

FCC Test Report

Product Name : LIFX Module Board

Model No. : LMB

FCC ID. : 2AA53-LIFX01

Applicant : LIFI LABS INC.

Address : 524 UNION STREET #309, SAN FRANCISCO, CA, USA
94133

Date of Receipt : 2013/09/25

Issued Date : 2013/10/23

Report No. : 139516R-RFUSP43V01

Report Version : V1.0



Testing Laboratory

1313

The test results relate only to the samples tested.

The test report shall not be reproduced except in full without the written approval of Quietek Corporation.

Test Report Certification

Issued Date : 2013/10/23

Report No. : 139516R-RFUSP43V01




Product Name : LIFX Module Board
 Applicant : LIFI LABS INC.
 Address : 524 UNION STREET #309, SAN FRANCISCO, CA, USA 94133
 Manufacturer : LIFI LABS INC.
 Model No. : LMB
 FCC ID. : 2AA53-LIFX01
 EUT Voltage : AC 100-240V, 50/60Hz
 Trade Name : LIFX
 Applicable Standard : FCC CFR Title 47 Part 15 Subpart C Section 15.247: 2012
 ANSI C63.4: 2009
 Test Result : Complied

The test results relate only to the samples tested.


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Documented By : 

 (Carol Tsai / Engineering Adm. Assistant)

Reviewed By : 

 (Quale Tang n / Senior Engineer)

Approved By : 

 (Roy Wang / Manager)

Laboratory Information

We, **QuieTek Corporation**, are an independent RF consultancy that was established the whole facility in our laboratories. The test facility has been accredited/accepted (audited or listed) by the following related bodies in compliance with ISO 17025 specified testing scopes:

Taiwan R.O.C.	:	TAF, Accreditation Number: 1313 NCC, Certificate No : NCC-RCB-07
USA	:	FCC, Registration Number: 365520
Canada	:	IC, Submission No: 150981

The related certificate for our laboratories about the test site and management system can be downloaded from QuieTek Corporation's Web Site:<http://www.quietek.com/tw/ctg/cts/accreditations.htm>

The address and introduction of QuieTek Corporation's laboratories can be founded in our Web site :
<http://www.quietek.com/>

If you have any comments, Please don't hesitate to contact us. Our contact information is as below:

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1. General Information




1.1. EUT Description

Product Name	LIFX Module Board
Product Type	Zigbee
Trade Name	LIFX
Model No.	LMB
Frequency Range/Channel Number	2405~2480MHz / 16 Channels
Type of Modulation	Direct Sequence Spread Spectrum (DSSS)
Antenna Type	PCB Antenna
Antenna Gain	1.92dBi

Working Frequency of Each Channel							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
Channel 1	2405 MHz	Channel 5	2425 MHz	Channel 9	2445 MHz	Channel 13	2465 MHz
Channel 2	2410 MHz	Channel 6	2430 MHz	Channel 10	2450 MHz	Channel 14	2470 MHz
Channel 3	2415 MHz	Channel 7	2435 MHz	Channel 11	2455 MHz	Channel 15	2475 MHz
Channel 4	2420 MHz	Channel 8	2440 MHz	Channel 12	2460 MHz	Channel 16	2480 MHz

Note:

1. This device is a LIFX Module Board including a 2.4GHz receiving function, and transmitting function.
2. The model difference is as follows :

Item	System Model	Module Model	Externals Color	Strategy of Fitting	
1	BUL-11-A21E26-W	LMB	White	E26	
2	BUL-11-A21E26-G	LMB	Gray	E26	
3	BUL-11-A21E27-W	LMB	White	E27	
4	BUL-11-A21E27-G	LMB	Gray	E27	
5	BUL-11-A21B22-W	LMB	White	B22	
6	BUL-11-A21B22-G	LMB	Gray	B22	

3. These test results on a sample of the equipment for the purpose of demonstrating compliance with Part 15 Subpart C Paragraph 15.247 for spread spectrum devices.
4. Regards to the frequency band operation; the lowest , middle and highest frequency of channel were selected to perform the test, and then shown on this report.
5. This device is a composite device in accordance with Part 15 regulations. The function receiving was measured and made a test report that the report number is 139516R-RFUSP37V02.

1.3. Test Mode

QuieTek has verified the construction and function in typical operation. All the test modes were carried out with the EUT in transmitting operation, which was shown in this test report and defined as follows:

Pre-Test Mode	
TX	Mode 1: Transmit
Final Test Mode	
TX	Mode 1: Transmit

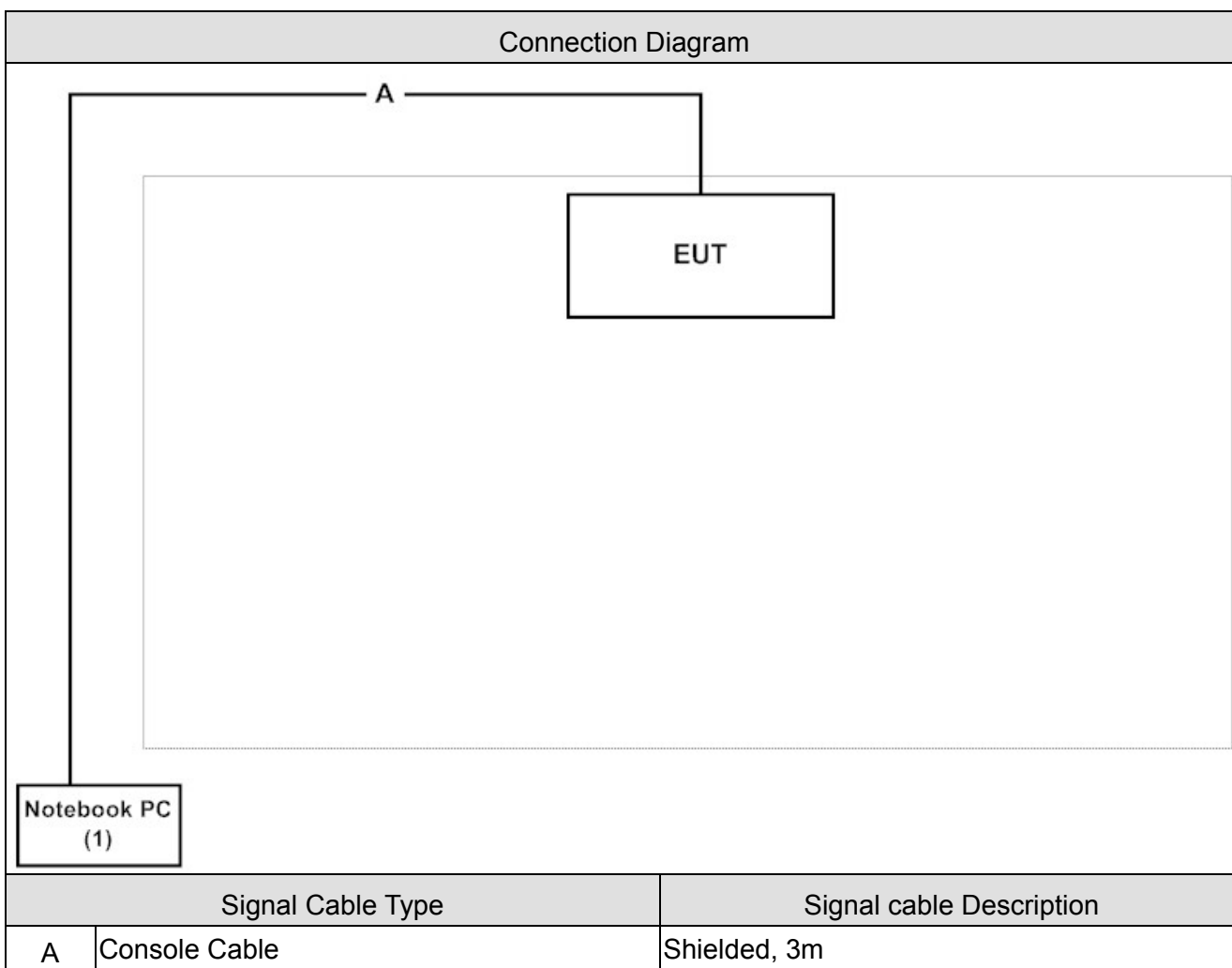
Emission	Mode 1
Conducted Emission	Yes
Peak Power Output	Yes
Radiated Emission	Yes
RF antenna conducted test	Yes
Band Edge	Yes
Number of hopping Frequency	No
Carrier Frequency Separation	No
Occupied Bandwidth	Yes
Dwell Time	No
Power Density	Yes

