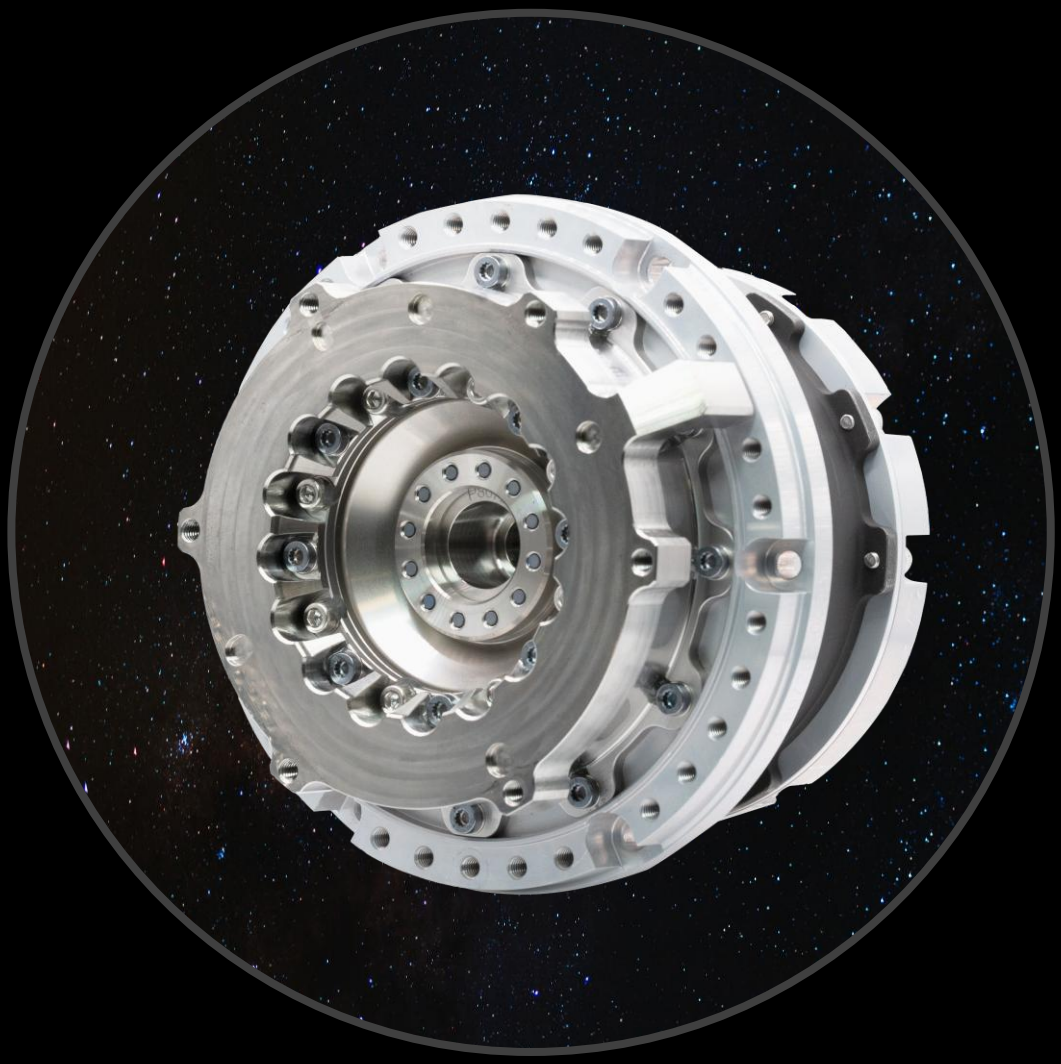
beyond gravity

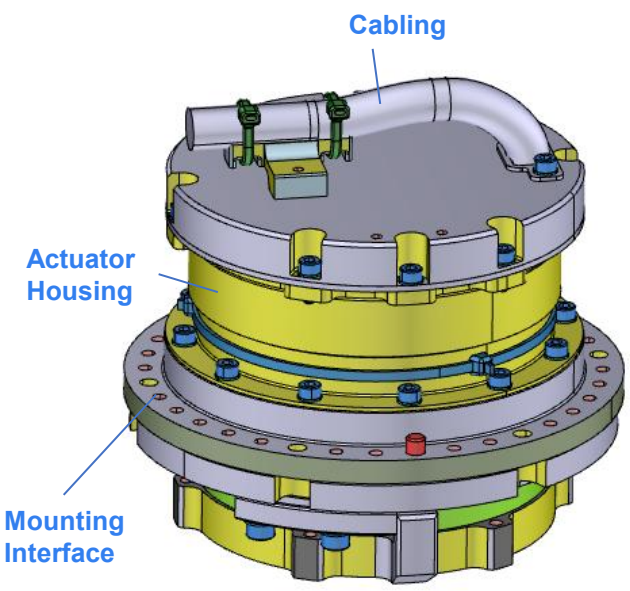


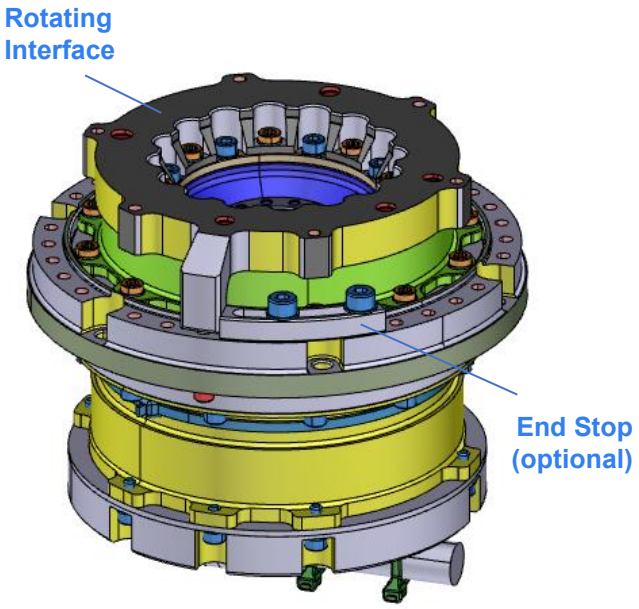
SARA21

General Purpose Rotary Actuator
Precise, Compact, Powerful.

Beyond Gravity offers the SARA21 general-purpose Satellite Appendage Rotary Actuator. 250+ units have been delivered, and 150+ units are successfully flying with a total accumulated flight heritage of 1000+ years. SARA21 is affordable, compact, powerful and robust, and can be used for various applications including deployment and positioning of solar arrays, antennas, shutters, or other spacecraft appendages.

Satellite Appendage Rotary Actuator





Huge Heritage, Proven Design

