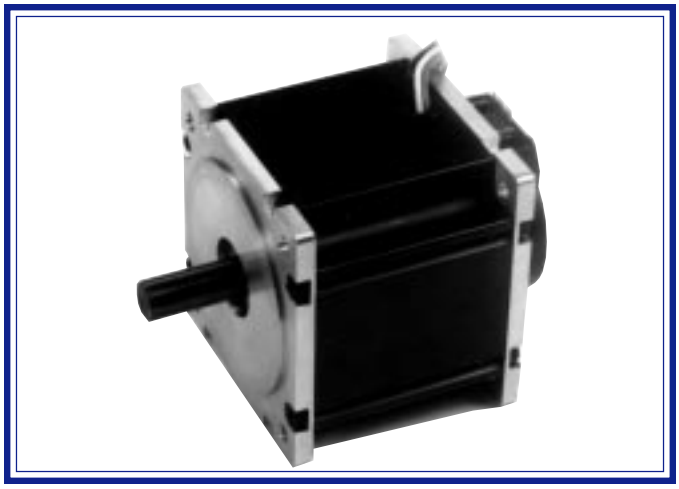
Quantum Series
Brushless DC Motors

Size 17, 23, 34 and 56
Brushless Servo Motors

Frameless and Housed



Engineering Guide

Hathaway
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Quantum Series Brushless DC Motors

Selection Guide

Quantum Series Selection Guide

Model	Cont. Stall Torque oz.in.	Nm	Max Rated Torque oz.in.	Nm	‡Max Cont Power Watt @RPM		Housed Diameter in.	mm	Housing Length in.	mm	Frameless Diameter in.	mm	Frameless Length in .	mm
QB01700	11.5	0.08	92	0.65	68	12500	1.64	41.7	2.125	54.0	1.410	35.81	1.34	34.0
QB01701	21.5	0.15	169	1.19	113	10000	1.64	41.7	2.625	66.7	1.410	35.81	1.84	46.7
QB01702	33.5	0.23	264	1.87	167	10000	1.64	41.7	3.125	79.4	1.410	35.81	2.34	59.4
QB01703	43.5	0.30	341	2.41	211	10000	1.64	41.7	3.625	92.1	1.410	35.81	2.84	72.1
QB02300	51.0	0.36	558	3.9	202	8000	2.30	58.4	2.800	71.1	2.180	55.37	1.64	41.6
QB02301	96.0	0.68	1117	7.9	311	7000	2.30	58.4	3.550	90.1	2.180	55.37	2.39	60.7
QB02302	138	0.98	1676	11.8	411	6000	2.30	58.4	4.300	109.2	2.180	55.37	3.14	79.7
QB02303	182	1.28	2212	15.6	528	6000	2.30	58.4	5.050	128.2	2.180	55.37	3.89	98.8
QB03400	115	0.81	761	5.3	410	7000	3.42	86.9	3.01	76.5	3.200	81.28	1.64	41.6
QB03401	222	1.57	1538	10.8	607	6000	3.42	86.9	3.76	95.5	3.200	81.28	2.39	60.7
QB03402	328	2.32	2307	16.2	846	5000	3.42	86.9	4.51	114.6	3.200	81.28	3.14	79.7
QB03403	429	3.03	2961	20.9	1072	5000	3.42	86.9	5.26	133.6	3.200	81.28	3.89	98.8
	ft.lb.	**Nm**	**ft.lb.**	**Nm**	**Watt @RPM**		**in.**	**mm**	**in.**	**mm**	**in.**	**mm**	**in .**	**mm**
QB05600	3.17	4.29	22.3	30.3	1282	4000	5.60	142.2	4.84	123.0	5.000	127.00	2.47	62.7
QB05601	5.92	8.03	43.7	57.2	1920	3000	5.60	142.2	5.84	148.3	5.000	127.00	3.47	88.1
QB05602	8.19	11.1	62.8	85.1	2471	3000	5.60	142.2	6.84	173.7	5.000	127.00	4.47	113.5
QB05603	10.4	14.1	83.7	113.5	2875	3000	5.60	142.2	7.84	199.0	5.000	127.00	5.47	138.9

‡ The maximum continuous output power may not be available on all versions due to winding constraints.
QS versions can attain higher output power levels. Please see page 18 for speed-torque curves.

Quantum Series Model Numbering

QB 023 01-B 00-HBE

- **QB** — Quantum Series Brushless Motor
- **023** — Nominal Frame Size in inches
- **01** — Frame Stack Length, 00 is shortest
- **B** — Winding Designation
- **00** — Design Modifications, 00 is standard
- **HBE** — Options
  - -H housed
  - -E encoder (specify)
  - -B holding brake
  - -R resolver
  - -D drive electronics
  - -G gland lead exit
  - -C motor connector
  - - I IP rating, IP44 std.
  - -P Packaging. Rugged housing.

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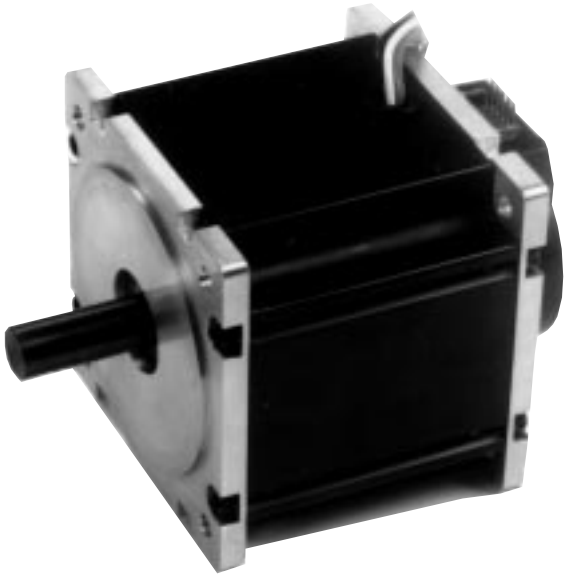
Quantum Series Brushless DC Motors

Product Description

Applications

Quantum Motors find application in a wide range of systems demanding compact, highly dynamic, and clean operating motors such as:

- Semiconductor manufacturing equipment and other clean room applications
- Disk drive media processing systems
- High reliability pumps and control systems including medical applications
- Coordinate measuring machines
- Large capacity tape and disk storage and retrieval systems
- Precision grinding/machining sytems for contact and eye glasses lenses
- Electronics pick and place automated assembly systems
- Machine tool axis drives



QB03400 housed motor with encoder

Quantum Series Brushless DC Motors

Quantum Series motors are designed for operation in highly dynamic velocity or position servo systems where compact size and low weight are system requirements. Quantum motors have been electro-mechanically optimized for high output torques, low cogging torque, and minimal cost through advanced engineering and a commitment to high volume production methods and extensive parts tooling.

Frameless Quantum Motor QB03400

Quantum Series Features

- Cont. stall torques 10 oz.in. to 10.4 ft.lb. (0.07 to 2.61 Nm)
- High torque to size and inertia ratios
- Housed frame sizes 17, 23, 34 and 56 frame sizes
- NEMA standard flange mounting
- Provision for foot mounting is integral to the housing
- Frameless versions available for tight integration into systems eliminating coupling torsional problems and resulting in a short axial length
- Both housed or frameless configurations with integrated Hall Effects sensors for commutation
- Winding and mechanical changes easily undertaken
- Wide range of mechanical options including brakes, resolvers, encoders, connections, and IP Rated sealing
- Stainless steel shafts standard on housed motors with long life bearings
- Rugged housing design that can easily be sealed to operate in tough application environments
- Coated magnets for corrosion protection
- Hall effect sensors with separate trigger magnets are spaced away from stator coils for greater electrical noise and heat immunity
- Quantum motors are compatible with six step (trapezoidal) or sine wave commutation
- Private labeling is available to qualified OEMs and resellers
- An extensive range of drive electronic solutions can be provided

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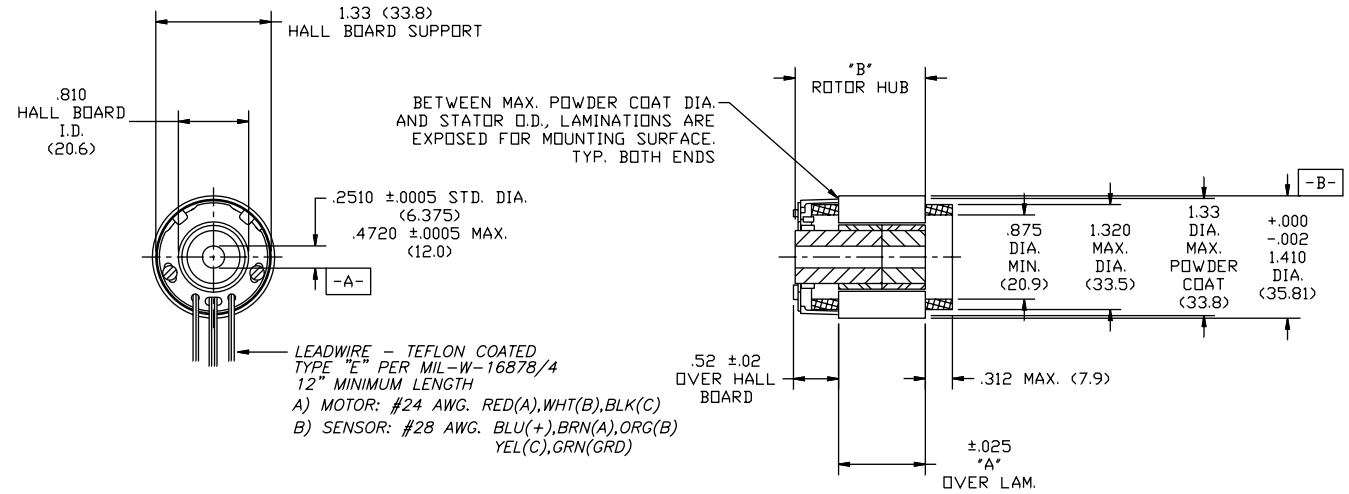
Quantum Series

Size 17

Brushless DC Motors

Frameless Motor

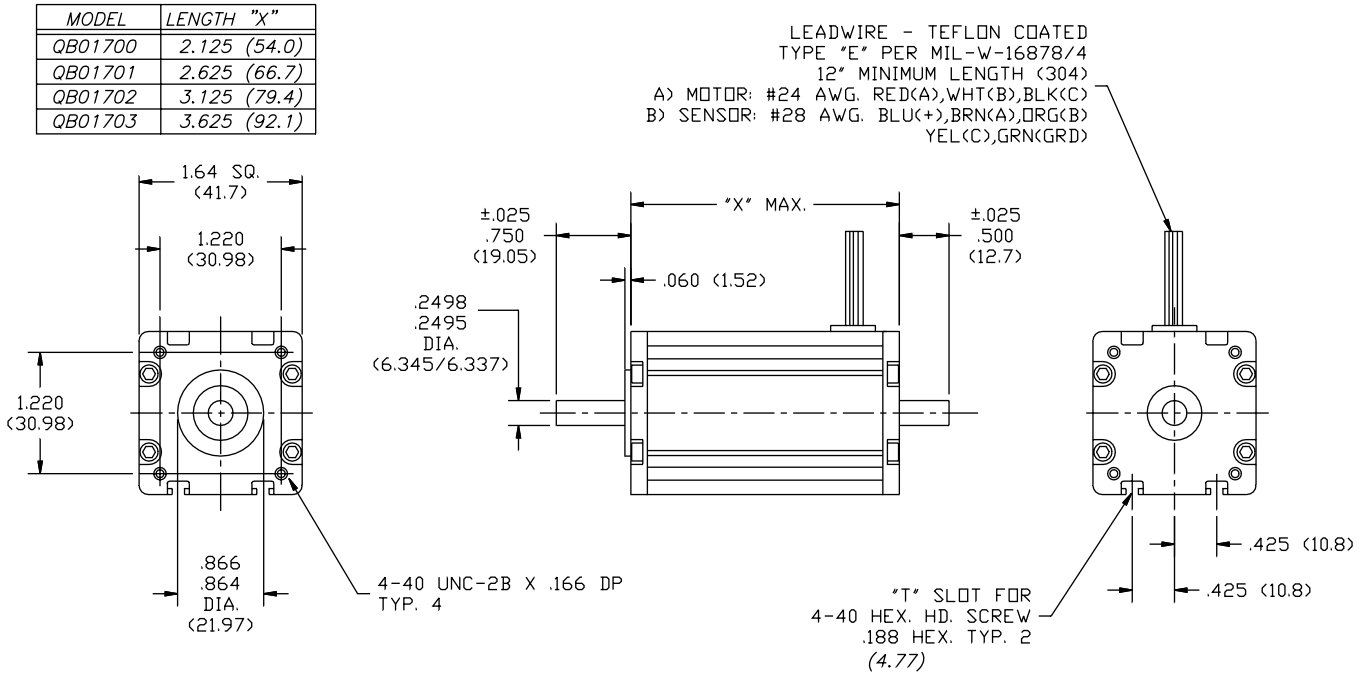


1. MOTOR SUPPLIED AS TWO SEPARATE COMPONENTS, ROTOR ASSEMBLY AND STATOR ASSEMBLY.
2. DIAMETERS "A" AND "B" TO BE CONCENTRIC WITHIN .002 WHEN MOUNTED.
3. STD. HUB LENGTH IS 1.000" LG. .500" HUBS ARE PROVIDED FOR CUSTOMER STACKING BEYOND 1.000".