1.4. Tested System Details

The types for all equipments, plus descriptions of all cables used in the tested system (including inserted cards) are:

Product	Manufacturer	Model No.	Serial No.	FCC ID	Power Cord	
1	Notebook PC	DELL	Vostro3400	7F808N1	DoC	Non-Shielded, 1.8m

1.5. Configuration of tested System



1.6. EUT Exercise Software

1	Setup the EUT as shown in Section 1.5
2	Execute the control program "WICEO FCC Test Tool" to control the EUT.
3	Configure the test mode, the test channel, and the data rate.
4	Press "Start TX" to start the continuous transmitting.
5	Verify that the EUT works properly.

1.7. Test Facility

Ambient conditions in the laboratory:

Items	Test Item	Required (IEC 68-1)	Actual
Temperature (°C)	FCC PART 15 C 15.207 Conducted Emission	15 - 35	23
Humidity (%RH)		25 - 75	50
Barometric pressure (mbar)		860 - 1060	950-1000
Temperature (°C)	FCC PART 15 C 15.247 Peak Power Output	15 - 35	23
Humidity (%RH)		25 - 75	50
Barometric pressure (mbar)		860 - 1060	950-1000
Temperature (°C)	FCC PART 15 C 15.247 Radiated Emission	15 - 35	25
Humidity (%RH)		25 - 75	54
Barometric pressure (mbar)		860 - 1060	950-1000
Temperature (°C)	FCC PART 15 C 15.247 RF antenna conducted test	15 - 35	24
Humidity (%RH)		25 - 75	48
Barometric pressure (mbar)		860 - 1060	950-1000
Temperature (°C)	FCC PART 15 C 15.247 Band Edge	15 - 35	25
Humidity (%RH)		25 - 75	50
Barometric pressure (mbar)		860 - 1060	950-1000
Temperature (°C)	FCC PART 15 C 15.247 Occupied Bandwidth	15 - 35	24
Humidity (%RH)		25 - 75	48
Barometric pressure (mbar)		860 - 1060	950-1000

2. Conducted Emission

2.1. Test Equipment

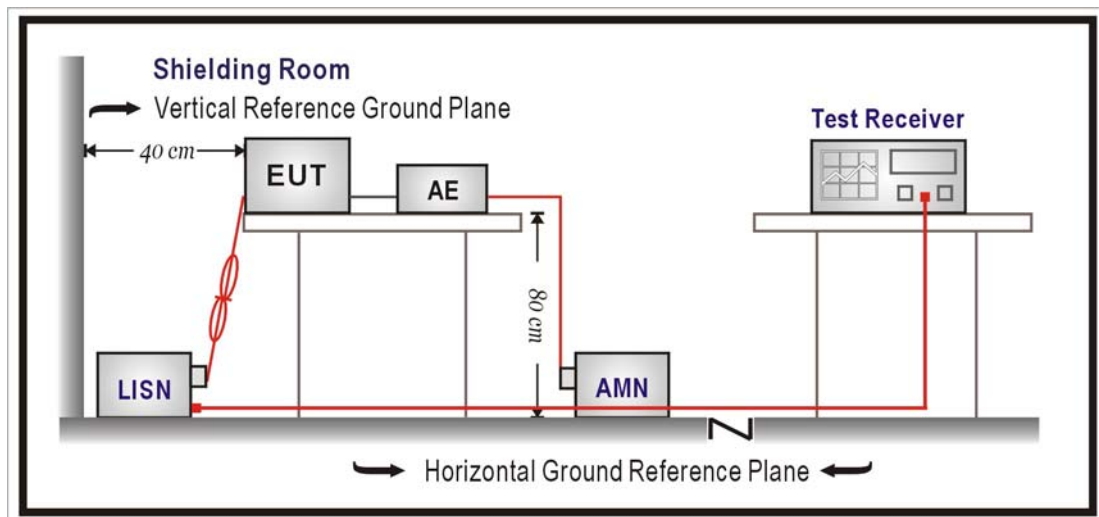
The following test equipments are used during the test:

Conducted Emission / SR3

Instrument	Manufacturer	Model No.	Serial No	Next Cal. Date
LISN	R&S	ENV216	100096	2014/08/01
LISN	R&S	ESH3-Z5	836679/022	2014/01/20
Test Receiver	R&S	ESCS 30	825442/017	2014/01/01

Note: 1. All equipments that need to calibrate are with calibration period of 1 year.

2.2. Test Setup



2.3. Limits

FCC Part 15 Subpart C Paragraph 15.207 Limits (dBuV)		
Frequency MHz	QP	AV
0.15 - 0.50	66-56	56-46
0.50 - 5.0	56	46
5.0 - 30	60	50

Remarks: In the above table, the tighter limit applies at the band edges.

2.4. Test Procedure

The EUT and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50 ohm /50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm /50uH coupling impedance with 50ohm termination. (Please refer to the block diagram of the test setup and photographs.)

Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.4: 2009 on conducted measurement.

Conducted emissions were investigated over the frequency range from 0.15MHz to 30MHz using a receiver bandwidth of 9 kHz.

