



Torque Motor (Direct Drive Motor)

Technical Information





Linear Motor Stage

- Automated transport / AOI application / Precision / Semiconductor
- With Iron-core
 - Coreless Type
 - Linear Turbo LMT
 - Planar Servo Motor
 - Air Bearing Platform
 - X-Y Stage
 - Gantry Systems



Linear Motor

- Machine tool / Touch panel industry / Semiconductor industry / Laser manufacturing machine / Glass cutting machine
- Ironcore linear motor-LMFA series, LMSA series, LMSC series
 - Ironless linear motor-LMC series, LMT series



Torque Motor (Direct Drive Motor)

- Inspection / Testing equipment / Machine tools / Robot
- Rotary Tables-TMS,TMY,TMN
 - TMRW Series
 - TMRI Series



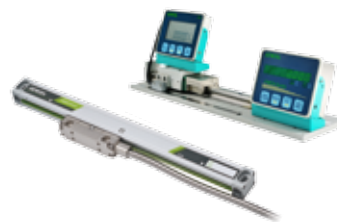
AC Servo Motor & Drive

- Semiconductor / Packaging machine / SMT / Food industry / LCD
- Drives-D1, D1-N, D2T
 - Motors-50W-2000W



Linear Actuator

- Hospital bed / Automatic window / Home care facility / Riveting / Press-fitting / Surface checks / Bending
- Servo Actuator-LAA series
 - LAM series
 - LAS series
 - LAN series
 - LAC series



Positioning Measurement System

- Cutting machines / Traditional gantry milling machines / Programmable drilling machines
- High Resolution
 - Signal Translator
 - High-precision Enclosed
 - High Efficiency Counter



Multi Axis Robot

- Pick-and-place / Assembly / Array and packaging / Semiconductor / Electro-Optical industry / Automotive industry / Food industry
- Articulated Robot
 - Delta Robot
 - SCARA Robot
 - Wafer Robot
 - Electric Gripper
 - Integrated Electric Gripper
 - Rotary Joint



Single Axis Robot

- Precision / Semiconductor / Medical / FPD
- KK, SK
 - KS, KA
 - KU, KE, KC



Medical Equipment

- Hospital / Rehabilitation centers / Nursing homes
- Robotic Gait Training System
 - Hygiene System
 - Robotic Endoscope Holder



Ball screw


- Precision Ground / Rolled
- Super S series
 - Super T series
 - Mini Roller
 - Ecological & Economical lubrication Module E2
 - Rotating Nut (R1)
 - Energy-Saving & Thermal-Controlling (C1)
 - 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




Torque Motor Rotary Table

Type	Size (mm)	Peak Torque (Nm)																	Accuracy (arcsec)	Repeatability (arcsec)	Page	Drive		Motor Power Cable		Encoder Cable		Features	Applications
		4.2	9	12	18	24	30	40	45	60	75	90	120	150	180	225	300	450				Type	Page	Type	Page	Type	Page		
TMN	118x118																		±10/±45	± 2.5	15		39	LMACS□□F	39	40	LMACE□□AA LMACE□□AM (With Hall sensor)	· Low profile · Hollow shaft · External rotary table	· LED inspection/processing · Semi-conductor transport, inspection/porcessing · Each kind of Assembly machines
	180x180																												
	230x230																												
	180x180																												
	230x230																												
TMY	φ 110																	±30	± 3	9		39	LMACS□□F	39	40	TMYxxG: LMACE□□AA	· External rotary table · High speed	· P&P · Turntable · Inspection machine · Automatic assembly machine · CD/DVD Mfg. system	
	φ 170																												
	φ 270																												
TMS	φ 110																	±10/±25	± 3	3		39	LMACS□□F	39	40	LMACE□□AA LMACE□□AM (With Hall sensor)	· Large torque · High precision	· P&P · Turntable · Index table · High-speed placement machine · Automatic assembly machine	
	φ 150																												
	φ 200																												
	φ 300																												

TMRW Torque motor

	External diameter (mm)	Peak Torque (Nm)														Page		
		36	60	66	83	112	120	119	156	178	203	223	280	335	390		583	
Torque motor	160	 TMRW13 TMRW13L	 TMRW15 TMRW15L		 TMRW17 TMRW17L			 TMRW1A TMRW1AL		 TMRW1F TMRW1FL								18
	198			 TMRW23 TMRW23L		 TMRW25 TMRW25L			 TMRW27 TMRW27L			 TMRW2A TMRW2AL		 TMRW2F TMRW2FL				20
	230						 TMRW43 TMRW43L					 TMRW45 TMRW45L		 TMRW47 TMRW47L		 TMRW4A TMRW4AL	 TMRW4F TMRW4FL	22

	External diameter (mm)	Peak Torque (Nm)														Page		
		275	456	490	640	750	810	910	1100	1230	1360	1600	1760	2400	2470		3600	
Torque motor	310	 TMRW73 TMRW73L	 TMRW75 TMRW75L		 TMRW77 TMRW77L			 TMRW7A TMRW7AL			 TMRW7F TMRW7FL							24
	385			 TMRWA3 TMRWA3L			 TMRWA5 TMRWA5L		 TMRWA7 TMRWA7L			 TMRWAA TMRWAAL		 TMRWAF TMRWAF				26
	485					 TMRWD3 TMRWD3L				 TMRWD5 TMRWD5L			 TMRWD7 TMRWD7L		 TMRWDA TMRWDAL	 TMRWDF TMRWDF	28	

	External diameter (mm)	Peak Torque (Nm)														Page		
														2360	3340		5020	
Torque motor	565														 TMRWG7 TMRWG7L	 TMRWGA TMRWGAL	 TMRWGF TMRWGFL	30

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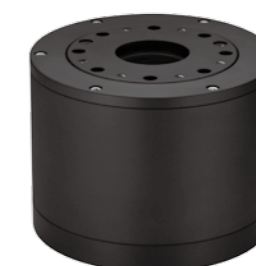


1. Torque Motor Rotary Tables

1.1 Product Overview and Applications

An extremely rigid connection between motor and load, and a servo-drive regulation ensures excellent acceleration capabilities and good uniformity of movement. HIWIN rotary tables and torque motors are especially well suited for tasks in automation due to the hollow shaft design. Media, cable systems or mechanical parts can be fed through without problems.

- No backlash
- Drive free of clearance
- Hollow shaft
- No gear transmission losses
- Maintenance free and compact
- Brush-free drive
- Extremely rigid support with cross-roller bearing
- IP65 available for TMS Series
- Integrated brake is available as an option
- Hall sensor is available as an option



Short and compact: HIWIN rotary tables are optimized for high torques and robust dynamics.

Table 1.1 Applications of Rotary Tables

Classification	Application	Features and Applications					
		Accuracy	Speed	Rigidity	Compactness	Cleanliness	Maintenance Free
Production equipment	CVD, wafer cleaning, ion implantation	○			○	○	○
	Semi-conductor transport, inspection/processing	○			○	○	○
Assembly machines	Assembly machines for electric components	○	○		○	○	○
	High-speed assembly machines for electronic components	○	○		○	○	○
	Various assembly machines	○	○		○	○	○
Machine tools	Tool changers		○		○		○
	C axis	○		○	○		○
Inspection/testing equipment	Machine part inspection	○			○		○
	Inspection of electric components	○			○		○
	Inspection of optical components	○			○		○
	Chemical analysis of liquids		○			○	○
	Various Inspection/testing equipment	○			○		○
Robots	Various assembly robots	○	○	○	○		○
	Various transport robots	○	○		○		○
	Inspection/Transport robots in clean rooms	○	○		○	○	○

1.2 TMS Rotary Tables

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

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



■ Model Numbers for TMS Series

	Motor specification					Function				
	TM	S	3	2	L	G	H	B	P	C
Series										
TM : Torque Motor										
Type										
S : Internal rotary table										
Size										
0 : External diameter Φ 110mm										
1 : External diameter Φ 150mm										
3 : External diameter Φ 200mm										
7 : External diameter Φ 300mm										
Rotor height										
2 : 20mm										
3 : 30mm										
4 : 40mm										
6 : 60mm										
8 : 80mm										
C : 120mm										
Wiring Code										
: Standard										
L : Low Back emf										
Feedback system										
G : Incremental										
Hall sensor										
: Without Hall sensor										
H : With Hall sensor										
Brake										
: Without brake										
B : With power-on brake (TMS1, TMS3, TMS7 Series)										
International Protection Standard										
: IP40(Standard)										
P : IP65										
Optional Specifications										
: Standard										
C : Customized										

1.2.1 TMS0 Series

TMS0 Dimensions

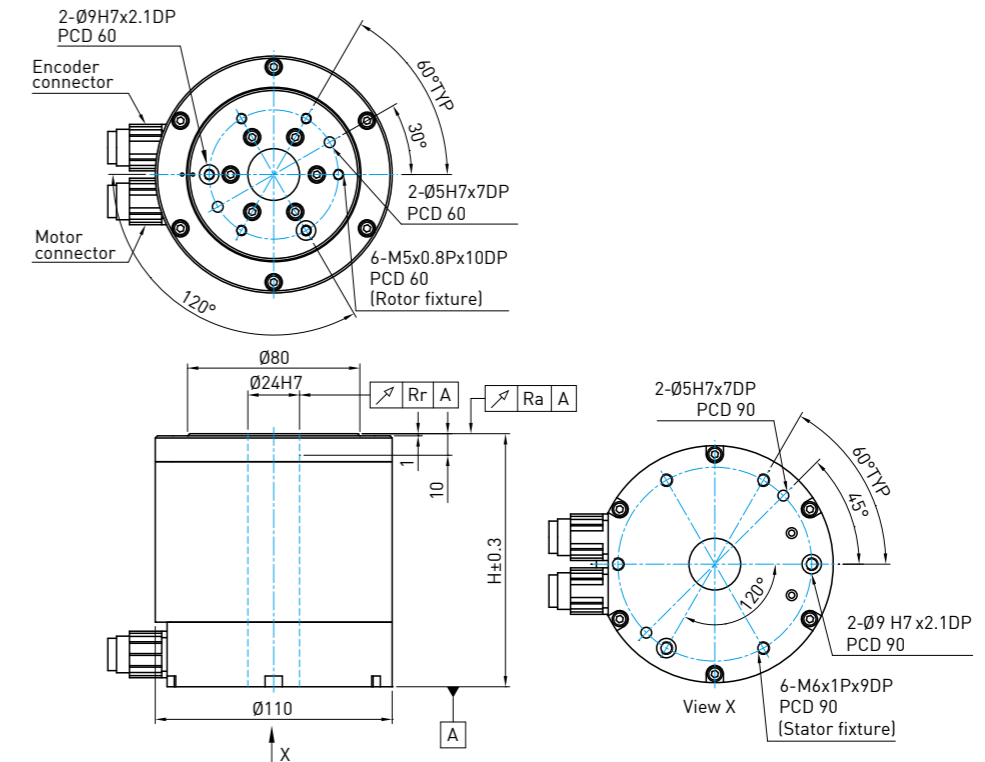


Table 1.2 TMS0 Specifications

	Symbol	Unit	TMS03G	TMS07G
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	$2p$		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
Nominal input voltage		V_{DC}		500(600 ²⁾)
Inertia of rotating parts	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	4,325,376 (Incremental, sin/cos 1Vpp)	
Repeatability		arc-sec	±3	
Accuracy		arc-sec	±45/±10 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

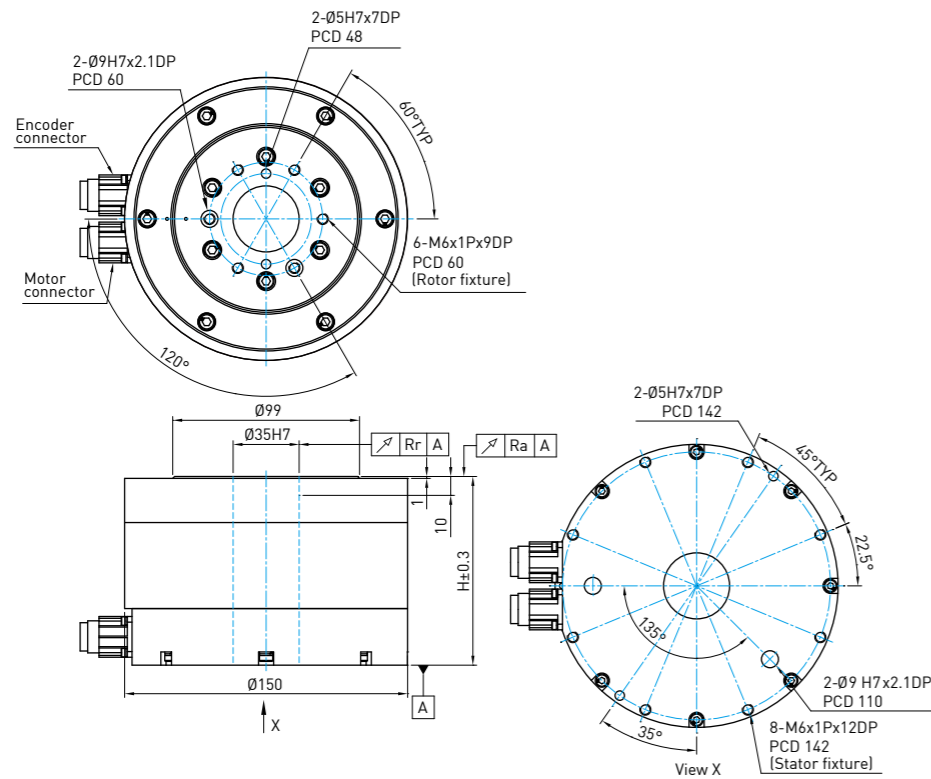
Note : ¹⁾ After error mapping

²⁾ Optional

*All the specifications in the table are in $\pm 10\%$ of tolerance except dimensions.

1.2.2 TMS1 Series

TMS1 Dimensions



1.2.3 TMS3 Series

TMS3 Dimensions

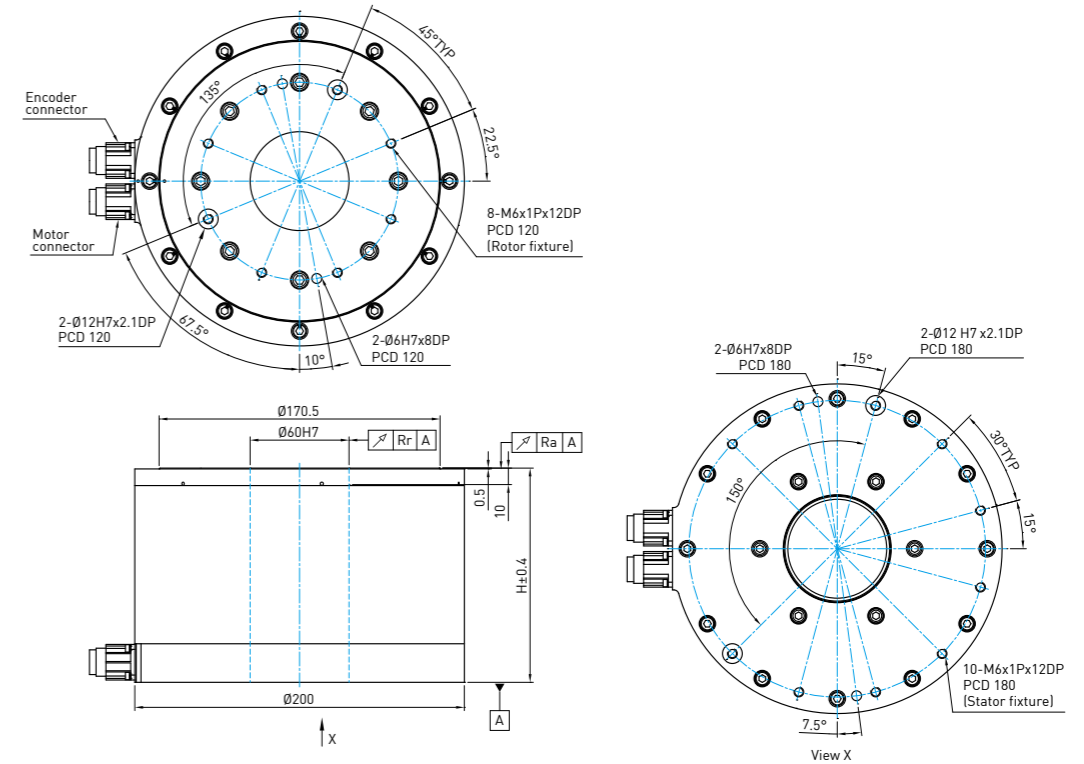


Table 1.3 TMS1 Specifications

	Symbol	Unit	TMS12G	TMS14G	TMS16G	TMS18G
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/√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			
Nominal input voltage	V _{dc}		500(600 ²)			
Inertia of rotating parts	J	kgm ²	0.006	0.0065	0.007	0.0075
Mass of motor	M _m	kg	7.2	8.5	9.8	11
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 (Incremental, sin/cos 1Vpp)			
Repeatability		arc-sec	±3			
Accuracy		arc-sec	±45/±10 ¹¹			
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 : ¹After error mapping

²Optional

*All the specifications in the table are in ±10% of tolerance except dimensions.

Table 1.4 TMS3 Specifications

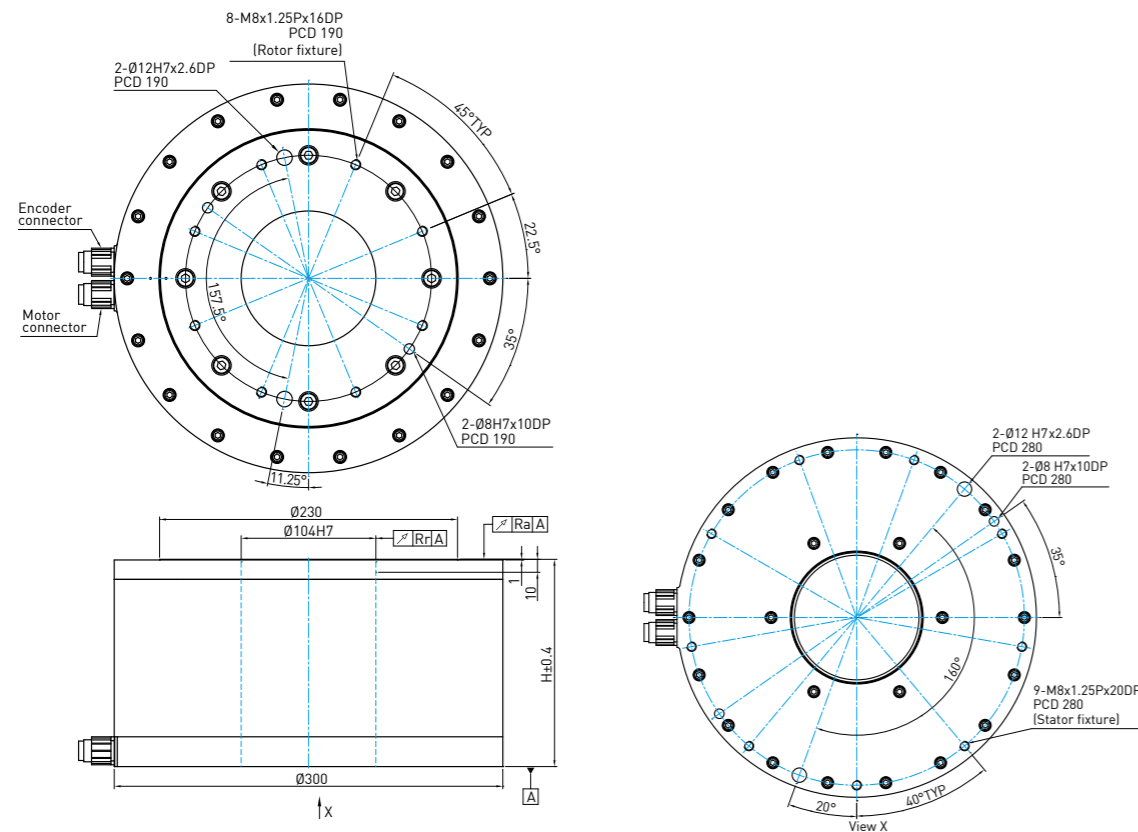
	Symbol	Unit	TMS32G	TMS34G	TMS34LG	TMS38G	TMS38LG	TMS3CG	TMS3CLG
Continuous torque	T _c	Nm	10	20	20	40	40	60	60
Continuous current	I _c	A _{rms}	3	3	6	3	6	3	6
Peak torque (Within 1s.)	T _p	Nm	30	60	60	120	120	180	180
Peak current (Within 1s.)	I _p	A _{rms}	9	9	18	9	18	9	18
Torque constant	K _t	Nm/A _{rms}	3.3	6.6	3.3	13.3	6.65	20	10
Electrical time constant	T _e	ms	4.7	4.8	4.4	5.3	4.5	5.9	5
Resistance (line to line at 25°C)	R ₂₅	Ω	5.8	8.4	1.7	13.6	2.9	18.8	3.9
Inductance (line to line)	L	mH	27	40	7.5	71.5	13	111	19.5
Number of poles	2 _p		22	22	22	22	22	22	22
Back emf constant (line to line)	K _v	V _{rms} /(rad/s)	1.6	3.2	1.6	6.4	3.2	9.6	4.8
Motor constant (line to line at 25°C)	K _m	Nm/√W	1.1	1.9	2.1	2.9	3.2	3.8	4.1
Thermal resistance	R _{th}	K/W	0.96	0.66	0.82	0.41	0.48	0.3	0.36
Temperature sensor			PTC SNM100						
Nominal input voltage	V _{dc}		500(600 ²)						
Inertia of rotating parts	J	kgm ²	0.014	0.02	0.02	0.026	0.026	0.035	0.035
Mass of motor	M _m	kg	14	17	17	22.5	22.5	28.5	28.5
Max. axial load	F _a	N	8000	8000	8000	8000	8000	8000	8000
Max. moment load	M	Nm	240	240	240	240	240	240	240
Max. speed		rpm	120	400	600	200	450	120	300
Resolution		p/rev	4,320,000 (Incremental, sin/cos 1Vpp)						
Repeatability		arc-sec	±2.5						
Accuracy		arc-sec	±25/±10 ¹¹						
Axial runout	R _a	mm	0.03(0.005 ²)						
Radial runout	R _r	mm	0.03(0.015 ²)						
Height	H	mm	130	150	150	190	190	230	230

Note : ¹After error mapping

²Optional

*All the specifications in the table are in ±10% of tolerance except dimensions.

