

FCC Part 15C

Measurement and Test Report

For

LM TECHNOLOGIES LTD.

66-68 Hagley Road, Birmingham West Midlands, United Kingdom

FCC ID: VVXLM048

Report Concerns: Original Report	Equipment Type: Bluetooth RS232 Adapter Mini
Model:	<u>LM048</u>
Report No.:	<u>STR07118088I</u>
Test/Witness Engineer:	<u>Lahm Peng</u>
Test Date:	<u>2007-12-01 to 2007-12-07</u>
Prepared By:	<p>Shenzhen SEM.Test Compliance Service Co., Ltd Room 609-610, Baotong Building, Baomin 1st Road, Baoan District, Shenzhen, Guangdong, P.R.C. (518133)</p>
Approved & Authorized By:	<div style="text-align: right;">  <hr style="width: 20%; margin: 0 auto;"/> Jandy So / PSQ Manager </div>

Note: This test report is limited to the above client company and the product model only. It may not be duplicated without prior permitted by SEM.Test Compliance Service Co., Ltd.

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1. GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

Client Information

Applicant: LM Technology Ltd.
 Address of applicant: 66-68 Hagley Road, Birmingham West Midlands, United Kingdom

Manufacturer: Rayson Electronic Manufactory
 Address of manufacturer: The Second Industrial Zone, Lou Village Gongming, Baoan, Shenzhen City, Guangdong Province, China

General Description of E.U.T

Items	Description
EUT Description:	Bluetooth RS232 Adapter Mini
Trade Name:	/
Model No.:	LM048
Max. Output Power	<15dBm
Frequency range:	2402-2480MHz
Number of channels:	79
Channel Separation:	1MHz
Type of Antenna:	Fixed Antenna
Size:	4.5x3.0x1.5cm

Note: The test data is gathered from a production sample, provided by the manufacturer.

1.2 Test Standards

The following report is prepared on behalf of LM Technologies Ltd. in accordance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.247 of the Federal Communication Commissions rules.

The objective is to determine compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.247 of the Federal Communication Commissions rules.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product, which result in lowering the emission, should be checked to ensure compliance has been maintained.

1.3 Related Submittal(s)/Grant(s)

No Related Submittal(s).

1.4 Test Methodology

All measurements contained in this report were conducted with ANSI C63.4-2003, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.

The equipment under test (EUT) was configured to measure its highest possible emission level. The test modes were adapted with Low Channel, Middle Channel and High Channel, accordingly in reference to the Operating Instructions.

1.5 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

United States of American Federal Communications Commission (**FCC**), and the registration number is **556682**
 Certification and Engineering Bureau of Industry Canada for radio equipment testing with the registration number is **6002**.

All measurement required was performed at laboratory of SGS-CSTC Standards Technical Services Co., Ltd., No.1 Workshop, M-10, Middle Section, Science & Technology Park, Nanshan District, Shenzhen, Guangdong, China.

1.6 EUT Exercise Software

The EUT exercise program used during the testing was designed to exercise the system components.

1.7 Accessories Equipment List and Details

Manufacturer	Description	Model	Serial Number
IBM	Notebook	R51e	LV14893
TP-LINK	Modem	TM-EC5658V	KT99CTQC-508
Lenovo	Printer	3110	OD65133711480

1.8 EUT Cable List and Details

Cable Description	Length (M)	Shielded/Unshielded	With Core/Without Core
USB Cable	1.2	Shielded	With Core
RS232 Cable	1.0	Shielded	Without Core

2. SUMMARY OF TEST RESULTS

FCC RULES	DESCRIPTION OF TEST	RESULT
§ 15.203; § 15.247(b)(4)(i)	Antenna Requirement	Compliant
§ 15.247(a)(1)(iii)	Quantity of Hopping Channel	Compliant
§ 15.247(a)(1)	Channel Separation	Compliant
§ 15.247(a)(1)(iii)	Time of Occupancy (Dwell time)	Compliant
§ 15.247(a)	20dB Bandwidth	Compliant
§ 15.247(b)(1)	Power Output	Compliant
§ 15.209(a)(f)	Radiated Emission	Compliant
§ 15.247(c)	Band edge	Compliant

3. §15.203 - ANTENNA REQUIREMENT

3.1 Standard Applicable

According to FCC 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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

3.2 Test Result

This product has a permanent antenna, fulfill the requirement of this section.

4. NUMBER OF HOPPING CHANNELS AND CHANNEL SPACING

4.1 Standard Applicable

According to FCC 15.247(a)(1), Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. 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

4.2 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Cal. Date	Due. Date
Agilent	Spectrum Analyzer	E4402B	US41192821	2007-06-20	2008-06-19
ETS	Receiver Antenna	2175	57337	2007-01-26	2008-01-25
ETS	50 ohm Coaxial Cable	SUCOFLEX 104	25498514	2007-01-26	2008-01-25

Statement of Traceability: All calibrations have been performed per the NVLAP requirements traceable to the NIST.

4.3 Test Procedure

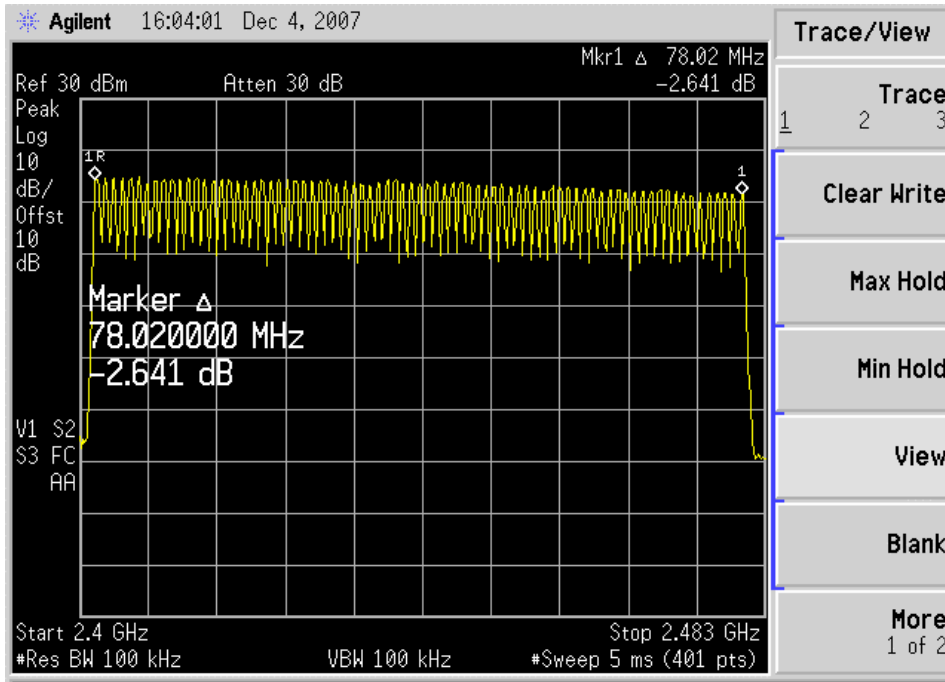
Set the Lowest channel to the Highest Channel, observed the band of 2400MHz to 2438.5MHz, than count it out the number of channels for comparing with the FCC rules. Adjust channel spacing can be read by adjusting the Analyzer SPAN.

