

High Torque Series

Brushless DC Motors

Direct Drive Housed and Frameless Brushless DC Motors



Engineering Guide

Hathaway
Emoteq, Inc

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High Torque Series

Product Description

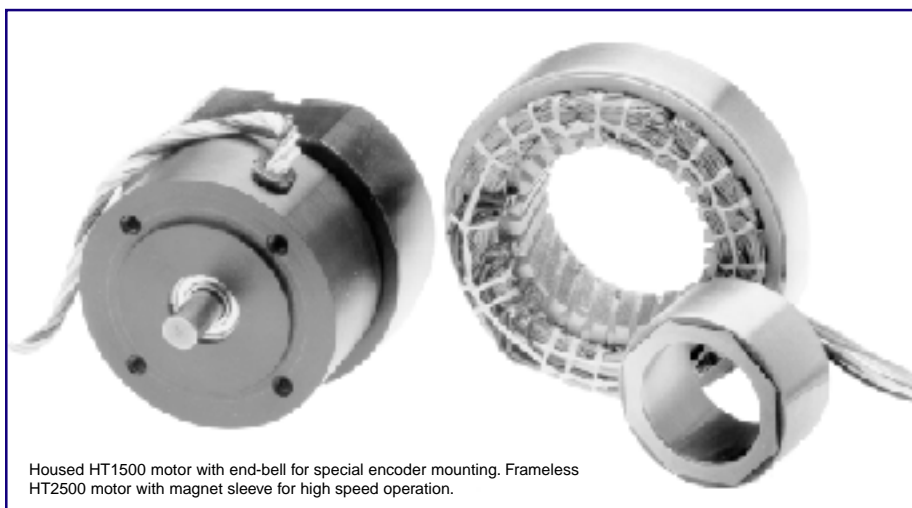
Brushless DC Motors

Design Features

- High torque to inertia and size ratios
- High energy Neodymium Iron Boron magnets standard
- Samarium Cobalt magnets for harsh environments
- Integral Hall effect sensors for commutation
- Extensive range of standard designs
- Mechanical/electrical changes readily undertaken
- Fast delivery on both standard and custom designs
- Performance and mechanical replacements for Kollmorgen Motor RBE(H) series brushless motors

Applications

- Semiconductor processing equipment
- Medical systems including life support
- Electronics manufacturing
- Robotic systems
- Precision machine tools
- Photographic materials processing
- Image acquisition and reproduction systems
- Laser sighting and control
- Cryogenic cooling pumps
- Optical glass manufacturing



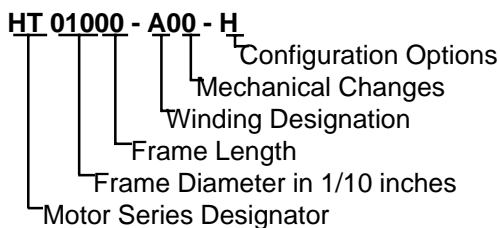
The **HT Series** is a family of three phase brushless motors available in a variety of diameters and lengths. Hall effect sensors for commutation are integral to the motor and require no setup on the part of the user.

The extensive range of standard HT Series motors is especially well suited to applications demanding high power density motors which minimize size, weight, and

inertia. Additionally, Hathaway can customize designs at a surprisingly low cost and deliver very quickly. Therefore, your system can be swiftly proven with the optimum design solution. Please call and discuss your needs with one of our knowledgeable applications engineers at (800) 221 7572. You'll be pleasantly surprised at how easy it is to deal with *this* specialty servo products company.

HT Series Model Numbering

A complete model number is comprised of a series designator, a frame size, frame length, winding designator, and mechanical changes and options. Model numbers for housed and frameless motors are the same except for the -H suffix indicating a housed motor. Certain options may only be specified with housed motors.



Motor Series Designator

HT High Torque (standard)
HS High Speed (high efficiency laminations)

HSS Low hysteresis (low cogging or very high speed)
SB Special versions

Frame Diameter

Frameless stator diameter (inches)

Frame Length

No. of stacks. Stack length varies with series

Windings

-A00 Standard (catalog) design
-X00 Special winding (new design not released by engineering)

-A0X Standard winding, special mechanical design

Mechanical Changes

Issued in numerical sequence. See specific drawing.

Configuration Options

- H Housed motor
- HE Housed motor with encoder
- HB Housed motor with integral brake.
- HR Housed motor with resolver
- T Tachometer (housed or frameless motor)