1.2.4 TMS7 Series TMS7 Dimensions



1.2.5 TMS Series T-N curves (DC bus voltage=325Vdc)

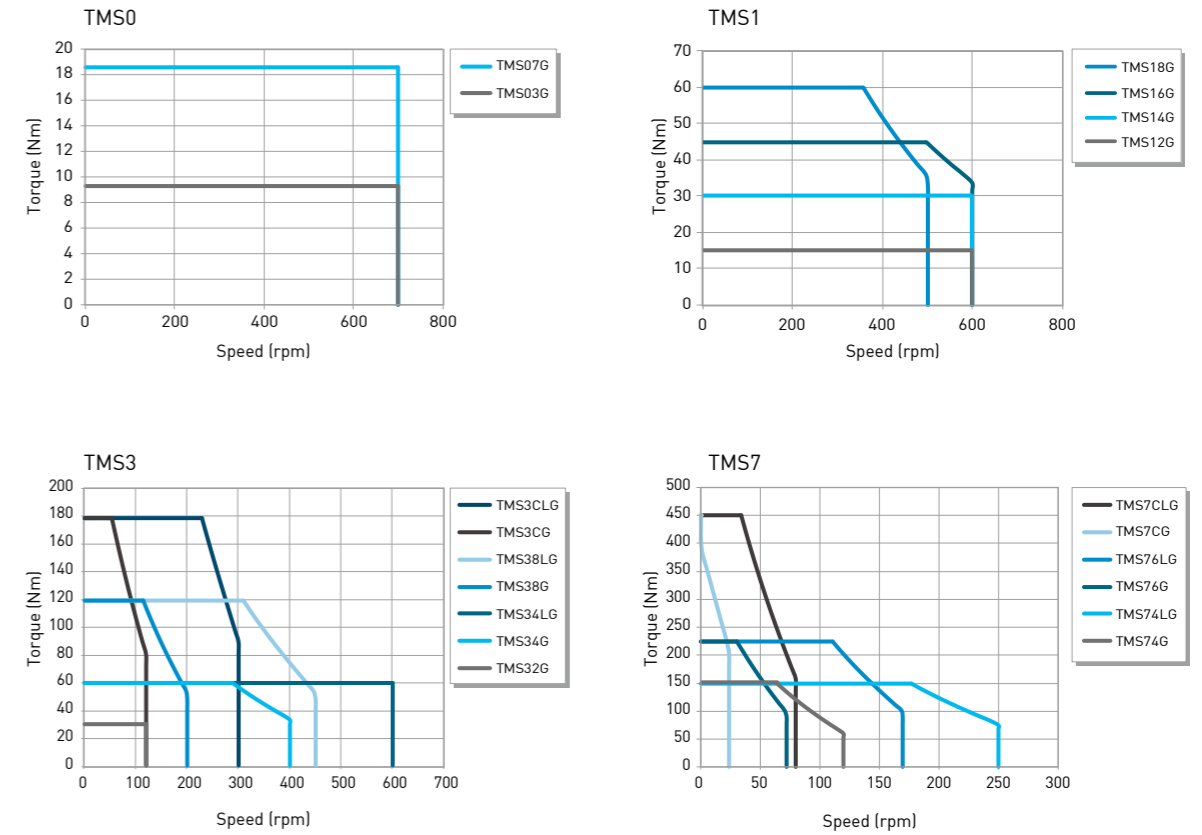


Table 1.5 TMS7 Specifications

	Symbol	Unit	TMS74G	TMS74LG	TMS76G	TMS76LG	TMS7CG	TMS7CLG
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	5	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	70	17.5	96.5	24.1	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/√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					
Nominal input voltage		V _{DC}	500(600 ²)					
Inertia of rotating parts	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 (Incremental, sin/cos 1Vpp)					
Repeatability		arc-sec	±2.5					
Accuracy		arc-sec	±25/±10 ¹¹					
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

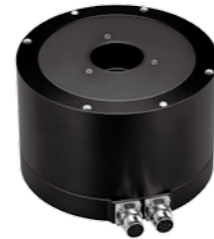
Note : ¹ After error mapping
² Optional

*All the specifications in the table are in ±10% of tolerance except dimensions.

1.3 TMY Rotary Tables

The TMY series is designed with an intergrated, high resolution feedback system which is optimized to achieve high dynamic motion, high torque and high precision. The TMY 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
- Maximum torque: 12~300 Nm
- Compatible with special environments



Model Numbers for TMY Series

Motor specification					Function
TM	Y	6	3	G	C

- Series
TM : Torque Motor
- Type
Y : Absolute resolver type
- Size
4 : External diameter Φ 110mm
6 : External diameter Φ 170mm
A : External diameter Φ 270mm
- Rotor height
3 : 30mm
4 : 40mm
5 : 50mm
8 : 80mm
A : 100mm
- Feedback system
: Absolute
G : Incremental (TMY6x/TMYAx)
- Optional Specifications
: Standard
C : Customized

1.3.1 TMY4 Series

TMY4 Dimensions

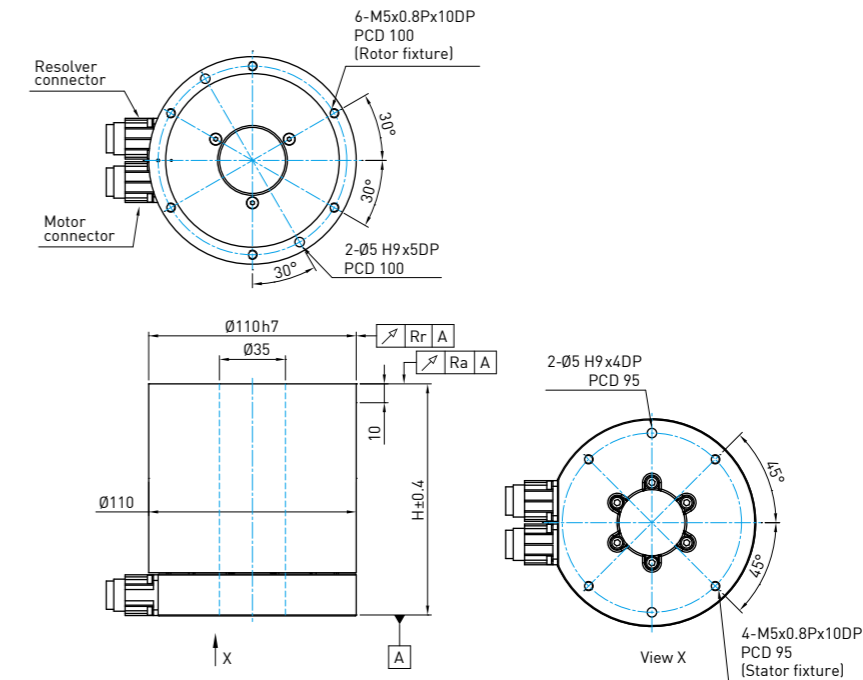


Table 1.6 TMY4 Specifications

	Symbol	Unit	TMY44	TMY48
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				PTC SNM100
Nominal input voltage		V _{DC}		500(600 ²⁾)
Inertia of rotating parts	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	300	300
Resolution		p/rev		920,000 (Absolute ¹⁾)
Repeatability		arc-sec		±3
Accuracy		arc-sec		±30
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⁾ The motor should be matched with corresponding HIWIN drive.

²⁾ Optional

*All the specifications in the table are in $\pm 10\%$ of tolerance except dimensions.

1.3.2 TMY6 Series

TMY6 Dimensions

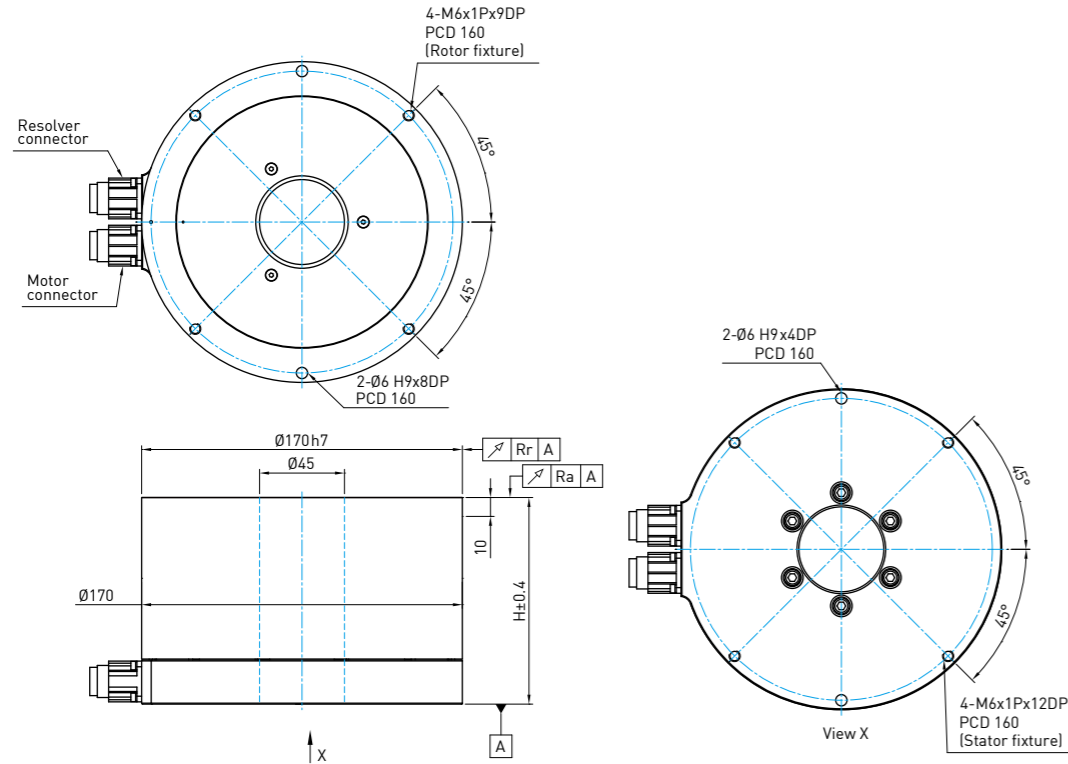


Table 1.7 TMY6 Specifications

	Symbol	Unit	TMY63G	TMY63D	TMY65G	TMY65D	TMY68G	TMY68D
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	$2p$		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					
Nominal input voltage	V_{dc}		500(600 ²)					
Inertia of rotating parts	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	300	500	300	400	300
Resolution ¹⁾		p/rev	4,320,000	920,000	4,320,000	920,000	4,320,000	920,000
Repeatability		arc-sec	± 3					
Accuracy		arc-sec	± 30					
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⁾ Incremental type with sin/cos 1Vpp, absolute type should be matched with corresponding HIWIN drive.
²⁾ Optional
 *All the specifications in the table are in $\pm 10\%$ of tolerance except dimensions.

1.3.3 TMYA Series

TMYA Dimensions

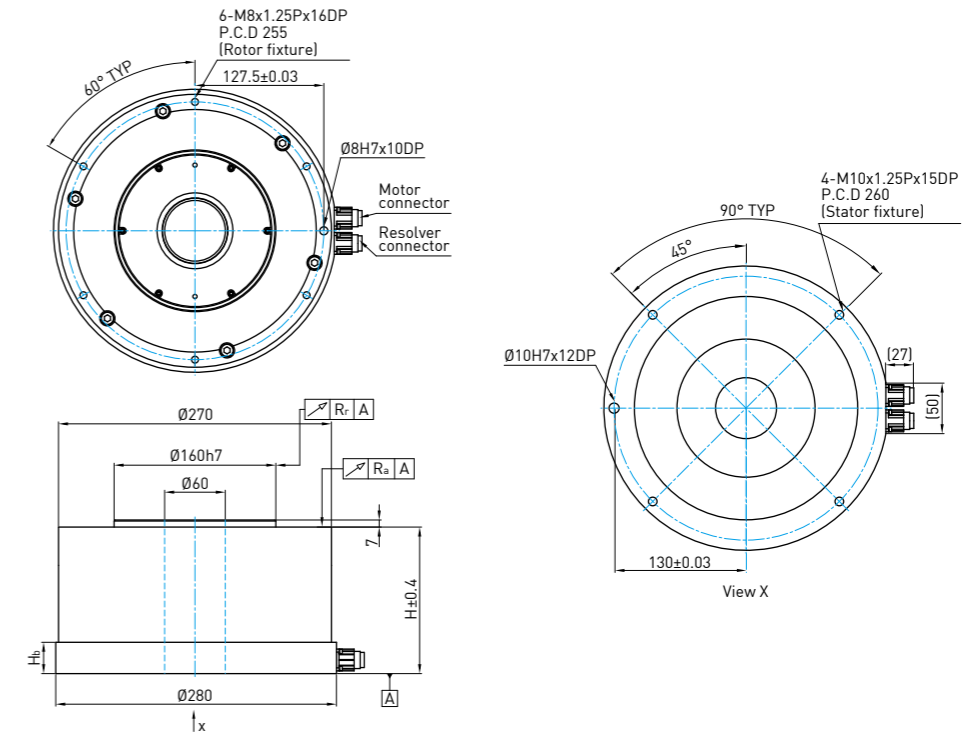


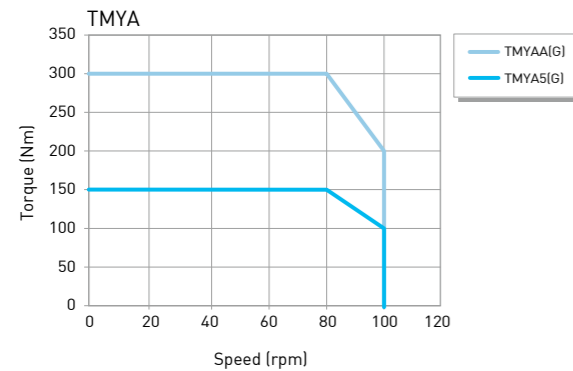
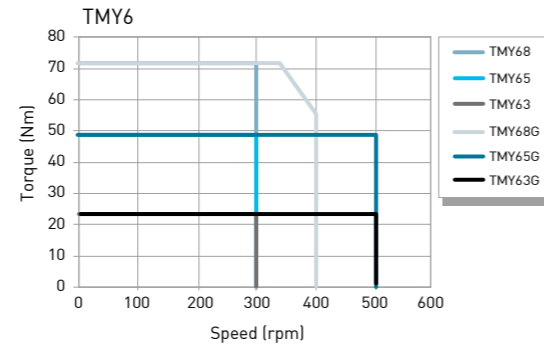
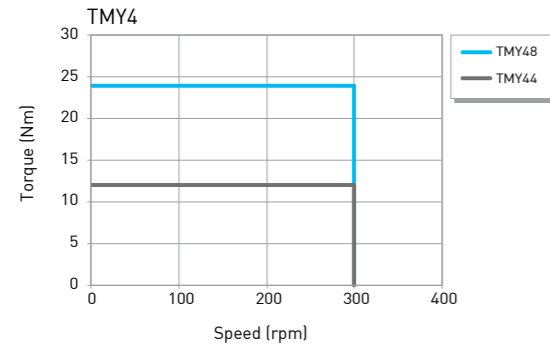
Table 1.8 TMYA Specifications

	Symbol	Unit	TMYA5G	TMYA5D	TMYAAG	TMYAAD
Continuous torque	T_c	Nm	50		100	
Continuous current	I_c	A_{rms}	2.2		4.4	
Peak torque (Within 1s.)	T_p	Nm	150		300	
Peak current (Within 1s.)	I_p	A_{rms}	6.6		13.2	
Torque constant	K_t	Nm/ A_{rms}	22.5		22.5	
Electrical time constant	T_e	ms	13.2		13.3	
Resistance (line to line at 25°C)	R_{25}	Ω	13.3		5.8	
Inductance (line to line)	L	mH	170		77	
Number of poles	$2p$		22		22	
Back emf constant (line to line)	K_v	$V_{rms}/(rad/s)$	13		13	
Motor constant (line to line at 25°C)	K_m	Nm/\sqrt{W}	5		7.6	
Thermal resistance	R_{th}	K/W	0.8		0.4	
Temperature sensor			PTC SNM100			
Nominal input voltage	V_{dc}		500(600 ²)			
Inertia of rotating parts	J	kgm^2	0.32		0.44	
Mass of motor	M_m	kg	54		71	
Max. axial load	F_a	N	8000		8000	
Max. moment load	M	Nm	240		240	
Max. speed		rpm	100		100	
Resolution ¹⁾		p/rev	4,320,000	920,000	4,320,000	920,000
Repeatability		arc-sec	± 3			
Accuracy		arc-sec	± 30			
Axial runout	R_a	mm	0.03(0.005 ²⁾)			
Radial runout	R_r	mm	0.03(0.015 ²⁾)			
Height	H	mm	145		200	
Height of base	H_b	mm	31			

Note : ¹⁾ Incremental type with sin/cos 1Vpp, absolute type should be matched with corresponding HIWIN drive.
²⁾ Optional
 *All the specifications in the table are in $\pm 10\%$ of tolerance except dimensions.

