

WIRELESS TEST REPORT – 381042-1R1TRWL

Applicant:

Satcube AB

Product:

Portable satellite terminal

Model:

Satcube Ku

FCC ID:

2AUV4SATCUBEKU

Specifications:

FCC 47 CFR Part 1, Subpart I, §1.1310

Date of issue: **November 19, 2020**

Andrey Adelberg, Senior EMC/Wireless Specialist

Tested by



Signature

David Duchesne, EMC/Wireless lab manager

Reviewed by



Signature

Nemko Canada Inc., a testing laboratory, is accredited by the Standards Council of Canada.
The tests included in this report are within the scope of this accreditation

Lab locations

Company name	Nemko Canada Inc.			
Facilities	Ottawa site: 303 River Road Ottawa, Ontario Canada K1V 1H2	Montréal site: 292 Labrosse Avenue Pointe-Claire, Québec Canada H9R 5L8	Cambridge site: 1-130 Saltsman Drive Cambridge, Ontario Canada N3E 0B2	Almonte site: 1500 Peter Robinson Road West Carleton, Ontario Canada K0A 1L0
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Test site registration	Organization	Recognition numbers and location		
	FCC/ISED	CA2040 (Ottawa/Almonte); CA2041 (Montreal); CA0101 (Cambridge)		
Website	www.nemko.com			

Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.

This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contained in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

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Section 1 Report summary

1.1 Test specifications

FCC 47 CFR Part 1, Subpart I, §1.1310	Radiofrequency radiation exposure limits.
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1.2 Exclusions

None

1.3 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was performed against all relevant requirements of the test standard except as noted in section 1.2 above. Results obtained indicate that the product under test complies in full with the requirements tested. The test results relate only to the items tested.

See "Summary of test results" for full details.

1.4 Test report revision history

Table 1.4-1: Test report revision history

Revision #	Date of issue	Details of changes made to test report
TRF	November 16, 2020	Original report issued
R1TRF	November 19, 2020	Added measurement results around the EUT

Section 2 Engineering considerations

2.1 Modifications incorporated in the EUT for compliance

There were no modifications performed to the EUT during this assessment.

2.2 Technical judgment

None

2.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 3 Test conditions

3.1 Atmospheric conditions

Temperature	15 °C – 35 °C
Relative humidity	30 % – 60 %
Air pressure	86 kPa (860 mbar) – 106 kPa (1060 mbar)

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

3.2 Power supply range

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages $\pm 5\%$, for which the equipment was designed.

Section 4 Measurement uncertainty

4.1 Uncertainty of measurement

UKAS Lab 34 and TIA-603-B have been used as guidance for measurement uncertainty reasonable estimations with regards to previous experience and validation of data. Nemko Canada, Inc. follows these test methods in order to satisfy ISO/IEC 17025 requirements for estimation of uncertainty of measurement for wireless products.

Measurement uncertainty budgets for the tests are detailed below. Measurement uncertainty calculations assume a coverage factor of $K = 2$ with 95% certainty.

Table 4.1-1: Measurement uncertainty

Test name	Measurement uncertainty, dB
All antenna port measurements	0.55
Conducted spurious emissions	1.13
Power density with Field sensor	0.015

Section 5 Summary of test results

5.1 Testing location

Test location (s)	Ottawa
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5.2 Testing period

Test start date	October 16, 2020
Test end date	October 16, 2020

5.3 Sample information

Receipt date	September 23, 2020
Nemko sample ID number	Item # 1

5.4 Test results

Table 5.4-1: Result summary

Part	Test description	Verdict
§1.1310(e)(1)	Limits for occupational/controlled exposure	Not applicable
§1.1310(e)(2)	Limits for general population/uncontrolled exposure	Pass

5.5 Technical information

All used IC test site(s) Reg. number	2040A-4
Frequency range, GHz	Sat: Transmit: 13.75 to 14.5, Receive: 10.95 to 12.75, Wi-Fi: 2400–2483.5 MHz
Test frequencies, GHz	Sat: 14.25, Wi-Fi: 2.437
Types of modulation	Sat: QPSK ¼, 8PSK ¼ and 16APSK ¼, Wi-Fi: OFDM
Channel bandwidth	Sat: 10, 7.5, 5 and 2.5, Wi-Fi: 20 MHz
RF power Max (W)	Sat:20 (43 dBm)
Measured BW (MHz) (99 %)	Sat:9
Calculated BW (kHz), as per TRC-43	N/A
Power requirements	24 V _{DC} (Via AC/DC adapter 100 – 240 V _{AC} , 47 – 63 Hz, 150 W)
Antenna information	Tx antenna gain = 31.2 dBi @ 13.75 GHz, 32 dBi @ 14.25 GHz, and 31.9 dBi @ 14.5 GHz