2.5. Test Specification

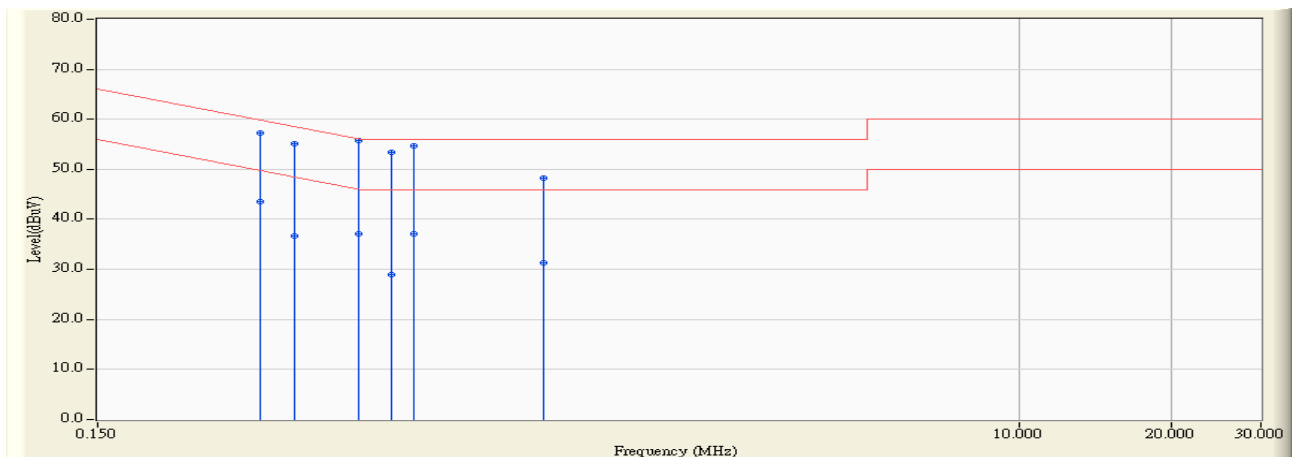
According to FCC Part 15 Subpart C Paragraph 15.207: 2012

2.6. Uncertainty

The measurement uncertainty is defined as ± 2.26 dB.

2.7. Test Result

Site : SR3	Time : 2013/10/01 - 17:40
Limit : CISPR_B_00M_QP	Margin : 10
Probe : SR3_LISN(16A)-3_0813 - Line1	Power : AC 120V/60Hz
EUT : LIFX Module Board	Note :

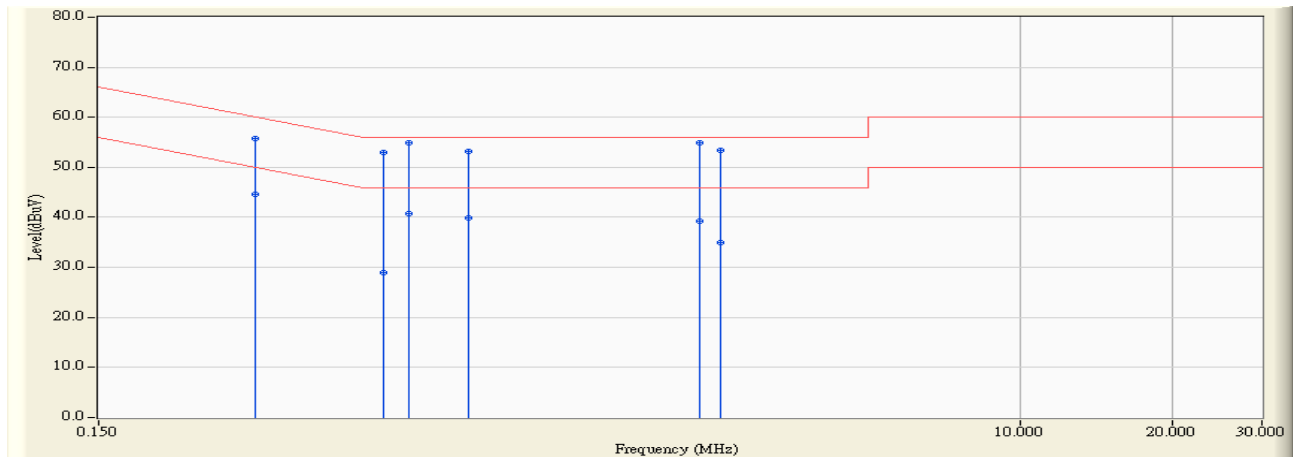


	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Measure Level (dBuV)	Margin (dB)	Limit (dBuV)	Detector Type
1	0.314	9.723	47.450	57.173	-2.689	59.862	QUASPEAK
2	0.314	9.723	33.740	43.463	-6.399	49.862	AVERAGE
3	0.369	9.760	45.390	55.150	-3.379	58.529	QUASPEAK
4	0.369	9.760	26.940	36.700	-11.829	48.529	AVERAGE
5	* 0.494	9.822	45.860	55.682	-0.423	56.104	QUASPEAK
6	0.494	9.822	27.250	37.072	-9.033	46.104	AVERAGE
7	0.572	9.848	43.470	53.318	-2.682	56.000	QUASPEAK
8	0.572	9.848	19.010	28.858	-17.142	46.000	AVERAGE
9	0.634	9.859	44.780	54.639	-1.361	56.000	QUASPEAK
10	0.634	9.859	27.300	37.159	-8.841	46.000	AVERAGE
11	1.142	9.940	38.390	48.330	-7.670	56.000	QUASPEAK
12	1.142	9.940	21.460	31.400	-14.600	46.000	AVERAGE

Note:

1. All Reading Levels are Quasi-Peak and average value.
2. " * ", means this data is the worst emission level.
3. Measurement Level = Reading Level + Correct Factor.

Site : SR3	Time : 2013/10/01 - 17:53
Limit : CISPR_B_00M_QP	Margin : 10
Probe : SR3_LISN(16A)-3_0813 - Line2	Power : AC 120V/60Hz
EUT : LIFX Module Board	Note :



	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Measure Level (dBuV)	Margin (dB)	Limit (dBuV)	Detector Type
1	0.306	9.709	46.000	55.709	-4.362	60.072	QUASIPeAK
2	0.306	9.709	34.910	44.619	-5.452	50.072	AVERAGE
3	0.548	9.830	43.130	52.960	-3.040	56.000	QUASIPeAK
4	0.548	9.830	19.230	29.060	-16.940	46.000	AVERAGE
5	0.615	9.842	45.020	54.862	-1.138	56.000	QUASIPeAK
6	0.615	9.842	30.810	40.652	-5.348	46.000	AVERAGE
7	0.810	9.890	43.230	53.120	-2.880	56.000	QUASIPeAK
8	0.810	9.890	29.940	39.830	-6.170	46.000	AVERAGE
9	* 2.322	9.950	45.030	54.980	-1.020	56.000	QUASIPeAK
10	2.322	9.950	29.360	39.310	-6.690	46.000	AVERAGE
11	2.545	9.970	43.510	53.480	-2.520	56.000	QUASIPeAK
12	2.545	9.970	25.050	35.020	-10.980	46.000	AVERAGE

Note:

1. All Reading Levels are Quasi-Peak and average value.
2. " * ", means this data is the worst emission level.
3. Measurement Level = Reading Level + Correct Factor.

3. Peak Power Output

3.1. Test Equipment

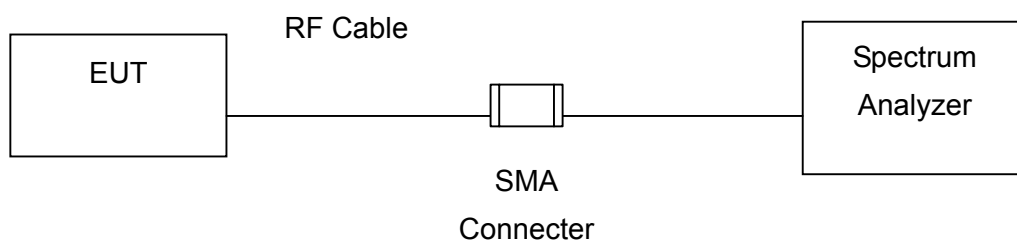
The following test equipment is used during the test:

Peak Power Output / SR7

Instrument	Manufacturer	Model No.	Serial No	Next Cal. Date
Spectrum Analyzer	Agilent	N9010A-EXA	US47140172	2014/08/05

Note: All equipment upon which need to calibrated are with calibration period of 1 year.