MODEL NO.	"A" STATOR	"B" ROTOR
QB01700	.500 (12.70)	1.000 (25.40)
QB01701	1.000 (25.40)	1.500 (38.10)
QB01702	1.500 (38.10)	2.000 (50.80)
QB01703	2.000 (50.80)	2.500 (63.5)

Housed Motor

MODEL	LENGTH "X"
QB01700	2.125 (54.0)
QB01701	2.625 (66.7)
QB01702	3.125 (79.4)
QB01703	3.625 (92.1)



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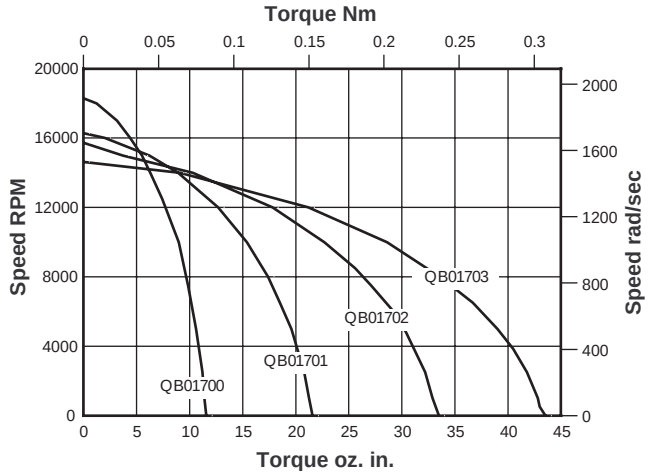
Quantum Series

Size 17

Brushless DC Motors

Parameter	Symbol	Unit	QB01700	QB01701	QB01702	QB01703
Size Constants						
Max Cont. Stall Torque	T_C	oz.in.	11.5	21.6	33.5	43.5
		Nm	0.08	0.15	0.23	0.30
Max Rated Torque, 25%	T_R	oz.in.	92.0	169	264	341
		Nm	0.65	1.19	1.87	2.41
Motor Constant,	K_M	oz.in./√W	3.20	4.99	6.85	8.11
		Nm/√W	0.023	0.035	0.048	0.057
Electrical Time Constant	T_E	msec	0.38	0.52	0.59	0.65
Mechanical Time Constant	T_M	msec	2.03	1.67	1.33	1.26
Thermal Resistance	TPR	°C/Watt	4.7	3.29	2.58	2.14
Viscous Damping	F_i	oz.in./rpm	7.5E-5	1.5E-4	2.3E-4	3.1E-4
		Nm/rpm	5.3E-7	1.1E-6	1.6E-6	2.2E-6
Max Cogging Torque	T_F	oz.in.	1.0	1.5	1.8	2.2
		Nm	7E-3	1.1E-2	1.3E-2	1.6E-2
Mechanical Constants						
Frameless Motor Inertia	J_M	oz.in.s²	1.4E-4	2.9E-4	4.4E-4	5.8E-4
		Kg.m²	1.0E-7	2.0E-6	3.1E-6	4.1E-6
Frameless Motor Weight	Wt	oz	2.5	5.0	7.4	9.7
		Kg	0.07	0.14	0.21	0.27
Housed Motor Inertia	J_M	oz.in.s²	1.5	3.0E-4	4.4E-4	5.9E-4
		Kg.m²	1.1E-6	2.1E-6	3.1E-6	4.2E-6
Housed Motor Weight	Wt	oz	7.8	12.1	16.4	20.5
		Kg	0.22	0.34	0.47	0.58
Number of Poles	-	-	6	6	6	6

Winding Constants													
			A	B	C	A	B	C	A	B	C	A	B	C
Design Voltage	V_P	Volts	24	40	130	24	40	130	24	40	130	24	40	130
Peak Torque	T_P	oz.in.	92	92	92	163	169	169	219	264	264	258	341	341
		Nm	0.65	0.65	0.65	1.15	1.19	1.19	1.55	1.87	1.87	1.82	2.41	2.41
Peak Current	I_P	Amperes	36	24	15	44	35	14	42	41	16	42	49	20
Torque Constant,±10%	K_T	oz.in./A	2.54	3.84	6.04	3.65	4.79	11.35	5.13	6.32	16.20	6.21	6.88	16.83
		Nm/A	0.018	0.027	0.043	0.026	0.034	0.080	0.036	0.045	0.114	0.043	0.049	0.119
No Load Speed	S_{NL}	RPM	12775	14068	29095	8874	11287	15488	6318	8555	10851	5302	7855	10444
		Rad/s	1337	1473	3046	829	1182	1621	661	895	1136	555	822	1093
BEMF Constant, ±10%	K_B	V/KRPM	1.88	2.84	4.46	2.70	3.54	8.39	3.79	4.67	11.98	4.52	5.09	12.44
		V/rad/s	0.018	0.027	0.043	0.026	0.034	0.080	0.036	0.045	0.114	0.043	0.049	0.119
Terminal Resistance, ±12%	R_M	Ohms	0.63	1.51	3.76	0.53	1.08	6.44	0.56	0.86	5.62	0.56	0.72	4.43
Terminal Inductance, ±30%	L_M	mH	0.24	0.55	1.36	0.28	0.48	2.69	0.33	0.50	3.29	0.37	0.47	2.81



Continuous Duty Speed/Torque Curves for 100°C Temperature rise.

The continuous duty speed/torque curves provide a guide to the operational capability of the motors. Continuous operation at a loadpoint on or under the curve limits the temperature rise of the motor to 100°C. Although the duration of acceleration or deceleration periods should be checked, the RMS speed and torque combination should also lie on or under the continuous duty curve. The curves assume housed motors mounted to a nominal size of aluminum heatsink in a 25°C ambient environment and still air cooling. Higher ambient temperatures will generally decrease the continuous duty capability of a motor. With increased heatsink areas or improved cooling such as forced air or water, the continuous duty capability of the motor may be increased. However, for most applications, the practical maximum motor temperature is 150°C with Hall effect sensors. Higher motor temperatures can easily be accomodated with different materials.

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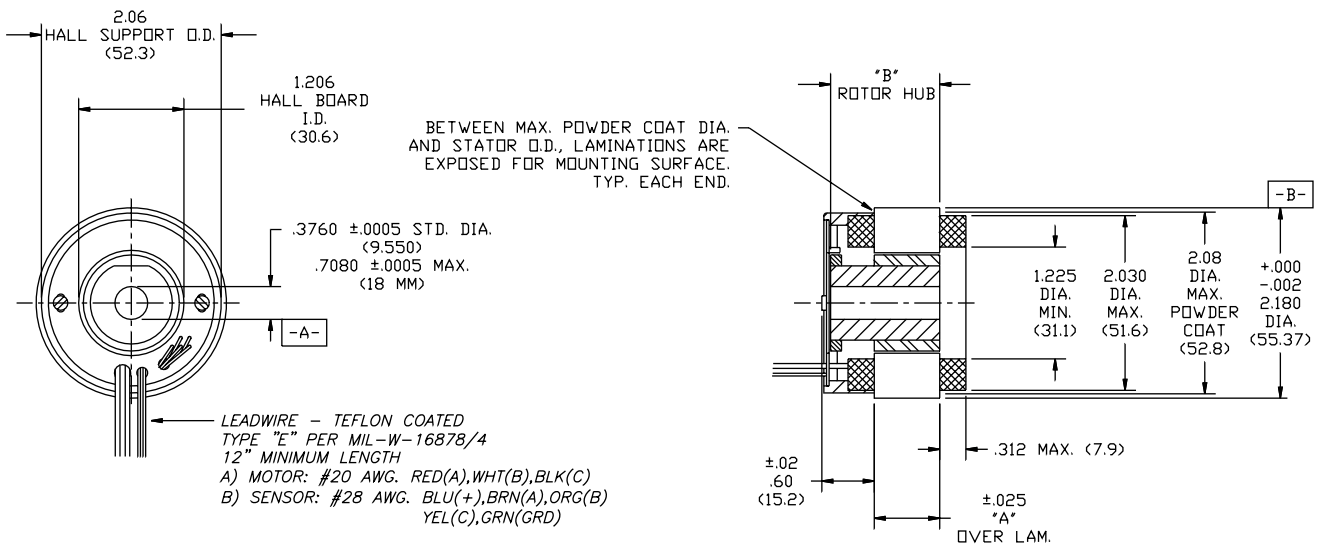
Quantum Series

Size 23

Brushless DC Motors

Frameless Motor



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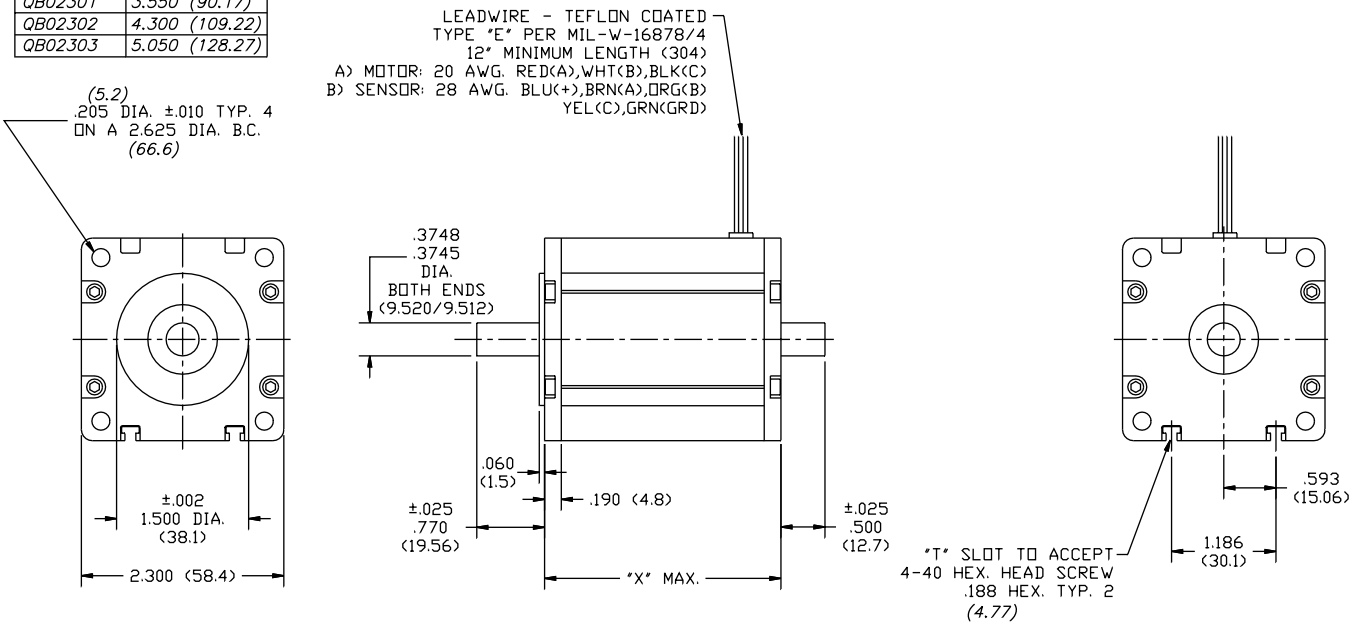
2. DIAMETERS "A" AND "B" TO BE CONCENTRIC WITHIN .002 WHEN MOUNTED
3. STD. HUB LENGTH IS 1.250" LG. .750" HUBS ARE PROVIDED FOR CUSTOMER STACKING BEYOND 1.250".

