

FCC ID: PQS-BM29001

Exhibit 2b

Engineering Report on Boomer II 900 MHz

Radiated Spurious Emissions (2.1053)



Assessment of Compliance

for

**Measurement of Field Strength of Spurious Radiation in accordance
with the FCC Rules & Regulations Part 2.1053 and 90**

Wireless OEM Modem Module BOOMER II 900 MHz

Wavenet Technologies Pty Ltd.



October 2002

APREL Project No.:WVTB-BoomerII-Modem-3922-2

51 Spectrum Way Nepean ON K2R 1E6
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Engineering Report

Subject: Measurement of Field Strength of Spurious
Radiation in accordance with the
FCC Rules & Regulations Part 2.1053 and 90

FCC ID: PQS-BM29001

Equipment: Wireless OEM Modem Module

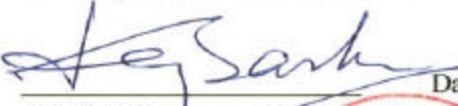
Model: BOOMER II 900 MHz

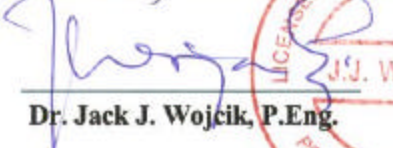
Client: Wavenet Technologies Pty Ltd.
140 Burswood Rd
Burswood, Perth, WA 6100
AUSTRALIA

Project #: WWTB-BoomerII-Modem-3922-2

Prepared By: APREL Laboratories,
Regulatory Compliance Division
51 Spectrum Way
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Approved by:  Date: Oct. 18, 2002
Jay Sarkar
Technical Director, Standards & Certification

Submitted by:  Date: Oct. 18, 2002
Jay Sarkar
Technical Director, Standards & Certification

Released by:  Date: Oct 18/02
Dr. Jack J. Wojcik, P.Eng.



FCC ID: PQS-BM29001
Applicant: Wavenet Technologies Pty Ltd.
Equipment: Wireless OEM Modem Module
Model: **BOOMER II 900 MHz**
Standard: FCC Rules and Regulations Part 2.1053 and 90

ENGINEERING SUMMARY

This report contains the results of Field Strength of Spurious Radiation measurement performed on a Wavenet Wireless OEM Modem Module attachment, for model **BOOMER II 900 MHz**, in accordance with the FCC Rules and Regulations Part 2.1053 and 90. The measurements were carried out using direct method and substitution method both as radiated.

The product was evaluated for spurious radiation when it was set at the highest ERP. The Wireless OEM Module is an 900 MHz OEM product for integration into customer end user equipment as an OEM modem and interfaces to it via the data interface port.

The modem provides a single band 896-901 MHz.

Test configuration: BOOMER II 900 MHz was tested as a stand-alone unit. 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 test jig was located below the turntable to minimise the interference during the spurious measurements as shown in the photographs at the appendix B. Cables connecting BOOMER II 900 MHz modem to the testing jig were fitted with ferrite bids to reduce any possible radiation coming from the jig.

This report presents test data for frequency band, 896-901 MHz, Mask J for three channels

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

Table 1
Summary of the Results

Test Description	Page No.	Test Set-up Figure No.	Results Summary
Field Strength of Spurious Radiation Ref. Paragraph 2.1053 and 90	8	1	Passed

INTRODUCTION

General

This report describes the results of the Field Strength of Spurious Radiation measurement conducted on a Wavenet Wireless OEM Modem Module, model **BOOMER II 900 MHz**.

Test Facility

The tests were performed for Wavenet Technologies Pty Ltd. by APREL Laboratories at APREL's EMI facility located in Nepean, Ontario, Canada. The laboratory operates an (3m and 10m) Open Area Test Site (OATS). The measurement facility is calibrated in accordance with ANSI C63.4-1992.

A description of the measurement facility in accordance with the radiated and AC line conducted test site criteria per 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. APREL is also accredited by Industry Canada.

Standard

The evaluation and analysis were conducted in accordance with FCC Rules and Regulations Parts 2.1053 and the appropriate limits (90).

***Personnel:** The equipment was tested by Roman Kuleba, RF-EMC Engineer. The methodology developed and the report was written by Jayanta (Jay) K. Sarkar, Technical Director, Standards and Certification.*

Test Equipment

The test equipment used during the evaluation is listed in Appendix A with calibration due dates.

