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NANOCOM AM2150-P_PS QUALIFICATION CERTIFICATE

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1. Introduction

1.1 Purpose

This document describes the environmental qualification tests carried out on the Nanocom AM2150-P and the Nanocom AM2150-PS S-band patch antenna system. The test plan and the definition of the Gomspace qualification is described [12]

1.2 References

Ref.	Document title	Document no.	Revision
[1]	Vibration Test Procedure	1029606	1.0
[2]	Vibration Test Report	1029609	1.0
[3]	Thermal Vacuum Test Procedure	1029607	1.0
[4]	Thermal Vacuum Test Report	1030285	1.0
[5]	Thermal Stress Test Procedure	1029605	1.0
[6]	Thermal Stress Test Report	1029608	1.1
[7]	Mechanical Shock Test Procedure	1027297	1.1
[8]	Mechanical Shock Test Report	1033088	1.0
[9]	Check out form	1022265	1.0
[11]	Check out manual	1029266	1.0
[12]	GomSpace Qualification Program	1012670	2.1

2. Total Ionizing Dose Qualification

The Nanocom AM2150-P and Nanocom AM2150-PS have not been exposed to qualification procedure for total Ionizing Dose. Main argument is that all the parts and components used for those products have flight heritage from the ANT2000 and other Gomspace antenna products. Components used are all passives.

The products are sandwiched around a mounting plate with a wideband stacked patch antenna element. The antenna element is 100% reuse from the ANT2000 product. On the back side of the mounting plate an adaptor PCB is connected. It consists of a hybrid and a termination resistor, and for AM2150-P two hybrids to do power splitting. All components on the adaptor PCB are also used in other Gomspace products with flight heritage.

3. Vibration Test Qualification

Test Facility: Hytec, Aalborg, Denmark

Product ID: Nanocom AM2150-P (108335), Nanocom AM2150-PS (108482) S-band antenna system.

Part no: 108335 rev. 1.0. Serial no. 2, 108482 rev. 1.0 Serial no. 2

Test Condition: Nanocom AM2150-P and Nanocom AM2150-PS is mounted on a 6U satellite structure. The RF connectors are equipped with RF cables. The satellite structure is mounted inside a POD. The antenna system is passive. This configuration is tested with respect to

Condition	Test levels
Random vibration	20Hz, 0.026g^2/Hz 50Hz, 0.16g^2/Hz 800Hz, 0.16g^2/Hz 2000Hz, 0.026g^2/Hz Overall, 14.1Grms
Sine vibration	Frequency, level [g] 5-11.5Hz, 17-20mm pp 11.5-100, 4.5G*
Sine burst	30Hz, 19cycles/7 loaded cycles, 15G

References: Gomspace Qualification Vibration test procedure and report [1,2].

Remarks: *) sine vibration is not tested in 8-100Hz as specified in [12] but in 11.5-100Hz due to technical issues at test facility. This does not cause any strength issues since no fundamental eigenfrequencies are present at these frequencies. Therefore, the load is more than covered by the 15 G at the quasi-static test.

The Nanocom AM2150-P and Nanocom AM2150-PS S-band patch antenna system is hereby tested with respect to vibration and is fully functional with the expected performance. This certificate ensures that performance, test conditions and test equipment are according to Gomspace quality.

4. Thermal Vacuum Qualification

Test Facility: Gomspace, Aalborg, Denmark

Product ID: Nanocom AM2150-P (108335), Nanocom AM2150-PS (108482) S-band antenna system.

Part no: 108335 rev. 1.0. Serial no. 2, 108482 rev. 1.0 Serial no. 2

Test Condition: Nanocom AM2150-P and Nanocom AM2150-PS is mounted on a 6U satellite structure and inserted into a thermal vacuum chamber.

The antennas are passive, and biasing is therefore not necessary.

Test description	Test levels
Thermal Vacuum	Temperature 50°C +/-3°C and -30°C +/-3°C Stabilized to 50°C Slope 2.5°C/min cycles 8 Time 48hours Dwell time 120minutes Pressure < 1.0x 10e-5mBar

References: Gomspace Qualification Thermal vacuum test procedure and report [3,4].

Remarks: The temperature of 50°C is the base temperature of the satellite structure thermal interface. The antenna modules were thermal cycled 12 times instead of 8 due to other product in the satellite structure.

The Nanocom AM2150-P and Nanocom AM2150-PS S-band patch antenna system is hereby tested with respect to thermal vacuum and is fully functional with the expected performance. This certificate ensures that performance, test conditions and test equipment are according to Gomspace quality.

5. Temperature Cycling / Thermal Stress Qualification

Test Facility: Gomspace, Aalborg, Denmark

Product ID: Nanocom AM2150-P (108335), Nanocom AM2150-PS (108482) S-band antenna system.

Part no: 108335 rev. 1.0. Serial no. 2, 108482 rev. 1.0 Serial no. 2

Test Condition: The modules are placed inside the thermal stress temperature chamber.

Test description	Test levels
Temperature cycling	-55°C for 15 minutes 100°C for 15minutes 500 cycles Switch time < 15minutes

References: Gomspace Qualification Thermal cycling test procedure and report [6,7].

Remarks: The modules ended up in having 546 thermal cycles 46 cycles more than anticipated. On both modules a solder joints to a 50 ohm termination resistor did show a minor fracture. I did not affect any performance of the unit.

The Nanocom AM2150-P and Nanocom AM2150-PS S-band patch antenna system is hereby tested with respect to thermal cycling / thermal stress and is fully functional with the expected performance. This certificate ensures that performance, test conditions and test equipment are according to Gomspace quality.

6. Mechanical Shock Qualification

Test Facility: Terma A/S, Lystrup, Denmark

Product ID: Nanocom AM2150-P (108335), Nanocom AM2150-PS (108482) S-band antenna system.

Part no: 108335 rev. 1.0. Serial no. 2 and 8, 108482 rev. 1.0 Serial no. 2 and 4

Test Condition: All four modules are mounted on the outer side of a 6U satellite structure together with other modules subject to shock test. The 6U structure were mounted inside a POD. The antenna modules were unbiased. RF cables connected to RF connectors.

Two Nanocom AM2150-P and two Nanocom AM2150-PS modules were used. Serial no. 8 and 4 are new direct from production and serial no. 2 is previously used for vibration, thermal vacuum and thermal stress qualification.

The POD was subject to pyro shocks with the following target SRS profile

Frequency [Hz]	SRS nominal (± 6 dB tolerance) [g]
100	40
1000	1000
2000	1500
10000	1500

Number of shocks per axis: two

References: Gomspace Qualification Mechanical shock test procedure and report [7,8].

Remarks: Two additional shocks were applied in the X-axis because the first two had less than 50% above target.

The Nanocom AM2150-P and Nanocom AM2150-PS S-band patch antenna system is hereby tested with respect to mechanical shock test and is fully functional with the expected performance. This certificate ensures that performance, test conditions and test equipment are according to Gomspace quality.

7. Summary

The Nanocom AM2150-P and Nanocom AM2150-PS S-band patch antenna system is tested according to the above-mentioned conditions and is fully functional and have the expected performance.

This certificate ensures that performance, test condition and test equipment are according to GomSpace quality.

As described in the test reports the Nanocom AM2150-P and Nanocom AM2150-PS modules are sandwiched around a mounting plate (several types available) with a wideband stacked patch antenna element on the “outside” and an adaptor PCB on the “inside” containing the antenna feed network and for the AM2150-PS an additional power splitter. The patch antenna and adaptor PCB are interconnected using RF compression connectors with flight heritage from ANT2000 and other GomSpace antenna products.