3.2. Test Setup



3.3. Test procedures

The EUT was setup according to ANSI C63.4, 2009 and tested according to FHSS test procedure of FCC Public Notice DA 00-705 for compliance to FCC 47CFR 15.247 requirements

3.4. Limits

For frequency hopping systems operating in the 902-928 MHz band: 1 Watt for systems employing at least 50 hopping channels; and, 0.25 Watts for systems employing less than 50 hopping channels.

For frequency hopping systems in the 2400-2483.5 MHz band employing at least 75 hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1Watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 Watt.

3.5. Test Specification

According to FCC Part 15 Subpart C Paragraph 15.247: 2012

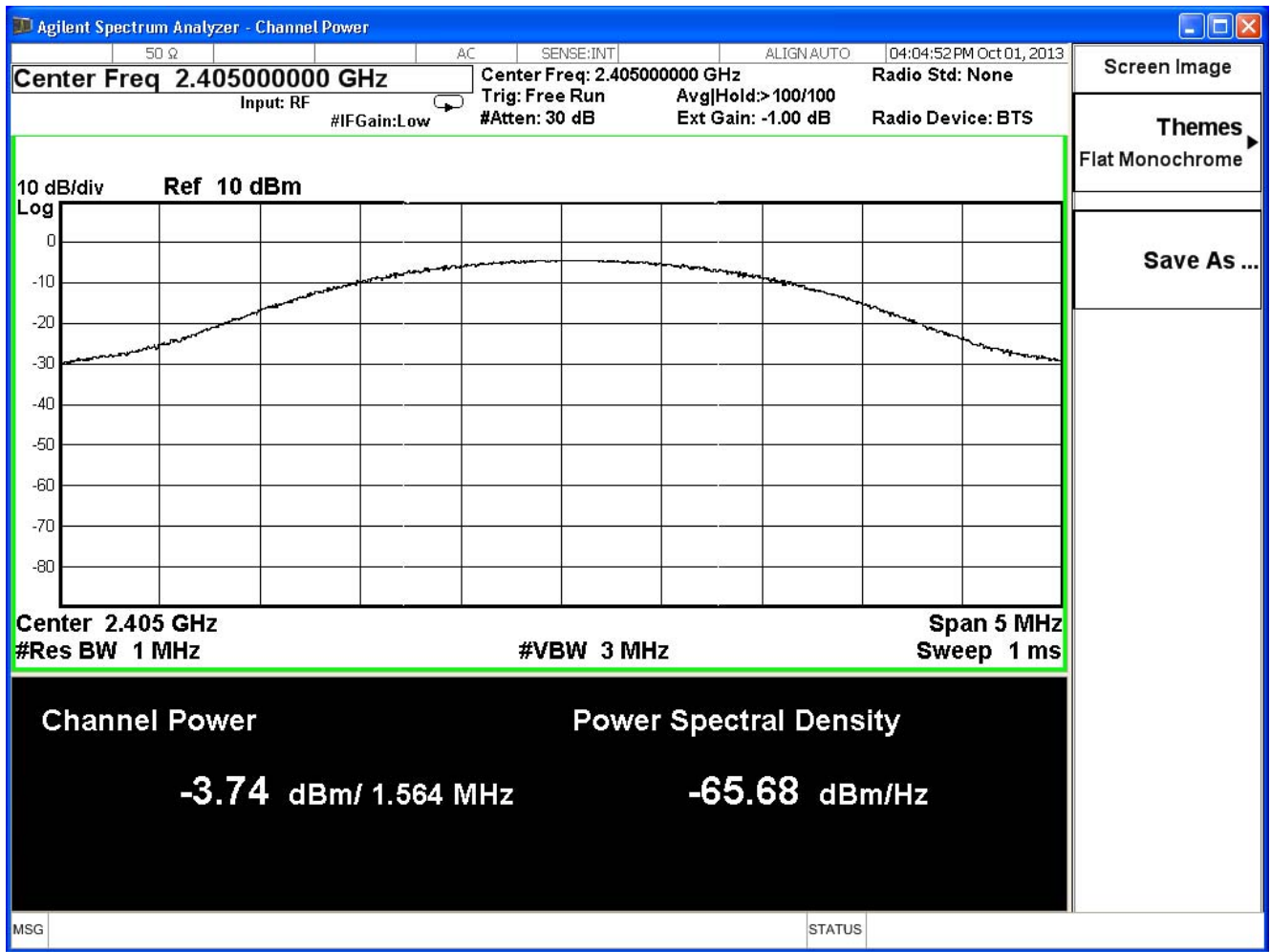
3.6. Test Result

Product	LIFX Module Board		
Test Item	Peak Power Output		
Test Mode	Mode 1: Transmit		
Date of Test	2013/10/01	Test Site	SR7

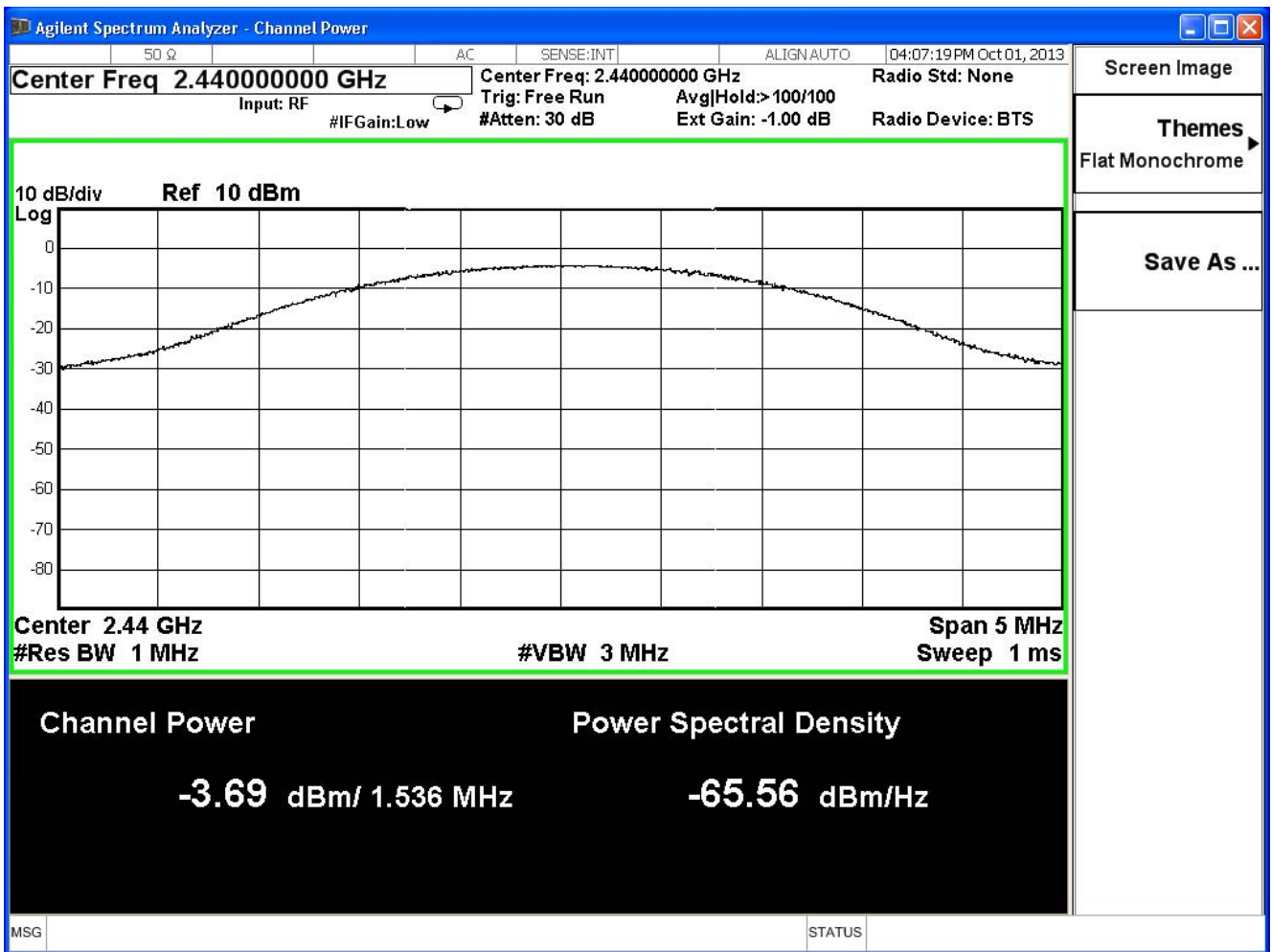
Channel No.	Frequency (MHz)	Measure Level (dBm)	Limit (dBm)	Result
1	2405	-3.74	≤ 30	Pass
8	2440	-3.69	≤ 30	Pass
16	2480	-4.01	≤ 30	Pass

