

# TORQUEMASTER

## BRUSHLESS SERVO MOTORS

### **4400 SERIES**

#### **Performance Benefits**

MTI Torque Systems specializes in the design of high performance brushless servo motors that provide efficiency, flexibility of application, and a long and trouble-free service life. Our TORQUEMASTER® 4400 series is no exception.

With fast response, accurate control and high torque-to-inertia ratios, you can count on the TORQUEMASTER 4400 Series of brushless servo motors to provide smooth operation throughout a full speed range. The 4400 Series delivers smooth and superior low speed performance, and maximum power ratings with low thermal resistance for high speed performance. In addition, with maximum torque in a smaller package, you can count on better pricing for a better overall value.

When integrated with high performance brushless amplifiers, TORQUE-MASTER 4400 Series brushless servo motors provide effective and highly efficient motion control solutions for a wide range of applications—including factory automation, packaging, robotics, machine tools, medical instrumentation and more.

#### **Design Features**

TORQUEMASTER BMR 4400 Series servo motors are rated from 27 lb.-in. to 67 lb.-in. with speeds and torque stability up to 10,000 RPM—accommodating DC bus voltages up to 350 volts. They utilize the latest in high performance Neodymium, permanent magnet technology, and are available in several standard windings (as well as custom windings) to meet your most demanding applications.

Each servo motor in the TORQUE-MASTER 4400 Series is ruggedly designed and manufactured for reliable performance. To satisfy many different applications, TORQUEMASTER 4400 Series motors are manufactured to NEMA/IEC specifications. For severe duty environments, the BMR design is also available with IP65 sealing.

#### **Series 4400, 350 VDC brushless servo motor — provides fast response, accurate control and high torque-to-inertia ratios**

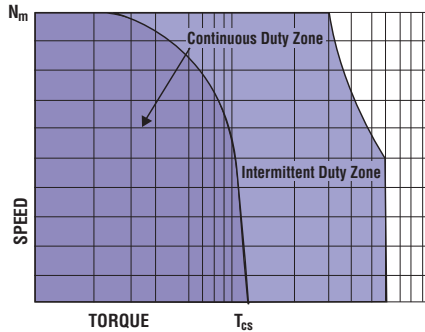
- Trouble free brushless construction
- Continuous torque ratings up to 67 lb.-in.—with speeds up to 10,000 RPM
- UL Recognition
- IP65 Sealing available
- NEMA mounting features available
- IEC 72 Metric specifications available
- Maximum torque per frame size with high performance Neodymium magnets
- Superior low speed performance
- Numerous custom options available



# BRUSHLESS SERVO MOTOR CHARACTERISTICS

SYMBOL	MOTOR PARAMETER	UNITS	BMR4427D	BMR4445D	BMR4467D
$N_m$	Max Operating Speed	RPM	7000	7000	6600
$T_C$	Max Stall Torque	lb.-in.(Nm)	27 (3.0)	45 (5.1)	67 (7.6)
$T_{Pk}$	Peak Torque	lb.-in.(Nm)	115 (13.0)	200 (22.6)	300 (33.9)
$K_T$	Torque Sensitivity	lb.-in./AMP(Nm/Amp)	4.2 (.47)	4.2 (.47)	4.2 (.47)
$K_e$	Back E.M.F.	Volts/Krpm	50	50	53
$R_a$	Resistance Line to Line	Ohms	2.56	0.92	0.53
$L$	Inductance Line to Line	Millihenry	9.36	5.73	3.34
$J_m$	Rotor Inertia	lb.-in.-sec <sup>2</sup> (Kg-m <sup>2</sup> )	0.0026 (0.00029)	0.0042 (0.00048)	0.0072 (0.00081)
$T_F$	Static Friction	lb.-in.(Nm)	.125 (.014)	.156 (.0176)	.28 (.0316)
$F_i$	Viscous Friction	Lb-In/Krpm	0.125	.188	.28
$R_{th}$	Thermal Resistance	Deg C/Watt	0.725	0.62	.567
$T_m$	Mechanical Time Const.	Millisec.	3.3	1.92	1.9
$T_e$	Electrical Time Const.	Millisec	4	5.7	6.3
$W_T$	Motor Weight	Lbs(Kg)	12 (5.4)	16 (7.24)	23 (10.41)

## TORQUE PERFORMANCE CURVES



NOTE: Continuous torque specifications obtained with motor mounted to an 8.5"x12"x 0.25" aluminum plate at 25°C ambient. Typical values are within ±10% of rating.

