

Assessment of Compliance

with respect to

FCC Rules & Regulations
Part 15 Subparts 109, 209, 247, 249

for

Digital Transmission System



Engineering Report

Subject: Assessment of Compliance with Respect to
FCC Rules & Regulations Part 15.247
Digital Transmission System

FCC ID: T8E-E1000

Product: 2450 MHz Wireless Temperature Acquisition Device

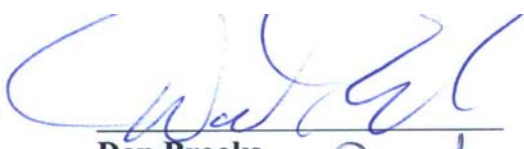
Model: LHZ05042

Client: LinearHertz
6550 Francois-Mauriac
Laval, Quebec
CANADA, H7R 6B7

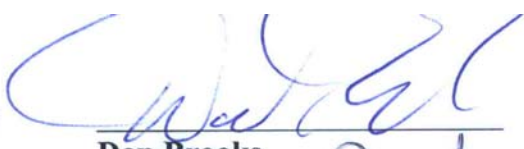
Project #: LIHB-SANTORIO-5243

Prepared By: APREL Laboratories,
Regulatory Compliance Division

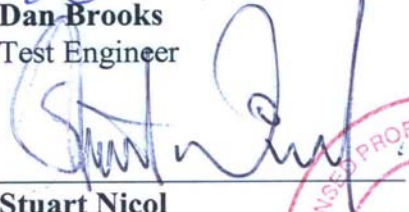
Tested by:


Dan Brooks
Test Engineer

Date:


July 31/2006

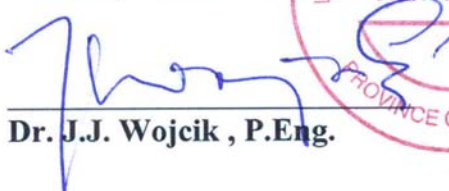
Approved by:


Stuart Nicol
Director, Product Development and Doseimetric R & D

Date:

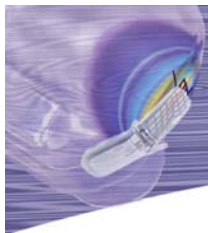
31 / July / 2006

Released by:


Dr. J.J. Wojcik , P.Eng.

Date:

Aug 1/06.



FCC ID: T8E-E1000
Applicant: LinearHertz
Equipment: 2450 MHz Temperature Acquisition Device
Model: LHZ05042
Standard: FCC Rules and Regulations Part15 Subpart 247, Digital Transmission System

ENGINEERING SUMMARY

This report contains the results of the measurements performed on a **Temperature Acquisition Device**. The tests were carried out in accordance with the FCC Rules and Regulations Part 15 subparts 109,209,247,249.

Based on the test results, it is certified that the product meets the applicable requirements as set forth in the above specifications for Certification.

Temperature Acquisition Device Santorio Meteo

Summary of the Results

Test Description	Figure & Table No.	Page No.	Results Summary
Peak Power Output, (EIRP) Ref. FCC Part15 subparts; 247(b)(3)	Table.1 Figure.1-3	7-9	Passed
Bandwidth 6dB Ref. FCC Part15 subpart: 247(a)(2)	Table.2 Figures.4-6	10-12	Passed
Power Spectral Density Ref. FCC part15 subpart: 247(d)	Table.3 Figures.7-9	13-15	Passed
Spurious Radiated Emissions Ref. FCC Part15 subpart: 249, 209(a)	Table.4	16,17	Passed
Radiated Emissions Ref. FCC part15 subpart: 109(a)	Figure.10-11	18,19	Passed
Radiated Emissions (receiver) Ref. FCC part15 subpart: 109(a),	Figures.12,13	20,21	Passed

INTRODUCTION

General

This report describes the results of selected tests performed on EUT device LHZ 05042 **Santorio System Meteo**, provided by LinearHertz.

Test Facility

The tests were performed for LinearHertz, 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 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 FCC registration number is 90416.

All equipment used is calibrated or verified, APREL is acceptable by FCC to perform Declaration of Conformity (DoC) testing under the FCC rules.

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Standard

The evaluation and analysis were conducted in accordance with FCC Rules and Regulations Part 15: Subparts, 109(a), 209, 205(a), 247(a)(2), 247(b)(3), and 247(d)

Test Equipment

The test equipment used during the evaluation is listed in Appendix A. Calibration of all test equipment is performed at 12 month intervals.

Environmental Conditions

Measurements were conducted under normal laboratory conditions including open area test site.

- Temperature: 23 °C ± 2
- Relative Humidity: 30 - 50 %
- Air Pressure: 101 kPa ± 3



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FCC SUBMISSION INFORMATION

FCC ID: **T8E-E1000**

Equipment: **2450 MHz Temperature Acquisition Device**

Model: **Santorio**

For: Certification

Applicant: **LinearHertz.**
6550 Francois-Mauriac
Laval, Quebec
CANADA, H7R 6B7

Manufacturer: **M2S Electronics LTD**
285 De Celles
Quebec City, Quebec
CANADA, G2C 1K7

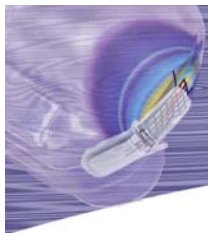
Test Laboratory: APREL Laboratories
51 Spectrum Way
Nepean, Ontario
Canada K2R 1E6



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MANUFACTURER'S DATA

FCC ID:	T8E-E100
Equipment Type:	2450 MHz Temperature Acquisition Device
Model:	LHZ05042
Manufacturer:	M2S Electronics LTD
Development Stage of Unit:	Pre-Production



Test: **Peak Equivalent Isotropic Radiated Power (EIRP)**

Test Mode: **Digital Transmission System**

Ref.: **FCC 15.247(b)(3)**

Criteria: The maximum output power shall not exceed one Watt EIRP peak power for the devices operating in the 2400-2483.5 MHz band.

Peak transmit power must be measured over any interval of continuous transmission using instruments calibrated in terms of a RMS equivalent voltage. To obtain a true peak measurement for the emissions in question over the full bandwidth of the channel the results shall be properly adjusted for any instrument limitations. Such as, detector response times, limited resolution bandwidth capability when compared to the emission bandwidth, sensitivity.

Set-up: See Figure.14.

Equipment: See Appendix A.

Procedure: **Equivalent Isotropic Radiated Power (EIRP):**

The Equivalent Isotropic Radiated Power EIRP measurements were taken using antenna substitution method at APREL Laboratory's open area test site (OATS) measurement facility. This open area test site is calibrated to ANSI C63.4. Documents 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 File No.: 90416).

The test was set-up as illustrated in Figure.14. The EUT was configured to operate at maximum power with appropriate mode of operation. The equipment under test was placed on a turntable positioned 3 meters away from the receiving antenna, which in turn was connected to the spectrum analyzer.

For each transmitter frequency, the received signal was maximized by rotating exhibit.1 the turntable and adjusting the height of the receiving antenna. The mobile device was replaced by a half-wave dipole antenna vertically polarized with the dipole antenna placed in the same location as the test device. The signal generator level was adjusted to obtain the same reading on the spectrum analyzer.

