



C Squared Systems, LLC
65 Dartmouth Drive
Auburn, NH 03032
(603) 644-2800
support@csquaredsystems.com



RADIO FREQUENCY EXPOSURE REPORT

DEERING HIGH SCHOOL

**370 STEVENS AVENUE
PORTLAND, ME 04103**

June 12, 2015

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1. Introduction

At the request of Portland Public Schools, radiofrequency emissions measurements were performed by C Squared Systems, LLC on June 9, 2015 at the Deering High School, located at 370 Stevens Avenue in Portland, ME. The focus of the assessment was to measure and record radio frequency exposure limits within the school.

2. FCC Guidelines for Evaluating RF Exposure Limits

In 1985, the FCC established rules to regulate radio frequency (RF) exposure from FCC licensed antenna facilities. In 1996, the FCC updated these rules, which were further amended in August 1997 by OET Bulletin 65 Edition 97-01. These new rules include Maximum Permissible Exposure (MPE) limits for transmitters operating between 300 kHz and 100 GHz. The FCC MPE limits are based upon those recommended by the National Council on Radiation Protection and Measurements (NCRP), developed by the Institute of Electrical and Electronics Engineers, Inc., (IEEE) and adopted by the American National Standards Institute (ANSI).

The FCC general population/uncontrolled limits set the maximum exposure to which most people may be subjected. General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that 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.

Public exposure to radio frequencies is regulated and enforced in units of milliwatts per square centimeter (mW/cm²). The general population exposure limits for the various frequency ranges are defined in the attached "FCC Limits for Maximum Permissible Exposure (MPE)" in Attachment B of this report.

Higher exposure limits are permitted under the occupational/controlled exposure category, but only for persons who are exposed as a consequence of their employment provided they are fully aware of the potential for exposure, and are able to exercise control over their exposure. General population/uncontrolled limits are five times more stringent than the levels considered acceptable for occupational, or radio frequency trained individuals. Attachment B contains excerpts from OET Bulletin 65 and defines the Maximum Exposure Limit.

Finally, it should be noted that the MPE limits adopted by the FCC for both general population / uncontrolled exposure and for occupational / controlled exposure incorporate a substantial margin of safety and have been established to be well below levels generally accepted as having the potential to cause adverse health effects.

3. RF Sources

There are multiple RF sources inside and on the roof of the school, including a guyed tower which supports antennas for the City of Portland and U.S. Cellular, a 4x4 MIMO 2.4/5GHz WIFI system with access points throughout the school, walkie-talkies used by PPS maintenance personnel, and various electronics, including computer monitors, iPad tablets, personal cell phones, and televisions.



Figure 1: City of Portland / U.S. Cellular Guyed Tower



Figure 2: Example WIFI Access Point

4. Survey Equipment and Procedures

Frequencies from 300 kHz to 50 GHz were measured using the Narda Probe EA 5091, E-Field, shaped, FCC probe in conjunction with the NBM550 survey meter. The EA 5091 probe is “shaped” such that in a mixed signal environment (i.e.: more than one frequency band is used in a particular location), it accurately measures the percent of MPE.

From FCC OET Bulletin No. 65 - Edition 97-01 – “A useful characteristic of broadband probes used in multiple-frequency RF environments is a frequency-dependent response that corresponds to the variation in MPE limits with frequency. Broadband probes having such a "shaped" response permit direct assessment of compliance at sites where RF fields result from antennas transmitting over a wide range of frequencies. Such probes can express the composite RF field as a percentage of the applicable MPEs”.

Probe Description - As suggested in FCC OET Bulletin No. 65 - Edition 97-01, the response of the measurement instrument should be essentially isotropic, (i.e., independent of orientation or rotation angle of the probe). For this reason, the Narda EA 5091 probe was used for these measurements.

