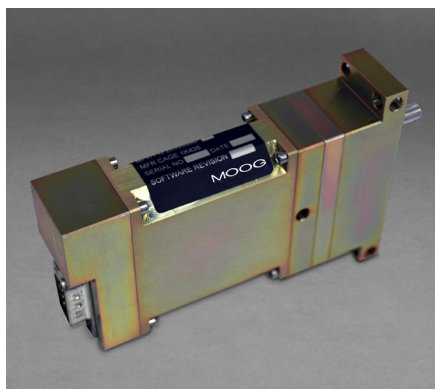




MODEL 220 ROTARY SERVO ACTUATOR



The Model 220 is a high performance rotary servo electromechanical actuator that utilizes rare earth brushless DC motors, magnetic encoder and position loop control electronics all integrated into one compact package. It is well suited for aerospace and unmanned airborne platforms due to its high performance and small envelope. It can also be used in a variety of applications as it is a self-contained

servo motion solution. Although it is specified with a 7,500 hour life, Moog has tested the Model 220 actuator, meeting 16,000 hours, and the unit was still operating within specifications.

The 220 actuator is one of our most versatile designs, and it is offered in multiple variants including RS-485 digital and RC / PWM analog communications. Moog also has a design that develops twice the peak torque.

TYPICAL APPLICATIONS

- Unmanned air vehicles — tactical, medium long endurance and MALE / HALE vehicles
 - Control surfaces requiring servo actuation
- Target drones — control surfaces, speed brakes
- Utility actuation — throttle control, doors, spoilers
- Electric aircraft, eVTOL, eSTOL, air taxis and urban air mobility vehicles — tilting mechanism, flight control, landing gear



MODEL 220 ROTARY SERVO ACTUATOR

FEATURES

- Stainless steel spur gear train
- 8 ball bearings
- Machined aluminum structure and housing
- Stainless steel output shaft, 0.25 inch SAE spline (Models 22000000-01 and -02)
- Consult factory for custom shafts and output arms
- Brushless permanent magnet motor design
- High temperature capability
- Contactless shaft position sensor
- Differential analog position feedback
- Offered either with full RS-485 digital control or RC/PWM analog control
- Modifiable parameters (default parameters installed at factory)
 - Total electrical stroke angle
 - Null position
 - Direction orientation
 - Torque limit
 - Loss of signal - hold last position, return to zero or coast
 - PID constants
 - Dead band
 - Telemetry scaling
 - Feedforward gains
- GUI interface for programming and parameter modification

BENEFITS

- Robust structural design
- Mechanical stops
- Low weight to power performance
- Customizable

DESIGN AND CONSTRUCTION

- IPC-6012, Class 3
- J-STD-001B, Class 3
- IPC-A-610, Class 3

ENVIRONMENTAL SPECIFICATIONS

RTCA DO-160G Test

Description	Details
Robust Random Vibration	Section 8, Category R Performance, figure 8-1 curve E (7.94 Gs) Endurance, figure 8.4 curve E (11.33 Gs)
Shock	Section 7, Category B Operational 6 G, 11 mS Crash safety 20 G, 11 mS
Temperature	Section 4, Category C4 and Section 5, Category A Combined Test: Temperature variation: 10° C / minute Operating temperature: -40° to +70° C Ground survival temperature: -55° to +85° C
Altitude	Section 4, Category C4 35,000 feet
Humidity	Section 6, Category B Severe humidity environment Ten cycles (240 hours)
Waterproofness	Section 10, Category W Drip proof
Sand and Dust	Section 12, Category D Dust
Power Input	Section 16, Category AX (Section 18, included) Nominal 18 to 30.3 VDC
Radio Frequency Susceptibility	Section 20, Category RR Conducted 10 kHz to 400 MHz Radiated 100 MHz to 1 GHz
Electrostatic Discharge (ESD)	Section 25, Category A 15 kV
Induced Signal Susceptibility	Section 19, Category ZW Magnetic and electric fields