### Relationship Between $K_e$ & $K_T$

Torque Systems uses the following important motor performance parameters for the 3 phase square wave and 3 phase sine wave brushless motors in order to properly account for the British Imperial unit system currently used in the US.

$$K_e = \text{Line-to-line volts-peak} / \text{Krpm}^*$$

$$K_T = \text{Pound-inches (lb-in)} / \text{peak phase amps}$$

$K_e$  is related to  $K_T$  as follows:

$$K_T = K_e / 11.834 \text{ for 3 phase square wave current driven amplifiers}$$

$$K_T = K_e / 13.662 \text{ for 3 phase sinusoidal wave current driven amplifiers}$$

$$*\text{Krpm} = 1000 \text{ rpm}$$

For "RMS" values, divide peak values by  $\sqrt{2}$

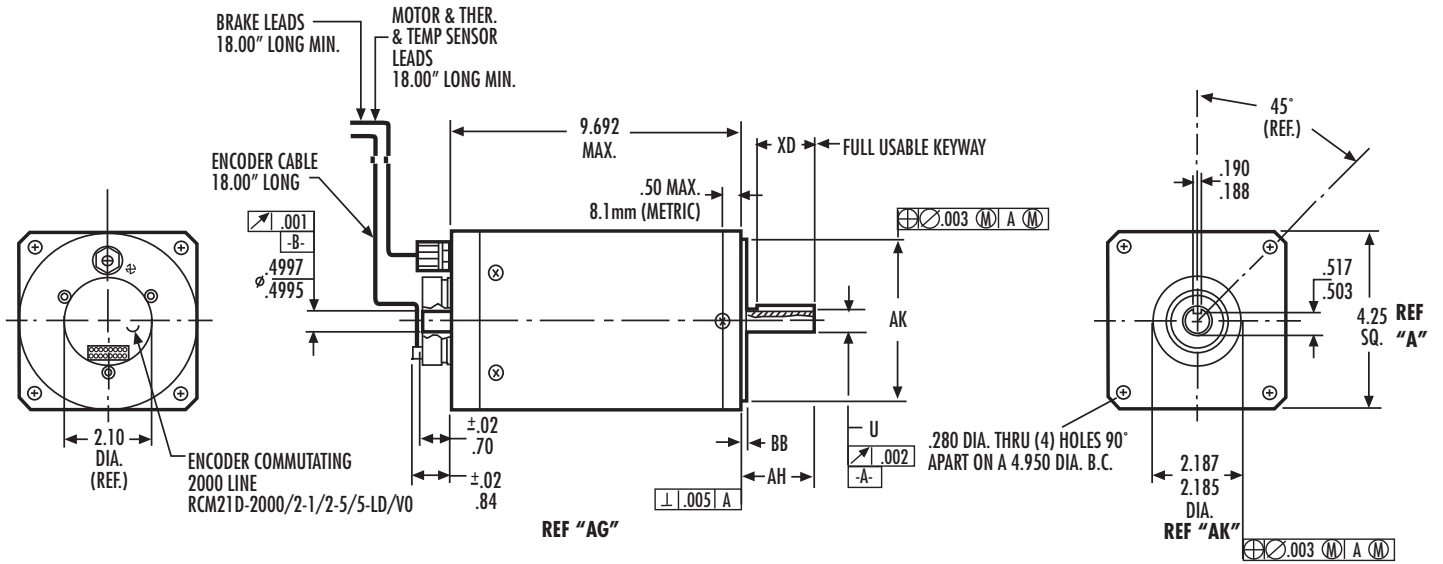
### STANDARD SPEED/TORQUE CURVE DATA FOR SIZING A SERVO MOTOR

$N_m$  = Maximum speed, continuous operation

$T_{cs}$  = Continuous stall torque

All specifications subject to change without notice.

