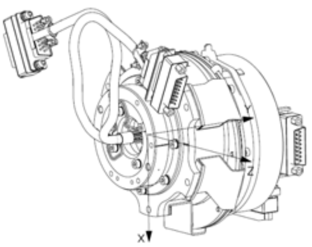
SEPTA® 41
Solar Array Drive Assembly

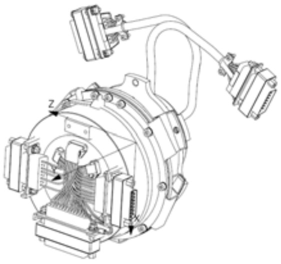
RUAG Space | Schaffhauserstrasse 580 | CH-8052 Zurich | Switzerland
Phone +41 44 306 2211 | info.space@ruag.com | www.ruag.com/space

Together ahead. RUAG

GENERAL DESCRIPTION

The SEPTA 41 Solar Array Drive Assembly (SADA) is designed to fulfill applications on micro satellites with a mass of approximately 200 kg in LEO and MEO orbit that are used for scientific or telecommunications purposes by using a standard product to minimise costs on system level. The SADA is fully space qualified and consists of an actuator, a slip ring assembly (composed of a collector for power and signal transfer) and two potentiometers for position feedback. Cold redundancy can be achieved by equipping the SADA with two identical embedded drive electronics for main and redundant operation. The SADA has flight heritage since 2006 with more than 38’000 full cycles performed and over 40 years of accumulated component fight heritage (C.F.H.).

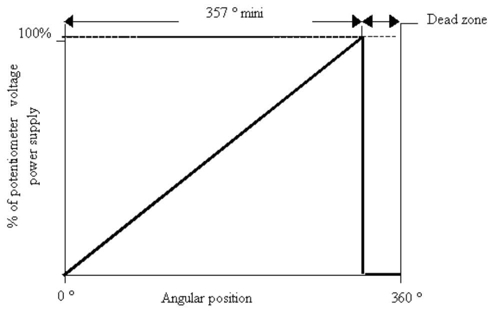




The main functions of the SEPTA 41 are to sustain and rotate the Solar Array Panel in both, forward or reverse directions, as well as transfer power, signals and grounding from the Solar Array to the satellite. The SEPTA 41-E has a rotational resolution of 23’040 steps by micro stepping and 360 steps by direct drive. The position of the Solar Array is measured using two redundant potentiometers delivering an accuracy of ±1°.

The collector consists of 11 current transfer rings made from gold plated brass, rated for the following currents: 10 power tracks at 1.65 A; 1 ground track at 1.65 A; 2 signal tracks for the potentiometer. Moulding of rings and contacts wires, together with wires and soldering points, within a charged space qualified epoxy gives a very high electrical insulation.

Position measurement is achieved using main and redundant potentiometers, which feedback an analogue 0 V to 5 V signal, delivering a continuous angular position of the SADA with a full measurement scale of 360°. The potentiometers have a total resistance of 10 kΩ ±10%.



The SADA is powered using a two phase hybrid stepper motor with redundant windings giving 360 resp. 23040 (by micro stepping) stable (un-powered) positions of the output shaft over one revolution.

OPTIONS

The SEPTA 41-E incorporate fully space adequate electronics integrated at the rear of the SEPTA 41 on two separate PCB’s. The SEPTA 41-E version can be fed using 23.6 V to 34 V regulated power bus.

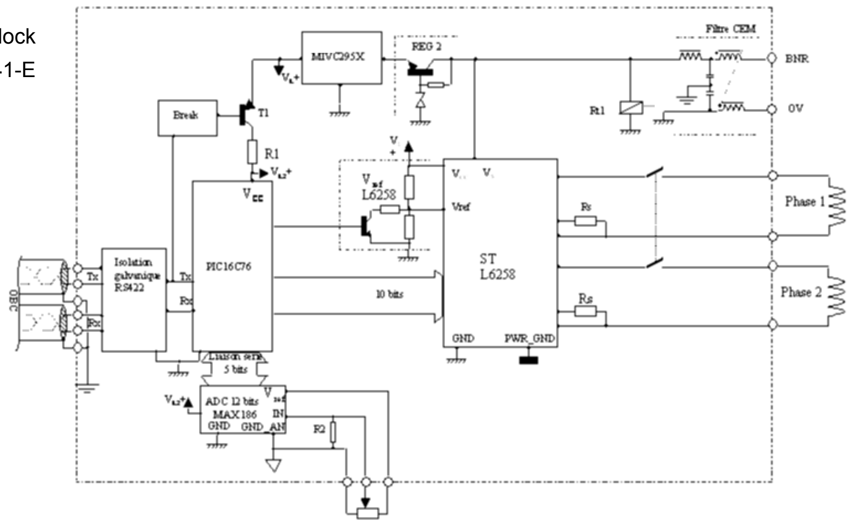
The SEPTA 41-M version without embedded electronics can be powered directly with a dual phase sinusoidal 21 V to 36 V input with a maximum current of 80 mA. This version may be upgraded to provide higher torque levels by using 76 Ω windings.

