Assessment of Compliance

For

Maximum Permissible Exposure Evaluation with Respect to FCC Rule Part 47CFR §2.1091 and the Standards ANSI/IEEE C95.1-1999 and C95.3-1992

Wireless OEM Modem Module
Boomer II 800 MHz

Wavenet Technologies Pty Ltd.

November 2002

APREL Project No. WVTB-Boomer II-Modem 3922-1

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Engineering Report

Subject: **Maximum Permissible Exposure Evaluation with Respect to FCC Rule Part 47CFR §2.1091 and the standards ANSI/IEEE C95.1-1999 and C95.3-1992**

FCC ID: **PQS-BM28001**

Equipment: **Wireless OEM Modem Module**

Model: **Boomer II 800 MHz**

Client: **Wavenet Technologies Pty Ltd.**
140 Burswood Road
Burswood, Perth, WA 6100
Australia

Project #: WVTB-Boomer II-3922-1

Prepared by: **APREL Laboratories,**
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Approved by: _____ Date: Nov. 20, 2002
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Submitted by: _____ Date: Nov. 20, 2002
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Released by: _____ Date: Nov 20/02
Dr. Jack J. Wojcik, P.Eng.

FCC ID: PQS-BM28001
Client : Wavenet Technologies Pty Ltd.
Equipment : Wireless OEM Modem Module
Model : BOOMER II 800 MHz

ENGINEERING SUMMARY

This report contains the results of the evaluation performed on the **Wavenet OEM Wireless Modem, Model BOOMER II 800MHz**. The tests were carried out in accordance with the applicable requirements of FCC rules found in 47CFR §2.1091 and the standards ANSI/IEEE C95.1-1999 and C95.3-1992.

The Wireless OEM Module is an 800 MHz OEM product for integration into customer end user equipment as an OEM modem and interfaces to it via the data interface port. It was tested using a whip standard ¼ wave portable antenna mounted on a ground plane and the unit connected to a test jig. The output power of the unit was set at maximum value and running with 100% duty cycle.

The modem provides two available bands: a) 806-821 MHz and b) 821-824 MHz. The bands are firmware controlled and can not be switched by the user. The DUI was tested on two frequencies: 806 MHz (low channel of 806-821 MHz band) and 821 MHz (low channel of 821-824 MHz band) which has the highest ERP among three channels.

The methodology and results for the tests are described in the appropriate section of this report.

The maximum RF-power exposure level measured at 20 cm from the antenna for 806-821 MHz band was 0.178 mW/cm^2. The maximum power exposure level measured at 20 cm from the antenna for 821-824 MHz band was 0.145 mW/cm^2. Users and installers should be provided with the appropriate operating instructions regarding safe distances, for satisfying RF exposure compliance.

(The results presented in this report relate only to the sample tested.)

FCC SUBMISSION INFORMATION

FCC ID:	**PQS-BM28001**
Equipment:	Wireless OEM Modem Module
Model:	BM28001 800 MHz
For:	Certification
Applicant:	**Wavenet Technologies Pty Ltd.** 140 Burswood Road Burswood, Perth, WA 6100 Australia
Manufacturer:	**Wavenet Technologies Pty Ltd.** 140 Burswood Road Burswood, Perth, WA 6100 Australia
Evaluated by:	**APREL Inc.** 51 Spectrum Way Nepean, Ontario Canada, K2R 1E6

ACRONYMS

CBT	Calibration Before Test
CNR	Calibration Not Required
DUI	Device Under Investigation
ERP	Effective Radiated Power
FCC	Federal Communications Commission
MPE	Maximum Permissible Exposure
N/A	Not Applicable
NTS	Not To Scale
OEM	Original Equipment Manufacturer
QA	Quality Assurance

1.0 INTRODUCTION

1.1 General

This report describes the Maximum Permissible Exposure (MPE) tests on a **Wavenet BOOMER II 800MHz OEM Wireless Modem,** connected to a test jig and using a whip standard ¼ wave portable antenna mounted on a ground plane, the combination hereinafter called the DUI (Device Under Investigation).

1.2 Scope

MPE evaluation was performed on the DUI in accordance with the requirements of the FCC rules for RF compliance found in 47CFR §2.1091 and the standard ANSI/IEEE C95.3-1992, IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave. This Engineering Report contains the following:

- Methodology as to how the tests were performed.
- Test results and analysis.
- Identification of the test equipment used for the testing.
- Test set-up diagram.

1.3 Schedule

The MPE tests were completed on November 2002.

2.0 APPLICABLE DOCUMENTS

FCC Rule Part 47CFR §2.1091

ANSI/IEEE C95.1-1999, IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3kHz to 300GHz.

ANSI/IEEE C95.3-1992, IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave.

OET Bulletin 65 (Edition 97-01) Supplement C (Edition 01-01), Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields.

3.0 TEST SAMPLE

The MPE test described in this procedure was performed on:

- Wavenet BOOMER II 800MHz OEM Wireless Modem, connected to a test jig and using a whip standard ¼ wave portable antenna mounted on a ground plane.

4.0 GENERAL REQUIREMENTS

4.1 Location of Test Facilities

The tests were performed by APREL Laboratories at APREL's test facility located in Nepean, Ontario, Canada. The laboratory operates a 3 and 10 meter Open Area Test Site (OATS) measurement facility. The test site is calibrated to ANSI C63.4-1992.

A description of the measurement facility in accordance with the radiated and AC line conducted test site criteria in ANSI C63.4-1992 is on file with the Federal Communications Commission and is in compliance with the requirements of Section 2.948 of the Commissions rules and regulations. APREL's registration number is 90416.

APREL is accredited by Standard Council of Canada, under the PALCAN program (ISO Guide 25). All equipment used is calibrated or verified in accordance with the intent of AQAP-6/MIL-STD-45662. APREL is also accredited by Industry Canada (formerly DOC) and recognised by the Federal Communications Commission (FCC).