MODEL NO.	"A" STATOR	"B" ROTOR
QB02300	.750 (19.05)	1.250 (31.75)
QB02301	1.500 (38.10)	2.000 (50.80)
QB02302	2.250 (57.15)	2.750 (69.85)
QB02303	3.000 (76.2)	3.500 (88.90)

Housed Motor

MODEL NO.	"X"
QB02300	2.800 (71.12)
QB02301	3.550 (90.17)
QB02302	4.300 (109.22)
QB02303	5.050 (128.27)



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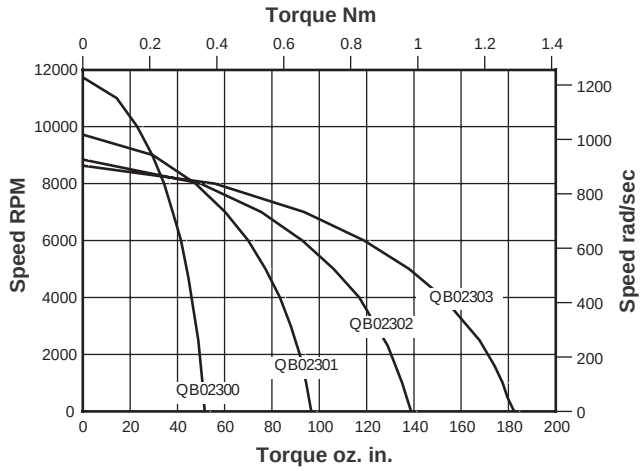
Quantum Series

Size 23

Brushless DC Motors

Parameter	Symbol	Unit	QB02300	QB02301	QB02302	QB02303
Size Constants						
Max Cont. Stall Torque	T_C	oz.in.	51	96	138	182
		Nm	0.36	0.68	0.98	1.28
Max Rated Torque, 25%	T_R	oz.in.	558	1117	1676	2212
		Nm	3.94	7.9	11.8	15.6
Motor Constant,	K_M	oz.in./√W	10.8	17.2	22.0	25.7
		Nm/√W	0.076	0.121	0.155	0.181
Electrical Time Constant	T_E	msec	0.94	1.14	1.22	1.25
Mechanical Time Constant	T_M	msec	1.30	1.03	0.94	0.92
Thermal Resistance	TPR	°C/Watt	2.79	2.00	1.59	1.26
Viscous Damping	F_i	oz.in./rpm	3.5E-4	7.5E-4	1.1E-3	1.5E-3
		Nm/rpm	2.5E-6	5.3E-6	7.9E-6	1.1E-5
Max Cogging Torque	T_F	oz.in.	2.6	4.1	5.1	6.3
		Nm	0.018	0.029	0.036	0.044
Mechanical Constants						
Frameless Motor Inertia	J_M	oz.in.s²	1.0E-3	2.1E-3	3.2E-3	4.3E-3
		Kg.m²	7.6E-6	1.5E-5	2.3E-5	3.0E-5
Frameless Motor Weight	Wt	oz	8.9	17.1	25.3	33.4
		Kg	0.25	0.48	0.71	0.95
Housed Motor Inertia	J_M	oz.in.s²	1.1E-3	2.2E-3	3.3E-3	4.3E-3
		Kg.m²	7.9E-6	1.5E-5	2.3E-5	3.0E-5
Housed Motor Weight	Wt	oz	24.1	32.6	41.2	50.1
		Kg	0.68	0.92	1.17	1.42
Number of Poles	-	-	6	6	6	6

Winding Constants														
			A	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**	**A**	**B**	**C**
Design Voltage	V_P	Volts	24	40	130	24	40	130	24	40	130	24	40	130
Peak Torque	T_P	oz.in.	516	558	558	658	849	1106	1080	1396	1659	1107	1465	2212
		Nm	3.64	3.94	3.94	4.65	6.00	7.81	7.63	9.86	11.72	7.82	10.34	15.62
Peak Current	I_P	Amperes	95	81	32	61	62	40	100	104	56	77	81	70
Torque Constant,±10%	K_T	oz.in./A	5.4	6.8	17.1	10.7	13.5	27.1	10.7	13.4	29.4	14.3	17.8	31.4
		Nm/A	0.038	0.048	0.121	0.076	0.096	0.192	0.076	0.095	0.208	0.101	0.126	0.222
No Load Speed	S_{NL}	RPM	5994	7888	10254	3014	3981	6470	3014	4035	5860	2269	3026	5588
		Rad/s	627	826	1073	315	416	677	315	422	624	237	316	585
BEMF Constant, ±10%	K_B	V/KRPM	4.0	5.0	12.6	7.9	10.0	20.0	7.9	9.9	21.8	10.5	13.2	23.2
		V/rad/s	0.038	0.048	0.121	0.076	0.096	0.192	0.076	0.095	0.208	0.101	0.126	0.222
Terminal Resistance, ±12%	R_M	Ohms	0.25	0.40	2.53	0.39	0.63	2.55	0.24	0.38	2.00	0.31	0.48	1.61
Terminal Inductance, ±30%	L_M	mH	0.23	0.38	2.37	0.45	0.72	2.88	0.29	0.46	2.22	0.39	0.60	1.87



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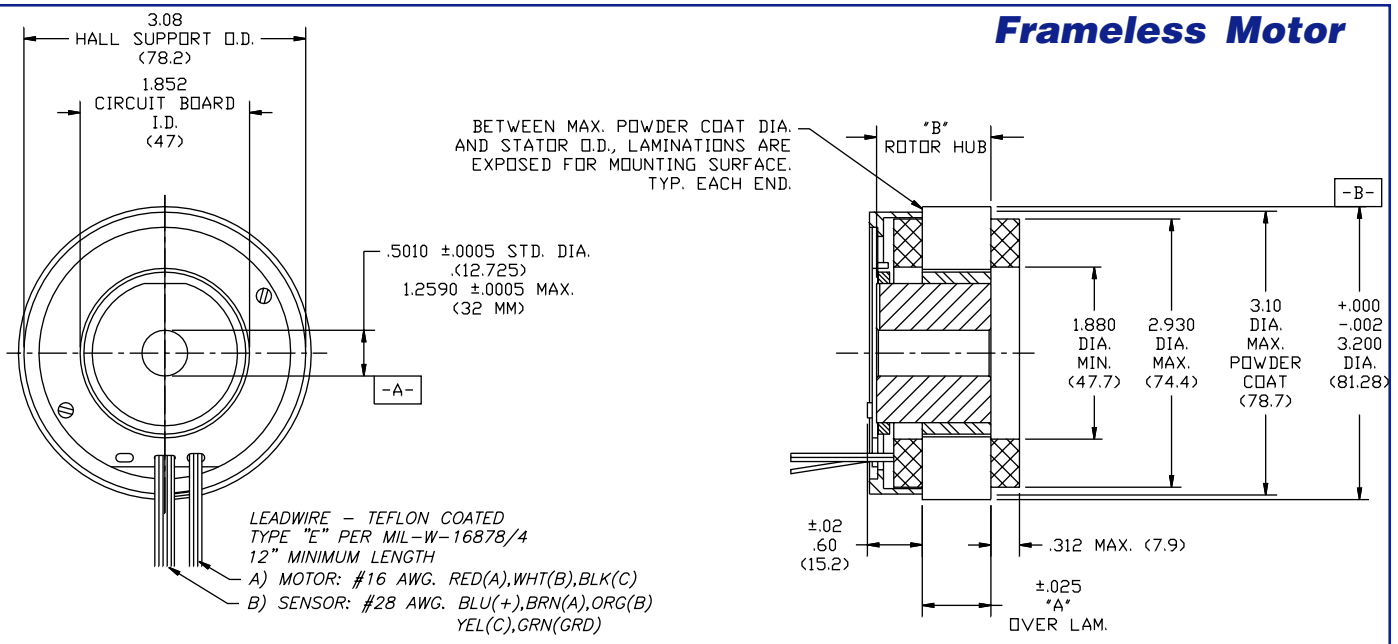
Quantum Series

Size 34

Brushless DC Motors

Frameless Motor



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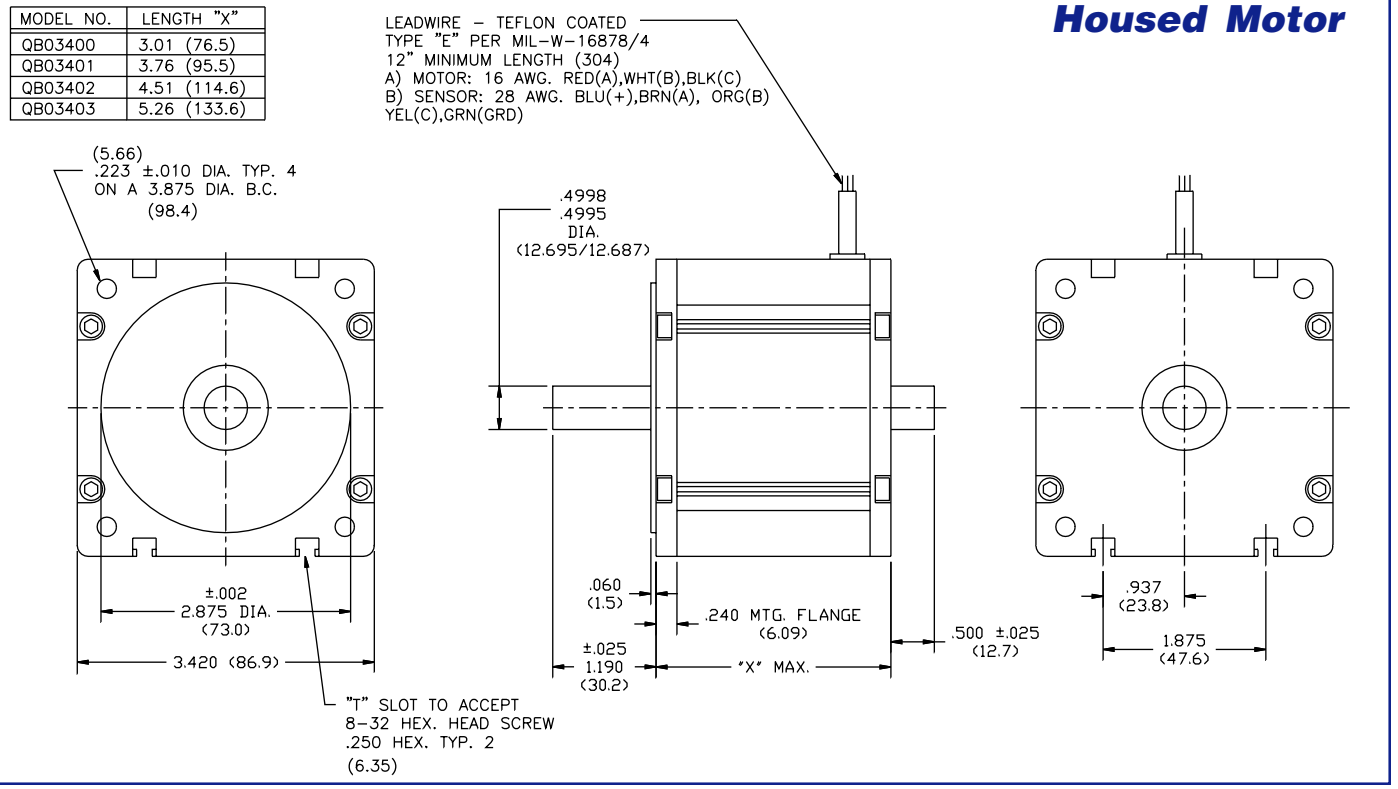
MODEL NO.	"A" STATOR	"B" ROTOR
QB03400	.750 (19.05)	1.250 (31.75)
QB03401	1.500 (38.10)	2.000 (50.80)
QB03402	2.250 (57.15)	2.750 (69.85)
QB03403	3.000 (76.20)	3.500 (88.90)

Housed Motor

MODEL NO.	LENGTH "X"
QB03400	3.01 (76.5)
QB03401	3.76 (95.5)
QB03402	4.51 (114.6)
QB03403	5.26 (133.6)



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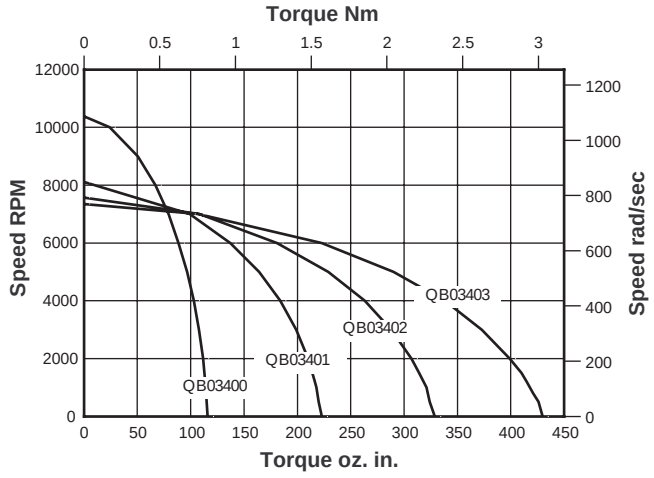
Quantum Series