The following SEPTA 41 Models are available:

	Drive Electronics	21 V to 36V **Potentiometer**	**285Ω motor Windings**	**76Ω motor Windings ***
SEPTA 41-E	x	x	x	-
SEPTA 41-M	-	x	x	-
SEPTA 41-MM*	-	x	-	x

* A PFM approach is requested for this model

Figure 1: SADE Block Diagram SEPTA 41-E

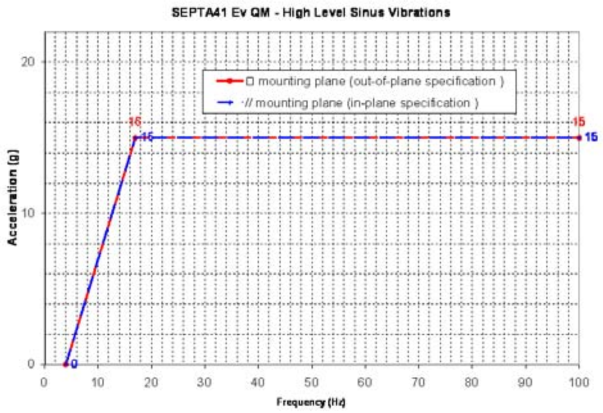


ESD

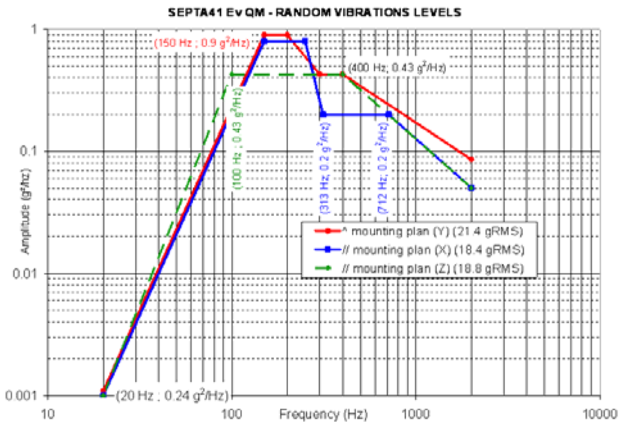
SEPTA 41-E is ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulates on the human body and test equipment and can discharge without detection. Although the SADA features proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.

VIBRATION LEVEL

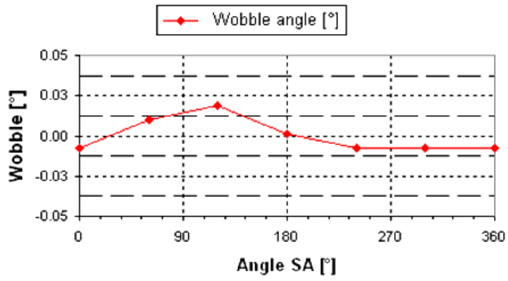
For SEPTA 41 acceleration levels for X- and Z-axis, parallel to mounting plate, for random vibration levels is given as follows:

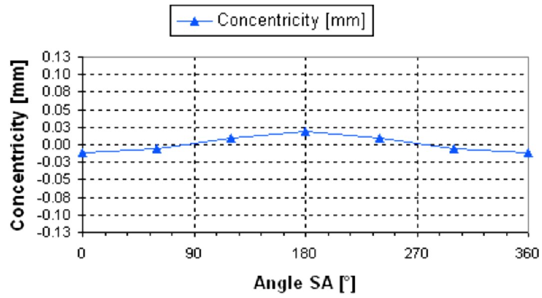


Random vibration levels for acceleration on all axes correspond with the following diagram:



WOBBLE & CONCENTRICITY





PACKAGING AND STORAGE

As delivered by RUAG SPACE the SEPTA 41 is mounted on a handling tool equipped with shock detectors.