4.2 Personnel

EMC/EMI testing staff member, Roman Kuleba, carried out all MPE tests. The report was originated by Jayanta (Jay) Sarkar.

4.3 Failure Criteria

The device under investigation was considered to have failed if any of the following occurred:

When the MPE limits exceeded those permitted by appropriate limits defined by the FCC.

4.4 Power Source Required

The following nominal DC Power was maintained during the test:

Voltage: 3.8 VDC.

4.5 Tolerance

The following tolerances on test conditions, exclusive of equipment accuracy, were maintained:

Voltage: 3.8 V ± 10%.

5.0 TEST INSTRUMENTATION & CALIBRATION

5.1 General

APREL Laboratories, located in Nepean, Ontario is equipped with the necessary instrumentation to ensure accurate measurement of all data recorded during the tests outlined in this document. To ensure continued accuracy, each instrument is re-calibrated at intervals established by APREL and based on standards traceable to the National and International Standards. Accuracy surveillance is a function of APREL Quality Assurance.

5.2 MPE Test Equipment Required

The test equipment required to perform the MPE testing is listed in paragraph 7.2.

5.3 Calibration Requirements

All test equipment instrumentation required for MPE qualification testing was calibrated and controlled.

6.0 ELECTRICAL/MECHANICAL DESCRIPTION

The MPE Test Program was performed on a **Wavenet BOOMER II 800MHz OEM Wireless Modem,** connected to a test jig and using a whip standard ¼ wave portable antenna mounted on a ground plane, the combination hereinafter called the DUI. The test sample consisted of the components supplied by the customer and described below.

6.1 Test Unit Description

The **Wavenet BOOMER II 800MHz OEM Wireless Modem,** connected to a test jig and using a whip standard ¼ wave portable antenna mounted on a ground plane consisted of the following components:

Description
OEM Wireless Modem (Wavenet BOOMER II 800MHz)
Whip standard ¼ wave portable antenna
Test Jig

The test frequency and power were set to 806 MHz (low channel of 806-821 MHz band) and 821 MHz (low channel of 821-824 MHz band) and with the maximum output power. The transmission duty cycle was set to 100%.

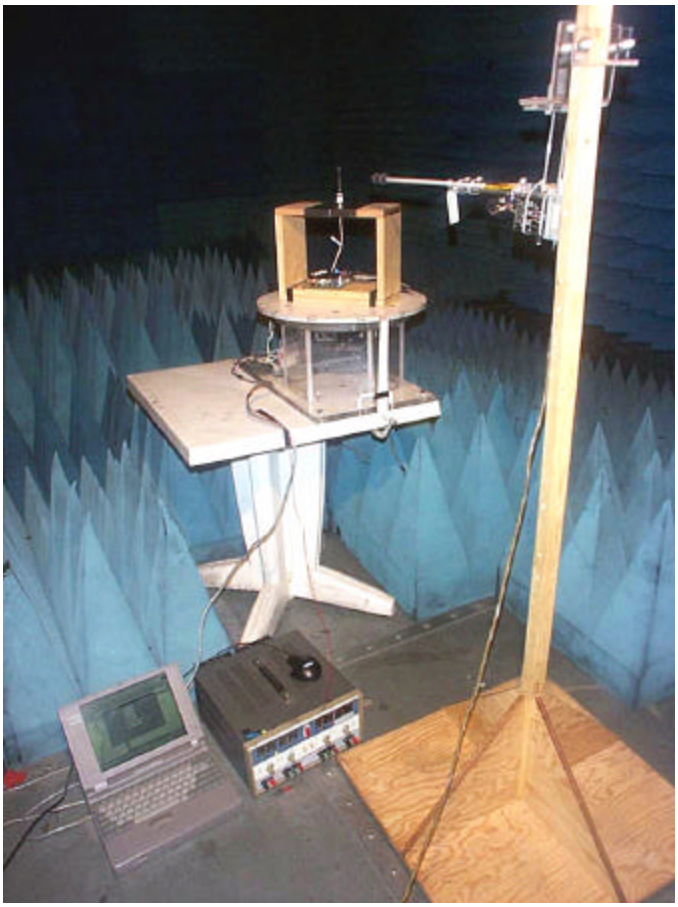
6.2 MPE Test Setup

a) The whip antenna shall be installed in the centre of a ground plane.

b) The DUI shall be placed on a turntable in the OATS and in such a way that the antenna will be located on the centre of rotation. (See Figures 6.2.1 and 6.2.2).

c) The DUI shall be connected to the 3.8 VDC power supply and a laptop computer. The Laptop computer and the power supply shall be located underneath the turntable.

d) For the selection and placement of the measuring probe, the requirements of ANSI/IEEE C95.3-1992 shall be met.



