



ACTUATION AND MOTION SYSTEMS

FOR AEROSPACE AND DEFENSE APPLICATIONS

ABOUT MOOG

Moog utility / multi-purpose actuators and servo actuators can be used for a variety of high performance applications and are standard building blocks used in ruggedized systems. We utilize our expertise in DC electromagnetics, gearing, rate and position loop servo electronics and mechanical design in these assemblies. Moog rotary and linear electromechanical actuators are used in:

- Fixed and Rotary Wing Aircraft
- Unmanned Vehicles / Remotely Operated Vehicles
- Ground Vehicles
- Radar Systems
- Remote Weapon Stations
- EO / IR Sensor Pods
- Valve / Damper Actuators
- eVTOL / Advanced Air Mobility



CAPABILITY

Moog has been developing specialized high technology and utility electromechanical actuators for over 35 years. Our capability includes in-house design, manufacturing expertise, engineering support and qualification for these products.

PRODUCT RANGE

Products range from 25 to 2,500 in-lb for rotary and 100 to 2,000 lbf for linear configurations. We can offer our assemblies with integral servo control electronics. Moog offers a variety of communication interfaces including analog, (+/- 10 VDC for example), RS232 / 422 / 485, R/C PWM and CAN Bus. We design for redundancy if required by our customer.

Moog is a FAA certified repair station and can offer hardware in support of repairs, upgrades or overhauls.

FAA / EASA Approved Repair Station Location, Blacksburg, VA
FAA Repair Station: 21MR057C
Cage Code: 99932

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AS9100:2016 Certified
ISO9001:2005 Certified

These products were previously manufactured at Moog's Springfield, PA, facility.

ROTARY ACTUATORS

Rotary servoactuators utilize brush and brushless type DC motors using both neodymium and rare earth magnets. These units have been designed with separate or integrated analog or digital amplifiers, spur gearing and potentiometers or rotary magnetic encoders (RME) as feedback devices. Typical applications include Unmanned Aerial Vehicles (UAVs) , Remotely Piloted Vehicles (RPVs), electric Vertical Take-Off and Landing (eVTOL) vehicles, target drones and utility aircraft applications.

ROTARY ACTUATORS					
Model	Size in (mm)	Load Torque in-lbs	Stroke	Weight lbs	Operating Voltage vdc
220	0.90 x 2.7 x 4.1 (22.9 x 68.6 x 104.1)	50 or 100 Depending on Output Configuration	±45°	0.6	28
820	1.5 x 3.2 x 4.3 (38.1 x 81.3 x 114.1)	80 Rated 150 Peak	±45°	2.8	28
863	1.6 x 4.1 x 4.5 (40.6 x 103.9 x 113.0)	150 Rated 320 Peak	±45°	2.0	28
935	2.3 x 4.8 x 6.6 (58.4 x 121.9 x 167.6)	150 Rated 600 Peak	±45°	3.9	28
965	3.5 x 7.1 x 9.8 (88.9 x 180.3 x 248.9)	2,200 Rated 2,500 Peak	±90°	11.5	28

CUSTOM DESIGNS

Our experience makes us familiar with numerous types of rotary and linear electromechanical actuation requirements. We offer our customers a solution from dozens of product configurations or a baseline design. We recognize that it is not always possible to utilize an existing design, so we are equally comfortable in offering customization to meet individual customer needs. Customizations often include expanded angular deflection, unique mounting provisions and/or relocation of connectors or other mechanical parts. Moog works closely with each customer to help select the appropriate model with a focus towards meeting program milestones and goals.

Moog is committed to work with our customers in providing a solution to customer specific requirements if an existing design is not available. We are experts in design, development, qualification and certification. In addition to the hardware development, our sites include program management professionals who can support SDRL creation, milestone reporting and overall risk mitigation. Moog offers extensive engineering experience in mechanical, electrical and system disciplines to our customers.



MODEL 220



MODEL 820



MODEL 863



MODEL 935



MODEL 965

LINEAR ACTUATORS

Linear actuators translate rotary motion to linear motion. They have the same features and similar applications as rotary units. This actuator configuration is used to control linear motion. It utilizes high performance DC motors coupled to high efficiency gearing. A ball screw or lead screw / nut assembly is typically used to translate the rotary to linear motion. It typically integrates a position transducer and fail-safe brake in a robust structural design. Moog can couple the actuator with position loop servo control electronics. We can also offer several actuators with redundancy through the motor and feedback device.