The SEPTA 41 must be kept in a clean room class 8 (100'000) environment and shall be protected from direct UV-light. If moved out of a clean environment, it has to be double bagged and sealed in antistatic protective foil (ESD) under dry nitrogen.

DELIVERABLES

- FM- or PFM-Units
- Transport and Handling Jigs (temporary only)
- EIDP (CD-ROM):
    - Certificate of Conformity
    - CIDL & ABCL
    - Logbook
    - Interface Control Document
    - User's Manual
    - RfD's / RfW's
    - NCR's
    - Minutes of Meetings
    - Acceptance Test Plan
    - Acceptance Test Report

FLIGHT MODEL ACCEPTANCE PROGRAM

The flight model acceptance program includes the following tests:

- Inspection and control
- Mass measurement
- Functional characteristics measurement
- Vibration tests (FM-level)
- Thermal vacuum cycling with performance tests
- Inspection and Control

DESIGN CHARACTERISTICS

Mechanism	
Drive direction	Forward and reverse rotation (endless rotation)
Speed range	0 to 1 rev / 15 min
Maximum rotation speed	0.4°/s
1 revolution	23040 steps
1 step	0.015°
Qualified life span	5 years in orbit + 5 year storage (2 years integrated on Satellite)
Revolutions performance	2000 on ground 38 000 orbital rotations
Qualification sequence	1770-equivalent rotations

Motor	
Winding resistance	285 Ω ±5%
Number of steps per revolution of motor	360
Stable positions (motor is unpowered)	360
SA holding torque (unpowered motor)	≥ 0.05 Nm
SA average torque(powered motor)	≥ 0.3 Nm
Output torque (powered motor)	≥ 0.2 Nm

Power Transfer (forward or reverse line)	
Number of power transfers	11 (+1Signal)
Current	1.65 A
Voltage	Nom. 33 V
Power transfer	Min. 185 W Max. 600 W
Insulation	≥ 10 MΩ
Noise	< 5 mV_{RMS}/A

Position Measurement	
Potentiometer resistance	10 kΩ ± 10%
Potentiometer accuracy	±1°
Potentiometer electrical course and dead-band	over 357° / 3°
Potentiometer linearity	±0.5%

Dimension	
External diameter	110 mm
Fixation flange diameter	120 mm
Total length (from SA interface flange to rear part)	110 mm
Mass	M ≤ 1.7 kg

Mechanical Interface

PF interface	See Figure 2 to 4
SA interface	See Figure 2 to 4

Power Consumption (worst case)

	V_{BUS}	P_{motor}	P_{SADE}	Total Power
Nominal	33 V	1.59 W	2.23 W	3.82 W
Maximum	34 V	1.8 W	2.3 W	4.10 W

Qualified Temperatures

	T_{min}	$T_{Ambient}$	T_{max}
Ground Storage	+ 10°C	+22°C	+ 40°C
In orbit non operational	- 30°C		+ 60°C
Cold start-up limit	- 30°C		+ 55°C
In orbit operational	- 20°C	+22°C	+ 55°C

Environment conditions during operation

Orbits	LEO	MEO	
Radiation Total Dose (Shielding 2.5 mm Al)		15 krad (*)	

* Additional shielding can be applied.

SADM Connectors

J1A	SA power	DAMA15P
J1B	SA power & signal interface	DAMA15S
J2	PCU power & signal interface	DBMA25S
J3	PDU motor power supply interface	DAMA15P
J4	OBC command & motor position interface	DAMA15S

Radiative Interface	Slip ring housing	Motor housing	Electronic housing
External finish (nature)	Black anodizing	Black paint	Black anodizing
Emissivity (ε)	0.85	0.85	0.85
Absorption (α)	0.80		0.80

Conductive interface	Qualification
Axial load (F_y)	1000 N
Radial load (F_{xz})	1000 N
Torsion moment (M_y)	10 Nm
Bending moment (M_{xz})	30 Nm

Stiffnesses

Axial stiffness (K_y)	> $1.2*10^8$ N/m
Radial stiffness (K_{xz})	> $6*10^7$ N/m
Torsion angular stiffness ($K_{\theta y}$)	> $2*10^4$ Nm/rad
Driving Stiffness	13 Nm/rad