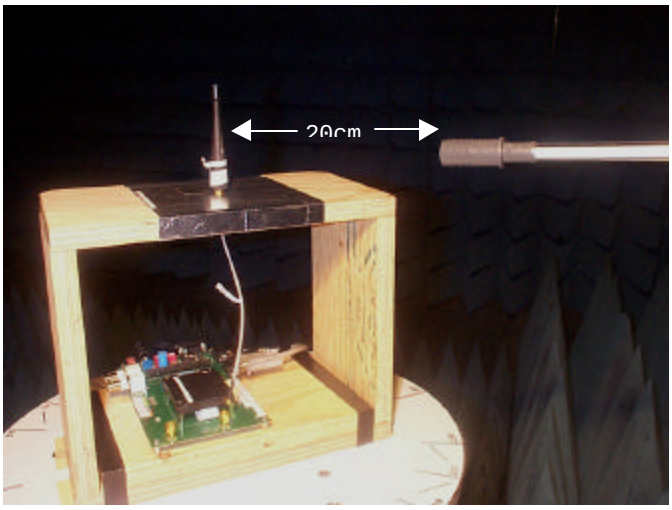


Figure 6.2.1. Photographs of the Setup

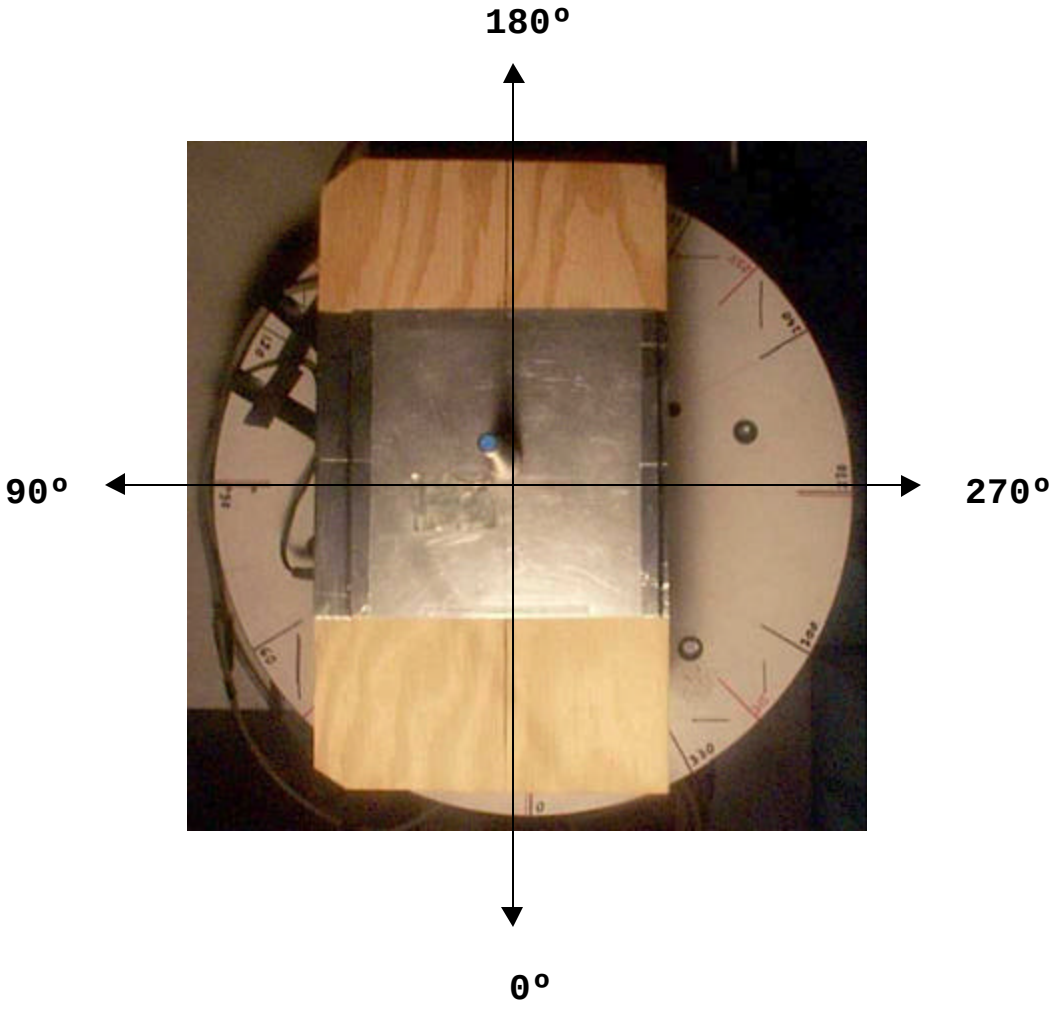


Figure 6.2.2. Plan View of Ground Plane

7.0 MAXIMUM PERMISSIBLE EXPOSURE (MPE) TEST

7.1 Purpose

This test method is used to verify that the DUI meets the MPE requirements as defined in the criteria for general population/uncontrolled exposure when operating at maximum ERP and in all operating modes.

7.2 Test Equipment

Description	Manufacturer	Model No.	Calibration Due Date
E-Field Probe	APREL Inc.	MPE-APL-2	CBT*
Digital multimeter	Fluke	8505A	Nov. 05, 2003
RF Signal Generator	Hewlett Packard	83640B	Sept. 30, 2003
RF Power Meter	Hewlett Packard	438A	Sept. 05, 2003
TEM Cell	Fisher Custom Comm. Inc.	FCC-TEM-JM1	CNR
20 dB Attenuator	Narda	4774-20	Oct. 15, 2003
RF Amplifier	APREL Inc.	-	CNR
Mast	APREL Inc.	-	N/A
Turntable	APREL Inc.	-	N/A
DC power supply	Astron	VS-20M	N/A
Anechoic Chamber	APREL Inc.	-	N/A

CBT: Calibrate Before Test, in this instance November 16, 2002

7.3 Criteria

Power Density Limits – The DUI shall not generate a power density beyond the limits in the frequency band listed in the left hand column of Table 7.3.1, and the power density given in the right hand column.

Table 7.3.1

Power Density Limits
for General Population/Uncontrolled Exposure

Frequency Range	Power Density (mW/cm^2)
300 - 1500 MHz	f/1500

Note: f = frequency in MHz

Power Density Limits for Uncontrolled Exposure on given frequencies:

For: f_{TX} = 806 MHz, $$Limit = \frac{f_{MHz}}{1500} = \frac{806\,MHz}{1500} = 0.537\,mW/cm^2$$

For: f_{TX} = 821 MHz, $$Limit = \frac{f_{MHz}}{1500} = \frac{821\,MHz}{1500} = 0.547\,mW/cm^2$$

7.4 Test Procedure

The power density shall be measured 20 cm from the radiating antenna axis above the ground plane (see Figure 6.2.3). The measurements shall be performed at two transmitting frequencies (f_{TX} = 806 MHz and f_{TX} = 821 MHz) and with the highest power and 100% duty cycle. The measured values shall be recorded.

