

# Actuation and Motion Systems

*Product Guide*



**MOOG**  
COMPONENTS GROUP

# About Moog Components Group

## Multi-purpose Actuators and Servoactuators

Moog's multi-purpose actuators and servoactuators 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 Aircrafts
- Unmanned Vehicles / Remotely Operated Vehicles
- Ground Vehicles
- Radar Systems
- Remote Weapon Stations
- SATCOM Pedestals
- EO / IR Sensor Pods
- Cockpit Door Locks
- Valve / Damper Actuators

## Capability

Moog has been developing specialized high technology and utility electromechanical actuators for over 25 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-lbt 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 as required by the customer.

Moog Components Group is a FAA certified repair station and can offer hardware in support of AOG services.

### FAA / EASA Approved Repair Station Location, Springfield, PA

FAA Repair Station: L17R251Y	750 West Sproul Road
EASA (JAA): 145.5497	Springfield, PA 19064-4084 USA
Cage Code: 1K426	Tel: +1-610-328-4000
	Fax: +1-610-605-6216

### FAA / EASA Approved Repair Station Location, Blacksburg, VA

FAA Repair Station: 21MR057C	1213 North Main Street
Cage Code: 99932	Blacksburg VA 24060-3127 USA
	Tel: +1-540-552-3011
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## 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 imbedded analog or digital amplifiers, spur gearing and potentiometers as feedback devices. Typical applications include UAV, RPV, target drones and utility aircraft applications.

Model	Size in (mm)	Load Torque (in-lbs)	Stroke	Weight (lbs)	Power (VDC)
 <b>220</b>	.90 x 2.7 x 4.1 (22.9 x 68.6 x 104.1)	50 or 100 in-lbs (Depending on Output Configuration)	±45°	.6	28
 <b>820</b>	1.5 x 3.2 x 4.3 (38.1 x 81.3 x 114.1)	80 in-lbs Rated 150 in-lbs Peak	0-90°	2.8	28
 <b>863</b>	1.6 x 4.1 x 4.5 (40.6 x 103.9 x 113.0)	Continuous Holding Torque 150 in-lbs 320 in-lbs Peak	±45°	2.0 Max	28
 <b>865-66</b>	2.3 x 4.75 x 5.0 (52.4 x 120.7 x 127)	300 in-lbs Stall	±46°	3	28 and ±15
 <b>905-01 / 04</b>	2.3 x 4.9 x 5.4 (58.4 x 124.5 x 137.2)	150 in-lbs Rated 300 in-lbs Peak	±33°	3	28 and ±15
 <b>915</b>	4.95 x 4.5 x 6.2 (125.7 x 114.3 x 157.5)	300 in-lbs Peak	±46°	7	28
 <b>918</b>	4.06 x 2.50 x 4.35 (103.1 x 63.5 x 110.5)	5.8 oz-in @ 300 rpm	±3,600°	2	20
 <b>935</b>	2.3 x 4.8 x 6.6 (58.4 x 121.9 x 167.6)	150 in-lbs Rated 600 in-lbs Peak	±46°	3.9	28
 <b>959</b>	2.3 x 4.8 x 6.6 (58.4 x 121.9 x 167.6)	160 in-lbs Rated 700 in-lbs Peak	0-90°	5.0	28
 <b>965</b>	3.50 x 7.10 x 8.90 (88.9 x 180.3 x 226.1)	2,200 in-lbs Rated 2,500 in-lbs Peak	±45°	10.7	28 and ±15
 <b>971</b>	3.0 x 3.48 x 6.56 (76.2 x 88.4 x 166.6)	15 Rated 200 Peak	±30°	3.2 (Actuator Only)	28

# Linear Actuators

## Linear Actuators (Fractional Horsepower)

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 Components Group can couple the actuator with position loop servo control electronics. We can also offer the actuator with redundancy through the motor and feedback device.