The output power **P** from the cable connecting the dipole was directly measured with the RF power meter PM. The effective radiated power table.1 (ERP) was calculated according to the relation in equation (1).

$$\text{Equation (1)} \quad \text{ERP}_{(\text{dBm})} = \text{P}_{(\text{dBm})} + \text{CF}_{(\text{dB})} + \text{0}_{(\text{dBd})}$$

The equivalent isotropic radiated power (EIRP) was calculated according to the relation in equation (2).

$$\text{Equation (2)} \quad \text{EIRP}_{(\text{dBm})} = \text{ERP}_{(\text{dBm})} + 2.15\text{dBi}$$

Table.1 Equivalent Isotropic Radiated Power (EIRP)

Channel #	Transmitting Frequency MHz	SA Reading dBuV	PM Reading dBm	CF Cable, Coupler dB	Measured ERP dBm	EIRP dBm
1 (lower band)	2410	68.46	-34.69	38.51	3.82	5.97
4 (mid band)	2425	68.39	-35.48	38.51	3.03	5.18
8 (upper band)	2445	67.58	-36.22	38.51	2.29	4.44

Results: PASSED. See Table.1. Figures.1-3

Figure.1 Peak Power Channel.1

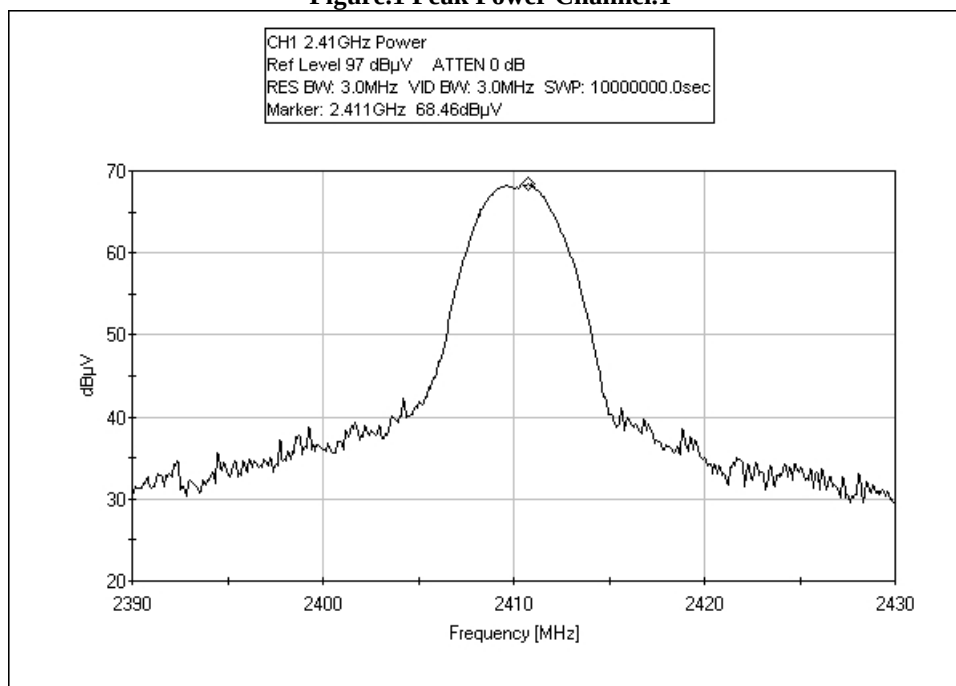
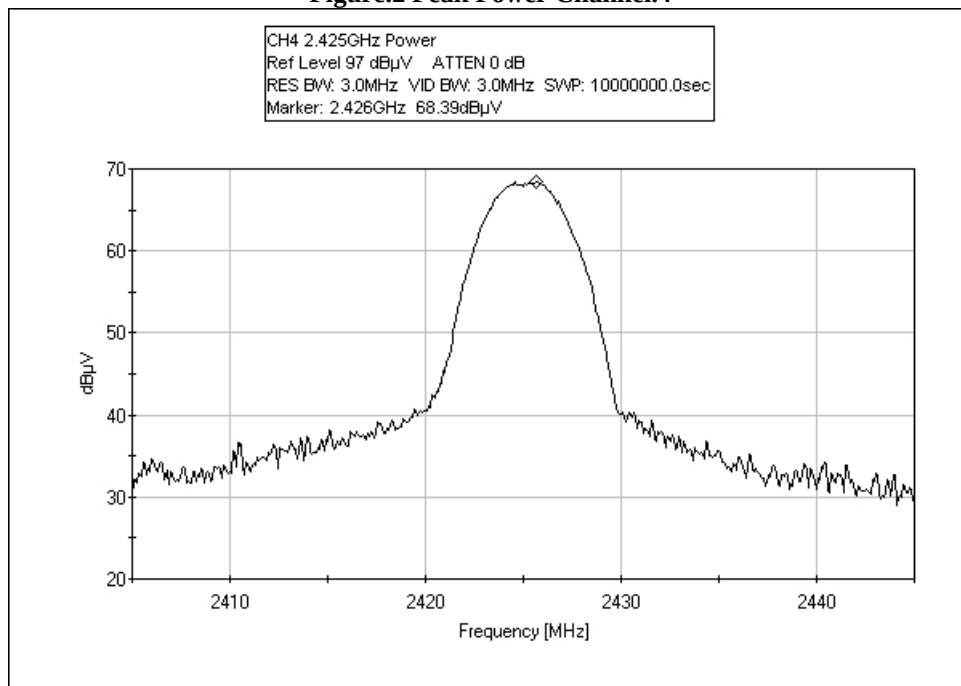
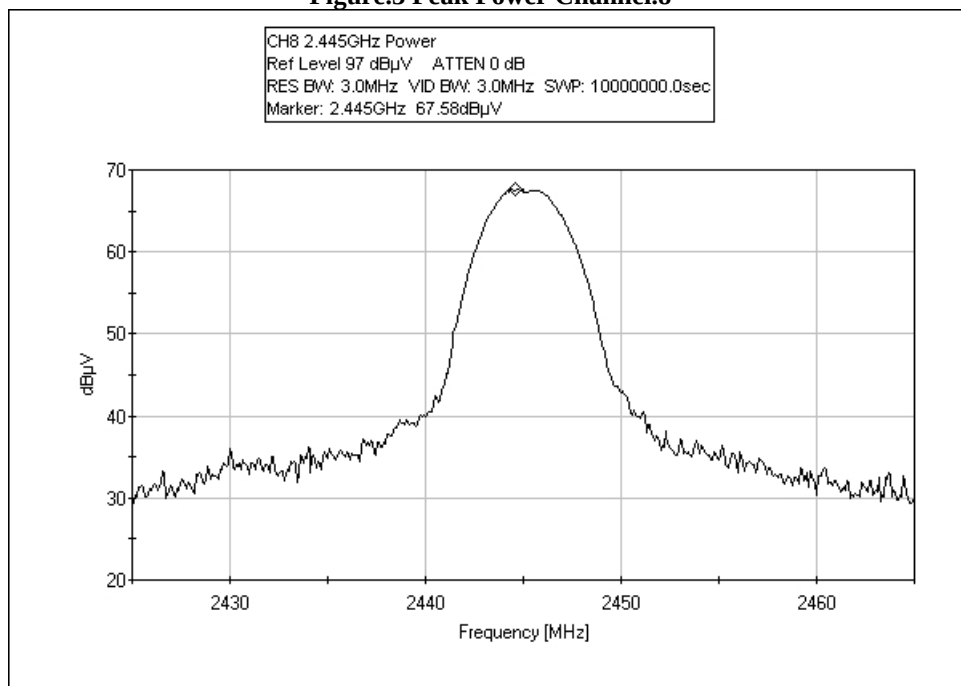
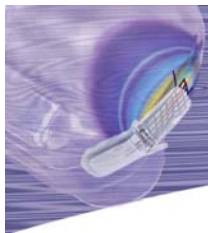


Figure.2 Peak Power Channel.4**Figure.3 Peak Power Channel.8**



Test: 6 dB Bandwidth (MHz)

Test Mode: Digital Transmission System

Ref.: FCC 15.247(a)(2)

Criteria: Digital transmission Systems operating in the 2400-2483.5 MHz band requires a minimum 6dB bandwidth of at least 500 kHz.

Set-up: See Figure.14.

Equipment: See Appendix A.

Procedure: 6dB bandwidth (MHz):

The 6 dB bandwidth 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 File No.: 90416).