- More than 150 SARA21 in space, first flight 2005. Cumulated flight heritage of 1000+ years.
- Qualified in various qualification campaigns
- In continuous production for 20 years, very stable supply chain
- Production capacity up to 40 units per year

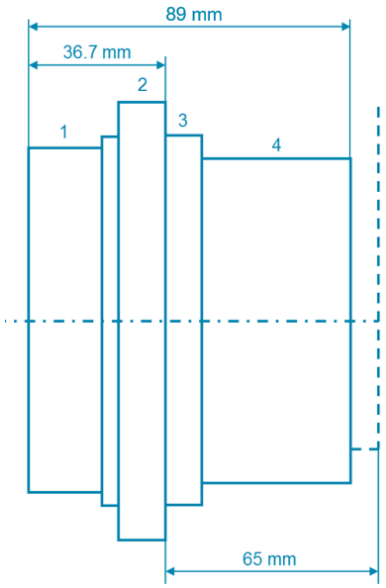
Flexible and Robust

- Typically used in antenna pointing, but other applications are possible
- High torque capacity, safely back-drivable
- Simple stepper motor interface

Tailored for you

- Huge engineering expertise allowing adaptation for unusual and specific applications
- Adapted interfaces, test scope, modifications, are feasible on request.

Envelope Drawing



A detailed interface drawing can be provided on request.