Model		Size in (mm)	Force (lbs)	Stroke (in)	Weight (lbs)	Power (VDC)
	310	2.00 x 3.34 x 8.42 (50.8 x 84.8 x 213.9)	300 Rated 1,000 Peak	3	4.5	28
	868	10.17 x 2.75 x 4.95 (258.3 x 69.9 x 125.7)	150 +/- 450 @ 13 Hz Rated	0.81	7 Max	28
	973	3.25 x 3.56 x 11.17 (82.6 x 90.4 x 283.7)	350 Rated 1,120 Stall	4.50	6.3	28
	974	3.88 x 4.75 x 14.75 (98.6 x 120.7 x 374.6)	1,500 Rated	7.25	8.1	28
	981	2.50 x 4.05 x 14.00 (63.5 x 102.9 x 355.6)	10 Rated 30 Stall	±.65	4.75	28

# Continuous Rotation Actuators

## Continuous Rotation Actuators

Continuous rotation electromechanical actuators offer 360 degrees or greater rotation for many critical applications. These actuators are suitable for radar pedestals, electro-optical targeting or other high resolution positioning needs. Products are available that offer very low backlash and / or very high position feedback and control.

Model	Size in (mm)	Load Torque (in-lbs)	Stroke	Weight (lbs)	Power (VDC)
 <b>940</b>	3.18 x 3.15 x 4.69 (80.8 x 80.01 x 119.1)	165 Rated	Continuous Rotation	2.8	270
 <b>813</b>	7.76 x 4.33 (197.0 x 109.9)	320 Rated	Continuous Rotation	12.5	28
 <b>250</b>	3.15 OD x 11.29 (80.0 OD x 286.7)	270 Rated	Continuous Rotation	8.5	48
 <b>873</b>	1.6 x 3.5 x 5.8 (40.6 x 88.9 x 142.3)	40 Rated 130 Peak	Continuous Rotation	3.9	150 and ±15
 <b>874</b>	1.25 x 2.35 x 4.0 (31.8 x 59.7 x 101.6)	12 Rated 30 Peak	Continuous Rotation	1.4	150 and ±15
 <b>875</b>	1.25 x 2.35 x 4.0 (31.8 x 59.7 x 101.6)	21 Rated 46 Peak	Continuous Rotation	3.0	150 and ±15
 <b>878</b>	6.09 x 3.22 x 1.61 (154.7 x 81.8 x 40.8)	37 @ 84 rpm	Continuous Rotation	2.4 Max	28
 <b>917</b>	11.30 x 4.59 x 6.53 (287.0 x 116.6 x 165.8)	220 oz-in @ 960 rpm	Continuous Rotation	11	115 VRMs, 400 Hz
 <b>980-10 980-20</b>	4.06 x 4.06 x 14.0 (103.1 x 103.1 x 355.6)	168 Rated	Continuous Rotation	17.3 (Actuator Only)	3-Phase 120 / 208 400 Hz

# Transducers & Position Sensors

Transducers have been employed on both military and commercial aircraft to provide position feedback information of flight control surfaces to the flight computers, autopilots and cockpit displays.