Section 6 Information provided by the applicant

6.1 Disclaimer

This section contains information provided by the applicant and has been utilized to support the test plan. Inaccurate information provided by the applicant can affect the validity of the results contained within this test report. Nemko accepts no responsibility for the information contained within this section and the impact it may have on the test plan and resulting measurements.

6.2 Applicant

Company name	Satcube AB
Address	Box 7111 SE-40232 Gothenburg, Sweden

6.3 Manufacturer

Company name	Satcube AB
Address	Anders Carlssons gata 7, SE-41755 Gothenburg, Sweden

6.4 EUT information

Serial number	000021
Description/theory of operation	The EUT is a portable satellite terminal that provides broadband connectivity.
HW version	1.0.0
SW version	0.4.24

6.5 EUT setup details

6.5.1 EUT test configuration

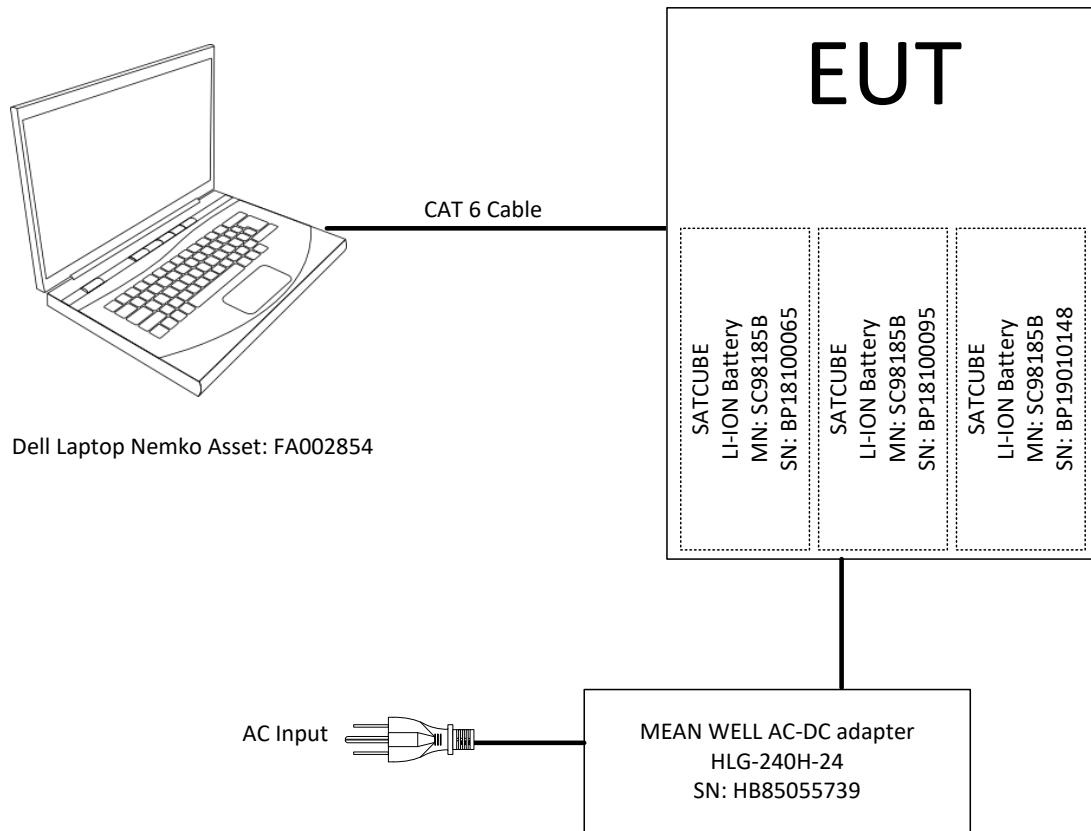


Figure 6.5-1: block diagram

Section 7 Test equipment

7.1 Test equipment list

Table 7.1-1: Equipment list

Equipment	Manufacturer	Model no.	Asset no./SN	Cal cycle	Next cal.
100 kHz – 60 GHz Broadband Field Strength meter	Narda	NARD-NBM550-S	30094/H-1247	2 years	July 29, 2022
100 MHz – 60 GHz Isotropic probe, E-Field probe	Narda	NARD-EF6092	28945/C-0191	2 years	June 3, 2022

