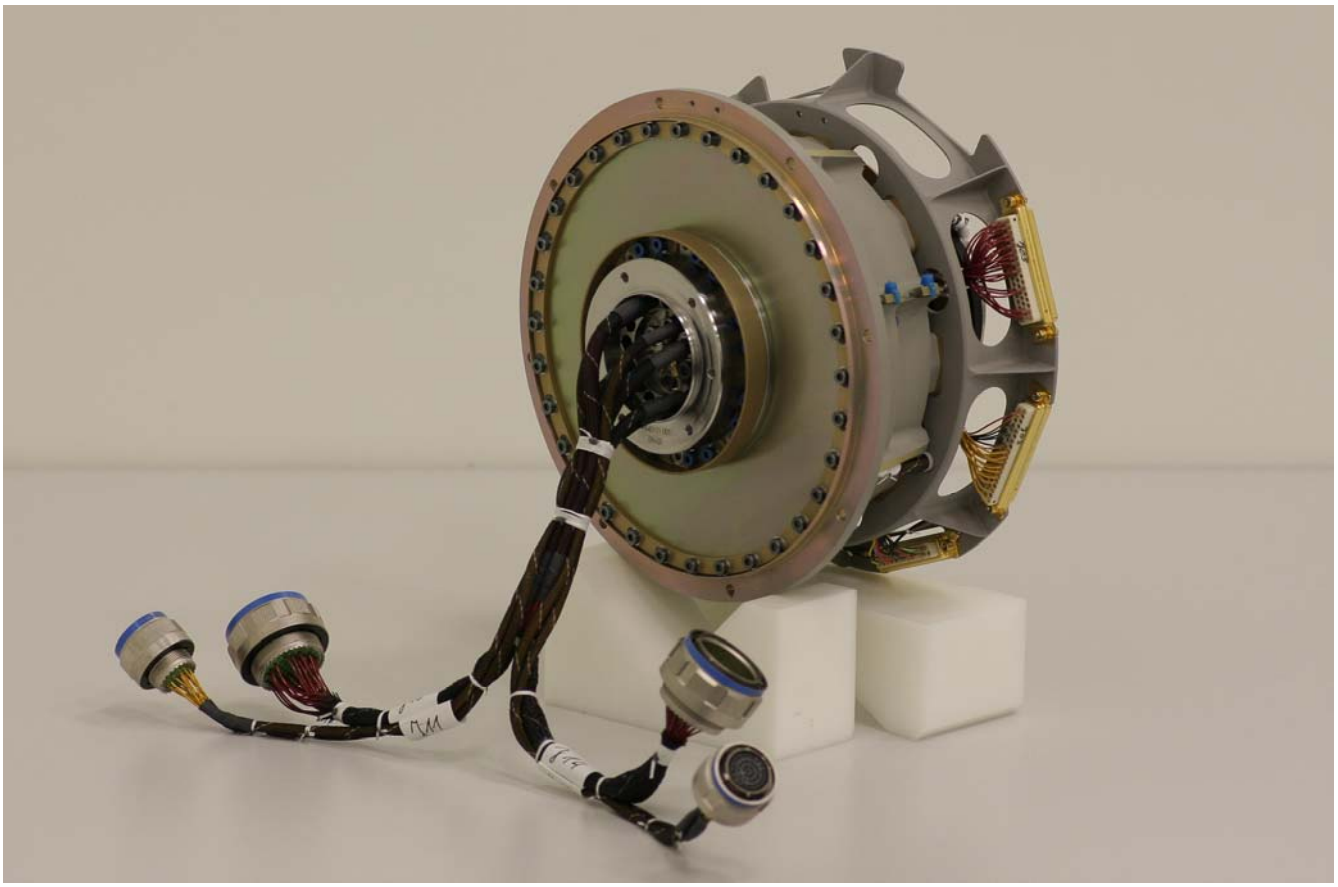
SEPTA® 24

Solar Array Drive Assembly



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GENERAL DESCRIPTION

The SEPTA 24 Solar Array Drive Assembly (SADA) is designed to fulfill a large range of applications on satellites with a mass of approximately 5000 kg in LEO, MEO and GEO orbit that are used for scientific or telecommunications purposes by using a standard product to minimise costs on system level. The SADA consist of a Solar Array Drive Electronic (SADE), up to two Solar Array Drive Mechanisms (SADMs) and the interconnecting harness. For customers preferring to use their own SADE design, the SADM can be purchased individually.