1.3.4 TMY Series T-N curves

(DC bus voltage=325V_{DC})



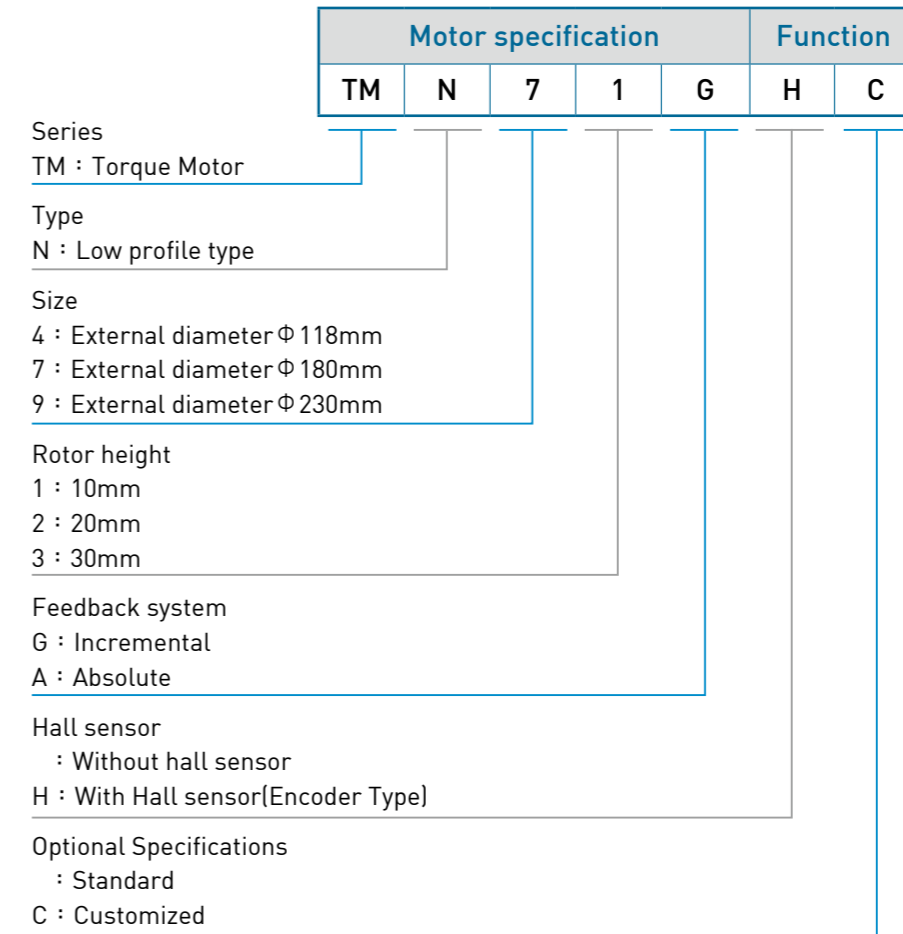
1.4 TMN Rotary Tables

The TMN series is designed with an extremely low profile and a high resolution resolver/ optical encoder optimized to achieve high dynamic motion, high torque and high precision. The TMN series is a perfect fit for industries that require high precision but less force.

- Outer rotating structure
- Space saving with Low profile design
- High resolution optical encoder/ resolver selectable
- Maximum torque: 4.2~39.6 Nm

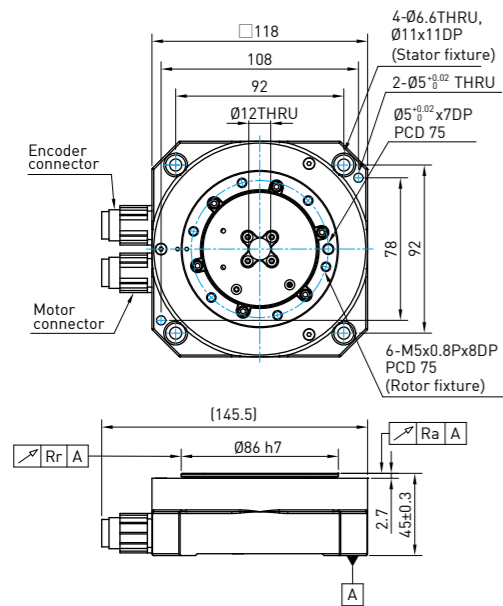


Model Numbers for TMN Series

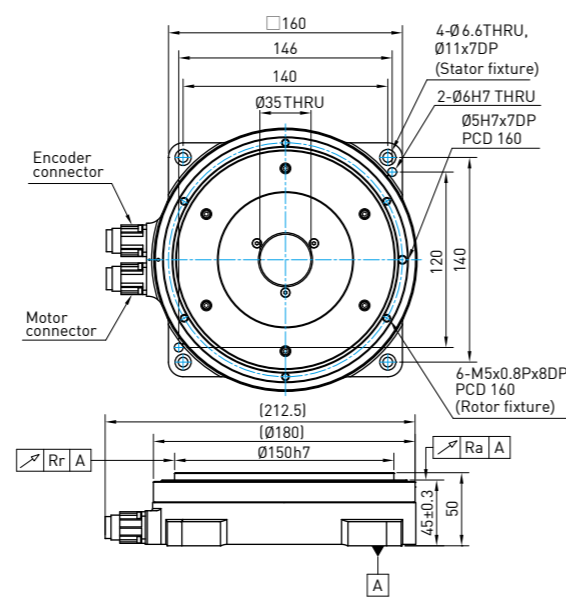


■ TMN Dimensions

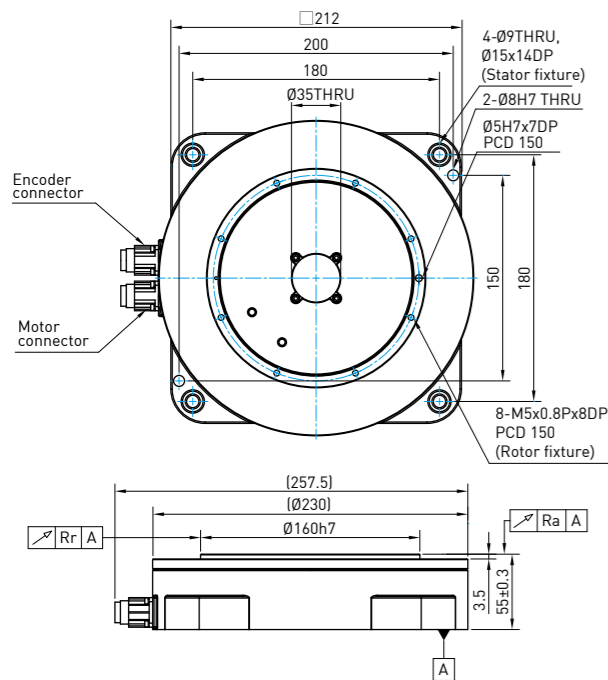
TMN42



TMN71



TMN93



1.4.1 TMN Incremental Series

Table 1.9 TMN Specifications

	Symbol	Unit	TMN42G	TMN71G	TMN93G
Continuous torque	T _c	Nm	1.4	3.7	13.2
Continuous current	I _c	A _{rms}	1.5	3.4	3.4
Peak torque (Within 1s.)	T _p	Nm	4.2	11.1	39.6
Peak current (Within 1s.)	I _p	A _{rms}	4.5	10.2	10.2
Torque constant	K _t	Nm/A _{rms}	0.97	1.09	3.9
Electrical time constant	T _e	ms	1.8	4.1	5.4
Resistance (line to line at 25°C)	R ₂₅	Ω	4.59	2.22	4.3
Inductance (line to line)	L	mH	8.18	9.02	23.2
Number of poles	2 _p		16	16	22
Back emf constant (line to line)	K _v	V _{rms} /[rad/s]	0.56	0.63	2.25
Motor constant(line to line at 25°C)	K _m	Nm/√W	0.4	0.6	1.5
Thermal resistance	R _{th}	K/W	4.84	1.95	1.01
Temperature sensor			PTC SNM100		
Nominal input voltage	V _{dc}		500(600 ²⁾)		
Inertia of rotating parts	J	kgm ²	0.003	0.008	0.012
Mass of motor	M _m	kg	2	3.5	7.5
Max. axial load	F _a	N	600	1000	1000
Max. moment load	M	Nm	30	50	50
Max. speed		rpm	700	600	500
Resolution		p/rev	4,320,000	4,325,376	4,320,000
			(Incremental, sin/cos 1Vpp)		
Repeatability		arc-sec	±2.5	±2.5	±2.5
Accuracy		arc-sec	±45/±10 ¹⁾	±45/±10 ¹⁾	±45/±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	118x118x45	160x160x50	212x212x55

Note : ¹⁾ After error mapping
²⁾ Optional

*All the specifications in the table are in ±10% of tolerance except dimensions.

1.4.2 TMN absolute Series

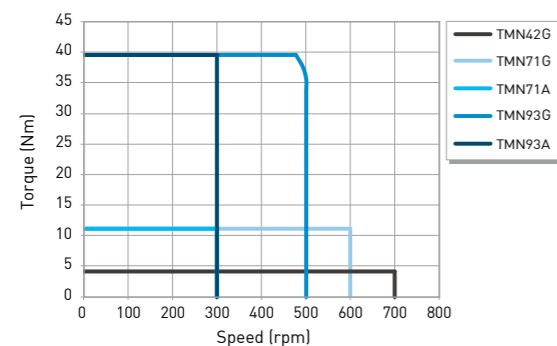
Table 1.10 TMN Specifications

	Symbol	Unit	TMN71A	TMN93A
Continuous torque	T _c	Nm	3.7	13.2
Continuous current	I _c	A _{rms}	3.4	3.4
Peak torque (Within 1s.)	T _p	Nm	11.1	39.6
Peak current (Within 1s.)	I _p	A _{rms}	10.2	10.2
Torque constant	K _t	Nm/A _{rms}	1.09	3.9
Electrical time constant	T _e	ms	4.1	5.4
Resistance (line to line at 25°C)	R ₂₅	Ω	2.22	4.3
Inductance (line to line)	L	mH	9.02	23.2
Number of poles	2 _p		16	22
Back emf constant (line to line)	K _v	V _{rms} /(rad/s)	0.63	2.25
Motor constant(line to line at 25°C)	K _m	Nm/√W	0.6	1.5
Thermal resistance	R _{th}	K/W	1.95	1.01
Temperature sensor			PTC SNM100	
Nominal input voltage		V _{DC}	500(600 ²⁾)	
Inertia of rotating parts	J	kgm ²	0.008	0.012
Mass of motor	M _m	kg	3.5	7.5
Max. axial load	F _a	N	1000	1000
Max. moment load	M	Nm	50	50
Max. speed		rpm	300	300
Resolution		p/rev	920,000 (Absolute ¹⁾)	
Repeatability		arc-sec	±2.5	±2.5
Accuracy		arc-sec	±30	±30
Axial runout	R _a	mm	0.03(0.005 ²⁾)	
Radial runout	R _r	mm	0.03(0.015 ²⁾)	
Size	WxLxH	mm	160x160x50	212x212x55

Note : ¹⁾ The motor should be matched with corresponding HIWIN drive.
²⁾ Optional
 *All the specifications in the table are in ±10% of tolerance except dimensions.

1.5.3 TMN Series T-N curves

(DC bus voltage=325V_{DC})



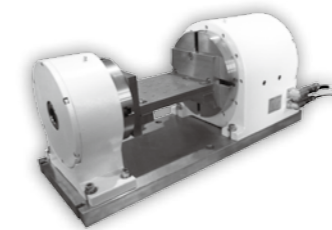
2. TMRW Torque Motor



The combination of a high torque stator and rotor meets the most demanding specifications in high precision industry. By using a water cooled design, high torque can be achieved.

- Water cooled
- Large hollow shaft
- Maximum torque up to 5020 Nm
- The concentricity of the stator and rotor will be calibrated before shipment

Example : Index table



Model Numbers for TMRW Series

Motor specification				Function		Winding Code
TM	RW	4	7	L	C	XX

Series

TM : Torque Motor

Type

RW : Water cooling type

External diameter of the stator's lamination stack

- 1 : Φ 140mm
- 2 : Φ 175mm
- 4 : Φ 210mm
- 7 : Φ 291mm
- A : Φ 360mm
- D : Φ 450mm
- G : Φ 530mm

Rotor height

- 3 : 30mm
- 5 : 50mm
- 7 : 70mm
- A : 100mm
- F : 150mm

Winding code

- : Standard
- L : Low Back emf

Optional Specifications

- : Standard
- C : Customized

: Standard

XX : Winding code

2.1 TMRW1 Series

2.1.1 TMRW1 Dimensions

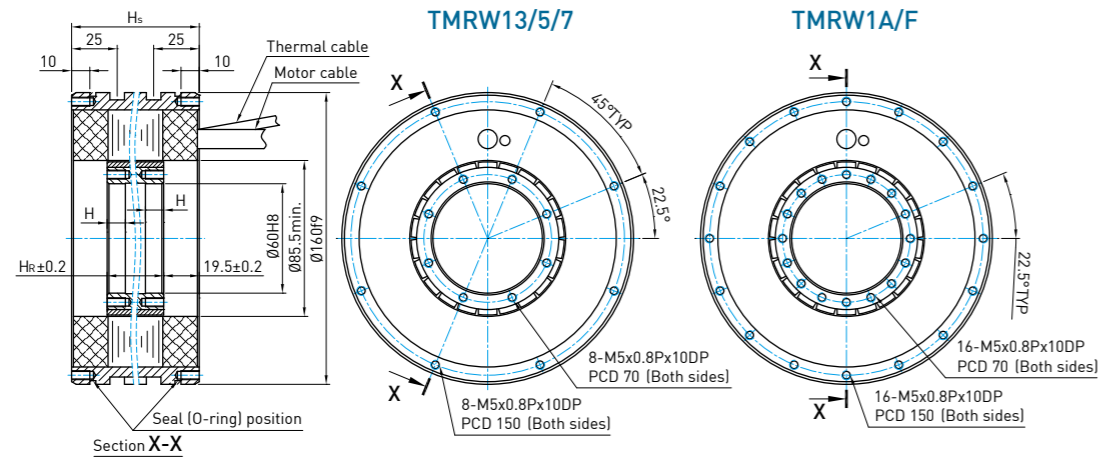


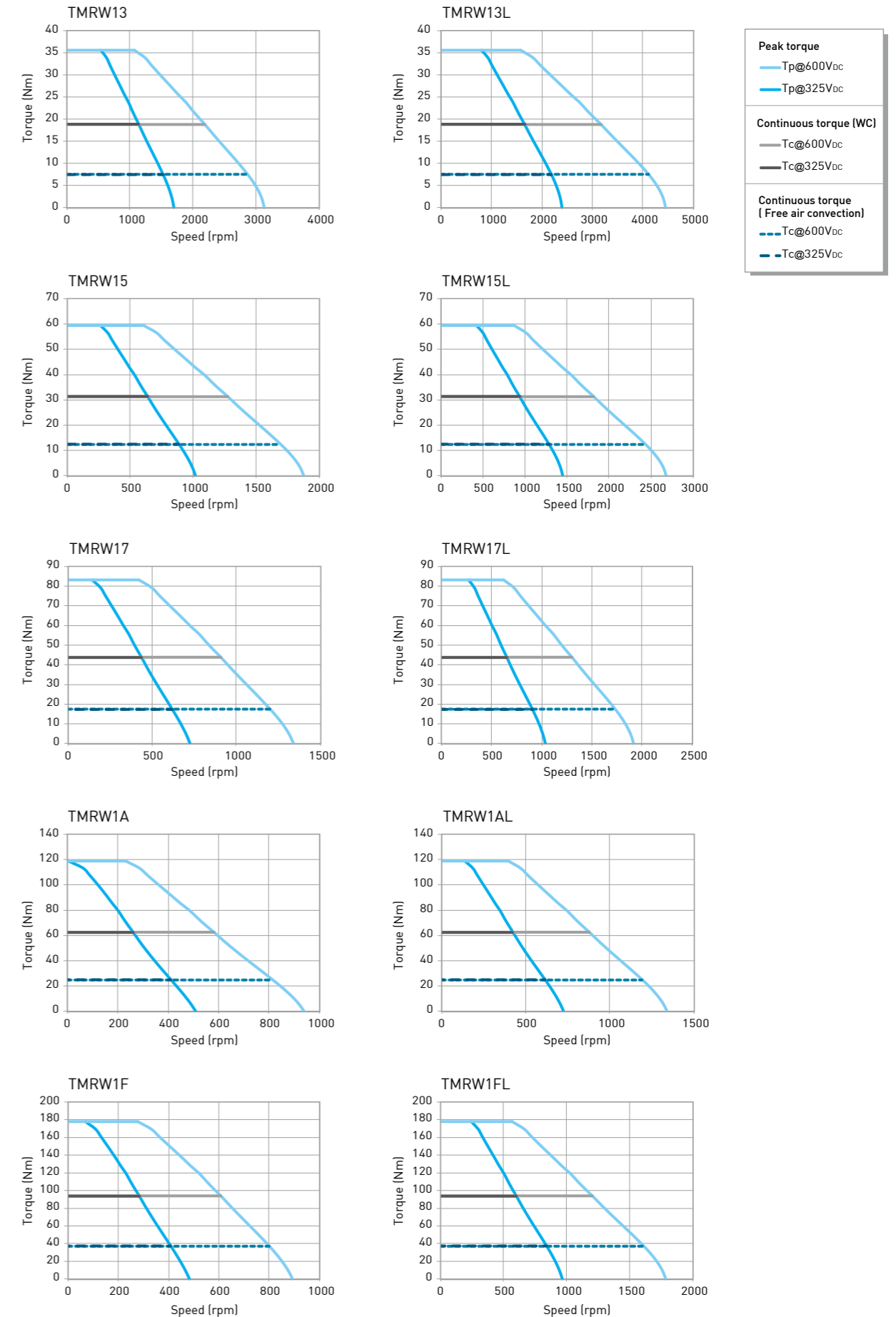
Table 2.1 TMRW1 Specifications

	Symbol	Unit	TMRW13	TMRW13L	TMRW15	TMRW15L	TMRW17	TMRW17L	TMRW1A	TMRW1AL	TMRW1F	TMRW1FL	
Continuous torque	T_c	Nm	7.5	7.5	12.4	12.4	17.4	17.4	24.9	24.9	37.3	37.3	
Continuous current	I_c	Arms	4	5.7	4	5.7	4	5.7	4	5.7	5.7	11.4	
Continuous torque (WC)	T_{cw}	Nm	18.8	18.8	31.3	31.3	43.8	43.8	62.5	62.5	93.8	93.8	
Continuous current (WC)	I_{cw}	Arms	10	14.4	10	14.4	10	14.4	10	14.4	14.4	28.8	
Stall torque	T_s	Nm	5	5	9	9	12	12	17	17	26	26	
Stall current	I_s	Arms	2.8	4	2.8	4	2.8	4	2.8	4	4	8	
Stall torque (WC)	T_{sw}	Nm	13	13	22	22	31	31	44	44	66	66	
Stall current (WC)	I_{sw}	Arms	7	10.1	7	10.1	7	10.1	7	10.1	10.1	20.2	
Peak torque(Within 1s.)	T_p	Nm	35.6	35.6	59.4	59.4	83.1	83.1	118.8	118.8	178.1	178.1	
Peak current(Within 1s.)	I_p	Arms	27	38.9	27	38.9	27	38.9	27	38.9	38.9	77.8	
Torque constant	K_t	Nm/Arms	1.87	1.32	3.1	2.18	4.36	3.06	6.23	4.36	6.55	3.27	
Electrical time constant	T_e	ms	3.2	3.2	3.6	3.4	3.6	4.1	4	4.1	3.9	4.3	
Resistance (line to line at 25°C)	R_{25}	Ω	3.3	1.6	4.5	2.36	6.2	2.9	7.7	3.8	5.5	1.37	
Inductance (line to line)	L	mH	10.5	5.1	16	8	22.5	11.9	31	15.5	21.7	5.9	
Number of poles	$2p$		22										
Back emf constant (line to line)	K_v	$V_{rms}/rad/s$	1.08	0.76	1.8	1.26	2.52	1.76	3.6	2.52	3.78	1.89	
Motor constant (at 25°C)	K_m	Nm/\sqrt{W}	0.84	0.85	1.19	1.16	1.43	1.46	1.83	1.83	2.28	2.28	
Thermal resistance	R_{th}	K/W	1.2	1.22	0.88	0.83	0.64	0.67	0.51	0.51	0.35	0.36	
Thermal resistance (WC)	R_{thw}	K/W	0.192	0.191	0.141	0.129	0.102	0.105	0.082	0.08	0.056	0.056	
Thermal sensor			PTC SNM100+SNM120+KTY84										
Max. DC BUS	V_{dc}		750										
Inertia of rotor	J	kgm^2	0.001	0.001	0.0016	0.0016	0.0023	0.0023	0.0033	0.0033	0.0049	0.0049	
Max. speed at conti. Torque		rpm	2800	4000	1600	2400	1150	1700	800	1170	760	1600	
Max. speed at conti. Torque (WC)		rpm	2200	3200	1200	1750	830	1300	580	870	540	1200	
Max. speed at max. Torque		rpm	1000	1600	600	830	400	610	230	390	210	560	
Mass of rotor	M_r	kg	0.6	0.6	1	1	1.4	1.4	2	2	3	3	
Mass of stator	M_s	kg	3.7	3.7	5.1	5.1	6.2	6.2	8.6	8.6	12.2	12.2	
Height of stator	H_s	mm	70	70	90	90	110	110	140	140	190	190	
Height of rotor	H_r	mm	31	31	51	51	71	71	101	101	151	151	
Height	H	mm	10	10	15	15	15	15	15	15	15	15	

Note : WC : water cooled

*All the specifications in the table are in $\pm 10\%$ of tolerance except dimensions.