a) The probe shall be positioned close to, and parallel to, the ground plane with its tip 20 cm from the radiating antenna, and its axis normal to the antenna.

b) Rotate the turntable so that the probe is at the 0° position (see Figure 7.3.1).

c) Turn on the DUI and allow a sufficient time for stabilization.

d) Turn on the transmitter, set the transmitting frequency to 806 MHz and simulate normal operation conditions. Operate the transmitter at full rated output power. Record the characteristics of the transmit power (duty cycle 100 %).

e) Determine the location of the maximum power density: locate the maximum emissions by scanning vertically along the DUI's antenna. Take and record measurements of the power density at a number of points along the length of the antenna as well as just past its tip.

f) At every 30° of rotation take and record a measurement of the power density at the maximum power density height as for at least the following locations:

- half the maximum power density height
- height halfway between the maximum power density height and the tip of the radiating antenna
- just above the tip of the antenna

g) Repeat steps d) to f) for transmitting frequency 821 MHz.

h) Turn off the DUI.

7.5 Results for 806 MHz

The output power of the device has been set to the highest rated output power. For f_{TX} = 806 MHz measured ERP was 1.828 W.

Table 7.5.1 presents the results of the measurements made along the length of the antenna in order to find the location of the maximum power density (the antenna has a height of 9 cm). Column 1 shows the height at which the measurements were taken and column 2 shows the results (power density). Column 3 indicates limit for the MPE in the controlled environment. Margin to the limit is given in column 4.

Table 7.5.1
Power Density Measured at 90° as a Function of Height
Test Frequency: 806 MHz

Height [cm]	Measured Power Density [mW/cm^2]	Limit [mW/cm^2]	Margin [mW/cm^2]
20	0.142	0.54	0.398
15	0.178*	0.54	0.362
11	0.171	0.54	0.369
10	0.161	0.54	0.379
9	0.151	0.54	0.389
8	0.123	0.54	0.417
7	0.116	0.54	0.424
6	0.119	0.54	0.421
5	0.103	0.54	0.437
4	0.098	0.54	0.442
3	0.083	0.54	0.457
2	0.081	0.54	0.459
1	0.081	0.54	0.459
0	0.085	0.54	0.455

* Highest measured value

The data in the Table 7.5.1 is presented in the Figure 7.5.1 along with the data measured in other directions.

Test performed by: Kristen Rounds **Date:** November, 2002

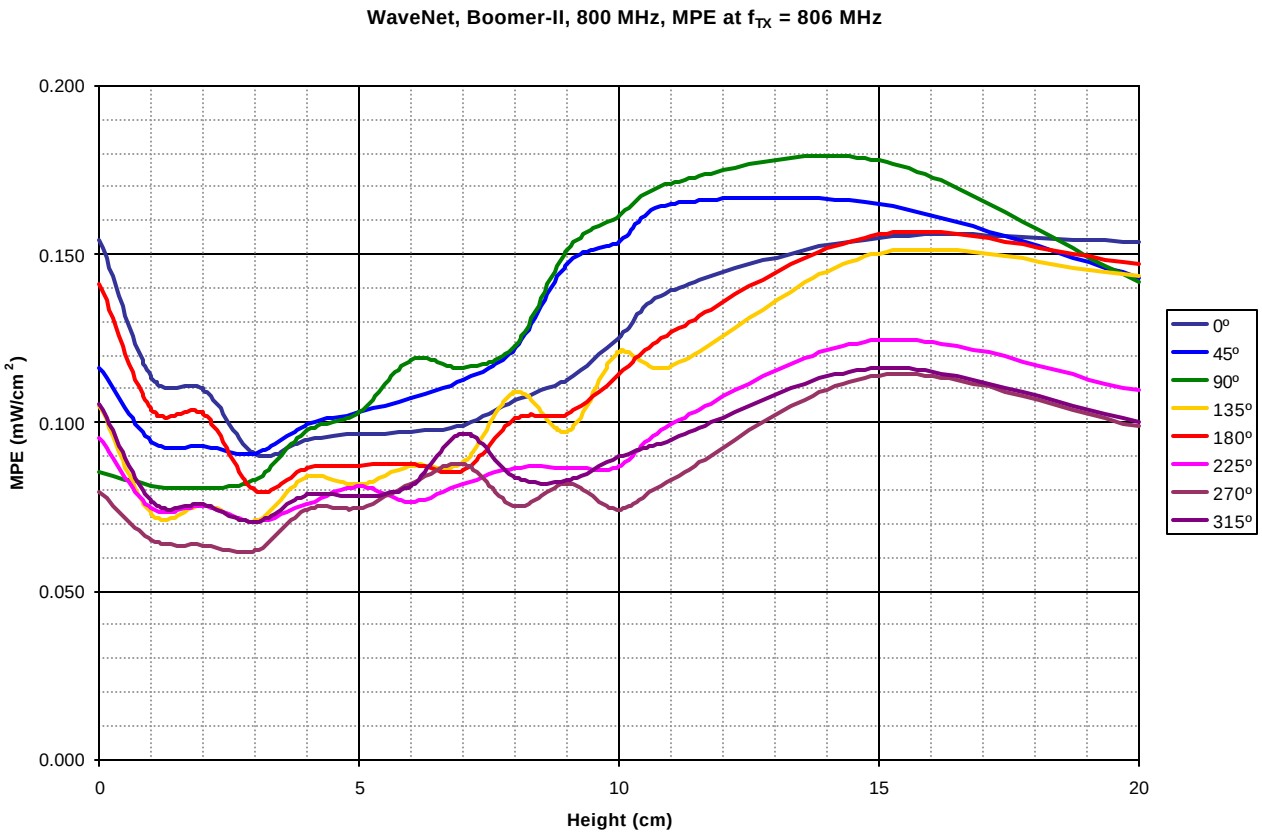


Figure 7.5.1 Measured Power Density v.s. Height for f_{TX} = 806 MHz

Table 7.5.2 presents the results of the measurements made around the antenna at every 45° of rotation. Column 1 in both parts shows the angle at which the measurements were taken and columns 2 through 8 show the measured power density at the different heights in the range from 1 cm to 20 cm from the ground plane. According to ANSI/IEEE C95.1-1999 the exposure values are those obtained by spatially averaging measured values over an area equivalent to the vertical cross-section (projected area) of the human body. Therefore, the MPE value is determined by averaging the adjusted total power density along a vertical line up to the height of a typically tall individual, taken here as 6 ft or 180 cm. So the averaging has to be done over those measurements made between 1 and 20 cm above the ground plane. Column 9 in both parts shows the results of this averaging.