Environmental Conditions

Measurements were conducted in open area test site. Temperature: $20^{\circ}\text{C} \pm 2$,
Relative Humidity: 30 - 50 % , Air Pressure: $101 \text{ kPa} \pm 3$.

FCC SUBMISSION INFORMATION

FCC ID: **PQS-BM29001**

Equipment type: **Wireless OEM Modem Module**

Model: **BOOMER II 900 MHz**

For: Certification

Applicant: **Wavenet Technologies Pty Ltd.**
140 Burswood Rd
Burswood, Perth, WA 6100
AUSTRALIA

Manufacturer: **Wavenet Technologies Pty Ltd.**
140 Burswood Rd
Burswood, Perth, WA 6100
AUSTRALIA

Evaluated by: **APREL Laboratories**
51 Spectrum Way
Nepean, Ontario
Canada K2R 1E6

MANUFACTURER'S DATA

FCC ID: PQS-BM29001

Equipment Type: Wireless OEM Modem Module

Model: BOOMER II 900 MHz

Reference: FCC Rules and Regulations Parts 2 and Part 90

Manufacturer: Wavenet Technologies Pty Ltd

Development Stage of Unit: Prototype

GENERAL SPECIFICATIONS

1. Frequency Range: 896.00 to 901.00 MHz (Transmitter)
2. Measured ERP 1.556 W (31.92 dBm)
3. Emission Designators Per 47 CFR § 2.201 and §2.202 9K8F1D
4. Antenna Impedance: 50 Ohms

Measurement: Field Strength of Spurious Emissions

BOOMER II 900 MHz

Frequency Band: 896-901 MHz

Ref.: FCC Part 2.1051 and Part 90.210

Criteria: *Emission Mask J (896~901MHz)*. The power of emissions must be attenuated below the power of the unmodulated carrier (P) on any frequency removed from the centre of the authorized bandwidth by a displacement frequency (f_a in kHz) of more than 9.5 kHz: At least $50 + 10 \log (P)$ dB. This is calculated to be -20 dBm or 77.6 dB μ V.

Set-up: See Figure 1.a

Equipment: See Appendix A.

Procedure: A. Direct Method as Radiated (See Section B for Substitution Method).

The final measurements were taken at APREL Laboratory's open area test site (OATS) measurement facility. This open area test site is calibrated to ANSI C63.4 document and a description of the measurement facility 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.
(FCC Registration No.:90416).

The **DUI** was configured to operate at maximum power with appropriate modulation. Special software was employed in order that the transmitter was processing data in a normal manner.

Prior to final measurement in the OATS, preliminary radiated spurious emissions were scanned in a shielded enclosure at a distance of 1 m using biconical, log-periodic and horn antennas in order to determine the characteristic frequencies of the field strength of spurious emissions. Based on this information, measurements were performed in the OATS at these characteristic frequencies using calibrated antennas

All field strength measurements were made with a spectrum analyser and the appropriate calibrated antenna for the frequency range from 9 kHz up to 10th harmonics of the transmit frequency (see equipment list for the calibrated antenna used).

Test configuration: **BOOMER II 900 MHZ** was tested as a stand-alone unit. 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 test jig was located below the turntable to minimise the interference during the spurious measurements as shown in the photographs at the appendix B. Cables connecting BOOMER II modem to the testing jig were fitted with ferrite bids to reduce any possible radiation coming from the jig.

The **BOOMER II 900 MHZ** was placed on a turntable positioned 3 meters away from the calibrated receiving antenna, which in turn was connected to the spectrum analyzer. For each identified frequency, the received signal was maximised by the positioning of the turntable and the height of the antenna. The process was repeated for both horizontal and vertical polarisation.

Information submitted includes the relative radiated power of each spurious emission with reference to the calculated 77.6 dBµV/m limit per 90.210(j) assuming all emissions are radiated from half-wave dipole antenna.

Measurements given in the spurious emissions test result tables contain: analyzer reading, correction factor, and final reading. The final field strength level are derived from the analyzer measurement and the correction factor (antenna factor and cable loss) as shown in the following example:

Sample Calculation for direct method

A. Spectrum analyzer reading

At 1798 MHz, a spurious level of 30.3 dBµV @ 3 meters is measured.

