Modular Actuator Product Line

The Customizable Actuator for Space Precision Rotation (CASPR) product line offers accurateand smooth rotation of spacecraft payloads. It can be used for antenna pointing mechanisms (single axis or biaxial) on communications satellites, or coupled with a slip ring for solar array driving applications. Its long-life design can be adapted for shorter-life missions.

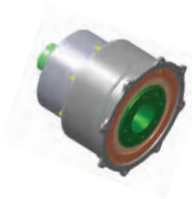
Design Highlights

The actuator comes in two sizes for small (CASPR 10) and medium (CASPR 20) payloads.

- Optional position feedback
- Low torque disturbance
- Two-phase or three phase motors
- Zero backlash (harmonic drive gears)
- High stiffness

CASPR 20

- 5.5"dia. x 6" long
- 516 in-lbs torque @28V
- Articulate 1-3 meter antenna

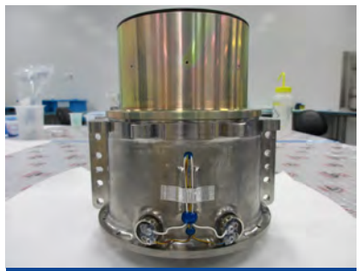


CASPR 10

- 3.6"dia. x 4" long
- 78 in-lbs torque @ 28V
- Articulate <1 meter antenna

Applicability

- LEO, HEO, MEO, and GEO orbits
- Flight heritage
- Class A-D versions available



CASPR 20 Flight Hardware

Heritage Products (Cont.)

Extra Large Rotary Actuators (TRL 9)

High Stiffness/Torque Applications

- Extended boom steering mechanisms with beryllium structural parts
- High torsional stiffness and large center aperture for cable routing
- 10.5" diameter Zero-Cogging Motor
- Dual chamber, counter rotating cable wrap with RF and DC data and power transmission
- High strength external stop assembly to handle large inertial loads

Key Requirements	
Range of Travel (deg)	<340
Weight (lbs)	75-84
Lifetime Travel (1x)(1x10⁶ deg)	30
Max Rate (deg/s)	1.60
Resolver Accuracy (deg)	.026
Stiffness, Torsion (1x10⁶ in-lb/rad)	1.7
Stiffness, Bending (1x10⁶ in-lb/rad)	~4.6
Drive Torque (in-lb)	615
Motor Type	2 Phase

Custom Mechanisms

Key Requirements			
Option	Deployment	Latch	Linear
Range of Travel (deg)	<= 90 deg	1 inch	3.8 inch
Weight (lbs)	80	9	12.3
Design Life (deployments)	40	200	15,330
Resolver Accuracy	1x and 32x	N/A	N/A
Max Rate	.17 deg/s	.1 in/s	0.868 in/s
Energized Holding Capability	3000 in-lbf	5700 lbf	>45 lbs
Motor Type	BLDC	BLDC	4 phase

Custom Mechanisms

Optical pointing, high-speed scanning (terrestrial or space applications), flip mechanisms, tracking and launching mechanisms

Examples:

- 4 axis deployable boom assembly
- High torque latch actuator with bevel gears
- Linear actuator utilizing ball screw with photo-resistor position feedback

For more information, please contact:
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Common Space Vehicle Mechanisms

NORTHROP GRUMMAN

Actuators at a Glance

Northrop Grumman has been delivering space mechanisms for stowing and articulating spacecraft payloads and solar arrays for 40+ years with 100% mission success and our modular actuators are represented on over 50 missions. Our designs specialize in:

- Long-life or high-use missions
- Low disturbance (induced vibrations reduced for simultaneous operation of payloads)
- Precision pointing (higher altitude missions)

NORTHROP GRUMMAN

Heritage Products

Deployment Actuators (TRL 9)

Key Requirements			
Application	Structure	Cable Winder	Cable Winder
Weight (lbs)	7.9	10.3	8.0
Motor Type	Stepper	Brush DC	Brush DC
Max Rate (deg/s)	.9	14	12.7
Min Stall / Drive Torque (in-lb)	600	1285	585

Mechanisms to deploy structure or to spool cables. High torque output with current limit drive, or stepper motor (or micro-stepping for low disturbance).