The test was set-up as illustrated in Figure.14. The EUT was configured to operate at maximum power with appropriate mode of operation. The equipment under test was placed on a turntable positioned 3 meters away from the receiving antenna, which in turn was connected to the spectrum analyzer.

For each transmitter frequency, the received signal was maximized by rotating the turntable exhibit.1 and adjusting the height of the receiving antenna.

Table.2
6dB Bandwidth (MHz)

Channel #	Frequency (MHz)	6dB Bandwidth (MHz)
1 (lower band)	2410	1.61
4 (mid band)	2425	1.60
8 (upper band)	2445	1.60

Results: PASSED. See Table.2. Figures.4-6

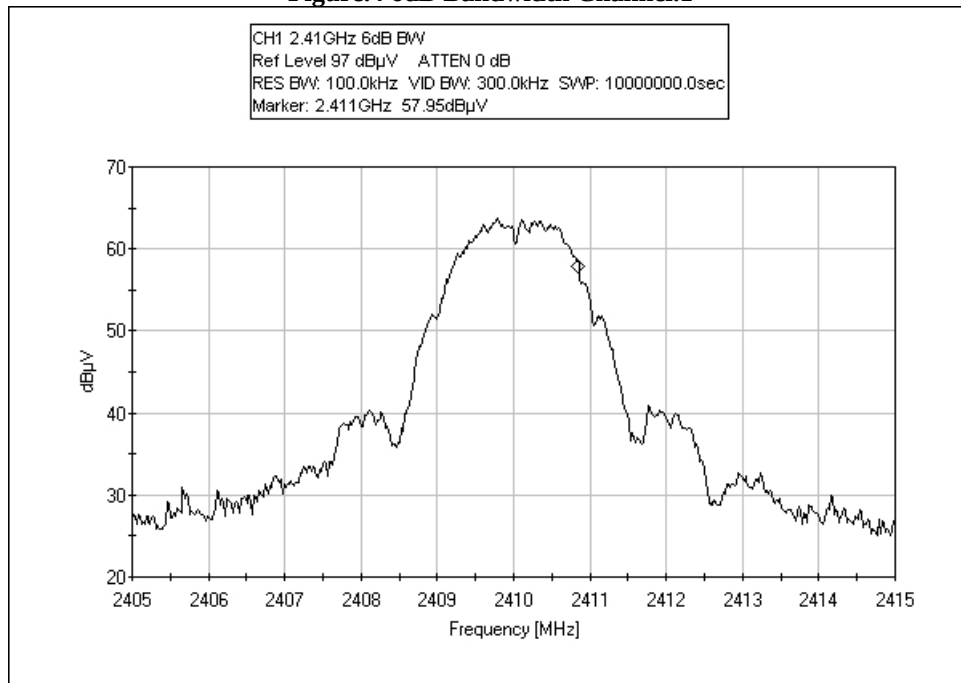
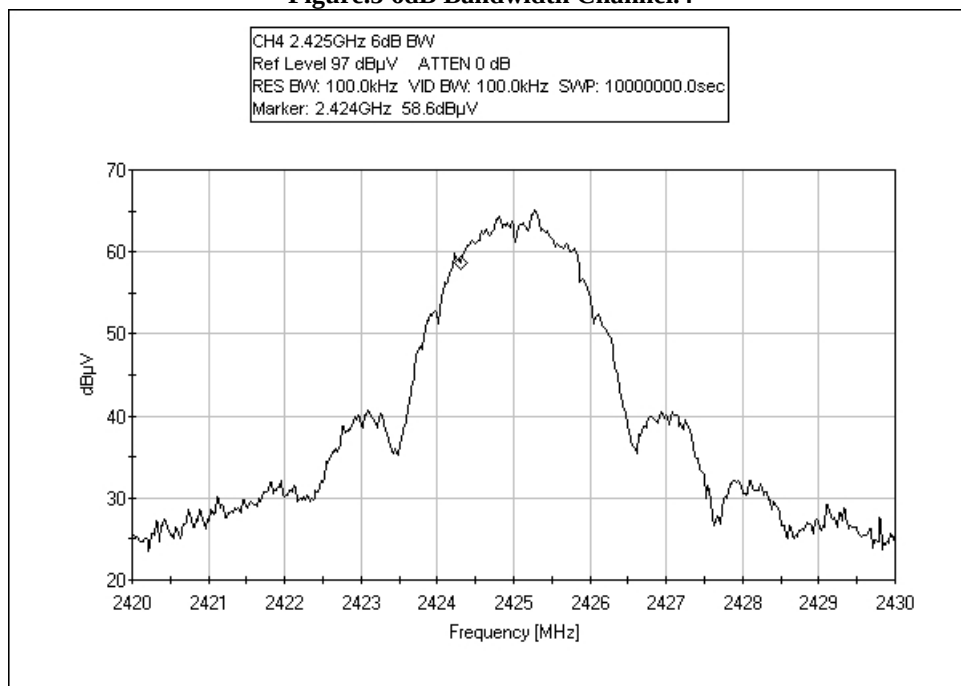
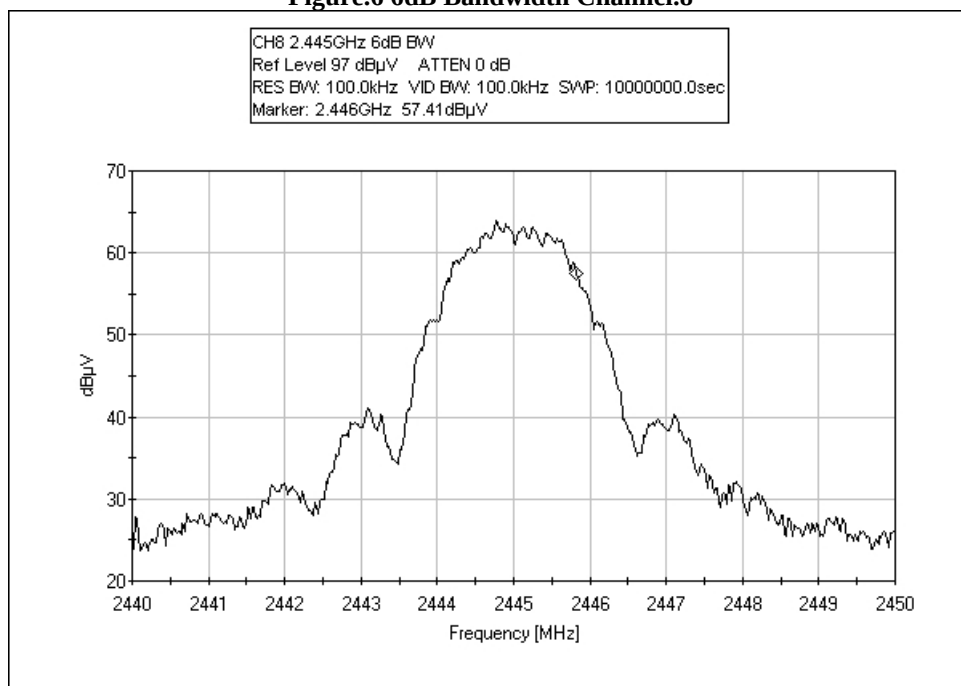
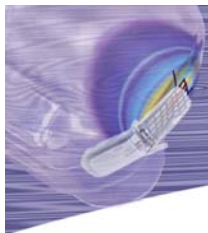
Figure.4 6dB Bandwidth Channel.1**Figure.5 6dB Bandwidth Channel.4**

Figure.6 6dB Bandwidth Channel.8



Test: Radiated Power Spectral Density

Test Mode: Digital Transmission System

Ref.: FCC 15.247(d)

Criteria: In any 100kHz bandwidth outside the frequency band in which the digitally modulated intentional radiator is operating. The radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power.

