TORQUEMASTER™

BRUSH SERVO MOTORS

3500 SERIES

Series 3500, is a high performance, permanent magnet brush servo motor for use in various industrial direct drive or geared servo systems

- Rugged industrial construction
- Continuous torque ratings up to 11 lb.-in. —with speeds up to 4600 RPM (no load)
- Peak torque ratings up to 94 lb.-in.
- IP65 Sealing available
- High torque-to-inertia ratio delivers maximum torque per frame size
- Superior low speed performance
- Numerous custom options available

Performance Benefits

Cleveland Motion Controls specializes in the design of high performance brush servo motors that provide efficiency, flexibility of application, and a long and trouble-free service life. Our TORQUEMASTER™ 3500 series is no exception.

With fast response, accurate control and high torque-to-inertia ratios, you can count on the TORQUEMASTER 3500 Series of brush servo motors to provide smooth operation throughout a full speed range. The 3500 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 brush amplifiers, TORQUEMASTER 3500 Series brush 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 3500 Series brush servo motors are rated from 4.3 lb.-in. to 11 lb.-in. with speeds and torque stability up to 4600 RPM. They utilize the latest in high performance permanent magnet technology, and are available in eight standard windings to meet your most demanding applications.

Each brush servo motor in the TORQUEMASTER 3500 Series is ruggedly designed and manufactured for reliable performance.

Motors can be customized to fit your exact application with tachometers, encoders, brakes and other options.

TORQUE SYSTEMS

Improving Productivity Worldwide

Cleveland Motion Controls
An IMC Company

MOTOR CHARACTERISTICS

	SYMBOL		UNITS	3509	3515	3528
	T_C	Cont. Torque	Lb-In	4.25	6.44	10.63
	T_P	Peak Torque	Lb-In	37.5	56.3	93.8
	T_F	Static Friction	Lb-In	0.25	0.3	0.32
	F_i	Viscous Friction	Lb-In/KRPM	0.08	0.09	0.14
	T_R	Cogging Torque	Lb-In	0.06	0.07	0.11
	J_M	Inertia	Lb-In-sec^2	.0006	.0008	.0015
	R_{TH}	Thermal Res	Deg C/watt	3.7	3.1	2.3
	T_{TH}	Thermal Time	Minute	15	20	25
	t_m	Mech Time	Millisec	5.5	3.9	3.5
	t_e	Elect Time	Millisec	1.5	1.7	2
	F_C	Commutation	Factor	2060	2990	4960
	Wt	Weight	Lbs	3.8	5	7.5

Note: All values at 25°C Ambient.

WINDING						
A	K_T	Torq. Sens.	Lb-In/Amp	.39	.59	*
	R_A	Arm. Resis.	Ohms	0.16	0.2	*
	K_V	Back E.M.F	Volts/KRPM	4.6	7.0	*
	F_C/K_T	P_b	Watts	332	315	*
B	K_T	Torq. Sens.	Lb-In/Amp	.52	.79	*
	R_A	Arm. Resis.	Ohms	0.27	0.34	*
	K_V	Back E.M.F	Volts/KRPM	6.1	9.4	*
	F_C/K_T	P_b	Watts	248	235	*
C	K_T	Torq. Sens.	Lb-In/Amp	.65	.99	1.74
	R_A	Arm. Resis.	Ohms	0.53	0.67	1.01
	K_V	Back E.M.F	Volts/KRPM	7.7	11.8	20.6
	F_C/K_T	P_b	Watts	198	188	178
D	K_T	Torq. Sens.	Lb-In/Amp	.82	1.26	2.21
	R_A	Arm. Resis.	Ohms	0.67	.84	1.3
	K_V	Back E.M.F	Volts/KRPM	9.7	14.9	26.2
	F_C/K_T	P_b	Watts	157	148	140
E	K_T	Torq. Sens.	Lb-In/Amp	1.04	1.59	2.79
	R_A	Arm. Resis.	Ohms	1.05	1.34	2.04
	K_V	Back E.M.F	Volts/KRPM	12.3	18.8	33.0
	F_C/K_T	P_b	Watts	124	117	111
F	K_T	Torq. Sens.	Lb-In/Amp	1.29	1.99	3.5
	R_A	Arm. Sens.	Ohms	1.7	2.12	3.2
	K_V	Back E.M.F	Volts/RPM	15.3	23.5	41.3
	F_C/K_T	P_b	Watts	100	94	89
G	K_T	Torq. Sens.	Lb-In/Amp	1.64	2.52	4.43
	R_A	Arm. Resis.	Ohms	2.7	3.4	5.12
	K_V	Back E.M.F	Volts/KRPM	19.4	29.8	52.3
	F_C/K_T	P_b	Watts	78	74	70
H	K_T	Torq. Sens.	Lb-In/Amp	2.08	3.18	5.59
	R_A	Arm. Resis.	Ohms	4.3	5.4	8.14
	K_V	Back E.M.F	Volts/KRPM	24.5	37.6	66.1
	F_C/K_T	P_b	Watts	62	59	55

