MACCON
MOTION UNDER CONTROL

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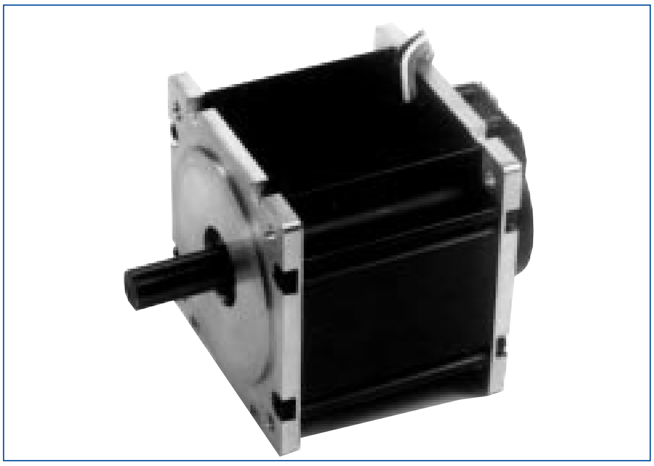
# Quantum Series

## Size 17, 23, 34 and 56 Brushless Servo Motors

## Frameless and Housed



## Engineering Guide

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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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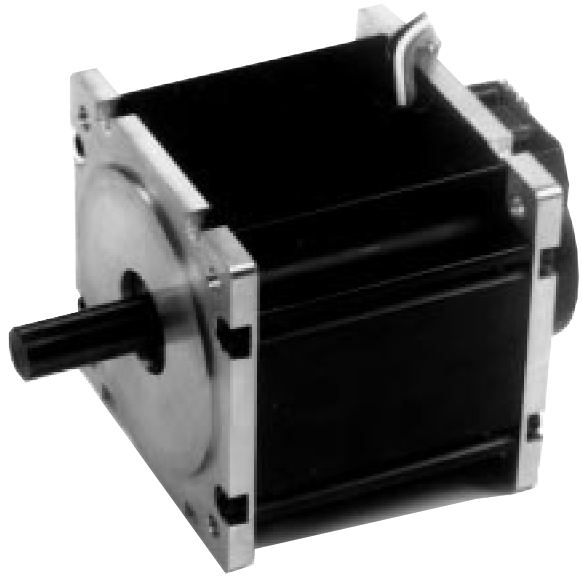
# QB Series

## 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***

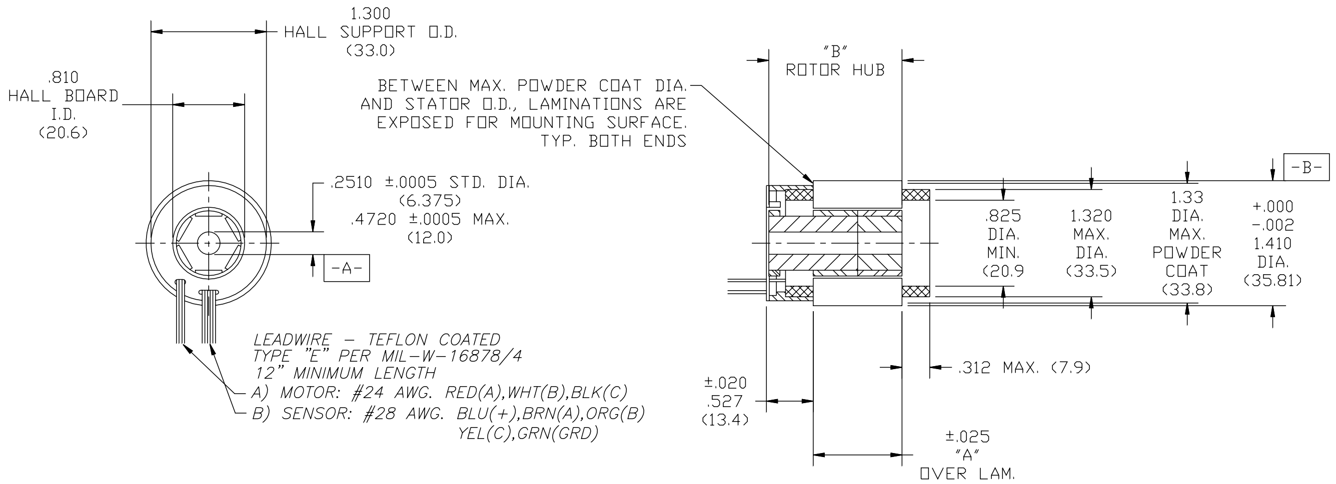
### Quantum Series Features

- 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

# Quantum Series

## Size 17

### Frameless Motor

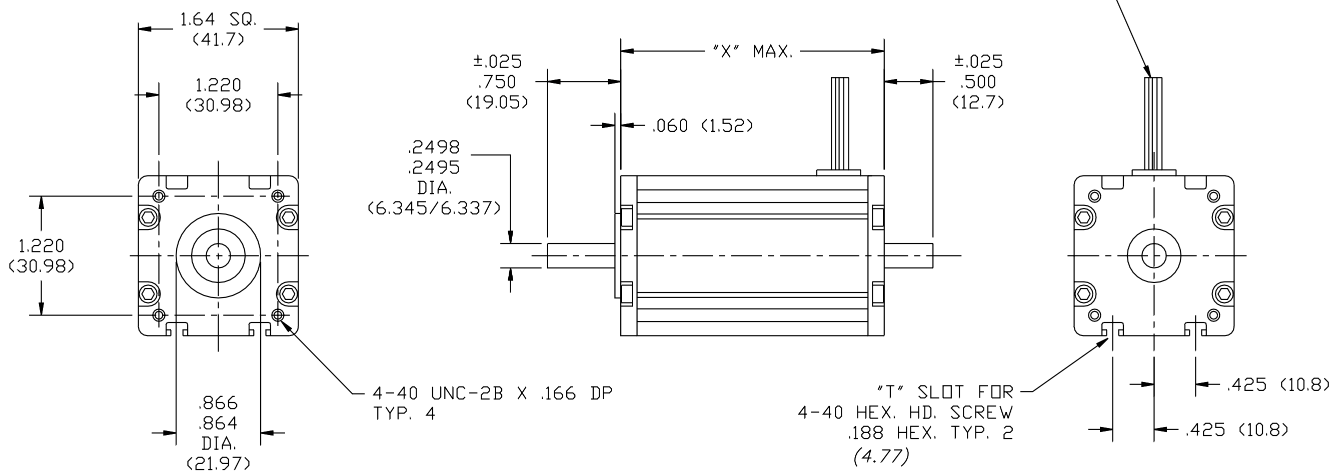



1. MOTOR SUPPLIED AS TWO SEPARATE COMPONENTS, ROTOR ASSEMBLY AND STATOR ASSEMBLY.
2. DIAMETERS "A" AND "B" TO BE CONCENTRIC WITHIN .002 WHEN MOUNTED.
3. STD. HUB LENGTH IS 1.000" LG. .500" HUBS ARE PROVIDED FOR CUSTOMER STACKING BEYOND 1.000".

| 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

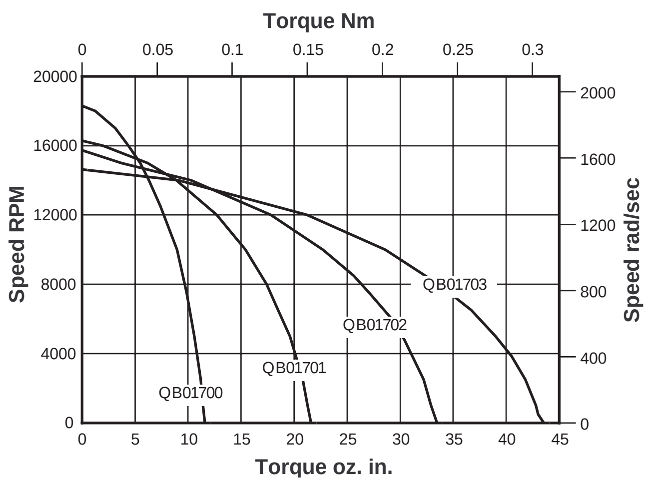
## Size 17

## Electrical and Mechanical Data

| Size Constants | Symbol | Unit | QB01700 | QB01701 | QB01702 | QB01703 |
|---|---|---|---|---|---|---|
| **Max Cont. Stall Torque** | $T_C$ | Nm | 0.08 | 0.15 | 0.23 | 0.30 |
| **Max Rated Torque, 25%** | $T_R$ | Nm | 0.65 | 1.19 | 1.87 | 2.41 |
| **Motor Constant,** | $K_M$ | 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** | $F_i$ | Nm/rpm | 5.3E-7 | 1.1E-6 | 1.6E-6 | 2.2E-6 |
| **Max Cogging Torque** | $T_F$ | Nm | 7E-3 | 1.1E-2 | 1.3E-2 | 1.6E-2 |
| **Mechanical Constants** | | | | | | |
| **Frameless Motor Inertia** | $J_M$ | Kg.m² | 1.0E-7 | 2.0E-6 | 3.1E-6 | 4.1E-6 |
| **Frameless Motor Weight** | Wt | Kg | 0.07 | 0.14 | 0.21 | 0.27 |
| **Housed Motor Inertia** | $J_M$ | Kg.m² | 1.1E-6 | 2.1E-6 | 3.1E-6 | 4.2E-6 |
| **Housed Motor Weight** | Wt | Kg | 0.22 | 0.34 | 0.47 | 0.58 |
| **Number of Poles** | - | - | 6 | 6 | 6 | 6 |

| Winding Constants | Symbol | Unit | QB01700 A | QB01700 B | QB01700 C | QB01701 A | QB01701 B | QB01701 C | QB01702 A | QB01702 B | QB01702 C | QB01703 A | QB01703 B | QB01703 C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Design Voltage** | $V_P$ | Volts | 24 | 40 | 130 | 24 | 40 | 130 | 24 | 40 | 130 | 24 | 40 | 130 |
| **Peak Torque** | $T_P$ | 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%** | $K_T$ | 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 |