2.1.2 TMRW1 Series T-N curves



2.2 TMRW2 Series

2.2.1 TMRW2 Dimensions

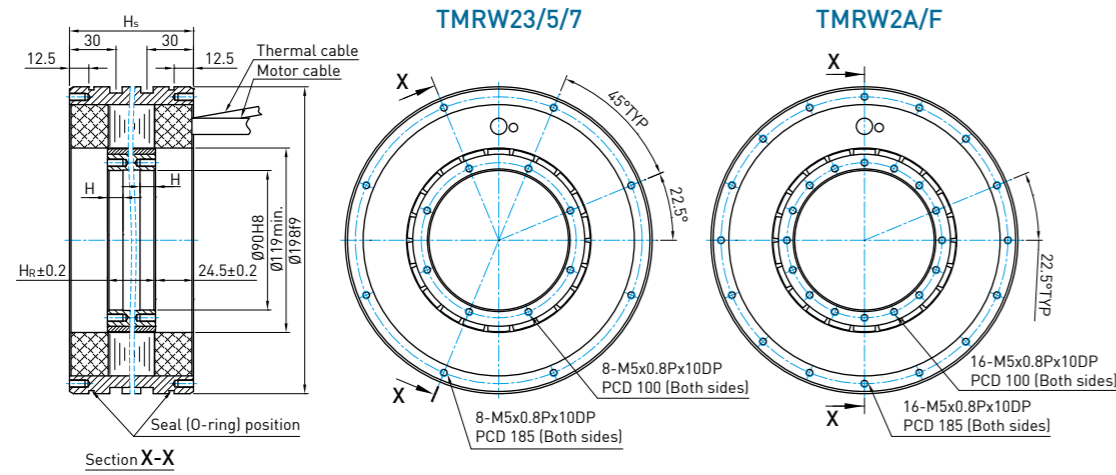


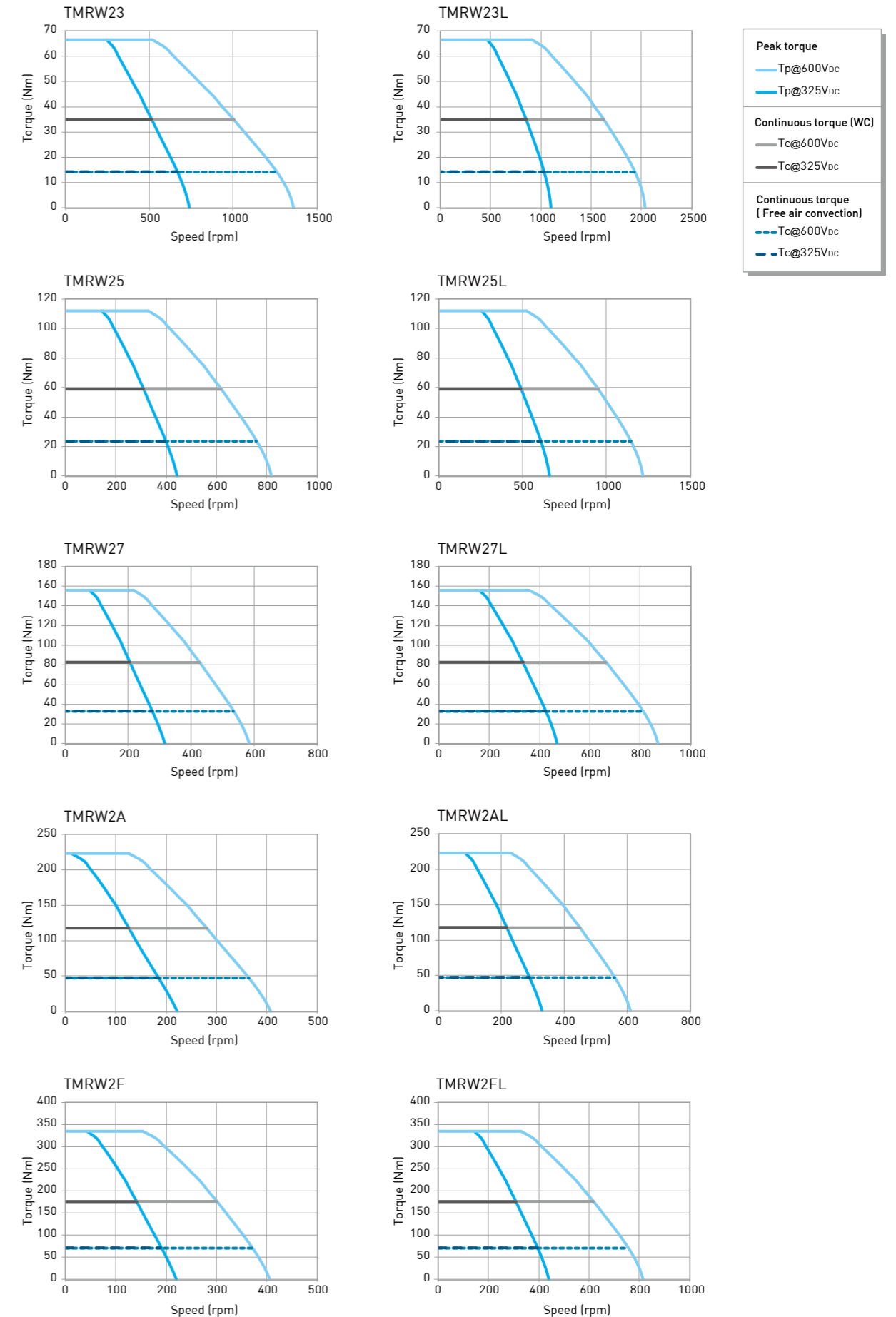
Table 2.2 TMRW2 Specifications

	Symbol	Unit	TMRW23	TMRW23L	TMRW25	TMRW25L	TMRW27	TMRW27L	TMRW2A	TMRW2AL	TMRW2F	TMRW2FL
Continuous torque	T _c	Nm	14.2	14.2	23.6	23.6	33	33	47.3	47.3	71	71
Continuous current	I _c	Arms	3.3	4.9	3.3	4.9	3.3	4.9	3.3	4.9	4.9	9.9
Continuous torque (WC)	T _{cw}	Nm	35	35	59	59	82.5	82.5	117.5	117.5	176	176
Continuous current (WC)	I _{cw}	Arms	8.3	12.3	8.3	12.3	8.3	12.3	8.3	12.3	12.3	24.6
Stall torque	T _s	Nm	10	10	17	17	23	23	33	33	50	50
Stall current	I _s	Arms	2.3	3.4	2.3	3.4	2.3	3.4	2.3	3.4	3.4	6.9
Stall torque (WC)	T _{sw}	Nm	25	25	41	41	58	58	82	82	123	123
Stall current (WC)	I _{sw}	Arms	5.8	8.6	5.8	8.6	5.8	8.6	5.8	8.6	8.6	17.2
Peak torque(Within 1s.)	T _p	Nm	66.5	66.5	112	112	156	156	223	223	334.5	334.5
Peak current(Within 1s.)	I _p	Arms	22.3	33.2	22.3	33.2	22.3	33.2	22.3	33.2	33.2	66.4
Torque constant	K _t	Nm/ Arms	4.29	2.8	7.16	4.8	10.03	6.72	14.32	9.6	14.39	7.2
Electrical time constant	T _e	ms	5.8	6.1	6.8	6.5	6.5	6.5	7.4	6.5	7.2	6.9
Resistance (line to line at 25°C)	R ₂₅	Ω	4.3	1.9	5.7	2.5	7.8	3.5	9.6	5	6	1.5
Inductance (line to line)	L	mH	24.95	11.5	39	16.23	50.7	22.72	70.8	32.46	43	10.4
Number of poles	2 _p		22									
Back emf constant (line to line)	K _v	V _{rms} /rad/s	2.48	1.6	4.13	2.77	5.79	3.88	8.27	5.54	8.31	4.15
Motor constant (at 25°C)	K _m	Nm/√W	1.68	1.72	2.45	2.49	2.92	2.94	3.78	3.52	4.83	4.78
Thermal resistance	R _{th}	K/W	1.35	1.39	1.02	1.06	0.75	0.75	0.61	0.53	0.44	0.43
Thermal resistance (WC)	R _{thw}	K/W	0.214	0.22	0.161	0.167	0.118	0.12	0.096	0.084	0.07	0.07
Thermal sensor			PTC SNM100+SNM120+KTY84									
Max. DC BUS	V _{dc}		750									
Inertia of rotor	J	kgm ²	0.0027	0.0027	0.0045	0.0045	0.0063	0.0063	0.009	0.009	0.013	0.013
Max. speed at conti. Torque		rpm	1260	1900	750	1130	525	800	360	550	360	740
Max. speed at conti. Torque (WC)		rpm	1060	1600	610	950	420	660	280	440	275	610
Max. speed at max. Torque		rpm	590	900	330	525	210	360	125	225	120	330
Mass of rotor	M _r	kg	0.95	0.95	1.6	1.6	2.2	2.2	3.2	3.2	4.8	4.8
Mass of stator	M _s	kg	6.1	6.1	8.4	8.4	10.2	10.2	14.2	14.2	20.1	20.1
Height of stator	H _s	mm	80	80	100	100	120	120	150	150	200	200
Height of rotor	H _r	mm	31	31	51	51	71	71	101	101	151	151
Height	H	mm	10	10	15	15	15	15	15	15	15	15

Note : WC : water cooled

*All the specifications in the table are in ±10% of tolerance except dimensions.

2.2.2 TMRW2 Series T-N curves



2.3 TMRW4Series

2.3.1 TMRW4 Dimensions

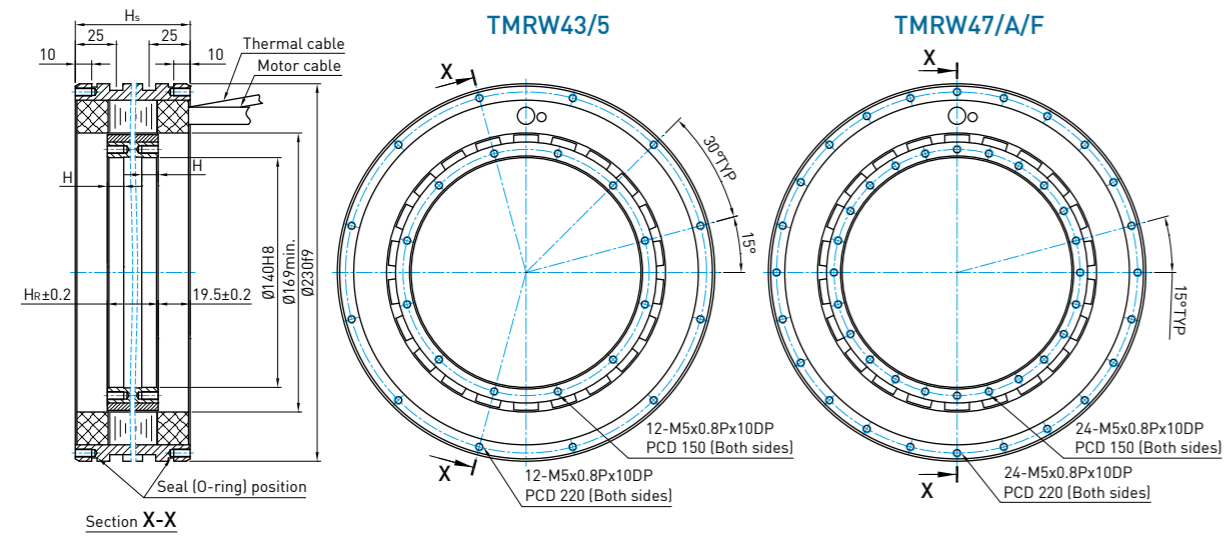


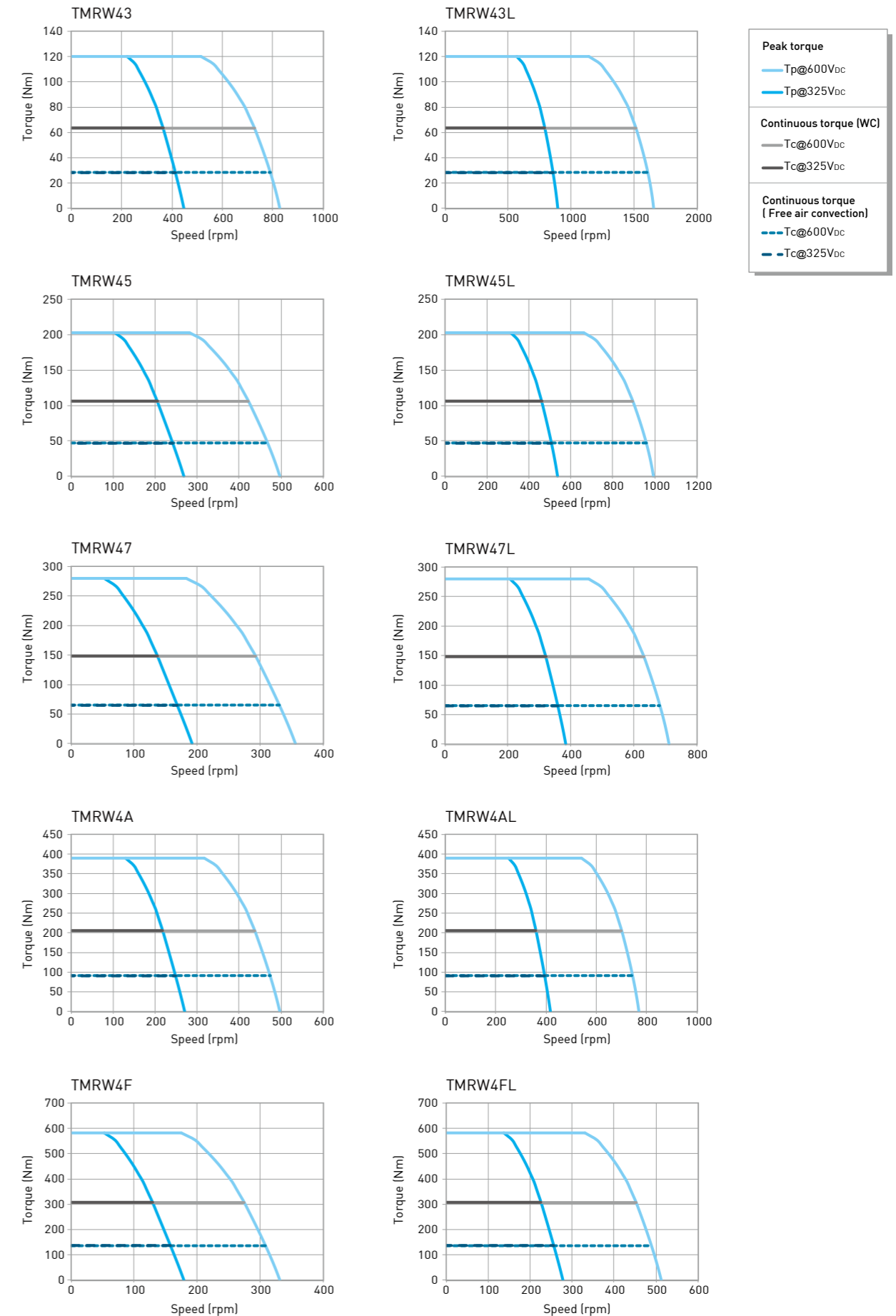
Table 2.3 TMRW4 Specifications

	Symbol	Unit	TMRW43	TMRW43L	TMRW45	TMRW45L	TMRW47	TMRW47L	TMRW4A	TMRW4AL	TMRW4F	TMRW4FL
Continuous torque	T _c	Nm	28.2	28.2	47	47	65	65	91	91	136	136
Continuous current	I _c	Arms	4	8	4	8	4	8	8	12	8	12
Continuous torque (WC)	T _{cw}	Nm	63.5	63.5	106	106	148	148	205	205	307	307
Continuous current (WC)	I _{cw}	Arms	9	18	9	18	9	18	18	27	18	27
Stall torque	T _s	Nm	20	20	33	33	46	46	64	64	95	95
Stall current	I _s	Arms	2.8	5.6	2.8	5.6	2.8	5.6	5.6	8.4	5.6	8.4
Stall torque (WC)	T _{sw}	Nm	44	44	74	74	104	104	144	144	215	215
Stall current (WC)	I _{sw}	Arms	6.3	12.6	6.3	12.6	6.3	12.6	12.6	18.9	12.6	18.9
Peak torque (Within 1s.)	T _p	Nm	120	120	203	203	280	280	390	390	583	583
Peak current (Within 1s.)	I _p	Arms	24.3	48.6	24.3	48.6	24.3	48.6	48.6	72.9	48.6	72.9
Torque constant	K _t	Nm/Arms	7.06	3.53	11.76	5.88	16.47	8.23	11.76	7.61	17.65	11.42
Electrical time constant	T _e	ms	4.1	4.1	4.3	4.3	4.7	4.7	4.8	4.3	5.2	4.4
Resistance (line to line at 25°C)	R ₂₅	Ω	4.38	1.1	6.01	1.5	7.63	1.9	2.5	1.06	3.66	1.58
Inductance (line to line)	L	mH	17.9	4.5	26	6.38	35.7	8.93	12.1	4.57	19.13	6.9
Number of poles	2p		22									
Back emf constant (line to line)	K _v	V _{rms} /rad/s	4.08	2.04	6.8	3.4	9.5	4.75	6.79	4.39	10.19	6.59
Motor constant (at 25°C)	K _m	Nm/√W	2.75	2.74	3.91	3.92	4.8	4.81	5.87	6.01	7.26	7.36
Thermal resistance	R _{th}	K/W	0.9	0.9	0.66	0.66	0.52	0.52	0.4	0.41	0.27	0.28
Thermal resistance (WC)	R _{thw}	K/W	0.179	0.178	0.13	0.13	0.102	0.103	0.078	0.082	0.053	0.055
Thermal sensor			PTC SNM100+SNM120+KTY84									
Max. DC BUS	V _{dc}		750									
Inertia of rotor	J	kgm ²	0.0085	0.0085	0.014	0.014	0.022	0.022	0.029	0.029	0.045	0.045
Max. speed at conti. Torque		rpm	770	1600	450	950	320	670	460	730	300	470
Max. speed at conti. Torque (WC)		rpm	710	1500	410	890	290	620	420	680	260	440
Max. speed at max. Torque		rpm	500	1100	270	660	180	450	300	500	160	300
Mass of rotor	M _r	kg	1.4	1.4	2.4	2.4	3.3	3.3	4.7	4.7	7.1	7.1
Mass of stator	M _s	kg	5.8	5.8	7.8	7.8	9.6	9.6	12.7	12.7	18.7	18.7
Height of stator	H _s	mm	70	70	90	90	110	110	140	140	190	190
Height of rotor	H _r	mm	31	31	51	51	71	71	101	101	151	151
Height	H	mm	10	10	15	15	15	15	15	15	15	15

Note : WC : water cooled

*All the specifications in the table are in ±10% of tolerance except dimensions.