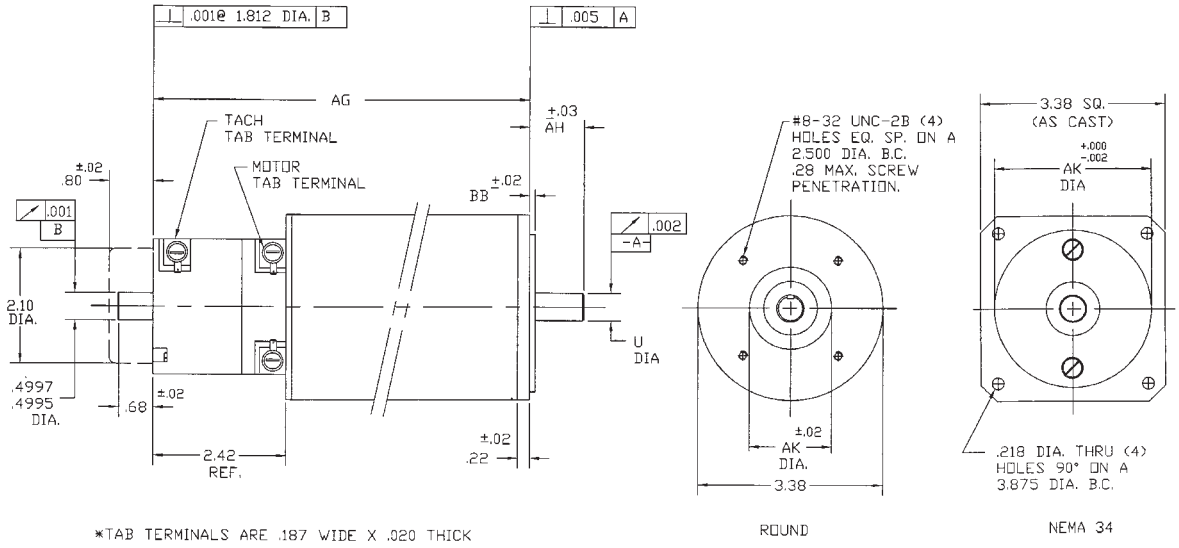
Note: Continuous torque specifications obtained with motor mounted to an 10" x 10" x 0.25" alum. plate at 25 C° ambient. Typical values are within ±10% of rating.

*Consult Factory

For custom designs please consult factory.

All specifications subject to change without notice.

MECHANICAL SPECIFICATIONS



*TAB TERMINALS ARE .187 WIDE X .020 THICK

ROUND

NEMA 34

DIMENSION CHART

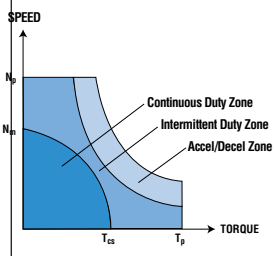
MOTOR	AG	AG	U DIA.		AH		AK		BB	
	Motor Only Inches (Metric)	Motor Tach Inches (Metric)	STD	NEMA	STD	NEMA	STD	NEMA	STD	NEMA
3509	3.24 (82.3)	4.75 (120.7)	.4999/.4994	.3750/.3745	1.00	1.19	2.875	2.875	0.10	0.06
3515	3.99 (101.3)	5.50 (139.7)	.4999/.4994	.3750/.3745	1.00	1.19	2.875	2.875	0.10	0.06
3528	5.24 (133.1)	6.75 (171.5)	.4999/.4994	.3750/.3745	1.00	1.19	2.875	2.875	0.10	0.06

Note: Consult factory for AG length with cover option.

METRIC (mm): DIMENSIONS ALL FRAME SIZES

SHAFT:	DIA	12h6	**MOUNTING:**	PILOT	38
	LENGTH	25.0		B.C.	63.5
				HOLE SIZE	6.6

TORQUE PERFORMANCE CURVES



NOTE: Continuous torque specifications obtained with motor mounted to an 10"x10"x.25" aluminum plate at 25 C° ambient. Typical values are within ±10% of rating.

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

Nm = Maximum speed, continuous operation

Np = Peak speed, acceleration/deceleration and intermittent duty

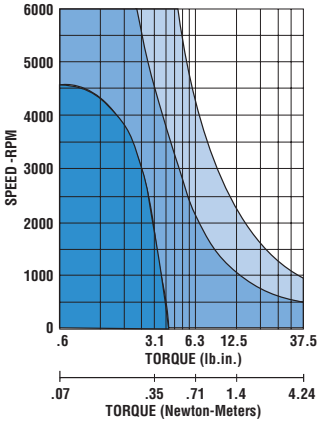
Tcs = Continuous stall torque

Tp = Peak torque

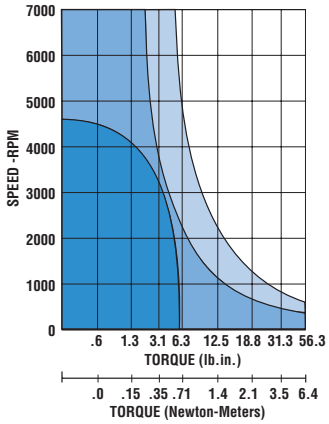
All specifications subject to change without notice.