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High Torque Series

Size Constants

Brushless DC Motors

HT Series Model Number	Max. Rated Torque		Max. Cont. Stall Torque		Max. Cont. Power Pout Watts	Motor Constant		Elect. Time Constant T _E Msec	Mech. Time Constant T _M Msec	Thermal Resistance TPR °C/Watt	Hysteresis Drag Torque T _H		Viscous Damping Coefficient F _i		Max. Cogging Torque T _F		No. of Poles n
	T _{MAX}	Nm	T _C	Nm		K _M	oz. in./√Watt				Nm/√Watt	oz. in.	Nm	oz. in./RPM	Nm/RPM	oz. in.	
	oz. in.	Nm	oz. in.	Nm	Watts	oz. in./√Watt	Nm/√Watt	Msec	Msec	°C/Watt	oz. in.	Nm	oz. in./RPM	Nm/RPM	oz. in.	Nm	n
00800	11	0.07	1.0	0.007	7	0.64	0.004	0.10	3.4	21.1	0.03	2.0E-4	4.3E-6	3.0E-8	0.2	0.001	6
00801	27	0.19	2.0	0.014	11	1.10	0.008	0.15	2.3	17.1	0.06	4.0E-4	8.6E-6	6.1E-8	0.6	0.004	6
00802	34	0.24	3.0	0.019	13	1.45	0.010	0.21	2.0	14.6	0.09	7.0E-4	1.3E-5	9.3E-8	1.1	0.008	6
01000	35	0.24	2.9	0.021	11	1.40	0.098	0.18	1.8	10.8	0.11	7.8E-4	4.3E-5	3.0E-7	0.4	0.003	6
01001	75	0.53	5.9	0.042	17	2.62	0.018	0.30	0.9	9.3	0.23	1.7E-3	8.8E-5	6.3E-7	0.6	0.004	6
01002	117	0.83	8.9	0.063	22	3.71	0.026	0.39	0.7	8.2	0.36	2.5E-3	1.3E-4	9.5E-7	0.7	0.005	6
01003	159	1.12	11.8	0.084	26	4.67	0.033	0.46	0.6	7.4	0.49	3.5E-3	1.8E-4	1.3E-6	0.8	0.006	6
01500	83	0.58	7	0.048	31	2.34	0.017	0.28	3.0	6.6	0.19	0.001	6.6E-5	4.7E-7	0.7	0.005	6
01501	166	1.17	13	0.092	44	4.33	0.031	0.49	1.7	6.0	0.39	0.003	1.3E-4	9.1E-7	1.2	0.009	6
01502	254	1.79	19	0.133	55	5.94	0.042	0.66	1.3	5.4	0.57	0.004	1.8E-4	1.3E-6	1.8	0.013	6
01503	358	2.52	24	0.171	63	7.28	0.051	0.83	1.2	4.9	0.76	0.005	2.5E-4	1.7E-6	2.5	0.018	6
01504	428	3.02	29	0.204	67	8.45	0.060	1.03	1.1	4.7	0.95	0.007	3.0E-4	2.1E-6	3.2	0.023	6
01505	506	3.57	33	0.234	71	9.47	0.067	1.25	1.0	4.4	1.13	0.008	3.6E-4	2.5E-6	3.9	0.027	6
02000	188	1.33	16	0.114	48	4.8	0.034	0.25	5.0	4.8	0.51	0.004	2.7E-4	1.9E-6	1.1	0.008	8
02001	448	3.16	32	0.229	63	9.3	0.066	0.47	2.5	4.4	1.08	0.008	5.5E-4	3.9E-6	2.2	0.016	8
02002	702	4.95	46	0.326	73	12.7	0.090	0.63	2.0	4.1	1.63	0.012	8.2E-4	5.8E-6	2.4	0.017	8
02003	886	6.25	59	0.416	82	15.5	0.110	0.80	1.8	3.8	2.13	0.015	1.0E-3	7.5E-6	2.9	0.021	8
02004	1077	7.60	73	0.518	94	18.6	0.132	1.04	1.5	3.5	2.64	0.019	1.3E-3	9.2E-6	3.2	0.023	8
02005	1278	9.02	83	0.586	97	20.6	0.146	1.22	1.5	3.3	3.17	0.022	1.5E-3	1.1E-5	3.9	0.028	8
02300	329	2.32	30	0.215	56	7.9	0.056	0.34	5.3	3.7	1.05	0.007	8.2E-4	5.8E-6	1.9	0.014	12
02301	675	4.76	61	0.413	81	15.0	0.106	0.61	2.8	3.3	2.16	0.015	1.6E-3	1.1E-5	2.8	0.020	12
02302	1035	7.31	88	0.620	97	20.8	0.147	0.83	2.2	3.1	3.28	0.023	2.4E-3	1.7E-5	3.8	0.027	12
02303	1298	9.16	113	0.798	111	25.8	0.182	1.04	1.9	2.8	4.20	0.030	3.0E-3	2.1E-5	5.0	0.036	12
02304	1561	11.0	137	0.966	123	30.0	0.212	1.27	1.7	2.6	5.17	0.037	3.8E-3	2.6E-5	6.1	0.043	12
02305	1838	12.9	157	1.105	129	33.6	0.238	1.50	1.6	2.5	6.16	0.043	4.5E-3	3.1E-5	7.3	0.052	12
02500	152	1.07	25	0.182	59	7.0	0.049	0.48	4.4	3.6	0.79	0.005	3.9E-4	2.8E-6	2.0	0.014	8
02501	331	2.34	55	0.386	92	14.2	0.100	0.87	2.0	3.2	1.66	0.011	7.8E-4	5.6E-6	2.6	0.018	8
02502	509	3.60	79	0.558	111	19.5	0.137	1.09	1.6	2.9	2.53	0.017	1.1E-3	8.4E-6	3.0	0.021	8
02503	693	4.90	106	0.751	134	24.9	0.176	1.31	1.3	2.6	3.39	0.024	1.6E-3	1.1E-5	3.5	0.024	8
02504	876	6.19	131	0.925	152	29.5	0.208	1.44	1.1	2.4	4.25	0.030	1.9E-3	1.4E-5	3.9	0.027	8
02505	1058	7.48	154	1.089	167	33.4	0.236	1.53	1.1	2.2	5.10	0.036	2.3E-3	1.7E-5	4.2	0.028	8
03000	292	2.06	51	0.36	89	11.2	0.08	0.79	5.4	2.9	1.23	0.009	8.6E-4	6.0E-6	2.8	0.020	12
03001	618	4.36	114	0.81	130	24.2	0.17	1.36	2.3	2.6	3.02	0.021	2.1E-3	1.5E-5	4.2	0.030	12
03002	975	6.88	168	1.19	157	33.7	0.24	1.69	1.7	2.3	4.82	0.034	3.4E-3	2.4E-5	5.9	0.042	12
03003	1287	9.08	231	1.63	189	44.2	0.31	1.91	1.3	2.1	6.62	0.047	4.6E-3	3.2E-5	8.1	0.058	12
03004	1703	12.0	270	1.91	200	49.7	0.35	2.00	1.3	2.0	8.42	0.059	5.9E-3	4.2E-5	10.4	0.073	12
03005	2583	18.2	284	2.01	191	50.5	0.36	1.99	1.5	1.8	10.3	0.073	7.3E-3	5.2E-5	12.8	0.091	12
03800	674	4.7	99	0.70	170	17.7	0.12	0.93	4.1	1.8	2.72	0.019	2.0E-3	1.4E-5	2.9	0.020	12
03801	1681	11.8	204	1.43	241	34.9	0.25	1.77	2.0	1.6	5.74	0.041	4.2E-3	3.0E-5	6.1	0.043	12
03802	2392	16.9	290	2.05	276	48.5	0.34	2.49	1.6	1.5	8.67	0.061	6.3E-3	4.4E-5	8.1	0.057	12
03803	3477	24.5	378	2.67	312	61.6	0.43	3.05	1.3	1.4	11.40	0.081	8.2E-3	5.8E-5	10.9	0.077	12
03804	4279	30.2	464	3.27	349	72.7	0.51	3.67	1.2	1.3	13.79	0.097	9.8E-3	6.9E-5	13.9	0.098	12
03805	5132	36.2	546	3.85	383	82.3	0.58	4.28	1.1	1.2	16.23	0.115	1.1E-2	8.1E-5	16.5	0.117	12
05000	1313	9.2	201	1.41	271	30.2	0.21	1.56	4.5	1.3	4.79	0.034	3.6E-3	2.6E-5	5.5	0.039	12
05001	3019	21.3	419	2.96	380	61.2	0.43	3.00	2.4	1.2	10.26	0.072	7.5E-3	5.3E-5	13.4	0.095	12
05002	4405	31.1	623	4.40	464	86.9	0.61	4.14	1.8	1.1	15.59	0.110	1.1E-2	8.0E-5	19.1	0.135	12
05003	5760	40.6	790	5.57	498	108.6	0.76	5.05	1.6	1.0	20.89	0.147	1.5E-2	1.0E-4	23.7	0.167	12
05004	7156	50.5	997	7.04	591	128.0	0.90	5.93	1.4	0.9	25.48	0.180	1.8E-2	1.3E-4	29.6	0.209	12
05005	8651	61.0	1192	8.41	665	146.2	1.03	6.87	1.3	0.8	29.82	0.211	2.1E-2	1.5E-4	36.2	0.256	12
	ft.lb.	Nm	ft.lb.	Nm	Watts	ft.lb./√Watt	Nm/√Watt	Msec	Msec	°C/Watt	ft.lb.	Nm	ft.lb. RPM	Nm RPM	ft.lb.	Nm	n
07000	42.2	57.2	4.6	6.3	921	0.49	0.66	3.55	4.8	0.63	0.100	0.136	7.8E-5	1.0E-4	0.14	0.19	12
07001	103.7	140.6	9.5	12.9	1265	0.98	1.33	6.62	2.5	0.59	0.207	0.282	1.5E-4	2.1E-4	0.30	0.41	12
07002	149.6	202.8	13.6	18.4	1432	1.36	1.84	8.89	2.0	0.56	0.315	0.427	2.4E-4	3.2E-4	0.46	0.63	12
07003	194.6	263.9	17.3	23.5	1555	1.68	2.28	11.11	1.7	0.53	0.406	0.551	3.0E-4	4.1E-4	0.64	0.87	12
07004	241.3	327.2	21.3	28.9	1702	2.01	2.72	14.11	1.5	0.49	0.495	0.671	3.6E-4	5.0E-4	0.81	1.10	12
09000-.00	65.6	88.9	12.0	16.3	2179	0.89	1.20	5.97	5.5	0.40	0.172	0.233	1.3E-4	1.8E-4	0.16	0.22	12
09000-.01	26.5	35.9	11.4	15.5	2183	0.84	1.14	7.22	6.0	0.40	0.610	0.217	1.2E-4	1.6E-4	0.13	0.18	12
09000-.02	27.5	37.4	11.4	15.5	3623	0.84	1.14	7.26	6.0	0.40	0.119	0.162	3.7E-5	5.1E-5	0.13	0.17	12
09001-.00	127.6	173.0	23.8	32.2	2897	1.69	2.29	9.74	2.9	0.37	0.345	0.468	2.5E-4	3.5E-4	0.35	0.47	12
09001-.01	52.0	70.5	22.6	30.6	2935	1.61	2.18	12.35	3.3	0.37	0.318	0.431	2.3E-4	3.1E-4	0.30	0.40	12
09001-.02	53.7	72.8	22.2	30.1	4607	1.57	2.13	11.83	3.4	0.37	0.238	0.322	7.3E-5	9.9E-5	0.29	0.39	12
09002-.00	190.7	258.5	34.6	46.9	3353	2.38	3.23	12.43	2.23	0.34	0.518	0.702	3.8E-4	5.2E-4	0.55	0.75	12
09002-.01	78.0	105.7	32.6	44.2	3386	2.24	3.04	15.71	2.51	0.34	0.474	0.643	3.4E-4	4.6E-4	0.46	0.63	12
09002-.02	80.7	109.4	32.1	43.5	5189	2.20	2.98	14.97	2.61	0.34	0.357	0.484	1.0E-4	1.5E-4	0.46	0.63	12