## Speed/Torque Curves



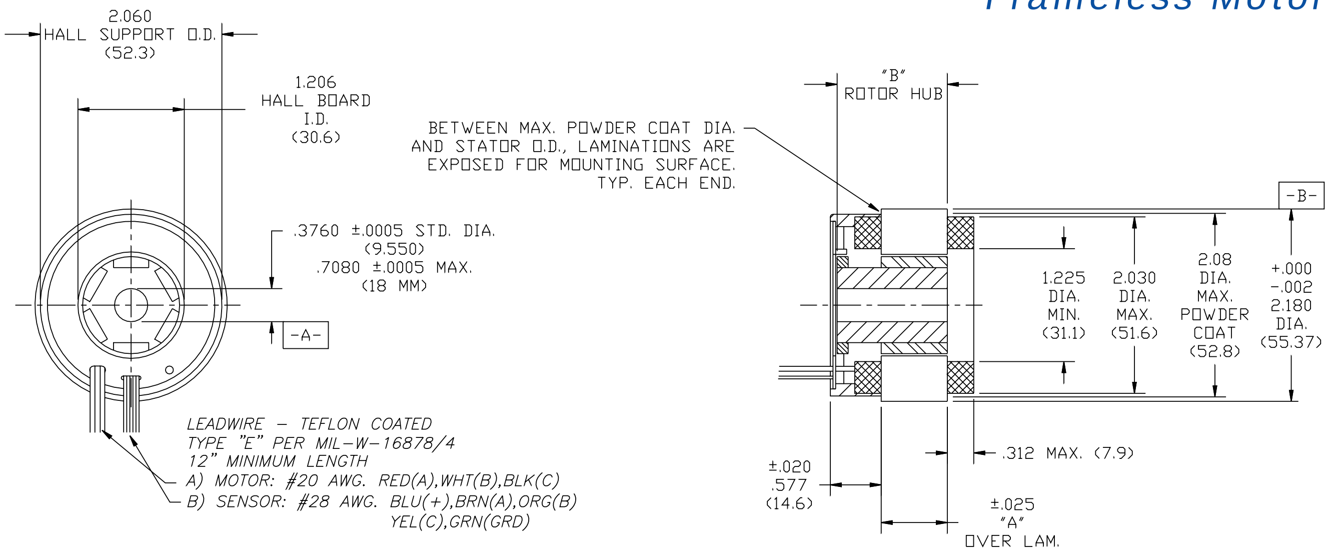

### *Continuous Duty Speed/Torque Curves for 100°C Temperature rise.*

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

# Quantum Series

## Size 23

### Frameless Motor

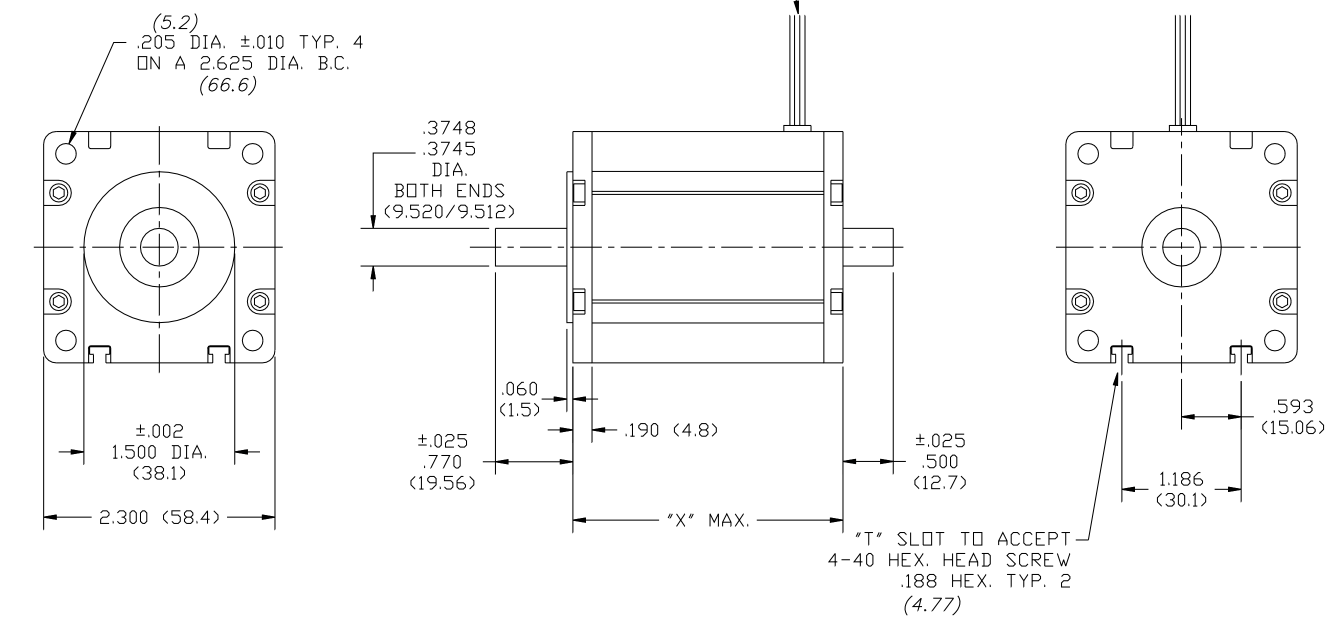



1. MOTOR SUPPLIED AS TWO SEPARATE COMPONENTS, ROTOR ASSEMBLY AND STATOR ASSEMBLY.
2. DIAMETERS "A" AND "B" TO BE CONCENTRIC WITHIN .002 WHEN MOUNTED
3. STD. HUB LENGTH IS 1.250" LG. .750" HUBS ARE PROVIDED FOR CUSTOMER STACKING BEYOND 1.250".

| 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

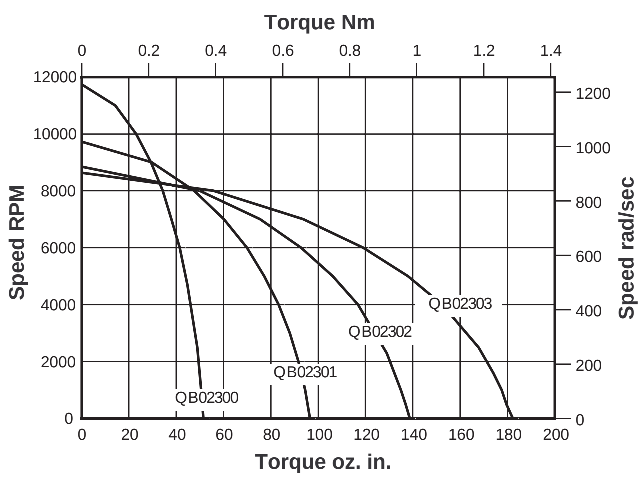
## Size 23

## Electrical and Mechanical Data

| Size Constants | Symbol | Unit | QB02300 | QB02301 | QB02302 | QB02303 |
|---|---|---|---|---|---|---|
| **Max Cont. Stall Torque** | $T_C$ | Nm | 0.36 | 0.68 | 0.98 | 1.28 |
| **Max Rated Torque, 25%** | $T_R$ | Nm | 3.94 | 7.9 | 11.8 | 15.6 |
| **Motor Constant,** | $K_M$ | 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** | $F_i$ | Nm/rpm | 2.5E-6 | 5.3E-6 | 7.9E-6 | 1.1E-5 |
| **Max Cogging Torque** | $T_F$ | Nm | 0.018 | 0.029 | 0.036 | 0.044 |
| **Mechanical Constants** | | | | | | |
| **Frameless Motor Inertia** | $J_M$ | Kg.m² | 7.6E-6 | 1.5E-5 | 2.3E-5 | 3.0E-5 |
| **Frameless Motor Weight** | Wt | Kg | 0.25 | 0.48 | 0.71 | 0.95 |
| **Housed Motor Inertia** | $J_M$ | Kg.m² | 7.9E-6 | 1.5E-5 | 2.3E-5 | 3.0E-5 |
| **Housed Motor Weight** | Wt | 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** | $T_P$ | 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%** | $K_T$ | 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 |