4.4 Environmental Conditions

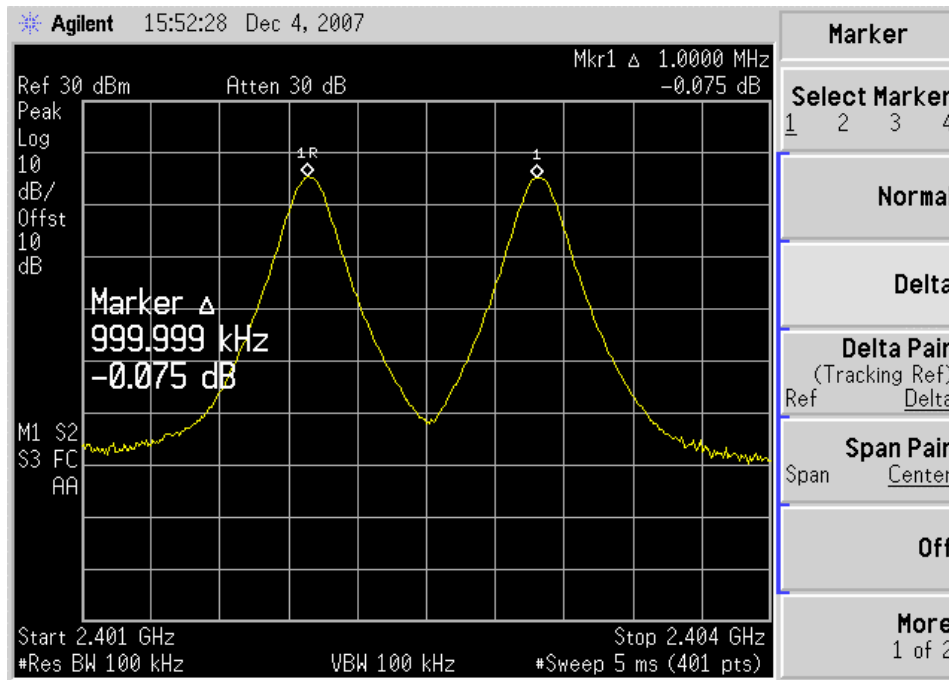
Temperature:	20° C
Relative Humidity:	54%
ATM Pressure:	1011 mbar

