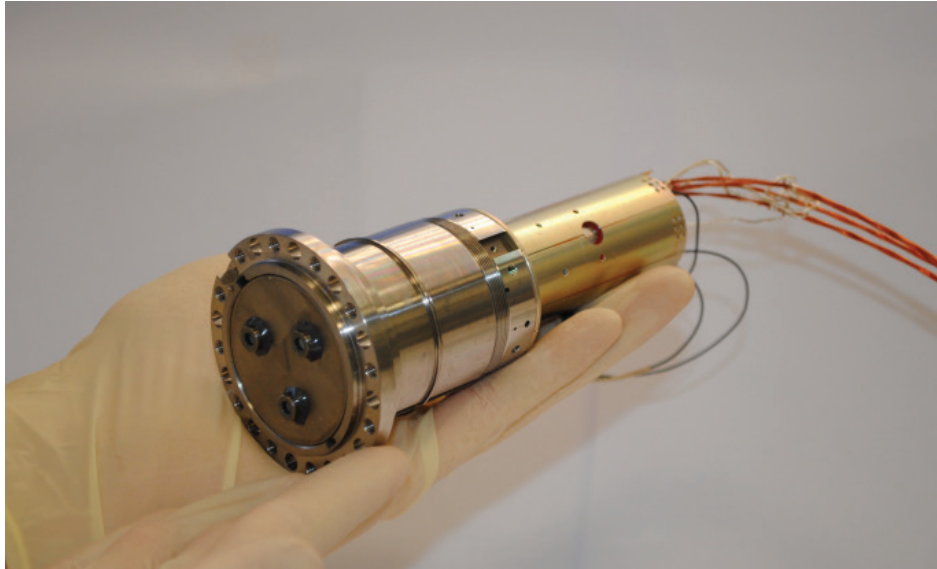


# Small Actuator 15 (SA15)

The Small Actuator (SA) is a low mass actuator with high unpowered detent torque feature, maintaining its pointing direction in unpowered condition even under high back driving torques.



The Small Actuator SA15 consists of a permanent magnet high detent torque stepper motor, a planetary gear, and high load output bearings.

The Small Actuator SA15 is based on the actuator built to drive the Aperture Cover of the Sentinel 4 instrument on the ESA Meteosat 3rd generation satellite. A total of 2 QMs and 7 FMs are built for the Sentinel 4 programme. The SA15 is used in RUAG Electric Propulsion Pointing (EPPM) mechanisms.

The main advantages of the SA15 are:

- Low mass: The whole SA15 mass including all sensors is below 690 g
- High torque: The measurable output torque of the actuator is 23 Nm at any operating temperature
- High unpowered detent torque: The purely magnetic unpowered detent torque of the actuator is selectable up to 15.3 Nm without taking into account friction which gives additional margin
- Long Life: Life test according to ECSS
- ECSS compliant: The actuator is developed in accordance to ECSS within an ESA development programme

## Options

The following options are available:

- Redundant ring potentiometer around actuator (length constant, diameter increases)
- Redundant high precision end switches
- Embedded end stops
- Redundant temperature sensors
- Dry lubrication for low temperature applications
- Customized angles at the output shaft hole pattern along the pitch circle diameter
- Customized angles at the housing hole pattern along the pitch circle diameter
- Flexible harness and piping routing for Electric Propulsion Pointing Mechanisms
- Custom motor winding resistance, 2 or 3 phase, bipolar or unipolar windings

The SA15 is part of the RSA modular actuator system, containing motor NEMO26 and planetary gear PG26 of the RSA modular actuator system. To fulfill specific requirements, the full range of motors and gears of the RSA modular actuator system can be exploited.

### **Packaging, Handling and Storage**

The item is delivered double bagged with GN<sub>2</sub> and desiccants, in a plastic box. Foam pads provide protection against handling loads. The item shall only be handled in a clean room CC100000 or better. The item contains electrostatic discharge (ESD) sensitive parts. ESD precautions shall apply to protect the item against electrostatic discharge.

### **Deliverables**

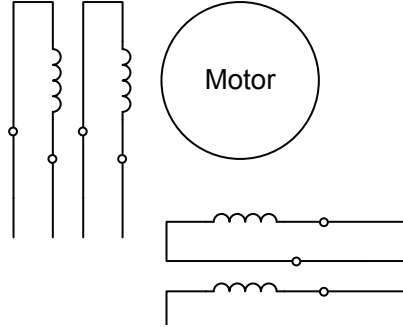
- FMs or PFMs
- Transport box
- EIDP: Certificate of Conformity, Configuration Item Data List, Parts-, Materials- and Processes-List, Logbook, Mechanical and Electrical Interface Control Document, User Manual, Requests for Deviation and Requests for Waiver, Non Conformance Reports, Minutes of Meetings, Acceptance Test Plan, Acceptance Test Report