Set-up: See Figure.14.

Equipment: See Appendix A.

Procedure: Power Spectral Density:

The power spectral density 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 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 File No.: 90416).

The test was set-up as illustrated in Figure.14. The EUT was configured to operate at maximum power with appropriate mode of operation. The equipment under test was placed on a turntable exhibit.1 positioned 3 meters away from the receiving antenna, which in turn was connected to the spectrum analyzer.

For each transmitter frequency, the received signal was maximized by rotating the turntable and adjusting the height of the receiving antenna.

Table.3
100kHz Bandwidth 20dBc Limit

Channel #	Frequency (MHz)	100kHz Bandwidth Limit 20dBc (MHz)
1 (lower band)	2410	>20dB
4 (mid band)	2425	>20dB
8 (upper band)	2445	>20dB

Results: PASSED. See Table.3. Figures.7-9

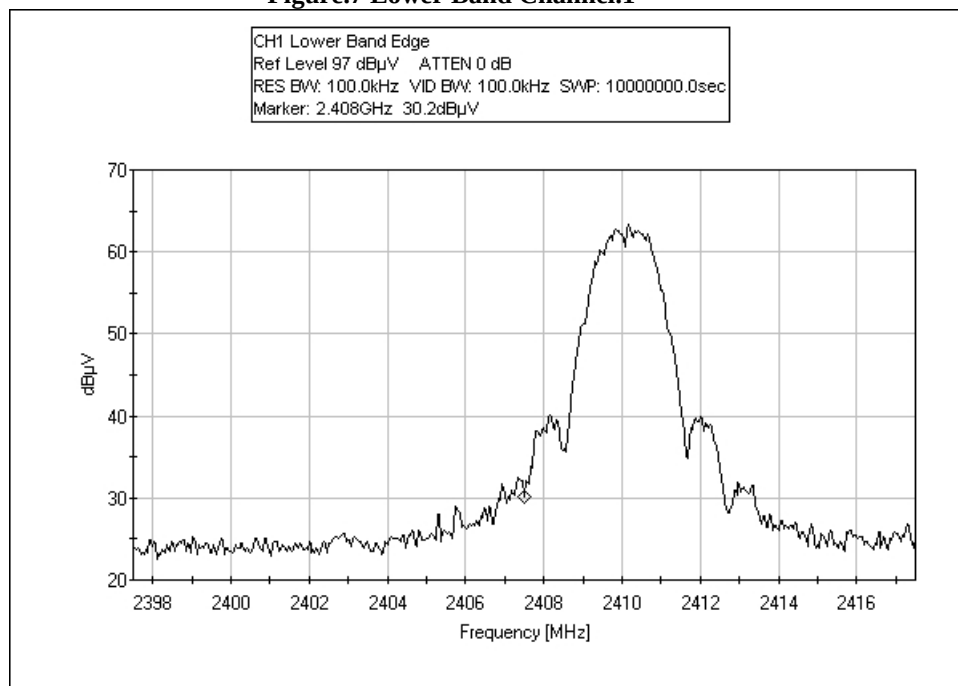
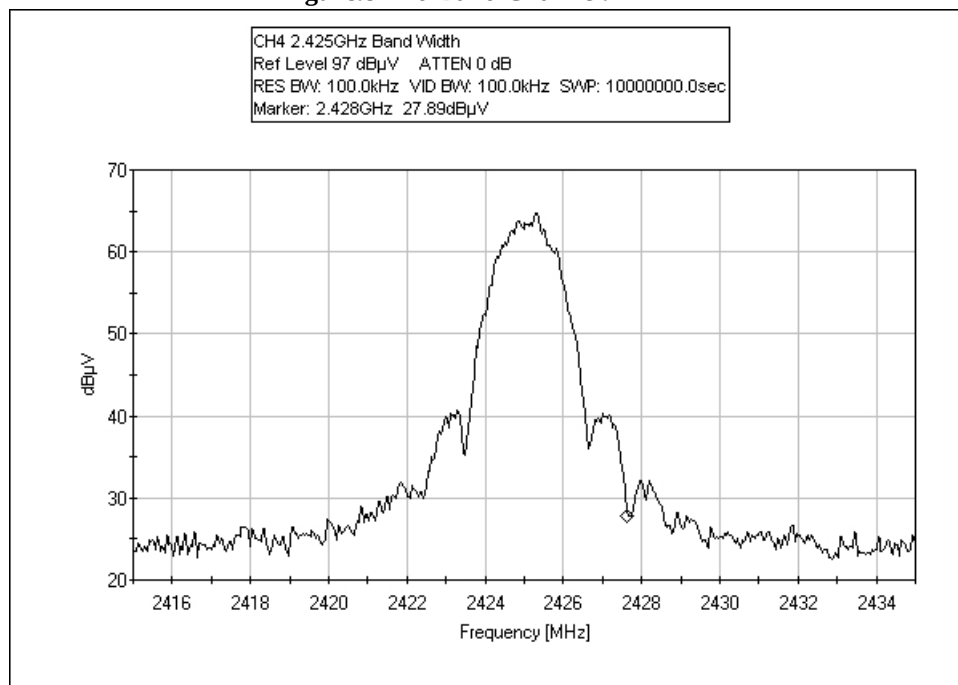
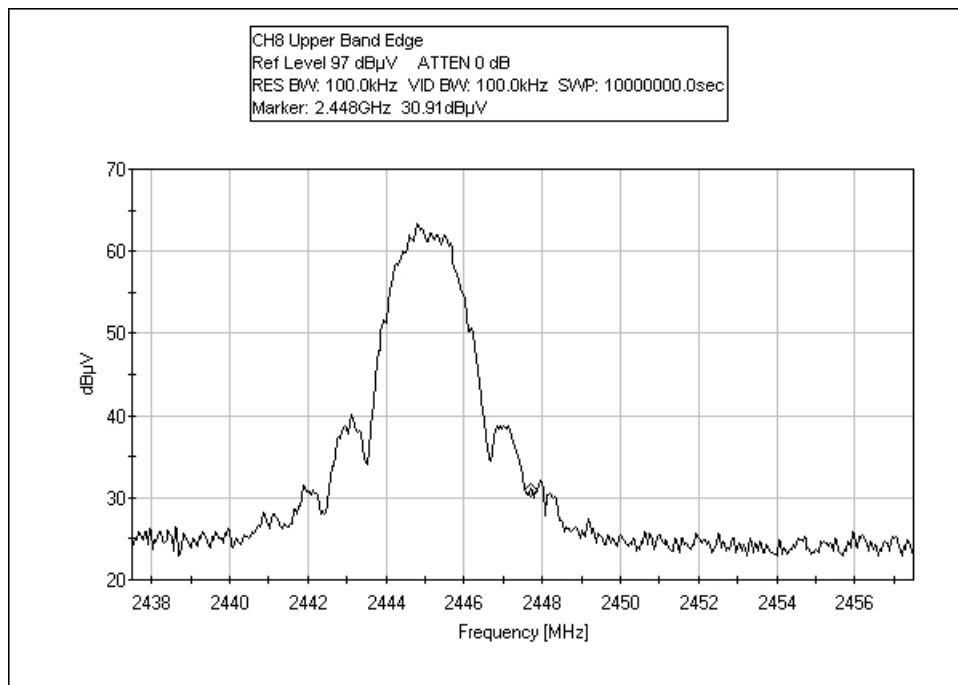
Figure.7 Lower Band Channel.1**Figure.8 Mid Band Channel.4**

Figure.9 Upper Band Channel.8

Test: **Spurious Radiated Emissions** SAR & HAC Instruments for Wireless • Consulting • Research • Standards • Compliance • Training

Test Mode: **Digital Transmission System**

Ref: **FCC Part 15.209**

Criteria: The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (**P**) by a factor of at least $43 + 10 \log (\mathbf{P})$ dB.