Note: Measure Level =Reading value + cable loss

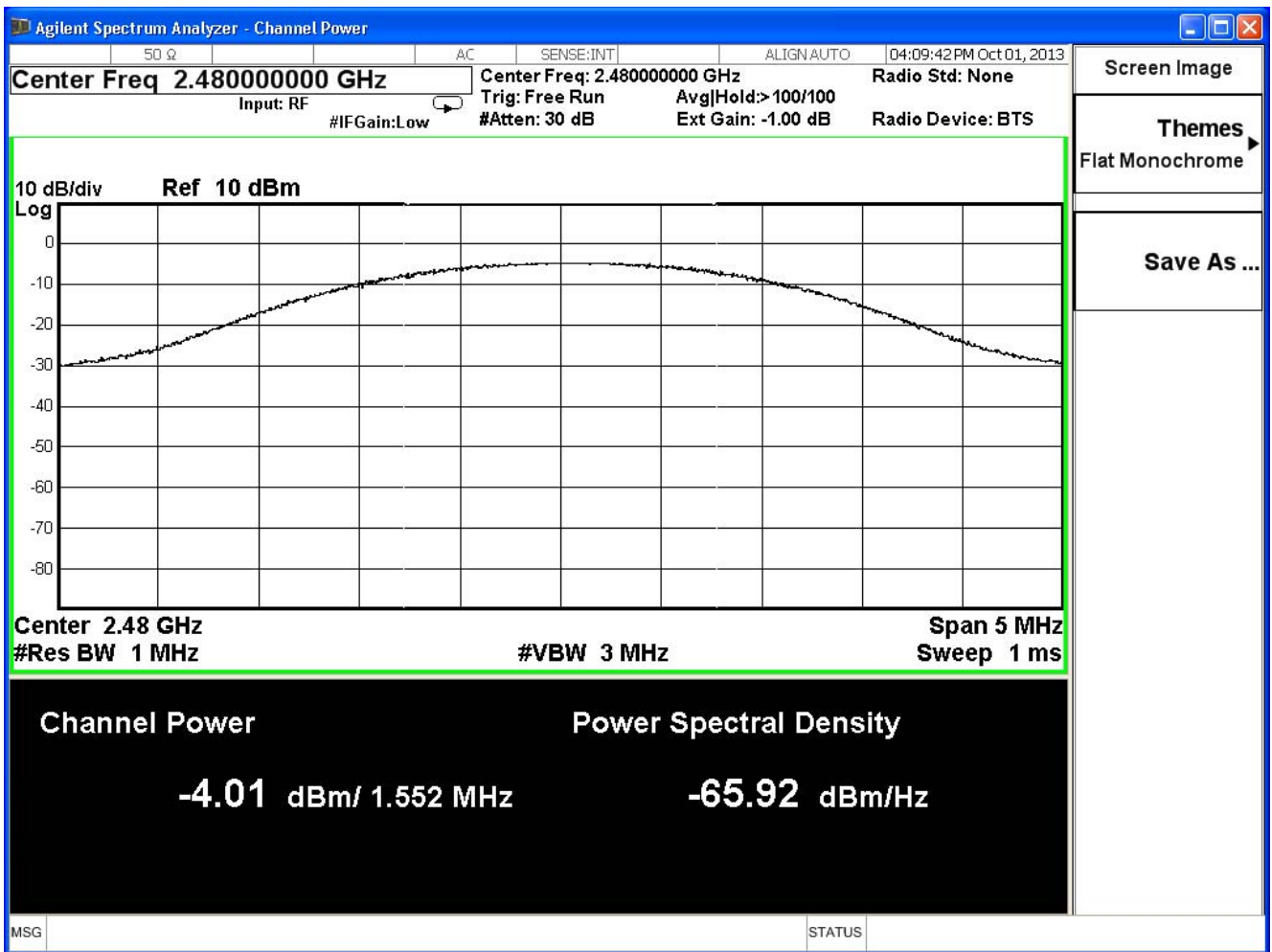
Channel 1



Channel 8



Channel 16



4. Radiated Emission

4.1. Test Equipment

The following test equipments are used during the test:

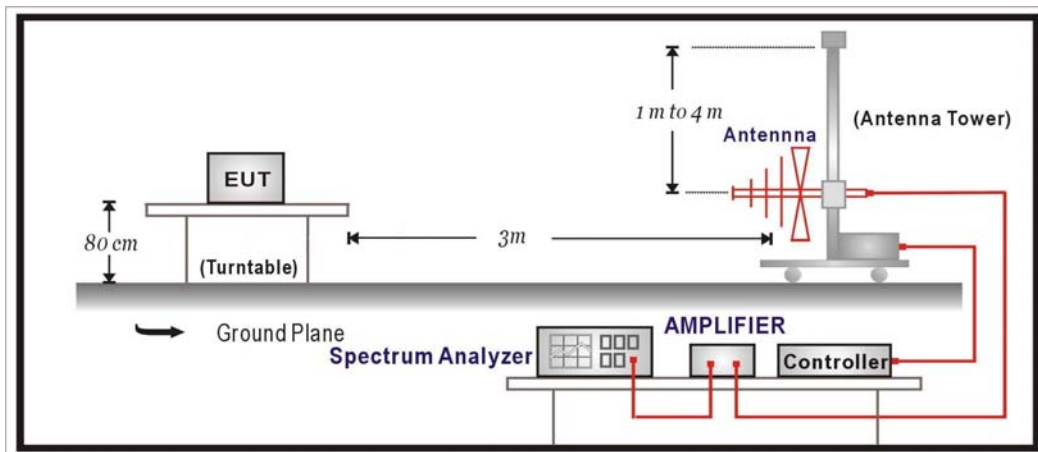
Radiated Emission / CB1

Instrument	Manufacturer	Model No.	Serial No	Next Cal. Date
Bilog Antenna	SCHAFFNER	CBL6112B	2895(CB1)	2014/08/14
Double Ridged Guide Horn Antenna	Schwarzback	BBHA 9120	D743	2014/02/17
Pre-Amplifier	MITEQ	AMF-4D-005180-24-10P	888003	2014/06/09
Pre-Amplifier	QuieTek	AP-025C	CHM-0706049	2014/02/19
Spectrum Analyzer	Agilent	E4440A	MY46187335	2014/01/27
k Type Cable	Huber Suhner	Sucoflex 102	25623/2	2014/02/21