4.5 Summary of Test Results/Plots

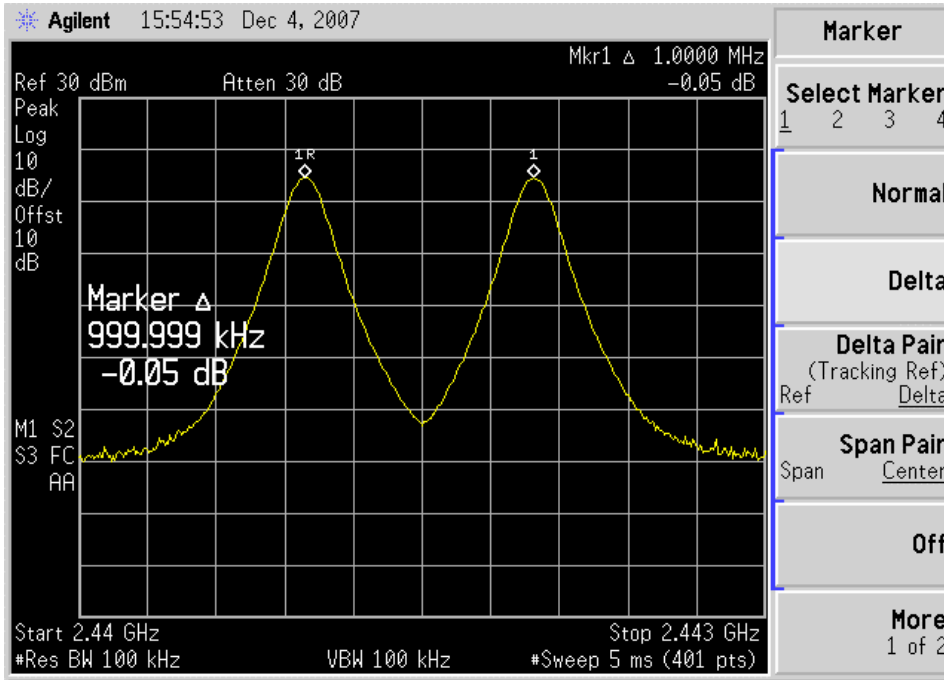
No. of Channel=79



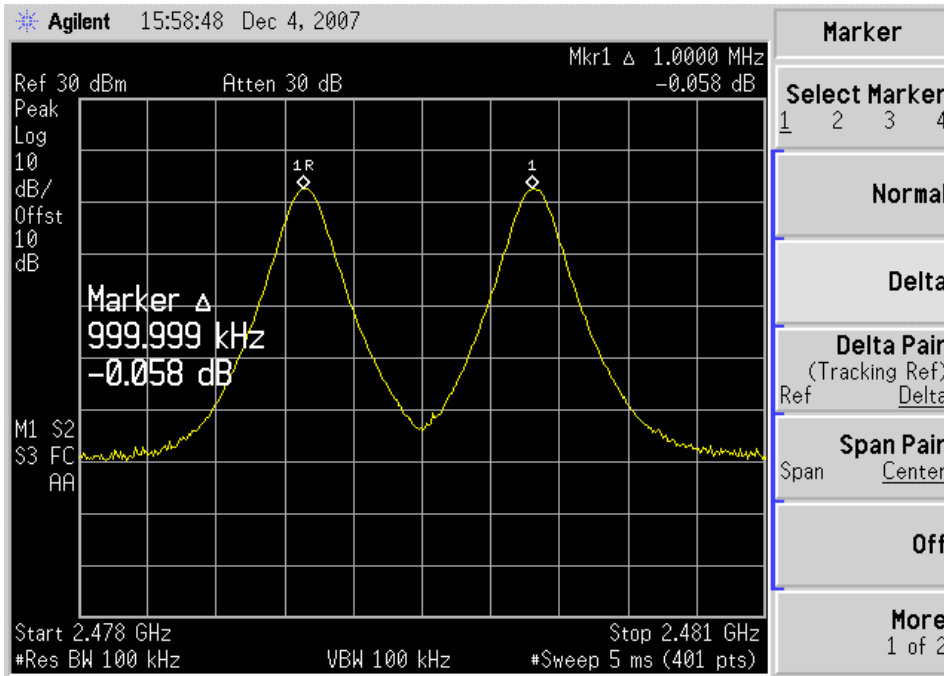
Channel Spacing (Low CH=1MHz)



Channel Spacing (Middle CH=1MHz)



Channel Spacing (High CH=1MHz)



5. DWELL TIME OF A HOPPING CHANNEL

5.1 Standard Applicable

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

5.2 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Cal. Date	Due. Date
Agilent	Spectrum Analyzer	E4402B	US41192821	2007-06-20	2008-06-19
ETS	50 ohm Coaxial Cable	SUCOFLEX 104	25498514	2007-01-26	2008-01-25

Statement of Traceability: All calibrations have been performed per the NVLAP requirements traceable to the NIST.

5.3 Test Procedure

1. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
2. Set center frequency of spectrum analyzer = operating frequency.
3. Set the spectrum analyzer as RBW, VBW=1MHz, Span = 0Hz.
4. Repeat above procedures until all frequency measured was complete.

5.4 Environmental Conditions

Temperature:	20° C
Relative Humidity:	54%
ATM Pressure:	1011 mbar

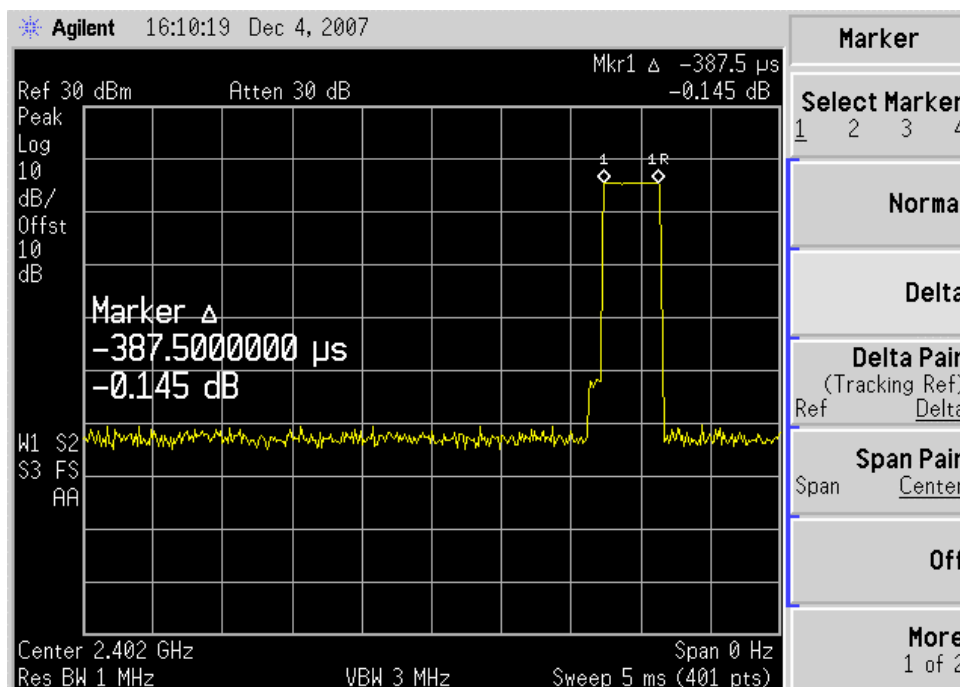
5.5 Summary of Test Results/Plots

The dwell time within a 31.6 second period in data mode is independent from the packet type (packet length). The calculation for a 31.6 second period is as follows:

$$\text{Dwell time} = \text{time slot length} * \text{hop rate} / \text{number of hopping channels} * 31.6\text{s}$$

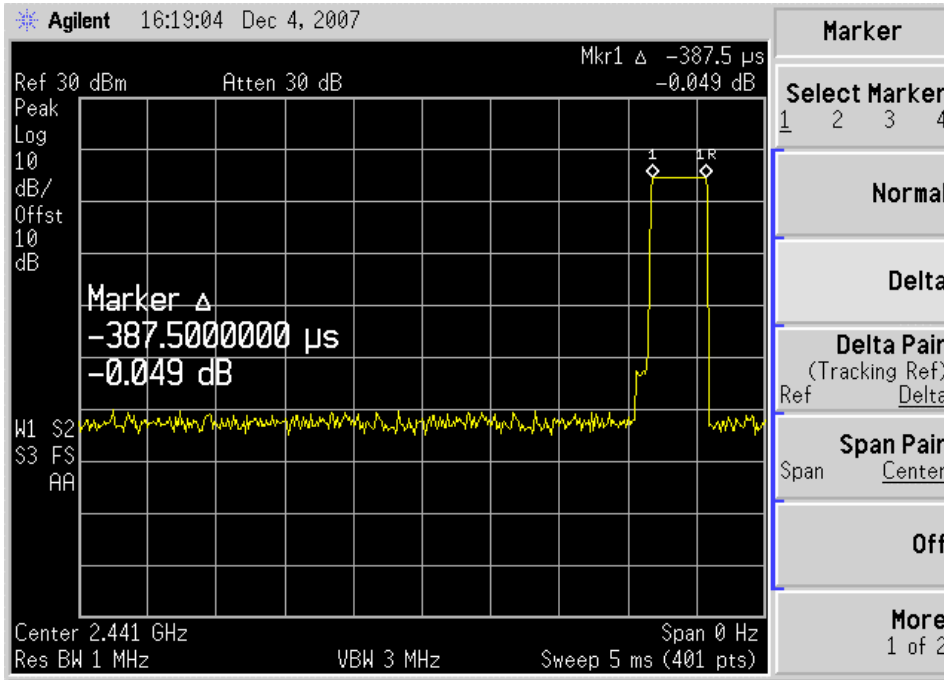
Test data is corrected with the worse case, which the packet length is DH1.

