Lab Code: 200167-0

FCC PART 15.247

TEST AND MEASUREMENT REPORT

For

Lysar Industries

PO Box 717, York, WESTERN AUSTRALIA, AUSTRALIA 6302

FCC ID:W5CEQ1

Report Type:	**Product Type:**
Original Report	Wireless Digital Audio Transmitter

Test Engineer:	Victor Zhang
Report Number:	R0903104-247-Base
Report Date:	2009-04-22
Reviewed By:	Boni Baniqued Sr. RF Engineer
Prepared By: **(66)**	Bay Area Compliance Laboratories Corp. 1274 Anvilwood Ave Sunnyvale, CA 94089, USA Tel: (408) 732-9162 Fax: (408) 732 9164

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R0903104-247-Base	Original	2009-03-23
1	R0903104-247-Base	Revised typo	2009-04-22

1 GENERAL INFORMATION

1.1 Product Description for Equipment under Test (EUT)

The *Lysar Industries* Product FCC ID: W5CEQ1, the "EUT" as referred to in this report is Wireless Digital Audio Transmitter. The EUT is a state of the art audio communication device specifically designed as a base controller. The EQ1 Wireless communication system works from 2401.5MHz to 2480.5MHz.

1.2 Mechanical Description of EUT

The *EUT* measures as follows:
Base Controller: *125mm L x 77 mm W x 28 mm H* and weighs approximately *115.5g*

** The test data gathered are from typical production sample, serial number: R0903104-1, assigned by BACL.*

1.3 EUT Photograph

Base Controller
Please refer to Exhibit C for more EUT photographs.

1.4 Objective

This type approval report is prepared on behalf of *Lysar Industries* in accordance with Part 2, Subpart J, Part 15, Subparts A, B, and C.

1.5 Related Submittal(s)/Grant(s)

N/A

1.6 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI C63.4-2003.

1.7 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the values range from $\pm$2.0 for Conducted Emissions tests and $\pm$4.0 dB for Radiated Emissions tests are the most accurate estimates pertaining to uncertainty of EMC measurements at BACL.

Detailed instrumentation measurement uncertainties can be found in BACL report QAP-018.

1.8 Test Facility

The semi-anechoic chambers used by BACL to collect radiated and conducted emissions measurement data is located in the building at it's facility in Sunnyvale, California, USA.

BACL's test sites have been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports have been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 11 and December 10, 1997 and Article 8 of the VCCI regulations on December 25, 1997. The facility complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2003.

The Federal Communications Commission and Voluntary Control Council for Interference has the reports on file and is listed under FCC registration number: 90464 and VCCI Registration No.: C-1298 and R-1234. The test site has been approved by the FCC and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACL is a National Institute of Standards and Technology (NIST) accredited laboratory, under the National Voluntary Laboratory Accredited Program (Lab Code 200167-0). The current scope of accreditations can be found at http://ts.nist.gov/ts/htdocs/210/214/scopes/2001670.htm

2 SYSTEM TEST CONFIGURATION

2.1 Justification

The system was configured for testing in accordance with ANSI C63.4-2003.
The EUT was tested in the testing mode to represent *worst*-case results during the final qualification test.

2.2 EUT Exercise Software

The software is provided by customer. The EUT exercise program used during radiated testing was designed to exercise the system components.

2.3 Special Accessories

N/A.

2.4 Equipment Modifications

No modifications were made to the EUT.

2.5 Local Support Equipment

Manufacturers	Descriptions	Models	Serial Numbers
Compaq	Laptop	EVO N610C	7E32KT81F03C
Everfine	DC Power Supply	WY305	809024

2.6 Internal Configuration

Base Controller

Manufacturer	Description	Model	Serial Number
Lysar Industries	Main PCB Board	XC1 Base R2	-

2.7 Interface Ports and Cabling

Cable Description	Length (m)	From	To
Unshielded DC Power Cable	<3m	EUT	DC Battery/DC Power Supply

3 SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Results
§15.203	Antenna Requirements	Compliant
§15.207 (a)	Conducted Emissions	N/A*
§ 15.205	Restricted Bands	Compliant
§15.209	Radiated Emissions	Compliant
§ 15.109	Receiver Spurious Emission	Compliant
§15.247 (a) (1)	Channel Bandwidth	Compliant
§15.247 (a) (1)	Hopping Channel Separation	Compliant
§15.247 (a) (1) (iii)	Number of Hopping Frequencies Used	Compliant
§15.247 (a) (1) (iii)	Dwell Time	Compliant
§15.247 (b) (1)	Maximum Peak Output Power	Compliant
§ 15.247 (d)	100 kHz Bandwidth of Frequency Band Edge	Compliant
§ 15.247 (i) & §2.1091	RF Exposure	Compliant

Note: * EUT is battery powered by aircraft 12Vdc.

4 §15.203 - ANTENNA REQUIREMENT

4.1 Applicable Standard

According to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

Refer to statement below for compliance.

"The antenna for this device is an integral antenna that the end user cannot access. Furthermore the device is for indoor/outdoor use as detailed in the Users Manual and Operational Description".

4.2 Antenna Connected Construction

The antenna for this device is an integral antenna that the end user cannot access. It is fully enclosed by the EUT chassis and removal/modification would result in irreparable damage to the device.

☒ **Compliant** ☐ **N/A**

5 §15.205, §15.209 & §15.247 - RADIATED EMISSIONS

5.1 Applicable Standard:

FCC §15.205 Restricted bands of operation

(a) Except as shown in 15.205 paragraphs (d), only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	MHz	MHz	GHz	GHz
0.090 – 0.110	8.291 – 8.294	16.69475 – 16.69525	156.7 – 156.9	1435 – 1626.5	3.332 – 3.339	10.6 – 12.7
0.495 – 0.505	8.362 – 8.366	25.5 – 25.67	162.0125 –167.17	1645.5 – 1646.5	3.3458 – 3.358	13.25 – 13.4
2.1735 – 2.1905	8.37625 – 8.38675	37.5 – 38.25	167.72 – 173.2	1660 – 1710	3.600 – 4.400	14.47 – 14.5
4.125 – 4.128	8.41425 – 8.41475	73 – 74.6	240 – 285	1718.8 – 1722.2	4.5 – 5.15	15.35 – 16.2
4.17725 – 4.17775	12.29 – 12.293	74.8 – 75.2	322 – 335.4	2200 – 2300	5.35 – 5.46	17.7 – 21.4
4.20725 – 4.20775	12.51975 – 12.52025	108 – 121.94	399.9 – 410	2310 – 2390	7.25 – 7.75	22.01 – 23.12
6.215 – 6.218	12.57675 – 12.57725	123 – 138	608 – 614	2483.5 – 2500	8.025 – 8.5	23.6 – 24.0
6.26775 – 6.26825	13.36 – 13.41	149.9 – 150.05	960 – 1240	2690 – 2900	9.0 – 9.2	31.2 – 31.8
6.31175 – 6.31225	16.42 – 16.423	156.52475 – 156.52525	1300 – 1427	3260 – 3267	9.3 – 9.5	36.43 – 36.5
						Above 38.6

(b) Except as provided in 15.205 paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

(c) Except as provided in paragraphs (d) and (e), regardless of the field strength limits specified elsewhere in this Subpart, the provisions of this Section apply to emissions from any intentional radiator.

☒ **Compliant** ☐ **N/A**

FCC §15.209 Radiated emission limits, general requirements.

(a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100 **	3
88 - 216	150 **	3
216 - 960	200 **	3
Above 960	500	3

*** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.*

(b) In the emission table above, the tighter limit applies at the band edges.

☒ **Compliant** ☐ **N/A**

5.2 Test Setup

The radiated emissions tests were performed in the 3-meter semi-anechoic chamber test site, using the setup in accordance with ANSI C63.4-2003. The specification used was the FCC 15 Subpart C limits.