Table 7.5.2

Power Density Measured
at every 45° as a Function of Height
Test Frequency: 806 MHz

Angular Position (°)	Measured RF-field Power Density (mW/cm^2) for different heights							Averaged Values (mW/cm^2)	MPE Limit (mW/cm^2)
	0 cm	1 cm	2 cm	3 cm	4 cm	5 cm	6 cm		
0º	0.154	0.113	0.110	0.090	0.095	0.097	0.097	0.12	0.54
45º	0.116	0.095	0.093	0.091	0.100	0.103	0.107	0.12	0.54
90º	0.085	0.081	0.081	0.083	0.098	0.103	0.119	0.12	0.54
135º	0.105	0.073	0.075	0.071	0.084	0.082	0.087	0.10	0.54
180º	0.141	0.104	0.103	0.080	0.087	0.087	0.088	0.11	0.54
225º	0.095	0.075	0.075	0.071	0.076	0.081	0.077	0.09	0.54
270º	0.079	0.065	0.064	0.062	0.074	0.075	0.082	0.08	0.54
315º	0.105	0.077	0.076	0.071	0.079	0.078	0.081	0.09	0.54

Angular Position (°)	Measured RF-field Power Density (mW/cm^2) for different heights							Averaged Values (mW/cm^2)	MPE Limit (mW/cm^2)
	7 cm	8 cm	9 cm	10 cm	11 cm	15 cm	20 cm		
0º	0.099	0.107	0.113	0.125	0.139	0.155	0.154	0.12	0.54
45º	0.113	0.122	0.147	0.154	0.165	0.165	0.143	0.12	0.54
90º	0.116	0.123	0.151	0.161	0.171	0.178	0.142	0.12	0.54
135º	0.088	0.109	0.097	0.121	0.117	0.150	0.144	0.10	0.54
180º	0.086	0.101	0.103	0.114	0.127	0.156	0.147	0.11	0.54
225º	0.082	0.087	0.087	0.087	0.100	0.125	0.110	0.09	0.54
270º	0.088	0.075	0.082	0.074	0.083	0.114	0.099	0.08	0.54
315º	0.097	0.084	0.083	0.090	0.095	0.116	0.100	0.09	0.54