CH Low:



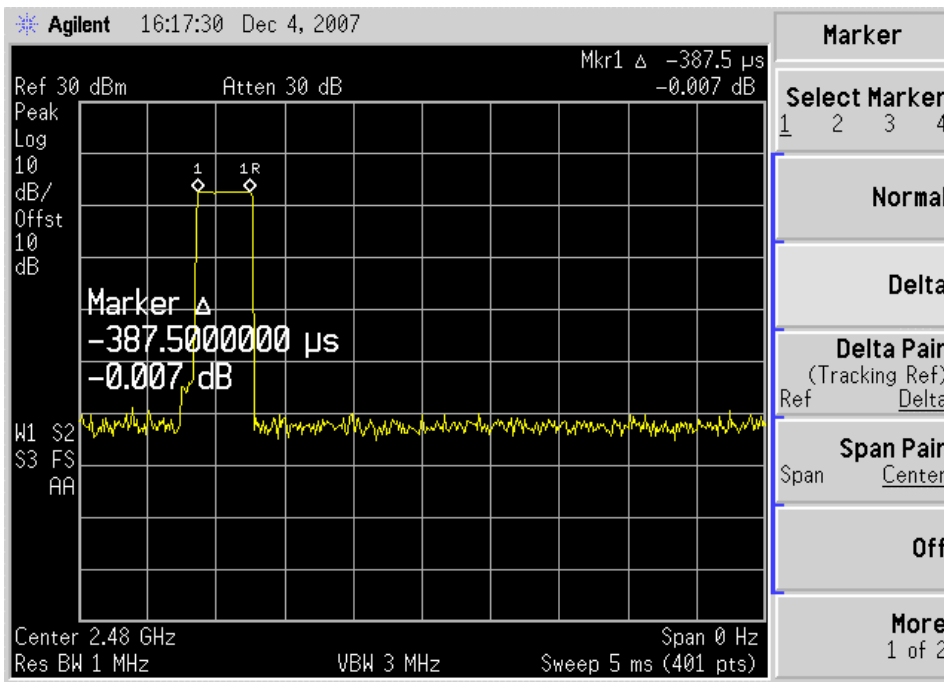
$$\text{DH1 time slot} = 0.3875 \text{ (ms)} * (1600/(79)) * 31.6 = 248 \text{ (ms)} < 400 \text{ (ms)}$$

CH Mid:



$$\text{DH1 time slot} = 0.3875 \text{ (ms)} * (1600/(79)) * 31.6 = 248 \text{ (ms)} < 400 \text{ (ms)}$$

CH High:



$$\text{DH1 time slot} = 0.3875 \text{ (ms)} * (1600/(79)) * 31.6 = 248 \text{ (ms)} < 400 \text{ (ms)}$$

6. 20-dB BANDWIDTH

6.1 Standard Applicable

According to 15.247(a)(1)(iii). For frequency hopping systems operating in the 2400MHz-2483.5 MHz no limit for 20dB bandwidth.

6.2 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Cal. Date	Due. Date
Agilent	Spectrum Analyzer	E4402B	US41192821	2007-06-20	2008-06-19
ETS	50 ohm Coaxial Cable	SUCOFLEX 104	25498514	2007-01-26	2008-01-25

Statement of Traceability: All calibrations have been performed per the NVLAP requirements traceable to the NIST.

6.3 Test Procedure

1. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
2. Set center frequency of spectrum analyzer = operating frequency.
3. The spectrum analyzer as RBW=10KHz (1 % of Bandwidth.), Sweep=auto
4. Mark the peak frequency and -20dB (upper and lower) frequency.