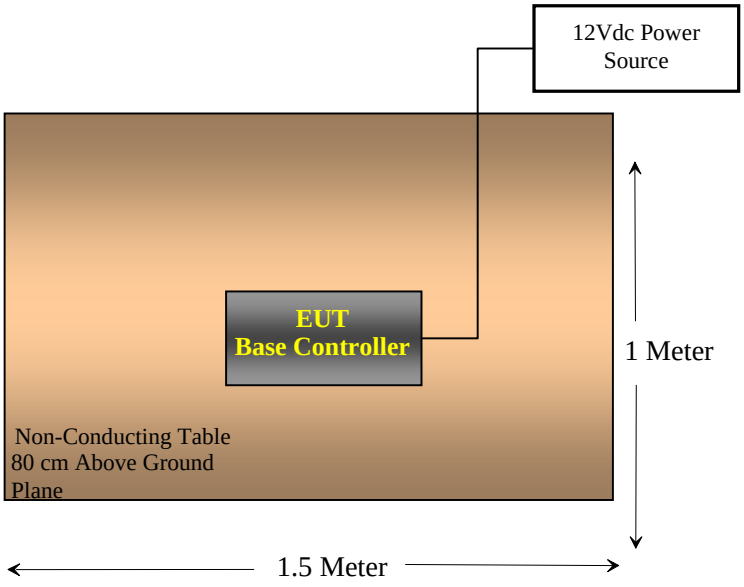
5.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Number	Calibration Dates
Mini-Circuits	Pre-amplifier	ZKL-2	7786100643	2009-03-03
HP	Pre-amplifier	8449B	3147A00400	2008-10-22
Sunol Science Corp	Combination Antenna	JB1 Antenna	A103105-3	2008-03-25
A. H. Systems	Antenna, Horn, DRG	DRG-118/A	1132	2008-07-28
Agilent	Spectrum Analyzer	E4440A	MY44303352	2008-04-28

Statement of Traceability: BACL attests that all calibrations have been performed per the NVLAP requirements, traceable to NIST.

5.4 Test Setup Diagram

Base Controller:



5.5 Environmental Conditions

Temperature:	21-22 ºC
Relative Humidity:	43-44 %
ATM Pressure:	101.2-102.1 kPa

**The testing was performed by Victor Zhang from 2009-03-11 to 2009-03-21.*

5.6 Test Procedure

For the radiated emissions test, the EUT, and all support equipment power cords was connected to the AC floor outlet.

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

The EUT is set 3 meter away from the testing antenna, which is varied from 1-4 mete, and the EUT is placed on a turntable, which is 0.8 meter above ground plane, the table shall be rotated for 360 degrees to find out the highest emission. The receiving antenna should be changed the polarization both of horizontal and vertical.

The spectrum analyzer or receiver is set as:

Below 1000 MHz:

RBW = 100 kHz / VBW = 300 kHz / Sweep = Auto

Above 1000 MHz:

(1) Peak: RBW = 1MHz / VBW = 1MHz / Sweep = Auto
(2) Average: RBW = 1MHz / VBW = 10Hz / Sweep = Auto

5.7 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

Corrected Amplitude = Indicated Reading + Antenna Factor + Cable Factor - Amplifier Gain

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7dB means the emission is 7dB below the maximum limit. The equation for margin calculation is as follows:

Margin = Corrected Amplitude - Limit

5.8 Summary of Test Results

According to the data hereinafter, the EUT complied with the FCC Title 47, Part 15, Subpart C, section 15.205, 15.209 and 15.247 standard's radiated emissions limits and had the worst margin of:

30-1000 MHz:

Worst case

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Channel, Range**
-15.79	208.017	Horizontal	30 MHz – 1GHz

Above 1 GHz:

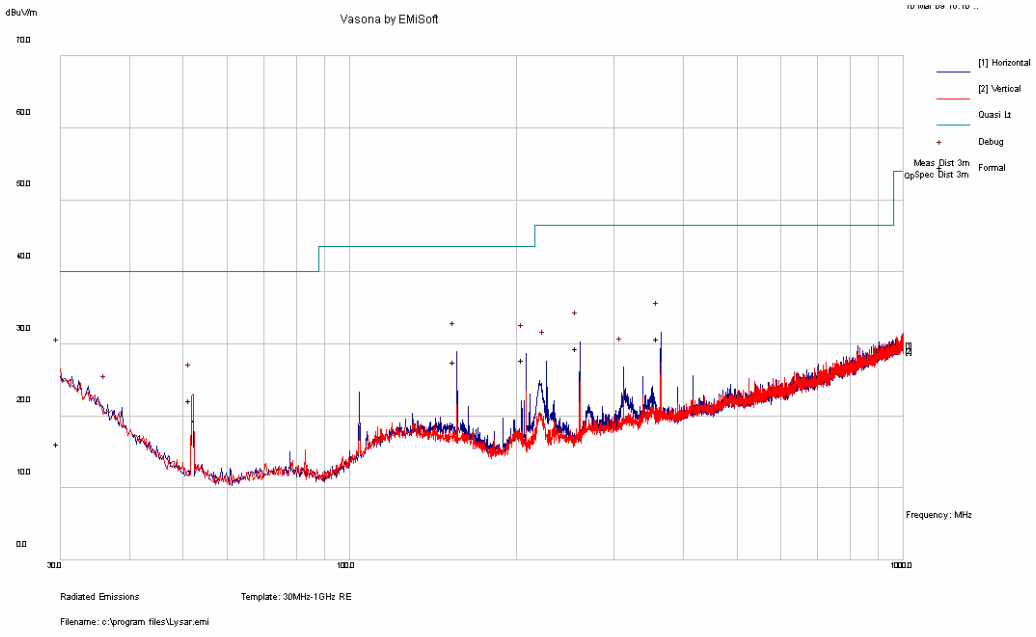
Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Channel, Range**
-16.29	4803	Horizontal	Low, 1~25 GHz
-14.58	4883	Horizontal	Mid, 1~25 GHz
-14.39	4961	Horizontal	High, 1~25 GHz

Please refer to the following table and plots for specific test result details

5.9 Radiated Emissions Test Result Data:

30 MHz – 1 GHz:

Radiated Emission at 3 meters, *Worst-case*



Frequency (MHz)	Quasi-Peak (dBµV/m)	Antenna Height (cm)	Correction Factor (dB)	Antenna Polarity (H/V)	Azimuth (degrees)	Part 15C Limit (dBµV/m)	Margin (dB)
208.017	27.71	140	-6.91	H	114	43.5	-15.79
364.015	30.69	100	-2.65	H	252	46.5	-15.81
156.004	27.45	217	-6.32	H	101	43.5	-16.05
260.012	29.34	124	-5.43	H	145	46.5	-17.16
52.011	22.16	100	-11.37	V	147	40	-17.84
30.014	16.06	267	2.53	V	168	40	-23.94

1 GHz – 25 GHz:

Radiated Emission at 3 meters

Low Channel 2401.5 MHz

Frequency (MHz)	S.A. Reading (dBµV)	Azimuth Degrees	Test Antenna		Ant. & Amp. Factor (dB/m)	Cable Loss (dB)	Duty Cycle Factor (dB)	Cord. Reading (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Comments
			Height (m)	Polar. (H/V)							
4803	56.32	345	1.58	H	-6.83	8.22	0	57.71	74	-16.29	Peak
4803	55.25	256	1.08	V	-6.83	8.22	0	56.64	74	-17.36	Peak
4803	56.32	345	1.58	H	-6.83	8.22	28.2	29.51	54	-24.49	Ave
4803	55.25	256	1.08	V	-6.83	8.22	28.2	28.44	54	-25.56	Ave

Middle channel 2441.5 MHz

Frequency (MHz)	S.A. Reading (dBµV)	Azimuth Degrees	Test Antenna		Ant. & Amp. Factor (dB/m)	Cable Loss (dB)	Duty Cycle Factor (dB)	Cord. Reading (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Comments
			Height (m)	Polar. (H/V)							
4883	57.66	345	1	H	-6.53	8.29	0	59.42	74	-14.58	Peak
4883	57.15	256	1	V	-6.53	8.29	0	58.91	74	-15.09	Peak
4883	57.66	345	1	H	-6.53	8.29	28.2	31.22	54	-22.78	Ave
4883	57.15	256	1	V	-6.53	8.29	28.2	30.71	54	-23.29	Ave

High channel 2480.5 MHz

Frequency (MHz)	S.A. Reading (dBµV)	Azimuth Degrees	Test Antenna		Ant. & Amp. Factor (dB/m)	Cable Loss (dB)	Duty Cycle Factor (dB)	Cord. Reading (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Comments
			Height (m)	Polar. (H/V)							
4961	57.49	154	1	H	-6.24	8.36	0	59.61	74	-14.39	Peak
4961	56.84	267	1.07	V	-6.24	8.36	0	58.96	74	-15.04	Peak
4961	57.49	154	1	H	-6.24	8.36	28.2	31.41	54	-22.59	Ave
4961	56.84	267	1.07	V	-6.24	8.36	28.2	30.76	54	-23.24	Ave