2.3.2 TMRW4 Series T-N curves



2.4 TMRW7 Series

2.4.1 TMRW7 Dimensions

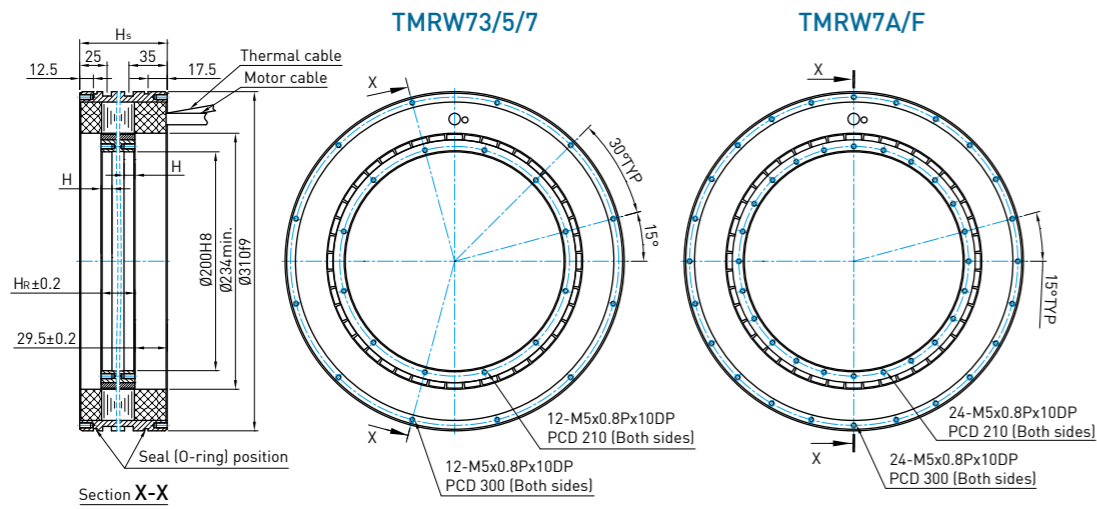


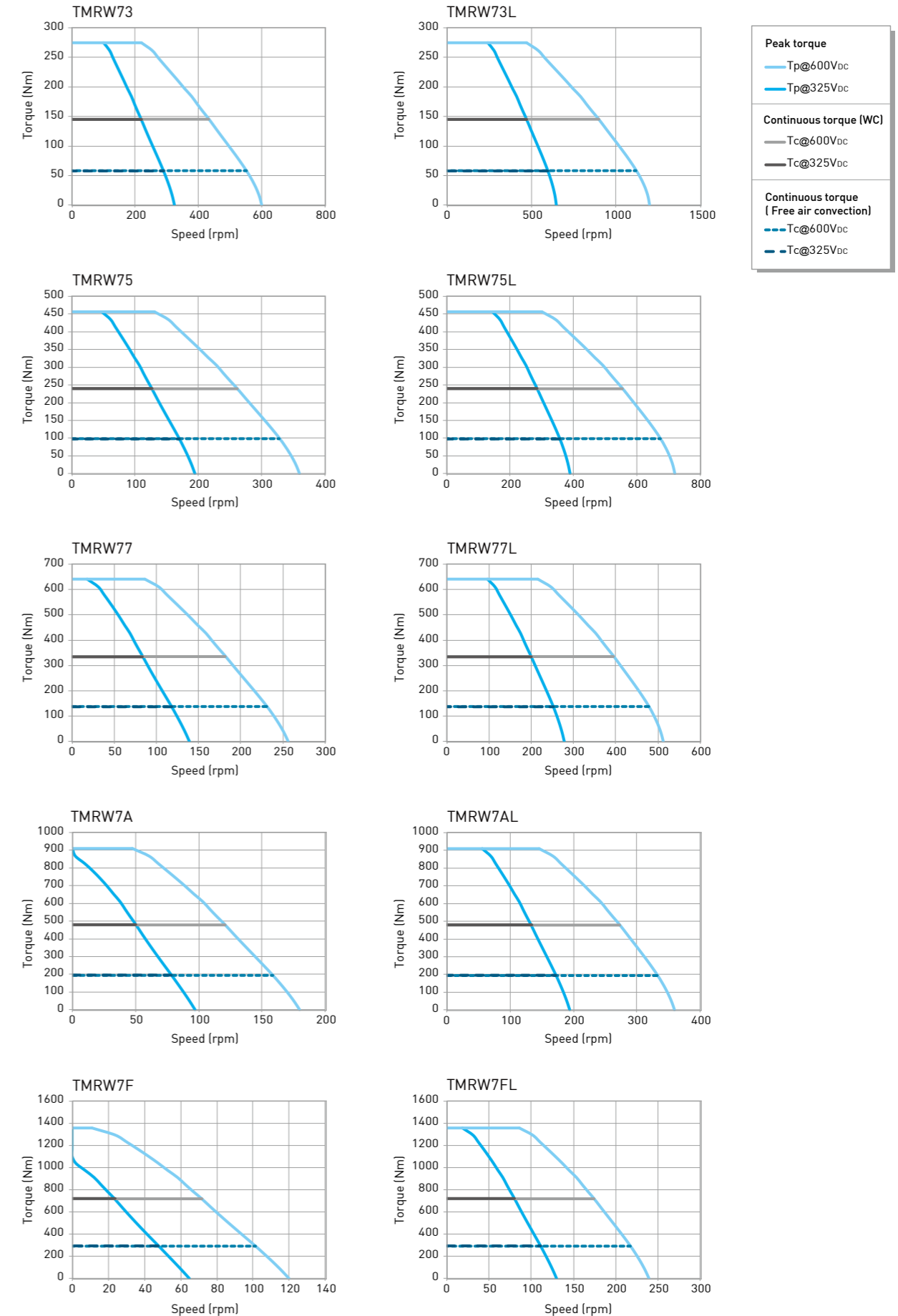
Table 2.4 TMRW7 Specifications

	Symbol	Unit	TMRW73	TMRW73L	TMRW75	TMRW75L	TMRW77	TMRW77L	TMRW7A	TMRW7AL	TMRW7F	TMRW7FL
Continuous torque	T_c	Nm	58	58	98	98	137	137	195	195	293	293
Continuous current	I_c	Arms	6	12	6	12	6	12	6	12	6	12
Continuous torque (WC)	T_{cw}	Nm	145	145	240	240	335	335	480	480	720	720
Continuous current (WC)	I_{cw}	Arms	15	30	15	30	15	30	15	30	15	30
Stall torque	T_s	Nm	41	41	69	69	96	96	137	137	205	205
Stall current	I_s	Arms	4.2	8.4	4.2	8.4	4.2	8.4	4.2	8.4	4.2	8.4
Stall torque (WC)	T_{sw}	Nm	102	102	168	168	235	235	336	336	504	504
Stall current (WC)	I_{sw}	Arms	10.5	21	10.5	21	10.5	21	10.5	21	10.5	21
Peak torque (Within 1s.)	T_p	Nm	275	275	456	456	640	640	910	910	1360	1360
Peak current (Within 1s.)	I_p	Arms	40.5	81	40.5	81	40.5	81	40.5	81	40.5	81
Torque constant	K_t	Nm/Arms	9.77	4.89	16.3	8.15	22.8	11.4	32.56	16.28	48.85	24.45
Electrical time constant	T_e	ms	5	4.9	5.6	5.6	5.6	5.6	5.6	5.6	5.6	5.8
Resistance (line to line at 25°C)	R_{25}	Ω	3	0.81	4.19	1.05	5.52	1.38	7.52	1.88	10.84	2.5
Inductance (line to line)	L	mH	15	4	23.45	5.86	30.9	7.73	42.07	10.52	60.68	14.6
Number of poles	$2p$		44									
Back emf constant (line to line)	K_v	$V_{rms}/(rad/s)$	5.64	2.82	9.4	4.7	13.2	6.6	18.8	9.4	28.2	14.1
Motor constant (at 25°C)	K_m	Nm/\sqrt{W}	4.56	4.38	6.52	6.51	7.92	7.94	9.68	9.68	12.11	12.61
Thermal resistance	R_{th}	K/W	0.59	0.54	0.42	0.42	0.32	0.32	0.23	0.23	0.16	0.18
Thermal resistance (WC)	R_{thw}	K/W	0.094	0.087	0.067	0.067	0.051	0.051	0.037	0.037	0.026	0.028
Thermal sensor			PTC SNM100+SNM120+KTY84									
Max. DC BUS	V_{dc}		750									
Inertia of rotor	J	kgm^2	0.023	0.023	0.039	0.039	0.059	0.059	0.079	0.079	0.11	0.11
Max. speed at conti. Torque		rpm	560	1110	325	675	225	475	160	325	100	210
Max. speed at conti. Torque (WC)		rpm	470	890	270	580	180	400	115	275	72	170
Max. speed at max. Torque		rpm	270	460	150	340	90	230	50	150	13	85
Mass of rotor	M_r	kg	2.5	2.5	4.1	4.1	5.7	5.7	8.1	8.1	12.1	12.1
Mass of stator	M_s	kg	14.2	14.2	18.9	18.9	23.7	23.7	30.9	30.9	43.6	43.6
Height of stator	H_s	mm	80	80	100	100	120	120	150	150	200	200
Height of rotor	H_r	mm	31	31	51	51	71	71	101	101	151	151
Height	H	mm	10	10	15	15	15	15	15	15	15	15

Note : WC : water cooled

*All the specifications in the table are in $\pm 10\%$ of tolerance except dimensions.

2.4.2 TMRW7 Series T-N curves



2.5 TMRWASeries

2.5.1 TMRWA Dimensions

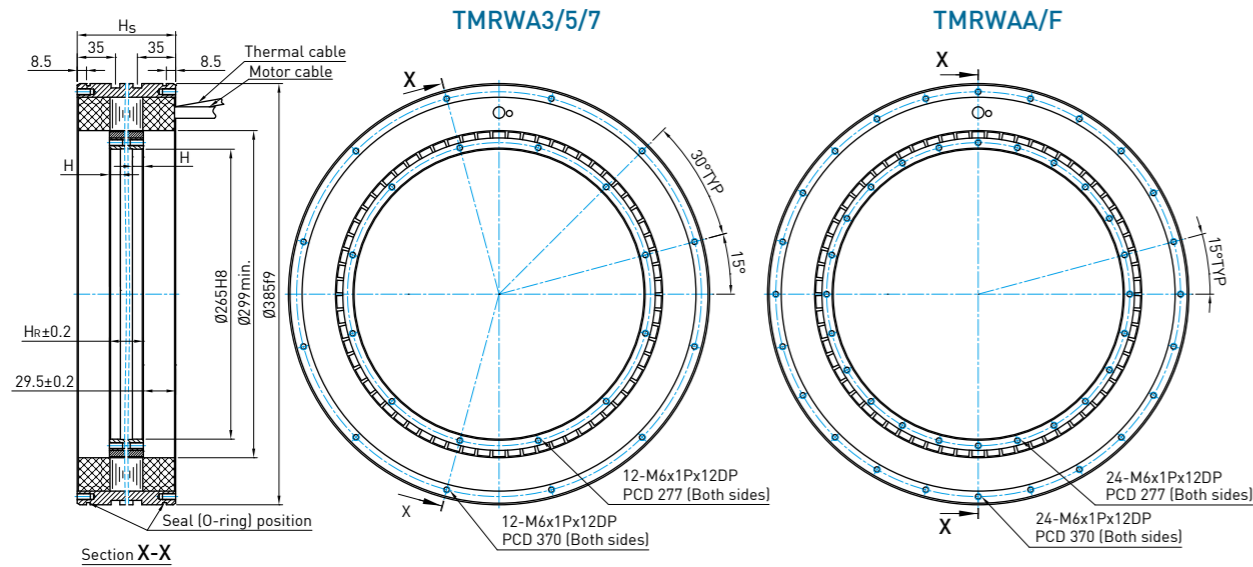


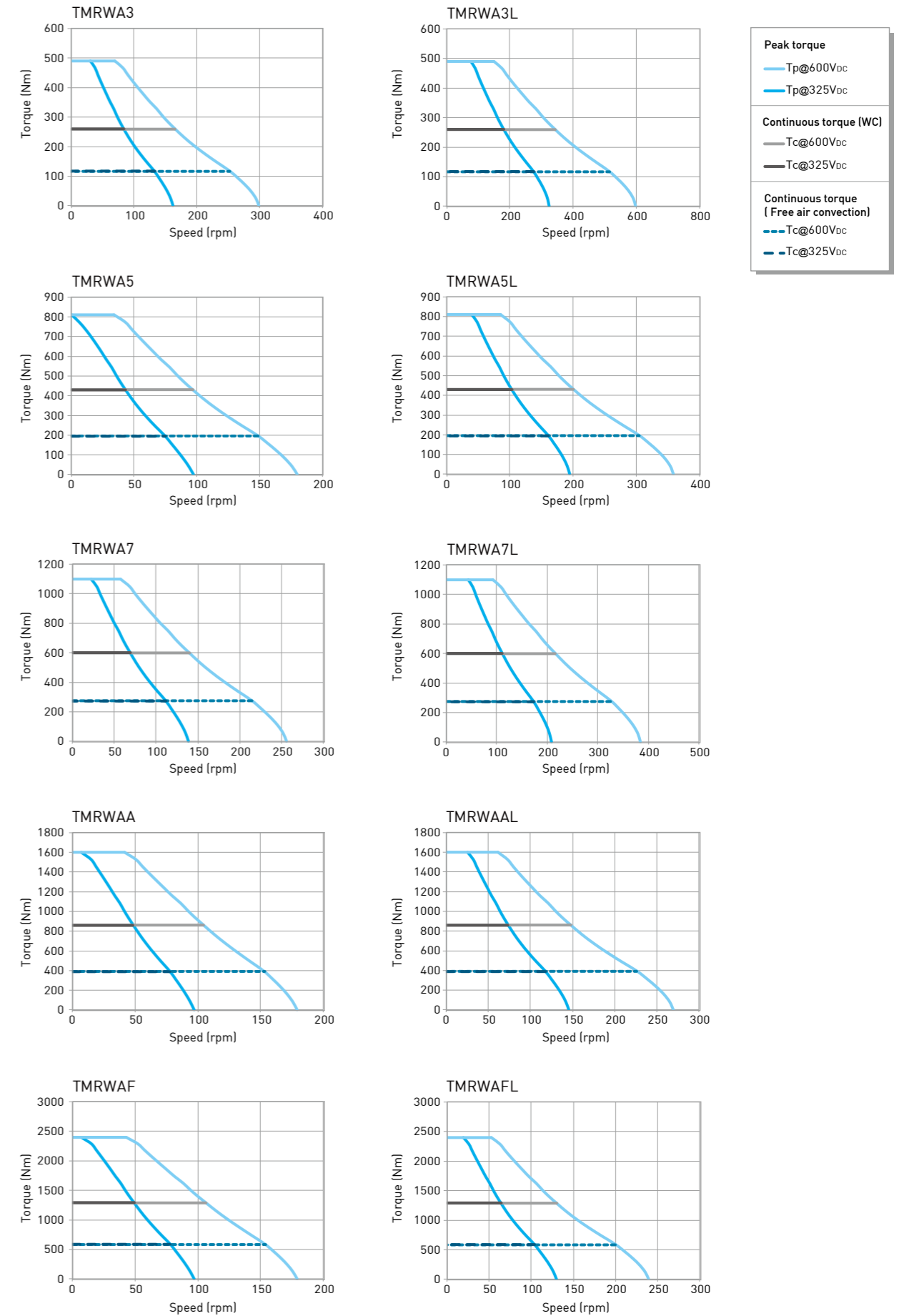
Table 2.5 TMRWA Specifications

	Symbol	Unit	TMRWA3	TMRWA3L	TMRWA5	TMRWA5L	TMRWA7	TMRWA7L	TMRWAA	TMRWAAAL	TMRWAF	TMRWAFAL
Continuous torque	T_c	Nm	117	117	195	195	274	274	390	390	585	585
Continuous current	I_c	Arms	6	12	6	12	12	18	12	18	18	24
Continuous torque (WC)	T_{cw}	Nm	260	260	430	430	600	600	860	860	1290	1290
Continuous current (WC)	I_{cw}	Arms	15	30	15	30	30	45	30	45	45	60
Stall torque	T_s	Nm	82	82	137	137	192	192	273	273	410	410
Stall current	I_s	Arms	4.2	8.4	4.2	8.4	8.4	12.6	8.4	12.6	12.6	16.8
Stall torque (WC)	T_{sw}	Nm	182	182	301	301	420	420	602	602	903	903
Stall current (WC)	I_{sw}	Arms	10.5	21	10.5	21	21	31.5	21	31.5	31.5	42
Peak torque (Within 1s.)	T_p	Nm	490	490	810	810	1100	1100	1600	1600	2400	2400
Peak current (Within 1s.)	I_p	Arms	40.5	81	40.5	81	81	121.5	81	121.5	121.5	162
Torque constant	K_t	Nm/Arms	19.57	9.79	32.6	16.32	22.84	15.23	32.63	21.75	32.63	24.45
Electrical time constant	T_e	ms	10	10	7.5	7.5	8.4	8.2	8.1	8	8.6	7.7
Resistance (line to line at 25°C)	R_{25}	Ω	3.57	0.89	7.1	1.78	2.2	0.98	2.97	1.32	1.98	1
Inductance (line to line)	L	mH	35.7	8.93	53.4	13.35	18.5	8	24.2	10.5	17	10
Number of poles	$2p$		66									
Back emf constant (line to line)	K_v	$V_{rms}/rad/s$	11.3	5.65	18.8	9.42	13.18	8.79	18.83	12.55	18.83	14.12
Motor constant (at 25°C)	K_m	Nm/\sqrt{W}	8.43	8.44	9.96	9.94	12.57	12.56	15.4	15.4	18.86	18.89
Thermal resistance	R_{th}	K/W	0.49	0.49	0.25	0.25	0.2	0.2	0.15	0.15	0.1	0.1
Thermal resistance (WC)	R_{thw}	K/W	0.079	0.079	0.04	0.04	0.032	0.032	0.024	0.024	0.016	0.016
Thermal sensor			PTC SNM100+SNM120+KTY84									
Max. DC BUS	V_{dc}		750									
Inertia of rotor	J	kgm^2	0.065	0.065	0.1	0.1	0.15	0.15	0.21	0.21	0.32	0.32
Max. speed at conti. Torque		rpm	250	510	140	300	210	320	140	220	140	200
Max. speed at conti. Torque (WC)		rpm	160	340	90	200	135	210	90	140	92	125
Max. speed at max. Torque		rpm	65	150	35	80	55	90	35	60	35	50
Mass of rotor	M_r	kg	3.1	3.1	5.1	5.1	7.1	7.1	10.2	10.2	15.3	15.3
Mass of stator	M_s	kg	20.1	20.1	26.8	26.8	34.5	34.5	44.9	44.9	63.1	63.1
Height of stator	H_s	mm	90	90	110	110	130	130	160	160	210	210
Height of rotor	H_r	mm	31	31	51	51	71	71	101	101	151	151
Height	H	mm	10	10	15	15	15	15	15	15	15	15

Note : WC : water cooled

*All the specifications in the table are in $\pm 10\%$ of tolerance except dimensions.