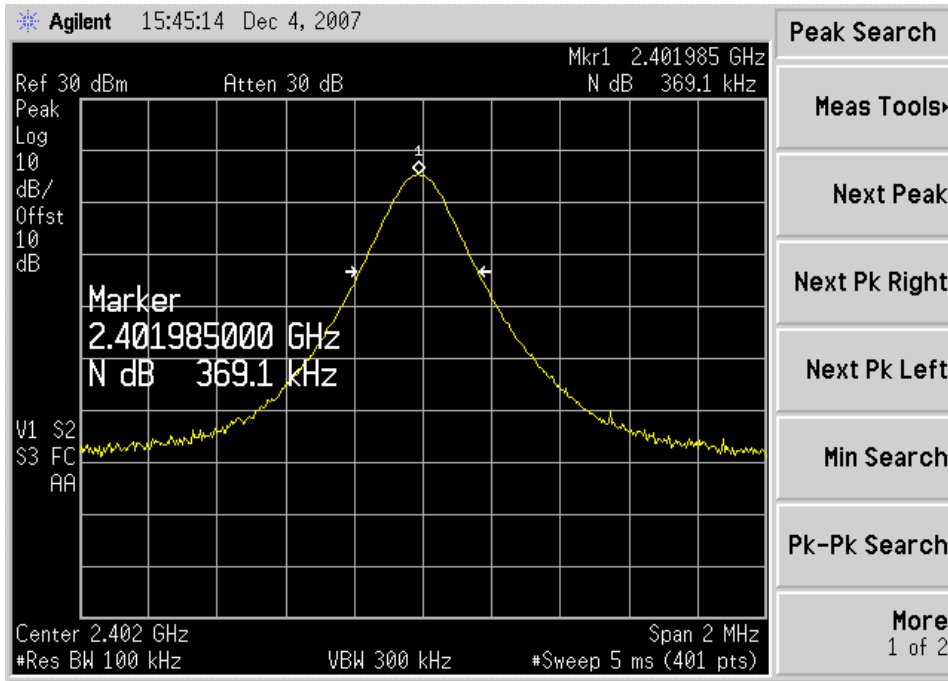
6.4 Environmental Conditions

Temperature:	24° C
Relative Humidity:	53%
ATM Pressure:	1018 mbar

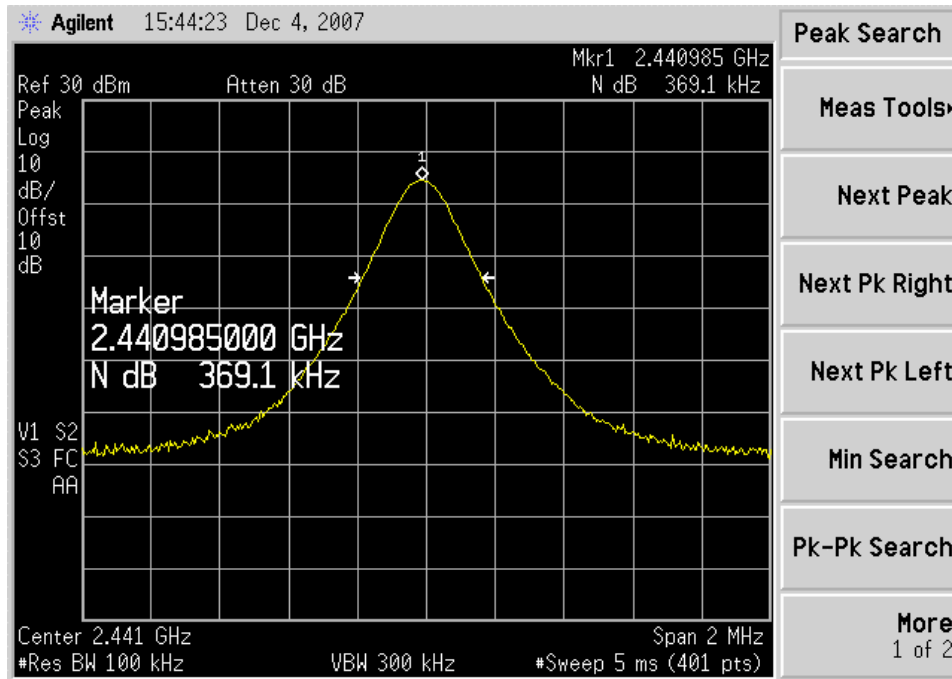
6.5 Summary of Test Results/Plots

Frequency MHz	20 dB Bandwidth kHz	Limit dB
2402	369.1	/
2441	369.1	/
2480	369.1	/

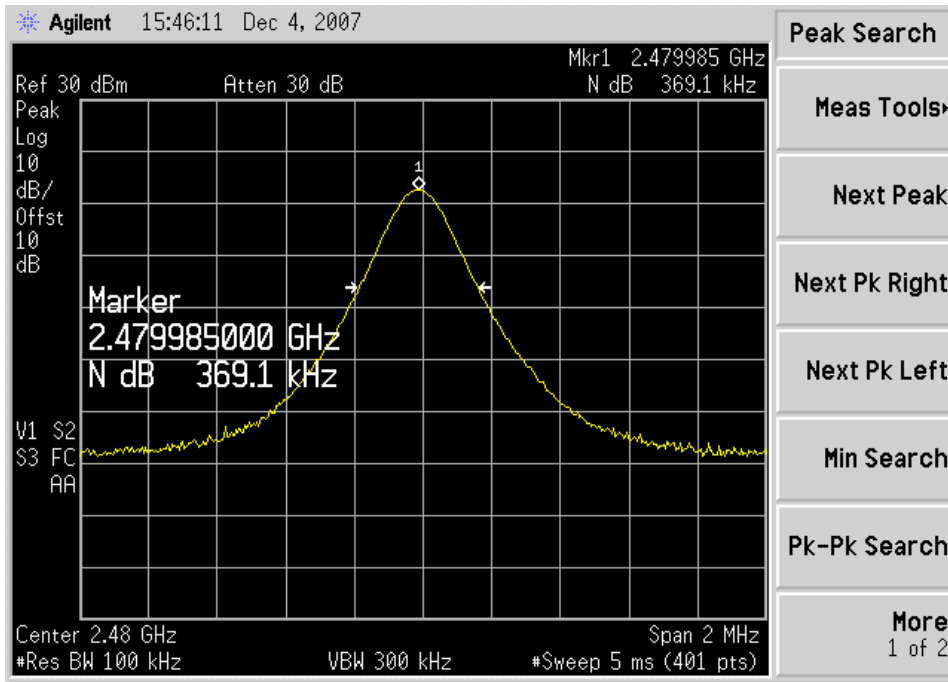
CH Low:



CH Mid:



CH High:



7. POWER OUTPUT

7.1 Standard Applicable

According to 15.247(b)(1). For frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725–5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

7.2 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Cal. Date	Due. Date
Agilent	Spectrum Analyzer	E4402B	US41192821	2007-06-20	2008-06-19
ETS	50 ohm Coaxial Cable	SUCOFLEX 104	25498514	2007-01-26	2008-01-25

Statement of Traceability: All calibrations have been performed per the NVLAP requirements traceable to the NIST.

7.3 Test Procedure

The device under test has an integral antenna and the power was measured on a radiated basis.

7.4 Environmental Conditions

Temperature:	21° C
Relative Humidity:	55%
ATM Pressure:	1011 mbar

7.5 Summary of Test Results/Plots

2402 MHz 33.57 mW (Conducted peak output power)

2441 MHz 28.58 mW (Conducted peak output power)

2480 MHz 18.84 mW (Conducted peak output power)

8. FIELD STRENGTH OF SPURIOUS EMISSIONS

8.1 Measurement Uncertainty

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the best estimate of the uncertainty of a radiation emissions measurement is ± 3.0 dB.

8.2 Standard Applicable

According to §15.247(c), 15.205 15.209(b) & 15.35 (b), the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Section 15.209:

30 - 88 MHz 40 dBuV/m @3M

88 -216 MHz 43.5 dBuV/m @3M

216 -960 MHz 46 dBuV/m @3M

Above 960 MHz 54dBuV/m @3M

The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply.