Base on the Manufacture's information, the average value can be calculated by a "Duty Cycle Correction Factor" as follows:

The dwell time is less than 100ms and is 1/260=3.846 ms
Duty Cycle correction factor= 20 Log (3.846/100) = -28.2 dB

Restricted Band Edge (Near Band Edge): Low channel

Frequency (MHz)	S.A. Reading (dBµV)	Azimuth Degrees	Test Antenna		Ant. & Amp. Factor (dB/m)	Cable Loss (dB)	Cord. Reading (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Comments
			Height (m)	Polar. (H/V)						
2324.517	39.04	153	1	H	-7.35	5.55	37.24	54	-16.76	Ave
2324.432	38.27	191	1	V	-7.35	5.55	36.47	54	-17.53	Ave
2324.517	45.96	153	1	H	-7.35	5.55	44.16	74	-29.84	Peak
2324.432	43.21	191	1	V	-7.35	5.55	41.41	74	-32.59	Peak

Restricted Band Edge (Near Band Edge): High channel

Frequency (MHz)	Receiver Reading (dBµV)	Azimuth Degrees	Ant. Height (m)	Ant. Polar. (H/V)	Ant. & AMP Factor (dB/m)	Cable Loss (dB)	Cord. Reading (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Comments
2481.624	56.87	195	1	H	-6.96	5.76	55.67	74	-18.33	Peak
2486.294	34.22	174	1.51	V	-6.96	5.76	33.02	54	-20.98	Ave
2486.294	53.20	174	1.51	V	-6.96	5.76	52.00	74	-22.00	Peak
2481.624	37.95	195	1	H	-6.96	5.76	36.75	74	-37.25	Ave

6 §15.247 (a) (1) – HOPPING CHANNEL BANDWIDTH

6.1 Applicable Standard

According to §15.247(a) (l), the maximum 20 dB bandwidth of the hopping channel shall be presented.

6.2 Measurement Procedure

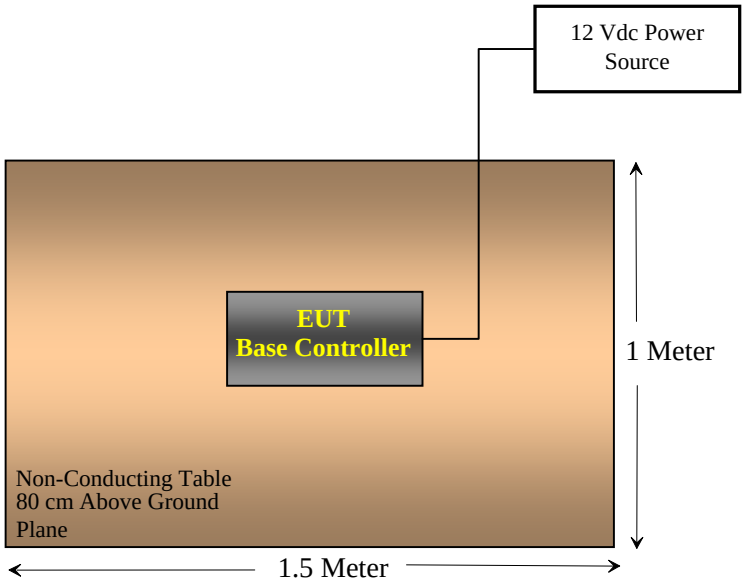
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emissions bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

6.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Number	Calibration Dates
Mini-Circuits	Pre-amplifier	ZKL-2	7786100643	2009-03-03
HP	Pre-amplifier	8449B	3147A00400	2008-10-22
A. H. Systems	Antenna, Horn, DRG	DRG-118/A	1132	2008-07-28
Agilent	Spectrum Analyzer	E4440A	MY44303352	2008-04-28

*** Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

6.4 Test Setup Diagram



6.5 Environmental Conditions

Temperature:	21-22 ºC
Relative Humidity:	43-44 %
ATM Pressure:	101.2-102.1 kPa

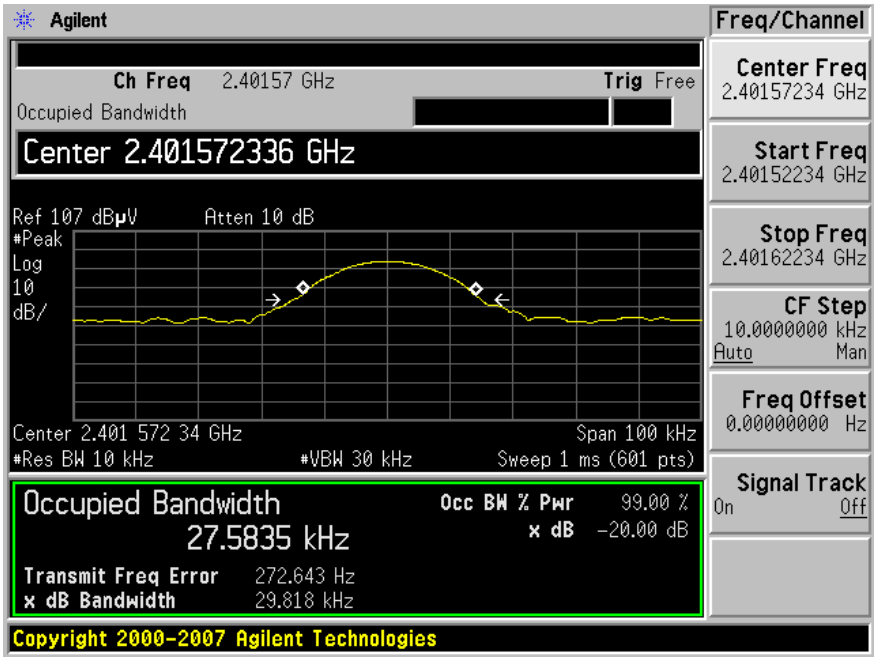
**The testing was performed by Victor Zhang from 2009-03-11 to 2009-03-21.*

6.6 Measurement Results

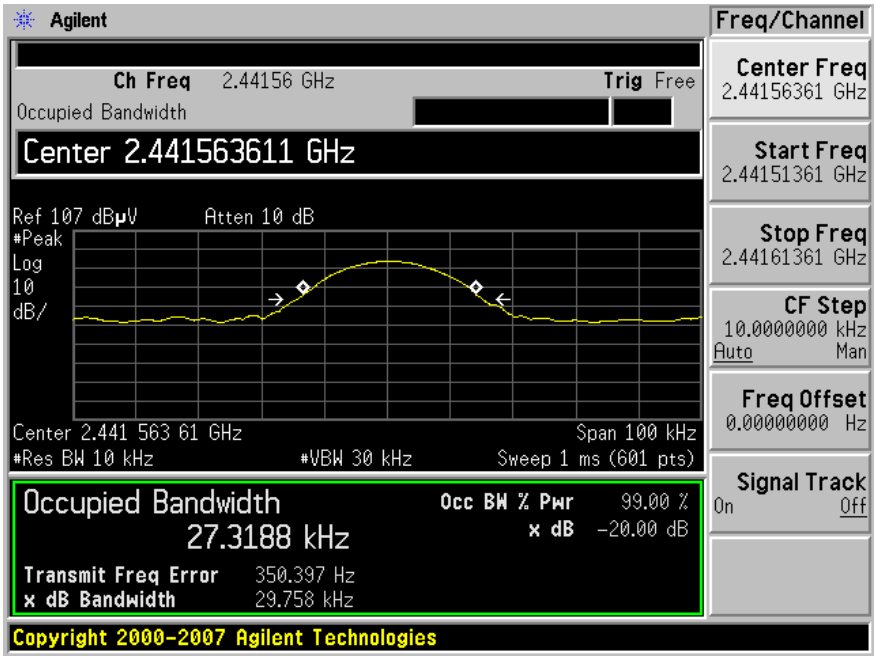
Channel	Frequency (MHz)	20 dB Occupied Bandwidth (kHz)
Low	2401.5	29.818
Mid	2441.5	29.758
High	2480.5	30.454

Please refer to the following plots.