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Winding Constants

HT Series Model Number	Design Voltage	Peak Torque @ Vp		Peak Current @ Vp	Torque Sensitivity		No Load Speed @ Vp		Back EMF Constant		Terminal Resistance	Terminal Inductance
	Vp volts	oz. in.	Nm	Amps	oz. in./Amp.	Nm/Amp.	RPM	rad/sec	V per KRPM	V per rad/s	Rm Ohms	Lm mH
00800	24	6	0.04	3.3	1.7	0.01	18224	1908	1.3	0.01	7.19	0.72
00801	24	14	0.10	6.8	2.1	0.01	15341	1604	1.5	0.01	3.53	0.54
00802	24	18	0.13	6.3	2.8	0.02	11185	1171	2.1	0.02	3.83	0.79
01000	24	13	0.09	3.5	3.6	0.03	8580	898	2.7	0.03	6.76	1.24
01001	24	33	0.23	6.5	5.0	0.04	6280	658	3.7	0.04	3.70	1.12
01002	24	56	0.39	9.5	5.9	0.04	5400	565	4.4	0.04	2.52	0.99
01003	24	78	0.55	11.8	6.7	0.05	4780	501	4.9	0.05	2.04	0.94
01500	24	30	0.21	6.9	4.3	0.03	7301	765	3.2	0.03	3.46	0.96
01501	24	60	0.43	8.1	7.4	0.05	4290	449	5.5	0.05	2.96	1.44
01502	24	92	0.65	10.1	9.1	0.06	3499	366	6.8	0.06	2.38	1.57
01503	24	130	0.92	13.3	9.8	0.07	3283	344	7.2	0.07	1.80	1.50
01504	24	156	1.10	14.2	11.0	0.08	2917	306	8.1	0.08	1.70	1.75
01505	24	184	1.29	15.7	11.7	0.08	2744	287	8.6	0.08	1.53	1.91
02000	24	68	0.48	8.6	8.0	0.06	3986	417	5.9	0.06	2.81	0.71
02001	24	163	1.15	12.8	12.7	0.09	2521	264	9.4	0.09	1.87	0.88
02002	24	255	1.80	16.8	15.2	0.11	2112	221	11.2	0.11	1.43	0.90
02003	24	322	2.27	17.8	18.1	0.13	1771	186	13.4	0.13	1.35	1.07
02004	24	392	2.76	18.4	21.3	0.15	1507	158	15.7	0.15	1.31	1.35
02005	24	465	3.28	21.1	22.0	0.16	1456	153	16.3	0.16	1.14	1.39
02300	24	97	0.68	6.2	15.6	0.11	2027	212	11.6	0.11	3.89	1.32
02301	24	199	1.40	7.2	27.5	0.19	1161	122	20.3	0.19	3.32	2.02
02302	24	305	2.15	8.9	34.3	0.24	932	98	25.4	0.24	2.70	2.24
02303	24	382	2.70	9.1	41.9	0.30	762	80	31.0	0.30	2.64	2.76
02304	24	459	3.24	9.7	47.3	0.33	676	71	34.9	0.33	2.47	3.14
02305	24	541	3.82	10.7	50.3	0.36	635	67	37.2	0.36	2.23	3.36
02500	24	76	0.53	4.9	15.6	0.11	2040	214	11.5	0.11	4.92	2.34
02501	24	208	1.47	9.1	22.9	0.16	1400	147	16.9	0.16	2.64	2.31
02502	24	327	2.31	12.0	27.3	0.19	1180	124	20.2	0.19	2.00	2.18
02503	24	474	3.35	15.3	30.9	0.21	1040	109	22.9	0.21	1.57	2.05
02504	24	581	4.10	16.5	35.1	0.25	910	95	25.9	0.25	1.45	2.10
02505	24	693	4.89	18.4	37.7	0.26	850	89	27.9	0.26	1.31	2.00
03000	24	182	1.29	11.0	16.5	0.11	1930	202	12.2	0.11	2.17	1.72
03001	24	386	2.73	10.7	36.3	0.25	880	92	26.8	0.25	2.25	3.06
03002	24	609	4.30	13.7	44.6	0.31	720	75	33.0	0.31	1.76	2.96
03003	24	804	5.68	13.8	58.3	0.41	550	58	43.1	0.41	1.74	3.32
03004	24	1064	7.52	19.1	55.7	0.39	580	61	41.2	0.39	1.26	2.50
03005	24	1614	11.40	42.5	38.0	0.26	850	89	28.1	0.26	0.56	1.12
03800	100	385	2.72	4.73	81.4	0.58	1639	172	60.2	0.58	21.12	19.7
03801	100	961	6.78	7.54	127.4	0.90	1052	110	94.2	0.90	13.26	23.5
03802	100	1367	9.65	7.93	172.3	1.22	778	81	127.4	1.22	12.61	31.4
03803	100	1987	14.03	10.4	191.0	1.35	702	74	141.2	1.35	9.61	29.3
03804	100	2445	17.27	11.3	216.1	1.53	621	65	159.8	1.53	8.84	32.5
03805	100	2932	20.71	12.7	231.0	1.63	581	61	170.8	1.63	7.88	33.7
05000	100	1010	7.13	11.1	90.6	0.64	1477	155	67.0	0.64	8.97	14.0
05001	100	2323	16.40	14.4	161.1	1.14	833	87	119.2	1.14	6.94	20.8
05002	100	3389	23.93	15.2	223.3	1.58	602	63	165.1	1.58	6.59	27.3
05003	100	4431	31.29	16.6	266.5	1.88	504	53	197.1	1.88	6.02	30.4
05004	100	5505	38.87	18.5	297.7	2.10	451	47	220.1	2.10	5.41	32.1
05005	100	6654	46.99	20.7	321.1	2.27	418	44	237.5	2.27	4.83	33.2
	volts	ft.lb.	Nm	Amps	ft.lb./Amp.	Nm/Amp.	RPM	rad/sec	V per KRPM	V per rad/s	Ohms	mH
07000	145	28.1	38.1	22.7	1.2	1.7	820	86	176	1.7	6.4	22.7
07001	145	69.1	93.7	34.4	2.0	2.7	506	53	285	2.7	4.2	27.9
07002	145	99.7	135.2	37.2	2.7	3.6	380	40	380	3.6	3.9	34.6
07003	145	129.8	175.9	41.1	3.2	4.3	323	34	448	4.3	3.5	39.2
07004	145	160.9	218.1	44.3	3.6	4.9	281	29	515	4.9	3.3	46.1
09000-.00	145	65.6	88.9	52.7	1.2	1.7	820	86	176	1.7	1.97	11.7
09000-.01	145	26.5	35.9	56.4	0.5	0.6	2170	227	66	0.6	0.31	2.2
09000-.02	145	27.6	37.4	101.2	0.3	0.4	3740	392	38	0.4	0.10	0.8
09001-.00	145	127.7	173.0	73.3	1.7	2.3	590	62	247	2.3	1.06	10.3
09001-.01	145	52.0	70.5	83.0	0.6	0.8	1630	171	89	0.8	0.15	1.9
09001-.02	145	53.7	72.9	119.7	0.4	0.6	2270	238	64	0.6	0.08	1.0
09002-.00	145	190.7	258.5	91.2	2.1	2.8	490	51	296	2.8	0.77	9.6
09002-.01	145	78.0	105.7	113.3	0.7	0.9	1480	155	97	0.9	0.09	1.5
09003-.02	145	80.7	109.4	135.3	0.6	0.8	1710	179	85	0.8	0.07	1.1