2.5.2 TMRWA Series T-N curves



2.6 TMRWD Series

2.6.1 TMRWD Dimensions

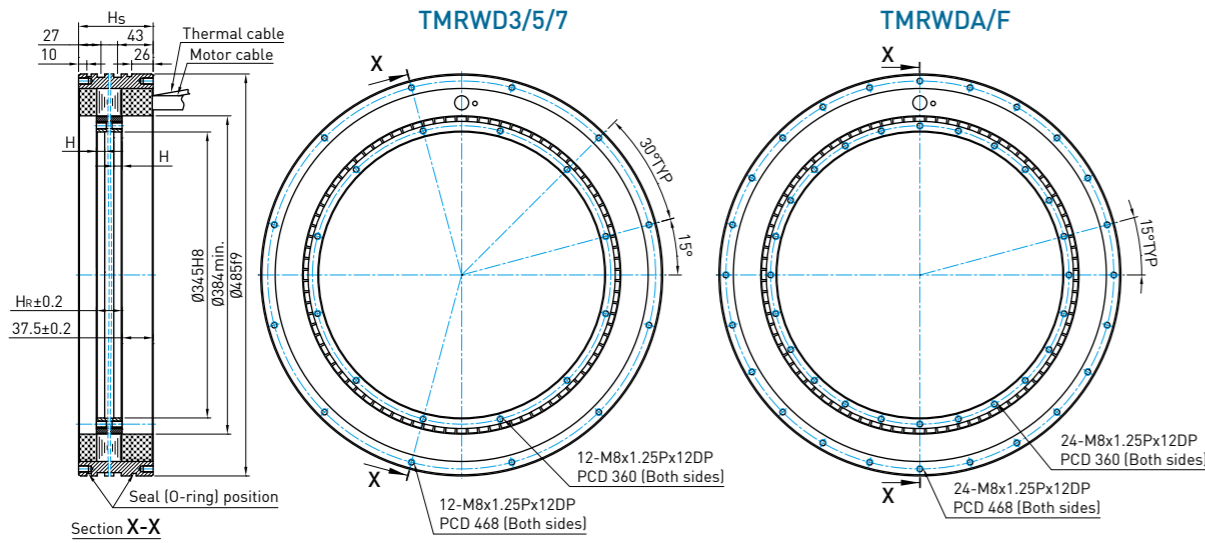


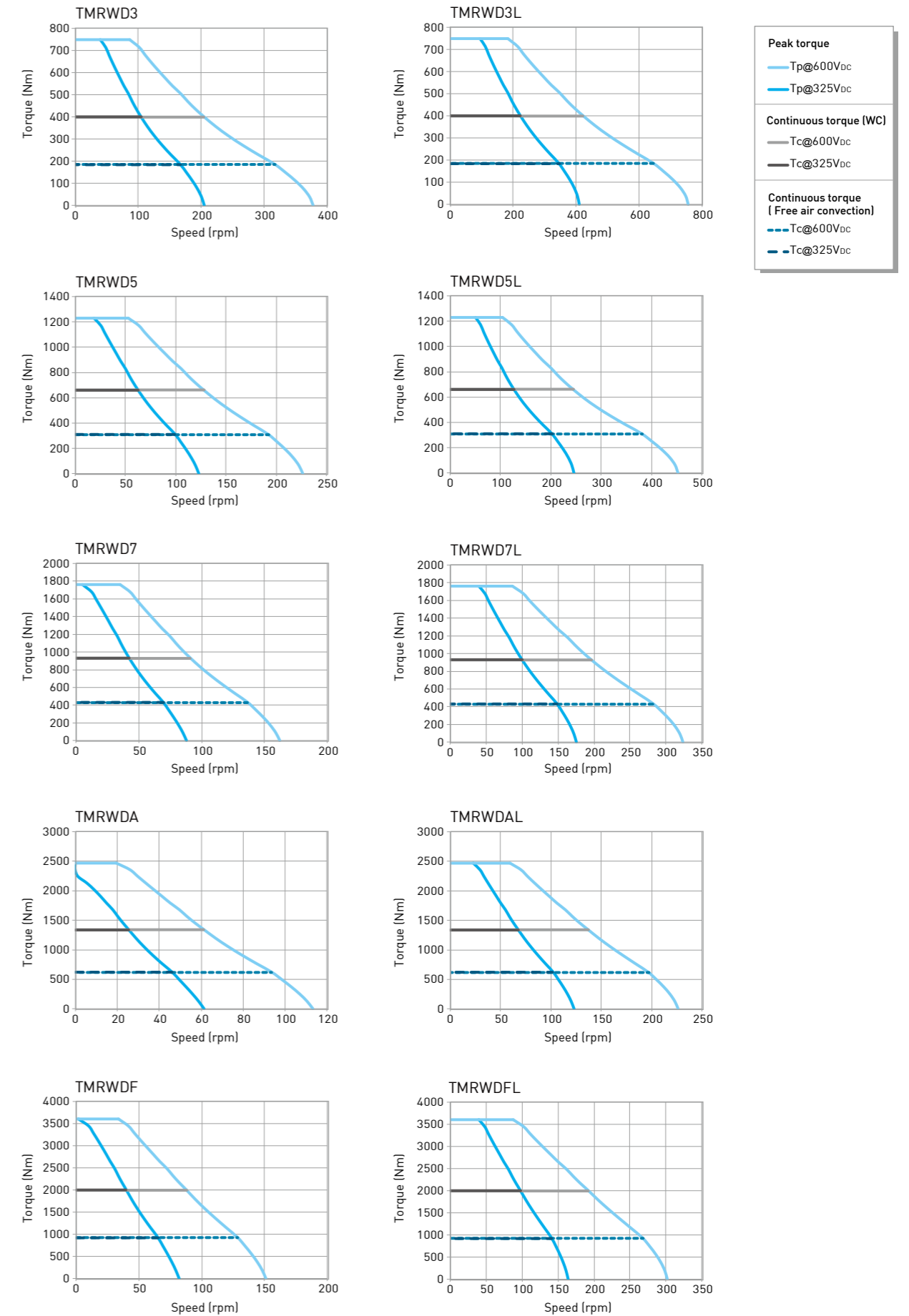
Table 2.6 TMRWD Specifications

	Symbol	Unit	TMRWD3	TMRWD3L	TMRWD5	TMRWD5L	TMRWD7	TMRWD7L	TMRWDA	TMRWDAL	TMRWDF	TMRWDFL
Continuous torque	T_c	Nm	185	185	310	310	430	430	619	619	925	925
Continuous current	I_c	Arms	12	24	12	24	12	24	12	24	24	48
Continuous torque (WC)	T_{cw}	Nm	400	400	660	660	930	930	1340	1340	2000	2000
Continuous current (WC)	I_{cw}	Arms	30	60	30	60	30	60	30	60	60	120
Stall torque	T_s	Nm	130	130	217	217	301	301	433	433	648	648
Stall current	I_s	Arms	8.4	16.8	8.4	16.8	8.4	16.8	8.4	16.8	16.8	33.6
Stall torque (WC)	T_{sw}	Nm	280	280	462	462	651	651	938	938	1400	1400
Stall current (WC)	I_{sw}	Arms	21	42	21	42	21	42	21	42	42	84
Peak torque (Within 1s.)	T_p	Nm	750	750	1230	1230	1760	1760	2470	2470	3600	3600
Peak current (Within 1s.)	I_p	Arms	81	162	81	162	81	162	81	162	162	324
Torque constant	K_t	Nm/Arms	15.48	7.74	25.8	12.9	36.11	18.1	51.6	25.8	38.7	19.35
Electrical time constant	T_e	ms	7.1	7.1	7.1	8.1	7.1	7.1	7	7.3	7.9	
Resistance (line to line at 25°C)	R_{25}	Ω	1.57	0.39	2.31	0.59	3.04	0.76	4.14	1.04	1.35	0.33
Inductance (line to line)	L	mH	11.13	2.78	16.3	4.78	21.5	5.38	29.3	7.33	9.9	2.6
Number of poles	$2p$		88									
Back emf constant (line to line)	K_v	$V_{rms}/(rad/s)$	8.94	4.47	14.9	7.45	20.85	10.43	29.8	14.9	22.35	11.18
Motor constant (at 25°C)	K_m	Nm/\sqrt{W}	10.05	10.08	13.88	13.73	16.78	16.78	20.7	20.65	27.08	27.39
Thermal resistance	R_{th}	K/W	0.28	0.28	0.19	0.19	0.14	0.14	0.11	0.11	0.08	0.08
Thermal resistance (WC)	R_{thw}	K/W	0.045	0.045	0.030	0.030	0.023	0.023	0.017	0.017	0.013	0.013
Thermal sensor			PTC SNM100+SNM120+KTY84									
Max. DC BUS	V_{dc}		750									
Inertia of rotor	J	kgm^2	0.16	0.16	0.26	0.26	0.37	0.37	0.53	0.53	0.8	0.8
Max. speed at conti. Torque		rpm	300	630	180	390	130	275	90	190	125	260
Max. speed at conti. Torque (WC)		rpm	200	420	120	250	85	190	60	133	80	190
Max. speed at max. Torque		rpm	85	175	50	115	30	85	18	60	30	80
Mass of rotor	M_r	kg	5.5	5.5	9.2	9.2	12.8	12.8	18.3	18.3	22	22
Mass of stator	M_s	kg	22.8	22.8	38	38	53.2	53.2	76	76	90	90
Height of stator	H_s	mm	90	90	110	110	130	130	160	160	210	210
Height of rotor	H_r	mm	31	31	51	51	71	71	101	101	151	151
Height	H	mm	10	10	15	15	15	15	15	15	15	15

Note : WC : water cooled

*All the specifications in the table are in $\pm 10\%$ of tolerance except dimensions.

2.6.2 TMRWD Series T-N curves



2.7 TMRWG Series

2.7.1 TMRWG Dimensions

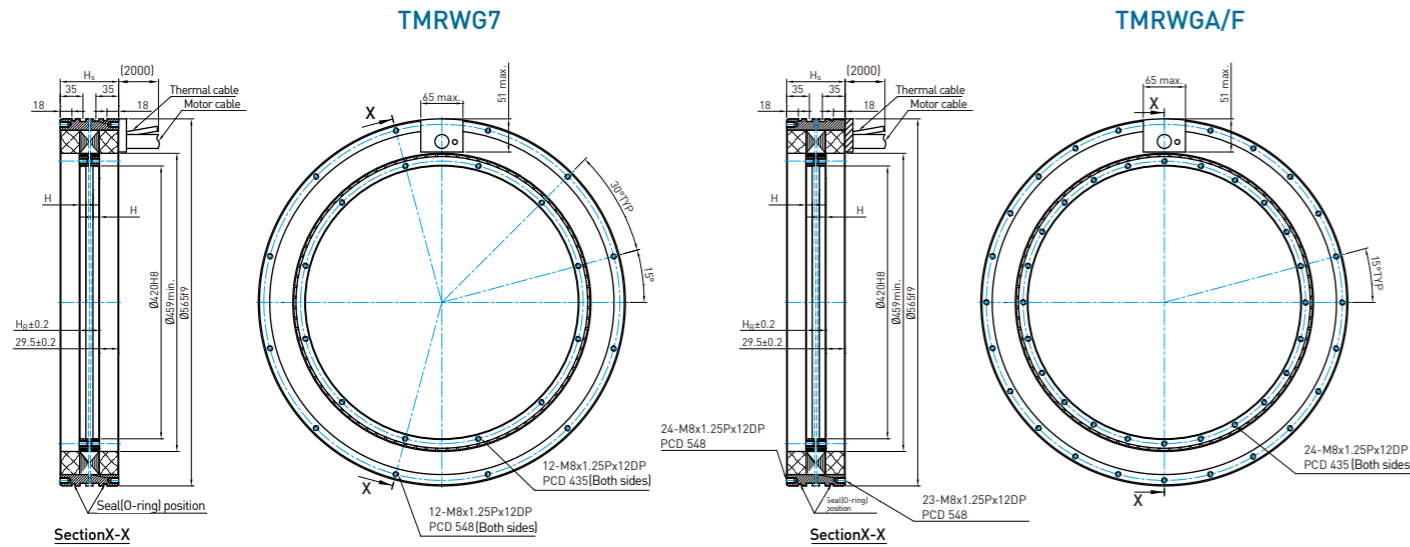


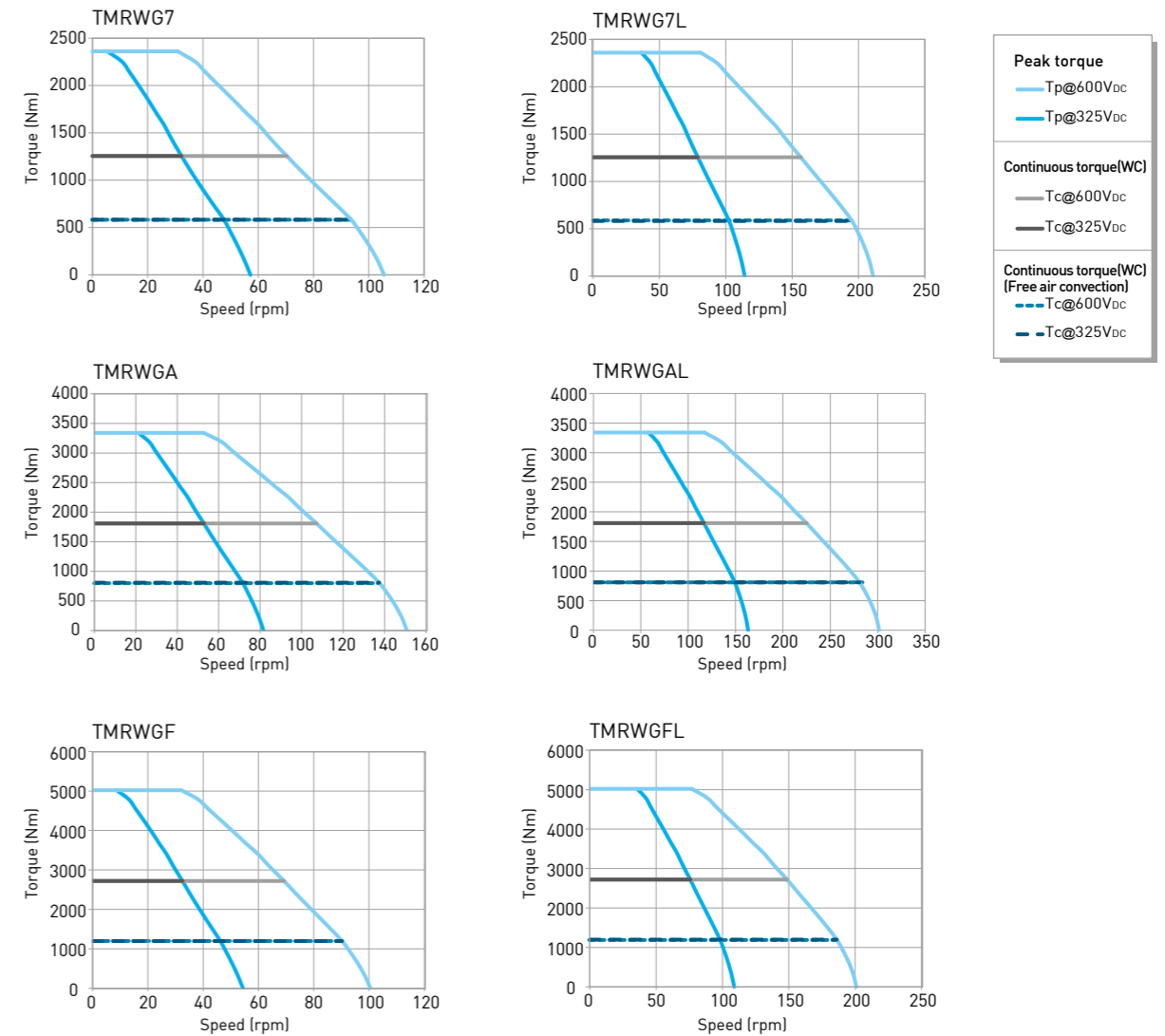
Table 2.7 TMRWG Specifications

	Symbol	Unit	TMRWG7	TMRWG7L	TMRWGA	TMRWGAL	TMRWGF	TMRWGL
Continuous torque	T _c	Nm	582	582	810	810	1200	1200
Continuous current	I _c	A _{rms}	10.5	21	21	42	21	42
Continuous torque (WC)	T _{cw}	Nm	1255	1255	1810	1810	2720	2720
Continuous current (WC)	I _{cw}	A _{rms}	26.3	52.5	52.5	105	52.5	105
Stall torque	T _s	Nm	407	407	567	567	840	840
Stall current	I _s	A _{rms}	7.4	14.7	14.7	29.4	14.7	29.4
Stall torque (WC)	T _{sw}	Nm	879	879	1267	1267	1904	1904
Stall current (WC)	I _{sw}	A _{rms}	18.4	36.8	36.8	73.5	36.8	73.5
Peak torque(for 1s)	T _p	Nm	2360	2360	3340	3340	5020	5020
Peak current(for 1s)	I _p	A _{rms}	71	142	142	284	142	284
Torque constant	K _t	Nm/A _{rms}	55.4	27.7	38.8	19.4	57	28.5
Electrical time constant	T _e	ms	7.8	7.2	8	8.3	8.9	8.8
Resistance (line to line at 25°C)	R ₂₅	Ω	3.3	0.83	1.06	0.27	1.46	0.37
Inductance (line to line)	L	mH	25.7	6	8.5	2.23	13	3.25
Number of poles	2 _p		88					
Back emf constant (line to line)	K _v	V _{rms} /rad/s	32	16	22.4	11.2	33.6	16.8
Motor constant (at 25°C)	K _m	Nm/√W	24.91	24.84	30.59	30.3	38.61	38.35
Thermal resistance	R _{th}	K/W	0.17	0.17	0.14	0.13	0.1	0.1
Thermal resistance (WC)	R _{thw}	K/W	0.028	0.028	0.022	0.021	0.016	0.016
Thermal sensor			PTC SNM100+SNM120+KTY84					
Max. DC BUS	V _{dc}		750					
Inertia of rotor	J	kgm ²	0.619	0.619	0.904	0.904	1.38	1.38
Max. speed at conti. Torque		rpm	90	190	130	280	90	180
Max. speed at conti. Torque (WC)		rpm	70	150	100	220	60	140
Max. speed at max. Torque		rpm	30	80	50	110	30	70
Mass of rotor	M _r	kg	13.3	13.3	19	19	28.3	28.3
Mass of stator	M _s	kg	61.1	61.1	75	75	107.5	107.5
Height of stator	H _s	mm	130	130	160	160	210	210
Height of rotor	H _r	mm	71	71	101	101	151	151
Height	H	mm	15	15	15	15	15	15

Note : WC : water cooled

*All the specifications in the table are in ± 10% of tolerance except dimensions.

2.7.2 TMRWG Series T-N curves



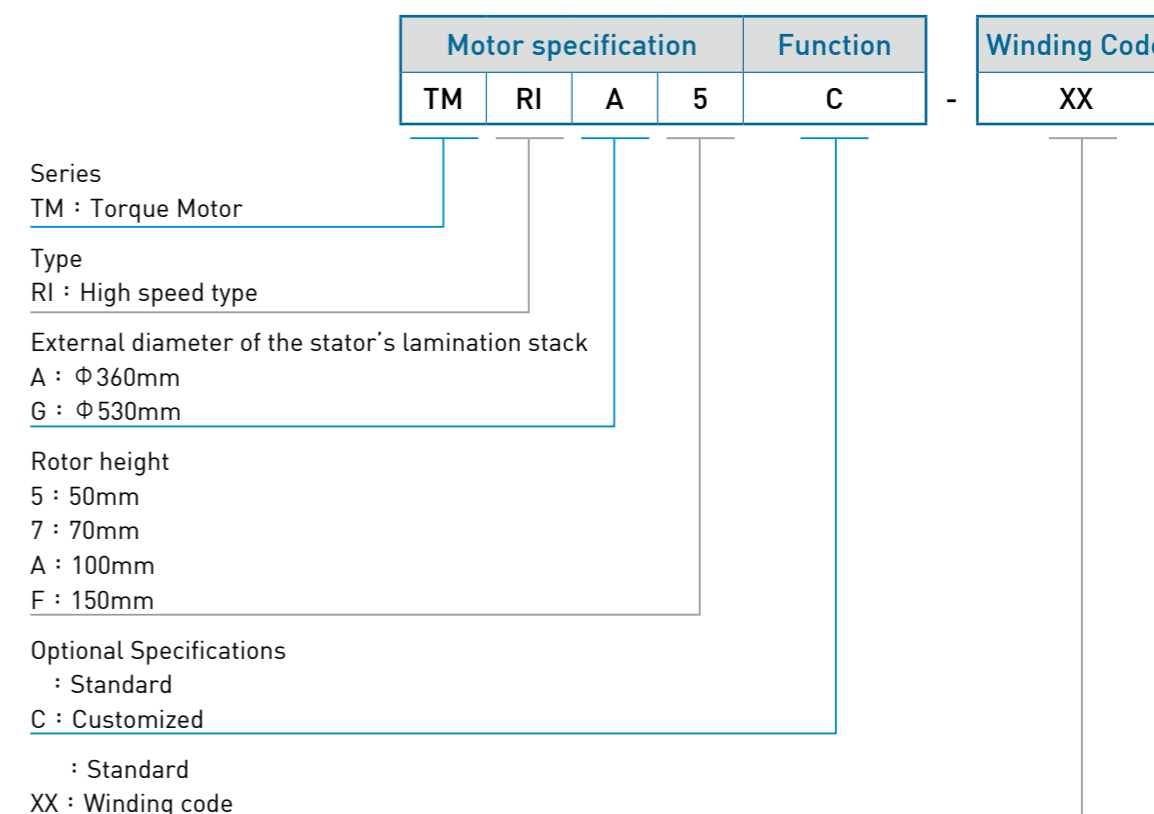
3. TMRI Torque Motor

Special rotor design, can be used with field weakening to achieve high speed requirements. The combination of a high torque stator and rotor meets the most demanding specifications in high precision industry. By using a water cooled design, high torque can be achieved.