## Speed/Torque Curves



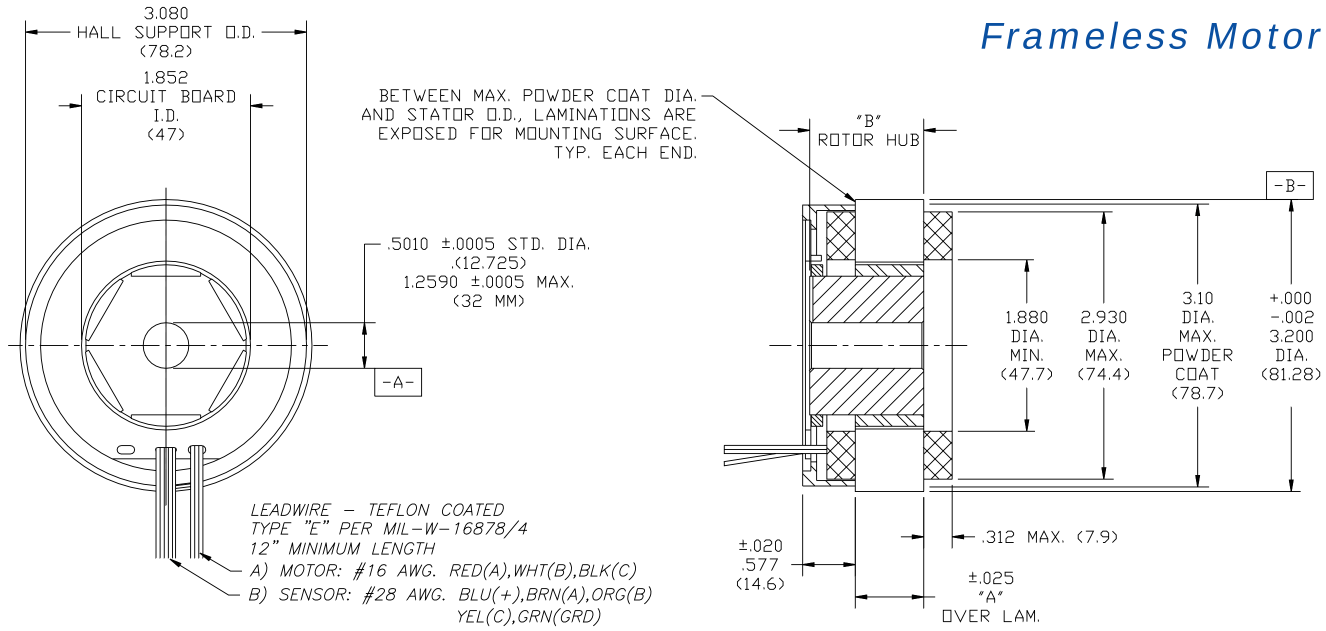

### Continuous Duty Speed/Torque Curves for 100°C Temperature rise.

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

# Quantum Series

## Size 34

## Frameless Motor

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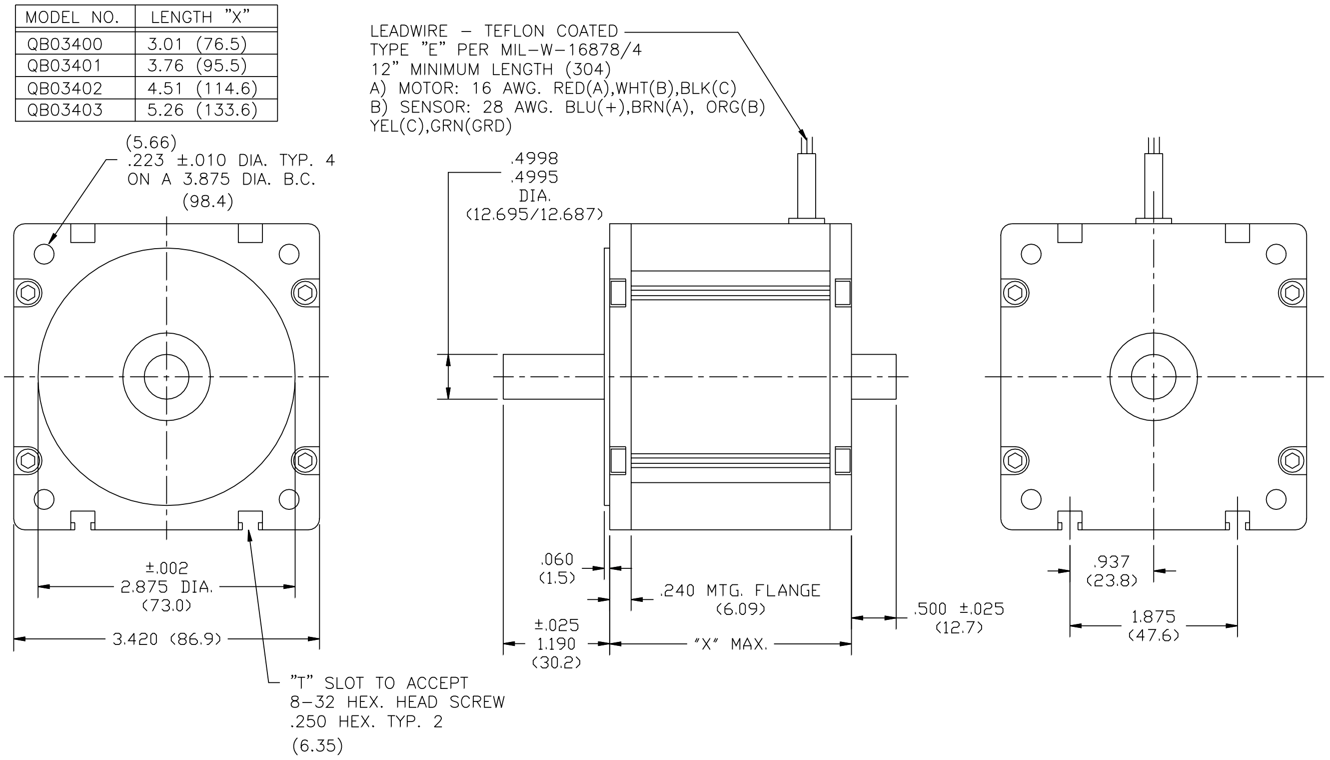
2. DIAMETERS "A" AND "B" TO BE CONCENTRIC WITHIN .002 WHEN MOUNTED.
3. STD. HUB LENGTH IS 1.250" LG. .750" HUBS ARE PROVIDED FOR CUSTOMER STACKING BEYOND 1.250"

| MODEL NO. | "A" STATOR | "B" ROTOR |
|---|---|---|
| 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

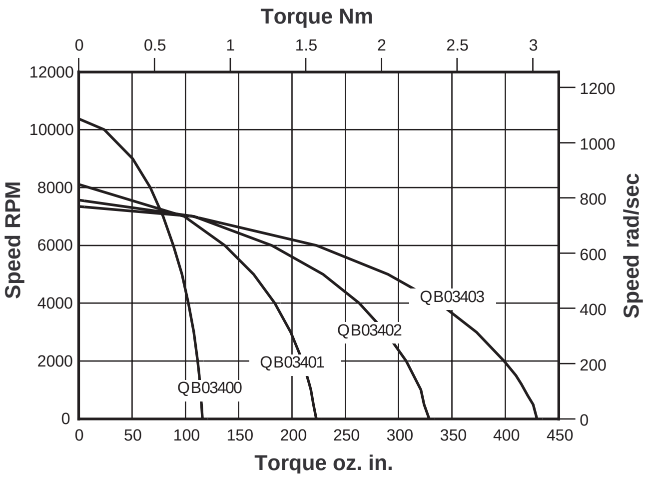
## Size 34

## Electrical and Mechanical Data

| Size Constants | Symbol | Unit | QB03400 | QB03401 | QB03402 | QB03403 |
|---|---|---|---|---|---|---|
| **Max Cont. Stall Torque** | $T_C$ | Nm | 0.81 | 1.57 | 2.32 | 3.03 |
| **Max Rated Torque, 25%** | $T_R$ | Nm | 5.38 | 10.8 | 16.2 | 20.9 |
| **Motor Constant,** | $K_M$ | 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** | $F_i$ | Nm/rpm | 5.1E-6 | 1.0E-5 | 1.6E-5 | 2.2E-5 |
| **Max Cogging Torque** | $T_F$ | Nm | 0.025 | 0.035 | 0.046 | 0.056 |
| **Mechanical Constants** | | | | | | |
| **Frameless Motor Inertia** | $J_M$ | Kg.m² | 5.2E-5 | 1.0E-4 | 1.5E-4 | 2.1E-4 |
| **Frameless Motor Weight** | Wt | Kg | 0.60 | 1.17 | 1.73 | 2.29 |
| **Housed Motor Inertia** | $J_M$ | Kg.m² | 5.3E-5 | 1.0E-4 | 1.5E-4 | 2.1E-4 |
| **Housed Motor Weight** | Wt | Kg | 1.55 | 2.24 | 2.92 | 3.6 |
| **Number of Poles** | - | - | 6 | 6 | 6 | 6 |

| Winding Constants | Symbol | Unit | QB03400 A | QB03400 B | QB03400 C | QB03401 A | QB03401 B | QB03401 C | QB03402 A | QB03402 B | QB03402 C | QB03403 A | QB03403 B | QB03403 C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Design Voltage** | $V_P$ | Volts | 24 | 40 | 130 | 24 | 40 | 130 | 24 | 40 | 130 | 24 | 40 | 130 |
| **Peak Torque** | $T_P$ | 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%** | $K_T$ | 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 |