Size 34

Brushless DC Motors

Parameter	Symbol	Unit	QB03400	QB03401	QB03402	QB03403
Size Constants						
Max Cont. Stall Torque	T_C	oz.in.	115	222	328	429
		Nm	0.81	1.57	2.32	3.03
Max Rated Torque, 25%	T_R	oz.in.	761	1538	2307	2961
		Nm	5.38	10.8	16.2	20.9
Motor Constant,	K_M	oz.in./√W	20.1	34.7	44.7	52.8
		Nm/√W	0.142	0.245	0.316	0.369
Electrical Time Constant	T_E	msec	1.89	2.57	2.78	2.37
Mechanical Time Constant	T_M	msec	2.59	1.74	1.57	1.53
Thermal Resistance	TPR	°C/Watt	1.87	1.51	1.15	0.92
Viscous Damping	F_i	oz.in./rpm	7.3E-4	1.5E-3	2.3E-3	3.2E-3
		Nm/rpm	5.1E-6	1.0E-5	1.6E-5	2.2E-5
Max Cogging Torque	T_F	oz.in.	3.5	5.0	6.5	8.0
		Nm	0.025	0.035	0.046	0.056
Mechanical Constants						
Frameless Motor Inertia	J_M	oz.in.s^2	7.4E-3	1.5E-2	2.2E-2	3.0E-2
		Kg.m^2	5.2E-5	1.0E-4	1.5E-4	2.1E-4
Frameless Motor Weight	Wt	oz	21.4	41.3	61.2	81.0
		Kg	0.60	1.17	1.73	2.29
Housed Motor Inertia	J_M	oz.in.s^2	7.5E-3	1.5E-2	2.2E-2	3.0E-2
		Kg.m^2	5.3E-5	1.0E-4	1.5E-4	2.1E-4
Housed Motor Weight	Wt	oz	54.6	78.1	103.3	127.3
		Kg	1.55	2.24	2.92	3.6
Number of Poles	-	-	6	6	6	6
Winding Constants			A B C	A B C	A B C	A B C
Design Voltage	V_P	Volts	24 40 130	24 40 130	24 40 130	24 40 130
Peak Torque	T_P	oz.in.	708 761 761	1535 1538 1538	2090 2307 2307	2516 2961 2961
		Nm	5.00 5.38 5.38	10.8 10.8 10.8	14.7 16.2 16.2	17.7 21.1 20.9
Peak Current	I_P	Amperes	51 49 34	81 65 40	91 81 51	96 100 74
Torque Constant,±10%	K_T	oz.in./A	13.7 15.4 21.8	18.8 23.5 37.6	22.9 28.2 45.0	26.0 29.4 39.6
		Nm/A	0.098 0.109 0.154	0.133 0.166 0.266	0.162 0.200 0.318	0.184 0.208 0.280
No Load Speed	S_{NL}	RPM	2367 3499 8037	1722 2286 4665	1413 1913 3802	1244 1835 4430
		Rad/s	247 366 841	180 240 488	148 200 408	130 192 464
BEMF Constant, ±10%	K_B	V/KRPM	10.1 11.4 16.1	13.9 17.4 27.8	16.9 20.9 33.3	19.2 21.7 29.3
		V/rad/s	0.097 0.109 0.154	0.133 0.166 0.266	0.162 0.200 0.318	0.184 0.208 0.280
Terminal Resistance, ±12%	R_M	Ohms	0.46 0.58 1.17	0.29 0.46 1.24	0.26 0.40 1.03	0.24 0.31 0.56
Terminal Inductance, ±30%	L_M	mH	0.88 1.11 2.24	0.75 1.18 3.03	0.73 1.11 2.82	0.59 0.75 1.36



Continuous Duty Speed/Torque Curves for 100°C Temperature rise.

The continuous duty speed/torque curves provide a guide to the operational capability of the motors. Continuous operation at a loadpoint on or under the curve limits the temperature rise of the motor to 100°C. Although the duration of acceleration or deceleration periods should be checked, the RMS speed and torque combination should also lie on or under the continuous duty curve. The curves assume housed motors mounted to a nominal size of aluminum heatsink in a 25°C ambient environment and still air cooling. Higher ambient temperatures will generally decrease the continuous duty capability of a motor. With increased heatsink areas or improved cooling such as forced air or water, the continuous duty capability of the motor may be increased. However, for most applications, the practical maximum motor temperature is 150°C with Hall effect sensors. Higher motor temperatures can easily be accomodated with different materials.

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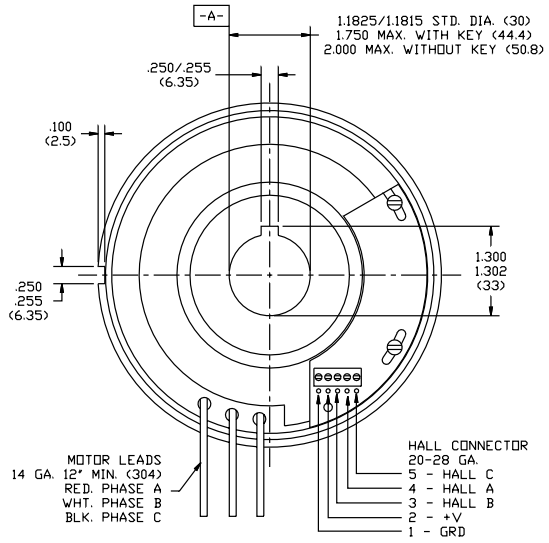
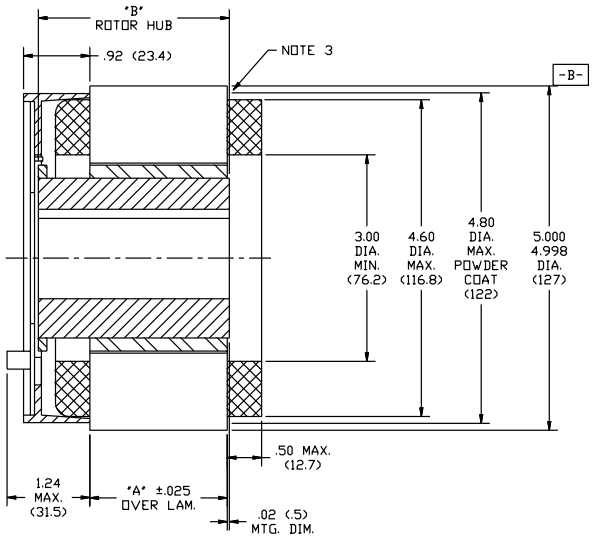
Quantum Series

Size 56

Brushless DC Motors

Frameless Motor

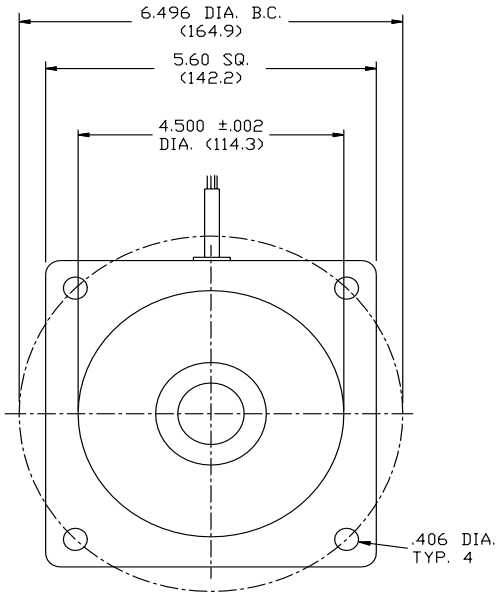


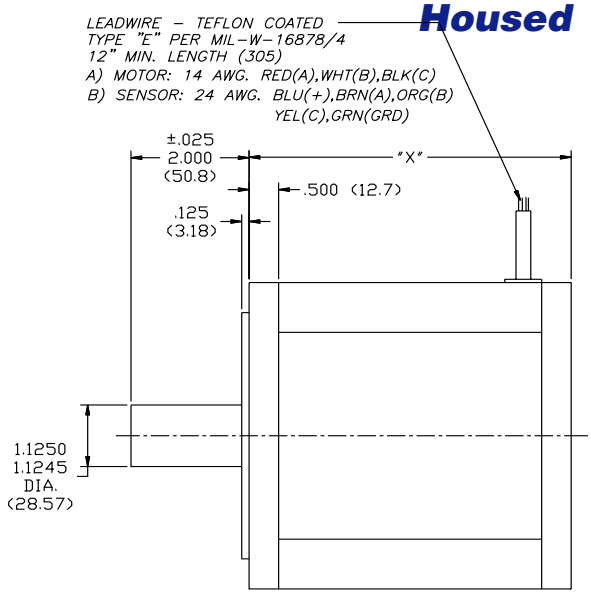


1. MOTOR SUPPLIED AS TWO SEPARATE COMPONENTS, ROTOR ASSEMBLY AND STATOR ASSEMBLY.
2. DIAMETERS "A" AND "B" TO BE CONCENTRIC WITHIN .005 WHEN MOUNTED.
3. BETWEEN STATOR O.D. AND POWDER COAT, LAMINATIONS ARE EXPOSED FOR MOUNTING SURFACE, BOTH ENDS.

MODEL	"A" STATOR	"B" ROTOR
5600	1.0 (25.4)	1.78 (45.2)
5601	2.0 (50.8)	2.81 (71.3)
5602	3.0 (76.2)	3.81 (96.7)
5603	4.0 (101.6)	4.84 (122.9)
5604	5.0 (127)	5.84 (148.3)
5605	6.0 (152.4)	6.87 (174.5)

Housed Motor





MODEL	"X"
QB05600	4.84 (123)
QB05601	5.84 (148.3)
QB05602	6.84 (173.7)
QB05603	7.84 (199)
QB05604	8.84 (224.5)
QB05605	9.84 (250)

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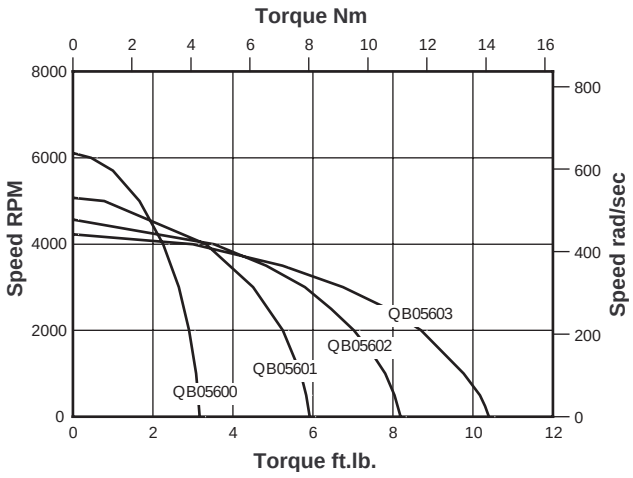
Quantum Series

Size 56

Brushless DC Motors

Parameter	Symbol	Unit	QB05600			QB05601			QB05602			QB05603		
Size Constants														
Max Cont. Stall Torque	T_C	ft.lb.	3.17			5.92			8.19			10.40		
		Nm	4.29			8.03			11.10			14.10		
Max Rated Torque, 25%	T_R	ft.lb.	22.3			43.7			62.8			83.7		
		Nm	30.3			57.2			85.1			113.5		
Motor Constant,	K_M	ft.lb./√W	0.42			0.65			0.809			0.957		
		Nm/√W	0.56			0.88			1.09			1.29		
Electrical Time Constant	T_E	msec	5.09			5.49			6.59			6.83		
Mechanical Time Constant	T_M	msec	1.13			0.93			0.92			0.88		
Thermal Resistance	TPR	°C/Watt	1.09			0.75			1.15			0.52		
Viscous Damping	F_i	ft.lb./rpm	1.7E-5			3.6E-5			5.5E-5			7.4E-5		
		Nm/rpm	2.3E-5			4.9E-5			7.5E-5			1.0E-4		
Max Cogging Torque	T_F	ft.lb.	0.057			0.099			0.141			0.182		
		Nm	0.078			0.134			0.191			0.247		
Mechanical Constants														
Frameless Motor Inertia	J_M	ft.lb.s²	2.7E-4			5.4E-4			8.1E-4			1.1E-3		
		Kg.m²	3.6E-4			7.3E-4			1.1E-3			1.5E-3		
Frameless Motor Weight	Wt	lb.	3.79			8.81			12.8			17.0		
		Kg	1.72			3.99			5.84			7.76		
Housed Motor Inertia	J_M	ft.lb.s²	4.6E-4			8.3E-4			1.2E-3			1.6E-3		
		Kg.m²	6.3E-4			1.1E-3			1.6E-3			2.1E-3		
Housed Motor Weight	Wt	lb.	10.59			17.31			23.0			28.8		
		Kg	4.80			7.84			10.4			13.0		
Number of Poles	-	-	8			8			8			8		
Winding Constants			A	B	C	A	B	C	A	B	C	A	B	C
Design Voltage	V_P	Volts	40	130	300	40	130	300	40	130	300	40	130	300
Peak Torque	T_P	ft.lb.	22.3	22.3	22.3	43.7	43.7	43.7	62.8	62.8	62.8	83.7	83.7	83.7
		Nm	30.3	30.3	30.3	59.2	59.2	59.2	85.1	85.1	85.1	113.5	113.5	113.5
Peak Current	I_P	Amperes	224	121	62	409	204	93	498	263	124	640	299	154
Torque Constant,±10%	K_T	ft.lb./A	0.100	0.184	0.358	0.107	0.214	0.467	0.126	0.238	0.504	0.131	0.280	0.541
		Nm/A	0.135	0.250	0.486	0.145	0.290	0.633	0.171	0.323	0.683	0.177	0.380	0.734
No Load Speed	S_{NL}	RPM	2830	4971	5896	2634	4281	4528	2235	3847	4192	2156	3270	3903
		Rad/s	296	520	617	275	448	474	234	402	439	225	342	408
BEMF Constant, ±10%	K_B	V/KRPM	14.3	26.1	50.8	15.1	30.3	66.2	17.8	33.8	71.5	18.5	39.7	76.8
		V/rad/s	0.135	0.250	0.486	0.145	0.290	0.633	0.171	0.323	0.683	0.177	0.380	0.734
Terminal Resistance, ±12%	R_M	Ohms	0.056	0.196	0.761	0.027	0.107	0.511	0.024	0.085	0.400	0.019	0.088	0.324
Terminal Inductance, ±30%	L_M	mH	0.287	0.981	3.715	0.146	0.586	2.788	0.160	0.570	2.556	0.127	0.585	2.187