# MECHANICAL SPECIFICATIONS\*



## DIMENSION CHART\*

PART NUMBER	AG	A		AK		BB	U	AH		XD	S	R
		STD	NEMA 42	STD	NEMA 42			STD	NEMA 42			
BMR4427	8.50	5.00	4.25	4.500	2.187	.15	.625	2.04	1.38	1.56	.188	.517/.502
BMR4445	9.75	5.00	4.25	4.500	2.187	.15	.625	2.04	1.38	1.56	.188	.517/.502
BMR4467	11.75	5.00	4.25	4.500	2.187	.15	.750	2.04	1.38	1.56	.188	.629/.644

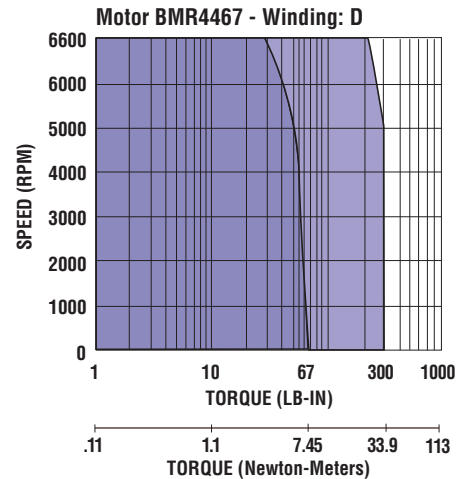
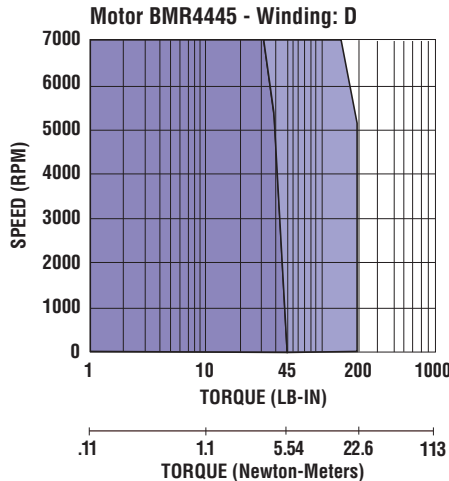
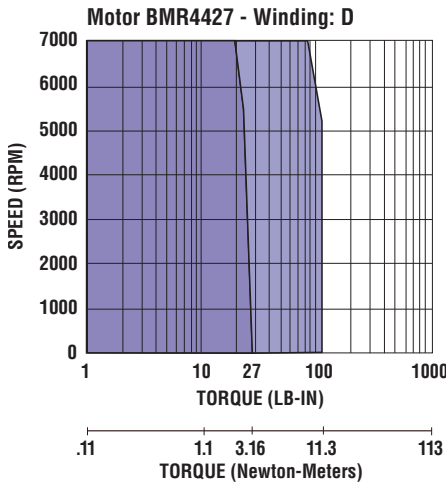
All dimensions meet NEMA 42 specifications except where indicated as standard.

Metric IEC 72 (mm)

BMR4427	215.9	127.0	95j6	3.5	16j6	50	36	6.0	13
BMR4445	247.7	127.0	95j6	3.5	16j6	50	36	6.0	13
BMR4467	298.4	127.0	95j6	3.5	19j6	50	36	6.0	16

NOTE: Dimension "AG" includes commutation feedback device and modular encoder shown on ordering information under COMMUTATION.  
For internal brake add 2.0" to dimension "AG"

## TORQUE PERFORMANCE CURVES



TORQUE SPEED CURVES OF OTHER WINDINGS AVAILABLE, CONSULT FACTORY.