## Speed/Torque Curves



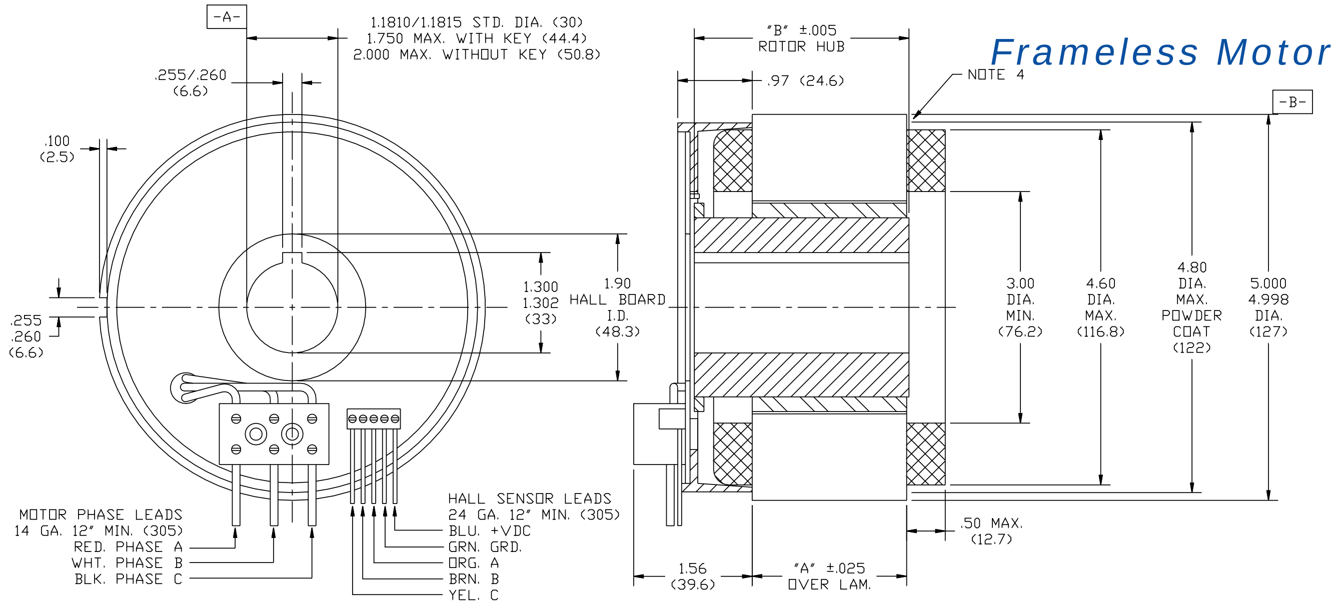

### Continuous Duty Speed/Torque Curves for 100°C Temperature rise.

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

# Quantum Series

## Size 56

### 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. STANDARD HUB LENGTH IS 1.78" LONG, MULTIPLE HUBS IN 1.00" INCREMENTS ARE PROVIDED FOR CUSTOMER STACKING BEYOND 1.78".
4. BETWEEN STATOR O.D. AND POWDER COAT, LAMINATIONS ARE EXPOSED FOR MOUNTING SURFACE, BOTH ENDS.
5. LEAD CONNECTION TO TERMINAL BLOCKS OPTIONAL.

| MODEL | "A" STATOR | "B" ROTOR |
|---|---|---|
| 5600 | 1.0 (25.4) | 1.78 (45.2) |
| 5601 | 2.0 (50.8) | 2.78 (70.6) |
| 5602 | 3.0 (76.2) | 3.78 (96) |
| 5603 | 4.0 (101.6) | 4.78 (121.4) |
| 5604 | 5.0 (127) | 5.78 (146.8) |
| 5605 | 6.0 (152.4) | 6.78 (172.2) |

### Housed Motor

Final definition of the housed versions of the QB05600 Series motors had not been completed at the time of printing.
Please contact our sales group for the latest information.

# MACCON
MOTION UNDER CONTROL

# Quantum Series

## Size 56

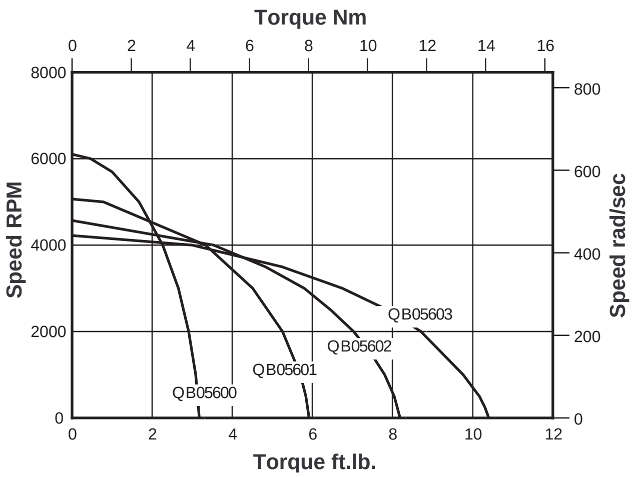
## Electrical and Mechanical Data

| Size Constants | Symbol | Unit | QB05600 | QB05601 | QB05602 | QB05603 |
|---|---|---|---|---|---|---|
| **Max Cont. Stall Torque** | $T_C$ | Nm | 4.29 | 8.03 | 11.10 | 14.10 |
| **Max Rated Torque, 25%** | $T_R$ | Nm | 30.3 | 57.2 | 85.1 | 113.5 |
| **Motor Constant,** | $K_M$ | 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** | $F_i$ | Nm/rpm | 2.3E-5 | 4.9E-5 | 7.5E-5 | 1.0E-4 |
| **Max Cogging Torque** | $T_F$ | Nm | 0.078 | 0.134 | 0.191 | 0.247 |

| Mechanical Constants | | | QB05600 | QB05601 | QB05602 | QB05603 |
|---|---|---|---|---|---|---|
| **Frameless Motor Inertia** | $J_M$ | $Kg.m^2$ | 3.6E-4 | 7.3E-4 | 1.1E-3 | 1.5E-3 |
| **Frameless Motor Weight** | Wt | Kg | 1.72 | 3.99 | 5.84 | 7.76 |
| **Housed Motor Inertia** | $J_M$ | $Kg.m^2$ | 6.3E-4 | 1.1E-3 | 1.6E-3 | 2.1E-3 |
| **Housed Motor Weight** | Wt | Kg | 4.80 | 7.84 | 10.4 | 13.0 |
| **Number of Poles** | - | - | 8 | 8 | 8 | 8 |

| Winding Constants | | | QB05600 A | QB05600 B | QB05600 C | QB05601 A | QB05601 B | QB05601 C | QB05602 A | QB05602 B | QB05602 C | QB05603 A | QB05603 B | QB05603 C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Design Voltage** | $V_P$ | Volts | 40 | 130 | 300 | 40 | 130 | 300 | 40 | 130 | 300 | 40 | 130 | 300 |
| **Peak Torque** | $T_P$ | 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%** | $K_T$ | 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 |