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High Torque Series

Mechanical Constants

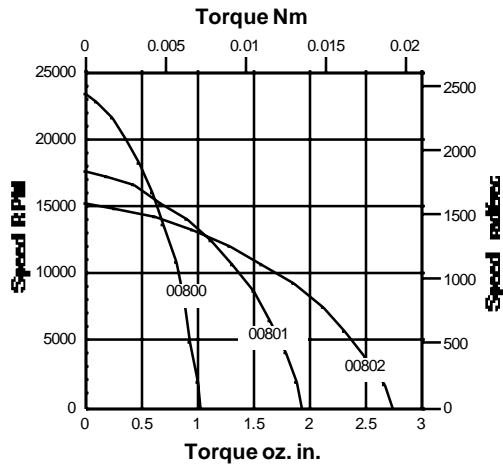
Brushless DC Motors

HT Series Model Number	Frameless Motor						Housed Motor																
	Stator O.D.		Rotor I.D.		Max. Rotor I.D.		Length		Rotor Inertia		Weight	Housing O.D.		Housing Length		Shaft O.D.	Rotor Inertia		Weight				
	in.	mm	in.	mm	in.	mm	in.	mm	oz.in.s ²	Kg.m ²	oz.	Kg	in.	mm	in.	mm	in.	mm	oz.in.s ²	Kg.m ²	oz.	Kg	
00800	0.760	19.30	0.1260	3.20	0.200	5.08	0.713	18.10	9.5E-6	6.7E-8	0.8	0.02	1.000	25.40	1.201	30.51	0.1251	3.17	1.0E-5	7.1E-8	2.3	0.07	
00801	"	"	"	"	"	"	1.113	28.27	1.9E-5	1.3E-7	1.3	0.04	"	"	1.601	40.67	"	"	1.9E-5	1.4E-7	2.9	0.08	
00802	"	"	"	"	"	"	1.513	38.43	2.8E-5	2.0E-7	1.8	0.05	"	"	2.001	50.83	"	"	2.9E-5	2.0E-7	3.4	0.10	
01000	1.050	26.67	0.1885	4.79	0.230	5.84	0.810	20.57	2.2E-5	1.6E-7	1.2	0.04	1.375	34.93	1.400	35.56	0.1875	4.76	2.5E-5	1.8E-7	3.5	0.10	
01001	"	"	"	"	"	"	1.210	30.74	4.4E-5	3.1E-7	2.3	0.06	"	"	1.800	45.72	"	"	4.8E-5	3.4E-7	4.8	0.13	
01002	"	"	"	"	"	"	1.610	40.88	6.6E-5	4.7E-7	3.3	0.09	"	"	2.200	55.88	"	"	7.0E-5	5.0E-7	6.1	0.17	
01003	"	"	"	"	"	"	2.010	51.05	8.8E-5	6.2E-7	4.4	0.12	"	"	2.600	66.04	"	"	9.3E-5	6.6E-7	7.4	0.21	
01500	1.488	37.79	0.2510	6.37	0.375	9.52	0.860	21.84	1.0E-4	7.3E-7	2.5	0.07	1.875	47.62	1.581	40.16	0.2501	6.35	1.1E-4	8.2E-7	7.5	0.21	
01501	"	"	"	"	"	"	1.260	32.00	2.0E-4	1.4E-6	4.6	0.13	"	"	1.981	50.32	"	"	2.2E-4	1.5E-6	9.7	0.28	
01502	"	"	"	"	"	"	1.660	60.16	3.1E-4	2.1E-6	6.8	0.19	"	"	2.381	60.48	"	"	3.2E-4	2.3E-6	12.0	0.34	
01503	"	"	"	"	"	"	2.060	52.32	4.1E-4	2.9E-6	8.9	0.25	"	"	2.781	70.64	"	"	4.1E-4	2.9E-6	14.2	0.40	
01504	"	"	"	"	"	"	2.460	62.48	5.1E-4	3.6E-6	11.0	0.31	"	"	3.181	80.80	"	"	5.4E-4	3.8E-6	16.4	0.46	
01505	"	"	"	"	"	"	2.860	72.64	6.1E-4	4.3E-6	13.1	0.37	"	"	3.581	90.96	"	"	6.5E-4	4.5E-6	18.6	0.53	
02000	1.937	49.19	0.3760	9.55	0.790	20.06	0.862	21.89	7.3E-4	5.2E-6	4.2	0.12	2.250	57.15	1.526	38.76	0.3751	9.52	8.1E-4	5.7E-6	11.7	0.33	
02001	"	"	"	"	"	"	1.262	32.05	1.4E-3	1.0E-5	7.8	0.22	"	"	1.926	48.92	"	"	1.5E-3	1.0E-5	15.5	0.44	
02002	"	"	"	"	"	"	1.662	42.21	2.1E-3	1.5E-5	11.4	0.32	"	"	2.326	59.08	"	"	2.2E-3	1.6E-5	19.3	0.55	
02003	"	"	"	"	"	"	2.062	52.38	2.9E-3	2.0E-5	15.0	0.43	"	"	2.726	69.24	"	"	3.0E-3	2.1E-5	23.1	0.66	
02004	"	"	"	"	"	"	2.462	62.53	3.6E-3	2.5E-5	18.8	0.53	"	"	3.126	79.40	"	"	3.7E-3	2.6E-5	27.1	0.77	
02005	"	"	"	"	"	"	2.862	72.70	4.3E-3	3.0E-5	22.3	0.63	"	"	3.526	89.56	"	"	4.5E-3	3.2E-5	30.8	0.87	
02300	2.376	60.35	0.5010	12.72	1.140	28.95	0.824	20.93	2.1E-3	1.4E-5	6.0	0.17	2.800	71.12	1.519	38.58	0.5001	12.70	2.4E-3	1.7E-5	19.5	0.55	
02301	"	"	"	"	"	"	1.224	31.08	4.2E-3	2.9E-5	11.5	0.33	"	"	1.919	48.74	"	"	4.5E-3	3.2E-5	25.3	0.72	
02302	"	"	"	"	"	"	1.624	41.24	6.3E-3	4.5E-5	17.0	0.48	"	"	2.319	58.90	"	"	6.7E-3	4.7E-5	31.2	0.88	
02303	"	"	"	"	"	"	2.024	51.41	8.5E-3	5.9E-5	22.5	0.64	"	"	2.719	69.06	"	"	8.9E-3	6.2E-5	37.1	1.05	
02304	"	"	"	"	"	"	2.424	61.57	1.0E-2	7.4E-5	28.0	0.79	"	"	3.119	79.22	"	"	1.1E-2	7.8E-5	42.9	1.22	