Sampling Description - At each measurement location, a spatially averaged measurement is collected over the height of an average human body. The NBM550 survey meter performs a time average measurement while the user slowly moves the probe over a distance range of 20 cm to 200 cm (about 6 feet) above ground level. The results recorded at each measurement location include average values over the spatial distance.

Instrumentation Information - A summary of specifications for the equipment used is provided in the table below.

Manufacturer	Narda Microwave			
Probe	EA 5091, Serial# 01135			
Calibration Date	June 2014			
Calibration Interval	24 Months			
Meter	NBM550, Serial# B-1149			
Calibration Date	June 2014			
Calibration Interval	24 Months			
Probe Specifications	Frequency Range	Field Measured	Standard	Measurement Range
	300 KHz-50 GHz	Electric Field	U.S. FCC 1997 Occupational/Controlled	0.2 – 600 % of Standard

Table 1: Instrumentation Information¹

Instrument Measurement Uncertainty - The total measurement uncertainty of the NARDA measurement probe and meter is no greater than ± 3 dB (0.5% to 6%), ± 1 dB (6% to 100%), ± 2 dB (100% to 600%). The factors which contribute to this include the probe’s frequency response deviation, calibration uncertainty, ellipse ratio, and isotropic response². Every effort is taken to reduce the overall uncertainty during measurement collection including pointing the probe directly at the likely highest source of emissions.

¹ Copies of Certificates of Calibration are provided as Attachments C and D to this report.

² For further details, please refer to Narda Safety Test Solutions NBM550 Probe Specifications, pg. 64 http://www.narda-sts.us/pdf_files/DataSheets/NBM-Probes_DataSheet.pdf

5. Survey Locations & Results

Table 2 below lists the measurements recorded on the Deering High School property at 39 different locations identified by the school prior to the survey (Reference Attachment E). Measurements were recorded at each location twice; once with the school's WIFI network active and again with the WIFI network inactive. The table also lists the presence of a WIFI access point for each measurement location. Pictures of each measurement location are not included, but can be furnished upon request.

All values shown in Table 2 are in reference to the FCC General Population MPE limit.

For any rooms where WIFI access points were present, the measurement was recorded within four feet of the access point.

Meas. Number	Measurement Location	WIFI Access Point Present?	Measured %MPE Value (WIFI ON)	Measured %MPE Value (WIFI OFF)
1	Room 212	Yes	< 1.00	1.30
2	2nd Floor Walkway to Cafeteria	No	< 1.00	1.15
3	Nurse's Office	No	< 1.00	1.02
4	2nd Floor Conference Room	Yes	< 1.00	< 1.00
5	Ludlow Street Side of Cafeteria	No	< 1.00	< 1.00
6	Guidance Office	Yes	< 1.00	1.22
7	Room 301	No	1.04	1.25
8	Room 302	Yes	1.35	1.27
9	Room 303	Yes	< 1.00	1.13
10	Room 304	Yes	< 1.00	1.18
11	Room 305	Yes	< 1.00	< 1.00
12	Room 306	No	< 1.00	< 1.00
13	Room 307	No	< 1.00	< 1.00
14	Room 308	Yes	< 1.00	1.18
15	3rd Floor Walkway to Library	No	< 1.00	1.63
16	Room 309	Yes	< 1.00	1.02
17	Room 310	No	< 1.00	< 1.00
18	Room 311	Yes	1.09	< 1.00
19	Room 312 (SW Windows)	No	1.02	< 1.00
20	Room 312 (SE Windows)	No	1.07	< 1.00
21	Room 313	Yes	1.31	< 1.00
22	Room 314	No	1.47	< 1.00
23	Room 315	Yes	1.54	< 1.00
24	Room 316	No	1.02	1.06
25	Rear of Library (Under WIFI AP)	Yes	1.32	1.14
26	Front of Library	Yes	1.47	1.39
27	Room 317	Yes	1.01	1.46
28	Room 318	Yes	1.08	1.07
29	Room 319	No	< 1.00	1.27
30	Room 320	Yes	< 1.00	1.26
31	Room 321	Yes	< 1.00	1.09
32	Room 322	Yes	1.06	< 1.00
33	Room 323	No	1.22	< 1.00
34	Room 401 (Egress Door Open)	No	< 1.00	< 1.00
35	Room 401 (Egress Door Closed)	No	< 1.00	< 1.00
36	Room 402 (Egress Door Open)	No	< 1.00	< 1.00
37	Room 402 (Egress Door Closed)	No	< 1.00	< 1.00
38	Room 403	No	1.66	< 1.00
39	Bus Stop on Ludlow Street	No	1.79	< 1.00