B. Correction factor (antenna factor, insertion loss of band pass filter and cable loss)

Cable loss: 2.6 dB

Antenna Factor: 27.9 dB

Total Correction Factor: $2.6 + 27.9 = 30.5$ dB/m

C. Final reading (Field Strength of spurious emission):

$$C = A + B$$

$$C = 30.3 \text{ dB}\mu\text{V} + 30.5 \text{ dB}$$

$$C = 60.8 \text{ dB}\mu\text{V/m @ 3 meters}$$

D. The criteria level.

The field intensity, which would be produced by the transmitter carrier operating into a half-wave dipole antenna (gain of 1.64), at a distance of 3 m, was calculated using the following formula:

$$\text{Field Strength of Carrier} = 10 \log_{10} [P_t \cdot G / (4 \cdot \pi \cdot r^2)] + 146 \text{ dB} = 129.5 \text{ dB}\mu\text{V/m}$$

Where:

P_t is transmitter carrier power = 1.556 W (ERP)

G is gain, 1.64

R is distance, 3 meters

$$\text{Criteria Limit} = \text{Field Strength of Carrier} - [50 + 10 \cdot \log_{10}(P_t)] = 77.6 \text{ dB}\mu\text{V/m}$$

Criteria at 3 meters from 1.556 Watt (ERP) into a half-wave dipole antenna is 77.6 dBm V/m for direct method in the frequency band 896-901 MHz, MASK J.

E = Margin (spurious emission below the reference level)

$$E = D - C$$

$$E = 77.6 \text{ dB}\mu\text{V/m} - 60.8 \text{ dB}\mu\text{V/m}$$

$$E = 16.8 \text{ dB (direct method)}$$

B: Substitution Method (Radiated)

The BOOMER II 900 MHz was also tested for spurious radiated emissions using the substitution method with a procedure similar to that used in the ERP measurement and described in the ERP measurement portion of the Test Report. A set of three reference dipoles, a horn antenna and a signal generator to duplicate the signal were used. Signals radiated from the BOOMER II 900 MHz on the fundamental frequency as well as second and third harmonic were evaluated by comparing to the signals transmitted from the reference dipoles. For testing the higher frequencies, fourth to 8th harmonics, a calibrated horn antenna with known gain was used as a replacement source of radiation thus substituting the BOOMER II. The duplicated reading (taken in dBm) was then referenced to the dipole.

Criteria: The criteria level using substitution method was calculated to be
-20 dBm in the frequency band 896-901 MHz, MASK J.

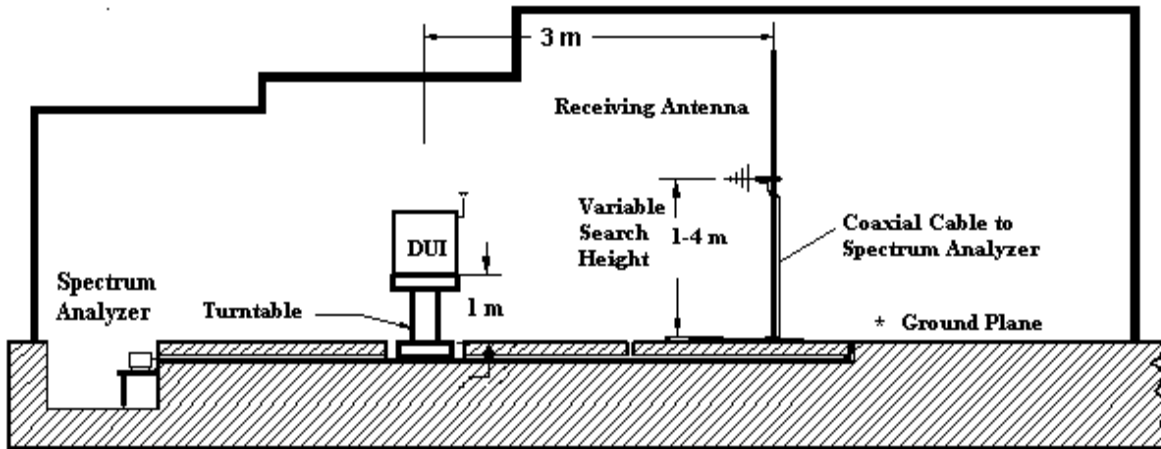
This level was obtained by using the following expression:

$$\text{Criteria}_{\text{Limit (dBm)}} = \text{ERP}_{\text{Carrier (dBm)}} - [50 + 10 \cdot \log_{10} \text{ERP}_{(W)}]$$