### **Acceptance Test**

- Dimensional inspection
- Visual inspection
- Mass measurement
- Functional check of sensors
- Functional check of motor
- Vibration test
- TV cycling test
- Starting current test at ambient conditions

## Performance

Description	Value
<b>General Characteristics</b>	
Mass	< 690 g
Envelope	See Mechanical ICD
Drive direction	Clock-wise and counter-clock-wise rotation
Pointing range	full rotation (optional embedded end-stops available)
Full Steps per output revolution	59616
Backlash at output shaft	< 42 arcmin
Lifetime	15 years in orbit + 5 years storage
Life profile (thermal vacuum life qualification)	60 cycles at +20°C, 35776 cycles at -40°C, 35776 cycles at +115°C Cumulated output angle: 642000 deg
Measurable Output Torque	cold (-40°C) 23 Nm ambient (+20°C) 23 Nm hot (+115°C) 23 Nm
ECSS factorized "Delivered Output Torque"	15 Nm
Unpowered holding torque at output shaft (min. motor magnetic detent torque multiplied with total gear ratio, without actuator internal friction)	8.7 Nm (selectable up to 15.3 Nm)
Clean Detent Torque	yes, stable detent positions at any half step and at any full step
Rolling bearing material (rings and balls)	AISI 440C
Lubrication	PFPE based fluid lubrication
Backdrivability in ambient air	yes

Description	Value
<b>Motors</b>	
Wiring scheme	
Winding resistance	cold (-40°C) 52 Ohm ambient (+20°C) 68 Ohm hot (+115°C) 94 Ohm
Coil inductance	9.1 mH
Voltage	26V +/- 10%
Power consumption at 20°C and nom. voltage	9.9 W
Operation	2 Phase bipolar wave drive alternatively: Full Step, Half Step or micro-stepping, unipolar version available
Redundant Windings	yes
External magnetic moment	< 1 Gauss at a distance of 30mm
<b>Ground Storage</b>	
Ground storage temperature	+10°C / +40°C
Ground storage humidity	20% / 50% RH
<b>Temperature Range</b>	
In orbit non-operational temperature	-100°C / +125°C
In orbit operation temperature, qualification range	-40°C / +115°C
Allowable temperature gradient between output shaft and housing	20°C

Description	Value										
<b>Electrical Connectors</b>											
Electrical Connector	Flying leads, Cable length customer specific										
<b>External Surfaces</b>											
External Finish	Ti6Al4V, untreated, Stainless Steel, passivated										
<b>External Loads</b>											
Axial (+20°C, isothermal, non-operating, no other external loads)	630 N										
Radial (+20°C, isothermal, non-operating, no other external loads)	900 N										
Bending (+20°C, isothermal, non-operating, no other external loads)	80 Nm										
<b>Stiffness</b>											
Axial stiffness (attached to rigid bodies)	> 60620 N/mm										
Radial stiffness (attached to rigid bodies)	> 36740 N/mm										
Bending stiffness	> 58560 Nm/rad										
Torsional stiffness when the motor is unpowered	345 Nm/rad										
<b>Vibrations</b>											
Vibration load (quasistatic)	90 g lateral, 90 g axial										
Vibration load (sine)	<table style="width: 100%; border: none;"> <tr> <td style="width: 50%;">Frequency in Hz</td> <td style="width: 50%;">Level in g</td> </tr> <tr> <td>5</td> <td>0,57</td> </tr> <tr> <td>80</td> <td>90</td> </tr> <tr> <td>82</td> <td>90</td> </tr> <tr> <td>100</td> <td>60</td> </tr> </table>	Frequency in Hz	Level in g	5	0,57	80	90	82	90	100	60
Frequency in Hz	Level in g										
5	0,57										
80	90										
82	90										
100	60										
Vibration load (random)	30 gRMS										
<b>Shock Input</b>											
Shock load	<table style="width: 100%; border: none;"> <tr> <td style="width: 50%;">Frequency in Hz</td> <td style="width: 50%;">SRS (Q=10)</td> </tr> <tr> <td>100</td> <td>20 gSRS</td> </tr> <tr> <td>1000</td> <td>1000 gSRS</td> </tr> <tr> <td>10000</td> <td>1000 gSRS</td> </tr> </table>	Frequency in Hz	SRS (Q=10)	100	20 gSRS	1000	1000 gSRS	10000	1000 gSRS		
Frequency in Hz	SRS (Q=10)										
100	20 gSRS										
1000	1000 gSRS										
10000	1000 gSRS										
<b>Export Licenses</b>											
Export Licenses	No components are under export control										

## Dimensions and Mechanical Interface