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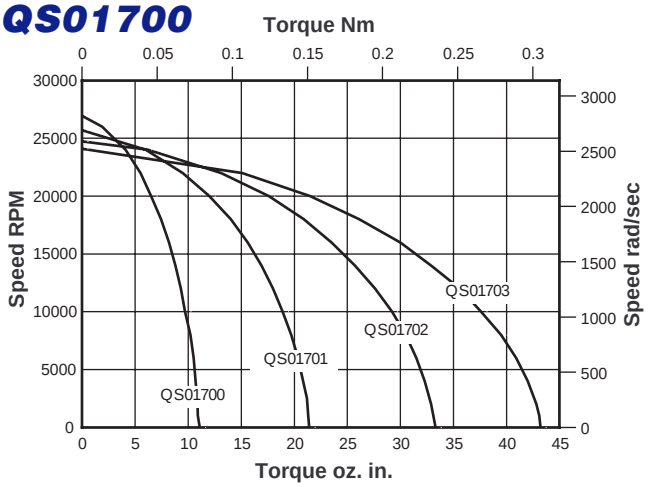
Quantum Series
Brushless DC Motors

QS High Efficiency

QS01700



QS High Efficiency Motors

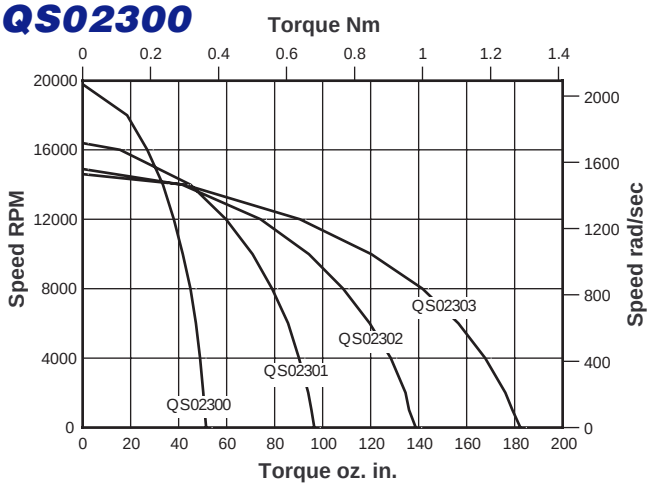
The QS versions of the Quantum Series of motors, are designed for increased operating efficiency at higher speeds. This is accomplished by the use of thinner, low core loss, lamination material. The result is that for a given temperature rise, the motor can operate at higher speed while still producing useful amounts of output torque compared to the standard Quantum Series motors (QB) that are optimized for servo perfomance at lower operating speeds.

The mechanical dimensions of the QS motors remain the same as the QB versions. Except for the Viscous Damping and Hysteresis Drag torque, the datasheet parameters for Size and Winding constants remain the same.

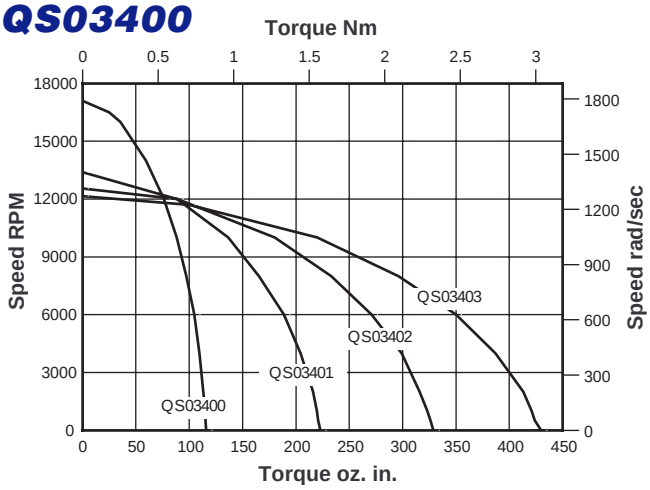
For loadpoints beyond those shown on the accompanying graphs, we can further optimize the magnetic circuit designs through geometry and material changes.

Additionally, windings which are optimized for a specific application's higher operating speeds can be provided.

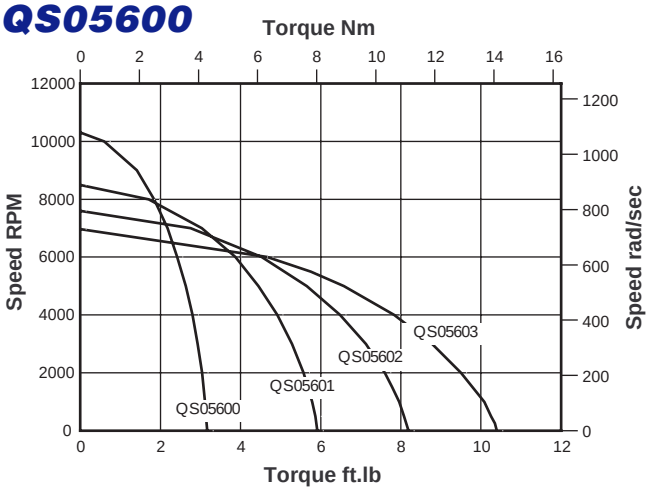
QS02300



QS03400



QS05600



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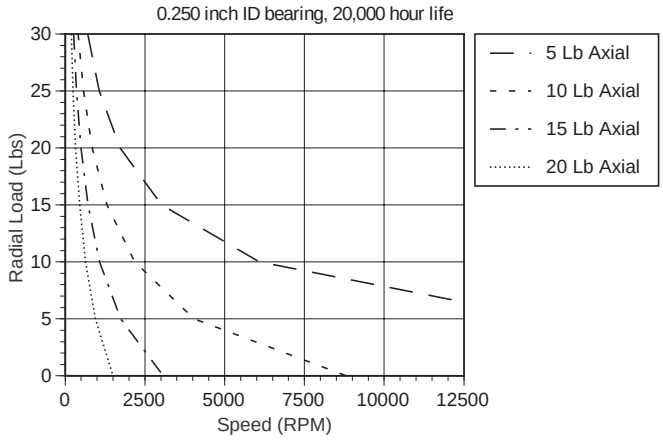
Quantum Series
Brushless DC Motors

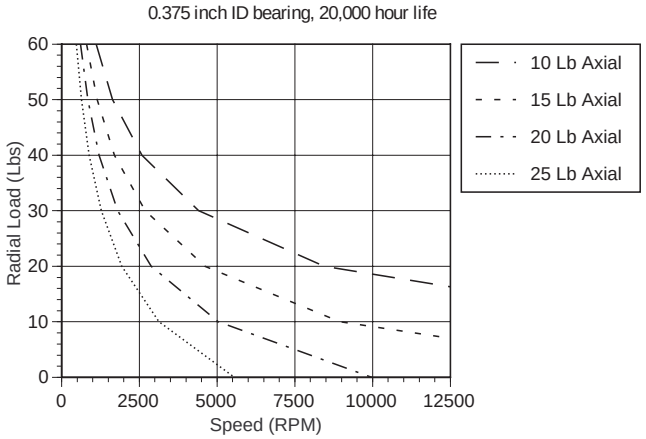
Bearing Life Curves

QB/QS01700



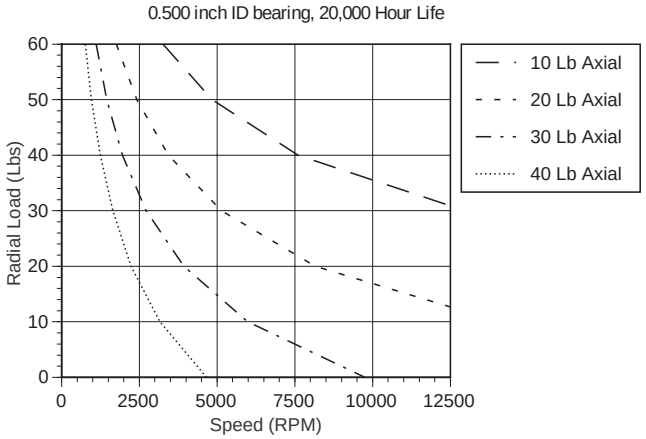
Calculations for life rating of 20,000 hours is based upon combined radial and axial loads.
Radial load applied 0.50 inches (12.7mm) from mounting face.
10 lb (44N) maximum axial preload.
8 mm ID bearing available.

QB/QS02300



Calculations for life rating of 20,000 hours is based upon combined radial and axial loads.
Radial load applied 0.50 inches (12.7mm) from mounting face.
15 lb (66N) maximum axial preload.
0.5 inch ID bearing available.
0.250 inch shaft option utilizes 0.375 inch ID bearings

QB/QS03400



Calculations for life rating of 20,000 hours is based upon combined radial and axial loads.
Radial load applied 0.75 inches (19mm) from mounting face.
20 lb (88N) maximum axial preload.
0.375 inch shaft utilizes 0.500 inch ID bearing
0.625 inch ID bearing available.

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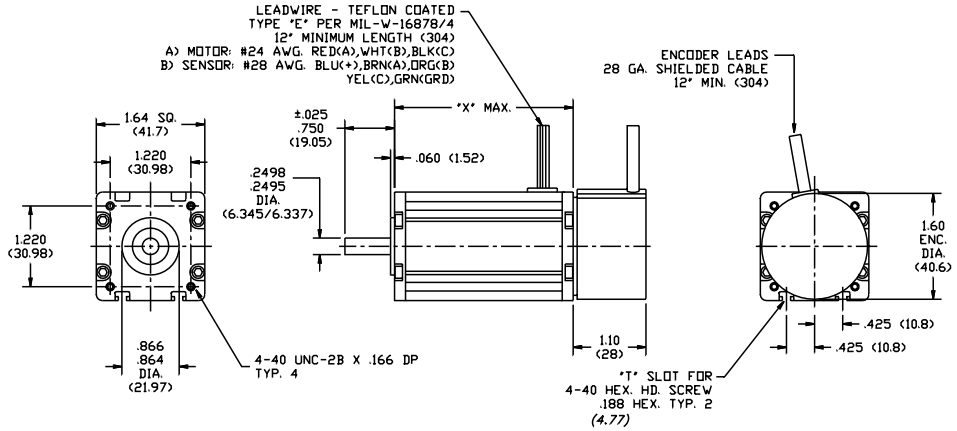
QB/QS01700 Series

MODEL	LENGTH "X"
QB01700	2.125 (54.0)
QB01701	2.625 (66.7)
QB01702	3.125 (79.4)
QB01703	3.625 (92.1)

ENCODER LEAD		
FUNCTION	WITH COMMUTATION	LINE DRIVER ONLY
+5V	RED	RED
GROUND	BLACK	BLACK
CH. A	BLUE	GREEN
CH. B	GREEN	ORANGE
CH. A INV.	BLU/BLK	RED/BLK
CH. B INV.	GRN/BLK	WHT/BLK
INDEX	VIOLET	WHITE
INDEX INV.	VIO/BLK	BLUE
COMM U	BROWN	
COMM V	GRAY	
COMM. W	WHITE	

1. ENCODER WITH INDEX AND LINE DRIVER.
   200, 400, 500, 1000, 1024 LINE COUNT AVAILABLE.
   OPTIONAL ENCODER WITH COMMUTATION CHANNELS.

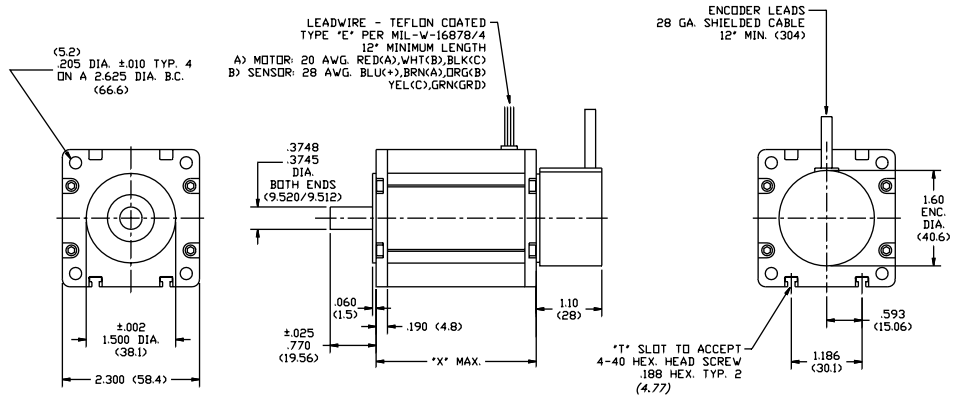


QB/QS02300 Series

MODEL NO.	"X"
QB02300	2.800 (71.12)
QB02301	3.550 (90.17)
QB02302	4.300 (109.22)
QB02303	5.050 (128.27)

ENCODER LEAD		
FUNCTION	WITH COMMUTATION	LINE DRIVER ONLY
+5V	RED	RED
GROUND	BLACK	BLACK
CH. A	BLUE	GREEN
CH. B	GREEN	ORANGE
CH. A INV.	BLU/BLK	RED/BLK
CH. B INV.	GRN/BLK	WHT/BLK
INDEX	VIOLET	WHITE
INDEX INV.	VIO/BLK	BLUE
COMM U	BROWN	
COMM V	GRAY	
COMM. W	WHITE	

1. ENCODER WITH INDEX AND LINE DRIVER.
   200, 400, 500, 1000, 1024 LINE COUNT AVAILABLE.
   OPTIONAL ENCODER WITH COMMUTATION CHANNELS.