## Speed/Torque Curves



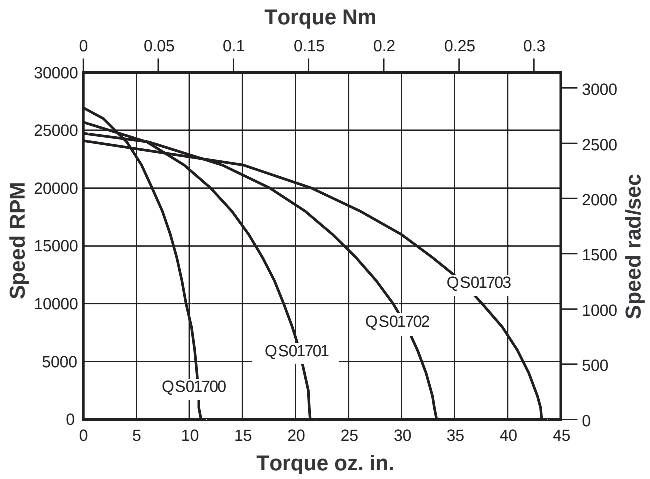

### Continuous Duty Speed/Torque Curves for 100°C Temperature rise.

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

# QB Series

## QS High Efficiency

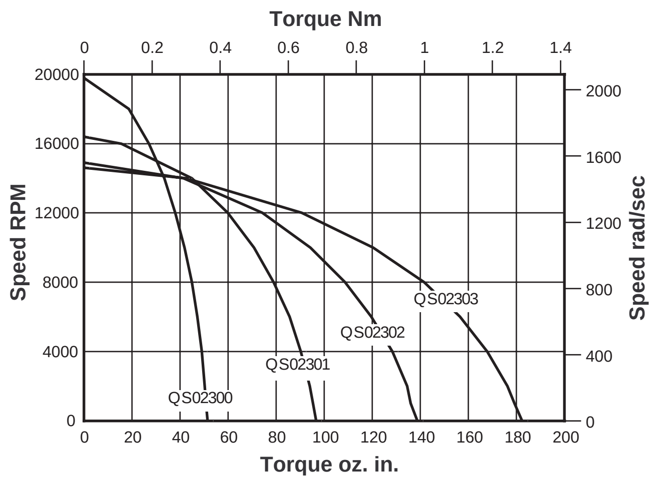
## QS01700



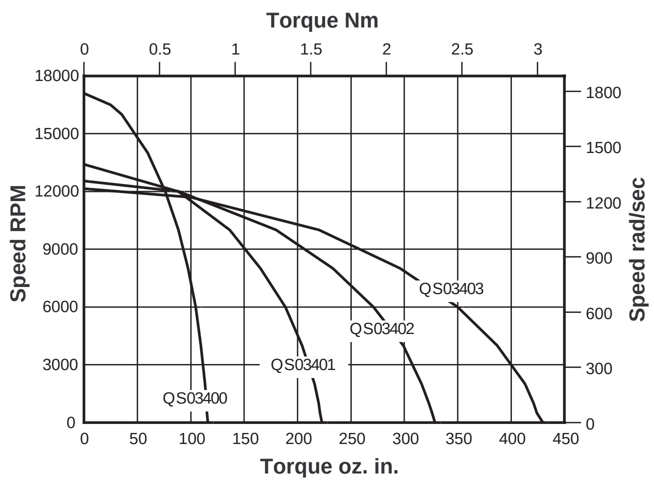

### QS High Efficiency Motors

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

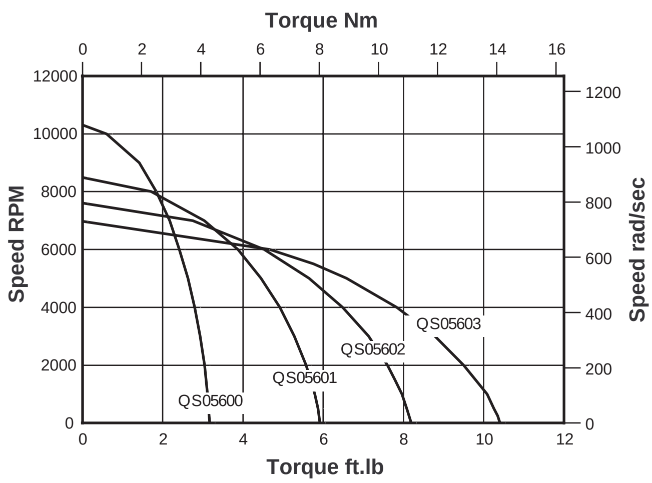
## QS02300




## QS03400




## QS05600

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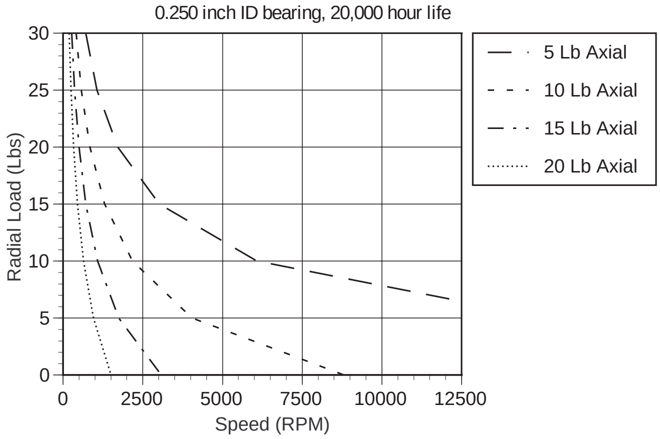
MOTION UNDER CONTROL

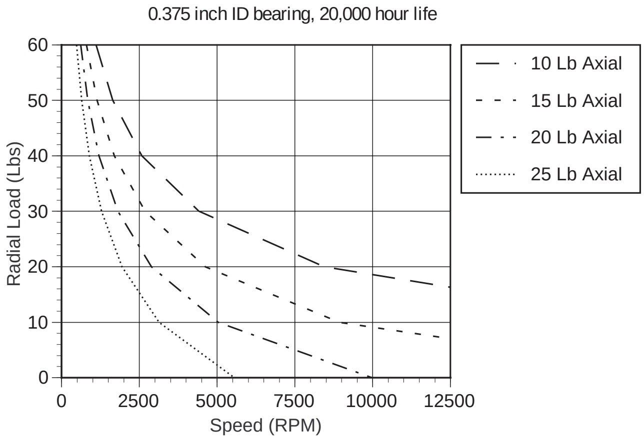
# QB Series
## Bearing Life Curves

### QB/QS01700



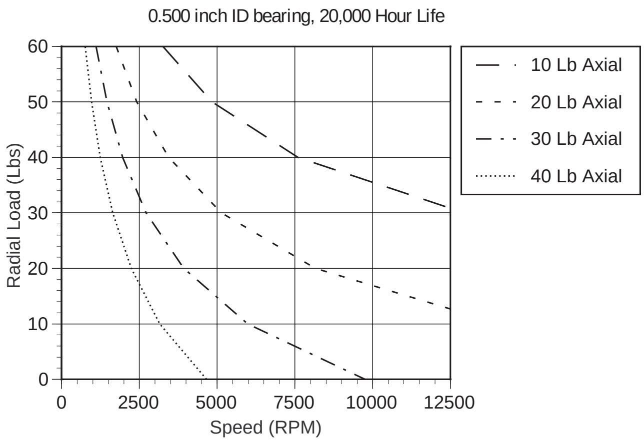

Calculations for life rating of 20,000 hours is based upon combined radial and axial loads.
Radial load applied 0.50 inches (12.7mm) from mounting face.
10 lb (44N) maximum axial preload.
8 mm ID bearing available.

