MACCON
MOTION UNDER CONTROL

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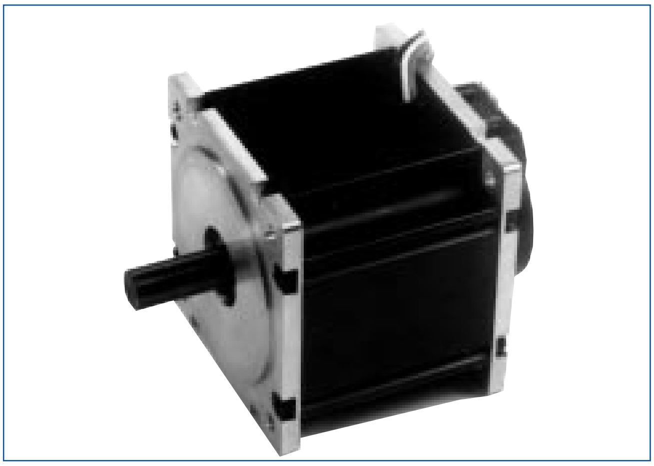
Quantum Series

Size 17, 23, 34 and 56 Brushless Servo Motors

Frameless and Housed



Engineering Guide

MACCON
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QB Series
Selection Guide

Quantum Series Selection Guide

Model	Cont. Stall Torque Nm	Max Rated Torque Nm	‡Max Cont Power Watt @	Diameter RPM	Housed Length mm	Housing Diameter mm	Frameless Length mm	Frameless mm
QB01700	0.0	0.65	68	12500	41.7	54.0	35.81	34.0
QB01701	0.15	1.19	113	10000	41.7	66.7	35.81	46.7
QB01702	0.23	1.87	167	10000	41.7	79.4	35.81	59.4
QB01703	0.30	2.41	211	10000	41.7	92.1	35.81	72.1
QB02300	0.36	3.9	202	8000	58.4	71.1	55.37	41.6
QB02301	0.68	7.9	311	7000	58.4	90.1	55.37	60.7
QB02302	0.98	11.8	411	6000	58.4	109.2	55.37	79.7
QB02303	1.28	15.6	528	6000	58.4	128.2	55.37	98.8
QB03400	0.81	5.3	410	7000	86.9	76.5	81.28	41.6
QB03401	1.57	10.8	607	6000	96.9	95.5	81.28	60.7
QB03402	2.32	16.2	846	5000	96.9	114.6	81.28	79.7
QB03403	3.03	20.9	1072	5000	96.9	133.6	81.28	98.8
QB05600	4.29	22.3	1282	4000	NA	NA	127.00	62.7
QB05601	8.03	57.2	1920	3000	NA	NA	127.00	88.1
QB05602	11.1	85.1	2471	3000	NA	NA	127.00	113.5
QB05603	14.1	113.5	2875	3000	NA	NA	127.00	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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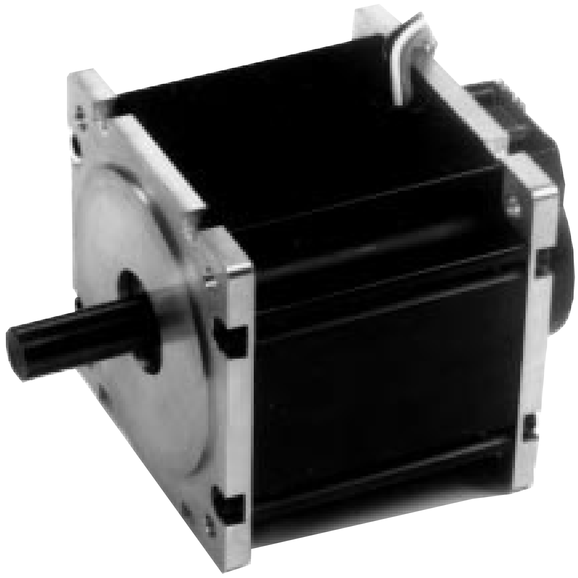
QB Series

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

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

QB Series

Glossary

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_F) 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 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

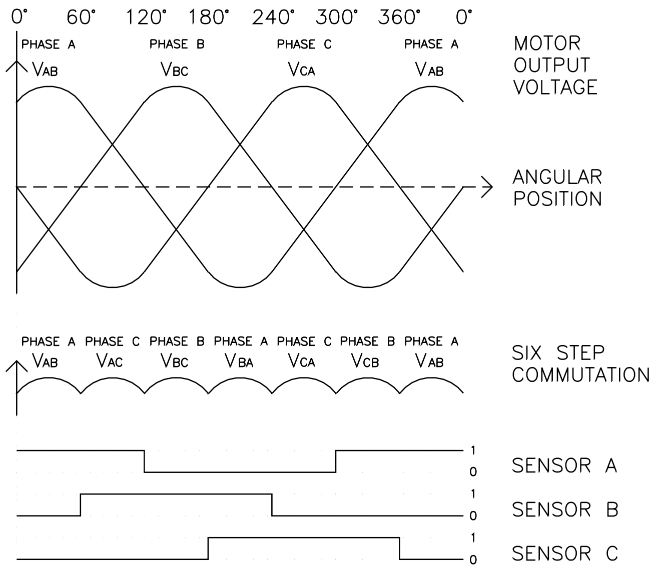
The drawings reflect the standard configurations for both the housed and frameless motors. Encoder and housing options are also detailed but customers may specify mechanical modifications such as shaft diameters and lengths as well as special mounting and cabling requirements.

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