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Report On

RF Exposure Assessment of the
Naim Audio
BLUE Bluetooth Module (FCC)

FCC ID: 2ACURBLUE
IC: 12217A-BLUE

Document 75927770 Report 04 Issue 1

November 2014



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SECTION 1

REPORT SUMMARY

RF Exposure Assessment of the
Naim Audio
BLUE Bluetooth Module



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1.1 INTRODUCTION

The information contained in this report is intended to show verification of the RF Exposure Assessment of the Naim Audio BLUE Bluetooth Module to the requirements of the applied test specifications.

| | |
|-------------------------------|--|
| Objective | To perform RF Exposure Assessment to determine the Equipment Under Test's (EUT's) compliance of the applied rules. |
| Applicant | Naim Audio |
| Manufacturer | Naim Audio |
| Manufacturing Description | Bluetooth Module |
| Model Number(s) | BLUE |
| Test Specification/Issue/Date | FCC KDB 447498D01 RSS-102 Issue 4 March 2010 Radiocommunications (Electromagnetic Radiation – Human Exposure) Standard: 2003 |
| Related Document(s) | FCC CFR 47 Part 1: 2013 FCC CFR 47 Part 2: 2013 Health Canada's Safety Code 6 ICNIRP 1998 National Council on Radiation Protection and Measurements (NRP) - Report No. 86(1986) 50383:2010 IEEE Std C95.1-2005 |



1.2 BRIEF SUMMARY OF RESULTS

1.2.1 General Public Exposure Levels

| Antenna Gain (Numeric) | Peak Output Power (mW) | Field | Calculated RF Exposure at .01 m (1cm) | General Public Exposure Limit | Application |
|------------------------|------------------------|-------|---------------------------------------|-------------------------------|---------------------------|
| 10.000 | 2.51 | S | 0.004 mW/cm ² | 1 mW/cm ² | FCC 47 CFR § 1.1310 |
| | | S | 0.04 W/m ² | 10 W/m ² | Canada's RF Safety Code 6 |
| | | E | 3.34 V/m | N/A V/m | FCC 47 CFR § 1.1310 |
| | | E | 3.34 V/m | 61.4 V/m | Canada's RF Safety Code 6 |
| | | H | 0.01 A/m | N/A A/m | FCC 47 CFR § 1.1310 |
| | | H | 0.01 A/m | 0.163 A/m | Canada's RF Safety Code 6 |

The calculations have shown that they **meet** the General Public Exposure Levels described in the FCC 47 CFR § 1.1310 Guidelines, Health Canada's RF exposure guideline Safety Code 6 and the limits at **20cm**, the point of investigation.

1.2.2 Occupational Exposure Levels

| Antenna Gain (Numeric) | Peak Output Power (mW) | Field | Calculated RF Exposure at .01 m (1cm) | Occupational Exposure Limit | Application |
|------------------------|------------------------|-------|---------------------------------------|-----------------------------|---------------------------|
| 10.000 | 2.51 | S | 0.004 mW/cm ² | 5 mW/cm ² | FCC 47 CFR § 1.1310 |
| | | S | 0.04 W/m ² | 50 W/m ² | Canada's RF Safety Code 6 |
| | | E | 3.34 V/m | N/A V/m | FCC 47 CFR § 1.1310 |
| | | E | 3.34 V/m | 137 V/m | Canada's RF Safety Code 6 |
| | | H | 0.01 A/m | N/A A/m | FCC 47 CFR § 1.1310 |
| | | H | 0.01 A/m | 0.364 A/m | Canada's RF Safety Code 6 |

The calculations have shown that they **meet** the Occupational Exposure Levels described in the FCC 47 CFR § 1.1310 Guidelines, Health Canada's RF exposure guideline Safety Code 6 and the limits at **20 cm**, the point of investigation.



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1.3 PRODUCT INFORMATION

1.3.1 Attestation

The wireless device described within this report has been shown to be capable of compliance with the basic restrictions related to human exposure to electromagnetic fields for both General public and Occupational. The calculations shown in this report were made in accordance the procedures specified in the applied test specification(s).

1.3.2 Technical Description

The Equipment under test was a Naim Audio BLUE Bluetooth Module. A full technical description can be found in the manufacturer's documentation.

All reported calculations were carried out on the relevant information supplied for the BLUE Bluetooth Module to demonstrate compliance with the applied test specification(s) the sample assessed was found to comply with the requirements of the applied rules.

1.4 SUMMARY

The RF exposure assessment is based upon the following criteria:

The BLUE Bluetooth Module operates in the frequency range of 2402 – 2480 MHz.

| | |
|------------|---------------|
| Gain | 10 dBi |
| Power | .00251 W |
| Distance | .20 m (20 cm) |
| Duty Cycle | 77% |



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SECTION 2

TEST DETAILS



2.1 RATIONALE FOR ASSESSMENT OF THE RF EXPOSURE

The aim of the assessment report is to evaluate the compliance boundary for a set of given input power(s) according to the basic restrictions (directly or indirectly via compliance with reference levels) related to human exposure to radio frequency electromagnetic fields.