Set-up: See figures.14

Equipment: See Appendix A.

Methodology: **Measurement by Substitution Method (Radiated):**

Test site: The radiated RF measurement was taken at APREL Laboratory's open area test site (OATS). 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 requirement of Section 2.948 of the Commissions rules and regulations. (FCC File No.: 90416)

The test was set-up as illustrated in Figure.14 and exhibit.1. The DUI was configured to operate at maximum power and placed on a turntable positioned 3m away from the calibrated receiving antenna which in turn was connected to the spectrum analyzer.

Reference dipoles and horn antenna, signal generator and gain amplifier were used to measure the reference level of the DUI on the fundamental frequency. Spurious frequencies, second and third harmonic etc. were evaluated by comparing to the signals transmitted from the calibration reference horn as seen in exhibit.1.

For each transmitter frequency, the received signal was maximized by rotating the turntable and adjusting the height of the receiving antenna. The mobile device was replaced by the respective half-wave dipole antenna vertically polarized in the same location as the test device, and the signal generator level was adjusted to obtain the same reading on the spectrum analyzer. The reference horn antenna was used in the substitution for the spurious frequencies.

Criteria level: The criteria level was calculated to be: LIMIT = - 13.0 dBm.

This level was obtained by using the following expression:

$$\text{Criteria}_{\text{Limit (dBm)}} = \text{ERP}_{\text{Carrier (dBm)}} - [43 + 10 * \log_{10} \mathbf{P}_{(w)}]$$

Example:

$$\text{Criteria}_{\text{Limit(dBm)}} = 3.82 \text{ dBm} - [43 + 10 * \log_{10} (2.41 \text{ mW})] = -13.0 \text{ dBm}$$

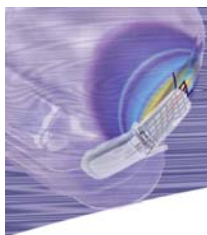
Results: **PASSED.**

See Table 4.

Table.4
Spurious Radiated Emissions

Frequency	ERP	FCC Maximum ERP Limit	Margin
MHz	dBm	dBm	dB
Channel 1 - Transmitting Frequency: 2410 MHz (Fundamental)			
4820	-37.38	-13.00	-24.38
7230	-52.48	-13.00	-39.48
9640	Nf	-13.00	
12050	Nf	-13.00	
14460	Nf	-13.00	
16870	Nf	-13.00	
19280	Nf	-13.00	
21690	Nf	-13.00	
24100	Nf	-13.00	
Channel 4 - Transmitting Frequency: 2425 MHz (Fundamental)			
4850	-43.02	-13.00	-30.02
7275	-51.33	-13.00	-38.33
9700	Nf	-13.00	
12125	Nf	-13.00	
14550	Nf	-13.00	
16975	Nf	-13.00	
19400	Nf	-13.00	
21825	Nf	-13.00	
24250	Nf	-13.00	
Channel 8 - Transmitting Frequency: 2445 MHz (Fundamental)			
4890	-53.31	-13.00	-40.31
7335	-51.42	-13.00	-38.42
9780	Nf	-13.00	
12225	Nf	-13.00	
14670	Nf	-13.00	
17115	Nf	-13.00	
19560	Nf	-13.00	
22005	Nf	-13.00	
24450	Nf	-13.00	

*NF – noise floor



Test: Radiated Emissions

Test Mode: Digital Transmission System

Ref: FCC Part 15.109(a)

Criteria: The field strength of radiated emissions from unintentional radiators at a distance of 3 meters, shall not exceed the values according to FCC Part 15.109(a). Radiated emission maximum allowable field strength for Class B Digital Devices at a distance of 3 meters is: 100 μ V/m (40.0 dB μ V/m) for the frequency range of 30 to 88 MHz, 150 μ V/m (43.5 dB μ V/m) for 88 to 216 MHz, 200 μ V/m (46.0 dB μ V/m) for 216 to 960 MHz, and 500 μ V/m (54.0 dB μ V/m) for frequencies above 960 MHz.

Set-up: See figures.14

Equipment: See Appendix A.

Methodology: Radiated emission measurements were made over the frequency range 30 MHz to above 960 MHz following the radiated emission limits of Subpart B, Section 15.109, paragraph A.

Measurement of radiated emissions was carried out following the test procedure ANSI C63.4-1992 Paragraph 8.1. The Open Site arrangement is shown in Figure.14.

Based on this information, measurements were performed in the open area test site at these characteristic frequencies. APREL Open Area Test Site is calibrated to ANSI C63.4-1992 and is filed with FCC. The test site is characteristically flat, free of reflecting structures. All reflecting objects, including test personnel, lie outside the perimeter of the ellipse (defined in ANSI C63.4-1992) or below the ground plane level. The horizontal and vertical site attenuation measurements are within ± 4 dB of the theoretical site attenuation of an ideal site. The DUI was placed on a turntable positioned 3 meters away from the receiving antenna, which in turn was connected to the spectrum analyzer. Both vertical and horizontal antenna polarizations were measured exhibits.2a and 2b. The DUI was operated in a manner that produced the highest emissions.

For each identified characteristic frequency, the received signal was maximized by appropriate positioning of the turntable and the height of the receiving antenna. The height of the antenna was adjusted between 1 m and 4 m in height above the ground plane. The turntable was rotated 360° from a remote control to maximize the emissions. The process was repeated for both horizontal and vertical polarization. All cables were arranged for maximum emission.

Radiated RF emission levels measured were identified as having been emitted by the DUI. Measurements were performed using the spectrum analyzer employing a CISPR quasi-peak detector function and 120 kHz bandwidth on frequencies from 30 MHz to 960 MHz, and for frequencies above 960 MHz employing an average detector function and 1 MHz resolution bandwidth. All measurements were performed, swept at discrete frequencies.

All measurements were performed using Quasi-peak function of the spectrum analyzer with 120 kHz bandwidth up to 960 MHz and above 960 MHz averaging detector function and 1 MHz resolution bandwidth were used.

Results: PASSED, See figures.10-11.