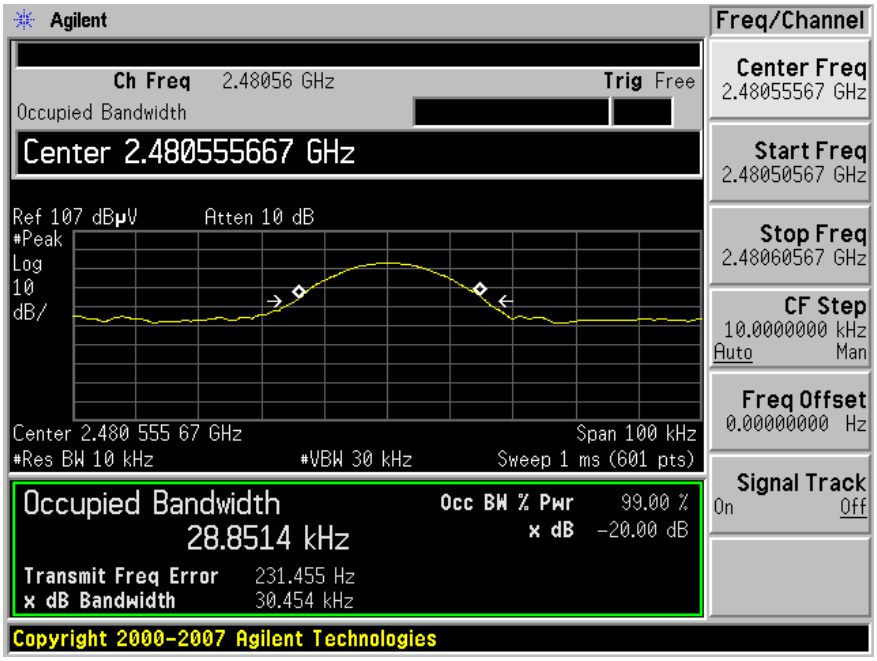
Low Channel



Middle Channel



High Channel



7 §15.247 (a) (1) - HOPPING CHANNEL SEPARATION

7.1 Applicable Standard

According to §15.247(a)(1): Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

7.2 Measurement Procedure

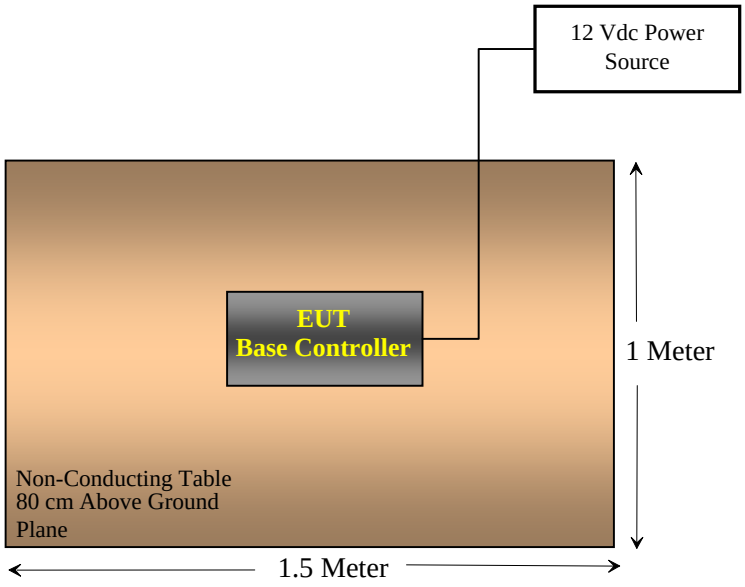
1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
2. Position the EUT on a bench without connection to measurement instrument Turn on the EUT and set it to any one convenient frequency within its operating range.
3. By using the Max-Hold function record the separation of two adjacent channels.
4. Measure the frequency difference of these two adjacent channels by SA MARK function, and then plot the result on SA screen.
5. Repeat above procedures until all frequencies measured were complete.

7.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Number	Calibration Dates
Mini-Circuits	Pre-amplifier	ZKL-2	7786100643	2009-03-03
HP	Pre-amplifier	8449B	3147A00400	2008-10-22
A. H. Systems	Antenna, Horn, DRG	DRG-118/A	1132	2008-07-28
Agilent	Spectrum Analyzer	E4440A	MY44303352	2008-04-28

*** Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

7.4 Test Setup Diagram



7.5 Environmental Conditions

Temperature:	21-22 ºC
Relative Humidity:	43-44 %
ATM Pressure:	101.2-102.1 kPa

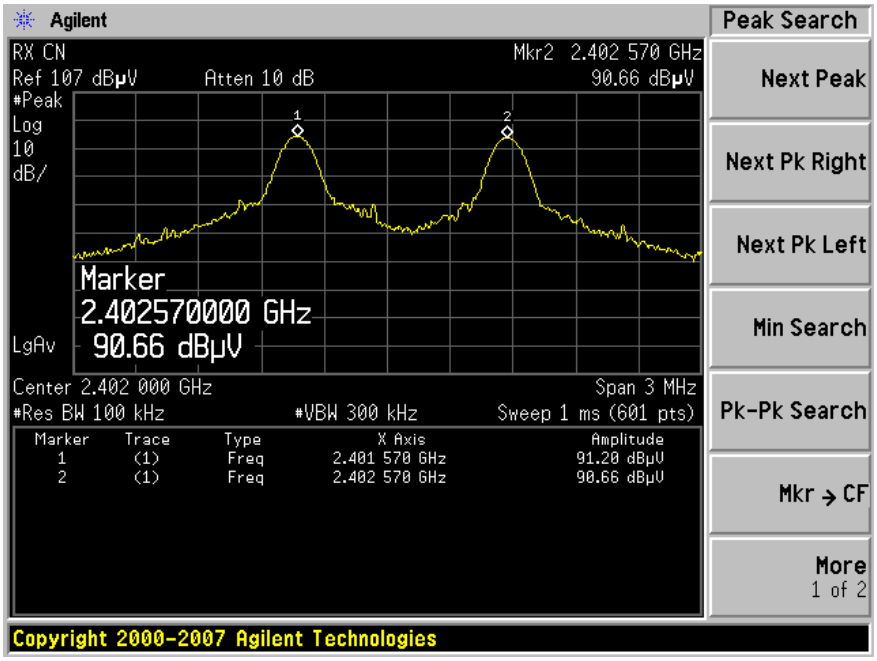
**The testing was performed by Victor Zhang from 2009-03-11 to 2009-03-21.*

7.6 Measurement Results

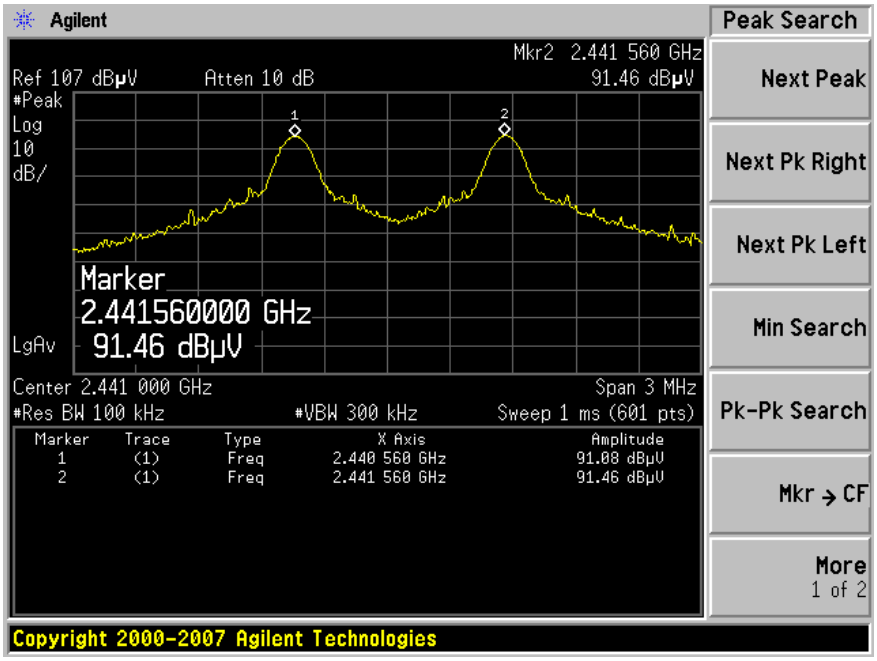
Channel	Frequency (MHz)	Channel Separation (kHz)	Limit (> 20 dB BW) (kHz)
Low	2401.5	1000	29.818
Mid	2441.5	1000	29.758
High	2480.5	1005	30.454

Please refer to the following plots.