- Water cooled
- Large hollow shaft
- Maximum torque up to 5300 NM
- The concentricity of the stator and rotor will be calibrated before shipment
- With field weakening to achieve high speed requirements

Example : Machine tool, Rotary table

■ Model Numbers for TMRI Series



3.1 TMRIA Series

3.1.1 TMRIA Dimensions

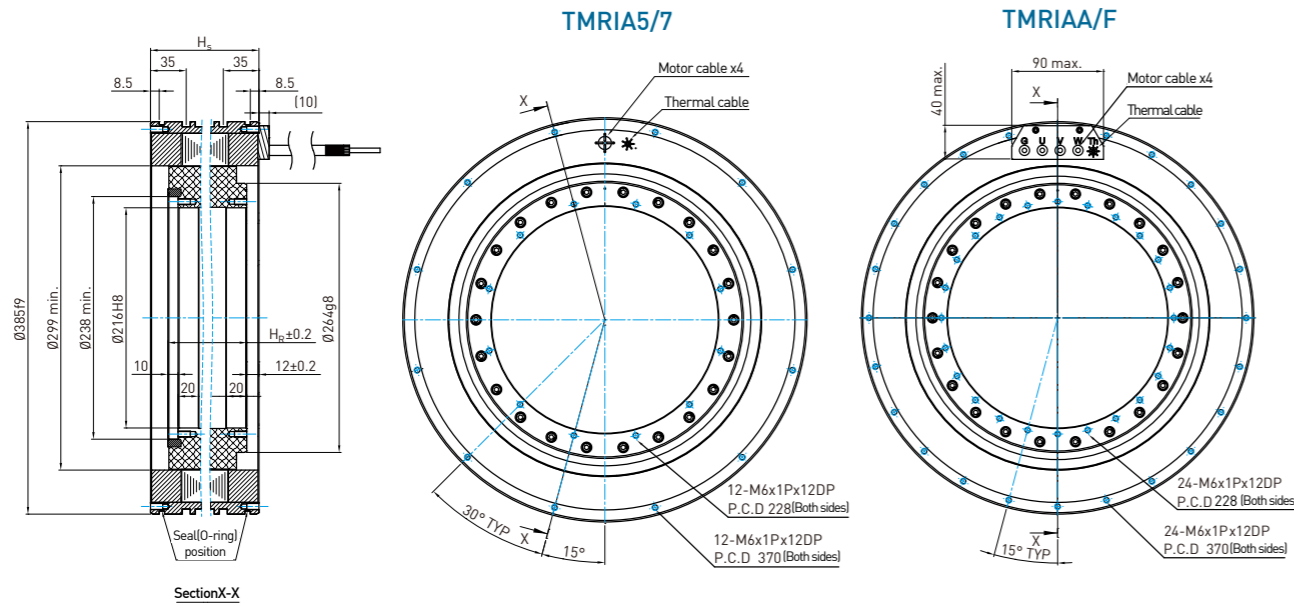


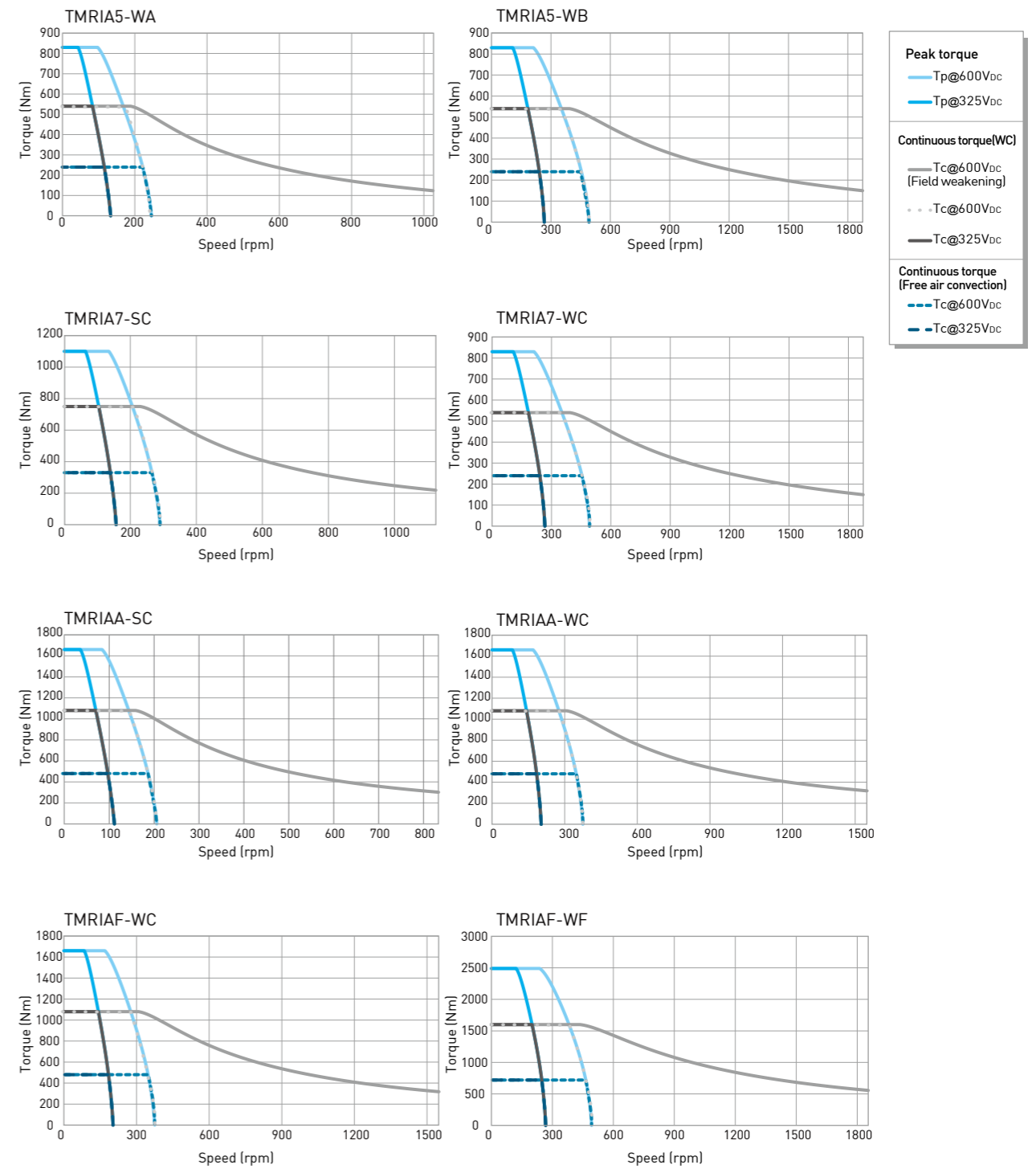
Table 3.1 TMRIA Specifications

	Symbol	Unit	TMRIA5-WA	TMRIA5-WB	TMRIA7-SC	TMRIA7-WC	TMRIAA-SC	TMRIAA-WC	TMRIAF-WC	TMRIAF-WF
Continuous torque	T _c	Nm	240	240	330	330	480	480	720	720
Continuous current	I _c	A _{rms}	11.2	22.4	18	33.6	18	33.6	33.6	67.2
Continuous torque (WC)	T _{cw}	Nm	540	540	750	750	1080	1080	1600	1600
Continuous current(WC)	I _{cw}	A _{rms}	27.9	55.8	45	83.7	45	83.7	83.7	167.4
Stall torque	T _s	Nm	168	168	231	231	336	336	504	504
Stall current	I _s	A _{rms}	7.8	15.7	10.6	23.5	10.6	23.5	23.5	47
Stall torque(WC)	T _{sw}	Nm	378	378	525	525	756	756	1120	1120
Stall current(WC)	I _{sw}	A _{rms}	19.5	39.1	30.1	58.6	30.1	58.6	58.6	117.2
Peak torque (Within 1s.)	T _p	Nm	830	830	1100	1100	1660	1660	2490	2490
Peak current (Within 1s.)	I _p	A _{rms}	75.3	150.6	121.5	225.9	121.5	225.9	225.9	451.8
Torque constant	K _t	Nm/ A _{rms}	23.76	11.88	20.18	11.08	28.39	15.59	23.75	11.86
Electrical time constant	T _e	ms	7.60	7.60	7.76	8.03	7.95	8.05	8.06	8.15
Resistance (Line to line at 25°C)	R ₂₅	Ω	2	0.5	0.98	0.29	1.32	0.38	0.53	0.13
Inductance (line to line)	L	mH	15.2	3.8	7.6	2.33	10.5	3.06	4.27	1.06
Number of poles	2p		66							
Back emf constant (line to line)	K _v	V _{rms} /(rad/s)	13.72	6.86	11.65	6.4	16.39	9	13.71	6.85
Motor constant (at 25°C)	K _m	Nm/√W	12.37	12.37	15.12	14.89	18.95	18.92	24.03	24.26
Thermal resistance	R _{th}	K/W	0.25	0.25	0.2	0.19	0.15	0.15	0.11	0.11
Thermal resistance (WC)	R _{thw}	K/W	0.041	0.041	0.032	0.031	0.024	0.024	0.017	0.017
Thermal sensor			PTC SNM100+SNM120+KTY84							
Max. DC BUS	V _{dc}		750							
Inertia of rotor	J	kgm ²	0.27	0.27	0.35	0.35	0.46	0.46	0.69	0.69
Max. speed (conti. torque(WC))	rpm		160	350	200	380	140	270	180	380
Max. speed (Field Weakening)	rpm		1000	1850	1100	1850	800	1500	1000	1850
Mass of rotor	M _r	kg	15.5	15.5	20.5	20.5	27	27	40.5	40.5
Mass of stator	M _s	kg	26.8	26.8	34.5	34.5	44.9	44.9	63.1	63.1
Height of stator	H _s	mm	110	110	130	130	160	160	210	210
Height of rotor	H _r	mm	81	81	101	101	131	131	181	181

Note : WC : water cooled

*All the specifications in the table are in ±10% of tolerance except dimensions.

3.1.2 TMRIA Series T-N curves



3.2 TMRIG Series

3.2.1 TMRIG Dimensions

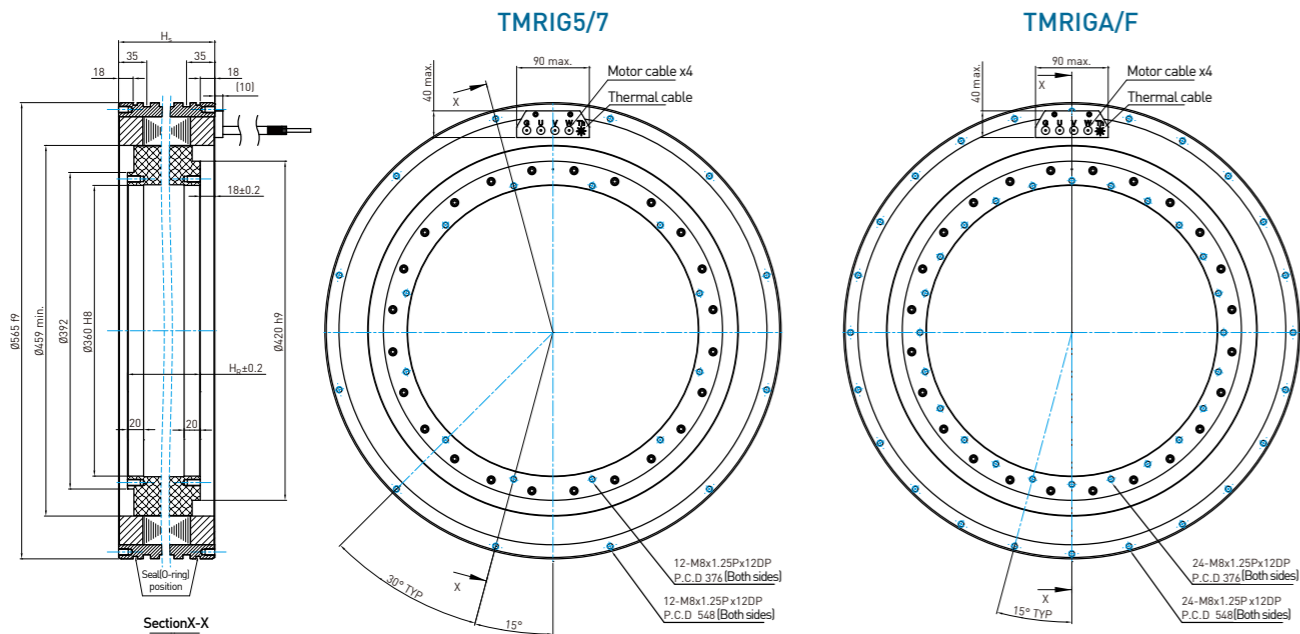


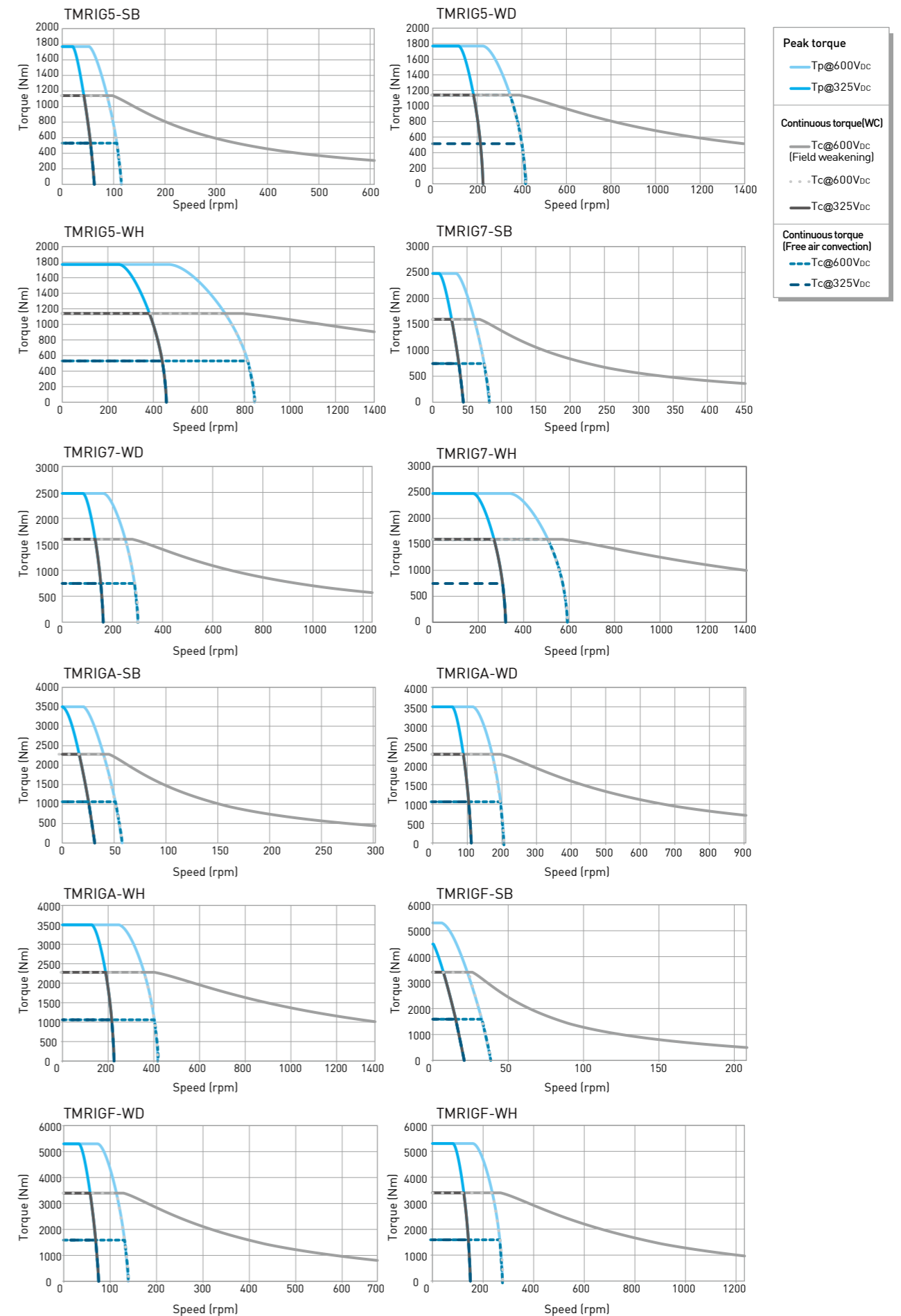
Table 3.2 TMRIG Specifications

	Symbol	Unit	TMRIG5-SB	TMRIG5-WD	TMRIG5-WH	TMRIG7-SB	TMRIG7-WD	TMRIG7-WH	TMRIGA-SB	TMRIGA-WD	TMRIGA-WH	TMRIGF-SB	TMRIGF-WD	TMRIGF-WH
Continuous torque	T _c	Nm	530	530	530	745	745	745	1060	1060	1060	1590	1590	1590
Continuous current	I _c	Arms	10.5	39	78	10.5	39	78	10.5	39	78	10.5	39	78
Continuous torque (WC)	T _{cw}	Nm	1140	1140	1140	1597	1597	1597	2280	2280	2280	3400	3400	3400
Continuous current(WC)	I _{cw}	Arms	26.3	95	190	26.3	95	190	26.3	95	190	26.3	95	190
Stall torque	T _s	Nm	371	371	371	522	522	522	742	742	742	1113	1113	1113
Stall current	I _s	Arms	7.4	27.3	54.6	7.4	27.3	54.6	7.4	27.3	54.6	7.4	27.3	54.6
Stall torque(WC)	T _{sw}	Nm	798	798	798	1118	1118	1118	1596	1596	1596	2380	2380	2380
Stall current(WC)	I _{sw}	Arms	18.4	66.5	133	18.4	66.5	133	18.4	66.5	133	18.4	66.5	133
Peak torque (Within 1s.)	T _p	Nm	1770	1770	1770	2480	2480	2480	3500	3500	3500	5300	5300	5300
Peak current (Within 1s.)	I _p	Arms	71	239	478	71	239	478	71	239	478	71	239	478
Torque constant	K _t	Nm/ Arms	50.70	14.00	6.90	71.00	19.40	9.90	101.30	28.40	14.00	152.10	42.10	21.10
Electrical time constant	T _e	ms	7.4	7.4	8.3	7.3	7.3	7.3	7.5	7.5	7.5	7.4	7.6	7.9
Resistance (Line to line at 25°C)	R ₂₅	Ω	2.4	0.18	0.04	3.2	0.24	0.06	4.4	0.32	0.08	6.5	0.46	0.11
Inductance (line to line)	L	mH	17.8	1.33	0.33	23.5	1.76	0.44	32.2	2.4	0.6	48.1	3.48	0.87
Number of poles	2 _p		88											
Back emf constant (line to line)	K _v	V _{rms} /(rad/s)	29.3	8.1	4	41	11.2	5.7	58.5	16.4	8.1	87.8	24.3	12.2
Motor constant (at 25°C)	K _m	Nm/√W	26.6	26.15	27.74	32.39	31.84	31.84	39.3	39.23	39.23	48.5	49.08	50.18
Thermal resistance	R _{th}	K/W	0.24	0.23	0.26	0.18	0.17	0.17	0.13	0.13	0.13	0.09	0.09	0.09
Thermal resistance (WC)	R _{thw}	K/W	0.038	0.039	0.044	0.029	0.029	0.029	0.021	0.022	0.022	0.014	0.015	0.016
Thermal sensor			PTC SNM100+SNM120+KTY84											
Max. DC BUS		V _{DC}	750											
Inertia of rotor	J	kgm ²	1.16	1.16	1.16	1.63	1.63	1.63	2.32	2.32	2.32	3.48	3.48	3.48
Max. speed (conti. torque(WC))		rpm	80	340	710	60	250	500	30	170	350	20	110	230
Max. speed (Field Weakening)		rpm	600	1360	1360	450	1200	1360	300	900	1360	200	650	1200
Mass of rotor	M _r	kg	27.3	27.3	27.3	38.3	38.3	38.3	54.7	54.7	54.7	82	82	82
Mass of stator	M _s	kg	48	48	48	61.1	61.1	61.1	75	75	75	107.5	107.5	107.5
Height of stator	H _s	mm	110	110	110	130	130	130	160	160	160	210	210	210
Height of rotor	H _r	mm	81	81	81	101	101	101	131	131	131	181	181	181