Figure.10

ANTENNA POLARIZATION: VERTICAL

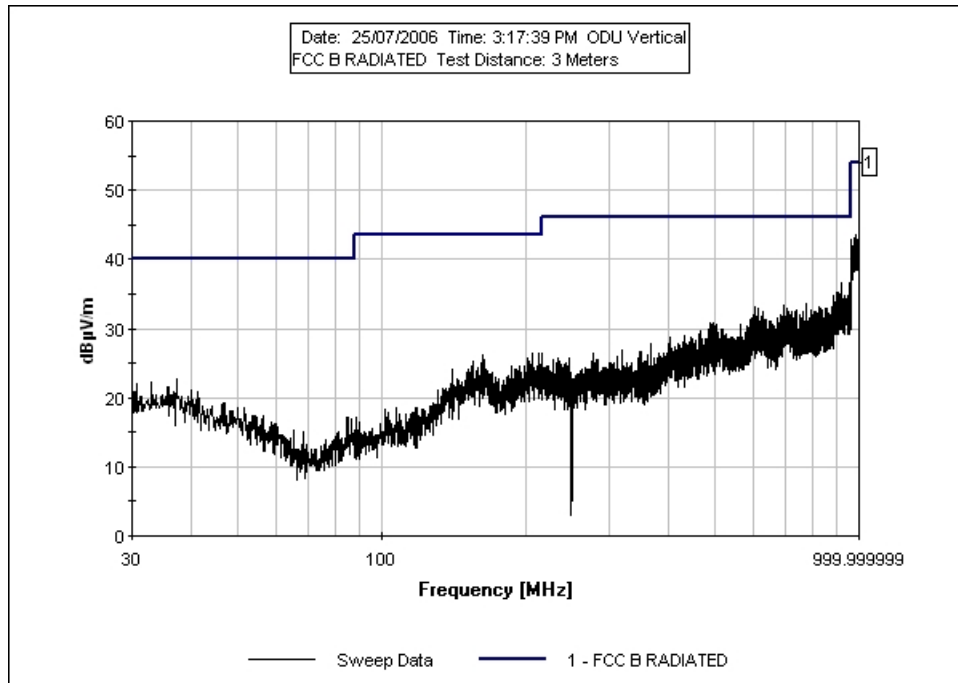
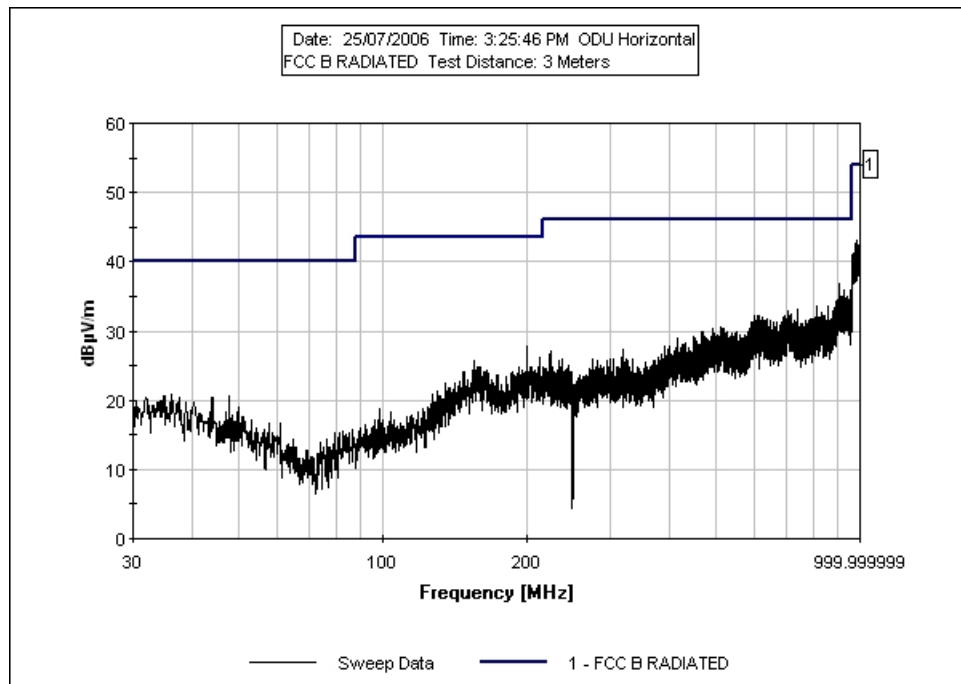


Figure.11



ANTENNA POLARIZATION: HORIZONTAL**APREL**
Laboratories

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Test: Radiated Emissions (Indoor Receiver Unit)**Test Mode:** Digital Transmission System**Ref:** FCC Part 15.109(a)

Criteria: The field strength of radiated emissions from unintentional radiators at a distance of 3 meters, shall not exceed the values according to FCC Part 15.109(a). Radiated emission maximum allowable field strength for Class B Digital Devices at a distance of 3 meters is: 100 μ V/m (40.0 dB μ V/m) for the frequency range of 30 to 88 MHz, 150 μ V/m (43.5 dB μ V/m) for 88 to 216 MHz, 200 μ V/m (46.0 dB μ V/m) for 216 to 960 MHz, and 500 μ V/m (54.0 dB μ V/m) for frequencies above 960 MHz.

Set-up: See figures.14**Equipment:** See Appendix A.

Methodology: Radiated emission measurements were made over the frequency range 30 MHz to above 960 MHz following the radiated emission limits of Subpart B, Section 15.109, paragraph A.

Measurement of radiated emissions was carried out following the test procedure ANSI C63.4-1992 Paragraph 8.1. The Open Site arrangement is shown in Figure 2.

Based on this information, measurements were performed in the open area test site at these characteristic frequencies. APREL Open Area Test Site is calibrated to ANSI C63.4-1992 and is filed with FCC. The test site is characteristically flat, free of reflecting structures. All reflecting objects, including test personnel, lie outside the perimeter of the ellipse (defined in ANSI C63.4-1992) or below the ground plane level. The horizontal and vertical site attenuation measurements are within ± 4 dB of the theoretical site attenuation of an ideal site. The DUI was placed on a turntable positioned 3 meters away from the receiving antenna, which in turn was connected to the spectrum analyzer. Both vertical and horizontal antenna polarizations were measured exhibits.2a and 2b. The DUI was operated in a manner that produced the highest emissions.

For each identified characteristic frequency, the received signal was maximized by appropriate positioning of the turntable and the height of the receiving antenna. The height of the antenna was adjusted between 1 m and 4 m in height above the ground plane. The turntable was rotated 360° from a remote control to maximize the emissions. The process was repeated for both horizontal and vertical polarization. All cables were arranged for maximum emission.

Radiated RF emission levels measured were identified as having been emitted by the DUI. Measurements were performed using the spectrum analyzer employing a CISPR quasi-peak detector function and 120 kHz bandwidth on frequencies from 30 MHz to 960 MHz, and for frequencies above 960 MHz employing an average detector function and 1 MHz resolution bandwidth. All measurements were performed, swept at discrete frequencies.

All measurements were performed using Quasi-peak function of the spectrum analyzer with 120 kHz bandwidth up to 960 MHz and above 960 MHz averaging detector function and 1 MHz resolution bandwidth were used.

Results: PASSED, See figure.12-13.