MODEL 220 ROTARY SERVO ACTUATOR

PERFORMANCE DATA SPECIFICATIONS

Features	Model 22000000-01	Model 22000000-02	Model 22000000-21
Operating Voltage	18 to 32 VDC	18 to 32 VDC	18 to 32 VDC
Operating Temperature Range	-40° to +71° C	-40° to +71° C	-40° to +71° C
Operating Altitude Range	Up to 50,000 ft	Up to 50,000 ft	Up to 50,000 ft
Weight	9 oz	9 oz	16 oz
Life	7,500 hrs	7,500 hrs	7,500 hrs
Mechanical Stroke	100° non jamming stops	100° non jamming stops	Continuous rotation (no stops)
Electrical Stroke	±45.0° - electronically limited	±45.0° - electronically limited	Standard unit ±45.0° Mod A unit ±115°
No Load Speed @ 28 VDC	350° / sec nom ¹	350° / sec nom ¹	220° / sec ¹
Static Current @ 28 VDC	60 mA max	60 mA max	60 mA max
Stall Torque	50 lb-in nom - electronically limited ¹	50 lb-in nom - electronically limited ¹	80 lb-in nom - electronically limited ¹
Continuous Torque @ 71° C	40 lb-in max	40 lb-in max	40 lb-in max
Line Current At Stall Torque	1 amp max	1 amp max	1.5 amp max each supply
Unpowered Backdrive Torque	< 20 oz-in	< 20 oz-in	< 35 oz-in
Power Point 24 VDC @ 25° C	250° / sec @ 25 lb-in nom ¹	250° / sec @ 25 lb-in nom ¹	130° / sec @ 50 lb-in ¹
Electromechanical Stiffness	50 lb-in / degree nom ¹	50 lb-in / degree nom ¹	50 lb-in / degree nom ¹
Backlash	< 60 arc min @ ±7 lb-in reversing load	< 60 arc min @ ±7 lb-in reversing load	< 60 arc min @ ±7 lb-in reversing load
Small Signal Frequency Response	3 dB Atten @ > 15 Hz no load ¹	3 dB atten @ > 15 Hz no load ¹	> 12 Hz no load ¹
Electrical Command Interface	Redundant half duplex RS-485 ²	Opto-isolated RC / PWM - 10 bit ³	Redundant half duplex RS-485 ²
Command And Position Resolution	12 bits ²	± 10 VDC differential for ± 45°	12 bits ²
Tuning Interface	Half duplex RS-485 via channel A ²	Half duplex RS-485 ²	Half duplex RS-485 via channel A ²

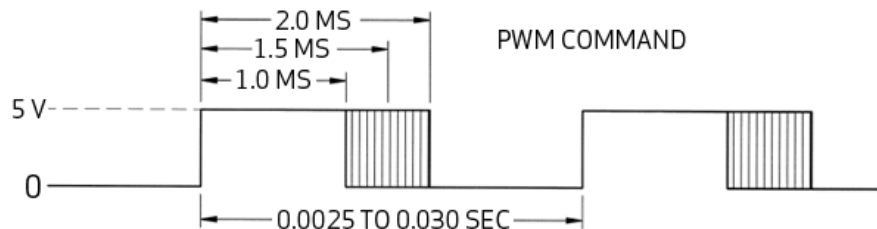
Notes:

¹Reference performance characteristics based on default tuning parameters. Characteristics may vary as turning parameters are modified.

²Contact Moog sales to receive detailed protocol information.

³See Figure 1 for RC / PWM command information (applies to Model 22000000-02).

FIGURE 1



AS VIEWED FROM SHAFT:
COMMAND PULSE WIDTH:

- 2.000 mSEC = 45° CCW
- 1.500 mSEC = 0°
- 1.000 mSEC = 45° CW

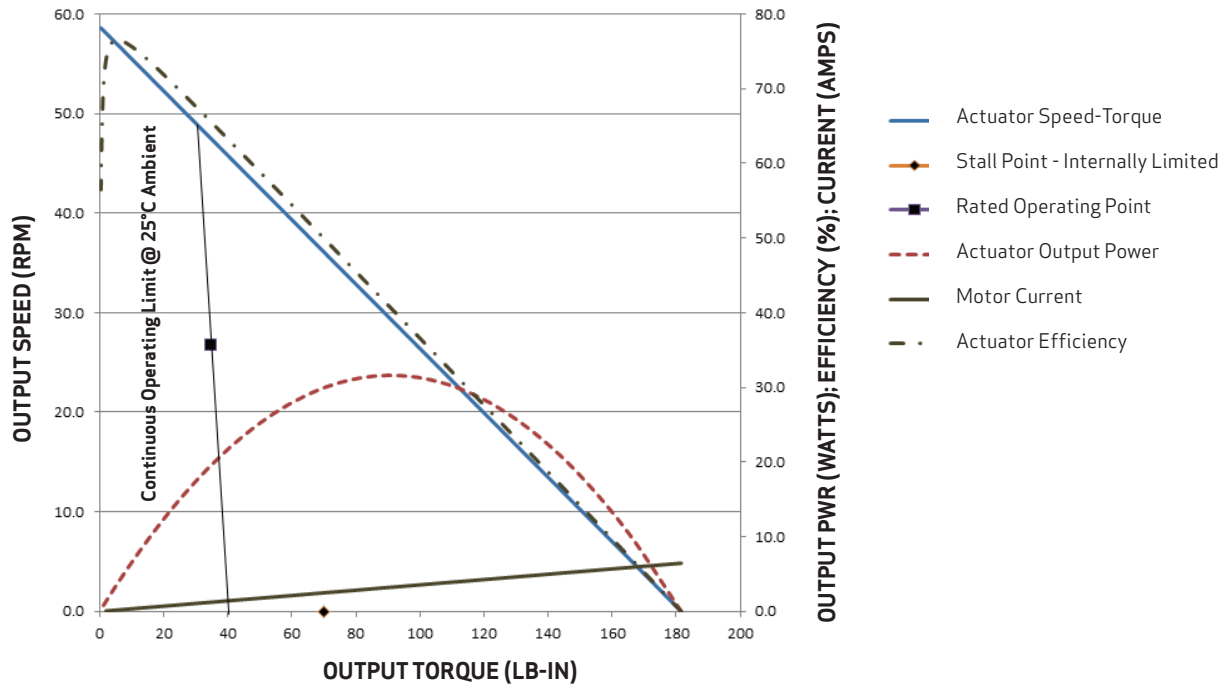
POS TELEMETRY:

- -10 VDC = 45° CCW
- +10 VDC = 45° CW

MODEL 220 ROTARY SERVO ACTUATOR

CALCULATED PERFORMANCE CURVES @ 24 VDC AND @ 25°C

(-01, -02 CONFIGURATIONS)



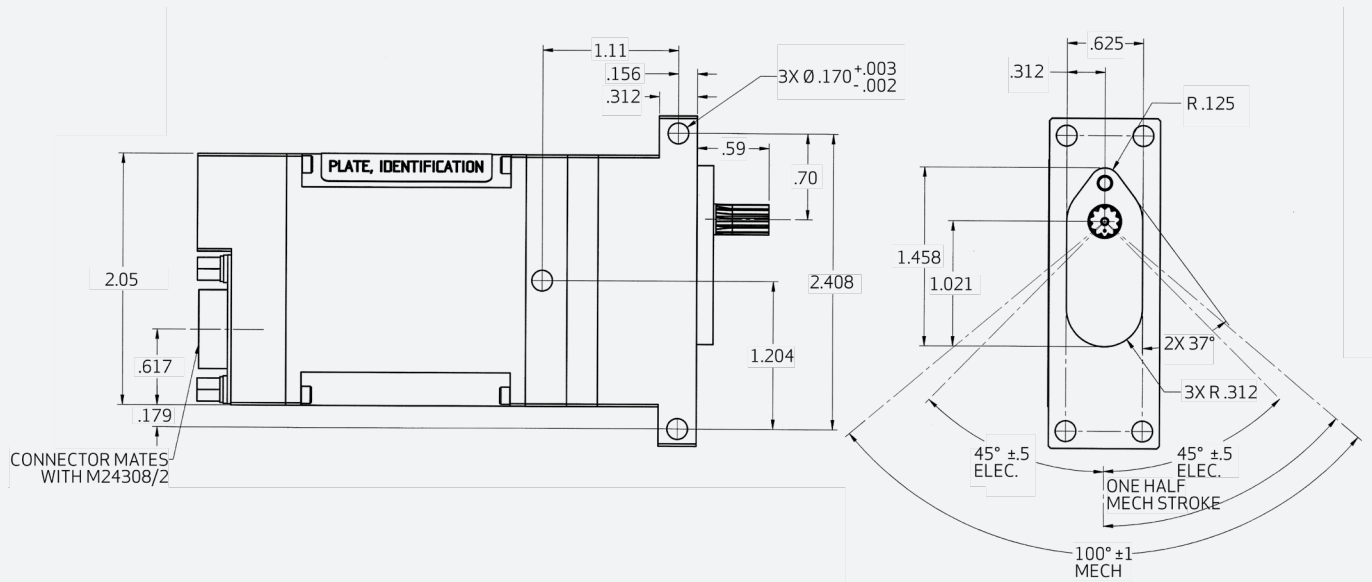
CONNECTOR PIN ASSIGNMENT

Pin Number	Model 22000000-01 RS-485 Half Duplex Redundant	Model 22000000-02 RC / PWM	Model 22000000-21 2 Wire RS-485 Dual Redundant	Pin Diagram
1	RxTx A - primary	PWM input command	RxTx A - primary	
2	RxTx B - primary	PWM command return	RxTx B - primary	
3	RxTx A - secondary	Position feedback +	RxTx A - secondary	
4	+28 VDC - secondary	RS-485 COM A	+28 VDC - secondary	
5	Chassis	Chassis	Chassis	
6	+28 VDC - primary	+28 VDC	+28 VDC - primary	
7	Primary return	28 VDC return	Primary return	
8	Secondary return	RS-485 COM B	Secondary return	
9	RxTx B - secondary	Position feedback -	RxTx B - secondary	

MODEL 220 ROTARY SERVO ACTUATOR

MECHANICAL DIMENSIONS (INCHES)

*Model 22000000-01 Shown Below



*Model 22000000-02 is similar to Model 22000000-01 in dimensions.