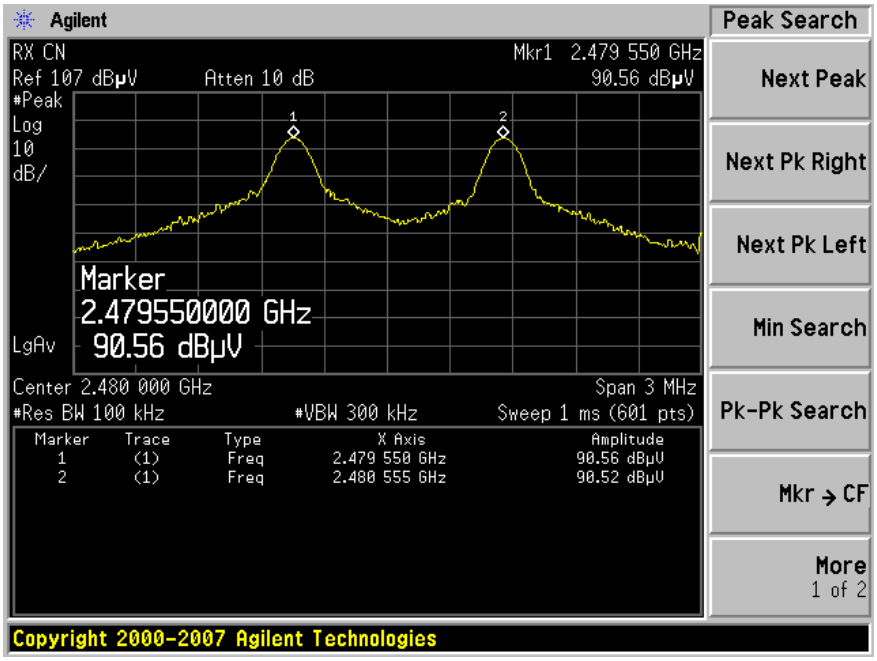
Low Channel



Middle Channel



High Channel



8 §15.247 (a) (1) (iii) - NUMBER OF HOPPING FREQUENCIES USED

8.1 Applicable Standard

According to §15.247(a)(1)(iii), frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels.

8.2 Measurement Procedure

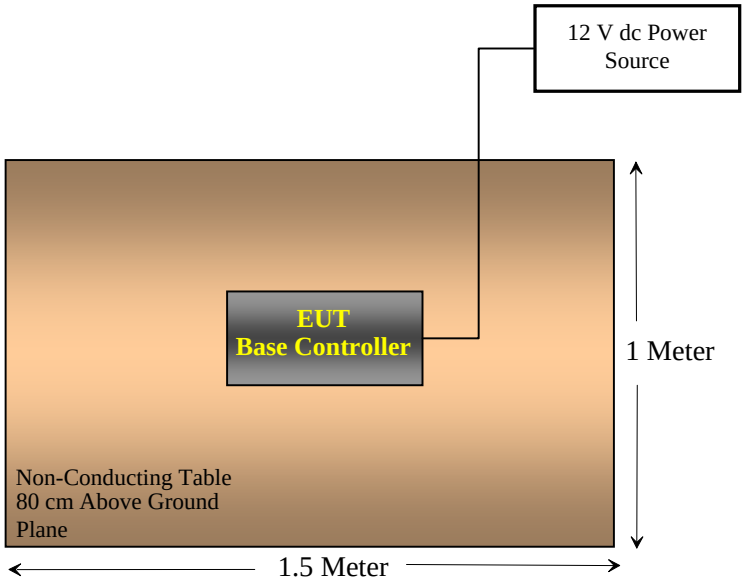
1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
2. Position the EUT on the bench without connection to measurement instrument. Turn on the EUT and set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set the SA on Max-Hold Mode, and then keep the EUT in hopping mode. Record all the signals from each channel until each one has been recorded.
4. Set the SA on View mode and then plot the result on SA screen.
5. Repeat above procedures until all frequencies measured were complete.

8.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Number	Calibration Dates
Mini-Circuits	Pre-amplifier	ZKL-2	7786100643	2009-03-03
HP	Pre-amplifier	8449B	3147A00400	2008-10-22
A. H. Systems	Antenna, Horn, DRG	DRG-118/A	1132	2008-07-28
Agilent	Spectrum Analyzer	E4440A	MY44303352	2008-04-28

*** Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

8.4 Test Setup Diagram



8.5 Environmental Conditions

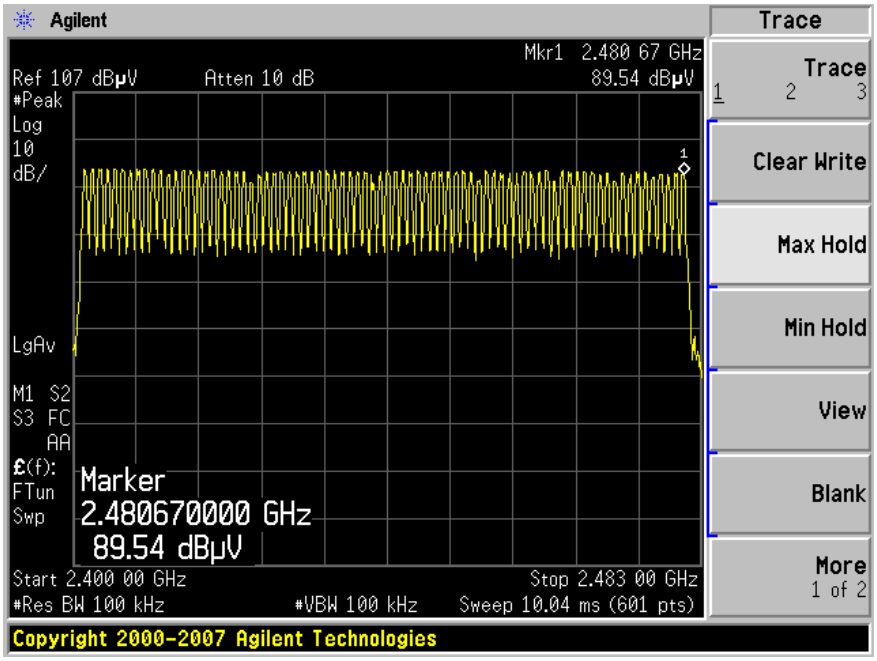
Temperature:	21-22 ºC
Relative Humidity:	43-44 %
ATM Pressure:	101.2-102.1 kPa

**The testing was performed by Victor Zhang from 2009-03-11 to 2009-03-21.*

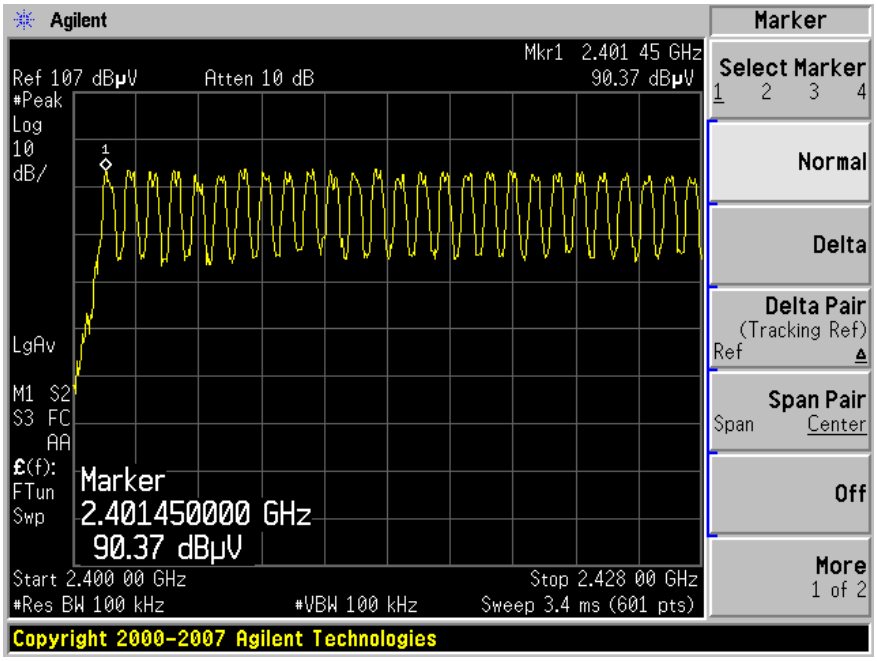
8.6 Measurement Result:

80 Channels, please refer to the following plot:

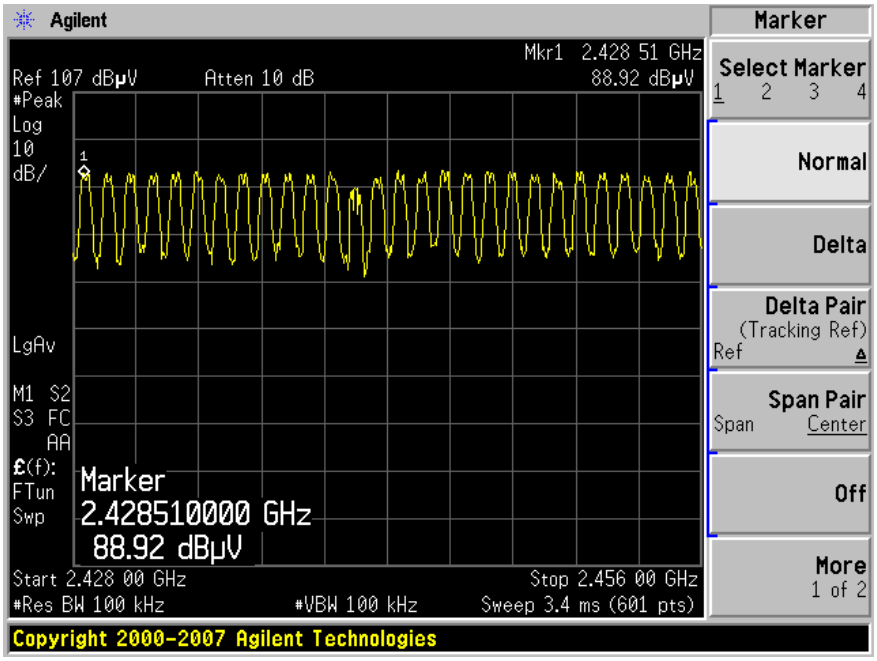
2400 ~2483.5 MHz



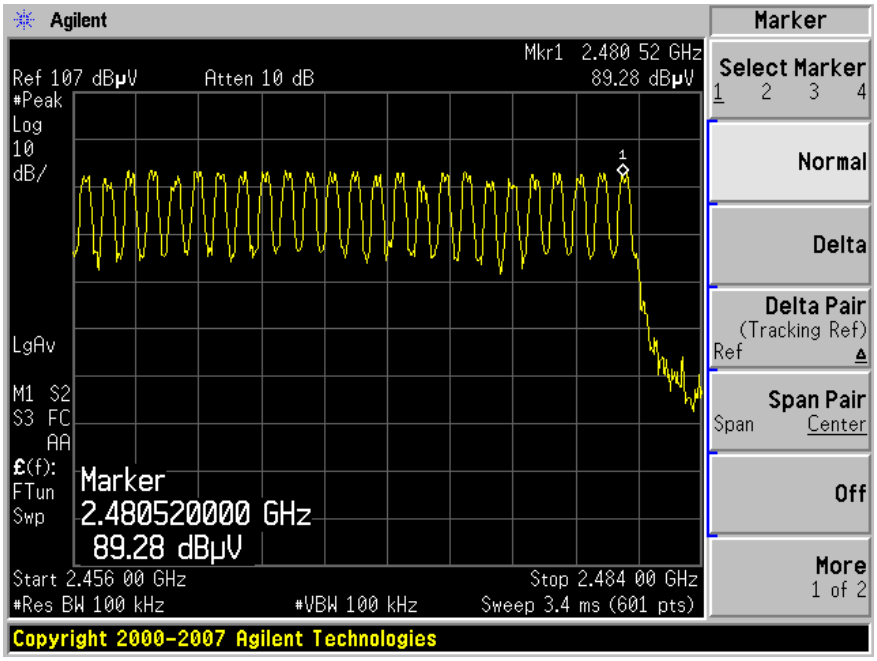
2400 ~ 2428 MHz



2428 ~ 2456 MHz



2456 ~ 2483.5MHz



9 §15.247(a) (1) (iii) - DWELL TIME

9.1 Applicable Standard

According to §15.247 (a)(1)(iii), the average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

9.2 Measurement Procedure

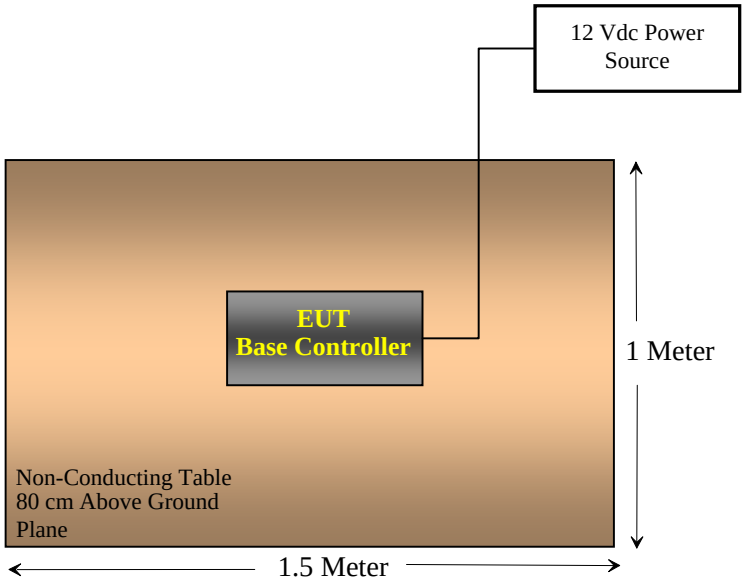
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT was set without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Adjust the center frequency of SA on any frequency be measured and set SA to zero span mode. And then, set RBW and VBW of spectrum analyzer to proper value.
4. Measure the time duration of one transmission on the measured frequency. And then plot the result with time difference of this time duration.
5. Repeat above procedures until all frequencies measured were complete.

9.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Number	Calibration Dates
Mini-Circuits	Pre-amplifier	ZKL-2	7786100643	2009-03-03
HP	Pre-amplifier	8449B	3147A00400	2008-10-22
A. H. Systems	Antenna, Horn, DRG	DRG-118/A	1132	2008-07-28
Agilent	Spectrum Analyzer	E4440A	MY44303352	2008-04-28

*** Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

9.4 Test Setup Diagram



9.5 Environmental Conditions

Temperature:	21-22 ºC
Relative Humidity:	43-44 %
ATM Pressure:	101.2-102.1 kPa

**The testing was performed by Victor Zhang from 2009-03-11 to 2009-03-21.*

9.6 Measurement Results:

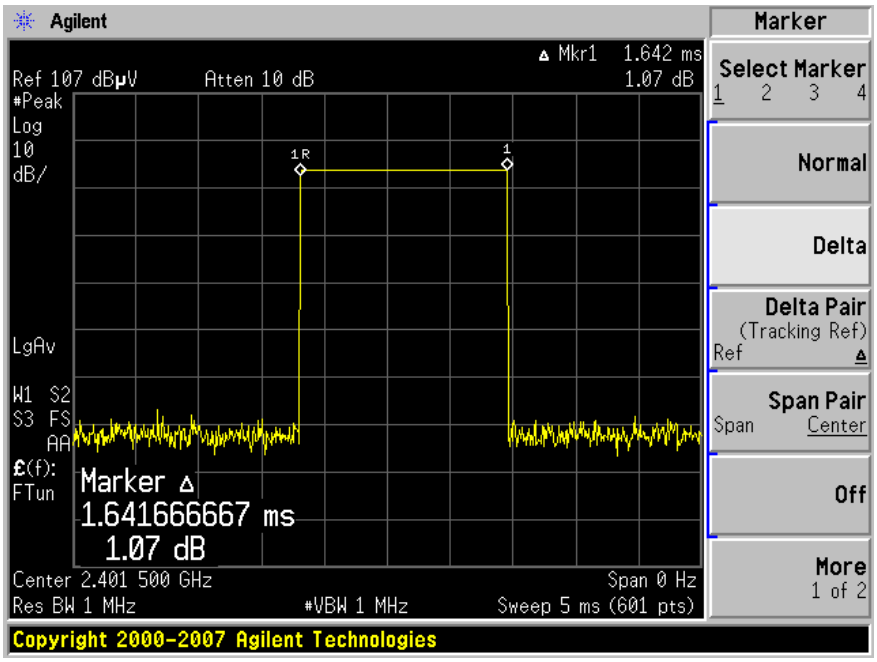
Channel	Frequency (MHz)	Pulse Width (ms)	Dwell Time (Sec.)	Limit (Sec.)	Results
Low	2401.5	1.6417	0.0843	0.4	Compliant
Mid	2441.5	1.6417	0.0843	0.4	Compliant
High	2480.5	1.6333	0.0839	0.4	Compliant