The data in Table 7.5.2.a is presented in Figure 7.5.2

Test performed by: Kristen Rowan **Date:** November, 2002

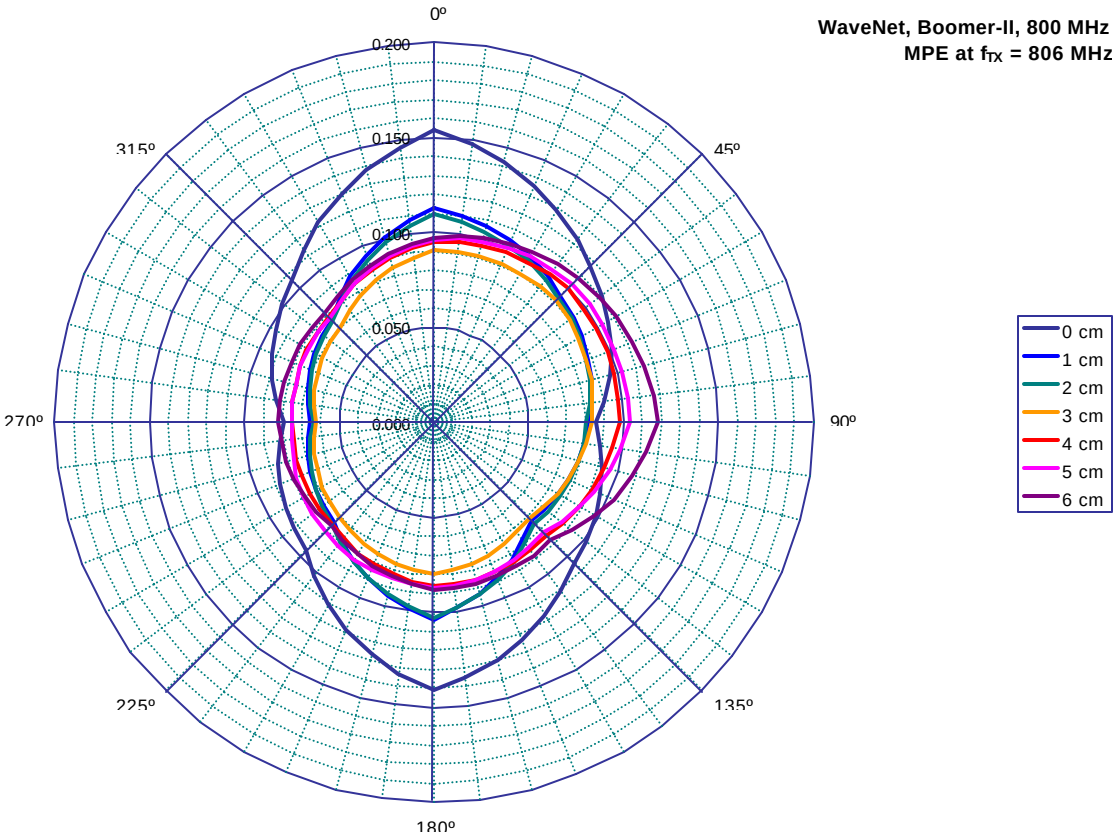


Figure 7.5.2a

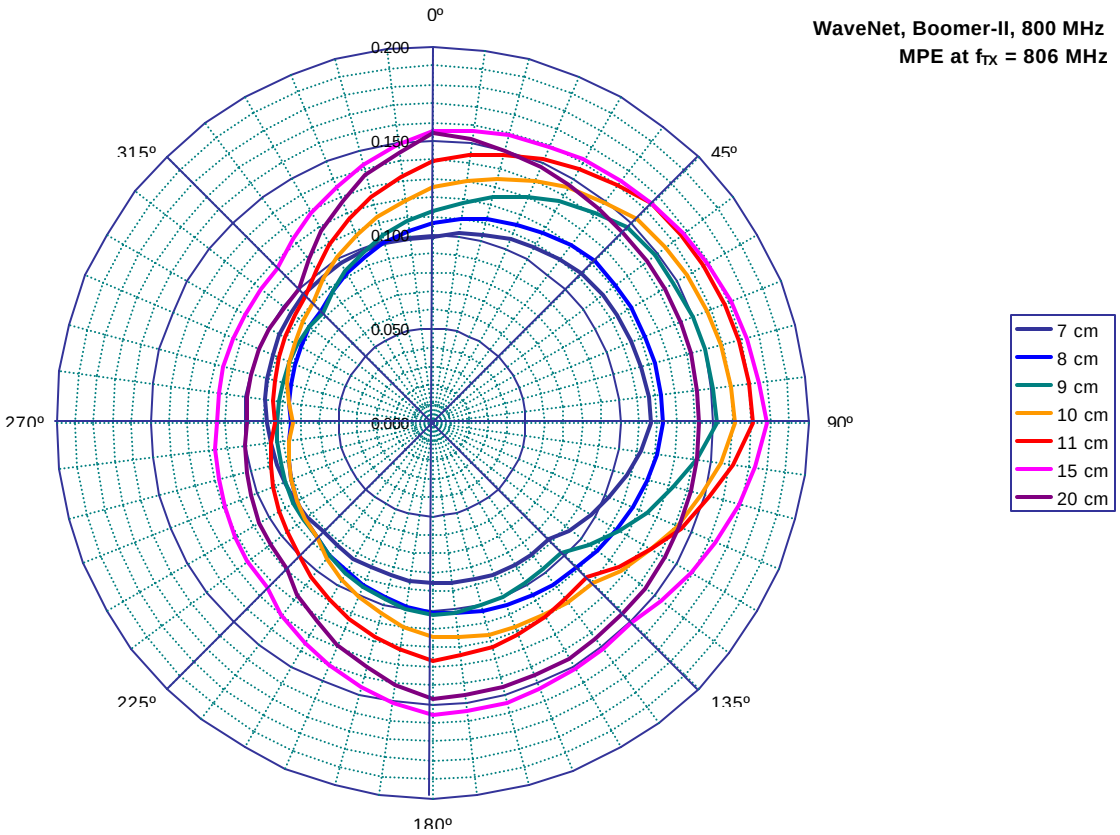


Figure 7.5.2.b

7.6 Results for 821 MHz

The output power of the device has been set to the highest rated output power. For f_{TX} = 821 MHz measured ERP was 1.496W.

Table 7.6.1 presents the results of the measurements made along the length of the antenna in order to find the location of the maximum power density (the antenna has a height of 9 cm). Column 1 shows the height at which the measurements were taken and column 2 shows the results (power density). Column 3 indicates limit for the MPE in the controlled environment. Margin to the limit is given in column 4.

Table 7.6.1
Power Density Measured at 45° as a Function of Height
Test Frequency: 821 MHz

Height [cm]	Measured Power Density [mW/cm^2]	Limit [mW/cm^2]	Margin [mW/cm^2]
20	0.130	0.54	0.410
15	0.145	0.54	0.395
11	0.112	0.54	0.428
10	0.110	0.54	0.430
9	0.096	0.54	0.444
8	0.079	0.54	0.461
7	0.071	0.54	0.469
6	0.067	0.54	0.473
5	0.065	0.54	0.475
4	0.063	0.54	0.477
3	0.055	0.54	0.485
2	0.055	0.54	0.485
1	0.060	0.54	0.480
0	0.065	0.54	0.475

* Highest measured value

The data in the Table 7.5.1 is presented in the Figure 7.6.1 along with the data measured in other directions.