Example:

$$\begin{aligned} \text{Criteria}_{\text{Limit(dBm)}} &= 31.9 \text{ dBm} - [50 + 10 \cdot \log_{10}(1.556 \text{ W})] \\ \text{Criteria}_{\text{Limit(dBm)}} &= 31.9 \text{ dBm} - (50 + 1.9) \text{ dB} = -20.0 \text{ dBm} \end{aligned}$$

Results: **Passed** . **See Tables 2 to 7 for direct method**
 See Tables 8 to 13 for substitution method



**Figure 1.a Test set up for the Field Strength of Spurious Radiation Measurement in OATS
(Not to scale)**



Fig. 1.b APREL's OATS (Open Area Test Site)

MEASUREMENT DATA

Table 2
Wireless OEM Modem Module
WaveNet Boomer II 900 MHz
Field Strength of Spurious Emissions
Fundamental frequency: 896 MHz, Ch. Low
Direct Method
Antenna Polarisation: Vertical

Harmonic No.	Frequency (MHz)	Measured Level dBm V A	Correction Factor DB/m B	Field Strength dBm V/m C	Criteria Level dBm V/m D	Margin (dB) E
Fundamenta l	896	103.2	26.2	129.4	-	-
1	1792	29.6	30.5	60.1	77.6	17.5
2	2688	20.3	32.7	53.0	77.6	24.6
3	3584	14.9	36.1	51.0	77.6	26.6
4	4480	15.5	37.0	52.5	77.6	25.1

C=A+B, E=D-C

MEASUREMENT DATA

Table 3
Wireless OEM Modem Module
WaveNet Boomer II 900 MHz
Field Strength of Spurious Emissions
Fundamental frequency: 896 MHz, Ch. Low
Direct Method
Antenna Polarisation: Horizontal

Harmonic No.	Frequency (MHz)	Measured Level dBm V A	Correction Factor DB/m B	Field Strength dBm V/m C	Criteria Level dBm V/m D	Margin (dB) E
Fundamenta l	896	88.8	26.2	115.0	-	-
1	1792	13.3	30.5	43.8	77.6	33.8
2	2688	13.1	32.7	45.8	77.6	31.8
3	3584	13.6	36.1	49.7	77.6	27.9
4	4480	13.2	37.0	50.2	77.6	27.4

C=A+B, E=D-C

MEASUREMENT DATA

Table 4
Wireless OEM Modem Module
WaveNet Boomer-II 900 MHz
Field Strength of Spurious Emissions
Fundamental frequency: 899 MHz, Ch. Medium
Direct Method
Antenna Polarisation: Vertical

Harmonic No.	Frequency (MHz)	Measured Level dBm V/m A	Correction Factor dBm V/m B	Field Strength dBm V/m C	Criteria Level dBm V/m D	Margin (dB) E
Fundamental	899	103.4	26.2	129.6	-	-
1	1798	30.3	30.5	60.8	77.6	16.8
2	2697	21.2	32.8	54.0	77.6	23.6
3	3596	15.5	36.1	51.6	77.6	26.0
4	4495	15.2	37.0	52.2	77.6	25.4

C=A+B, E=D-C

MEASUREMENT DATA

Table 5
Wireless OEM Modem Module
WaveNet Boomer-II 900 MHz
Field Strength of Spurious Emissions
Fundamental frequency: 899 MHz, Ch. Medium
Direct Method
Antenna Polarisation: Horizontal

Harmonic No.	Frequency (MHz)	Measured Level dBm V/m A	Correction Factor dBm V/m B	Field Strength dBm V/m C	Criteria Level dBm V/m D	Margin (dB) E
Fundamental	899	89.3	26.2	115.5	-	-
1	1798	12.9	30.5	43.4	77.6	34.2
2	2697	13.5	32.8	46.3	77.6	31.3
3	3596	13.5	36.1	49.6	77.6	28.0
4	4495	13.1	37.0	50.1	77.6	27.5