02305	"	"	"	"	"	"	2.824	71.73	1.3E-2	8.9E-5	33.4	0.95	"	"	3.519	89.38	"	"	1.3E-2	9.3E-5	48.7	1.38	
02500	2.500	63.50	0.5015	12.73	0.980	24.89	0.980	24.89	1.3E-3	0.9E-5	6.8	0.19	2.875	73.02	1.769	44.93	0.5001	12.70	1.5E-3	1.1E-5	20.2	0.57	
02501	"	"	"	"	"	"	1.380	35.05	2.6E-3	1.8E-5	13.3	0.37	"	"	2.169	55.09	"	"	2.8E-3	2.0E-5	27.3	0.77	
02502	"	"	"	"	"	"	1.780	45.21	3.8E-3	2.7E-5	19.7	0.55	"	"	2.569	65.25	"	"	4.2E-3	2.9E-5	34.2	0.97	
02503	"	"	"	"	"	"	2.180	55.37	5.1E-3	3.6E-5	26.3	0.74	"	"	2.969	75.41	"	"	5.5E-3	3.9E-5	41.4	1.17	
02504	"	"	"	"	"	"	2.580	65.53	6.4E-3	4.5E-5	32.8	0.93	"	"	3.369	85.57	"	"	6.8E-3	4.8E-5	48.4	1.37	
02505	"	"	"	"	"	"	2.980	75.69	7.7E-3	5.4E-5	39.2	1.11	"	"	3.769	95.73	"	"	8.1E-3	5.7E-5	55.4	1.57	
03000	2.991	75.97	0.5010	12.72	1.390	35.30	0.931	23.65	4.5E-3	3.2E-5	9.8	0.28	3.400	86.36	1.664	42.27	0.5001	12.70	4.8E-3	3.4E-5	30.7	0.87	
03001	"	"	"	"	"	"	1.331	33.81	8.9E-2	6.3E-5	18.7	0.53	"	"	2.064	52.43	"	"	9.3E-3	6.6E-5	39.9	1.13	
03002	"	"	"	"	"	"	1.731	44.07	1.3E-2	9.5E-5	27.6	0.78	"	"	2.464	62.59	"	"	1.4E-2	9.8E-5	49.2	1.39	
03003	"	"	"	"	"	"	2.131	54.13	1.8E-2	1.3E-4	36.7	1.04	"	"	2.864	72.75	"	"	1.8E-2	1.3E-4	58.7	1.66	
03004	"	"	"	"	"	"	2.531	64.29	2.2E-2	1.6E-4	45.5	1.29	"	"	3.264	82.91	"	"	2.3E-2	1.6E-4	67.9	1.92	
03005	"	"	"	"	"	"	2.931	74.45	2.7E-2	1.9E-4	54.6	1.55	"	"	3.664	93.07	"	"	2.8E-2	1.9E-4	77.3	2.19	
03800	3.730	94.74	0.6260	15.90	1.680	42.67	1.013	25.73	8.0E-3	0.6E-5	16.7	0.47	4.250	107.9	1.731	44.97	0.6251	15.87	9.0E-3	6.0E-5	46.6	1.32	
03801	"	"	"	"	"	"	1.413	35.89	1.7E-2	1.2E-4	30.1	0.85	"	"	2.131	54.13	"	"	1.7E-2	1.2E-4	60.5	1.71	
03802	"	"	"	"	"	"	1.813	46.05	2.5E-2	1.8E-4	43.3	1.23	"	"	2.531	64.29	"	"	2.6E-2	1.8E-4	74.2	2.10	
03803	"	"	"	"	"	"	2.213	56.21	3.4E-2	2.4E-4	57.0	1.62	"	"	2.931	74.45	"	"	3.5E-2	2.5E-4	88.6	2.51	
03804	"	"	"	"	"	"	2.613	66.37	4.2E-2	2.9E-4	70.6	2.00	"	"	3.331	84.61	"	"	4.3E-2	3.0E-4	102.7	2.91	
03805	"	"	"	"	"	"	3.013	76.53	5.0E-2	3.5E-4	83.9	2.38	"	"	3.731	94.77	"	"	5.2E-2	3.6E-4	116.6	3.31	
05000	5.000	127.0	2.5005	63.51	2.500	63.50	1.187	30.15	2.0E-2	1.4E-4	27.1	0.77	5.500	139.7	2.030	51.56	0.6251	15.87	2.9E-2	2.0E-4	62.3	1.77	
05001	"	"	"	"	"	"	1.587	40.31	4.0E-2	2.8E-4	45.9	1.30	"	"	2.430	61.72	"	"	6.3E-2	4.5E-4	90.6	2.57	
05002	"	"	"	"	"	"	1.987	50.47	6.0E-2	4.3E-4	64.9	1.84	"	"	2.830	71.88	"	"	9.7E-2	6.8E-4	119.2	3.38	
05003	"	"	"	"	"	"	2.387	60.63	8.0E-2	5.6E-4	83.7	2.37	"	"	3.230	82.04	"	"	1.3E-1	9.2E-4	147.5	4.18	
05004	"	"	"	"	"	"	2.787	70.78	1.0E-1	7.0E-4	102.4	2.90	"	"	3.630	92.20	"	"	1.6E-1	1.1E-3	175.8	4.98	
05005	"	"	"	"	"	"	3.187	80.95	1.2E-1	8.5E-4	121.4	3.44	"	"	4.030	102.4	"	"	2.0E-1	1.4E-3	204.4	5.79	
	in.	mm	in.	mm	in.	mm	in.	mm	lb.ft.s ²	Kg.m ²	lb.	Kg	in.	mm	in.	mm	in.	mm	lb.ft.s ²	Kg.m ²	lb.	Kg	
07000	7.100	180.3	3.2505	82.56	3.650	92.71	1.767	44.88	1.2E-3	1.6E-3	5.7	2.6	7.750	196.8	3.100	78.74	0.7501	19.05	1.5E-3	2.1E-3	15.6	7.1	
07001	"	"	"	"	"	"	2.437	61.90	2.4E-3	3.2E-3	10.3	4.7	"	"	3.770	95.76	"	"	3.2E-3	4.3E-3	21.9	9.9	
07002	"	"	"	"	"	"	3.107	78.92	3.6E-3	4.9E-3	14.5	6.6											