The SADM consists of an actuator, a slip ring assembly (composed of a collector for power and signal transfer) and potentiometers as well as a reference sensor ('reset switch') for position feedback. All these components are fully redundant.

This version of the SEPTA24 mechanism is based on a previous, fully qualified version, which is already in service on orbit on several GEO missions. All components and technologies used in the SEPTA24 SADA have significant flight heritage from various programs.

Within the SADA qualification campaign, the SADM will be qualified for 15 years continuous operation in a GEO environment (one output revolution per day). Qualification will be reached by the end of 2015. Qualification for other environments is available on request.

The main functions of the SEPTA 24 are to sustain and rotate the Solar Array Panel in both forward or reverse directions, as well as transfer power, signals and grounding from the Solar Array to the satellite. The SEPTA 24 has a very precise rotational resolution (step size) of 0.00625° and a maximum operational speed of one rotation per 18 minutes. The position of the Solar Array is measured using two redundant potentiometers. Thanks to a highly accurate calibration of the SADE, an accuracy of ±0.5° can be reached.

The slip ring assembly features up to 48 power tracks (24 forward + 24 return) rated for 6.2 A and 34 signal tracks at 0.5 A. In addition, two ground lines rated for 1 A are available. Moulding of rings and contacts wires, together with wires and soldering points, within a charged space qualified epoxy gives a very high electrical insulation. The full power and signal transfer section of the SADM is double insulated.

Position measurement is achieved using main and redundant potentiometers and an independent reset switch. The SADM's position can be requested via MIL bus from the SADE at any time.

The SADM is actuated using a two phase hybrid stepper motor with redundant windings giving 57600 stable (un-powered) positions of the output shaft over one revolution.

The SEPTA24 SADA is optimized for low-disturbance operation. The exported forces and torques have been characterized on Europe's leading measurement facility. This makes SEPTA24 the SADM of choice for scientific missions which require a low-noise platform and a high pointing stability.

The exported torque characteristics are available on request.

OPTIONS

The SEPTA 24 is available in a 12 or a 24 power line version (6.2 A each). The 24 line version is approx. 24mm longer and 1 kg heavier compared to the 12 line version.

Other options are available on request.

DESIGN CHARACTERISTICS

Operational Performance	
Drive direction	Forward and reverse; multiturn (no “unwind” needed)
Output speed range (nominal in orbit)	0 to 80 revs per day
Maximum output speed (ground testing)	0.75 °/s
Output Step Size (full step)	0.00625°
Life Time	15 years in orbit + 10 years on-ground storage (increased storage duration on request)
Revolutions Life Time	500 full revs on ground 5490 full revs on orbit (1 rev / day over 15 years)
Life Time Qualification Sequence	2000 + 13040 = 15040 full revs

Delivered Torque	
SA holding torque with motor unpowered	> 7 Nm
SA holding torque with motor powered	≥ 60 Nm
Torque Margin	Compliant to ECSS ECSS-E-ST-33-01C
Back-Driveability	Possible with un-powered motor

Power Transfer	
Number of power lines (1 line = 1 forward & 1 return track)	12 or 24 lines
Current	6.2 A_{RMS}
Voltage	Operational: up to 110 V Survival: 30s @ 500V_{DC}
Power transfer	up to 16.3 kW
Connector-to-Connector Resistance at 20 °C	< 30 mΩ (with standard harness configuration)
Connector-to-Connector Resistance at worst hot case	< 40 mΩ (with standard harness configuration)
Insulation	≥ 10 MΩ @ 500 V, 30s (double insulated)
Noise	≤ 5 mV_{RMS}/A

