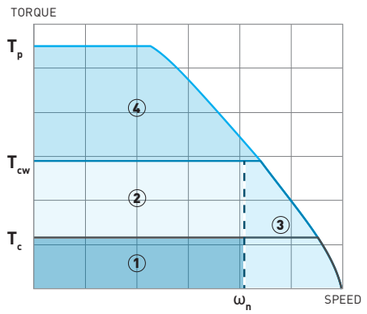
Maximum speed is defined as maximum speed provided under specific torque (usually continuous torque); if there is a bearing installed inside the motor, the maximum speed will be limited by the bearing's DN value. There are three conditions to define the maximum speed of a water-cooled motor: maximum speed under air-cooling continuous torque, maximum speed under water-cooling continuous torque and maximum speed under peak torque.

14. Rated speed: ωn(RPM)

The rated speed is defined as the speed at which when the motor is running continuously without a break and, the rotor does not suffer from excessive rotor temperature (>80 °C) due to iron loss, if the speed is exceeded, the duty cycle must be reduced or an additional rotor heat dissipation design must be done.Please refer to 17. T-N curve for details regarding motor operation range.

15. T-N Curve

The T-N curve is defined as the comparison chart of the torque and the speed that can be output under a certain input voltage of the motor. Considering the temperature rise of the motor, the figure can be divided into four operating ranges as shown below:



① When the motor is air-cooled and the torque is less than T_C, it can run continuously below ωn without break.
①+② When the motor is water-cooled and the torque is less than T_{CW}, it can run continuously below ω_n without break.
③ When the motor is air-cooled and the torque is less than T_C or when it is water-cooled and the torque is less than T_{CW}, the speed is greater than ω_n, the duty cycle must be reduced or additional design on rotor heat dissipation must be provided to avoid overheating of the rotor.
④ When the motor is air-cooled and the torque is greater than T_C or when it is water-cooled and the torque is greater than T_{CW}, the duty cycle must be reduced. When T_p is reached, only 1 second output is allowed to avoid overheating of the stator.

16. Maximum DC bus voltage

Maximum DC bus voltage is the maximum voltage for the motor operating in the normal environment.

17. Resolution: p/rev

Resolution is the quantity of the motor feedback points during one rotation.

18. Accuracy: arc-sec

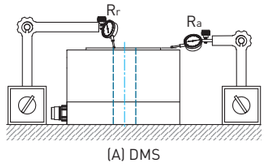
Accuracy is the error between the target position and the actual position; in the HIWIN's definition, the motor is measured clockwise and counterclockwise twice per 22.5° to take the maximum error.

19. (Bi-) Repeatability: arc-sec

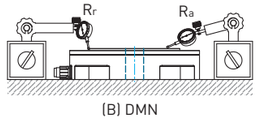
(Bi-)Repeatability is the repetition when the motor moves to the same angle.

20. Axial runout and radial runout:

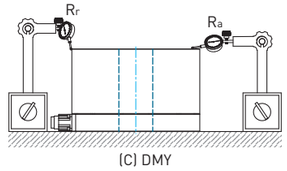
Axial runout is the runout R_a by measuring the parallel direction between the installation end and rotary axis when the motor rotates; radial runout is defined as runout R_r by measuring the vertical direction between the installation end and the rotary axis when the motor rotates. Due to different types of motor, refer to the figure below for the measurement criteria.



(A) DMS



(B) DMN

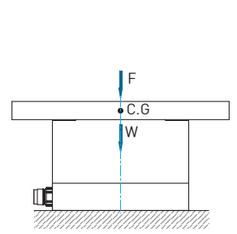


(C) DMY

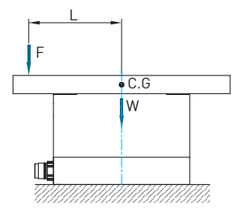
21. Loading capacity:

The load of motor must be considered when it is operating. The load can be calculated by external force and the installation to identify the motor structure tolerates or not. The axial force applied to the motor in the calculation needs be less than the maximum axial load $F_i < F_a$, and can be used when the applied torque needs to be less than the maximum torque load $M_i < M$.