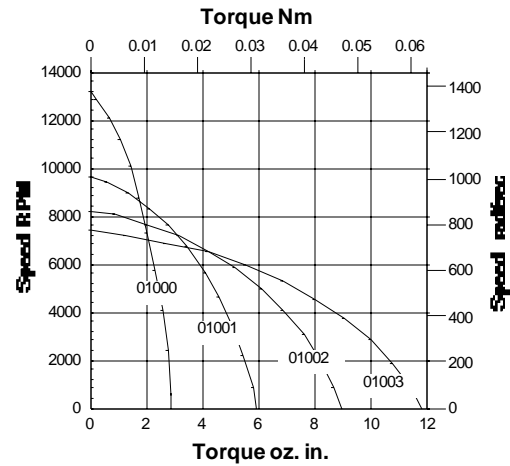
High Torque Series Speed/Torque Curves

Brushless DC Motors

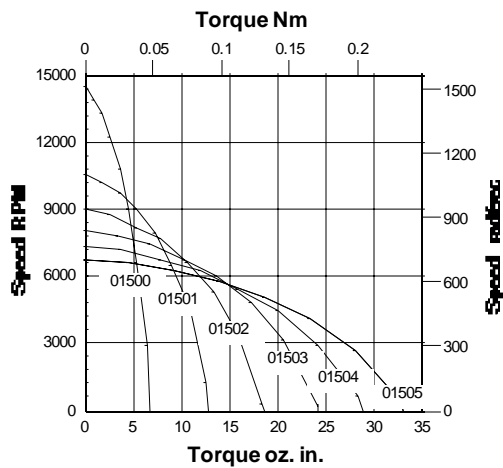
HT00800 Series



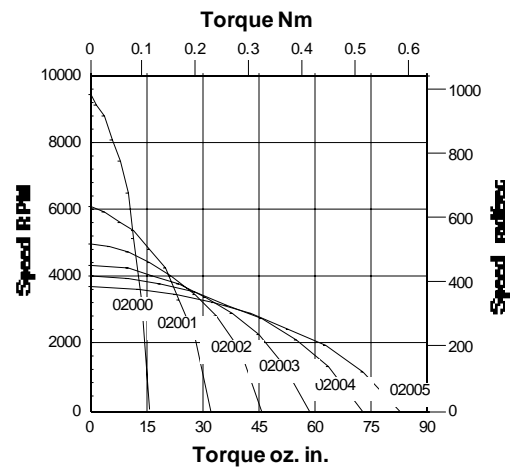
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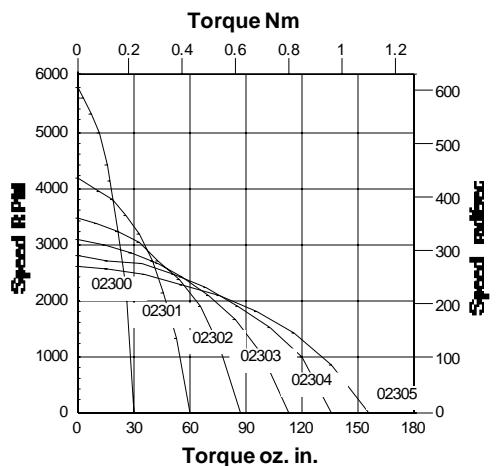
HT01500 Series



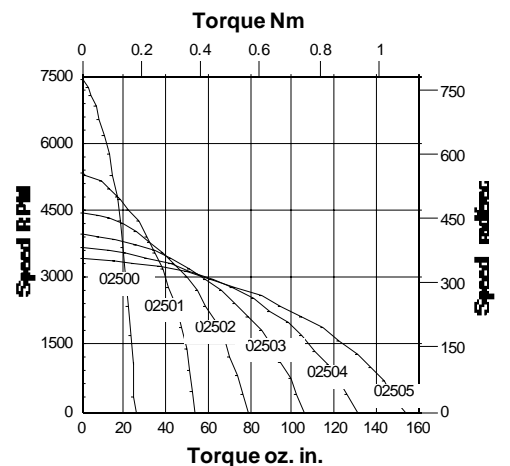
HT02000 Series



HT02300 Series



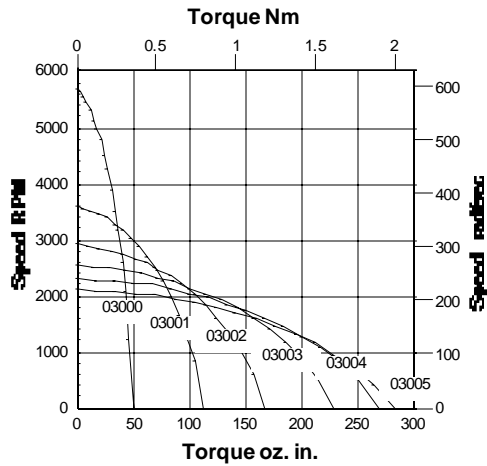
HT02500 Series



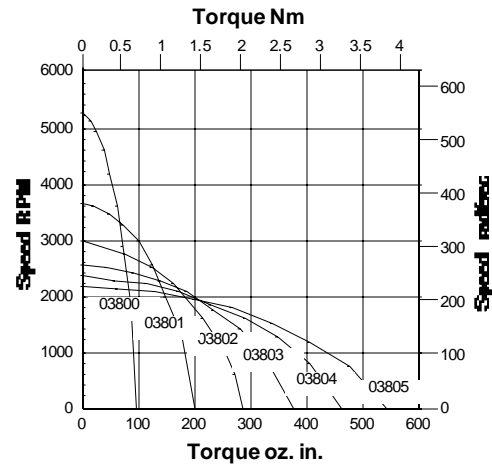
High Torque Series Speed/Torque Curves

Brushless DC Motors

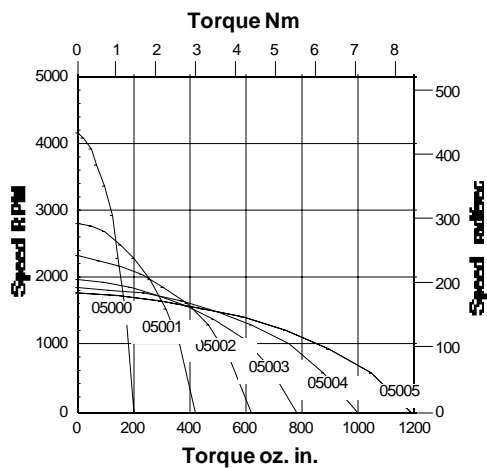
HT03000 Series



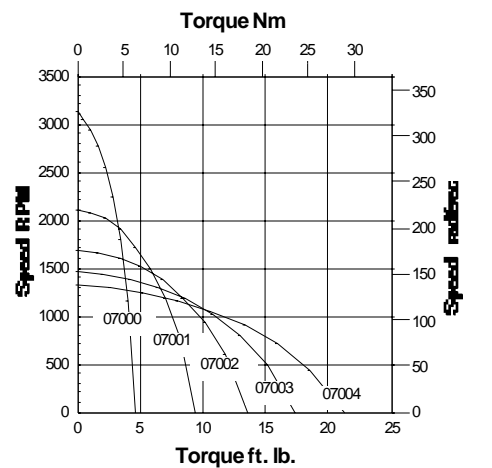
HT03800 Series



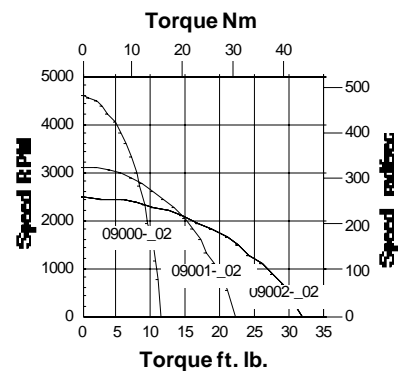
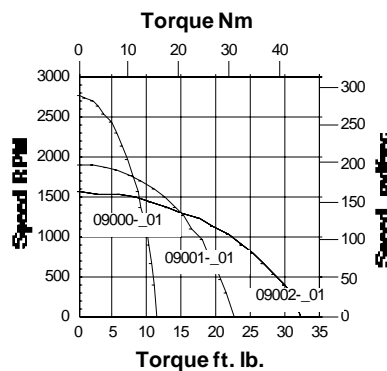
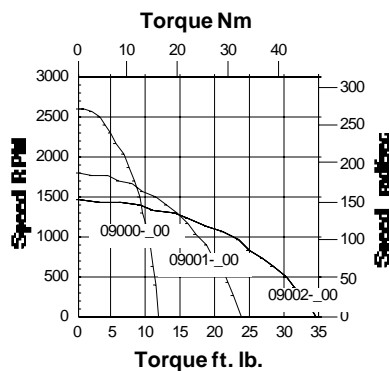
HT05000 Series