Test performed by: Ki. Cho Rowan **Date:** November, 2002

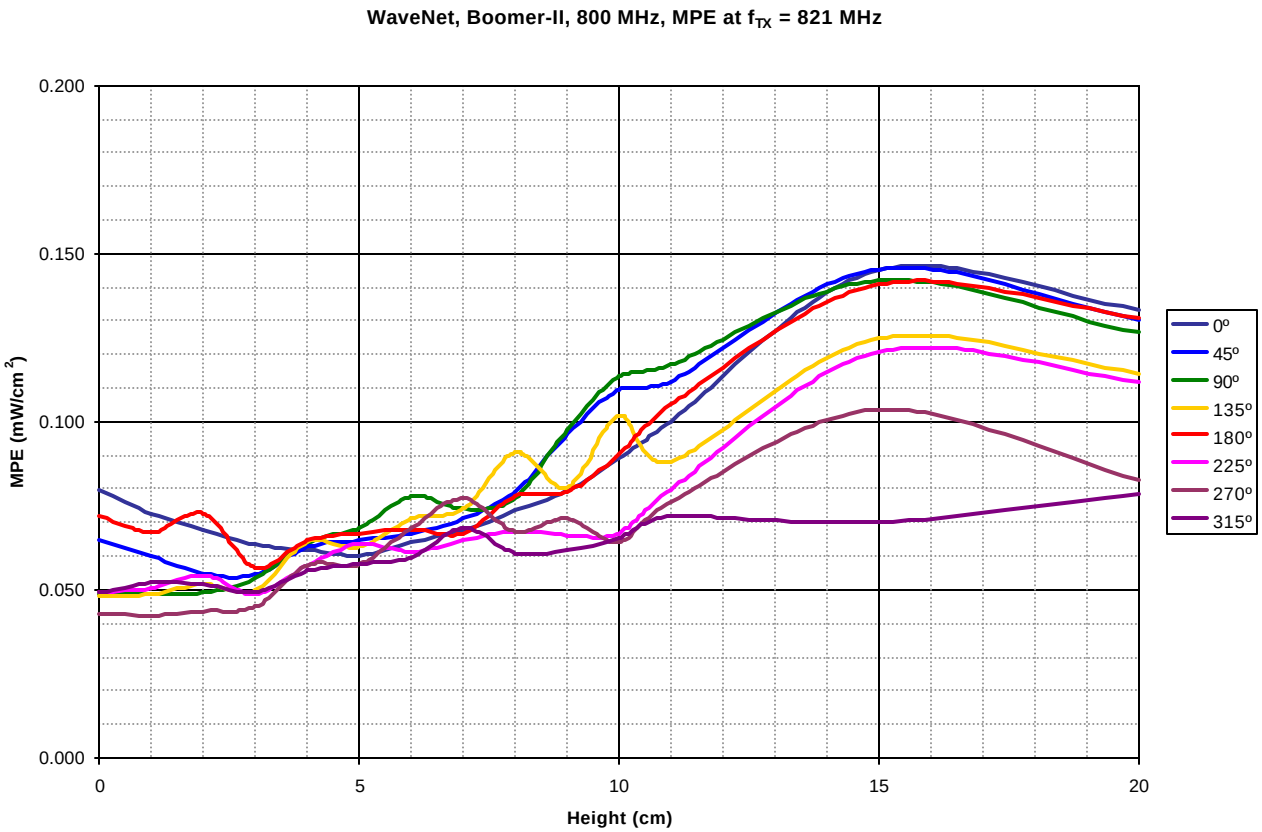


Figure 7.6.1 Measured Power Density v.s. Height for f_{TX} = 821 MHz

Table 7.6.2 presents the results of the measurements made around the antenna at every 45° of rotation. Column 1 shows the angle at which the measurements were taken and columns 2 through 8 show the measured power density at the different heights in the range from 1 cm to 20 cm from the ground plane. According to ANSI/IEEE C95.1-1999 the exposure values are those obtained by spatially averaging measured values over an area equivalent to the vertical cross-section (projected area) of the human body. Therefore, the MPE value is determined by averaging the adjusted total power density along a vertical line up to the height of a typically tall individual, taken here as 6 ft or 180 cm. So the averaging has to be done over those measurements made between 1 and 20 cm above the ground plane. Column 12 shows the results of this averaging.

Table 7.6.2
Power Density Measured
at every 45° as a Function of Height
Test Frequency: 821 MHz

Angular Position (°)	Measured RF-field Power Density (mW/cm^2) for different heights							Averaged Values (mW/cm^2)	MPE Limit (mW/cm^2)
	0 cm	1 cm	2 cm	3 cm	4 cm	5 cm	6 cm		
0º	0.080	0.073	0.068	0.063	0.062	0.060	0.064	0.08	0.54
45º	0.065	0.060	0.055	0.055	0.063	0.065	0.067	0.08	0.54
90º	0.049	0.049	0.049	0.053	0.064	0.068	0.078	0.08	0.54
135º	0.048	0.049	0.052	0.050	0.064	0.063	0.071	0.08	0.54
180º	0.072	0.067	0.073	0.056	0.065	0.067	0.068	0.08	0.54
225º	0.049	0.051	0.054	0.049	0.057	0.064	0.061	0.07	0.54
270º	0.043	0.042	0.044	0.045	0.057	0.058	0.068	0.06	0.54
315º	0.049	0.052	0.051	0.049	0.056	0.058	0.060	0.06	0.54

Angular Position (°)	Measured RF-field Power Density (mW/cm^2) for different heights							Averaged Values (mW/cm^2)	MPE Limit (mW/cm^2)
	7 cm	8 cm	9 cm	10 cm	11 cm	15 cm	20 cm		
0º	0.068	0.073	0.080	0.089	0.100	0.145	0.133	0.08	0.54
45º	0.071	0.079	0.096	0.110	0.112	0.145	0.130	0.08	0.54
90º	0.074	0.077	0.098	0.113	0.117	0.142	0.126	0.08	0.54
135º	0.074	0.091	0.080	0.102	0.088	0.125	0.114	0.08	0.54
180º	0.067	0.078	0.079	0.090	0.105	0.141	0.131	0.08	0.54
225º	0.065	0.067	0.066	0.067	0.080	0.121	0.112	0.07	0.54
270º	0.077	0.067	0.071	0.064	0.076	0.104	0.083	0.06	0.54
315º	0.068	0.061	0.062	0.065	0.072	0.070	0.078	0.06	0.54