Figure.12

ANTENNA POLARIZATION: VERTICAL

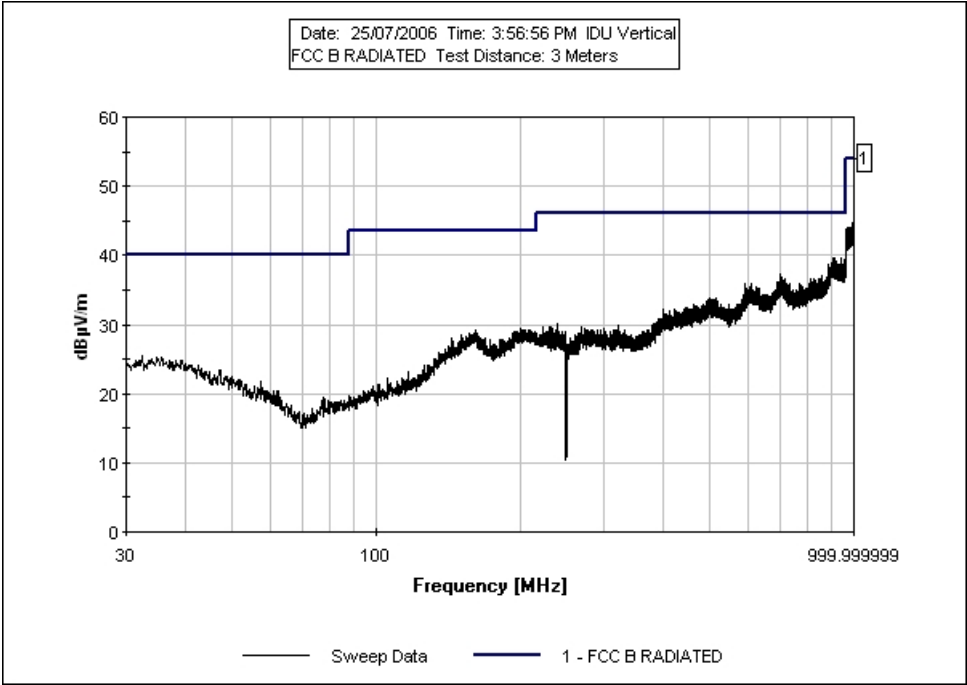


Figure.13

ANTENNA POLARIZATION: HORIZONTAL

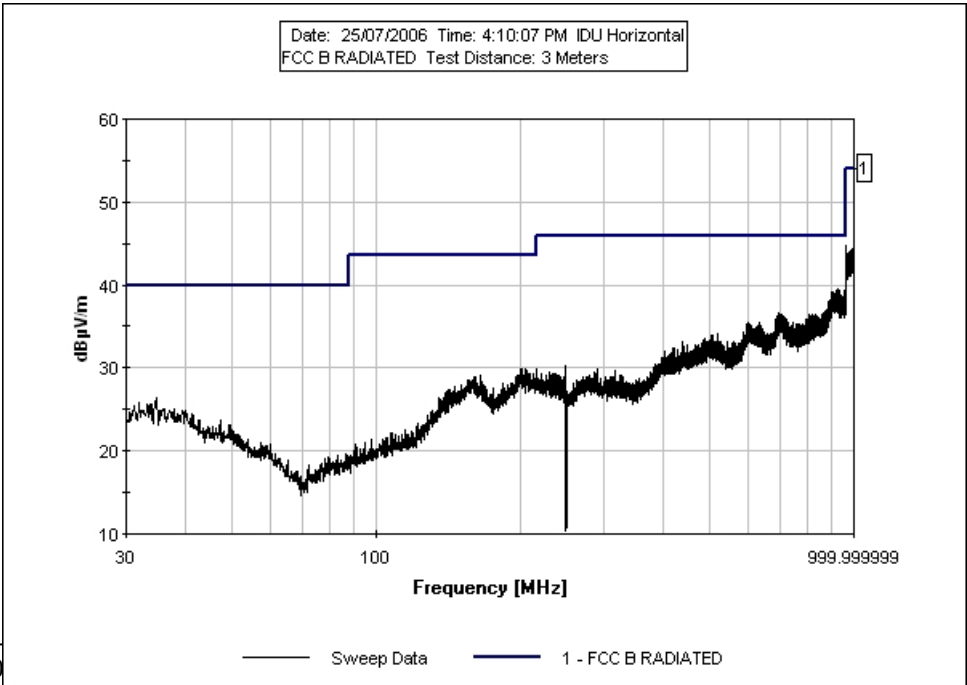


Exhibit.1a Peak Power Measurement Antenna Substitution Method

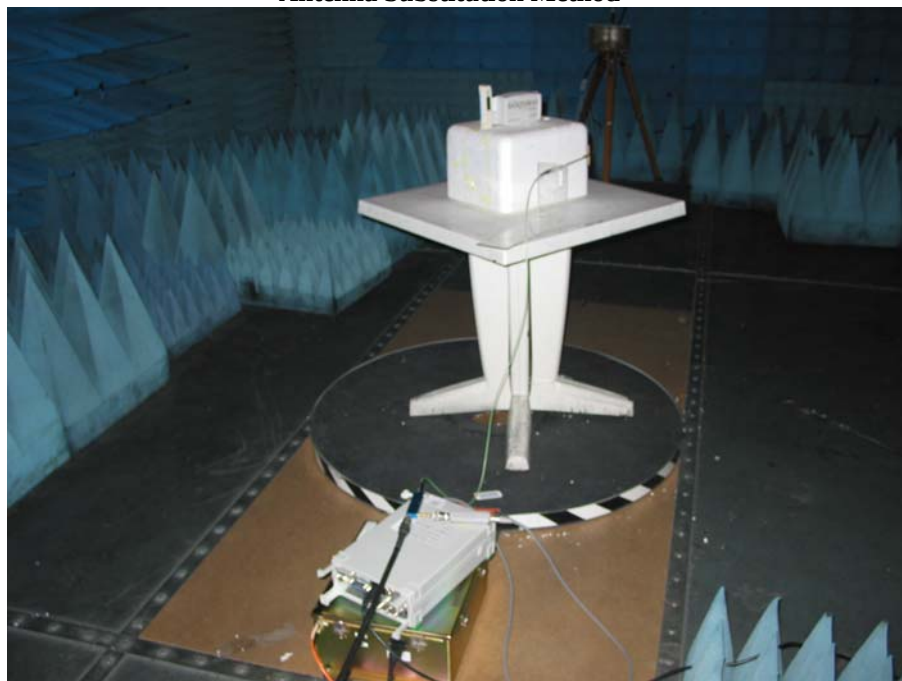


Exhibit.2a Radiated Emissions Measurement Frequency range: 30 MHz – 200 MHz

Vertical Polarization



Horizontal Polarization

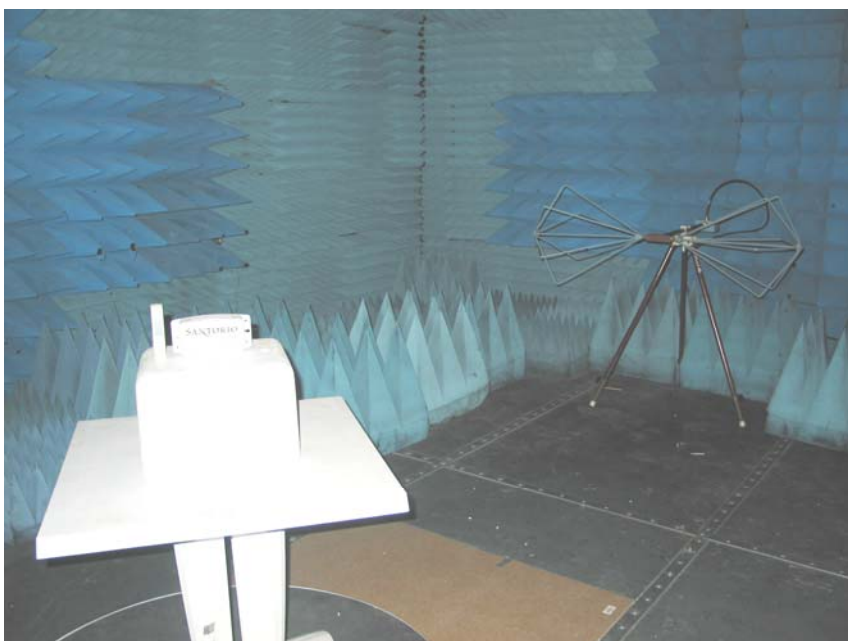
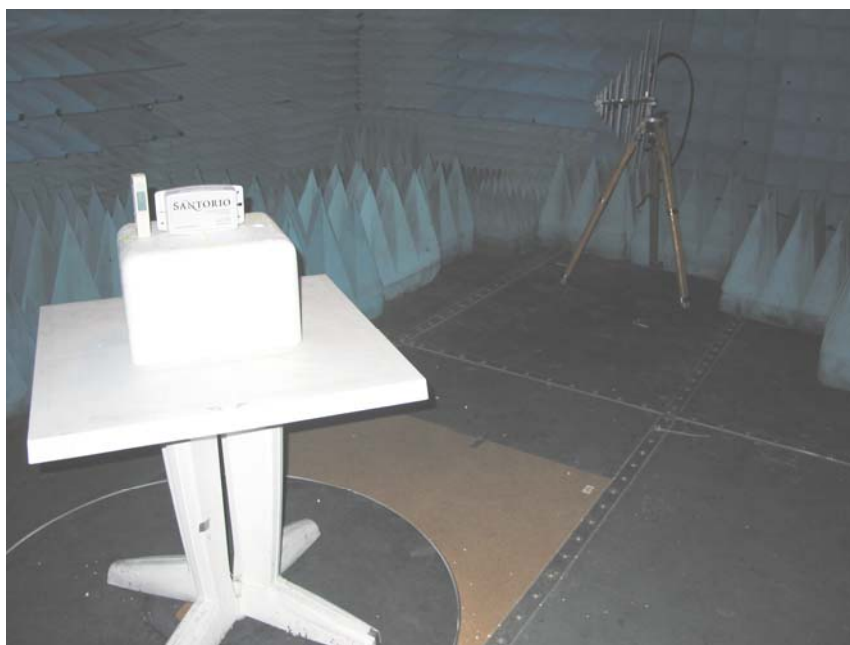