HT07000 Series



HT09000 Series



High Torque Series

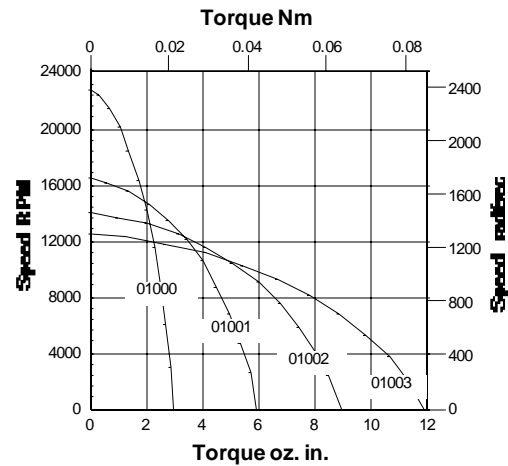
HS Series Curves

Brushless DC Motors

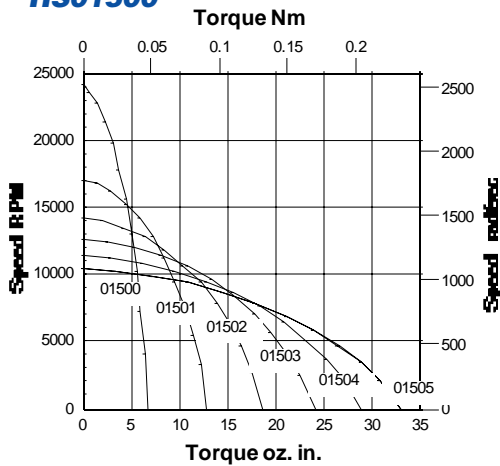
HS High Efficiency Motors

The HS versions of the High Torque Series of motors, are designed for increased operating efficiency at higher speeds. This is accomplished by the use of thinner, low core loss, lamination material. The result is that for a given temperature rise, the motor can operate at higher speed while still producing useful amounts of output torque compared to the standard motors (HT) that are optimized for servo performance at lower operating speeds. The mechanical dimensions of the HS motors remain the same as the HT versions. Except for the Viscous Damping and Hysteresis Drag torque, the datasheet parameters for Size and Winding constants remain the same.

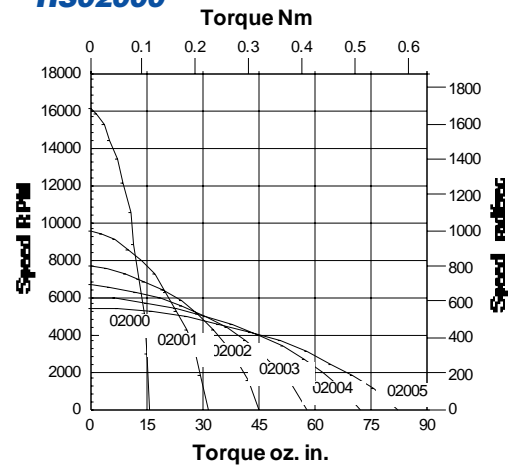
HS01000



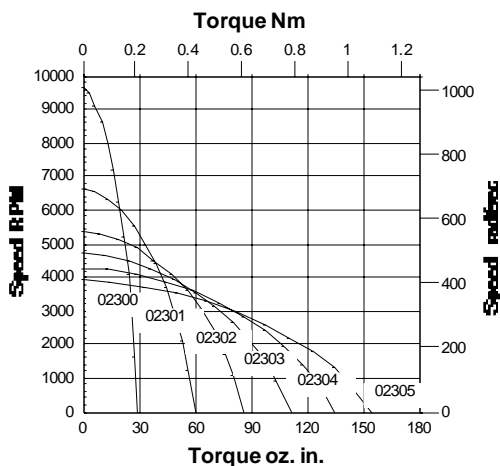
HS01500



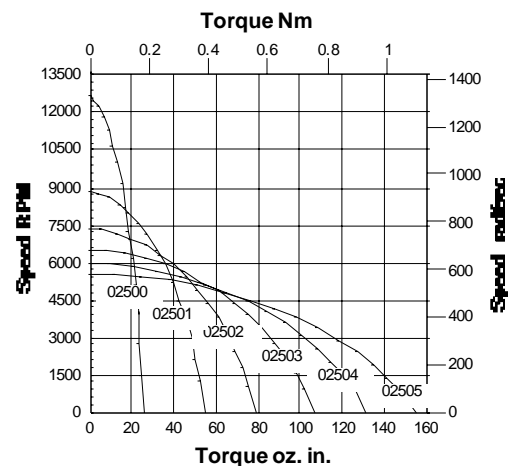
HS02000



HS02300



HS02500

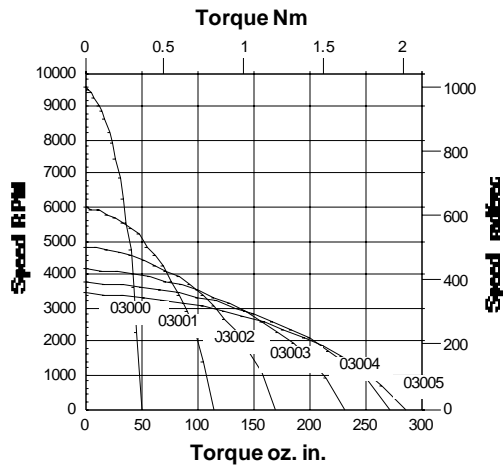


High Torque Series

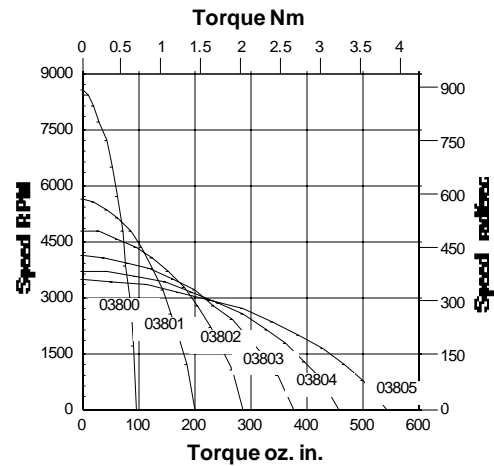
HS Series Curves

Brushless DC Motors

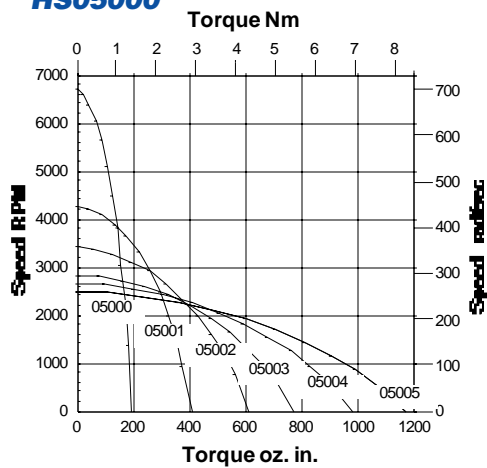
HS03000



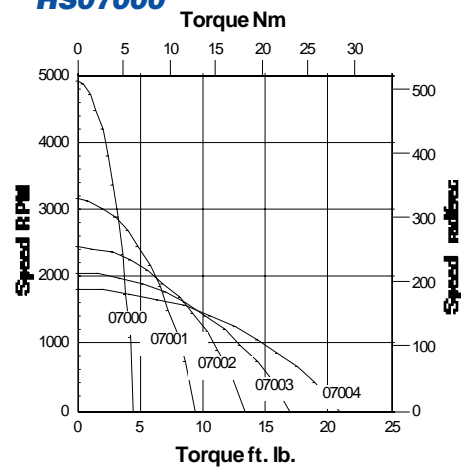
HS03800



HS05000



HS07000



The standard versions of the HT09000 Series motors already includes an HS version (HT09000-_02).