INVOLUTE SPLINE DATA

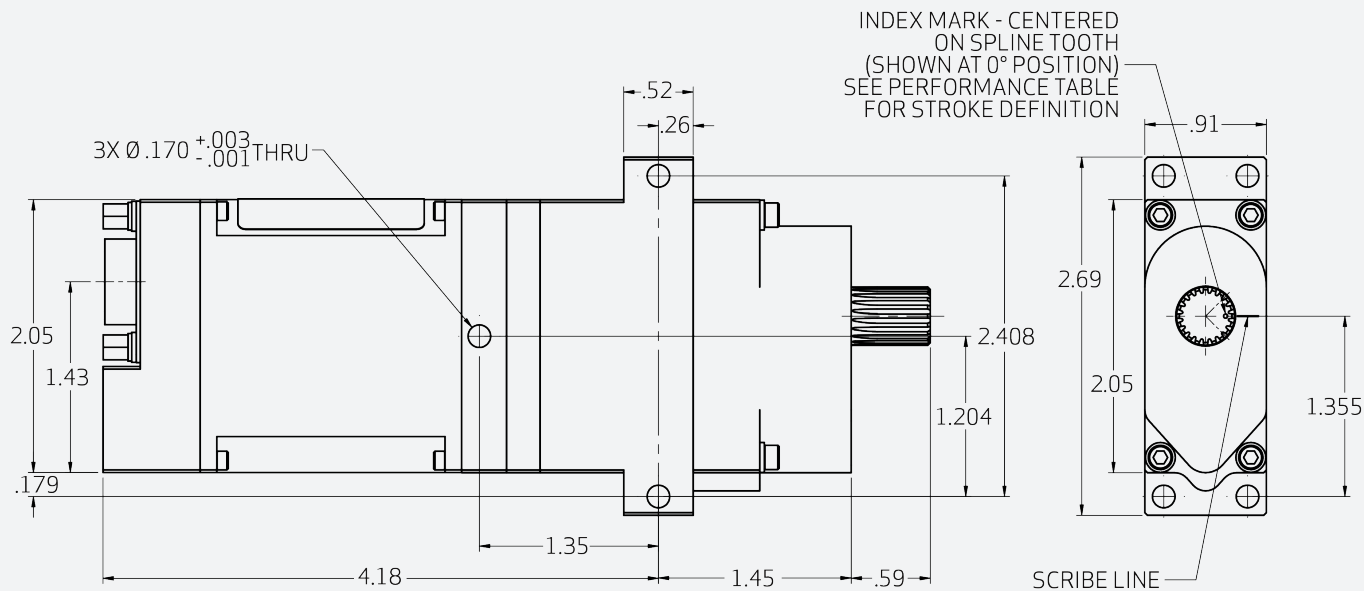
External Involute - Class 5 Fit
Fillet Root, Side Fit Per ANSI B92.1

Features	Model 22000000-01 and -02
Number of Teeth	11
Pitch	48 / 96
Pitch Diameter	0.2292
Pressure Angle	45
Base Diameter	0.1620
Major Diameter	.249 +0 -.001
Minor Diameter	0.2010
True Involute Form Diameter	0.2120
Effective Circular Tooth Thickness Maximum	0.0369
Actual Circular Tooth Thickness Minimum	0.0345
Fillet Radius	0
Measurement Over 0.0400 Diameter Pins	0.2911 min ref

MODEL 220 ROTARY SERVO ACTUATOR

MECHANICAL DIMENSIONS (INCHES)

Model 22000000-21 Shown Below



INVOLUTE SPLINE DATA

External Involute - Class 5 Fit
Fillet Root, Side Fit IAW ANSI B92.1

Features	Model 22000000-21
Number of Teeth	20
Diametral Pitch	48 / 96
Pressure Angle (Degrees)	30
Pitch Diameter	0.4167
Base Diameter	0.3608
Major Diameter	0.4375
Minor Diameter	0.364
True Involute Form Diameter	0.391
Effective Circular Tooth Thickness Maximum	0.0327
Actual Circular Tooth Thickness Minimum	0.0301
Fillet Radius	0.005
Measurement Over Wires (Ref)	0.4744

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Moog Space and Defense



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