### 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.

# QB Series

## Encoders

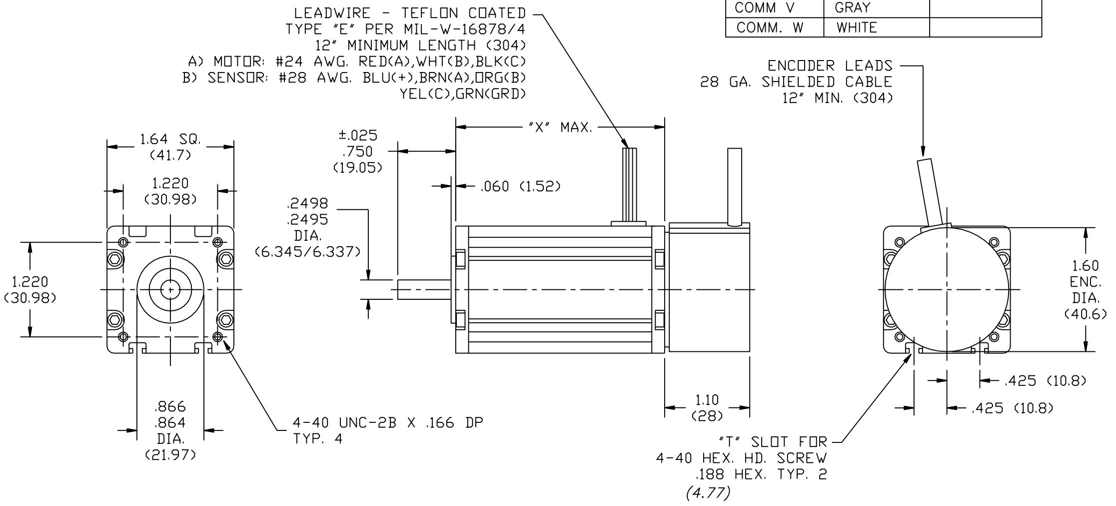
MOTION UNDER CONTROL

### QB/QS01700 Series

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

| 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 | |

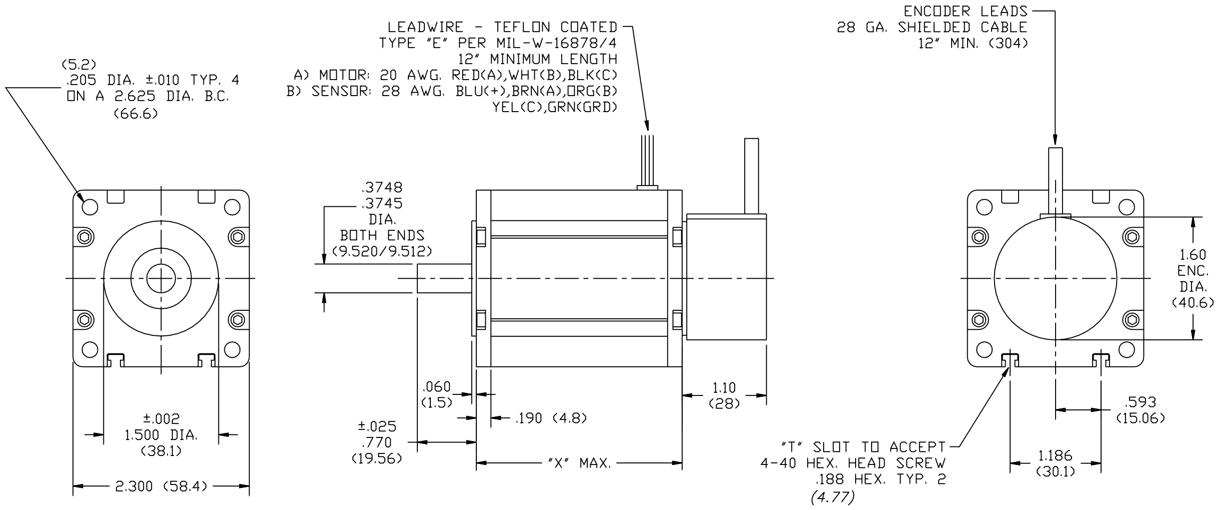



### QB/QS02300 Series

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

| 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 | |



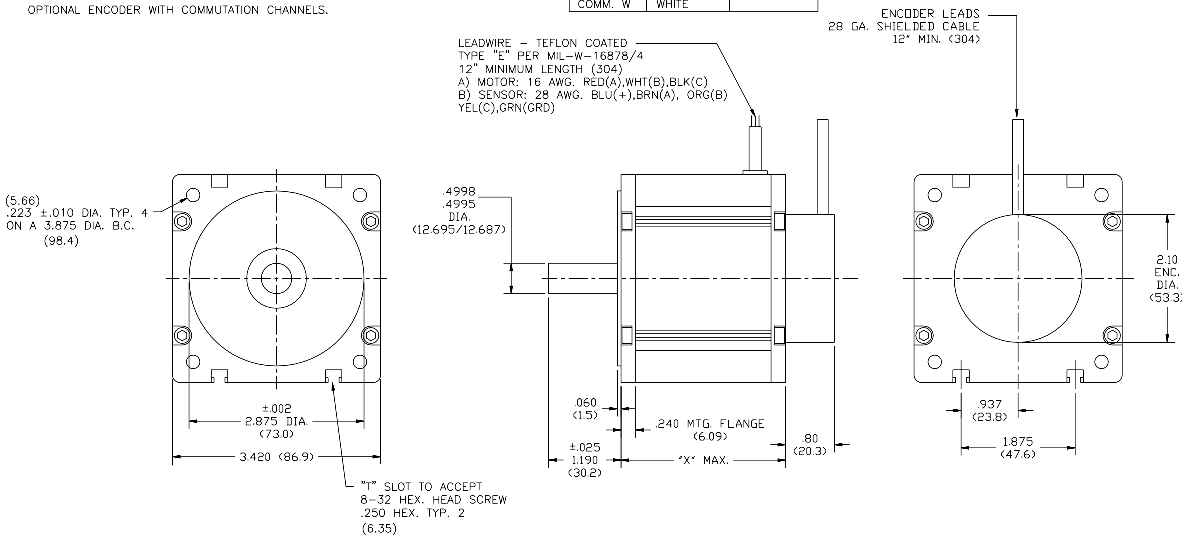
# QB Series
## Encoders

### 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 | |

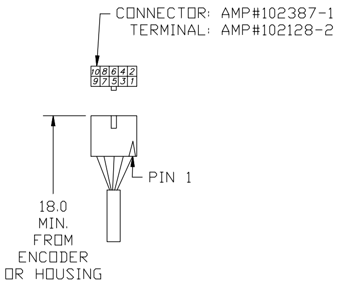
1. ENCODER WITH INDEX AND LINE DRIVER.
   500, 1000, 1024, 2000 AND 2048 LINE COUNT AVAILABLE.
   OPTIONAL ENCODER WITH COMMUTATION CHANNELS.

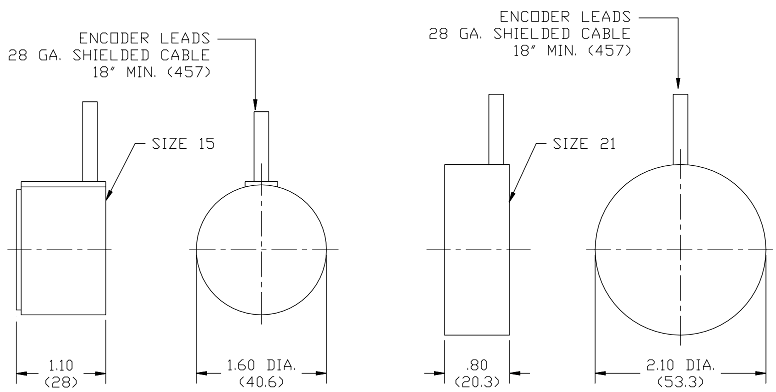



### Encoder Connections

| 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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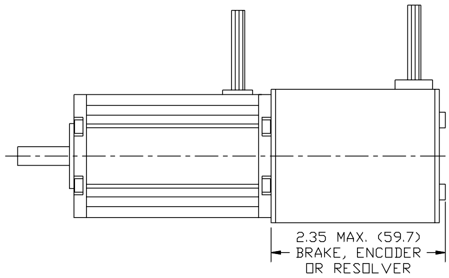
# QB Series

## 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) |

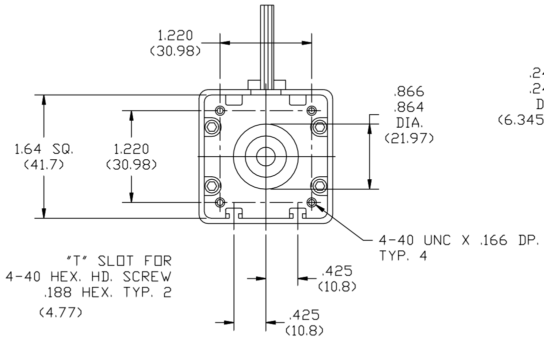
| ENCODER LEAD | | |
|---|---|---|
| FUNCTION | WITH COMMUTATION | LINE DRIVER ONLY |
| +5V | RED | RED |
| GROUND | BLACK | BLACK |
| CH. A | BLUE | GREEN |
| CH. B | GREEN | ORANGE |
| CH. A INV. | BLU/BLK | RED/BLK |
| CH. B INV. | GRN/BLK | WHT/BLK |
| INDEX | VIOLET | WHITE |
| INDEX INV. | VIO/BLK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

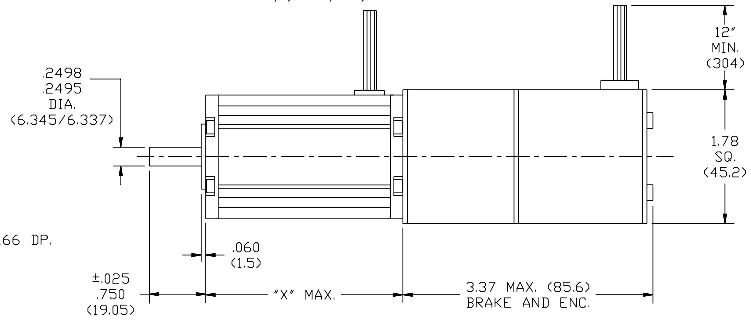



1. ENCODER WITH INDEX AND LINE DRIVER.
   200, 400, 500, 1000, 1024 LINE COUNT AVAILABLE.
   OPTIONAL ENCODER WITH COMMUTATION CHANNELS.
2. BRAKE: POWER-OFF FAILSAFE BRAKE, 24 VDC.
   1 IN-LB MIN. HOLDING TORQUE.
3. CONSULT FACTORY FOR RESOLVER SPECIFICATIONS.

*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*

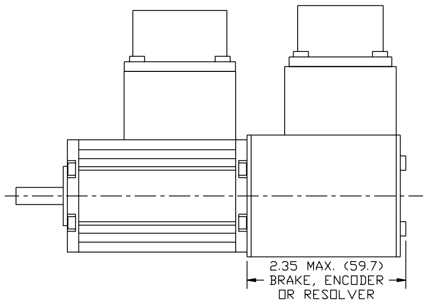


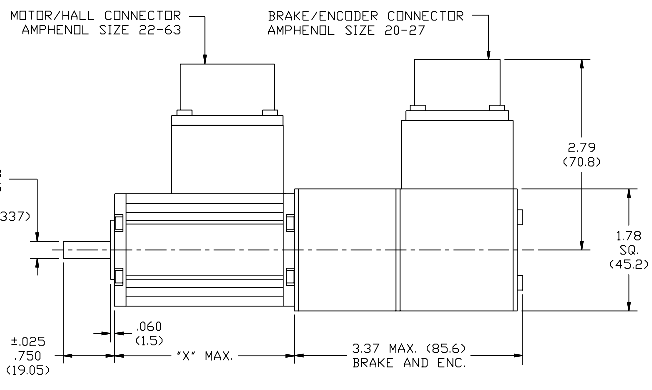

### QB/QS01700 Series

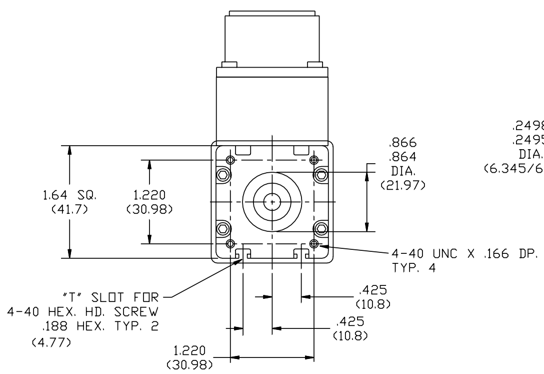
| MODEL NO. | "X" |
|---|---|
| QB01700 | 2.125 (54) |
| QB01701 | 2.625 (66.7) |
| QB01702 | 3.125 (79.4) |
| QB01703 | 3.625 (92.1) |

| 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 |




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.



MACCON
MOTION UNDER CONTROL

# QB Series

## Rugged Housings

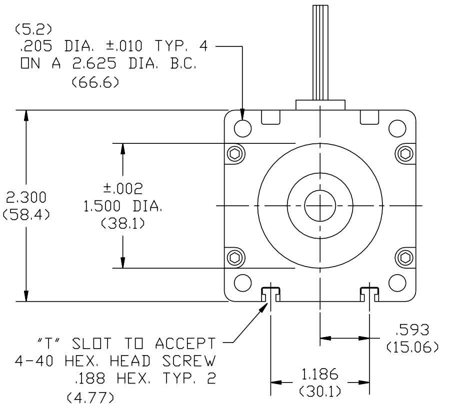
### QB/QS02300 Series

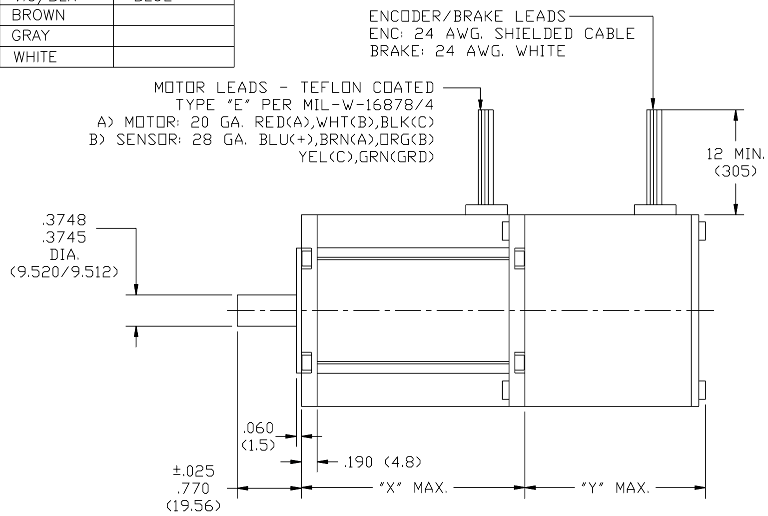
| MODEL NO. | "X" |
|---|---|
| QB02300 | 2.800 (71.12) |
| QB02301 | 3.550 (90.17) |
| QB02302 | 4.300 (109.22) |
| QB02303 | 5.050 (128.27) |
| QB02304 | 5.800 (147.3) |

| 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.