C=A+B, E=D-C

MEASUREMENT DATA

Table 6
Wireless OEM Modem Module
WaveNet Boomer-II 900 MHz
Field Strength of Spurious Emissions
Fundamental frequency: 901 MHz, Ch. High
Direct Method
Antenna Polarization: Vertical

Harmonic No.	Frequency (MHz)	Measured Level dBm V/m A	Correction Factor dBm V/m B	Field Strength dBm V/m C	Criteria Level dBm V/m D	Margin (dB) E
Fundamental	901	103.3	26.2	129.5	-	-
1	1802	29.5	30.6	60.1	77.6	17.5
2	2703	20.8	32.8	53.6	77.6	24.0
3	3604	16.0	36.2	52.1	77.6	25.5
4	4505	15.2	37.0	52.3	77.6	25.3

C=A+B, E=D-C

MEASUREMENT DATA

Table 7
Wireless OEM Modem Module
WaveNet Boomer-II 900 MHz
Field Strength of Spurious Emissions
Fundamental frequency: 901 MHz, Ch. High
Direct Method
Antenna Polarization: Horizontal

Harmonic No.	Frequency (MHz)	Measured Level dBm V/m A	Correction Factor dBm V/m B	Field Strength dBm V/m C	Criteria Level dBm V/m D	Margin (dB) E
Fundamental	901	90.6	26.2	116.8	-	-
1	1802	13.8	30.6	44.4	77.6	33.2
2	2703	13.3	32.8	46.1	77.6	31.5
3	3604	13.4	36.2	49.6	77.6	28.0
4	4505	13.5	37.0	50.5	77.6	27.1

C=A+B, E=D-C

MEASUREMENT DATA

Table 8

Wireless OEM Modem Module
WaveNet Boomer II 900 MHz
Field Strength of Spurious Emissions
Fundamental frequency: 896 MHz, Ch. Low
Substitution Method as Radiated
Antenna Polarisation: Vertical

Harmonic No.	Frequency (MHz)	ERP dBm	Limit dBm	Margin dB
Fundamenta l	896.0	31.7	-	-
1	1792.0	-37.9	-20.0	17.9
2	2688.0	-44.8	-20.0	24.8
3	3584.0	-47.1	-20.0	27.1
4	4480.0	-45.6	-20.0	25.6

C=A+B, E=D-C

MEASUREMENT DATA

Table 9

Wireless OEM Modem Module
WaveNet Boomer II 900 MHz
Field Strength of Spurious Emissions
Fundamental frequency: 896 MHz, Ch. Low
Substitution Method as Radiated
Antenna Polarisation: Horizontal

Harmonic No.	Frequency (MHz)	ERP dBm	Limit dBm	Margin dB
Fundamenta l	896.0	17.3	-	-
1	1792.0	-54.6	-20.0	34.6
2	2688.0	-53.1	-20.0	33.1
3	3584.0	-48.4	-20.0	28.4
4	4480.0	-47.8	-20.0	27.8

C=A+B, E=D-C

MEASUREMENT DATA

Table 10
Wireless OEM Modem Module
WaveNet Boomer II 900 MHz
Field Strength of Spurious Emissions
Fundamental frequency: 899 MHz, Ch. Medium
Substitution Method as Radiated
Antenna Polarisation: Vertical

Harmonic No.	Frequency (MHz)	ERP dBm	Limit dBm	Margin dB
Fundamenta l	899.0	31.7	-	-
1	1798.0	-37.4	-20.0	17.4
2	2697.0	-44.3	-20.0	24.3
3	3596.0	-46.6	-20.0	26.6
4	4495.0	-46.0	-20.0	26.0

C=A+B, E=D-C

MEASUREMENT DATA

Table 11
Wireless OEM Modem Module
WaveNet Boomer II 900 MHz
Field Strength of Spurious Emissions
Fundamental frequency: 899 MHz, Ch. Medium
Substitution Method as Radiated
Antenna Polarisation: Horizontal

Harmonic No.	Frequency (MHz)	ERP dBm	Limit dBm	Margin dB
Fundamenta I	899.0	17.6	-	-
1	1798.0	-54.9	-20.0	34.9
2	2697.0	-52.2	-20.0	32.2
3	3596.0	-48.7	-20.0	28.7
4	4495.0	-48.2	-20.0	28.2

