GomSpace A/S
Langagervej 6
9220 Aalborg E

NANOPOWER TSP 45W

Qualification Certificate

Reference: 1053540
Revision: 1.1
Date: 2025-06-20

GomSpace A/S
Langagervej 6
9220 Aalborg E

Document Title:	NanoPower TSP 45W Qualification Certificate		
Reference:	1053540	**Document Class**	QTCT
Revision number:	1.1	**Date:**	2025-06-20

Release Table:

Action	Name	Function	Initials / Signature	Date
Prepared / Owned by:	Dannie Toft Nielsen	Test Engineer	DTN	2023-09-13
Verified / Reviewed by:	Rasmus Bruus Nielsen	Mechanical Engineer	RABN	2024-02-02
Approved by:	Lars Vestergaard	PA Manager	LAV	2024-02-05

Document Change Log (Not mandatory)

Revision	Date	Initials	Description
0.1	2023-09-13	DTN	Initial draft
1.0	2024-02-06	DTN	Reviewed and approved
1.1	2025-06-20	LAV	Updated flight heritage

References

Reference	Document title	Document number	Revision, Date
[RD-1]	GomSpace Qualification Program	1012670	Rev. 2.3, 2023-03-24
[RD-2]	gs_qtrp_TSP 2030-3P vibration test report	1033030	Rev. 1.0, 2022-10-14
[RD-3]	gs-qtrp-TSP2030 shock test	1033028	Rev. 1.0, 2021-09-01
[RD-4]	gs-qtrp-TSP 2030-3P Thermal Vacuum Test report	1041076	Rev. 1.0, 2022-06-01
[RD-5]	gs-qtrp-NanoPower SADA 50 Radiation Total Ionizing Dose Test Report	1036048	Rev. 2.5, 2024-02-05
[RD-6]	gs-qtrp-Release Control Radiation Total Ionizing Dose Test Report	1039428	Rev. 1.0, 2022-03-18
[RD-7]	gs-qtrp-TSP-SADA-50 Thermal Stress Test Report	1044560	Rev. 1.0, 2022-10-06
[RD-8]	gs-qtrp-HDRM-Kit Thermal Stress Test Report	1044561	Rev. 1.0, 2022-10-06
[RD-9]	gs-qtrp-TSP Connect PCB Thermal Stress Test Report	1044562	Rev. 1.0, 2022-10-06
[RD-10]	TSP 45W Thermal Stress Test Report	1048131	Rev. 1.0, 2023-02-23
[RD-11]	gs_qtrp_TSP 2030-3P HDRM life_SA lifetime testing	1034315	Rev. 1.1, 2023-01-11
[RD-12]	gs-qtrp-NanoPower-SADA-50 lifetime test-1-0-INT	1055578	Rev. 1.1, 2024-01-26

TABLE OF CONTENTS

1. Qualification Tests

1.1 Purpose

This document describes the environmental qualification tests which is carried out on this specific product. In the following sections, the tests and the corresponding test results are summarized.

1.2 Product

Manufacturer Name: GomSpace
Product Name: NanoPower TSP 45W
Product Number: 108992

Included subcomponents:

Product Name	Product Number
SADA-50 Direct Drive Box Assembly	108215
TSP-HDRM-kit	108993
TSP_Connect	108615
TSP wing assembly	108662

1.3 Vibration Tests

The product has been subjected to the following tests.

Tests: Random Vibration
Sinusoidal Vibration
Quasi-static / Sine burst

Conditions: The product is mounted in a 6U GomSpace structure which is inserted inside a GomSpace Qualification POD. It is tested under the following test conditions.

Test Description	Test Conditions
Random Vibration	20Hz, 0.026G2/Hz 20-50Hz, +6 dB/oct 50-800Hz, 0.16G2/Hz 800-2000Hz, -6 dB/oct 2000Hz, 0.026G2/Hz Overall, 14.1Grms
Sinusoidal Vibration	5-8Hz, 20mm pp 8-100Hz, 4.5G
Quasi-static / Sine burst	30Hz, 15G, 19 cycles / 7 loaded cycles

Remarks: For details see the vibration test report, [RD-2]

Conclusion: The NanoPower TSP 45W is tested according to the above-mentioned conditions. The visual mechanical inspection and electrical / functional tests are passed. This certificate ensures that performance, test condition and test equipment are according to GomSpace quality.

1.4 Shock Tests

The product has been subjected to the following tests.

Tests: Shock

Conditions: The product is mounted on a 6U structure and shock test while in the GomSpace 6U vibration test pod – Test Facility: Terma. The device is exposed to two impacts at each axis, X, Y and Z.
It is tested under the following test conditions.

Test Description	Test Conditions
Shock Response Spectrum (SRS):	100Hz, 40G 1000Hz, 1000G 2000Hz, 1500G 10000Hz, 1500G +6dB / -6dB from the nominal shock 50% of the measured shock shall be above nominal shock

Remarks: For details see the shock test report, [RD-3]

Conclusion: The NanoPower TSP 45W is tested according to the above-mentioned conditions. The visual mechanical inspection and electrical / functional tests are passed. This certificate ensures that performance, test condition and test equipment are according to GomSpace quality.

1.5 Thermal Vacuum Tests

The product has been subjected to the following tests.

Tests: Thermal Vacuum (TVAC)

Conditions: The product is mounted in a 6U GomSpace structure, prepared with thermocouples and harness, armed for deploy test, installed in the TVAC chamber for test. The temperature range defined in the table below refers to the thermal interface of the product during test to ensure its operating temperatures are within specifications. It is tested under the following test conditions.