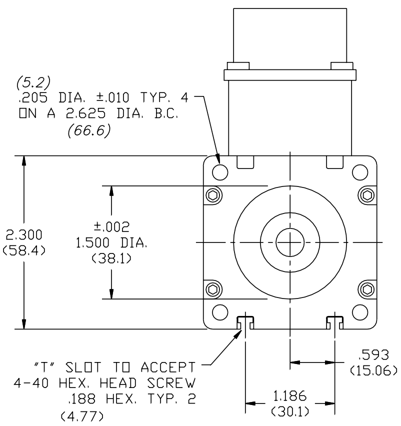

### QB/QS02300 Series

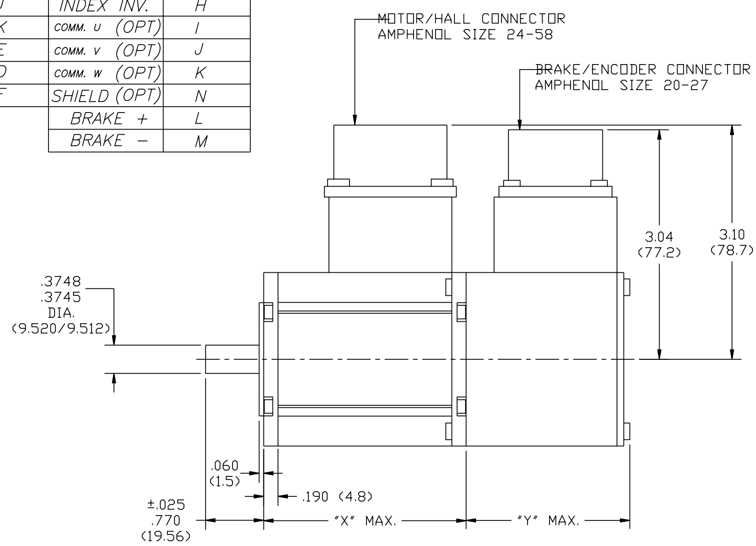
| MODEL NO. | "X" |
|---|---|
| QB02300 | 2.800 (71.12) |
| QB02301 | 3.550 (90.17) |
| QB02302 | 4.300 (109.22) |
| QB02303 | 5.050 (128.27) |
| QB02304 | 5.800 (147.3) |

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

| 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 |

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.



# QB Series

## Rugged Housings

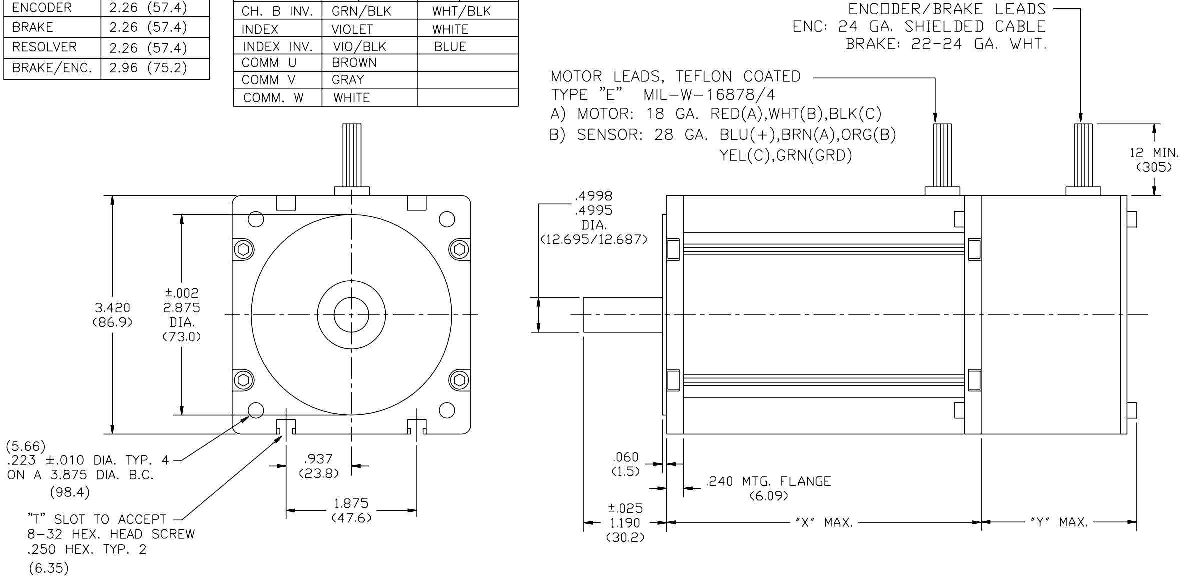
### QB/QS03400 Series

| 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.



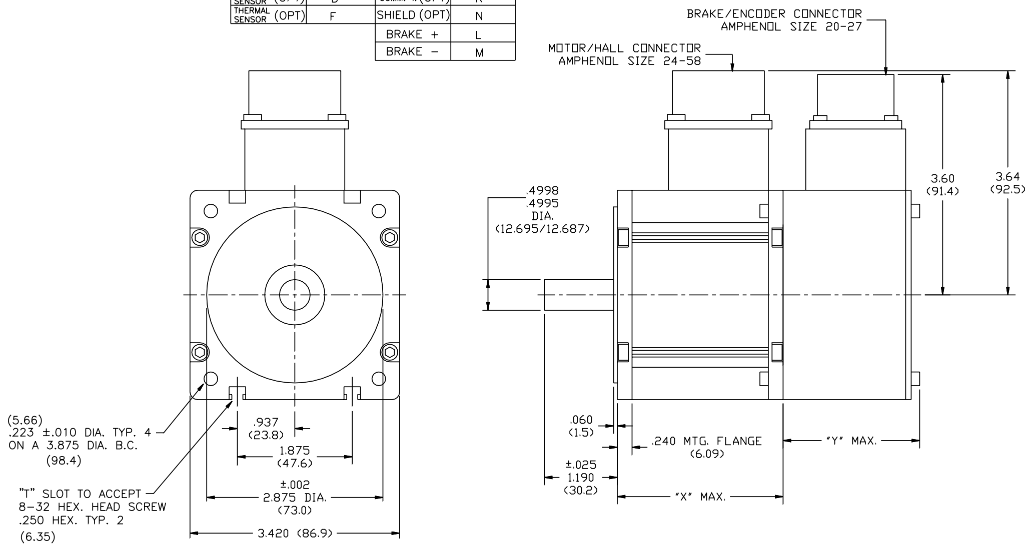

### QB/QS03400 Series

| 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 |

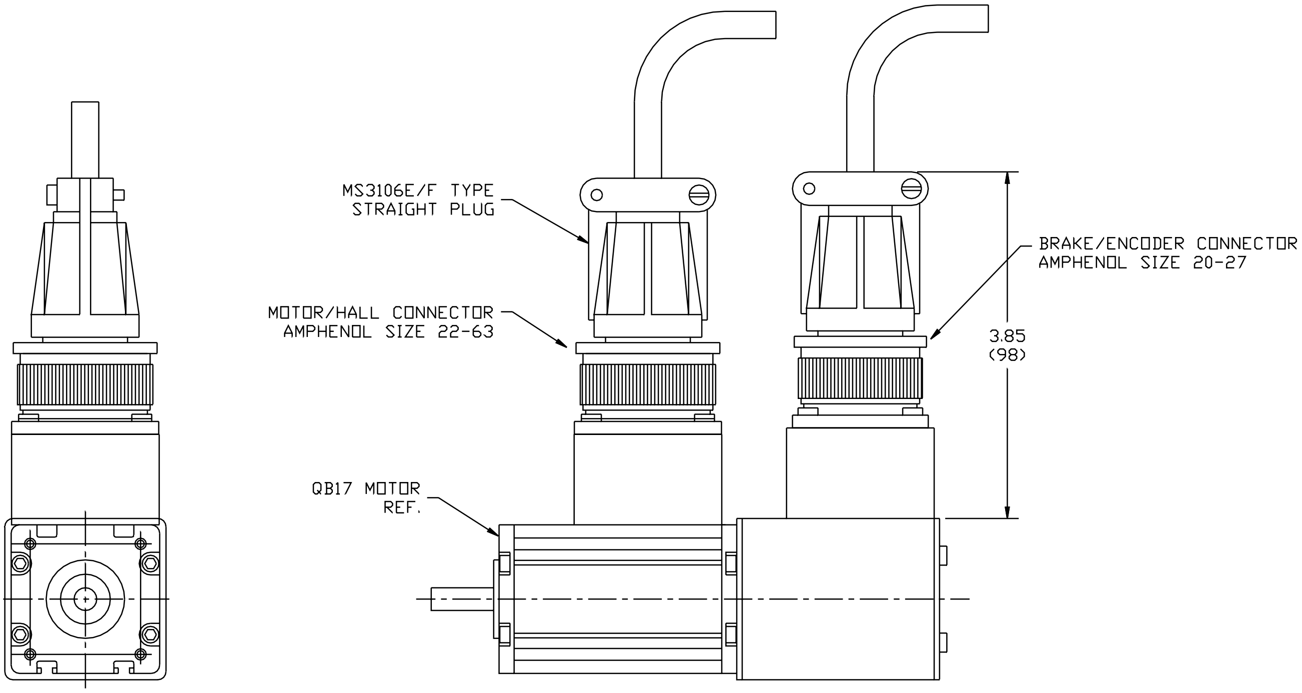
1. ENCODER, WITH INDEX AND LINE DRIVER.
   200, 400, 500, 1000 AND 1024 LINE COUNT AVAILABLE.
   OPTIONAL ENCODER WITH COMMUTATION CHANNELS.
2. BRAKE: POWER-OFF FAILSAFE BRAKE, 24 VDC.
   5 IN-LB, 10 IN-LB AND 40 IN-LB HOLDING TORQUE AVAILABLE.
3. CONSULT FACTORY FOR RESOLVER SPECIFICATIONS.