Table 2: Measured %MPE Values for the General Population³

³ Due to measurement uncertainty at low levels, any readings < 1.00% FCC Uncontrolled/General Population MPE are listed as such. See Section 4 for the measurement range of the probe.

It is important to note that it should not be assumed that measurements recorded while the WIFI network was turned off will necessarily be lower than measurements recorded while the WIFI network was active. Any and all other radiofrequency (RF) sources in the vicinity (two-way radio communications, police, fire, public safety transmissions, and cellular traffic are all uncontrolled, that is, they will have variations in transmitting power levels depending upon the activity level and traffic load on the networks. All of these RF sources may contribute to the emissions levels measured. For example, during the noon recess, the access points within the classrooms will likely have lower activity on them yet the number of students simultaneously using cell phones and wireless devices may increase, which in turn could increase the overall power density of the RF environment in the immediate vicinity of a deactivated access point.

6. Summary of Findings

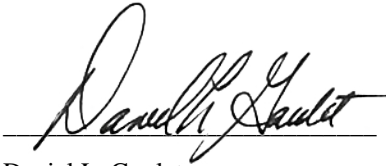
The measurement results for this site find that there are currently no areas within the building, or at ground level around the building, where percent of MPE values will exceed the General Population limit, as defined by the FCC.

- The highest measurement recorded within the school while the WIFI network was active was at Location 38 (Room 403) and was recorded at 1.66% (Average Uncontrolled/General Population).
- The highest measurement recorded within the school while the WIFI network was inactive was at Location 15 (3rd Floor Walkway to Library) and was recorded at 1.63% (Average Uncontrolled/General Population).
- The measurement recorded outside the school at Location 39 (Bus Stop on Ludlow Street) was recorded at 1.79% (Average Uncontrolled/General Population).

Our findings show that radio frequency emissions at the Deering High School are well below the exposure limits established by the FCC. The highest %MPE measured within or outside of the premises was recorded to be less than 2% of the limits established by the FCC for the Average Uncontrolled/General Population. It should also be noted that the new limits established by the FCC in 1997 are more conservative than the limits originally adopted by the FCC in 1985.

7. Statement of Certification

I certify to the best of my knowledge that the statements in this report are true and accurate. The measurements follow guidelines set forth in ANSI/IEEE Std. C95.3, ANSI/IEEE Std. C95.1, ANSI/IEEE Std C95.7 and FCC OET Bulletin 65 Edition 97-01.



Daniel L. Goulet
C Squared Systems, LLC

June 12, 2015

Date

Attachment A: References

OET Bulletin 65 - Edition 97-01 - August 1997 Federal Communications Commission Office of Engineering & Technology

ANSI C95.1-1982, American National Standard Safety Levels With Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 300 kHz to 100 GHz. IEEE-SA Standards Board

IEEE Std C95.3-1991 (Reaff 1997), IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave. IEEE-SA Standards Board

IEEE Std C95.7-2005, IEEE Recommended Practice for Radio Frequency Safety Programs, 3 kHz to 300 GHz. IEEE-SA Standards Board

Attachment B: FCC Limits for Maximum Permissible Exposure (MPE)