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Quantum Series
Brushless DC Motors

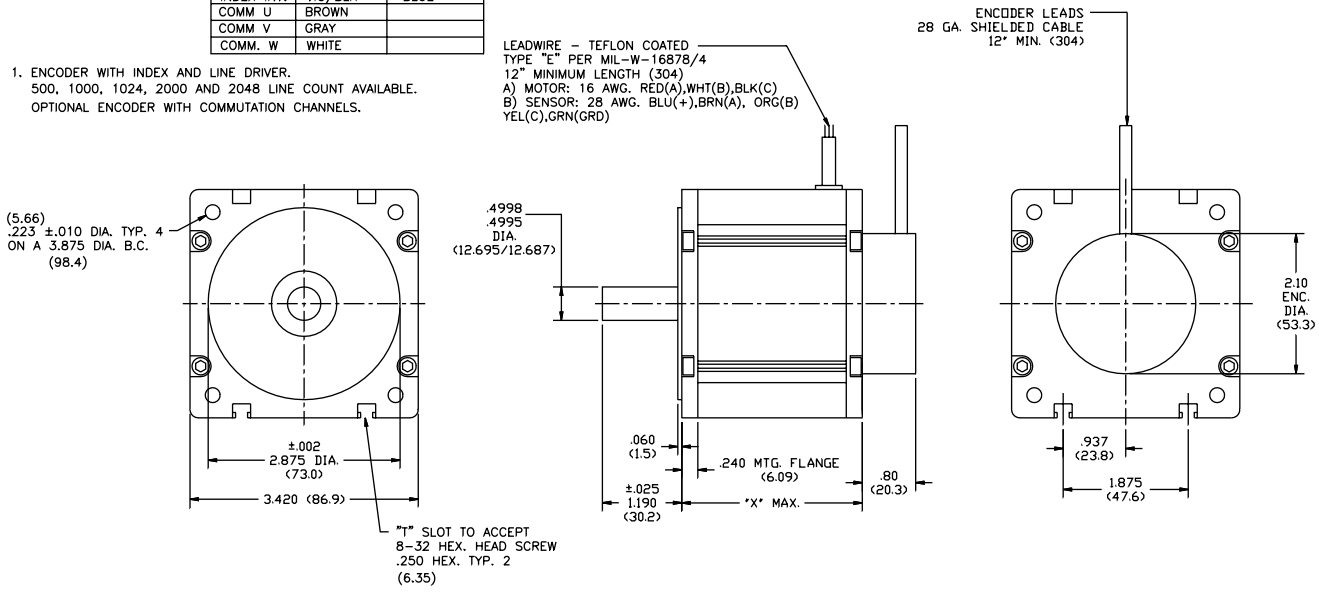
Encoders

QB/QS03400 Series

MODEL NO.	LENGTH "X"
QB03400	3.01 (76.5)
QB03401	3.76 (95.5)
QB03402	4.51 (114.6)
QB03403	5.26 (133.6)

ENCODER LEAD		
FUNCTION	WITH COMMUTATION	LINE DRIVER ONLY
+5V	RED	RED
GROUND	BLACK	BLACK
CH. A	BLUE	GREEN
CH. B	GREEN	ORANGE
CH. A INV.	BLU/BLK	RED/BLK
CH. B INV.	GRN/BLK	WHT/BLK
INDEX	VIOLET	WHITE
INDEX INV.	VIO/BLK	BLUE
COMM U	BROWN	
COMM V	GRAY	
COMM. W	WHITE	

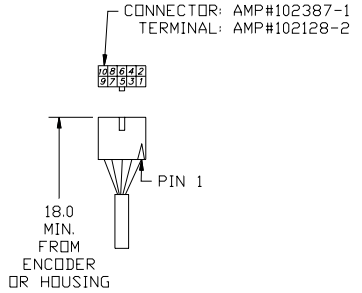
1. ENCODER WITH INDEX AND LINE DRIVER.
   500, 1000, 1024, 2000 AND 2048 LINE COUNT AVAILABLE.
   OPTIONAL ENCODER WITH COMMUTATION CHANNELS.

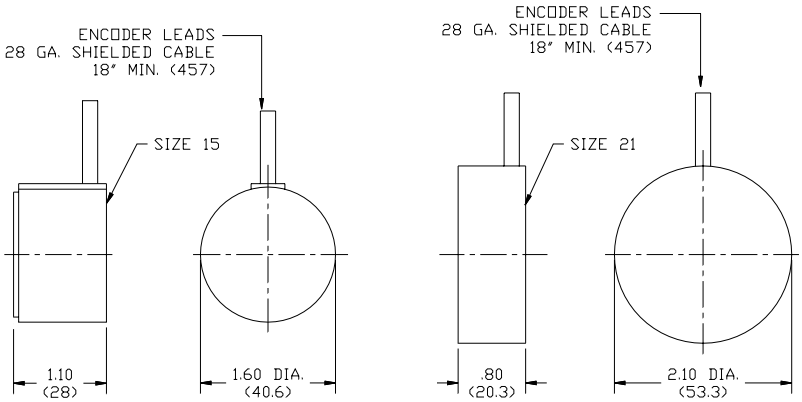


Encoder Connections

ENCODER TERMINATION			
FUNCTION	WITH COMMUTATION	LINE DRIVER ONLY	*CONNECTOR*
+5V	RED	RED	*PIN 1*
GROUND	BLACK	BLACK	*PIN 10*
CH. A	BLUE	GREEN	*PIN 4*
CH. B	GREEN	ORANGE	*PIN 6*
CH. A INV.	BLU/BLK	RED/BLK	*PIN 3*
CH. B INV.	GRN/BLK	WHT/BLK	*PIN 5*
INDEX	VIOLET	WHITE	*PIN 7*
INDEX INV.	VIO/BLK	BLUE	*PIN 9*
COMM U	BROWN		
COMM V	GRAY		
COMM. W	WHITE		

1. ENCODER WITH INDEX AND LINE DRIVER.
   OPTIONAL ENCODER WITH COMMUTATION CHANNELS.
   LINE COUNTS AVAILABLE:
   SIZE 15: 200, 400, 500, 1000, 1024
   SIZE 21: 500, 1000, 1024, 2000, 2048





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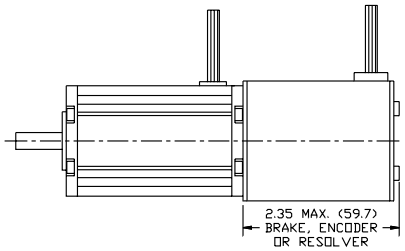
Quantum Series
Brushless DC Motors

Rugged Housings

QB/QS01700 Series

MODEL NO.	"X"
QB01700	2.125 (54)
QB01701	2.625 (66.7)
QB01702	3.125 (79.4)
QB01703	3.625 (92.1)

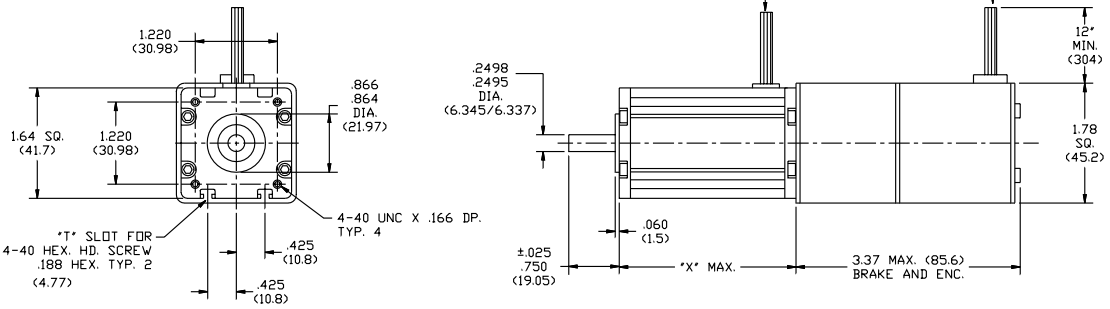
ENCODER LEAD		
FUNCTION	WITH COMMUTATION	LINE DRIVER ONLY
+5V	RED	RED
GROUND	BLACK	BLACK
CH. A	BLUE	GREEN
CH. B	GREEN	ORANGE
CH. A INV.	BLU/BLK	RED/BLK
CH. B INV.	GRN/BLK	WHT/BLK
INDEX	VIOLET	WHITE
INDEX INV.	VIO/BLK	BLUE
COMM U	BROWN	
COMM V	GRAY	
COMM. W	WHITE	



1. ENCODER WITH INDEX AND LINE DRIVER. 200, 400, 500, 1000, 1024 LINE COUNT AVAILABLE. OPTIONAL ENCODER WITH COMMUTATION CHANNELS.
2. BRAKE: POWER-OFF FAILSAFE BRAKE, 24 VDC. 1 IN-LB MIN. HOLDING TORQUE.
3. CONSULT FACTORY FOR RESOLVER SPECIFICATIONS.

LEADWIRE - TEFLON COATED TYPE "E" PER MIL-W-16878/4
A) MOTOR: #24 AWG. RED(A),WHT(B),BLK(C)
B) SENSOR: #28 AWG. BLU(+),BRN(A),ORG(B) YEL(C),GRN(GRD)

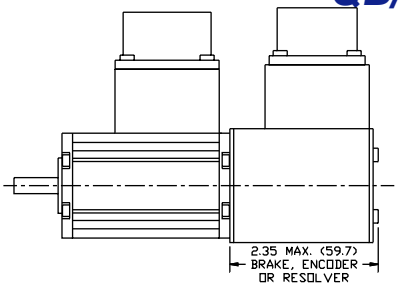
ENCODER/BRAKE LEADS
ENC: 24 AWG. SHIELDED CABLE
BRAKE: 24 AWG. WHITE



QB/QS01700 Series

MODEL NO.	"X"
QB01700	2.125 (54)
QB01701	2.625 (66.7)
QB01702	3.125 (79.4)
QB01703	3.625 (92.1)

22-63 CONNECTION		20-27 CONNECTION	
DESC.	PIN	DESC.	PIN
PHASE A	A	+5V	A
PHASE B	B	GRD.	B
PHASE C	C	CH. A	C
+ VDC	E	CH. B	D
GRD.	F	CH. A INV.	E
HALL A	H	CH. B INV.	F
HALL B	J	INDEX	G
HALL C	K	INDEX INV.	H
SHIELD (OPT)	N	comm. u (OPT)	I
CASE GROUND (OPT)	D	comm. v (OPT)	J
THERMAL SENSOR (OPT)	L	comm. w (OPT)	K
THERMAL SENSOR (OPT)	M	SHIELD (OPT)	N
		BRAKE +	L
		BRAKE -	M



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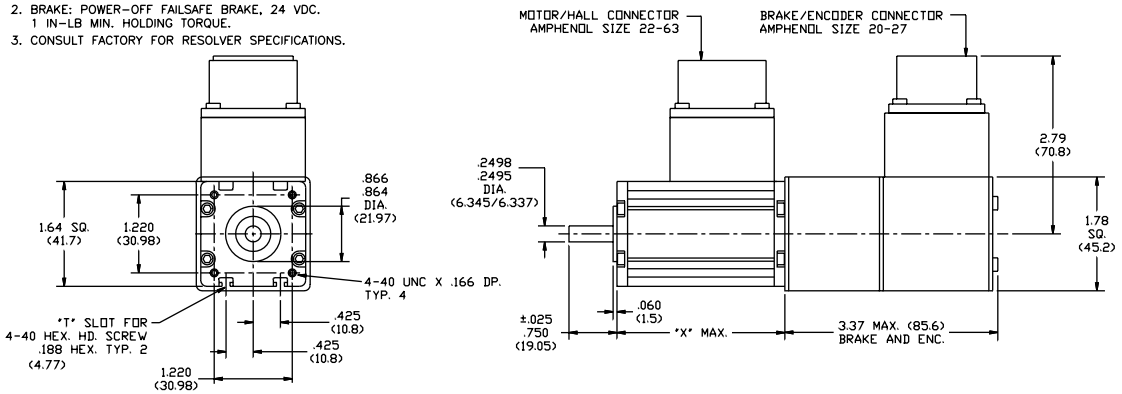

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Quantum Series
Brushless DC Motors