Section 8 Testing data

8.1 Limits for general population/uncontrolled exposures

8.1.1 Definitions and limits

FCC §1.1310(e):

- (2) Occupational/controlled exposure limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. The phrase fully aware in the context of applying these exposure limits means that an exposed person has received written and/or verbal information fully explaining the potential for RF exposure resulting from his or her employment. With the exception of transient persons, this phrase also means that an exposed person has received appropriate training regarding work practices relating to controlling or mitigating his or her exposure. In situations when an untrained person is transient through a location where occupational/controlled limits apply, he or she must be made aware of the potential for exposure and be supervised by trained personnel pursuant to §1.1307(b)(2) of this part where use of time averaging is required to ensure compliance with the general population exposure limit. The phrase exercise control means that an exposed person is allowed and also knows how to reduce or avoid exposure by administrative or engineering work practices, such as use of personal protective equipment or time averaging of exposure.
- (3) General population/uncontrolled exposure limits apply in situations in which the general public may be exposed, or in which persons who are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure. For example, RF sources intended for consumer use shall be subject to the limits for general population/uncontrolled exposure in this section.

Table 8.1-1: *Limits for Maximum Permissible Exposure (MPE) for general population/uncontrolled exposure*

Frequency range, MHz	Electric field strength, V/m	Magnetic field strength, A/m	Power density, mW/cm ²	Averaging time, minutes
0.3–1.34	614	1.63	100 ¹	30
1.34–30	824/ <i>f</i>	2.19/ <i>f</i>	(180/ <i>f</i>) ¹	30
30–300	27.5	0.073	0.2	30
300–1500	–	–	<i>f</i> /1500	30
1500–100000	–	–	1.0	30

Notes: Note: ¹ Plane wave equivalent power density. *f* is frequency in MHz

8.1.2 Test summary

Verdict	Pass		
Tested by	Andrey Adelberg	Test date	October 16, 2020

8.1.3 Observations, settings and special notes

Measurements in front of the antenna was performed with 0 deg elevation for different distances; 0 deg elevation is not a typical operating mode but the worst-case scenario for testing purposes.

8.1.4 Test data

Table 8.1-2: Power density in front of the antenna measurement results

Distance from EUT, m	Measured Power density, mW/cm ²	Power density limit, mW/cm ²	Margin, dB
1	34.6	1.0	-15.4
2	24.8	1.0	-13.9
3	16.7	1.0	-12.2
4	11.6	1.0	-10.7
5	11.9	1.0	-10.8
6	8.1	1.0	-9.1
7	4.4	1.0	-6.4
8	2.9	1.0	-4.6
9	3.1	1.0	-4.9
10	2.6	1.0	-4.1
11	2.0	1.0	-3.0
12	3.0	1.0	-4.7
13	3.0	1.0	-4.8
14	2.1	1.0	-3.1
15	2.5	1.0	-4.0
16	1.8	1.0	-2.6
17	2.2	1.0	-3.4
18	2.1	1.0	-3.2
19	0.9	1.0	0.5
20	0.7	1.0	1.5

Note: Margin was calculated as follows: $10 \times \log_{10}(\text{PSD limit} / \text{PSD measurement})$

Table 8.1-3: Power density around the antenna at 20 cm distance measurement results

Measurement height, cm	Angle, deg	Measured Power density, mW/cm ²	Power density limit, mW/cm ²	Margin, dB
20	45	0.9	1.0	0.1
20	90	0.5	1.0	0.5
20	135	0.1	1.0	0.9
20	180	0.0	1.0	1.0
20	225	0.0	1.0	1.0
20	270	0.4	1.0	0.6
20	315	0.8	1.0	0.2
70	45	0.7	1.0	0.3
70	90	0.3	1.0	0.7
70	135	0.0	1.0	1.0
70	180	0.1	1.0	0.9
70	225	0.1	1.0	0.9
70	270	0.4	1.0	0.6
70	315	0.8	1.0	0.2

Table 8.1-4: Power density within the EUT boundaries behind the antenna measurement results