(A) Limits for Occupational/Controlled Exposure⁴

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (E) (A/m)	Power Density (S) (mW/cm ²)	Averaging Time E ² , H ² or S (minutes)
0.3-3.0	614	1.63	(100)*	6
3.0-30	1842/f	4.89/f	(900/f ²)*	6
30-300	61.4	0.163	1.0	6
300-1500	-	-	f/300	6
1500-100,000	-	-	5	6

(B) Limits for General Population/Uncontrolled Exposure⁵

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (E) (A/m)	Power Density (S) (mW/cm ²)	Averaging Time E ² , H ² or S (minutes)
0.3-1.34	614	1.63	(100)*	30
1.34-30	824/f	2.19/f	(180/f ²)*	30
30-300	27.5	0.073	0.2	30
300-1500	-	-	f/1500	30
1500-100,000	-	-	1.0	30

f = frequency in MHz * Plane-wave equivalent power density

Table 3: FCC Limits for Maximum Permissible Exposure

⁴ Occupational/controlled 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. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

⁵ General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that 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.

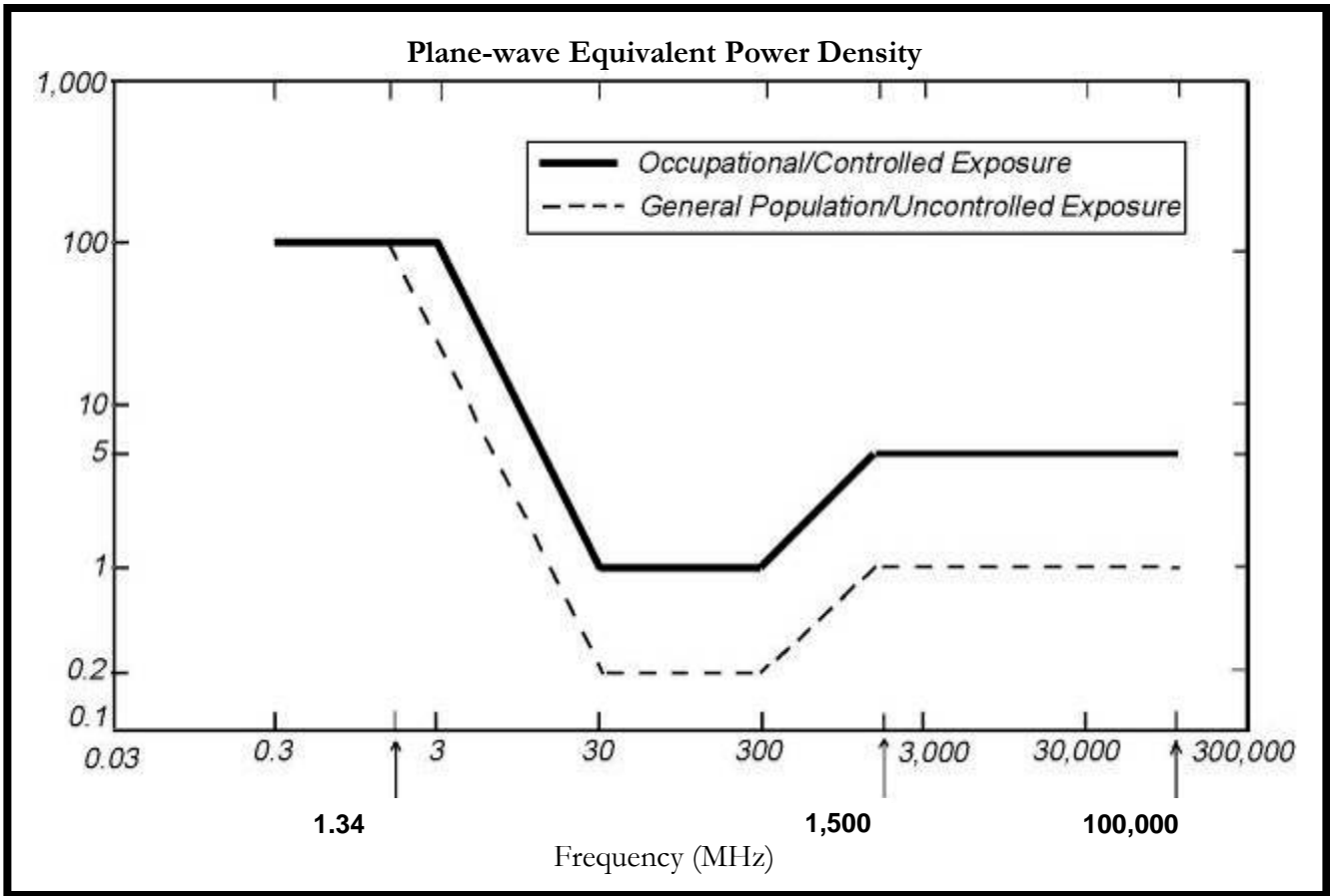


Figure 3: Graph of FCC Limits for Maximum Permissible Exposure (MPE)

Attachment C: Probe Calibration Certification

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Certificate of Calibration

L-3 Communications, Narda Microwave-East, hereby certifies that the referenced instrument has been calibrated by qualified personnel to Narda's approved test procedures.

Furthermore, the instrument meets, or exceeds, all published specifications and the calibration has been performed with test instrumentation that, where applicable, is traceable to the National Institute of Standards and Technology.

Narda's calibration measurements are traceable to the National Institute of Standards and Technology to the extent allowed by the bureau's calibration facilities.

Customer: C SQUARED SYSTEMS LLC Certificate #: 138525 2
AUBURN, NH 03032

Model #: 2402/07B Serial #: 01135
Description: FCC SHAPED PROBE 300 KHZ-50 G PO #: 000366