Brushless DC Motors

Size Constants

These parameters are dependent upon the size and shape of the motor but are largely independent of the winding used. However, special designs incorporating different lamination and magnet materials as well as design modifications such as increased magnetic air gaps can change these parameters. In such instances, a specific set of design data will be provided.

Maximum Rated Torque (T_R) is the amount of torque that the motor can produce without danger of demagnetizing the rotor. This torque is only available for short durations. Also, it may not be possible to produce the Maximum Rated Torque because of limitations of voltage and current (see Peak Torque).

Maximum Continuous Stall Torque (T_C) is the amount of torque produced at zero speed which results in a 75°C rise in temperature. Generally, the highest operating temperature that should be allowed is 150°C and is a combination of the ambient temperature and the temperature rise for a given operating condition.

Motor Constant (K_M) is the ratio of the peak torque to the square root of the input power at stall with 25°C ambient temperature. This ratio is useful during the initial selection of a motor because it indicates the ability of the motor to convert electrical power into torque.

$$K_M = T_P (\text{Peak Torque}) / \sqrt{P_P (\text{Peak Input Power})}$$

or

$$K_M = K_T (\text{Torque Constant}) / \sqrt{R_M (\text{Term. Resistance})}$$

Electrical Time Constant (t_E) is the ratio of inductance L_M in Henries, to the resistance R_M in Ohms. This is the inductance and resistance as measured across any two phases in a delta or wye configuration.

$$T_E = L_M / R_M$$

Mechanical Time Constant (t_M) is the time required to reach 63.2% of the motor's maximum speed after the application of constant DC voltage through the commutation electronics, ignoring friction, windage, and core losses.

$$T_M = J_M * R_M / K_T * K_B$$

Thermal Resistance (TPR) correlates winding temperature rise to the average power dissipated in the stator winding. The published TPR assumes that a housed motor is mounted to an aluminum heatsink of specific dimensions. Additional cooling from forced air, water jacketing, or increased heatsinking decreases the motor Thermal Resistance allowing higher power outputs than the published data.

Viscous Damping (F) represents the losses in the motor which are proportional to speed with an infinite source impedance. Such losses include windage, friction, and eddy currents.

Maximum Cogging Torque (T_C) is principally the static friction torque felt as the motor is rotated at low speed. The published value does not include the bearing friction of a housed motor.

Winding Constants

The winding constants are the parameters that vary with the number of wire turns per coil and the wire size. These parameters are collected under an alphabetical winding designation. A single frame size and length of motor will have several different windings. Special windings receive new designations in the sequence by which they are designed and released to production.

Design Voltage (V_P) is the nominal voltage required to produce the peak torque when the rotor speed is zero and the winding temperature is 25°C. As such, V_P is the product of I_P and R_M . At any temperature greater than 25°C, the required voltage to produce peak torque increases due to the increase in winding resistance. The design voltage is not a limit but a reference point for the data.

Peak Torque (T_P) is the nominal value of developed torque with the rated current I_P applied to the windings. For each winding specified the product of peak current (I_P) and nominal torque sensitivity (K_T) gives T_P unless the maximum rated torque (T_R) is reached.

Peak Current (I_P) is the rated current used to obtain the nominal peak torque from the motor with nominal torque sensitivity (K_T). I_P is generally the design voltage divided by the terminal resistance (R_M).

High Torque Series

Connection Diagrams

Brushless DC Motors

Torque Sensitivity (K_T) is the ratio of the developed torque to the applied current for a specific winding. K_T is related to the BEMF Constant K_B .

No Load Speed (S_{NL}) is the theoretical no load speed of the motor with the design voltage applied.

BEMF Constant (K_B) is the ratio of voltage generated in the winding to the speed of the rotor. K_B is proportional to K_T .

Terminal Resistance (R_M) is the winding resistance measured between any two leads of the winding in either a delta or wye configuration at 25°C.

Terminal Inductance (L_M) is the winding inductance measured between any two leads of the winding in either delta or wye configuration at 25°C.

Mechanical Data

Rotor inertia (J_M) is the moment of inertia of the rotor about its axis of rotation.

Motor Weight (W_M) is the weight of the standard motor.

Number of Poles (N_p) is the number of permanent magnet poles of the rotor. For the standard HT Series motors this ranges from six to twelve poles.

Speed-Torque Curves

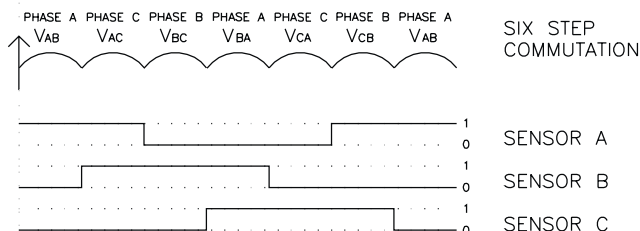
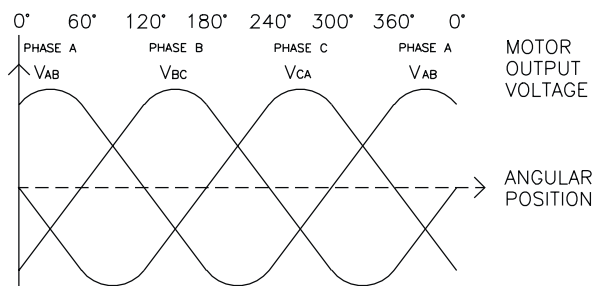
HT Series curves are for the standard catalog designs. The curves are based upon a 75°C rise over the ambient temperature.

HS Series curves are for the designs which substitute high efficiency laminations to allow operation at higher speeds.

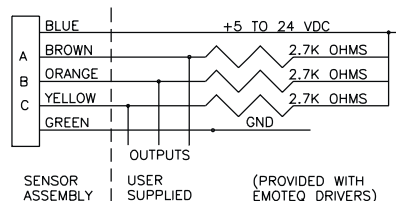
Motor Connections and Commutation Logic

MOTOR EXCITATION SEQUENCE AND SENSOR OUTPUT LOGIC FOR CW ROTATION VIEWING LEADWIRE END.

EXCITATION STEP		1	2	3	4	5	6	1
MOTOR LEADS	(RED) A	+	+	-	-	+	+	
	(WHT) B	-	+	+	-	-	+	
	(BLK) C	-	-	+	+	-	-	
SENSOR OUTPUTS	(BRN) A	1	1	0	0	1	1	
	(ORG) B	0	1	1	1	0	0	
	(YEL) C	0	0	0	1	1	1	0



HALL EFFECT CONNECTION DIAGRAM



High Torque Series

Brushless DC Motors

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All data subject to specific tolerances. All critical design data should be verified before final design. Errors due to rounding may exist in the data. Emoteq reserves the right to make changes without notice.

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