Measurement height, cm	Angle, deg	Measured Power density, mW/cm ²	Power density limit, mW/cm ²	Margin, dB
20	180	0.1	1.0	0.9
70	180	0.2	1.0	0.8

Test data, continued

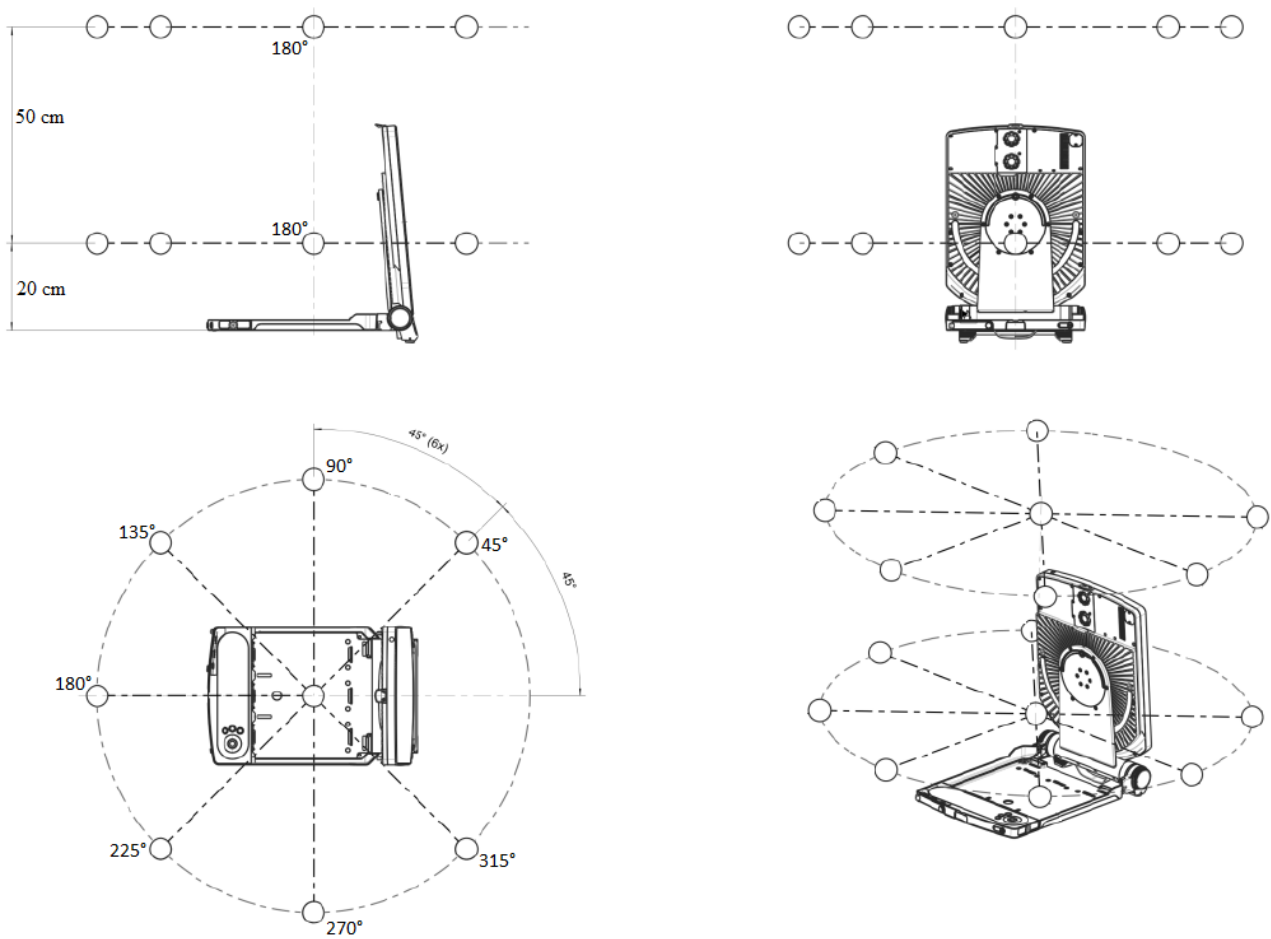


Figure 8.1-1: *Measurement points' location*

Minimum safety distance of 19 meters or more is required when operating with low elevation angles in front of the antenna.

End of report