EMISSIONS RADIATED OUTSIDE OF THE SPECIFIED FREQUENCY BANDS, EXCEPT FOR HARMONICS, SHALL BE ATTENUATED BY AT LEAST 20 dB BELOW THE LEVEL OF THE FUNDAMENTAL OR TO THE GENERAL RADIATED EMISSION LIMITS IN 15.209,WHICHEVER IS THE LESSER ATTENUATION.

Emissions that fall in the restricted bands (15.205) must be less than 54dBuV/m otherwise the spurious and harmonics must be attenuated by at least 20dB.

8.3 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Cal. Date	Due. Date
Rohde & Schwarz	EMI Test Receiver	ESI26	830245/009	2007-1-26	2008-1-25
ETS	Multi_Device Controller	2090	57230	2007-1-26	2008-1-25
ETS	Receiver Antenna	2175	57337	2007-1-26	2008-1-25
ETS	50 ohm Coaxial Cable	SUCOFLEX 104	25498514	2007-1-26	2008-1-25
Rohde & Schwarz	Horn Antenna	HF906	100014	2007-1-26	2008-1-25

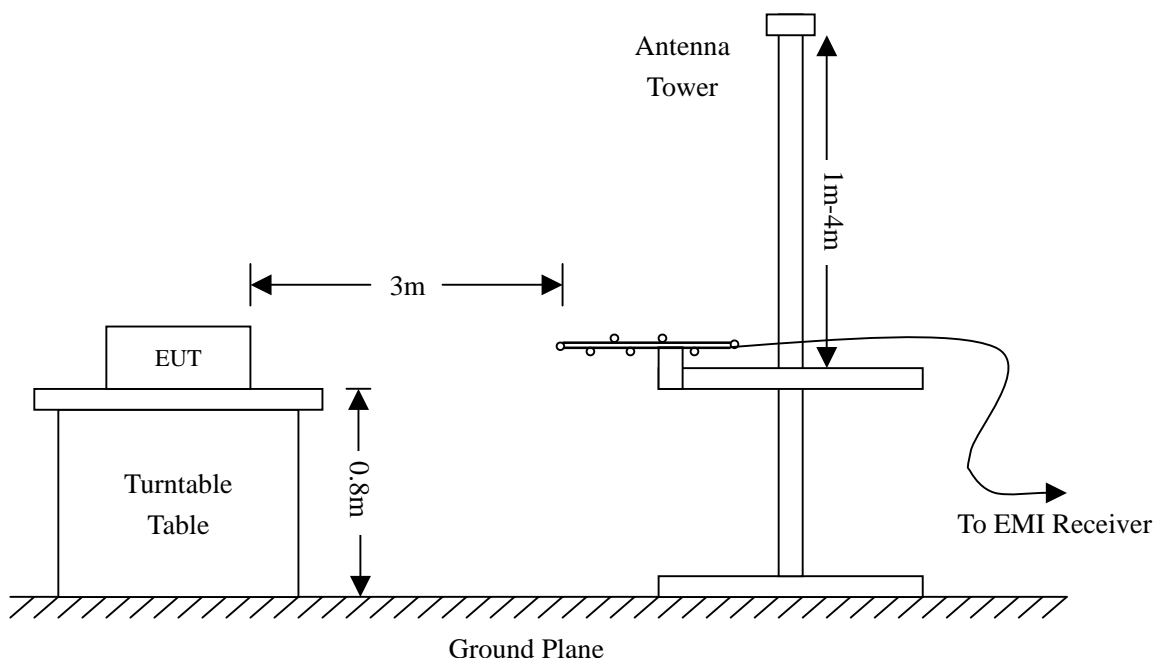
Statement of Traceability: All calibrations have been performed per the NVLAP requirements traceable to the NIST.

8.4 Test Procedure

The setup of EUT is according with per ANSI C63.4-2003 measurement procedure. The specification used was with the FCC Part 15.205 15.247(a) and FCC Part 15.209 Limit.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

The spacing between the peripherals was 3 cm.



8.5 Corrected Amplitude & Margin Calculation

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

$$\text{Corr. Ampl.} = \text{Indicated Reading} + \text{Ant. Factor} + \text{Cable Loss} - \text{Ampl. Gain}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -6dB μ V means the emission is 6dB μ V below the maximum limit for Class B. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Corr. Ampl.} - \text{FCC Part 15 Limit}$$

8.6 Environmental Conditions

Temperature:	22° C
Relative Humidity:	52%
ATM Pressure:	1012 mbar

8.7 Summary of Test Results/Plots

According to the data below, the FCC Part 15.205, 15.209 and 15.247 standards, and had the worst margin of:

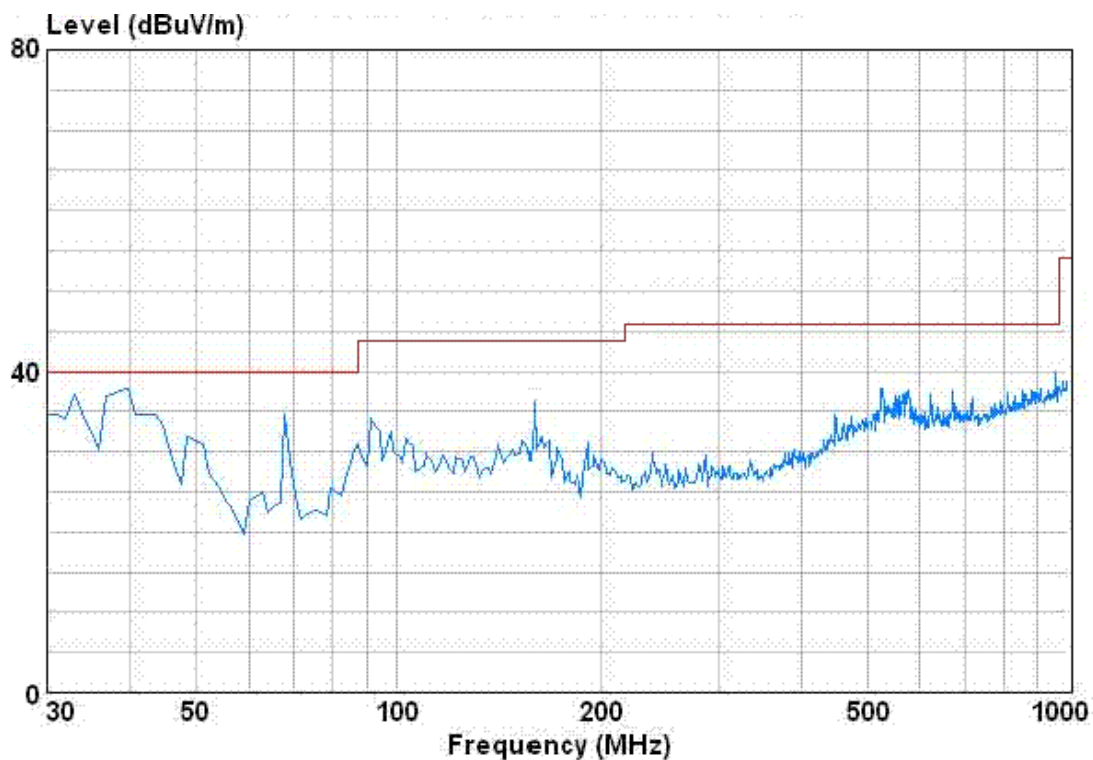
-2.0 dB μ V at 39.80 MHz in the Horizontal polarization for Middle Channel, 30 MHz to 25 GHz, 3Meters