TORQUE PERFORMANCE CURVES

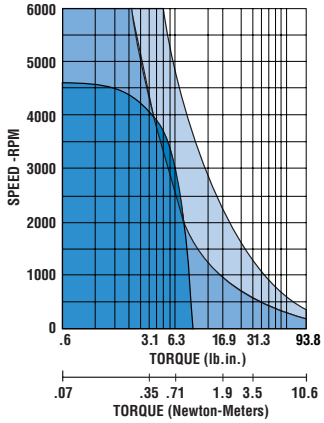
Motor 3509 - Winding: D



Motor 3515 - Winding: D



Motor 3528 - Winding: C



TORQUE SPEED CURVES OF OTHER WINDINGS AVAILABLE, CONSULT FACTORY.

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3500 SERIES

VOLTAGE EQUATION FOR MOTORS

$$\text{Volts} = \frac{K_T \times RPM}{84.4} + \frac{T \times R_A}{K_T} + V_B$$

where

K_T = torque constant, lb.-in. per amp
T = load torque plus motor friction torque-lb.-in.
R_A = armature resistance + brush resistance
V_B = brush voltage drop = 2 volts

Note: For armature resistance at maximum temperature rating, multiply catalog value of R by 1.5

MOTOR TORQUE RATING VS. SPEED

$$T_R = .94K_T\left[\frac{130}{R_{TH}} - \frac{RPM \times T_F}{84.4} - \frac{RPM^2 \times F_i}{84{,}375}\right]^{1/2} \Big/ 1.5\,R_A - T_F - \frac{RPM \times F_i}{1000}$$

where

T_R = rated torque (25°C ambient)-lb.-in.
K_T = torque sensitivity-lb.-in./amp
R_A = armature resistance
RPM = revolutions per minute
T_F = static friction torque-lb.-in.
F_i = viscous friction-lb.-in.
R_{TH} = thermal resistance

TO FIND: Higher Torque Rating for Intermittent Duty

$$\text{Let A} = \frac{\text{total cycle time in seconds}}{\text{thermal time constant of motors in seconds}}$$

$$\text{Let B} = \frac{\text{"on" time in seconds per cycle}}{\text{thermal time constant of motor in seconds}}$$

then with T_R = Rated torque for 100% duty
and T_{MAX} = Rated torque for intermittent duty

$$T_{MAX} = T_R \times \left[\frac{1 - e^{-A}}{1 - e^{-B}}\right]^{1/2}$$

Customize The 3500 Series To Your Exact Requirements

To satisfy various applications with cost-effective solutions, 3500 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 CMC. For assistance, call your local CMC distributor or CMC direct. We look forward to meeting your custom requirements.

TORQUE SYSTEMS

ORDERING INFORMATION (For Standard Options)

35 — SERIES

XX — LAM STACK
09
15
28

X — TACH
0 = None
T = Tach

XX — COMMUTATION/MAGNET
00 = STD

XX — ENCODER
M0 = Mod. Enc Prep
M1 = Self-contained Enc Prep
M2 = Mod 500 line, 2 channel, marker, line driver
M3 = Mod 1000 line, 2 channel, marker, line driver
S1 = Self-cont 1000 line, 2 channel, marker, line driver
S2 = Self-cont 2000 line, 2 channel, marker, line driver

X — BRAKE
00 = No Brake
B1 = 15 lb-in, 24 VDC

X — SEALING
0 = No sealing
B = IP65 w/o shaft seal
S = IP65
} Requires "Y, C, or M" Cover Option from TERMINATION list above

X — TERMINATION (see note below)
T = Tab terminals (std)
S = Screw terminals (optional)
W= 3 foot leads attached to tab terminals (optional)
Y = Cover w/3 foot long leads and cord grip (optional)
C = Cover w/MS 3102A-20-27P
M = Cover w/NPT

X — SHAFT
A = 1/2" dia. x 1" lg.
B = A plus 1/8" x .75" lg. keyway
E = 3/8" dia. x 1.19" lg. (NEMA 34)

X — MTG PLATE
A = 3 3/8" Round
C = 3 3/8" Square (NEMA 34)

X — WINDINGS MOTOR
A THRU H

X — WINDINGS TACH (V/KRPM)
0 = None
E = 3
F = 7
G = 15

NOTE:

Cover Option – consult factory for overall motor length.

Cleveland Motion Controls
Torque Systems Division
829A Middlesex Turnpike, Billerica, MA 01821-3954
Tel: (800) 669-5112 • (508) 667-5100 • Fax: (508) 663-6662

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