C=A+B, E=D-C

MEASUREMENT DATA

Table 12
Wireless OEM Modem Module
WaveNet Boomer II 900 MHz
Field Strength of Spurious Emissions
Fundamental frequency: 901 MHz, Ch. High
Substitution Method as Radiated
Antenna Polarisation: Vertical

Harmonic No.	Frequency (MHz)	ERP dBm	Limit dBm	Margin dB
Fundamenta l	901.0	31.9	-	-
1	1802.0	-37.9	-20.0	17.9
2	2703.0	-45.4	-20.0	25.4
3	3604.0	-45.8	-20.0	25.8
4	4505.0	-45.7	-20.0	25.7

C=A+B, E=D-C

MEASUREMENT DATA

Table 13
Wireless OEM Modem Module
WaveNet Boomer II 900 MHz
Field Strength of Spurious Emissions
Fundamental frequency: 901 MHz, Ch. High
Substitution Method as Radiated
Antenna Polarisation: Horizontal

Harmonic No.	Frequency (MHz)	ERP dBm	Limit dBm	Margin dB
Fundamenta l	901.0	19.2	-	-
1	1802.0	-53.7	-20.0	33.7
2	2703.0	-51.9	-20.0	31.9
3	3604.0	-48.5	-20.0	28.5
4	4505.0	-47.5	-20.0	27.5

C=A+B, E=D-C

Test performed by: Kuldeep Rana Date: October, 2002

APPENDIX A

List of Test Equipment

Table 14
Radiated Spurious Emissions
List of Equipment

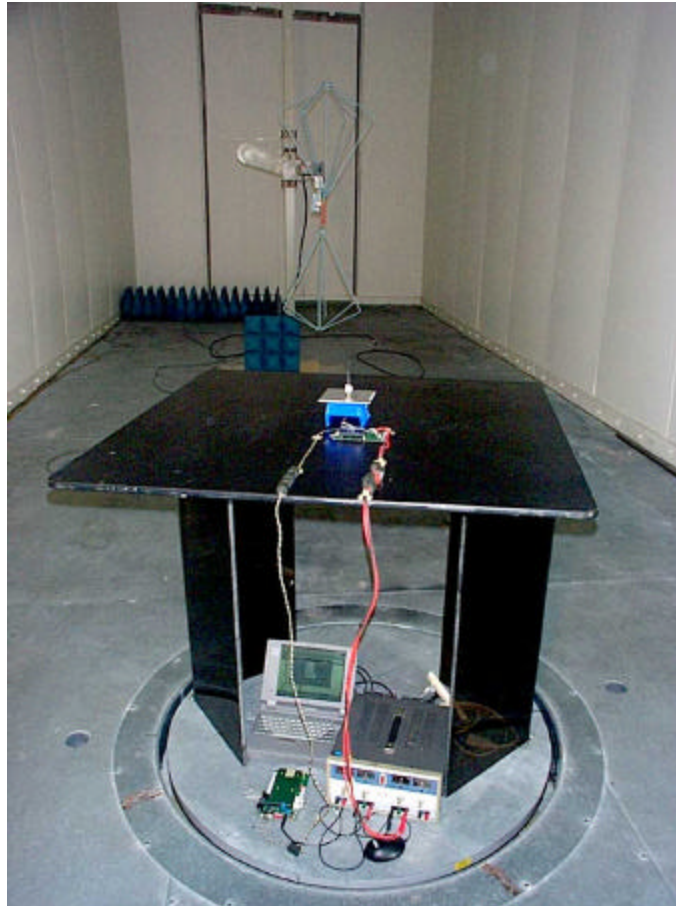
Description	Range	Manufacturer	Model #	APREL Asset #	Cal. Due Date
Spectrum Analyzer	9 kHz - 3 GHz	Anritsu	MS2661C	301330	Sept. 11, 2003
Spectrum Analyzer	9 kHz - 30 GHz	Anritsu	MS2667C	301386	September 5, 2003
RF Signal Generator	10 MHz – 26.5 GHz	Hewlett Packard	HP 8340 B	100955	October 5, 2003
Low Noise Antenna Pre-amplifier	30-1000 MHz	APREL Inc.	LNA-1	301415	August 27, 2003
Attenuator	20 dB	NARDA	9779-20	301533	August 15, 2003
High Pass Filter	3 GHz	--	KPMC 03570	301560	August 15, 2003
RF Power Meter	10 MHz - 18 GHz	Hewlett Packard	438A	301417	September 5, 2003
RF Power Sensor	10 MHz - 18 GHz	Hewlett Packard	8481A	100999	September 5, 2003
Biconical Antenna	20 MHz - 200 MHz	Eaton	94455-1	100890	July 18, 2003
Log - Periodic Antenna	200 MHz -1.0 GHz	Eaton	ALP-1	100063	July 31, 2003
Horn Antenna	1 – 18 GHz	APREL Inc.	AA – 118	100400	June 17, 2003
Anechoic Shielded Room	10 kHz - 10 GHz	APREL Inc.	–	301329	N/A
Reference Half -wave Dipole Antenna	815.00 MHz	APREL Inc.	–	301482	July 3, 2003
Reference Half -wave Dipole Antenna	1630.00 MHz	APREL Inc.	–	301549	July 3, 2003
Reference Half -wave Dipole Antenna	2500.00 MHz	APREL Inc.	–	301550	July 3, 2003
OATS	30 MHz – 1 GHz	APREL Inc.	3 m & 10 m	N/A	FCC: April 4, 2003 IC: Sept. 18, 2005
Mast with the Controller	1 m – 4 m	EMCO	1051 – 12	100507	N/A
Turntable with the Controller	0° - 360°	EMCO	1060 – 1.241	100506	N/A