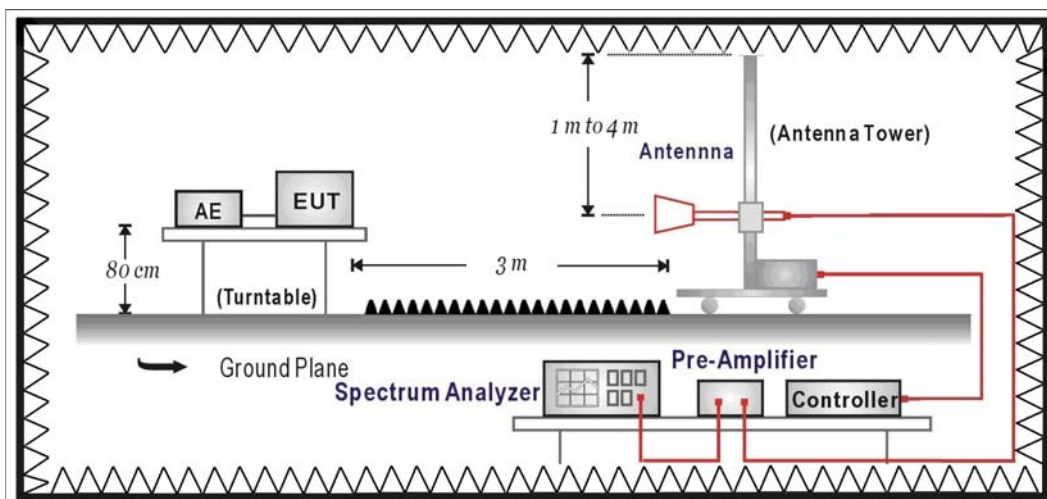
Note: 1. All equipments that need to calibrate are with calibration period of 1 year.

4.2. Test Setup

Under 1GHz Test Setup:



Above 1GHz Test Setup:



4.3. Limits

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 20dB below the level of the fundamental or to the general radiated emission limits in paragraph 15.209, whichever is the lesser attenuation.

FCC Part 15 Subpart C Paragraph 15.209 Limits		
Frequency MHz	uV/m	dBuV/m
30-88	100	40
88-216	150	43.5
216-960	200	46
Above 960	500	54

- Remarks :
1. RF Voltage (dBuV) = 20 log RF Voltage (uV)
 2. In the Above Table, the tighter limit applies at the band edges.
 3. Distance refers to the distance in meters between the measuring instrument antenna and the closed point of any part of the device or system.

4.4. Test Procedure

The EUT was setup according to ANSI C63.4, 2009 and tested according to FHSS test procedure of FCC Public Notice DA 00-705 for compliance to FCC 47CFR 15.247 requirements.

The EUT and its simulators are placed on a turn table which is 0.8 meter above ground. The turn table can rotate 360 degrees to determine the position of the maximum emission level. The antenna can move up and down between 1 meter and 4 meters to find out the maximum emission level.

Both horizontal and vertical polarization of the antenna are set on measurement. In order to find the maximum emission, all of the interface cables must be manipulated according to ANSI C63.4:2009 on radiated measurement.

On any frequency or frequencies below or equal to 1000 MHz, the limits shown are based on measuring equipment employing a quasi-peak detector function and on any frequency or frequencies above 1000 MHz the radiated limits shown are based upon the use of measurement instrumentation employing an average detector function. When average radiated emission measurement are included emission measurement below 1000 MHz, there also is a limit on the radio frequency emissions, as measured using instrumentation with a peak detector function, corresponding to 20 dB above the maximum permitted average limit. The bandwidth below 1GHz setting on the field strength meter is 120 kHz and above 1GHz is 1MHz.

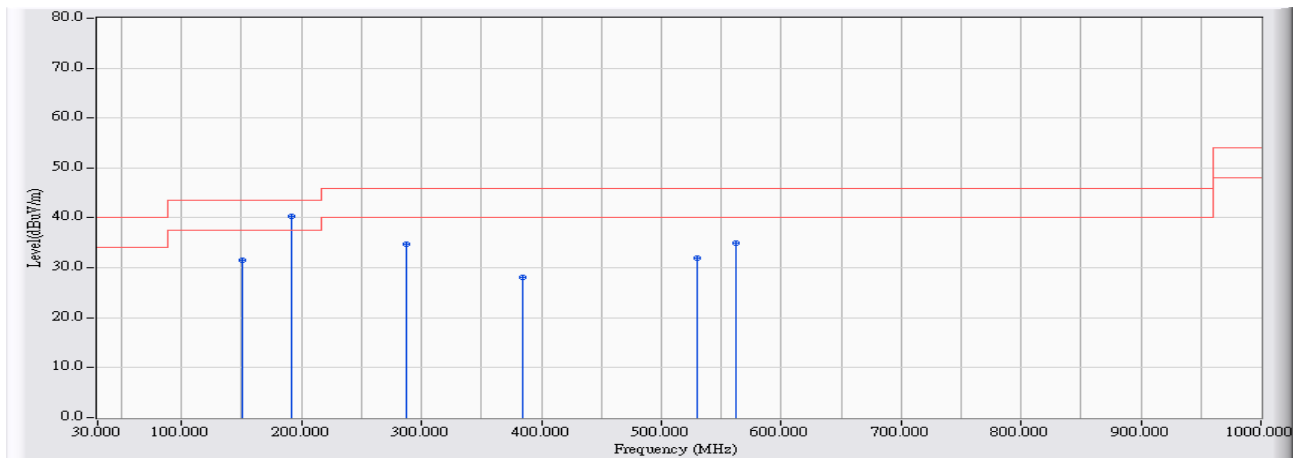
4.5. Test Specification

According to FCC Part 15 Subpart C Paragraph 15.247: 2012

4.6. Test Result

30MHz-1GHz Spurious

Site : CB1	Time : 2013/09/25 - 17:36
Limit : FCC_CLASS_B_03M_QP	Margin : 6
Probe : CB1_FCC_EFS_30-1G-2_1011 - HORIZONTAL	Power : AC 120V/60Hz
EUT : LIFX Module Board	Note : 2440MHz