The data in Table 7.6.2 is presented in Figure 7.6.2

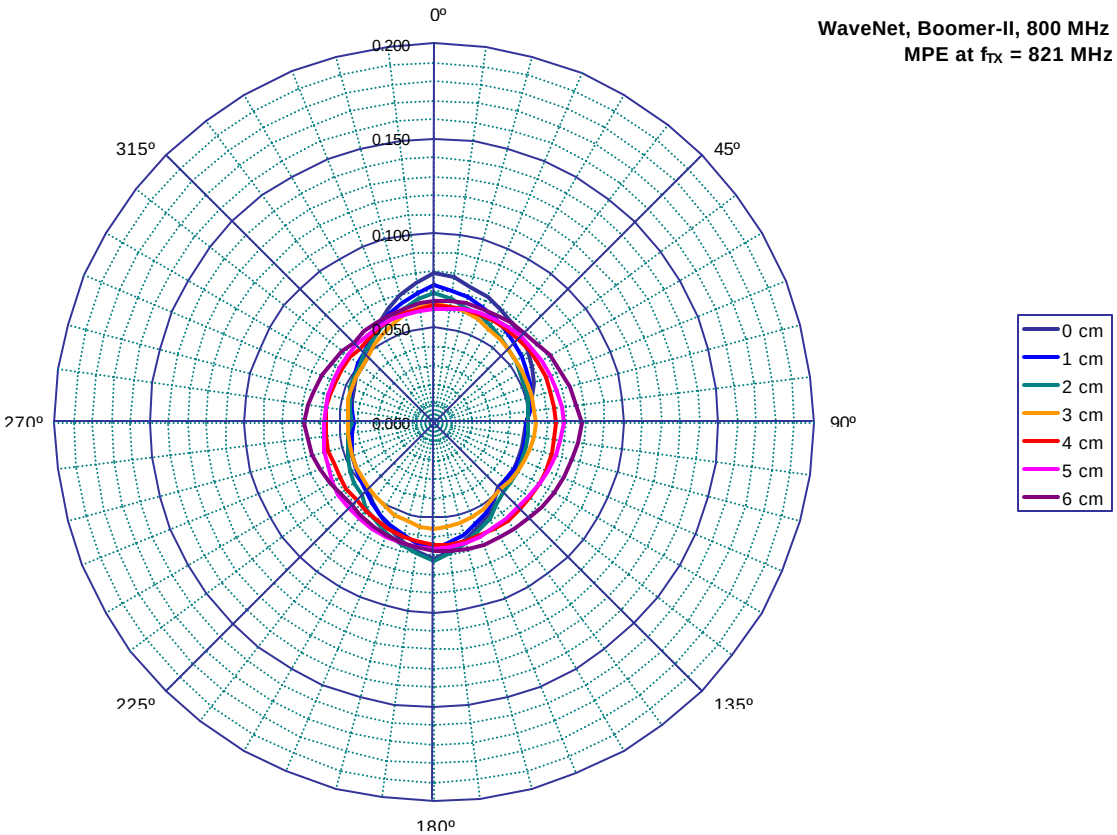


Figure 7.6.2.a

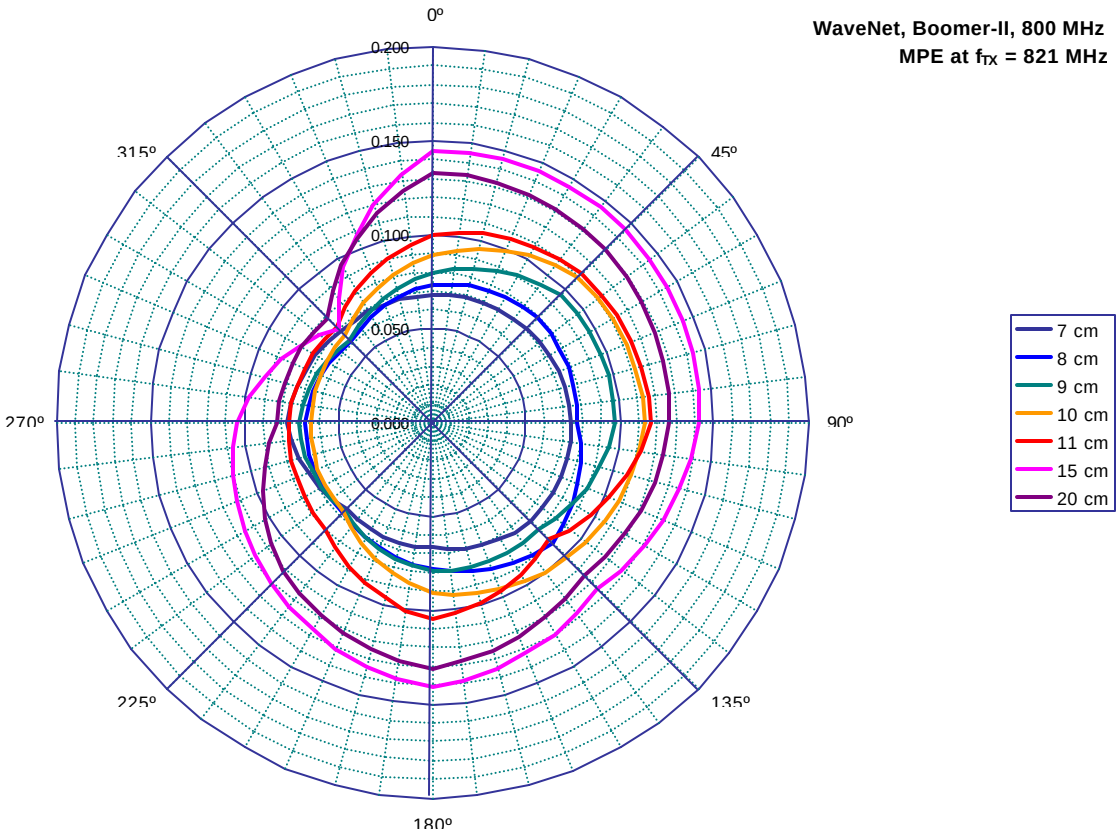


Figure 7.6.2.b

8.0 CONCLUSION

The DUI consisting of a **Wavenet BOOMER II 800MHz OEM Wireless Modem,** connected to a test jig and using a whip standard ¼ wave portable antenna mounted on a ground plane, will not exceed the MPE requirements at given distances exceeding 20 cm.

a) In the band 806-821 MHz the maximum power exposure level measured at 20 cm was 0.178 mW/cm^2, which is 33% of the maximum allowable.
b) In the band 806-821 MHz the maximum power exposure level measured at 20 cm was 0.145 mW/cm^2, which is 28% of the maximum allowable.