The chosen assessment method to establish the compliance boundary in the far-field region is the reference method as defined in EN50383:2010 Clause 5.2; E-field or H-field calculation. The method of calculation used is defined in EN50383:2010; Clause 8.2.2, 8.2.3 and 8.2.4.

The calculated values have been compared with limits provided in the ICNIRP guidelines. Calculations can be made in three separate regions, based on distance from the antenna. These are called:

- far-field region,
- radiating near-field region,
- reactive near-field region.

The theory that defines these regions is given in EN50383:2010 Annex A.

Far-field region

As shown in EN50383 Annex A, the far-field calculations are accurate when the distance, r , from an antenna of length D to a point of investigation is greater than

$$r = \frac{2D^2}{\lambda}$$

Where, r is the distance from the antenna to the point of investigation.

Radiating near-field region

The radiating near-field region of an antenna of length D as shown in EN50383 Annex A, this region is defined by

$$\frac{\lambda}{4} < r < \frac{2D^2}{\lambda}$$

Reactive near-field region

The reactive near-field region of an antenna as shown in EN50383 Annex A, this region is defined by

$$r \leq \frac{\lambda}{4}$$

Where, r is the distance from the antenna to the point of investigation.

Recommend $\lambda/4$ as the boundary between the radiated near-field and reactive near-field for RF exposure compliance assessment.



2.2 DEFINED LIMITS

The defined limits are in accordance with 47 CFR § 1.1310 Radiofrequency radiation exposure limits.

Reference levels for general public exposure to time-varying electric and magnetic fields (unperturbed rms values)

At 2402 MHz

| | | |
|-------------------------------------|---------|---------------------------|
| Power density (mW/cm ²) | = 1 | FCC 47 CFR § 1.1310 |
| Power density (W/m ²) | = 10 | Canada's RF Safety Code 6 |
| E-Field (Vm-1) | = N/A | FCC 47 CFR § 1.1310 |
| E-Field (Vm-1) | = 61.4 | Canada's RF Safety Code 6 |
| H-Field (Am-1) | = N/A | FCC 47 CFR § 1.1310 |
| H-Field (Am-1) | = 0.163 | Canada's RF Safety Code 6 |

Reference levels for occupational exposure to time-varying electric and magnetic fields (unperturbed rms values)

At 2402 MHz

| | | |
|-------------------------------------|---------|---------------------------|
| Power density (mW/cm ²) | = 5 | FCC 47 CFR § 1.1310 |
| Power density (W/m ²) | = 50 | Canada's RF Safety Code 6 |
| E-Field (Vm-1) | = N/A | FCC 47 CFR § 1.1310 |
| E-Field (Vm-1) | = 137 | Canada's RF Safety Code 6 |
| H-Field (Am-1) | = N/A | FCC 47 CFR § 1.1310 |
| H-Field (Am-1) | = 0.364 | Canada's RF Safety Code 6 |

2.3 ESTABLISHING WAVELENGTH AND 1/4 WAVELENGTH

| Frequency (MHz) | $\lambda = \frac{3 \times 10^8}{f}$ | | $\frac{\lambda}{4}$ | |
|--------------------|-------------------------------------|------------------|---------------------|------------------|
| | m | cm | m | cm |
| 2408 | 0.124584717607973 | 12.4584717607973 | 0.0311461794019934 | 3.11461794019934 |
| 2441 | 0.122900450634986 | 12.2900450634986 | 0.0307251126587464 | 3.07251126587464 |
| 2480 | 0.120967741935484 | 12.0967741935484 | 0.030241935483871 | 3.0241935483871 |



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2.4 FAR FIELD CALCULATIONS

The following calculations are based on: 10 dBi gain antenna

P = .00251 Watts or 2.51 milliwatts
G = 10.000 Numeric Gain
r = 20 centimetres or .2metres

The power flux:

$$S = \frac{PG(\theta, \phi)}{4\pi r^2} \quad S = 0.04 \text{ W/m}^2$$
$$S = 0.004 \text{ mW/cm}^2$$

The electric field strength:

$$E = \frac{\sqrt{30PG(\theta, \phi)}}{r} \quad E = 3.34 \text{ V/m}$$

The magnetic field strength:

$$H = \frac{E}{\eta_0} \quad H = 0.01 \text{ A/m}$$

The calculations meet the General Public Exposure Levels described in the FCC 47CFR§1.1310.
The calculations meet the General Public Exposure Levels described in the Canada's RF Safety Code 6.

The calculations meet the Occupational Exposure Levels described in the FCC 47CFR§1.1310
The calculations meet the Occupational Exposure Levels described in the Canada's RF Safety Code 6



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SECTION 3

DISCLAIMERS AND COPYRIGHT



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3.1 DISCLAIMERS AND COPYRIGHT

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