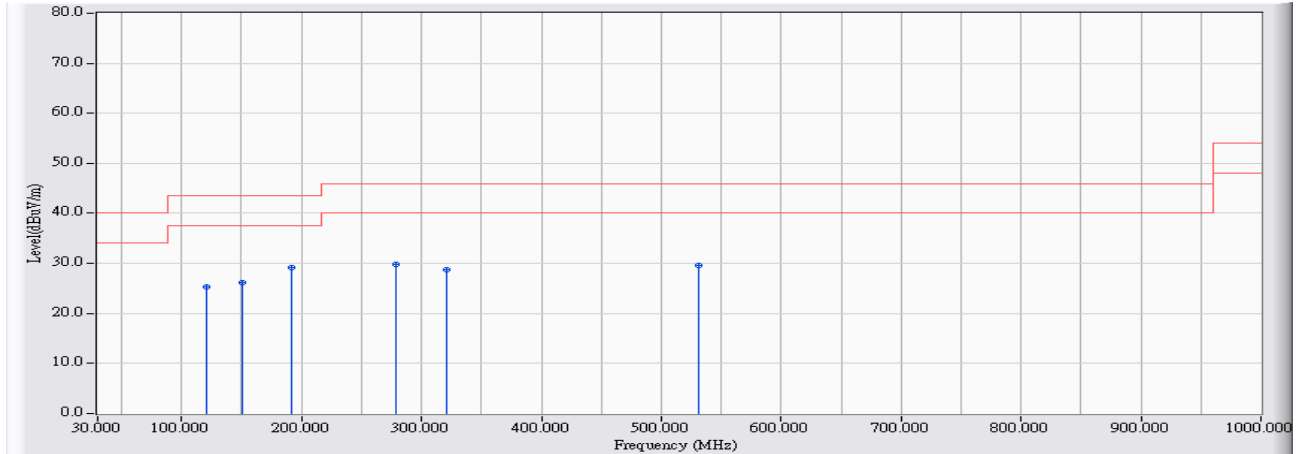


	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Measure Level (dBuV/m)	Margin (dB)	Limit (dBuV/m)	Detector Type
1	150.280	-23.344	54.873	31.528	-11.972	43.500	QUASPEAK
2	* 191.990	-24.742	65.160	40.418	-3.082	43.500	QUASPEAK
3	288.020	-20.087	54.924	34.837	-11.163	46.000	QUASPEAK
4	384.050	-17.816	45.923	28.107	-17.893	46.000	QUASPEAK
5	530.520	-15.419	47.287	31.868	-14.132	46.000	QUASPEAK
6	562.530	-15.373	50.263	34.890	-11.110	46.000	QUASPEAK

Note:

1. All Reading Levels are Quasi-Peak value.
2. “ * ”, means this data is the worst emission level.
3. Measurement Level = Reading Level + Correct Factor

Site : CB1	Time : 2013/09/25 - 17:40
Limit : FCC_CLASS_B_03M_QP	Margin : 6
Probe : CB1_FCC_EFS_30-1G-2_1011 - VERTICAL	Power : AC 120V/60Hz
EUT : LIFX Module Board	Note : 2440MHz



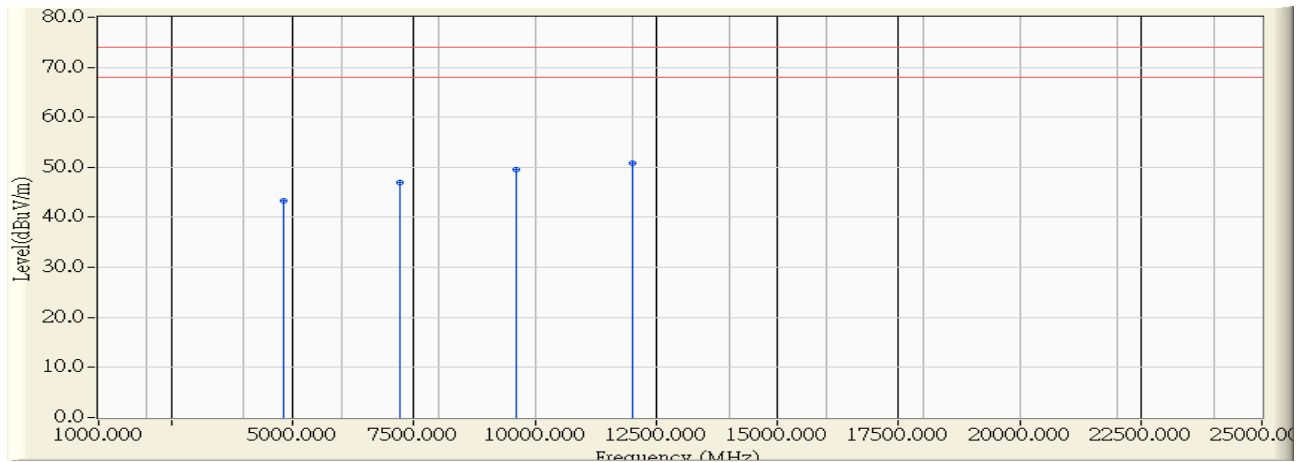
	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Measure Level (dBuV/m)	Margin (dB)	Limit (dBuV/m)	Detector Type
1	120.210	-22.188	47.512	25.324	-18.176	43.500	QUASPEAK
2	150.280	-23.344	49.409	26.064	-17.436	43.500	QUASPEAK
3	* 191.990	-24.742	53.866	29.124	-14.376	43.500	QUASPEAK
4	278.320	-20.203	49.959	29.757	-16.243	46.000	QUASPEAK
5	321.000	-19.413	48.075	28.662	-17.338	46.000	QUASPEAK
6	531.490	-15.418	44.927	29.509	-16.491	46.000	QUASPEAK

Note:

1. All Reading Levels are Quasi-Peak value.
2. “ * ”, means this data is the worst emission level.
3. Measurement Level = Reading Level + Correct Factor

Harmonic & Spurious:

Site : CB1	Time : 2013/09/28 - 14:18
Limit : FCC_SpartC_15.247_H_03M_PK	Margin : 6
Probe : CB1_FCC_EFS_1-18G-1_0901 - HORIZONTAL	Power : AC 120V/60Hz
EUT : LIFX Module Board	Note : 2405MHz

