GomSpace A/S
Langagervej 6
9220 Aalborg E

NANOCOM ANT2150

Qualification Certificate

Reference: 1028496
Revision: 1.2
Date: 2024-05-01

GomSpace A/S
Langagervej 6
9220 Aalborg E

Document Title:	NanoCom ANT2150 Qualification Certificate		
Reference:	1028496	**Document Class**	QTCT
Revision number:	1.2	**Date:**	2024-05-01

Release Table:

Action	Name	Function	Initials / Signature	Date
Prepared / Owned by:	Sebastian Andersen Dannie Toft Nielsen	Junior Engineer Test Engineer	SEAN DTN	2020-09-29 2023-05-15
Verified / Reviewed by:	Hans Kristian Kofoed	Product Owner	HKK	2024-02-07
Approved by:	Lars Vestergaard	PA Manager	LAV	2024-05-01

Document Change Log (Not mandatory)

Revision	Date	Initials	Description
1.0	2020-09-29	SEAN	Initial release
1.1	2024-02-09	DTN	New vibration, shock, irradiation, thermal stress test results added
1.2	2024-05-01	PHK	Updated with new thermal stress test using the “single peek frame”

References

Reference	Document title	Document number	Revision, Date
[RD-1]	GomSpace Qualification Program	1012670	Rev. 2.3, 2023-03-24
[RD-2]	gs-qtrp-nanocom-ant2150-dup Mechanical Vibration Test Report	1050573	Rev. 1.0, 2023-05-15
[RD-3]	gs-qtrp-nanocom-ant2150 Mechanical Shock Test Report	1054782	Rev. 1.0, 2023-11-16
[RD-4]	gs-qtrp-nanocom-ant2150 Thermal Vacuum Test Report	1055442	Rev. 1.0, 2023-12-20
[RD-5]	gs-qtrp-nanocom-ant2150 TID Test Report	1052937	Rev. 1.0, 2023-09-19
[RD-6]	gs-qtrp-nanocom-ant2150 Thermal Stress Test Report	1054960	Rev. 1.1, 2024-03-06

TABLE OF CONTENTS

1. Qualification Tests

1.1 Purpose

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

1.2 Product

Manufacturer Name: GomSpace
Product Name: NanoCom ANT2150-DUP
Product Number: 200346

Manufacturer Name: GomSpace
Product Name: NanoCom ANT2150-ISL
Product Number: 200347

Both variants are covered by this test since they share the same mechanics, i.e., antenna module, backplates and PCB, where the difference between the two products are the values of a few passive components only.

1.3 Vibration Tests

The product has been subjected to the following tests.

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

Conditions: Product is mounted in a 6U GomSpace structure which is mounted 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, 10mm p 8-100Hz, 4.5G
Quasi-static / Sine burst	30Hz, 15G, 19 cycles / 7 loaded cycles

Remarks: For details see the NanoCom ANT2150 vibration test report, [RD-2].

Conclusion: The NanoCom ANT2150 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: Mechanical Shock

Conditions: Product is mounted in the fixture for the GomSpace shock bench. The device is exposed to three 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 from the nominal shock 50% of the measured shock shall be above nominal shock

Remarks: For details see the NanoCom ANT2150 shock test report, [RD-3].

Conclusion: The NanoCom ANT2150 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: Product is mounted in a 6U GomSpace structure, prepared with thermocouples and harness, 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	-40 to +85°C (Non-Operational + Power ON) -40 to +55°C (Operational, TX Full Power, 100% duty cycle)
Pressure	<1e-5 mbar
Cycles	8
Dwell time	≥2 hours

Remarks: TX high power (31.8dBm / 100%) up to +55°C interface temperature.
TX high power (31.8dBm / 50%) up to +65°C interface temperature.
(In both above conditions board temperature will be below 85°C)

For details see the NanoCom ANT2150 TVAC test report, [RD-4].

Conclusion: The NanoCom ANT2150 is tested according to the above-mentioned conditions. The electrical / functional tests performed the 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: Product is mounted at plate for TID testing, prepared with harness and necessary logging equipment.
It is tested under the following test conditions.

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: Re-flashing the MCU after TID exposure failed. The issue is most likely caused by the charge-pump. Please note that re-flashing of MCU is not possible in orbit and the product will be fully functional up to the 20krad.

After the TID test, the MCU was replaced and proven the remaining components of the product are fully functional and resilient to the level of 20krad.

For details see the NanoCom ANT2150 TID test report, [RD-5].

Conclusion: The NanoCom ANT2150 is tested according to the above-mentioned conditions. The electrical / functional tests performed the are considered as conditionally passed.

An additional TID test without executing re-flashing after TID exposure is planned.

1.7 Thermal Stress Test

The product has been subjected to the following tests.

Tests: Thermal Stress (Accelerated Lifetime)

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

Test Description	Test Conditions
Temperature – hot plateau	100°C +5 /-0°C
Temperature – cold plateau	-55°C +0 /-5°C
Cycles	150
Dwell time	15 minutes

Remarks: For details see the NanoCom ANT2150 Thermal Stress test report, [RD-6].

Conclusion: The NanoCom ANT2150 is tested according to the above-mentioned conditions. The electrical / functional tests performed the are passed. This certificate ensures that performance, test condition and test equipment are according to GomSpace quality.

1.8 Flight Heritage

The NanoCom ANT2150 is at TRL 9 and has extensive flight heritage at several satellites since June 2017.