Environment conditions during launch

Random vibration:	**Frequency (Hz)**	**Qualification**
⊥ mounting plane	20 – 150	+ 10 dB/oct
	150 – 200	0.45 g²/Hz
	200 – 300	- 5.5 dB/oct
	300 – 400	0.215 g²/Hz
	400 – 2000	- 3 dB/oct
// mounting plane	20 – 150	+ 10 dB/oct
	150 – 250	0.4 g²/Hz
	250 – 313	- 18.5 dB/oct
	313 – 712	0.1 g²/Hz
	712 – 2000	- 4 dB/oct

High level sine vibration:	**Frequency (Hz)**	**Qualification**
	4 – 17 Hz	± 12.9 mm
	17 – 100 Hz	15.0 g

Shock levels for each axes (X, Y, Z):	**Frequency (Hz)**	**Shock input levels**
	200	300 g
	2000	1000 g
	10000	1000 g

DIMENSIONS AND MECHANICAL INTERFACES FOR SEPTA 41

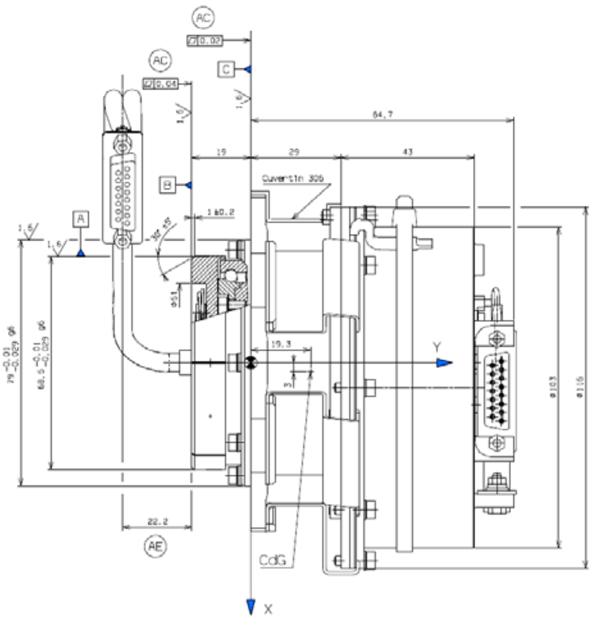


Figure 2: SEPTA 41 plan view

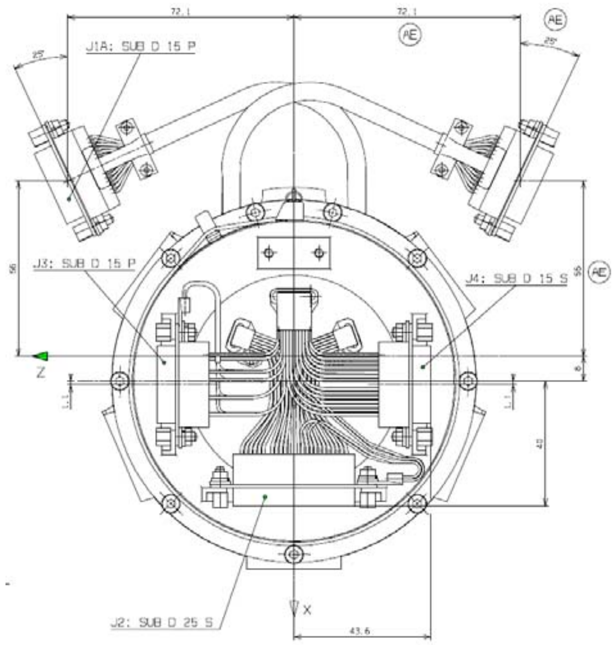


Figure 4: SEPTA 41 plan view with connectors

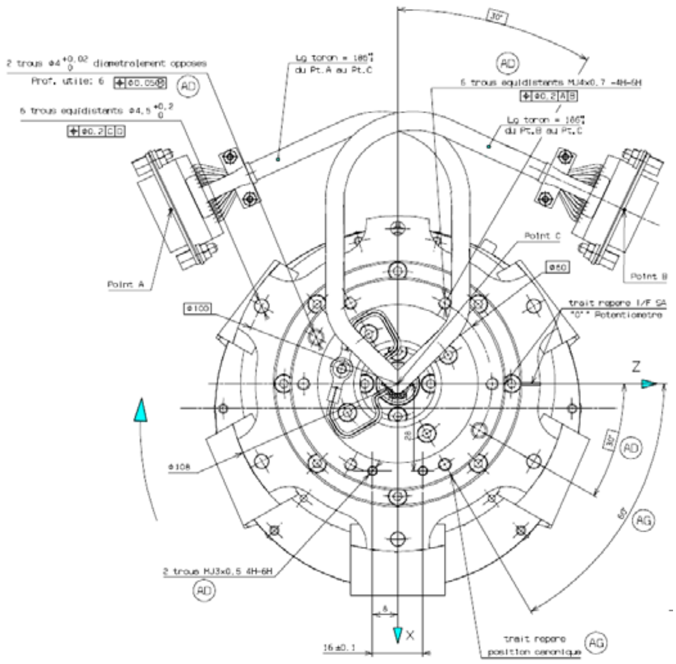


Figure 3: SEPTA 41 Solar Panel Interface side view

ELECTRICAL INTERFACES FOR SEPTA 41-E

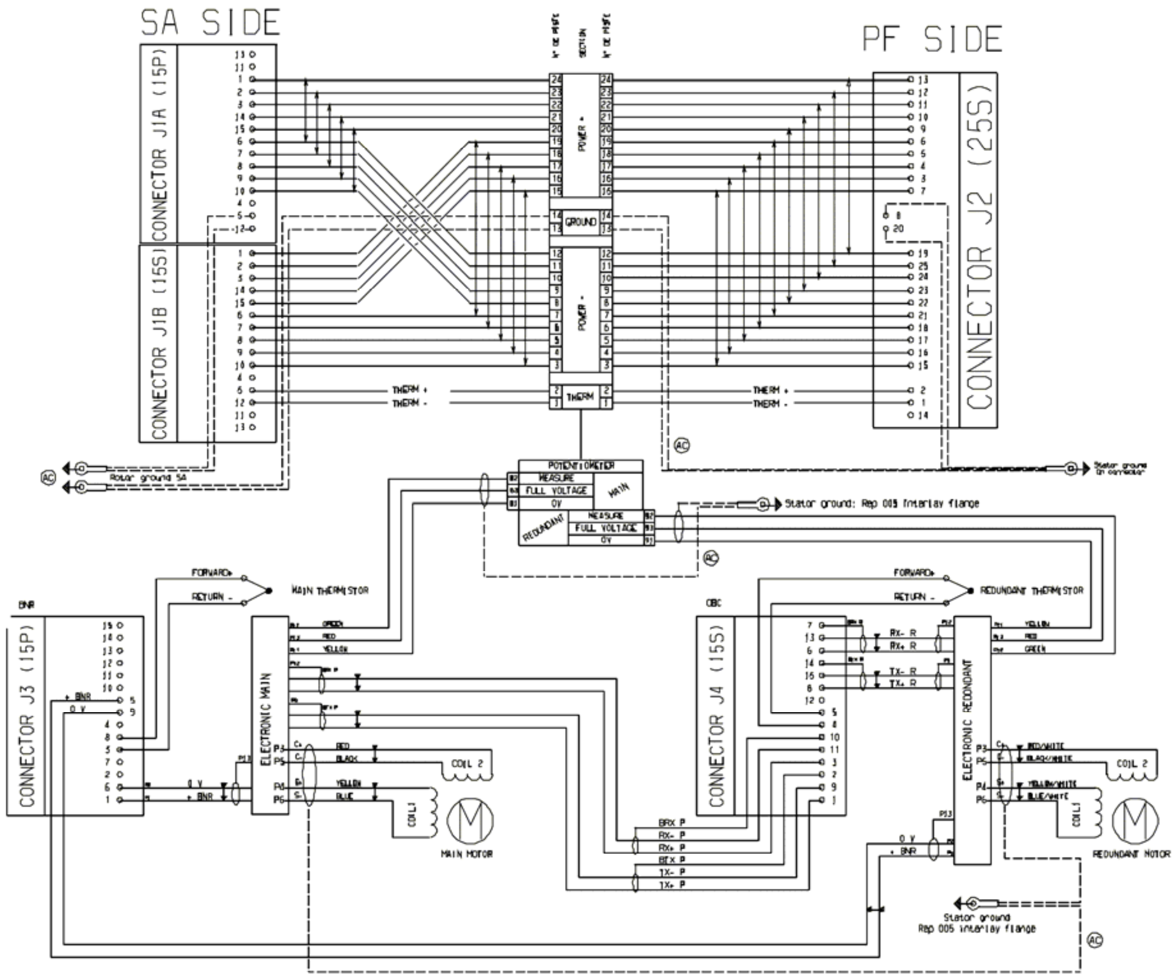


Figure 5: Septa 41 SADE electrical interface