Rugged Housings

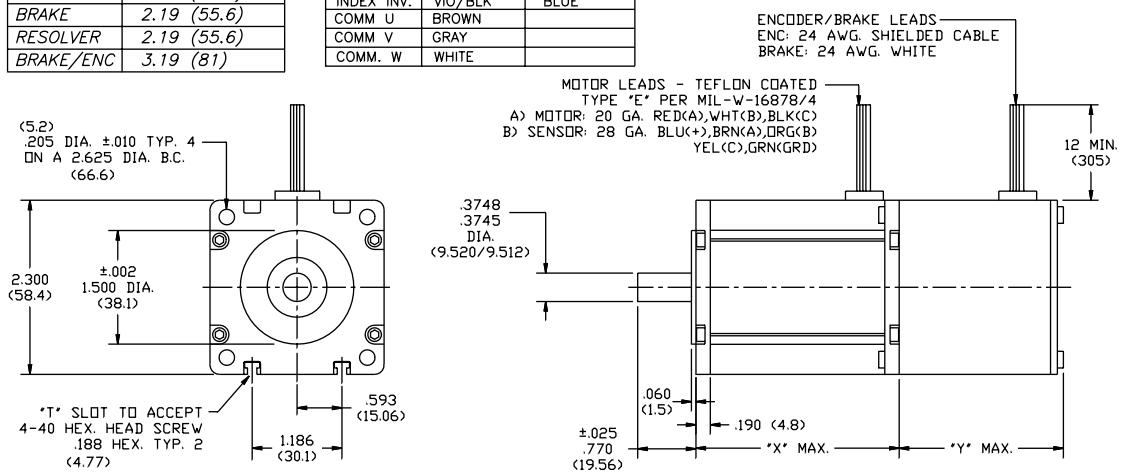
QB/QS02300 Series

MODEL NO.	"X"
QB02300	2.800 (71.12)
QB02301	3.550 (90.17)
QB02302	4.300 (109.22)
QB02303	5.050 (128.27)
QB02304	5.800 (147.3)

OPTION	"Y"
ENCODER	2.19 (55.6)
BRAKE	2.19 (55.6)
RESOLVER	2.19 (55.6)
BRAKE/ENC	3.19 (81)

ENCODER LEAD		
FUNCTION	WITH COMMUTATION	LINE DRIVER ONLY
+5V	RED	RED
GROUND	BLACK	BLACK
CH. A	BLUE	GREEN
CH. B	GREEN	ORANGE
CH. A INV.	BLU/BLK	RED/BLK
CH. B INV.	GRN/BLK	WHT/BLK
INDEX	VIOLET	WHITE
INDEX INV.	VIO/BLK	BLUE
COMM U	BROWN	
COMM V	GRAY	
COMM. W	WHITE	

1. ENCODER, WITH INDEX AND LINE DRIVER.
   200, 400, 500, 1000 AND 1024 LINE COUNT AVAILABLE.
   OPTIONAL ENCODER WITH COMMUTATION CHANNELS.
2. BRAKE: POWER-OFF FAILSAFE BRAKE, 24 VDC.
   5 IN-LB AND 10 IN-LB HOLDING TORQUE AVAILABLE.
3. CONSULT FACTORY FOR RESOLVER SPECIFICATIONS.



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OPTION	"Y"
ENCODER	2.19 (55.6)
BRAKE	2.19 (55.6)
RESOLVER	2.19 (55.6)
BRAKE/ENC	3.19 (81)

24-58 CONNECTION		20-27 CONNECTION	
DESC.	PIN	DESC.	PIN
PHASE A	A	+5V	A
PHASE B	B	GRD.	B
PHASE C	C	CH. A	C
+ VDC	M	CH. B	D
GRD.	N	CH. A INV.	E
HALL A	P	CH. B INV.	F
HALL B	H	INDEX	G
HALL C	J	INDEX INV.	H
SHIELD	K	COMM. U (OPT)	I
CASE GROUND (OPT)	E	COMM. V (OPT)	J
THERMAL SENSOR (OPT)	D	COMM. W (OPT)	K
THERMAL SENSOR (OPT)	F	SHIELD (OPT)	N
		BRAKE +	L
		BRAKE −	M

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   5 IN-LB AND 10 IN-LB HOLDING TORQUE AVAILABLE.
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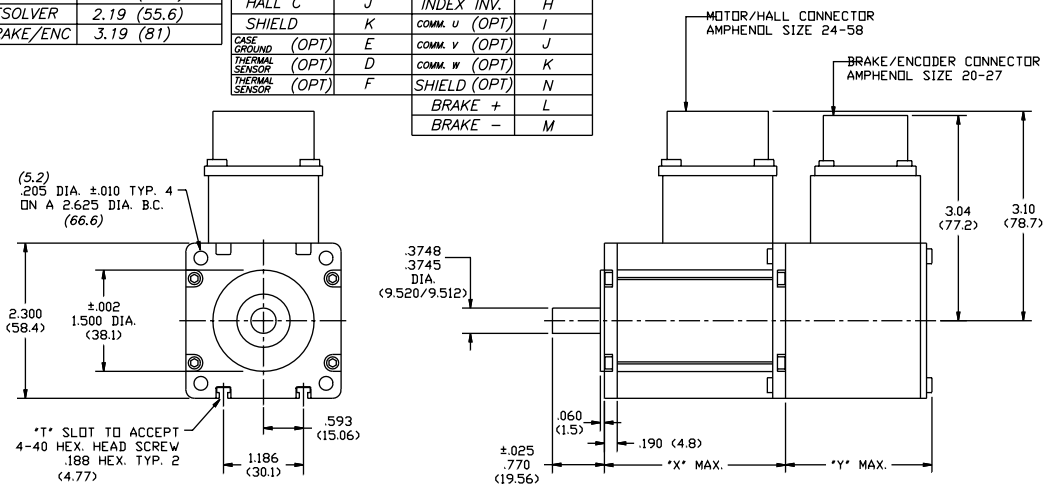

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Quantum Series
Brushless DC Motors

Rugged Housings

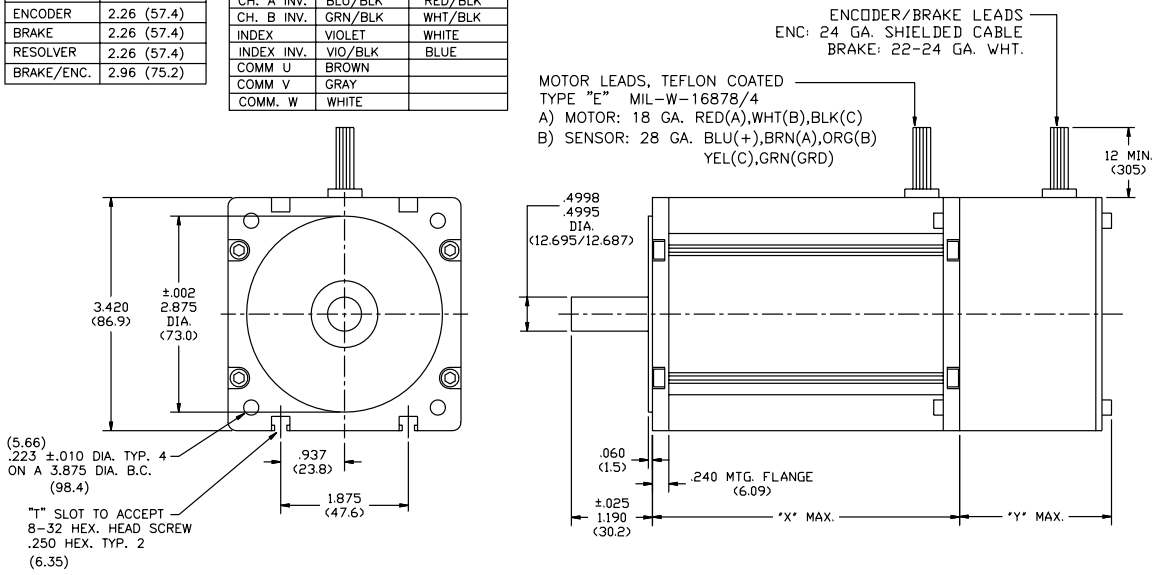
QB/QS03400 Series

MODEL NO.	"X"
QB03400	3.01 (76.5)
QB03401	3.76 (95.5)
QB03402	4.51 (114.6)
QB03403	5.26 (133.6)

OPTION	"Y"
ENCODER	2.26 (57.4)
BRAKE	2.26 (57.4)
RESOLVER	2.26 (57.4)
BRAKE/ENC.	2.96 (75.2)

ENCODER LEAD		
FUNCTION	WITH COMMUTATION	LINE DRIVER ONLY
+5V	RED	RED
GROUND	BLACK	BLACK
CH. A	BLUE	GREEN
CH. B	GREEN	ORANGE
CH. A INV.	BLU/BLK	RED/BLK
CH. B INV.	GRN/BLK	WHT/BLK
INDEX	VIOLET	WHITE
INDEX INV.	VIO/BLK	BLUE
COMM U	BROWN	
COMM V	GRAY	
COMM. W	WHITE	

1. ENCODER WITH INDEX AND LINE DRIVER.
   200, 400, 500, 1000 AND 1024 LINE COUNTS AVAILABLE.
   OPTIONAL ENCODER WITH COMMUTATION CHANNELS.
2. BRAKE: POWER-OFF FAILSAFE BRAKE, 24 VDC.
   5 IN-LB, 10 IN-LB AND 40 IN-LB HOLDING TORQUE AVAILABLE.
3. CONSULT FACTORY FOR RESOLVER SPECIFICATIONS.



QB/QS03400 Series

MODEL NO.	LENGTH "X"
QB03400	3.01 (76.5)
QB03401	3.76 (95.5)
QB03402	4.51 (114.6)
QB03403	5.26 (133.6)

OPTION	LENGTH "Y"
ENCODER	2.26 (57.4)
BRAKE	2.26 (57.4)
RESOLVER	2.26 (57.4)
BRAKE/ENC.	2.96 (75.2)

24-58 CONNECTION		20-27 CONNECTION	
DESC.	PIN	DESC.	PIN
PHASE A	A	+ 5V	A
PHASE B	B	GRD.	B
PHASE C	C	CH. A	C
+ VDC	M	CH. B	D
GRD.	N	CH. A INV.	E
HALL A	P	CH. B INV.	F
HALL B	H	INDEX	G
HALL C	J	INDEX INV.	H
SHIELD (OPT)	K	COMM. U (OPT)	I
CASE GROUND (OPT)	E	COMM. V (OPT)	J
THERMAL SENSOR (OPT)	D	COMM. W (OPT)	K
THERMAL SENSOR (OPT)	F	SHIELD (OPT)	N
		BRAKE +	L
		BRAKE -	M

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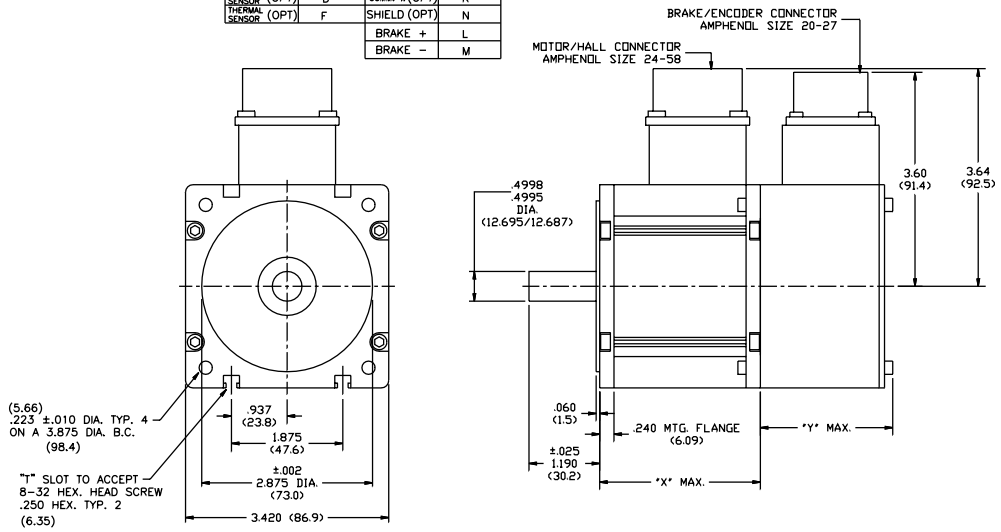
3. CONSULT FACTORY FOR RESOLVER SPECIFICATIONS.