- Continuous rotation
- Cable winder mechanisms have two assemblies:
  - Cable Drive Module (CDM)
  - Current Limiter Assembly (CLA)

Precision Pointing Mechanisms:

Single and multiple axes rotary mechanisms with cable management systems (RF and DC data/power transmission), zero cogging motors (optional jitter compensation algorithms), zero backlash gearing, highly accurate position feedback, and micro-stepping capability yielding arc-second magnitude pointing

Stop assembly options:

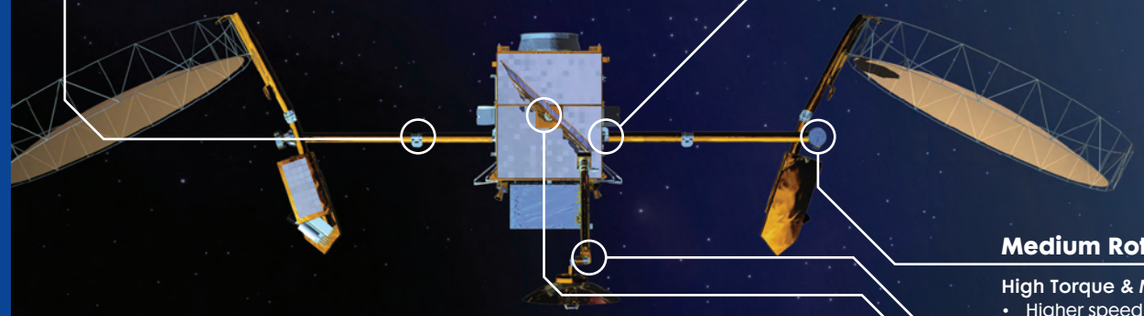
- Deployable/Stowage stops
- Large travel range (up to 510 degrees)

Large Rotary Actuators (TRL 9)

High Torque & Large Range of Travel

- Large payload (antenna or boom assembly) articulation

Key Requirements	
Range of Travel (deg)	±255
Weight (lbs)	38-138
Lifetime Travel (1x)(1x10⁶ deg)	100
Rate (deg/s)	2.3
Resolver Accuracy (deg)	.026
Stiffness, Torsion (1x10⁶ in-lb/rad)	390
Stiffness, Bending (1x10⁶ in-lb/rad) X-axis / Y-axis	1.6 / 2.0
Drive Torque (in-lb)	502
Motor Type	2 Phase



Medium Rotary Actuators (TRL 9)

High Torque & Medium Size Payload

- Higher speed capability with dual actuator configuration
- Higher torque options with larger motor

Key Requirements		
Range of Travel (deg)	±170	±160
Weight (lbs)	25-47	24-52
Lifetime Travel (1x)(1x10⁶ deg)	70	67.3
Rate (deg/s)	2.3	19.2
Resolver Accuracy (deg)	.026	.026
Stiffness, Torsion (1x10⁶ in-lb/rad)	0.28	0.22
Stiffness, Bending (1x10⁶ in-lb/rad)	1.5	~1.3
Drive Torque (in-lb)	425	502
Motor Type	2 Phase	2 Phase

Solar Array Drive Assembly (TRL 9)

Key Requirements			
Option	High Power	Scalable Power	Limited Angle
Range of Travel (deg)	Cont. rotation	Cont. rotation	170
Weight (lbs)	70.5	21.7	30
Lifetime Travel (1x)(1x10⁶ deg)	1.8 (5k revs)	21 (58k revs)	5.3
Rate (deg/sec)	.004 (1 rev/day)	0.5	0.5
Pwr/Sig circuits	50 pwr / 68 high sig & 28 low sig	12 rings @ 12 Amps (max)	78 (20 AWG)/ 48 (24 AWG)
Total Transfer Capability	384 Amps	~780 Amps (60 pwr/60sig)	168 Amps

Provides transmission of solar power and electronic signals between solar array and spacecraft; custom or modular slip ring designs for full 360-degree rotation or cable wrap design for limited angle rotations; EMI shielding; Electrically redundant

- SADA with limited travel (cable management system)
  - Provides bi-directional rotation to maintain limited angle positioning of the solar array
  - Provides absolute angular position knowledge
- SADA with continuous rotation (slip ring)
  - Provides continual 360-degree rotation of the solar array to maintain solar orientation
  - Provides null position information (via switch ring 1X/Rev)
- Configurable items:
  - Modular Slip ring - scalable power with 20 or 30 ring modules; Up to four modules (max 120 circuits)
  - Position Feedback: Switch Ring/Potentiometer/ Resolver

Biaxial Actuators (TRL 9)

Orthogonal Axes of Rotation/ "Cone" Coverage

- Commonly used to host medium sized antennas in different orbits (e.g. 1-2 meter diameter)
- RF/DC/waveguide for payload signal/power transmission
- Used for JWST, AEHF, STSS antennas

Key Requirements		
Range of Travel (deg)	<=45	<=340
Weight (lbs)	57.9	24-70.5
Lifetime Travel (1x)(1x10⁶ deg)	15	8
Rate (deg/s)	.47	3.0
Resolver Accuracy 3 sigma (deg) Spec/Capability	.005	.015
Stiffness, Torsion Inboard / Outboard (1x10³ in-lb/rad)	27.2	100
Drive Torque (in-lb)	554	557