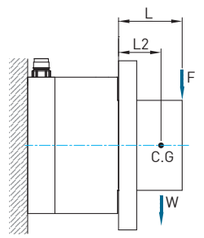
(A) External force=F
Axial force applied to the motor F_1=F+loading weight W
Torque applied to the motor M_1=0
(B) External force=F
Axial force applied to the motor F_2=F+loading weight W
Torque applied to the motor M_2 =FxL
(C) External force=F
Axial force applied to the motor F_3=F+loading weight W
Torque applied to the motor M_3 =Fx(L+0.03m)+Wx(L2+0.03m)



(A)



(B)

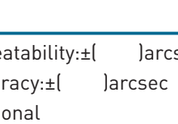
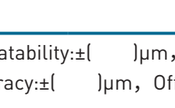
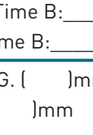
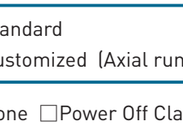
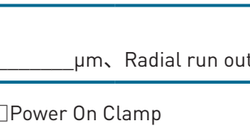
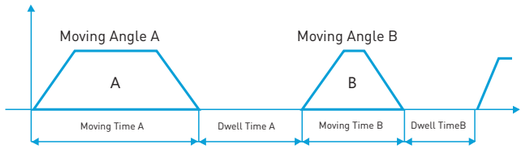


(C)

Appendix C : Environment

Operating Temperature	Temperature	+5 to +40°C
	Humidity	20 to 85% RH (no condensation)
Storage Temperature	Temperature	-10 to +50°C
	Humidity	20 to 85% RH (no condensation)
Atmosphere	Under 1000m, no corrosive gas, liquid and powder	

Appendix D : Motor Inquiry Form

Company Name:	Email:	Tel:	
Industrial:		Project Name:	
Environment	☐Normal environment(25°C)	☐Clean room,Class:	
	☐Polluted environment	☐Other:	
Installation	☐Horizontal 	☐Upside Down 	☐Laterally 
Load Type	☐ 	☐ 	☐Other
Load Conditions	Total moment of inertia: _____kgm^2 , Size:_____mm Separate document ☐Attached ☐Not attached		
	☐Balanced load (Number: _____,Mass:_____or Material:_____,Size: _____)		
	☐Unbalanced load (Number:_____,Mass:_____or Material:_____,Size:_____,Offset of C.G.:_____mm)		
	Note:		
Force	☐None ☐Yes:____kg,Offset of C.G.:____mm ☐At all times ☐When stopped ☐When rotating		
Application		☐Point to Point ☐Scan Moving Angle A:_____° Moving Time A:_____sec Dwell Time A:_____sec Moving Angle B:_____° Moving Time B:_____sec Dwell Time B:_____sec	
Required Accuracy	Repeatability:±( )arcsec *Repeatability:±( )μm，Offset of C.G. ( )mm Accuracy:±( )arcsec *Accuracy:±( )μm，Offset of C.G. ( )mm *optional		
Table Surface Rotation Accuracy	☐Standard ☐Customized (Axial run out_____μm、Radial run out_____μm)		
Clamp	☐None ☐Power Off Clamp ☐Power On Clamp		
Other Requirements			

Appendix E : FAQ

1. The difference between inner rotation type and outer rotation type direct drive motors

If we compare an inner rotation type and an outer rotation type direct drive motors of the same size, the outer rotation type one has larger torque. This is because its mechanical structure has a moment arm of a great distance. The inertia of the outer rotation type rotators is naturally bigger than that of the inner rotation type rotators. Therefore, when the outer rotation type motors work with loads, the inertia of the load is smaller, which makes control easier.

2. The comparison between mechanical transmission and direct drive motors

Mechanical transmission refers to motion performed by reducers, belts, worm gears and ball screws. Comparisons are listed in below table:

	Mechanical Transmission	Direct Drive Motors	
Structure	Complicated	Simple	
Size	Bigger	Smaller	
Accuracy	Low	(Very) High	Resulted from backlash
Noise	Loud	Quiet	
Duration	Short	Long	
Control and Drive	Simple	Complicated	
Maximum Speed	Low	High	Resulted from speed reduction ratio

3. Axial runout and radial runout

Radial runout is more influential to direct drive motor applications. When the workpiece is put on the motor, the radial runout shows the up and down swing of the rotating workpiece, which may have negative effect on the machining and processing.

4. The effect of motor inertia

The inertia of a servo motor is usually less than 15 or 10 times. This principle does not apply to direct drive motors in automation tasks. The best principle of the load inertia of a direct drive motor is less than 80 times.

5. The meaning of continuous torque and peak torque to the motor

Continuous torque is the torque powered by continuous current. Peak torque is the torque powered by peak current. Peak current cannot be input continuously. It can be input for only a few seconds or less; otherwise, the motor will be damaged.

Practically, peak torque is used during acceleration or deceleration. We can imagine a sprinter's energy output maximizes during acceleration or deceleration; However, the the sprinter cannot run a long distance without rest. Continuous torque is used to compare with equivalent torque, which is calculated from actual motion. If equivalent torque is less than continuous torque, the design should work well. If equivalent torque is greater than continuous torque, the motor will over-heat.

6. Position clamp and safety clamp

Position clamp: To clamp when the motor is in position. Reduce the resistance of the motor to outer

Safety clamp: To prevent the equipment from collision or moving caused by powering off.

Direct Drive Motor Technical Information

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