Notes:

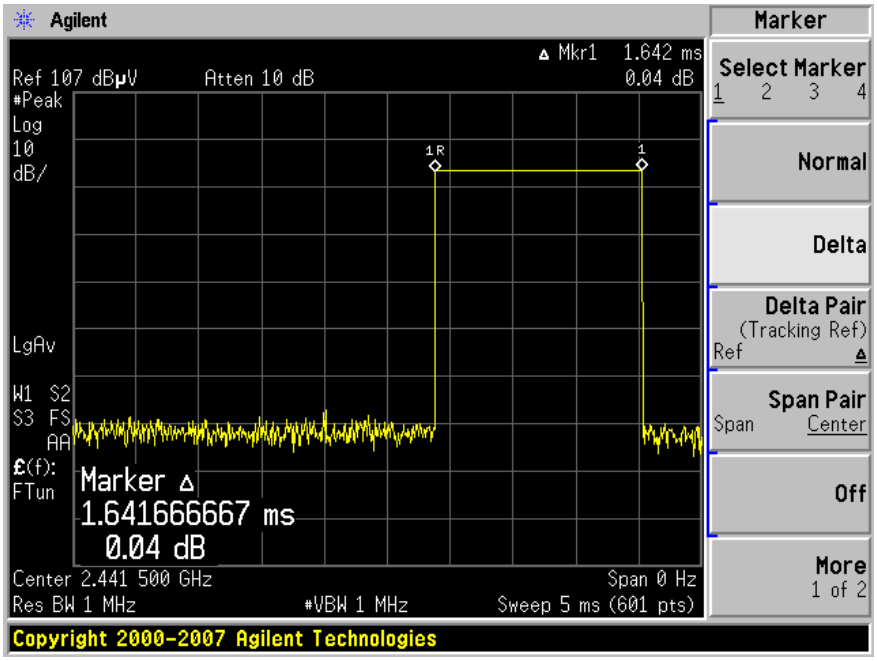
Dwell time = Pulse time*(hop rate/2/number of channels)*31.6 sec
• Hop Rate = 260
• Number of Channels = 80
Dwell time = Pulse time*(260/2/80)*31.6 sec

Please refer the following plots.

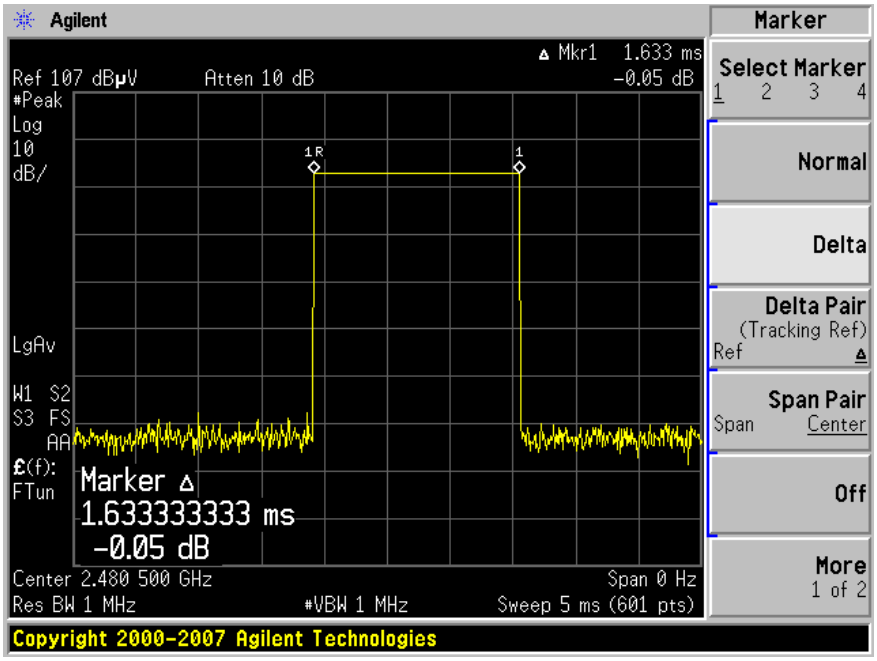
Low Channel



Middle Channel



High Channel



10 §15.247(B) (1) - MAXIMUM PEAK OUTPUT POWER

10.1 Applicable Standard

According to §15.247(b) (1), for frequency hopping systems in the 2400-2483.5MHz band employing at least 75 hopping channels, and all direct sequence systems, the maximum peak output power of the transmitter shall not exceed 1 Watt. For all other frequency hopping system in the 2400 – 2483.5 MHz band, the maximum peak output power of the transmitter shall not exceed 0.125 Watt.

According to DA 00-705 - Released March 30, 2000:

If antenna conducted tests cannot be performed on this device, radiated tests to show compliance with the peak output power limit specified in Section 15.247(b) and the spurious RF conducted emission limit specified in Section 15.247(c) are acceptable. As stated previously, a pre-amp, and, in the latter case, a high pass filter, are required for the following measurements.

1) Calculate the transmitter's peak power using the following equation:

$$E = \frac{\sqrt{30PG}}{d}$$

Where:

E is the measured maximum fundamental field strength in V/m, utilizing a RBW ≥ the 20 dB bandwidth of the emission, VBW > RBW, peak detector function. Follow the procedures in C63.4-1992 with respect to maximizing the emission.

G is the numeric gain of the transmitting antenna with reference to an isotropic radiator.

d is the distance in meters from which the field strength was measured.

P is the power in watts for which you are solving:

$$P = \frac{(E*d)^2}{30G}$$

10.2 Measurement Procedure

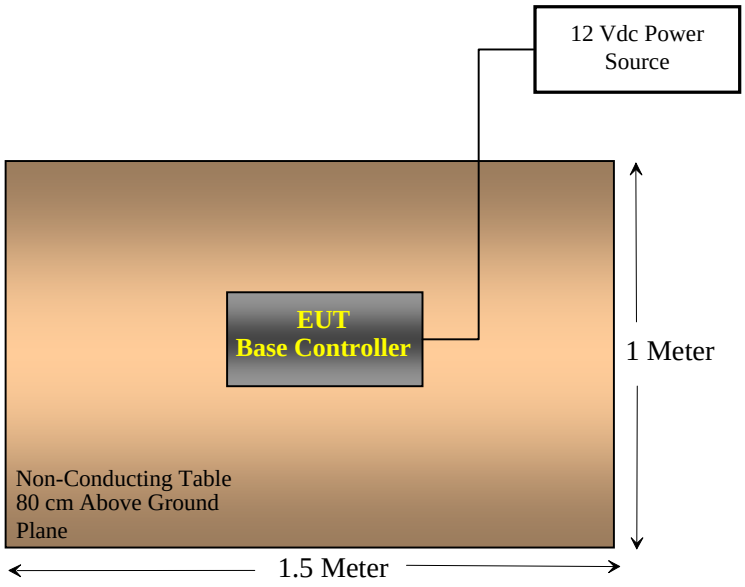
1. Place the EUT on the turntable and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.

10.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Number	Calibration Dates
Mini-Circuits	Pre-amplifier	ZKL-2	7786100643	2009-03-03
HP	Pre-amplifier	8449B	3147A00400	2008-10-22
A. H. Systems	Antenna, Horn, DRG	DRG-118/A	1132	2008-07-28
Agilent	Spectrum Analyzer	E4440A	MY44303352	2008-04-28
Sunol Science Corp	Combination Antenna	JB1 Antenna	A103105-3	2008-03-25

*** Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

10.4 Test Setup Diagram



10.5 Environmental Conditions

Temperature:	21-22 ºC
Relative Humidity:	43-44 %
ATM Pressure:	101.2-102.1 kPa

**The testing was performed by Victor Zhang from 2009-03-11 to 2009-03-21.*

10.6 Measurement Result

Measured at 3 Meter distance

Indicated		Table Azimuth (degrees)	Test Antenna		Output Power		FCC Part 15.247	
Frequency (MHz)	Field Strength Reading (dBµV)		Height (m)	Polar. (H/V)	(mW)	(dBm)	Limit (dBm)	Margin (dB)
2401.5	95.64	193	1.0	V	0.514	-2.89	21	-23.89
2401.5	91.46	175	1.88	H	0.196	-7.07	21	-28.07
2441.5	94.19	211	1.0	V	0.368	-4.34	21	-25.34
2441.5	91.57	175	1.5	H	0.201	-6.96	21	-27.96
2480.5	93.96	248	1.49	V	0.349	-4.57	21	-25.57
2480.5	91.18	159	1.48	H	0.184	-7.35	21	-28.35

Note: Antenna Gain = 3.3 dBi

11 §15.247 (d) - 100 KHz BANDWIDTH OF BAND EDGES

11.1 Applicable Standard

According to §15.247(c), in any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in §15.209(a) is not required.