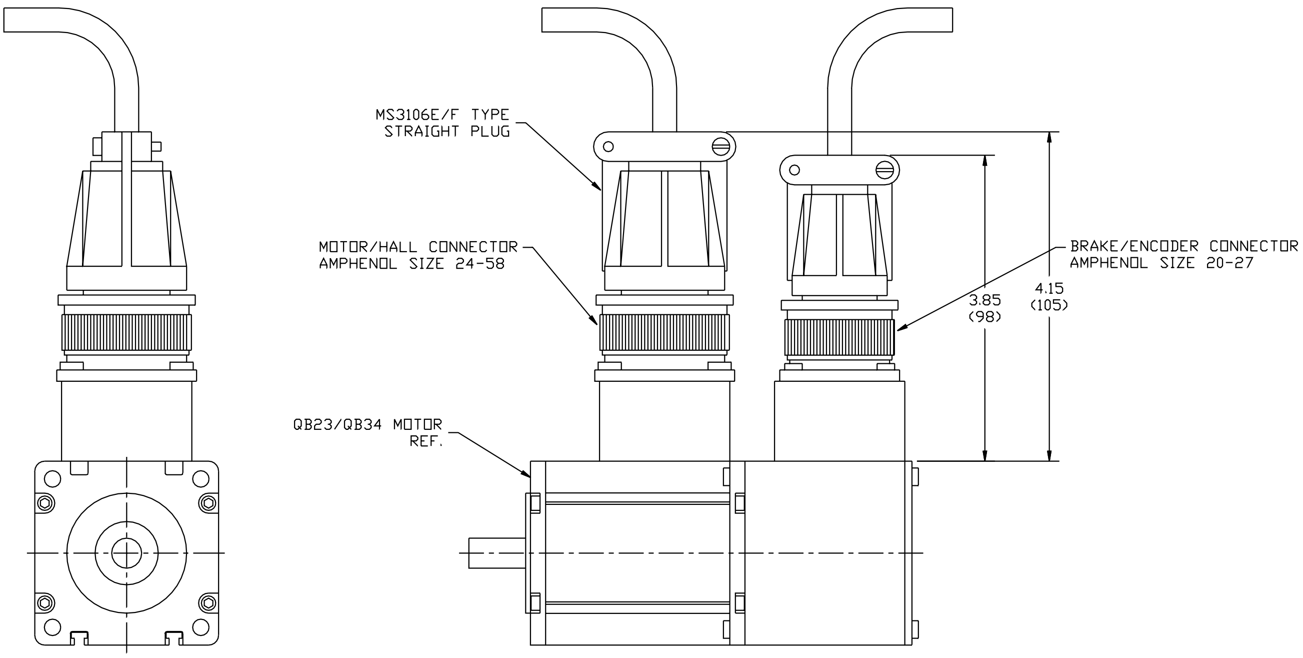
# QB Series

## Mating Connectors

### QB/QS01700 Series




### QB/QS02300/3400 Series

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# QB Series

## Brakes & Resolvers

### Holding Brake Options

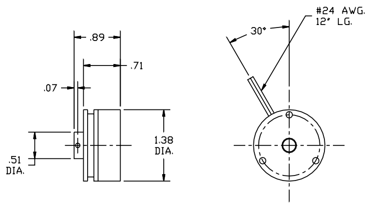



FIG. 1

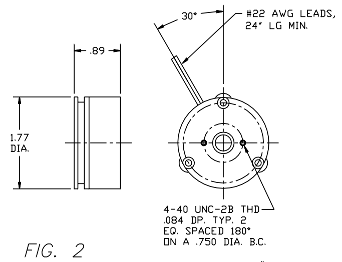



FIG. 2

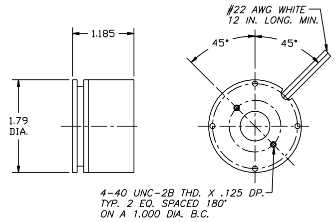



FIG. 3

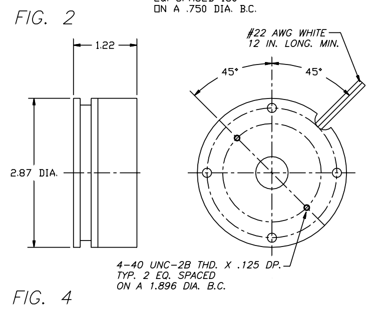
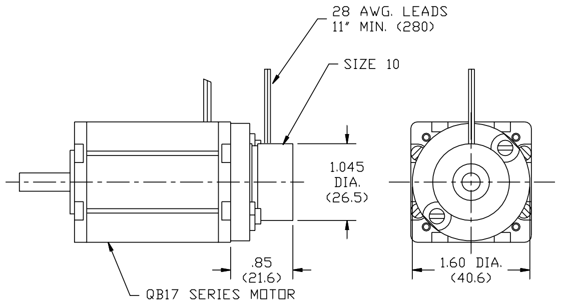


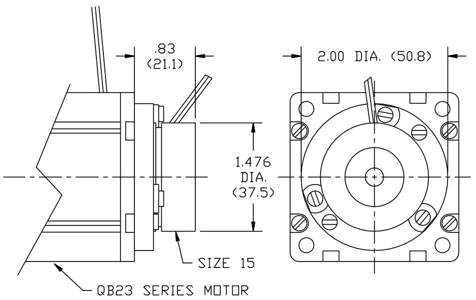

FIG. 4

| 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 |

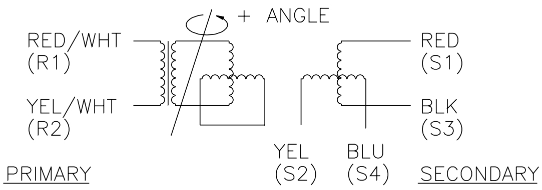
1. ENCODERS CAN BE MOUNTED TO EACH BRAKE EXCEPT 9760196. SEPERATE ENCODER MOUNTING PLATE REQUIRED ON BRAKES 9760184, 185

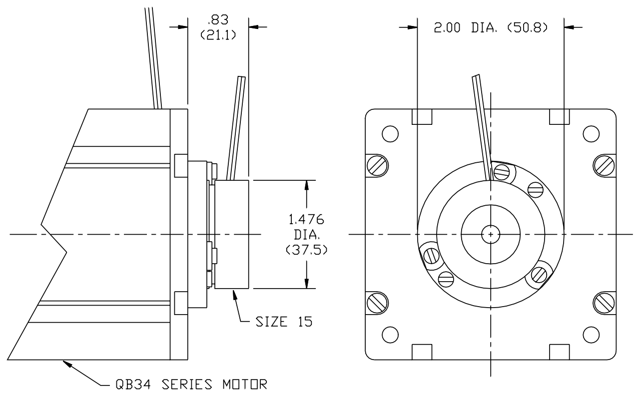
### Resolver Options




| 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 |



Page reserved for future use.

## 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 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

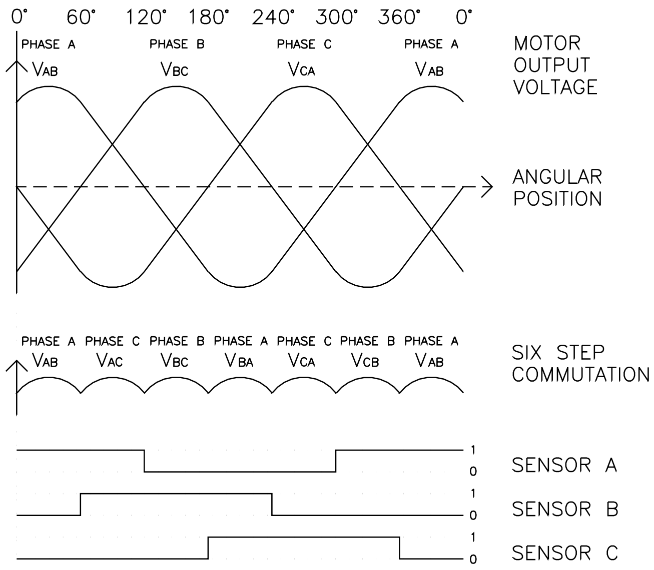
The drawings reflect the standard configurations for both the housed and frameless motors. Encoder and housing options are also detailed but customers may specify mechanical modifications such as shaft diameters and lengths as well as special mounting and cabling requirements.

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.

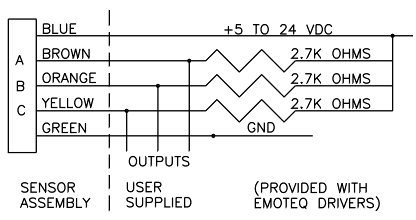
## Motor Connections and Commutation Logic

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



# Quantum Series

## Brushless DC Motors

MOTION UNDER CONTROL

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