Exhibit.2b Radiated Emissions Measurement Frequency range: 200 MHz – 1000 MHz

Vertical Polarization



Horizontal Polarization

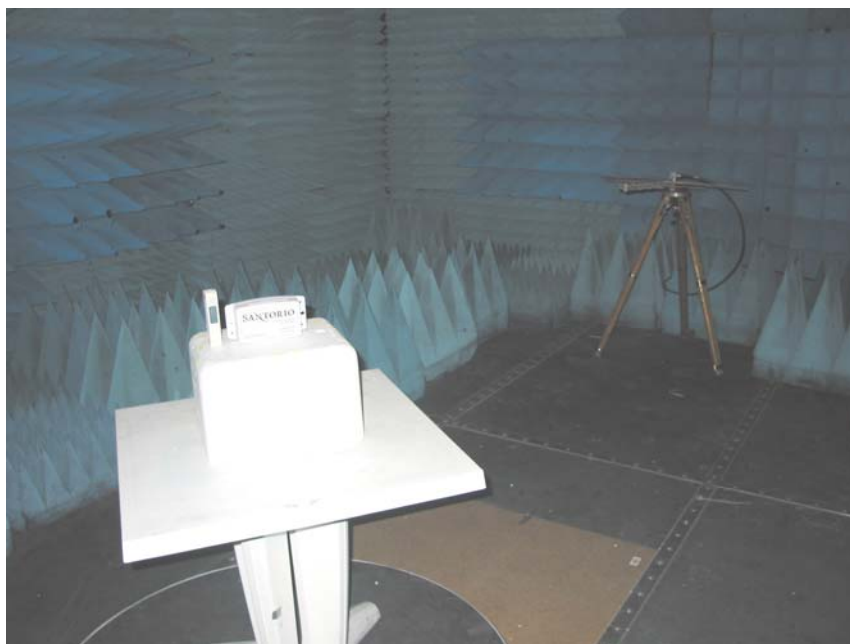


Figure.14. Test Set-up

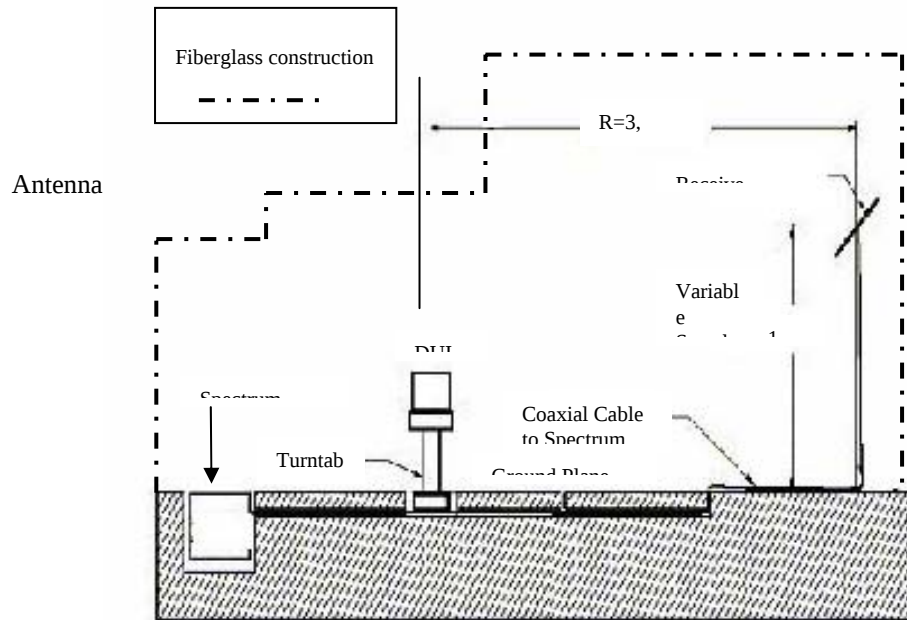


Figure 14.a: Test set up for the radiated emission measurement in

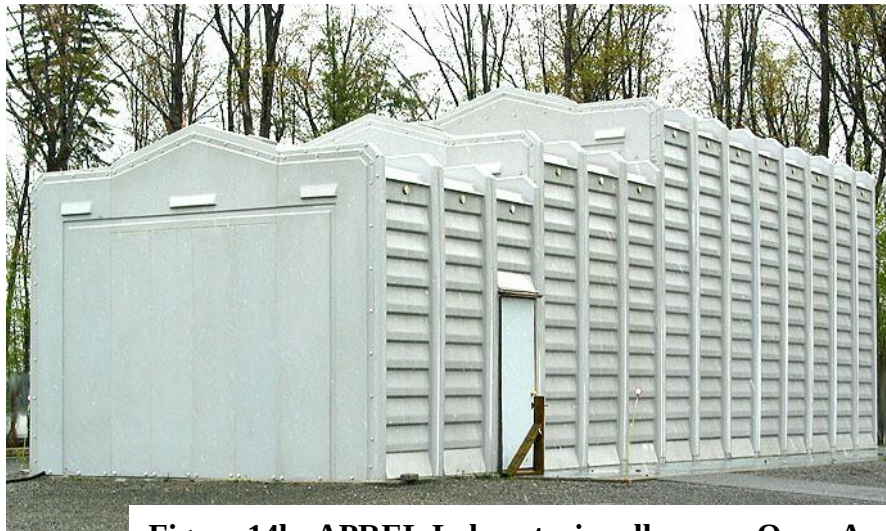


Figure 14b: APREL Laboratories all season Open Area Test

Note:

R=3 meter.

Instruments: Spectrum Analyzer, Signal Generator, and RF Power Amplifier.

Receiving Antenna: Double Ridged Horn.

RF absorbing materials were used on the ground plane between transmitting and receiving antenna.

APPENDIX A**List of Equipment used for Measurements**

Description	Range	Manufacturer	Model #	APREL Asset #	Cal. Due Date
Spectrum Analyzer	9 kHz – 30GHz	Anritsu	MS2667C	301386	September 5, 2006
RF Signal Generator	300kHz – 3GHz	Anritsu	MT8801C	301598	August 6, 2006
RF Power Meter	10 MHz – 26.5 GHz	Hewlett Packard	HP 8340 B	100955	Oct 5, 2006
RF Power Sensor	10 MHz - 18 GHz	Giga-tronics	8541C	301393	Oct.16, 2006
Bi-conical Antenna	10 MHz - 18 GHz	Giga-tronics	80601A	301394	Oct.16, 2006
Log Periodic Antenna	20 MHz-200 MHz	Eaton	94455-1	100890	July 18, 2007
Horn Antenna	200 MHz -1.0 GHz	Eaton	ALP-1	100063	July 31, 2006
Horn Antenna	1 GHz – 18 GHz	APREL Inc.	AA-118	100552	June 17, 2007
RF Antenna Pre-amplifier	1 GHz – 18 GHz	APREL Inc.	AA-118	100553	June 17, 2007
Microwave Pre-amplifier	30 MHz-1000MHz	APREL Inc.	LNA-1	301415	August 27, 2006
RF Amplifier	1 GHz – 26.5 GHz	Hewlett-Packard	8449B	301462	June 16, 2007
SAC / OATS	3m & 10 m	APREL Inc.	3 m & 10 m	N/A	N/A
High Pass Filter	10 kHz - 10 GHz	APREL Inc.	—	301329	N/A
Reference Dipole	2.32 GHz	APREL Inc.	ALD	301550	August 15, 2006
Notch Filter	20 dB	NARDA	9779-20	301533	August 15, 2006