Test Description	Test Conditions
Temperature	-55 to 90°C non-operational -40 to 90°C operational
Pressure	<1e-5 mbar
Cycles	1 non-operational + 7 operational
Dwell time	1,5 hours
TSP release	1 release, 28V, -40°C

Remarks: For details see the TVAC test report, [RD-4]

Conclusion: The NanoPower TSP 45W is tested according to the above-mentioned conditions. The electrical / functional tests performed are passed. This certificate ensures that performance, test condition and test equipment are according to GomSpace quality.

1.6 Radiation TID Tests

The product has been subjected to the following tests.

Tests: Radiation TID (Total Ionizing Dose)

Conditions: The product is mounted at plate for TID testing, prepared with harness and necessary logging equipment.
It is tested under the following test conditions.

SADA 50 and TSP-HDRM kit:

Test Description	Test Conditions
Method	Direct (Online)
Rate	Low dose – 36 to 360 rad(Si)/hour
Total dose	20 krad
Condition	Biased at room temperature
Annealing	>24 hours
Ageing	>168 hours

Remarks: For details see the radiation test reports, [RD-5] and [RD-6].
The SADA-50 shows an abnormality after 14,4krad, where the motor position reading was affected. After the annealing process, the system recovered and showed normal behaviour.
The Connect PCBA have no active component, hence not subject to this test.
The TSP wing assembly has not been TID tested - The active components are bypass diodes and a temperature sensor, which both has been tested in other GomSpace products.

Conclusion: The NanoPower TSP 45W is tested according to the above-mentioned conditions. The electrical / functional tests performed the post ageing process are passed. This certificate ensures that performance, test condition and test equipment are according to GomSpace quality.

1.7 Thermal Stress Test

The product has been subjected to the following tests.

Tests: Thermal Stress (Accelerated Lifetime)

Conditions: The product is prepared with thermocouples and installed at the shelf of the Thermal Stress chamber. It is tested under the following test conditions.

SADA 50, HDRM, Connect PCBA:

Test Description	Test Conditions
Temperature – hot plateau	100°C +5 /-0°C
Temperature – cold plateau	-55°C +0 /-5°C
Cycles	500
Dwell time	15 minutes

TSP wing assembly:

Test Description	Test Conditions
Profile 1	
Temperature – hot plateau	100°C +5 /-0°C
Temperature – cold plateau	-75°C +0 /-5°C
Cycles	3000
Dwell time	0 minutes
Profile 2	
Temperature – hot plateau	101°C +5 /-0°C
Temperature – cold plateau	-101°C +0 /-5°C
Cycles	8
Dwell time	15 minutes

Remarks: For details see the thermal stress test reports, [RD-7], [RD-8], [RD-9] and [RD-10].

Conclusion: The NanoPower TSP 45W is tested according to the above-mentioned conditions. The visual mechanical inspection and electrical / functional tests are passed. This certificate ensures that performance, test condition and test equipment are according to GomSpace quality.

1.8 Lifetime testing

The product has been subjected to the following tests.

Tests: Lifetime testing (HDRM System)

Conditions: The product is armed and installed in a deployment jig.
It is tested under the following test conditions.

HDRM:

Cycle calculations		
	On ground	**In orbit**
Cycles to qualify for	8	1
ECSS factor	4	10
Repetitions – **(Total 42)**	32	10

Test Conditions	
Pressure	1 ATM
Temperature	20 – 25°C

Remarks: For details see the lifetime test report, [RD-11].

Conclusion: The NanoPower TSP 45W is tested according to the above-mentioned conditions. The visual mechanical inspection and electrical / functional tests are passed. It was observed however, that a burn resistor was dislocated after the 26th repeated test. The HDRM system remain functional afterwards. This certificate ensures that performance, test condition and test equipment are according to GomSpace quality.

Tests: Lifetime testing (SADA-50 including harness and harness mechanism)

Conditions: The product is installed in a fixture for the hinge and harness test.
It is tested under the following test conditions.

Primary harness:

Cycle calculations				
	On ground	**In orbit**		
Cycle range	Until 1000	Until 10	11 – 1000	1001 - 100000
ECSS factor	4	10	4	2
Cycles	100	10	990	5800
Repetitions – **(Total 16060)**	400	100	3960	11600

Test Conditions	
Pressure	<1e-5 mbar
Temperature	20 – 25°C

SADA and primary hinge:

Cycle calculations				
	On ground	**In orbit**		
Cycle range	Until 1000	Until 10	11 – 1000	1001 - 100000
ECSS factor	4	10	4	2
Cycles	100	10	990	57700
Repetitions – **(Total 119860)**	400	100	3960	115400

Test Conditions	
Pressure	<1e-5 mbar
Temperature	20 – 25°C

Remarks: For details see the lifetime test report, [RD-12].

Conclusion: The NanoPower TSP 45W is tested according to the above-mentioned conditions. The visual mechanical inspection and electrical / functional tests are passed. This certificate ensures that performance, test condition and test equipment are according to GomSpace quality.

1.9 Flight Heritage

A variant of the NanoPower TSP 45W, without SADA-50 and only one wing panel at each side, is at TRL 9 and have flight heritage since April 2023, flying on a costumer mission.

The complete NanoPower TSP 45W, with SADA-50, has flight heritage since January 2025 on a customer mission, integrated by GomSpace.

Furthermore, a modified variant of the NanoPower TSP 45W has flight heritage on the Juventas satellite, part of the ESA HERA mission. The HERA space craft was launched in October 2024.