Date Calibrated: 17/Jun/2014 R.O. #: 138525

Hugh Saunders
Hugh Saunders
Test

Ralph Curcio
Ralph Curcio
Quality Assurance

This certificate shall not be reproduced, except in full, without written approval from L-3 Communications, Narda Microwave-East
L-3 COMMUNICATIONS, NARDA MICROWAVE-EAST, 435 MORELAND ROAD, HAUPPAUGE, NEW YORK 11788, TEL: 631-231-1700, FAX: 631-231-1711

Attachment D: Meter Calibration Certification

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Certificate of Calibration

L-3 Communications, Narda Microwave-East, hereby certifies that the referenced instrument has been calibrated by qualified personnel to Narda's approved test procedures.

Furthermore, the instrument meets, or exceeds, all published specifications and the calibration has been performed with test instrumentation that, where applicable, is traceable to the National Institute of Standards and Technology.

Narda's calibration measurements are traceable to the National Institute of Standards and Technology to the extent allowed by the bureau's calibration facilities.

Customer: C SQUARED SYSTEMS LLC Certificate #: 138525 1
AUBURN, NH 03032

Model #: 2401/01 Serial #: B-1149
Description: NBM-550 METER, BASIC UNIT PO #: 000366
Date Calibrated: 11/Jun/2014 R.O. #: 138525

Hugh Saunders
Hugh Saunders
Test

Ralph Curcio
Ralph Curcio
Quality Assurance

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Attachment E: Survey Locations

Portland Public Schools
 Requested Locations for RF Exposure Assessment by C2
 June 9, 2015 beginning at 9:30 AM

Room Number/Location	Notes
Second Floor	
Walkway to cafeteria	
Nurse's station	
Conference Room	
Cafeteria	windowwall closest to Ludlow Street
Third Floor	
Guidance	
301	
302	
303	
304	
305	
306	
307	
308	
Walkway to library	
309	
310	
311	
312	
313	
314	
315	
316	
Library	
317	
318	
319	
320	
321	
322	
323	
Fourth Floor	
401	egress door open
401	egress door closed
402	egress door open
402	egress door closed
403	
Grounds	
Bus drop off and pick up	Ludlow Street