Frequency MHz	Detector	Meter Reading dBuV	Direction Degree	Polar H / V	Antenna Loss dB	Cable loss dB	Amplifier dB	Correction Amplitude dBuV/m	Limit dBuV/m	Margin dB
<i>Below 1G</i>										
39.8	QP	46.0	0	H	17.7	0.6	26.29	38.0	40	-2.0
33.6	QP	38.9	45	H	24.1	0.6	26.29	37.3	40	-2.7
71.0	QP	52.5	160	V	8.6	0.8	26.08	35.8	40	-4.2
460.5	QP	47.4	120	V	17.4	2.3	25.73	41.4	46	-4.6
67.5	QP	51.9	120	H	8.5	0.8	26.12	35.1	40	-4.9
715.0	QP	43.1	45	V	20.3	3.1	25.67	40.8	46	-5.2
162.5	QP	48.7	120	H	12.7	1.1	25.43	37.1	43.5	-6.4
191.6	QP	48.3	90	V	11.8	1.3	25.23	36.2	43.5	-7.3
235.6	QP	50.2	270	V	11.9	1.3	24.88	38.5	46	-7.5
520.2	QP	42.7	145	H	18.3	2.5	25.87	37.6	46	-8.4
<i>Low Channel (1G to 25GHz)</i>										
4804	AV	45.8	60	V	34.0	2.7	34.0	48.5	54	-5.5
4804	AV	45.5	266	H	34.0	2.7	34.0	48.2	54	-5.8
7206	AV	42.2	43	V	36.3	3.2	33.8	47.9	54	-6.1
7206	AV	41.6	90	H	36.3	3.2	33.8	47.3	54	-6.7
4804	PK	49.9	98	V	34.0	2.7	34.0	52.6	74	-21.4
4804	PK	48.8	45	H	34.0	2.7	34.0	51.5	74	-22.5
7206	PK	45.6	185	V	36.3	3.2	33.8	51.3	74	-22.7
7206	PK	45.0	56	H	36.3	3.2	33.8	50.7	74	-23.3
2402	PK	105.6	66	V	32.2	2.0	33.5	106.3		(Fund.)
2402	AV	104.5	60	V	32.2	2.0	33.5	105.2		(Fund.)
2402	PK	102.1	135	H	32.2	2.0	33.5	102.8		(Fund.)
2402	AV	100.7	45	H	32.2	2.0	33.5	101.4		(Fund.)
<i>Middle Channel (1G to 25GHz)</i>										
4882	AV	45.9	43	V	34.0	2.7	34.0	48.6	54	-5.4
4882	AV	44.2	90	H	34.0	2.7	34.0	46.9	54	-7.1
7323	AV	40.7	60	V	36.1	3.2	33.8	46.2	54	-7.8
7323	AV	40.2	45	H	36.1	3.2	33.8	45.7	54	-8.3
4882	PK	48.2	60	V	34.0	2.7	34.0	50.9	74	-23.1
4882	PK	47.4	56	H	34.0	2.7	34.0	50.1	74	-23.9
7323	PK	44.3	185	V	36.1	3.2	33.8	49.8	74	-24.2
7323	PK	43.4	266	H	36.1	3.2	33.8	48.9	74	-25.1
2441	PK	103.9	45	V	32.2	2.0	33.5	104.6		(Fund.)
2441	AV	101.6	98	V	32.2	2.0	33.5	102.3		(Fund.)
2441	PK	101.6	60	H	32.2	2.0	33.5	102.3		(Fund.)
2441	AV	99.4	45	H	32.2	2.0	33.5	100.1		(Fund.)