Signal Transfer	
Number of signal lines (1 line = 1 forward & 1 return track)	17 lines
Number of SA Ground tracks	2 tracks
Current	0.5 A for signals 1.0 A for Grounding
Voltage	Operational: 55 V Survival: 30s @ 500V_{DC}
Connector-to-Connector Resistance at 20 °C	< 150 mΩ (with standard harness configuration)
Connector-to-Connector Resistance at worst hot case	< 180 mΩ (with standard harness configuration)
Insulation	≥ 10 MΩ at 500 V, 30s (double insulated)
Noise	≤10 mV_{RMS}/A

Position Measurement

Position Output over MIL-Bus (calibrated)	± 0.5° (outside of potentiometer deadband)
Position Output availability	0° … 356.5°
Alignment between main and redundant unit	< 2°

Note: The SADE is equipped with a deadband detector. A reading of 0° will be given, when the mechanism is in the zone between 356.6° and 360°.

Reference Switch

Reference Switch low	0° < α < 180° (± 2.5°)
Reference Switch high	180 < α < 360° (± 2.5°)
Reference Switch repeatability	< ± 0.1°
Alignment between position sensor and Reset Switch	< 2°

Note: The offset between mechanical zero position and the reference switch will be calibrated into the SADE. When commanded to the reference position, the SADA will end up at the correct position with an accuracy of the reference switch repeatability.

SADA Power Consumption

All values are for the complete SADA (SADE + 2 SADMs). Using other a different SADE might lead to other values.

Cruise Mode @ max. hot operational	< 22W
Cruise Mode @ min. cold operational	< 62 W
Worst case short term peak consumption (< 1s)	< 75 W

Qualification Temperature Levels

	S/C interface	S/A interface	S/C radiative interface
Ground Storage	10°C … 30°C	10°C … 30°C	10°C … 30°C
Hot Non-Operational (Survival)	+ 90°C	+ 115°C	+ 130°C
Hot Operational	+65°C	+110°C	+95°C
Cold Operational	– 20°C	– 55°C	– 60°C
Cold start-up limit	– 20°C	– 55°C	– 70°C
Cold Non-Operational (Survival)	– 40°C	– 60°C	– 70°C

Mechanical Qualification Levels

High level sine vibrations:

Frequency (Hz)	// *MOUNTING PLANE*	⊥ *MOUNTING PLANE*
5 to 19	± 10 mm	± 10 mm
19 to 100	15 g	15 g

Random vibrations:

⊥ *MOUNTING PLANE*		// *MOUNTING PLANE*	
Freq. (Hz)	*Level*	*Freq. (Hz)*	*Level*
20-100	+3 dB/oct	20-100	+3 dB/oct
100-300	0.5 g²/Hz	100-300	0.21 g²/Hz
300-2000	-5 dB/oct	300-2000	-5 dB/oct
Global:	16.9 g_{rms}		11.0 g_{rms}

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

Frequency	Shock input levels
100 Hz	20 g
400 Hz	300 g
1000 Hz	1000 g
10000 Hz	1000 g

Note: All dynamic mechanical levels are understood with a 3.5kg mass with a CoG at 75mm from the S/A interface plane.
Higher levels are possible on request.

Static Loads

Axial Load	± 1000 N
Radial Load	± 2000 N
Bending Load	± 360 Nm

Stiffnesses

Axial stiffness	3.15×10^7 N/m
Shear stiffness	2.5×10^7 N/m
Torsion angular stiffness	4.0×10^3 Nm/rad
Bending angular stiffness	3.8×10^4 Nm/rad
First eigenfrequency with 3.5 kg @ 75mm from S/A interface	> 140 Hz

DIMENSIONS AND MECHANICAL INTERFACES FOR SEPTA 24
(12 Power Lines)