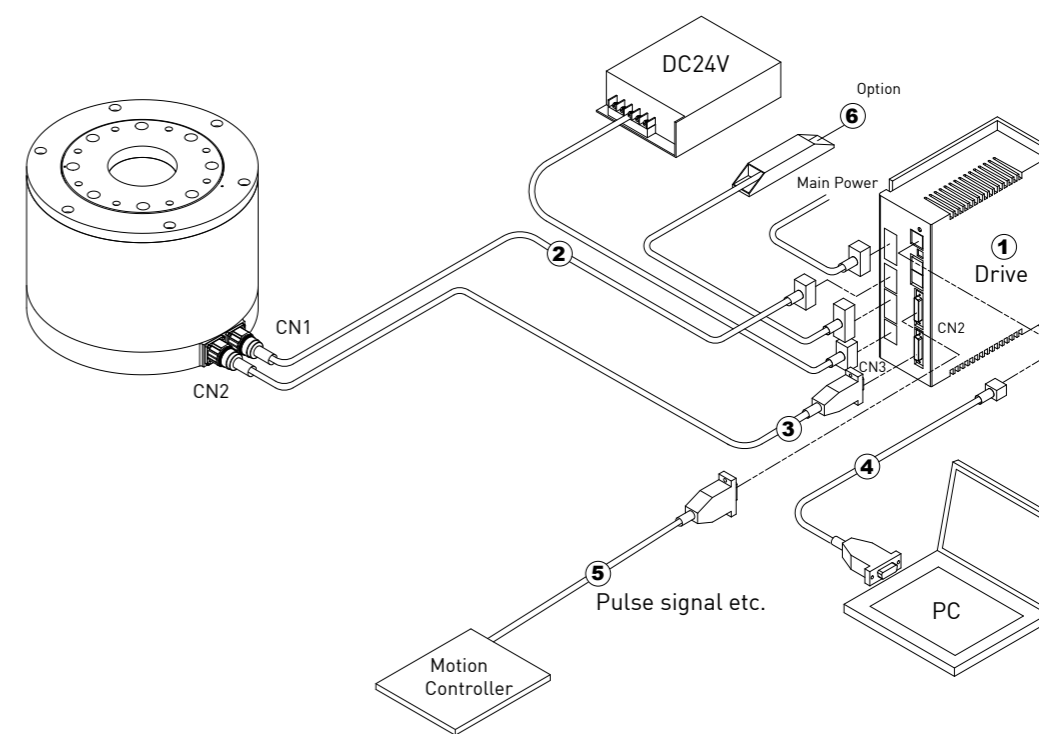
Note : WC : water cooled



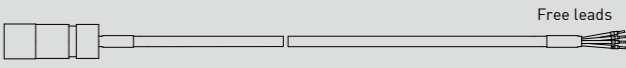
*All the specifications in the table are in ±10% of tolerance except dimensions.





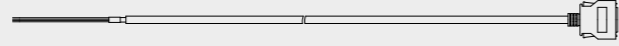
3.2.2 TMRIG Series T-N curves



4. Drives and Accessories



Part name	Model	Connector	Description
① Drive	D1-36-S2		For Incremental feedback types 
	D1-36-S4		For absolute feedback types 
② Motor Power Cable	LMACS□□F	Motor Connects (U,V,W)	For Torque Motor  Intercontec Model:BSTA880FR0886201A000

Part name	Model	Connector	Description
③ Position Signal Cable	LMACE□□AA	CN3	For incremental feedback types  Intercontec Model : ASTA876FR1085200A000 Drive Connector(3M) Model : 10120-3000VE
	LMACE□□AM		For incremental feedback types with hall sensor  Intercontec Model : ASTA876FR1085200A000 Drive Connector(3M) Model : 10120-3000VE
	LMACE□□AU		For TMY, TMNxxA Series  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
D1 Drive Accessory	D1-CK1		All Connector (Not Include CN3)
	D1-CK2		All Connector (Include CN3)
EMC Accessory	D1-EMC1		Used in Single Phase AC Power
	D1-EMC2		Used in Three Phase AC Power
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.

4.1 Pin Assignment

LMACE□□AA

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	20
Temperature Switch	11	T+	Purple	14
	12	T-	Yellow	15

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

LMACE□□AU

Function	8-10-0090 (Female)	Signal	Color (051400300069)	SCSI 20 (Male)
Resolver 1 (20/115)	1	VREF+	Brown	11
	4		White/Yellow	
	7	VREF-	White	3
	8		Yellow/Brown	
Resolver 2 (24/114)	2	SIN+	Green	16
	3	SIN-	Yellow	17
	9	COS+	Blue	18
	10	COS-	Red	19
	13	SIN+	Black	4
	14	SIN-	Purple	5
Temperature Switch	15	COS+	Grey	6
	16	COS-	Pink	7
	12	Inner shield	Inner shield	15
	Case	Outer shield	Outer shield	1/Case
Temperature Switch	11	T+	Brown/Green	14
	12	T-	White/Green	15

Appendix A: Motor Sizing

Start Motor Sizing

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

Requirement

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



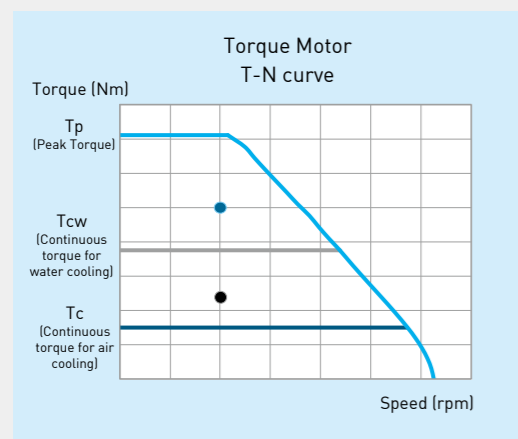
Torque calculation

- 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/s²)
 - ω : Angular velocity (rad/s)
 - J: Load inertia (kgm²)
 - J_m: Rotor inertia (kgm²)
 - 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)
 - ω_0 : 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 Requirement

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

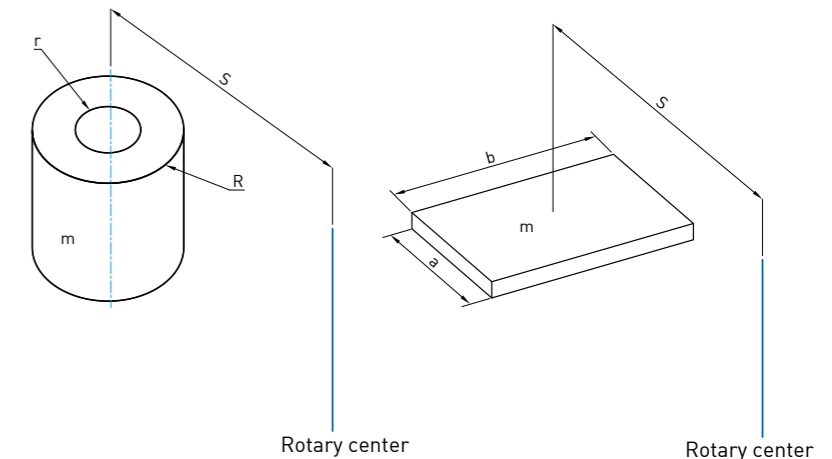
Loading inertia can be determined by 3D drawing software or according to the formula. The basic loading formula is as follows:

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

Motion equation

Basic kinematics equations are described as follows:

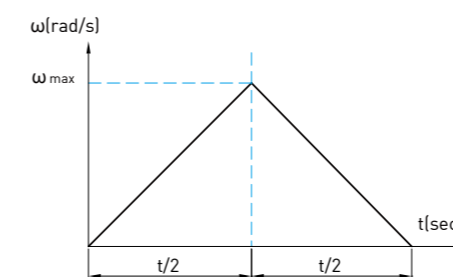
$$\omega = \omega_0 + \alpha t$$

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

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

Motion velocity profile

The motion profiles for torque motor are usually classified as "Trapezoid Profile" and "Triangle Profile", where the Trapezoid Profile is frequently used for scan. 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:



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

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

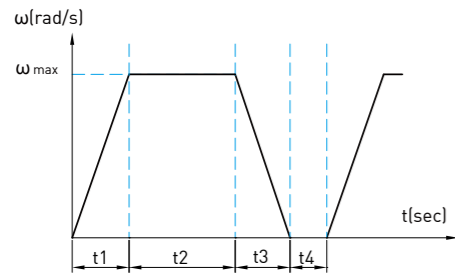
STEP 2 Torque calculation

The maximum torque can be calculated by the following equation

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

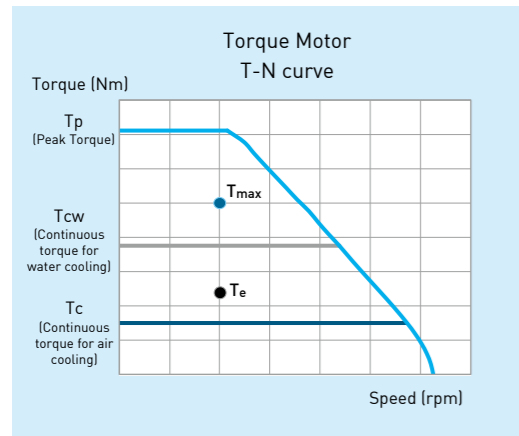
Where T_i is inertia torque, T_f is the torque which is caused by friction torque, cutting force or external force. In most cases, the motions are cyclic point-to-point movements. Assuming a cyclic motion shown in the following profile with a dwell time of t_4 second, the effective force can be calculated 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 is within the range of the T-N curve for the motor.



The motor sizing is determined as follows:

$$T_{max} < T_p$$

$$T_e < T_c$$

The user needs to consider the ratio of equivalent torque and continuous torque. Usually the ratio (T_e/T_c) is recommended within 0.7; continuous torque for TMRW series can be classified as air cooling and water cooling. If the motor is operated with water cooling, the comparison of equivalent torque can be based on water cooling continuous torque when selecting the motor.

The peak current I_{max} and effective current I_e can be calculated by bringing motor torque constant into the following equation (For K_t , please refer to Appendix B)

$$I_{max} = \frac{T_{max}}{K_t}$$

$$I_e = \frac{T_e}{K_t}$$

Example of motor sizing

Loading requirement: An aluminum disc with $\phi 500$ mm 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

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

Inertia of jig

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

Total inertia

$$J = J_1 + 8 \times J_2 = 0.375 + 8 \times 0.0235 = 0.563 \text{ kgm}^2$$

Motion profile

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

$$\theta = 45^\circ = \frac{45 \times \pi}{180} = 0.7854 \text{ rad}$$

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

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

STEP 2 Torque calculation

It is recommended that the ratio loading inertia (J) over motor rotator inertia (J_m) be less than 50. It can be roughly estimated 30 in motor sizing. Since $J/30 = 0.563/30 = 0.019 \text{ kgm}^2$, user can select the TMS34 ($J_m = 0.02 \text{ kgm}^2$)

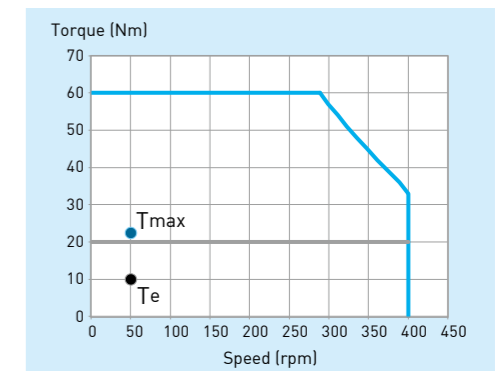
$$T_{max} = (J + J_m) \times \alpha_{max} + T_f = T_i + T_f = (0.563 + 0.02) \times 34.91 + 2 = 20.4 + 2 = 22.1 \text{ Nm}$$

Where $T_i = 20.4 \text{ Nm}$, $T_f = 2 \text{ Nm}$

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

STEP 3 Motor sizing and T-N curve confirmation

Finally, TMS34 can be selected according to the T_{max} and T_e . The peak torque $T_p = 60 \text{ Nm}$, the continuous torque $T_c = 20 \text{ Nm}$, the torque constant $K_t = 6.6 \text{ Nm/Arms}$, and the speed and torque under all operating conditions are within the range of T-N curve for TMS34.



Appendix B: Glossary

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

The back EMF constant, K_v , is the ratio of the back emf voltage (V_{rms}) 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/I_{cw} (Arms)

The continuous current, I_c , 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 (120°C for TMRW series). Under this condition, the motor reaches the rating continuous torque T_c ; in relation with the continuous current and coil temperature, TMRW series will respond to I_c for air cooling and I_{cw} for water cooling.

3. Continuous torque: T_c/T_{cw} (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 (120°C for TMRW series). This continuous torque corresponds to I_c/I_{cw} supplied to the motor; in relation with the continuous current and coil temperature, TMRW series will respond to T_c for air cooling and T_{cw} for water cooling.

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

Inductance is defined as inductance 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 defined as resistance 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 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 poles pair.

8. Peak current: I_p (Arms)

The peak current, I_p , is the current corresponding to maximum torque output of the motor, and the motor temperature reached by current can't demagnetize magnet; generally speaking, peak current can be granted to supply 1 second when the motor is operating in the normal condition, and then need to ensure it reaches the normal temperature to supply peak current.

9. Peak torque: T_p (Nm)

The peak torque, T_p , is the maximum torque that the motor output less than 1 second. Peak current corresponding to the torque can't demagnetize magnet.

10. Rotor inertia: J (kgm^2)

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

11. Stall current: I_s/I_{sw} (Arms)

The stall current, is the upper limit of current when the motor is at 25°C and in the stall condition; Depending on the heat dissipation, TMRW series will correspond to I_s for air cooling and I_{sw} for water cooling.

12. Stall torque: T_s/T_{sw} (Nm)

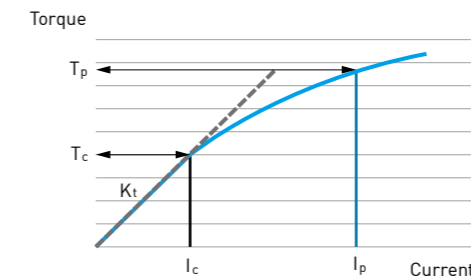
The stall current, T_s , is the upper limit of torque when the motor is at 25°C and in the stall condition; Depending on the heat dissipation, TMRW series will correspond to T_s for air cooling and T_{sw} for water cooling.

13. Thermal resistance: R_{th}/R_{thw} (K/W)

The thermal resistance, R_{th} , is defined as the resistance suffered heat from motor coil to dissipate the environment (consider the natural convection and radiation for air cooling when ambient temperature is at 25°C, and the force 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.

14. Torque constant: K_t (Nm/Arms)

The torque constant, K_t , is ratio between as the motor's output torque per RMS current. Except for TMRW series, output torque and input current shows a linear relationship. The non-linear relationship is due to saturation in the lamination stack.



15. Maximum speed

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 water-cooling motor: maximum speed under air-cooling continuous torque, maximum speed under water-cooling continuous torque and maximum speed under peak torque.

16. Maximum Input Voltage (Vdc):

Maximum input 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 system divided in one turn.

18. Accuracy: arc-sec

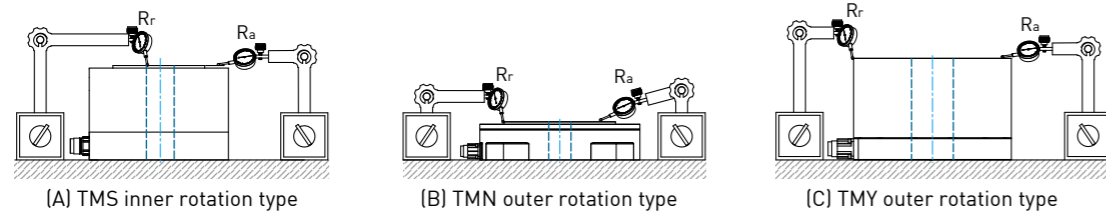
Accuracy is the error between the target position and the actual position; in the HIWIN's definition, the motor is measured clockwise and counterclockwise twice per 22.5° to take the maximum error.

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 Ra by measuring the parallel direction between the installation end and rotary axis when the motor rotates; radial runout is defined as runout Rr 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.



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

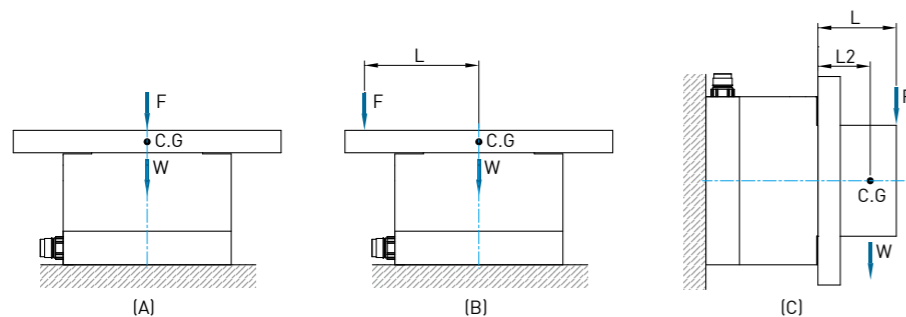
Axial force applied to the motor $F_1 = F + \text{loading weight } W$
Torque applied to the motor $M_1 = 0$

(B) External force=F

Axial force applied to the motor $F_2 = F + \text{loading weight } W$
Torque applied to the motor $M_2 = F \times L$

(C) External force=F

Axial force applied to the motor $F_3 = F + \text{loading weight } W$
Torque applied to the motor $M_3 = F \times (L + 0.03m) + W \times (L_2 + 0.03m)$



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 : Torque Motor Inquiry Form

Date: _____

Company Name: _____		Contact person: _____	
Email: _____		Title: _____	
Tel: _____ Fax: _____			
Industrial		Installation	<input type="checkbox"/> Horizontal <input type="checkbox"/> Laterally <input type="checkbox"/> (Upside Down)
Environment	<input type="checkbox"/> Normal environment (25°C) <input type="checkbox"/> Clean room, Class _____ <input type="checkbox"/> Pollution environment ° <input type="checkbox"/> Other _____		
Load Type	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Other _____	Shaft runout	<input type="checkbox"/> Standard <input type="checkbox"/> High Precision Run out of output Shaft Surface (a) _____ μm
Load Conditions	<input type="checkbox"/> Total moment of inertia: _____ kgm ² , Size: _____ mm <input type="checkbox"/> Load1, Number _____ Mass: _____ kg or Material: _____ Size: _____ mm Offset of C.G. : _____ mm <input type="checkbox"/> Load2, Number _____ Mass: _____ kg or Material: _____ Size: _____ mm Offset of C.G. : _____ mm <input type="checkbox"/> Load3, Number _____ Mass: _____ kg or Material: _____ Size: _____ mm Offset of C.G. : _____ mm		<input type="checkbox"/> Point to Point <input type="checkbox"/> Scan Moving Angle: _____ ° Moving Time: _____ sec Dwell Time: _____ sec
Force	<input type="checkbox"/> None <input type="checkbox"/> Yes: _____ kg, Offset of C.G. : _____ mm	Application	
Repeatability	_____ arc-sec		Special requirement:
Accuracy	_____ arc-sec		
Drive voltage	<input type="checkbox"/> 110V <input type="checkbox"/> 220V <input type="checkbox"/> Other _____ V		
Pulse format	<input type="checkbox"/> CW/CCW <input type="checkbox"/> A/B <input type="checkbox"/> STEP/DIR		
Brake	<input type="checkbox"/> None <input type="checkbox"/> Power Off Brake <input type="checkbox"/> Power On Brake		
The information below is to be filled out by our authorized agents. Recommended specification:			
Manager: _____		Engineer: _____ Salesperson: _____	

Torque Motor (Direct Drive Motor) Technical Information

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