11.2 Measurement Procedure

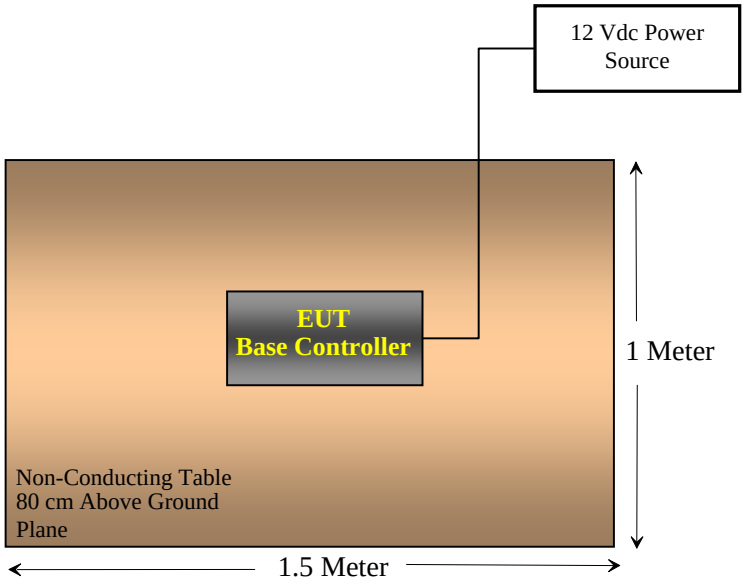
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set both RBW and VBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

11.3 Test Equipment List and Details

Manufacturers	Descriptions	Models	Serial Number	Calibration Dates
Mini-Circuits	Pre-amplifier	ZKL-2	7786100643	2009-03-03
HP	Pre-amplifier	8449B	3147A00400	2008-10-22
A. H. Systems	Antenna, Horn, DRG	DRG-118/A	1132	2008-07-28
Agilent	Spectrum Analyzer	E4440A	MY44303352	2008-04-28
Sunol Science Corp	Combination Antenna	JB1 Antenna	A103105-3	2008-03-25

*** Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

11.4 Test Setup Diagram



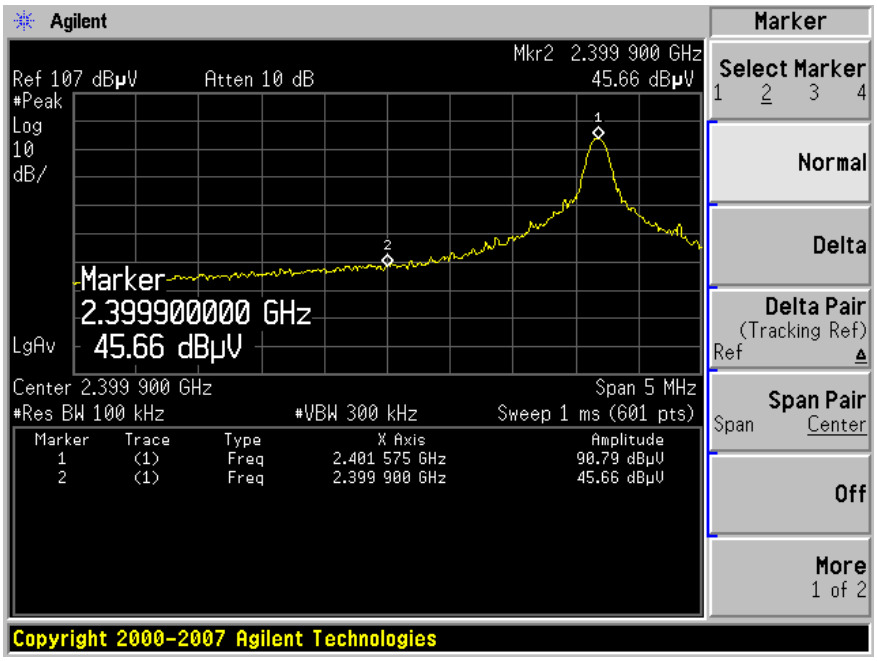
11.5 Environmental Conditions

Temperature:	21-22 ºC
Relative Humidity:	43-44 %
ATM Pressure:	101.2-102.1 kPa

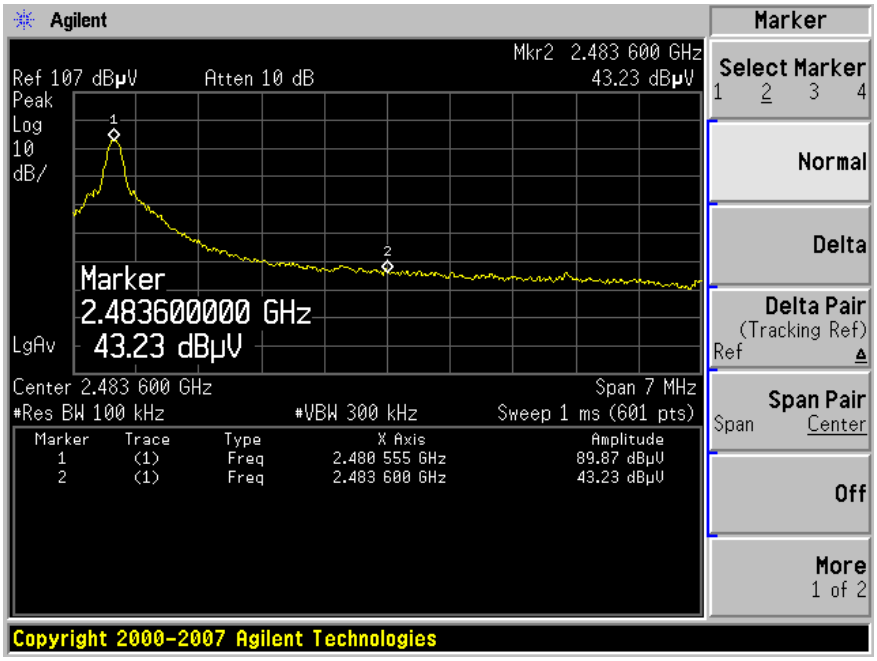
**The testing was performed by Victor Zhang from 2009-03-11 to 2009-03-21.*

Please refer to the following plots for results.

Lowest Channel



Highest Channel



12 § 15.247 (i) & § 2.1091 - RF EXPOSURE

12.1 Applicable Standard

According to §15.247(i) and §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

According to §1.1310 and §2.1091 RF exposure is calculated.

Limits for General Population/Uncontrolled Exposure

Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	**Electric Field Strength (V/m)**	**Magnetic Field Strength (A/m)**	**Power Density (mW/cm^2)**	**Averaging Time (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

12.2 MPE Prediction

Prediction of MPE limit at a given distance

Equation from page 10 of OET Bulletin 65 supplement B, Edition 97-01

$$S = \frac{E^2}{3770} = 37.7\ H^2$$

Where: S = power density (mW/cm2)
E = electric field strength (V/m)
H = magnetic field strength (A/m)

12.3 Conclusion

Maximum Field Strength (dBuV/m):	95.64
Maximum Field Strength (V/m):	0.0605
Prediction distance (cm):	20
Prediction frequency (MHz):	2401.5
Power density of prediction frequency at 20.0 cm (mW/cm^2):	0.0000971
MPE limit for uncontrolled exposure at prediction frequency (mW/cm^2):	1.0

The Base Controller is a mobile device. The power density level at 20 cm is 0.000000971mW/cm², which is below the uncontrolled exposure limit of 1.0mW/cm² at 2401.5 MHz.