LINEAR ACTUATORS					
Model	Size in (mm)	Force lbs	Stroke in	Weight lbs	Power vdc
981 Integrated Electronics	2.50 x 4.05 x 14.00 (63.5 x 102.9 x 355.6)	10 Rated 30 Stall	±.65	4.75	28
909	2.5 x 3.57 x 2.5 (63.5 x 90.68 x 63.5)	12 Rated	0.75	0.75	28
973 Dual Motor Construction	3.25 x 3.56 x 11.17 (82.6 x 90.4 x 283.7)	350 Rated 1,120 Stall	4.50	6.30	28
290 Integrated Electronics	15 x 4.27 x 1.9 (381 x 108.46 x 48.26)	1,500 Rated 2,500 Stall	7.75	6.00	28
974 Dual Motor Construction	3.88 x 4.75 x 14.75 (98.6 x 120.7 x 374.6)	1,500 Rated 2,150 Stall	7.25	8.10	28



MODEL 981

MODEL 909

MODEL 973

MODEL 290

MODEL 974

SOLUTIONS

Challenge

Customer needed to rapidly develop a higher reliability, digital interface source for servoactuators on a new eVTOL platform. The actuators are a drop-in replacement on all flight control surfaces and improve environmental and EMI performance.

Solution

Moog responded with a DSP-based control design that moves flaps, aileron and ruddervator positions despite the varying loads. Because aerodynamic loads are doubled at several positions on the vehicle, Moog developed a second stage bolt-on gearbox that doubles the output torque from 50 to 100 in-lbs, allowing use of the same basic configuration at multiple positions. Moog also designed a highly reliable solid-state solution for position feedback utilizing a magnetic encoder. We have continued to evolve the digital electronics, as well as our unique interface protocol. Moog is aware of and working towards industry standards regarding certification for use in civil airspace.



Challenge

Customer needed to develop a higher reliability, digital interface source for servoactuators on a tactical class UAV operating in a high altitude environment. The actuators offered meet the requirements for multiple flight control surfaces.

Solution

Moog provided a standard 150 in-lb rated rotary electromechanical servoactuator and developed a thermal management system that detects cold temperature environments (as low as -85°C). The actuator employs a fully integrated servo controller and film potentiometer position feedback along with a high reliability stainless steel gear train. The thermal system and integrated heater circuit allows operation at 100% performance through all operating extremes.



HIGHER LEVEL SOLUTIONS

Our unique product offering of motion technology (slip rings, motors, resolvers, drives and actuators) and fiber optic products provides the capital assets and engineering capabilities to design, manufacture and integrate these discrete products into an integrated gimballed mechanism. In today's business environment where many corporate strategies are to focus on core competencies, let Moog take the design and integration of these discrete components into fully functional and tested subassemblies that are ready for installation into the end-item assembly. If your strategy is to outsource these assemblies on a build-to-print basis, we are ready to apply our resources so you can achieve those goals too.

Our integrated assemblies range from simple combinations of slip rings and resolvers to sophisticated electromechanical assemblies including the motor, drive electronics, fiber optic rotary joints, hydraulic and pneumatic swivels and RF rotary joints. We also offer and provide fully integrated servo and utility actuators complete with precision gearing, clutches, brakes and closed-loop control electronics.

Our business strategy is simple, let Moog focus on what we do best so our customer can focus on what they do best. This strategy provides our customers with many measurable benefits.

DEFENSE PRODUCTS

ROTARY JOINTS AND SLIP RINGS

These high performance products are used in systems that require unrestrained, continuous rotation while transmitting power, data and media from a stationary device to a rotating structure. High bandwidth options include Ethernet, high definition video and other industry standard formats. Moog also has solutions including fiber optic rotary joints, fluid rotary unions and position sensors.



DIRECT DRIVE DC TORQUE MOTORS AND ALTERNATORS

Frameless torque motors are used in defense applications that require high power density and quick accelerations. The motors are optimized to minimize input power for maximum efficiency. Alternators in the same mechanical configuration can be used for mobile power generation.



RESOLVERS

Moog offers rugged resolvers that provide accurate positioning and velocity feedback, as well as commutation of brushless motors. These models withstand the shock and vibration levels often encountered in aerospace and military applications. They are used for vertical integration with motors and slip ring assemblies.



ACTUATORS

Utility / multi-purpose electromechanical actuators are available in both rotary and linear configurations and are standard building blocks in a variety of systems. Some of our actuators integrate servo electronics. These actuators are used on air, ground and unmanned applications.



HIGH SPEED DATA COMMUNICATIONS

Moog provides innovative components and communication sub-systems for both copper and optical fiber based systems used in harsh environments. Moog meets the demanding high speed and secure networking equipment requirements of today's modern defense systems. The product range includes electro-optical transceivers, link extenders, Ethernet media converters and switches, data aggregators and multiplexer/de-multiplexer solutions.



INTEGRATED MOTION ASSEMBLIES

Our higher level solutions range from simple combinations of individual products to sophisticated electromechanical assemblies including the motor, drive electronics, slip ring, fiber optic rotary joint, fluid / pneumatic swivel and RF rotary joint. Moog single-axis gimbal stage supports most payloads, and all the rotary components are integrated into one assembly. This design reduces set-up time and simplifies the installation process.



MOOG | Shaping the way our world moves™

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Moog Space and Defense



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