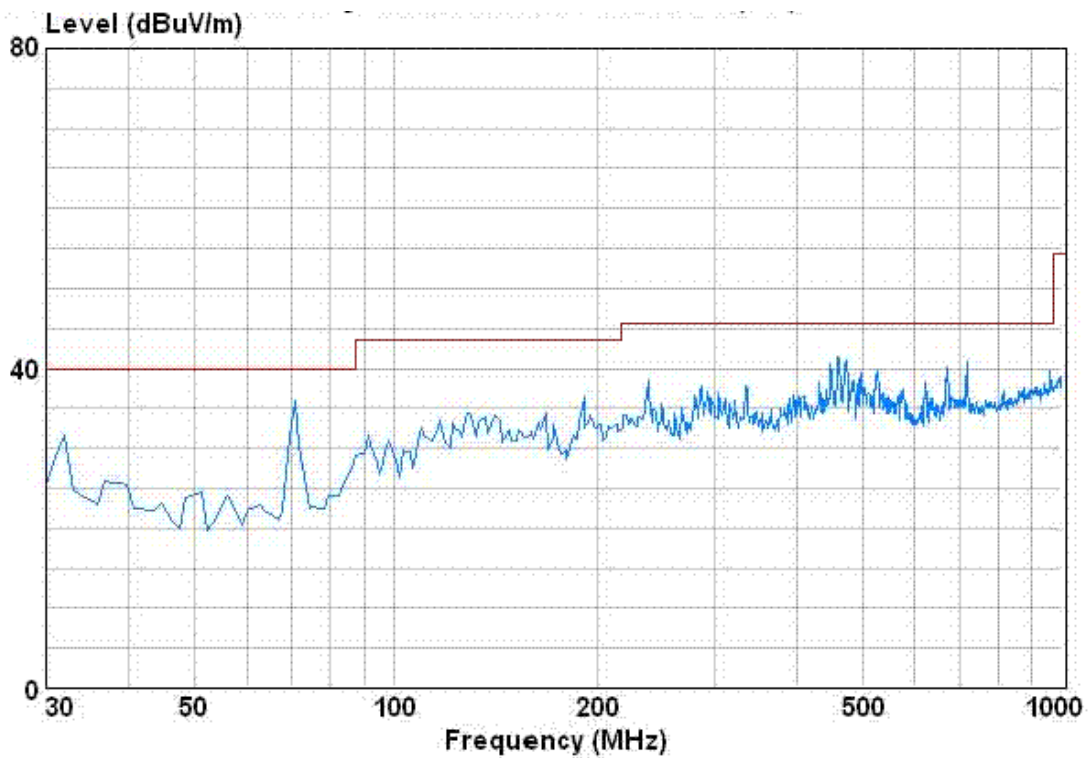
<i>High Channel (1G to 25GHz)</i>										
4960	AV	44.1	45	V	34.0	2.7	34.0	46.8	54	-7.2
7440	AV	41.2	90	V	36.0	3.2	33.8	46.6	54	-7.4
4960	AV	43.6	270	H	34.0	2.7	34.0	46.3	54	-7.7
7440	AV	40.8	60	H	36.0	3.2	33.8	46.2	54	-7.8
4960	PK	46.9	180	V	34.0	2.7	34.0	49.6	74	-24.4
4960	PK	46.5	90	H	34.0	2.7	34.0	49.2	74	-24.8
7440	PK	43.5	90	V	36.0	3.2	33.8	48.9	74	-25.1
7440	PK	43.0	45	H	36.0	3.2	33.8	48.4	74	-25.6
2480	PK	99.8	270	V	32.2	2.0	33.5	100.5		(Fund.)
2480	AV	97.9	60	V	32.2	2.0	33.5	98.6		(Fund.)
2480	PK	97.1	45	H	32.2	2.0	33.5	97.8		(Fund.)
2480	AV	95.6	90	H	32.2	2.0	33.5	96.3		(Fund.)

Note: Testing is carried out with frequency rang 30MHz to the tenth harmonics, which above 5th Harmonics is close to the noise base even antenna close up to 1meter distance according the measurement of ANSI C63.4.

Test Result/Plots:
From 30 MHz to 1 GHz
Horizontal



Vertical



9. OUT OF BAND EMISSIONS

9.1 Standard Applicable

According to §15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated 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, provided the transmitter demonstrates compliance with the peak conducted power limits.

9.2 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Cal. Date	Due. Date
Agilent	Spectrum Analyzer	E4402B	US41192821	2007-06-20	2008-06-19
ETS	Receiver Antenna	2175	57337	2007-01-26	2008-01-25
ETS	50 ohm Coaxial Cable	SUCOFLEX 104	25498514	2007-01-26	2008-01-25
Rohde & Schwarz	Horn Antenna	HF906	100014	2007-01-26	2008-01-25

Statement of Traceability: All calibrations have been performed per the NVLAP requirements traceable to the NIST.

9.3 Test Procedure

1. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
2. Set the spectrum analyzer as RBW, VBW=100KHz, Sweep = auto
3. Set the Lowest and Highest Transmitting Channel, observed the outside band of 2400MHz to 2438.5MHz, then mark the higher-level emission for comparing with the FCC rules.

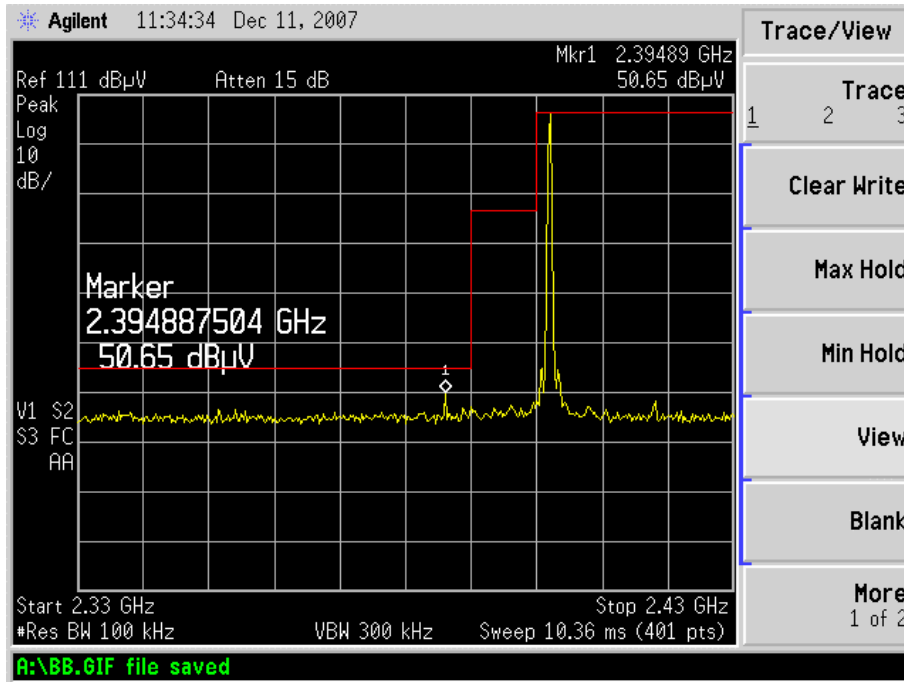
9.4 Environmental Conditions

Temperature:	21° C
Relative Humidity:	54%
ATM Pressure:	1011 mbar

9.5 Summary of Test Results/Plots

Frequency MHz	Atten dB	Limit dB	Result
2394.88	50.65	54	Pass
2496.00	46.42	54	Pass

Lowest Bandedge



Highest Bandedge