APPENDIX B

PHOTOGRAPHS



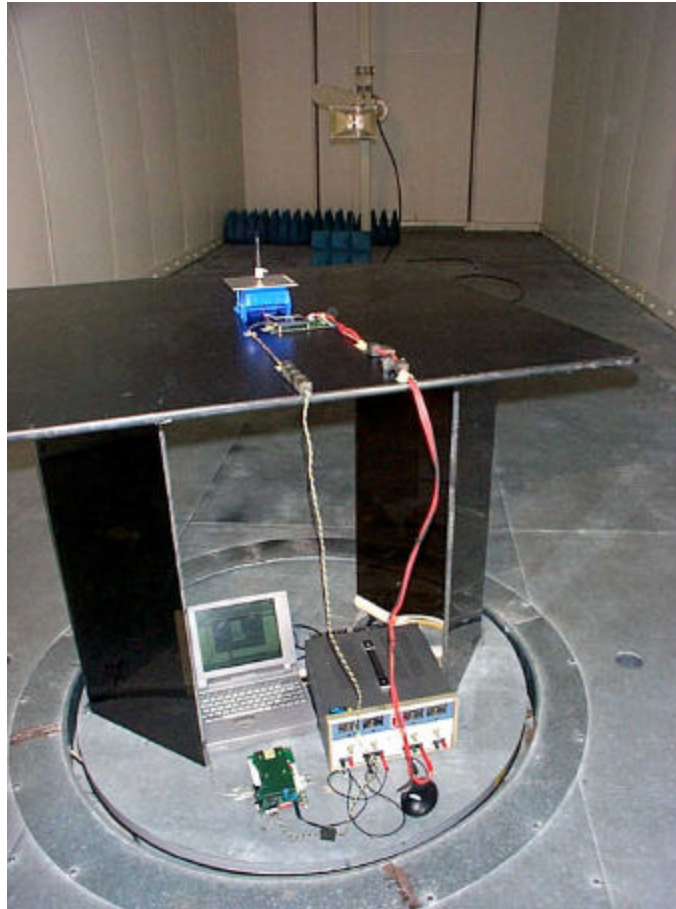
Wavenet BOOMER II (900 MHZ) Wireless OEM Modem Module



**WaveNet BOOMER II (900 MHz) Wireless OEM Modem Module
Testing for Spurious Emissions from Transmitter
Frequency Range: 30 MHz – 200 MHz**



WaveNet BOOMER II (900 MHz) Wireless OEM Modem Module
Testing for Spurious Emissions from Transmitter
Frequency Range: 200 MHz – 1 GHz



**Wavenet BOOMER II (900 MHz) Wireless OEM Modem Module
tested for Spurious Emissions from Transmitter
Frequency Range: 1 GHz – 18 GHz**