Model	Description	Size in (mm)	Power	Features
 <b>800-XX</b>	Model 800 monitors the stabilizer position of Boeing 757 and 767 commercial aircraft	4.0 OD x 5.2 L (101.6 OD x 132.1 L)	Input Voltage: 28 VRMS, 400 Hz	<ul style="list-style-type: none"> <li>• Position switches (up to 6)</li> <li>• Rotary Variable Differential Transformer (RVDT)</li> <li>• 1 speed synchro</li> <li>• Anti-backlash gearing</li> <li>• Robust structural design</li> <li>• High efficiency steel gearing</li> <li>• Flame arrestor</li> </ul>
 <b>932-02</b>	Model 932-02 is designed for a shaft position sensing on the C-5 military transport	2.0 OD x 4.75 L (50.8 OD x 120.7 L)	Input Voltage: 26 VAC, 400 Hz	<ul style="list-style-type: none"> <li>• Consists of 3 synchros and input shaft</li> <li>• 1:1 gearing</li> <li>• Single electrical connector for interfacing the excitation voltages and the synchro output signals</li> </ul>
 <b>933-01</b>	Model 933-01 is used in C-5 military transports to convert the mechanical position to appropriate electrical signals for position indication	2.0 OD x 1.78 L (50.8 OD x 45.25 L)	Input Voltage: 26 VAC, 400 Hz	<ul style="list-style-type: none"> <li>• Consists of 2 synchros and input shaft</li> <li>• 4:1 gearing</li> <li>• Single electrical connector for interfacing the excitation voltages and the synchro output signals</li> </ul>
 <b>943-XX</b>	Model 943 monitors the stabilizer position of the Boeing 747-400 commercial aircraft	3.26 OD x 4.70 L (82.8 OD x 119.4 L)	Input Voltage: 28 VRMS, 400 Hz	<ul style="list-style-type: none"> <li>• Rotary Variable Differential Transformer (RVDT)</li> <li>• 1 speed synchro</li> <li>• Flame arrestor</li> <li>• Anti-backlash gearing</li> <li>• Robust structural design</li> <li>• High efficiency steel gearing</li> </ul>
 <b>976</b>	Model 976 monitors the position of the nacelle of an unmanned aerial vehicle (UAV)	2.0 OD x 4.75 L (50.8 OD x 120.7 L)	Input Voltage: 6 VAC, 3,000 Hz	<ul style="list-style-type: none"> <li>• 5:4 gearing</li> <li>• Two Rotary Variable Differential Transformers (RVDT)</li> <li>• Single electrical connector for interfacing the excitation voltages and RVDT output signals</li> </ul>
 <b>978</b>	Dual RVDT for flight surface position feedback	2.5 OD x 2.53 L (63.5 OD x 64.3 L)	6 VAC @ 3,000 Hz	<ul style="list-style-type: none"> <li>• Open frame</li> <li>• Flying leads</li> </ul>
 <b>982</b>	Dual resolver HPVS for refueling nose position sensing	2.5 x 8.3 L (63.5 x 210.8 L)	28 VDC	<ul style="list-style-type: none"> <li>• Dual redundant sensor assembly</li> <li>• Self-calibration electronics</li> <li>• Dual MIL-Standard connectors</li> </ul>
 <b>157</b>	Triple Redundant Rotary Variable Differential Transformer (RVDT Sensor)	1.5 x 1.9 L (38.1 x 48.3 L)		<ul style="list-style-type: none"> <li>• On-board closed loop force, position and velocity control</li> <li>• Range of solutions from 2,000 to 200,000 N output force</li> <li>• Compact, light-weight designs</li> <li>• Serial bus interface options including EtherCAT</li> <li>• Very low hydraulic parasitic leakage</li> <li>• Rapid customization using additive manufacturing</li> </ul>
 <b>SST-086-307</b>	Smart Sensor	.76 x 2.2 L (19.3 x 255.9 L)	5 - 30 VDC	<ul style="list-style-type: none"> <li>• Electronics are internal. No need to source and install oscillator, demodulator or amplifier</li> <li>• Small size and weight: 0.8 inch diameter</li> <li>• Rugged: operates when subjected to a wide temperature range, vibration and shock</li> <li>• Reliable</li> </ul>

## Solutions



### Challenge

Customer needed to ensure system performance and high reliability of the flight control surfaces for a High Altitude Long Endurance Unmanned Aerial Vehicle (UAV). The UAV can be deployed for days at a time at altitudes up to 65,000 feet so temperature variation was critical for design.

### Solution

Moog provided a standard 150 in-lbt 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.



### Challenge

Customer needed to rapidly develop a higher reliability, digital interface source for servoactuators on a tactical class UAV. 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.



### Challenge

Continue to offer our customer a Build to Print (BTP) capability for ongoing support on the CH-47 program. Moog has been working with our prime customer and the US Army user for more than 25 years on this program.

### Solution

Moog manages and maintains a supply source for trim actuators. The actuator is used to trim the longitudinal axis of flight controls. It is controlled by the AFCS TRIM switches on the pilot and co-pilot cyclic control sticks. A servomotor is incorporated for flight director coupling in the longitudinal axis. Two CCDAs are installed in the CH-47F aircraft for the collective and the longitudinal axis. In addition to ongoing responsibility for multi-year support, Moog also conducted full-up environmental re-qualification of the units. Resulting efforts allow us to offer customer recommendations for design enhancement and any changes for continued compliance.

## Higher Level Solutions

Moog's 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.



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