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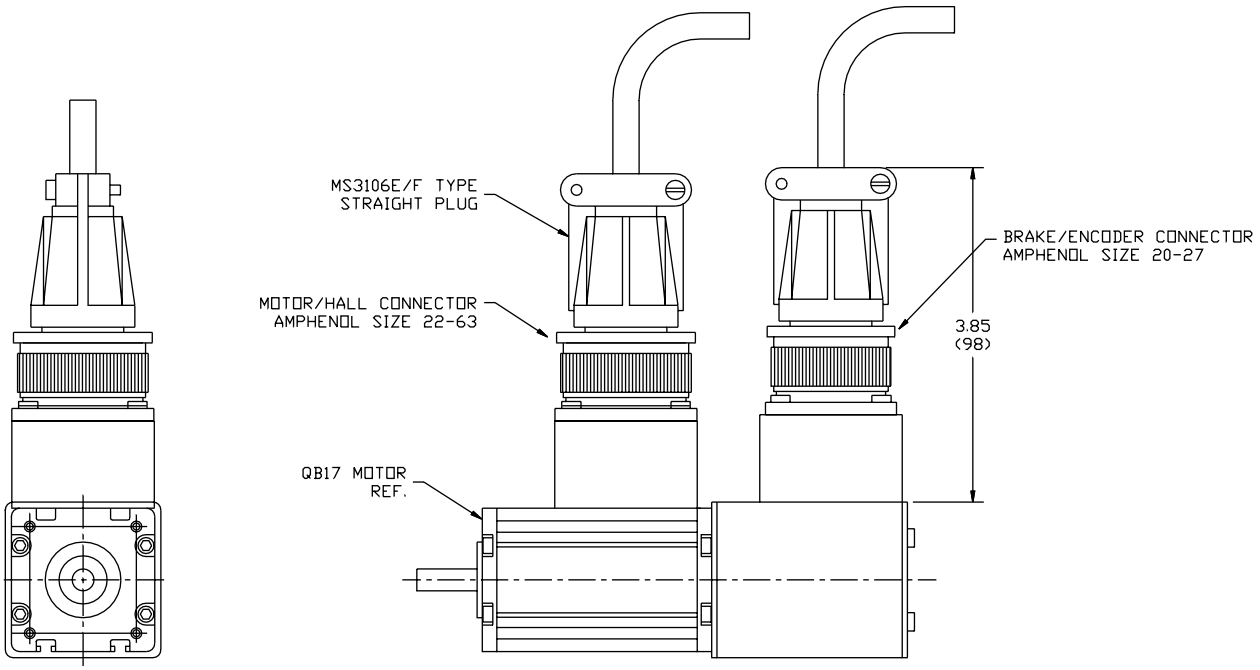
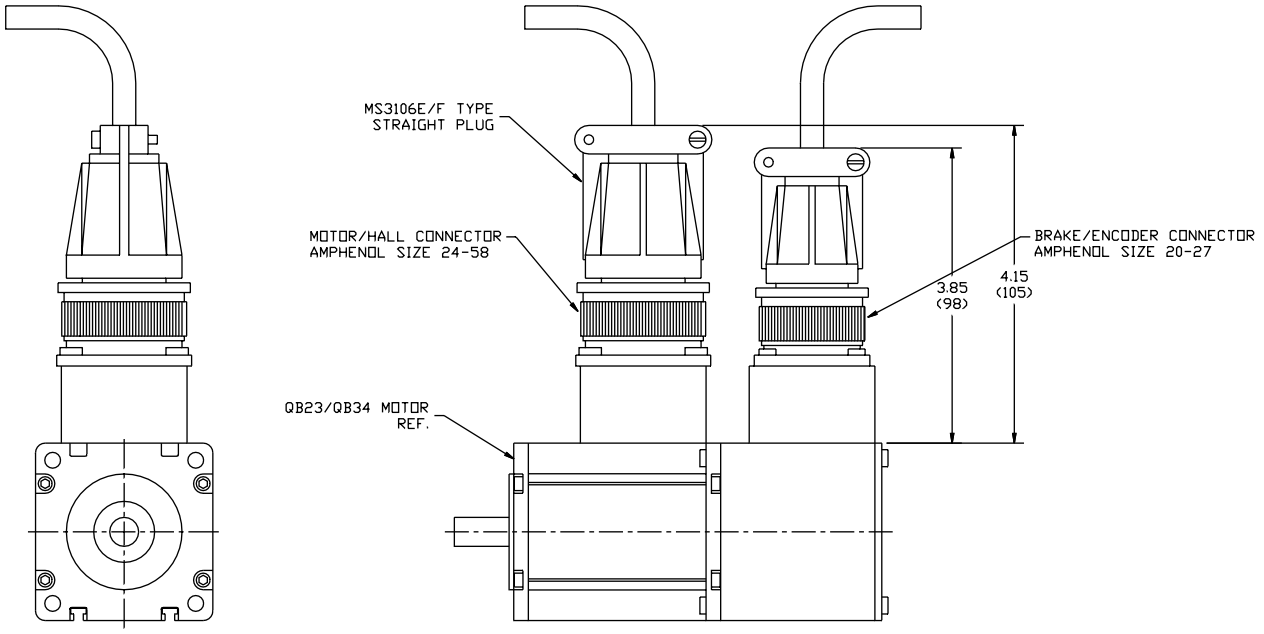
Quantum Series
Brushless DC Motors

Mating Connectors

QB/QS01700 Series



QB/QS02300/3400 Series



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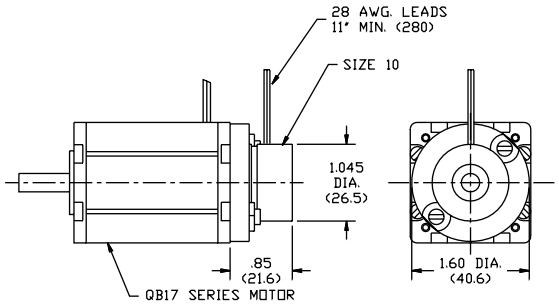
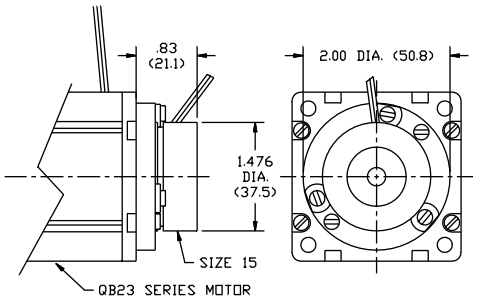
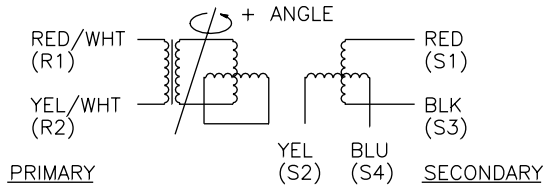
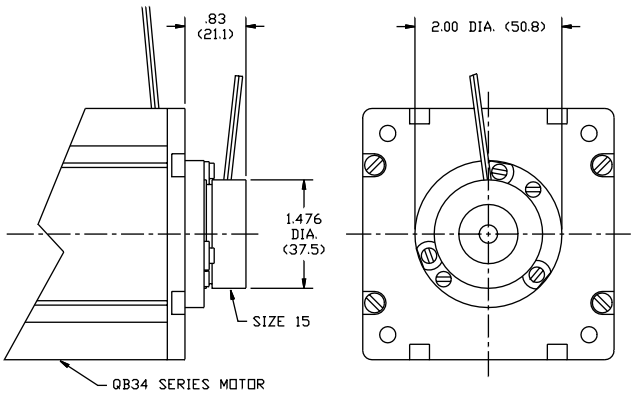
Resolver Options





RESOLVER SIZE 10 AND 15	
INPUT VOLTAGE	AC 7Vrms 10 KHZ
INPUT CURRENT	60 mA MAX.
TEMP. RANGE	−55° TO 155°C
MAX. OPERATING SPEED	10000 RPM





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Quantum Series
Brushless DC Motors

Holding Brake Options

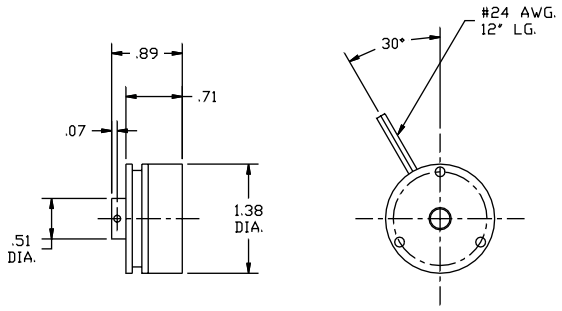

FIG. 1

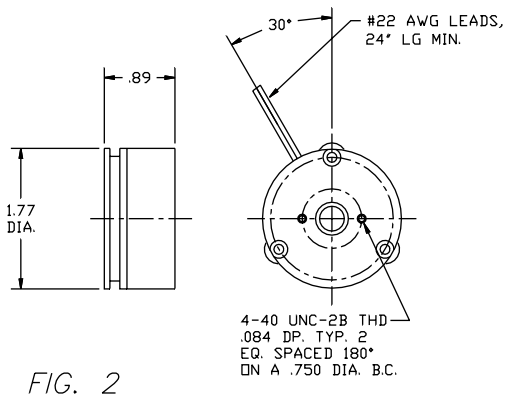

FIG. 2

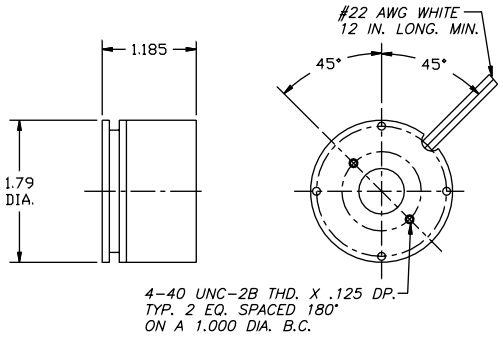

FIG. 3

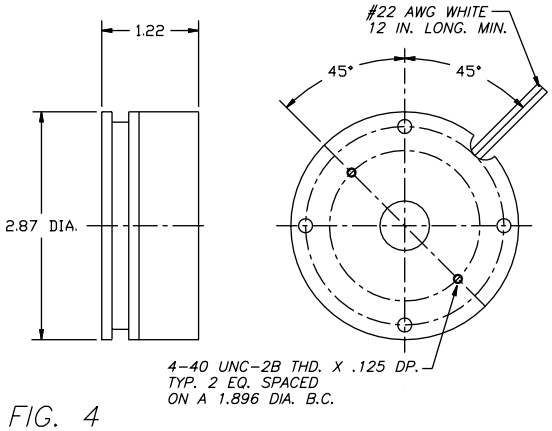

FIG. 4

BRAKE PART NO.	9760196 FIG. 1	9760183 FIG. 2	9760184 FIG. 3	9760185 FIG. 4
STATIC TORQUE:LB.IN(Nm) Min	1 (0.11)	5 (0.56)	10(1.12)	40(4.51)
COIL: VOLTAGE (DC)	24	24	24	24
RESISTANCE (OHMS) ±10%	138	82.3	52.5	36
WATTS (MAX)	–	7.0	11	16
PULL IN VOLTAGE (MAX. DC)	18	18	16	16

1. ENCODERS CAN BE MOUNTED TO EACH BRAKE EXCEPT 9760196. SEPARATE ENCODER MOUNTING PLATE REQUIRED ON BRAKES 9760184, 185

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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 Continuous Stall Torque (T_C) is the amount of torque produced at zero speed which results in a 100°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.

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).

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.

$K_M = T_P$ (Peak Torque)/$\sqrt{P_P}$ (Peak Input Power)
or
$K_M = K_T$ (Torque Constant)/ $\sqrt{R_M}$ (Terminal 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 motors 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.

Heatsink Sizes:
QB01700 Series 6 x 6 x 0.25 inches (152x152x6.3 mm)
QB02300 Series 8 x 8 x 0.25 inches (203x203x6.3 mm)
QB03400 Series 10x10x0.25 inches (254x254x6.3 mm)
QB05600 Series 12x12x0.50 inches (305x305x12.7mm)

Viscous Damping (F_0) gives an indication of the torque lost due to B.E.M.F. in the motor when the source impedance is zero. F_0 value can be represented as $F_0 = K_T * K_B / R_M$

Maximum Cogging Torque (T_F) 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.

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 QB Series this is generally a total of six (three north and three south).

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 a 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

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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).

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.

Configuration Drawings

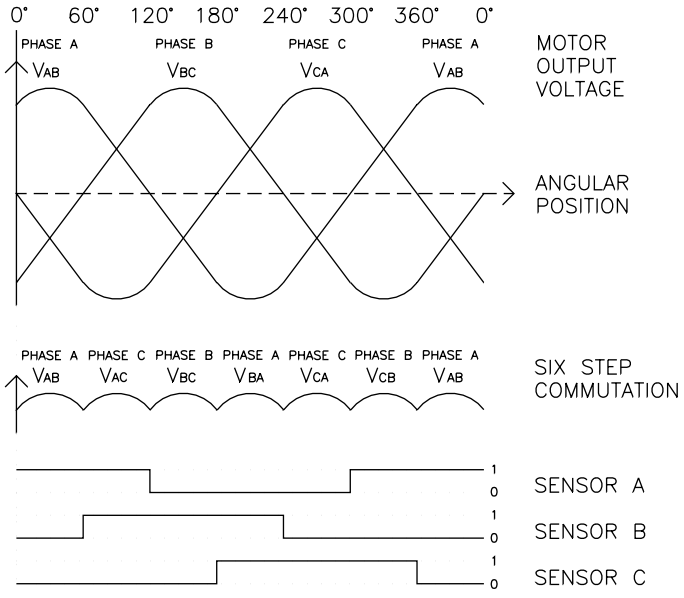
The drawings reflect the standard configurations for both the housed and frameless motors. Encoder and housing options are also detailed but customers may specify mechanical modifications such as shaft diameters and lengths as well as special mounting and cabling requirements.

Frameless motors are supplied with single stack rotor hubs for customer stacking to required rotor length. The Hall effects are integral to the stator assembly.

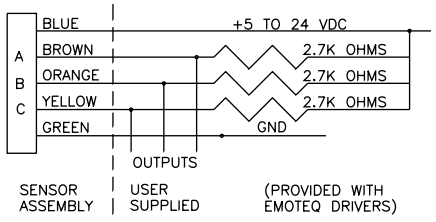
Motor Connections and Commutation Logic

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	0	1	1
	(ORG) B	0	1	1	1	0	0	0
	(YEL) C	0	0	0	1	1	1	0



HALL EFFECT CONNECTION DIAGRAM



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Sales Offices

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