## TERMINATION CHART

MOTOR/CABLE CODE	
Function	Wire Color
Motor M1	White
Motor M2	Black
Motor M3	Red
HALL CONNECTIONS	
+5-24V	Red
Common	Black
H1	Yellow
H2	Orange
H3	Green

**Note:** Separate drain wires for motor power and halls

## ENCODER WIRING CONNECTION CODE

Function	Wire Color
Encoder Output A	Green
Encoder Output $\bar{A}$	Brown
Encoder Output B	Orange
Encoder Output $\bar{B}$	Yellow
Encoder Output M	White
Encoder Output $\bar{M}$	Blue
Encoder +5 VDC	Red
Encoder Common	Black
Case Ground	Drain

### Note 1. Hall Sensor Specifications

Voltage = 5V to 24V  
 Current = 10 ma typical, 25 ma max.  
 Output = Open collector

### Note 2. Com. Encoder

Current = 250 ma

## BMR ORDERING INFORMATION – (For Standard Options)

BMR 4 027 A HA B A P A A 000

**FRAME SIZE**  
 4 = 4.21" Dia.

**STALL TORQUE**  
 427 = 27 lb-in  
 445 = 45 lb-in  
 467 = 67 lb-in

**WINDINGS**  
 A = 20 V/Krpm  
 D = 50 V/Krpm  
 E = 60 V/Krpm  
 G = 80 V/Krpm

**COMMUTATION/FEEDBACK (see note 3)**  
 HA = Hall Sensor only  
 RA = Resolver, 12 Arc Min  
 PA = Resolver, 7 Arc Min  
 SP = Special

Commutating Encoders	Line Count	Modular Encoders*
CC = 500		MC
CD = 1000		MD
CE = 1024		ME
CF = 2500		MF
SC = Special		MS

\*Modular Encoder selection includes Hall Sensor Commutation

**BRAKE (Internal) (see note 4)**  
 0 = None  
 B = 24 VDC Coil

**ENGINEERING MODIFICATIONS**

**SEALING**  
 0 = None  
 A = per IP65 w/o shaft seal  
 B = per IP65 w/shaft seal

**MOUNTING (see note 1)**  
 A = 5.00 Sq. Flange with .625" Dia. x 2.04" long shaft  
 D = NEMA 42 Flange with 0.625" Dia. x 1.38" long shaft  
 M = Metric IEC72 Flange w/12J6 Dia. shaft  
 S = Special Flange and shaft

**TERMINATIONS**  
 C = Connector, MS3102A-20-4P Motor MS3102A-22-14P Feedback  
 H = Heyco seal-tite w/1.5 ft shielded cable  
 P = Pipe Tap (NPT) w/1.5 ft shielded cable

**MATING CONNECTORS**  
 0 = None

### EXAMPLE:

BMR 4 427 A RA B 0 C A A 000

MODEL/FRAME ———— 4 ————

27 LB-IN STALL TORQUE ———— 427 ————

WINDING ———— A ————

COMMUTATION ———— RA ————

BRAKE ———— B ————

————— 0 ————

————— C ————

————— A ————

————— A ————

————— 000 ————

————— ENGINEERING MODIFICATIONS

————— SEALING

————— MOUNTING FEATURES

————— TERMINATIONS

————— MATING CONNECTORS

### Notes:

- Standard BMR4400 motor mounting flanges use NEMA 23 standards but allow oversized shaft diameters to carry the rated torque load. Standard NEMA shaft diameters are typically undersized for most servo ratings and are not recommended. Consult factory regarding acceptable load limits before ordering or applying this option.
- Standard encoders are dual channel line driver output with a marker pulse and complementary outputs.
- Brakes are for holding static loads and not designed to stop moving loads. Standard coils are 24 volts DC.

## CUSTOMIZE THE 4400 SERIES TO YOUR EXACT REQUIREMENTS

To satisfy various applications with cost-effective solutions, 4400 Series motors are readily available with a wide range of standard capabilities. Final designs are often the result of cooperative efforts between the customer's engineering department and MTI-Torque Systems. For assistance, call your local distributor or Torque Systems direct. We look forward to meeting your custom requirements.

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