Contact us: Beyond Gravity Schweiz AG | Nicolò Carletti, Sales Manager | nicolo.carletti@beyondgravity.com or sales-mss@beyondgravity.com

Operational Performance		
Drive direction	Continuous rotation in forward and reverse direction	
Output speed range (nominal in orbit)	0 to 1 rev / 12 min	
Max. output speed (ground testing)	0.5 °/s	
Harmonic drive reduction ratio	160:1	
Output Step Size (full step)	0.00625°	
Qualified Lifespan	15 years in orbit (+ 5 years storage with 2 years integrated on satellite)	
Revolutions performance	500 full revs or 125000 fine pointings (± 0.5°)	
Mechanism accuracy	± 0,01°	
Stepper motor characteristics		
Coil Resistance @ 20°C	76 Ω ± 10%	
Coil Inductance @ 20°C	156.0 mH ± 20%	
Number of steps per revolution of motor	360	
Stable positions (motor unpowered)	360	
Unpowered holding torque	≥ 7 Nm	
Powered Holding Torque @ 23.4V	≥ 30 Nm	
Nominal torque	≥ 25 Nm	
Position Measurement (coarse – output shaft)		
Position Output availability	0° … 356.5°	
Max. Dead Band	< 3.5°	
Resolution	28 Ω/°	
Linearity	± 0.1%	
Positioning accuracy	± 0.4°	
End-to-End Resistance	10 kΩ ±10%	
Operating Voltage	5V ± 10%	
Position Measurement (fine – motor shaft)		
Position Output availability	0° … 2.25° (x160)	
Max. Dead Band	< 0.022° (x160)	
Resolution	4488 Ω/°	
Linearity	± 0.1%	
Positioning accuracy (main vs. red.)	180° ± 0.4°	
End-to-End Resistance	10 kΩ ±10%	
Operating Voltage	5V ± 10%	
Mechanical properties		
External diameter	120 mm	
Total length	89 mm	
External cable length	0.5 m	
Mass (w/ external cable, w/o connector)	≤ 2.0 kg	
Power consumption		
Maximum conditions	23.4 V – 28,6 V operating voltage	≤ 17 W total power
Connector		
D-SUB connector	DCMA37P	

Temperature specification

	Tmin	*Tambient*	*Tmax*
Ground storage	+ 10°C	+ 22°C	+ 40°C
In orbit non-operational	- 100°C		+ 100°C
Cold start-up limit	- 65°C		
In orbit operational	- 50°C	+ 22°C	+ 85°C

Static Loads

	Case 1	*Case 2*
Axial Load (F_z)	10'000 N	0 N
Radial Load (F_{xy})	0 N	8'000 N
Bending Moment (M_{xy})	0 Nm	200 Nm

Stiffnesses

Axial stiffness (K_z)	≥ 21*10^6 N/m
Shear stiffness (K_{xy})	≥ 35*10^6 N/m
Torsion angular stiffness ($K_{\theta z}$)	≥ 10000 Nm/rad
Bending angular stiffness ($K_{\theta xy}$)	≥ 50000 Nm/rad

Mechanical Qualification Levels

High level sine vibrations:	*Frequency (Hz)*	*⊥ MOUNTING PLANE*	*// MOUNTING PLANE*
	5-22	± 10.0 mm	± 10.0 mm
	22-100	20g	20g
Sweep rate	2 oct/min		
Random vibrations:	*Frequency (Hz)*	*⊥ MOUNTING PLANE*	*// MOUNTING PLANE*
	20-50	+ 6 dB/oct	+ 6 dB/oct
	50-210	1.500 g^2/Hz	1.500 g^2/Hz
	210-285	1.500 g^2/Hz	- 20 dB/oct
	285-290	1.500 g^2/Hz	- 95 dB/oct
	290-300	1.500 g^2/Hz	0.060 g^2/Hz
	300-400	0.300 g^2/Hz	0.060 g^2/Hz
	400-417	0.300 g^2/Hz	+ 95 dB/oct
	417-600	0.300 g^2/Hz	0.300 g^2/Hz
	600-690	- 30 dB/oct	0.300 g^2/Hz
	690-700	- 35 dB/oct	0.100 g^2/Hz
	700-800	0.030 g^2/Hz	0.100 g^2/Hz
	800-925	+ 45 dB/oct	0.100 g^2/Hz
	925-1200	0.100 g^2/Hz	0.100 g^2/Hz
	1200-2000	- 6 dB/oct	- 6 dB/oct
	Global	25.5 g_{rms}	22.4 g_{rms}

Shock levels for each axis (X, Y, Z):

	Frequency	**Shock input levels**
	500 Hz	200 g
	3000 Hz	2000 g
	10000 Hz	2000 g