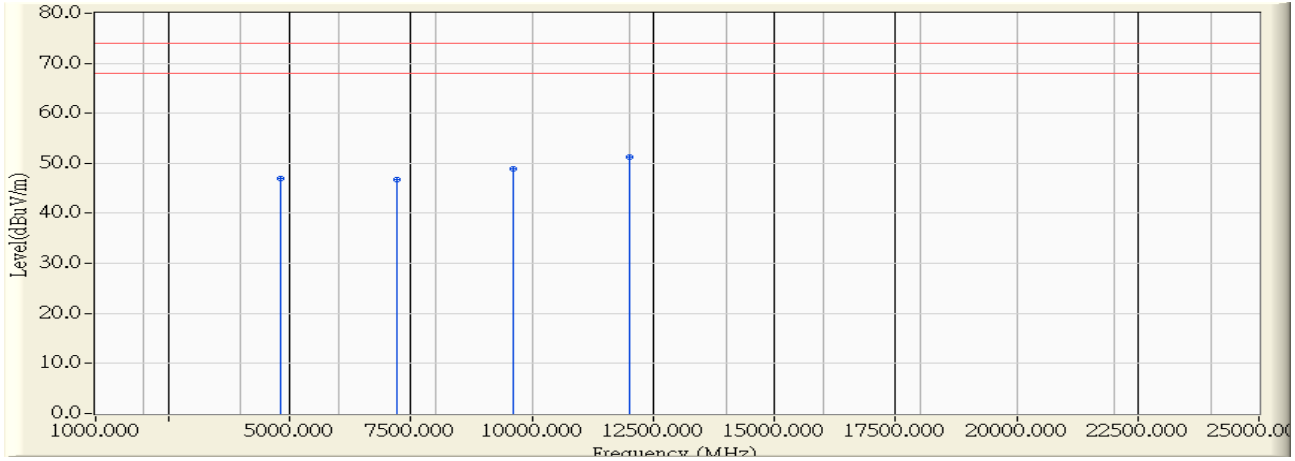


	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Measure Level (dBuV/m)	Margin (dB)	Limit (dBuV/m)	Detector Type
1	4810.000	-0.651	44.040	43.389	-30.611	74.000	PEAK
2	7215.000	5.400	41.590	46.990	-27.010	74.000	PEAK
3	9620.000	9.044	40.510	49.554	-24.446	74.000	PEAK
4	* 12025.000	11.131	39.790	50.921	-23.079	74.000	PEAK

Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. “ * ”, means this data is the worst emission level.
5. Measurement Level = Reading Level + Correct Factor.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The Emission above 13GHz were not included is because their levels are too low.

Site : CB1	Time : 2013/09/28 - 14:21
Limit : FCC_SpartC_15.247_H_03M_PK	Margin : 6
Probe : CB1_FCC_EFS_1-18G-1_0901 - VERTICAL	Power : AC 120V/60Hz
EUT : LIFX Module Board	Note : 2405MHz

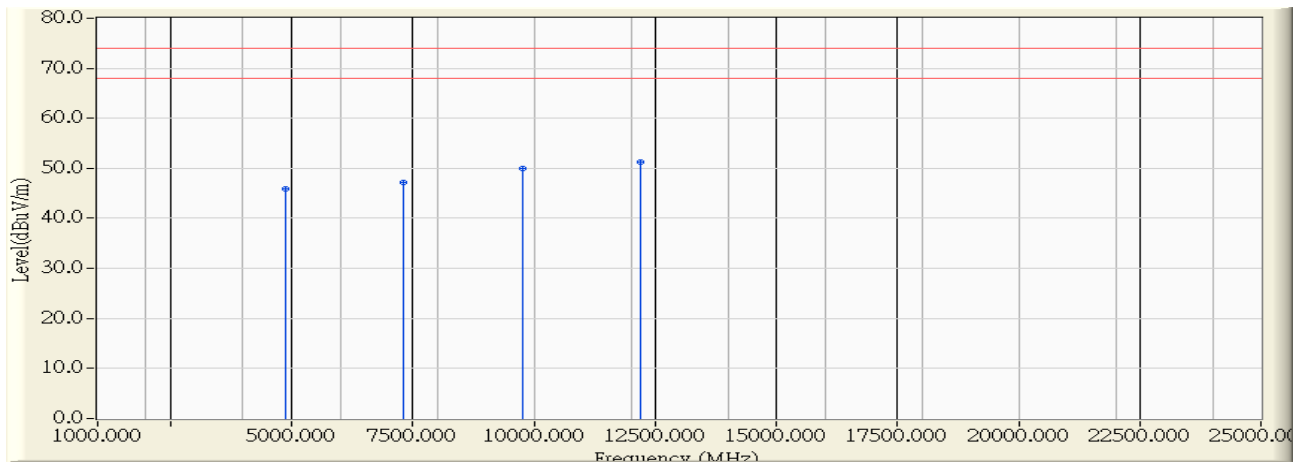


	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Measure Level (dBuV/m)	Margin (dB)	Limit (dBuV/m)	Detector Type
1	4810.000	-0.651	47.590	46.939	-27.061	74.000	PEAK
2	7215.000	5.400	41.360	46.760	-27.240	74.000	PEAK
3	9620.000	9.044	39.930	48.974	-25.026	74.000	PEAK
4	* 12024.000	11.131	40.150	51.282	-22.718	74.000	PEAK

Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. “ * ”, means this data is the worst emission level.
5. Measurement Level = Reading Level + Correct Factor.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The Emission above 13GHz were not included is because their levels are too low.

Site : CB1	Time : 2013/09/28 - 14:30
Limit : FCC_SpartC_15.247_H_03M_PK	Margin : 6
Probe : CB1_FCC_EFS_1-18G-1_0901 - HORIZONTAL	Power : AC 120V/60Hz
EUT : LIFX Module Board	Note : 2440MHz

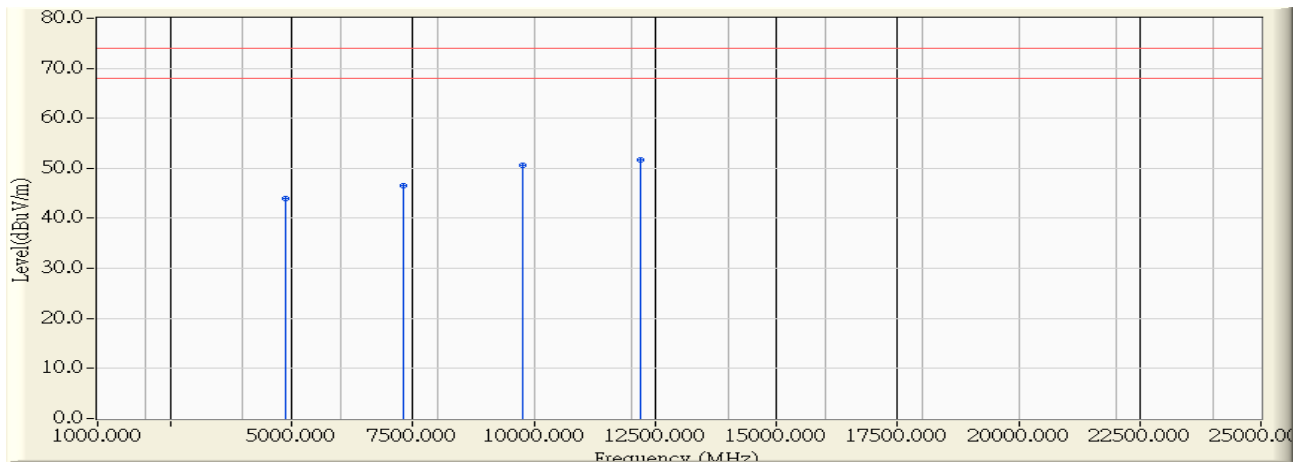


	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Measure Level (dBuV/m)	Margin (dB)	Limit (dBuV/m)	Detector Type
1	4880.000	-0.480	46.430	45.950	-28.050	74.000	PEAK
2	7320.000	5.627	41.630	47.257	-26.743	74.000	PEAK
3	9760.000	9.951	39.980	49.931	-24.069	74.000	PEAK
4	* 12200.000	11.051	40.270	51.321	-22.679	74.000	PEAK

Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. “ * ”, means this data is the worst emission level.
5. Measurement Level = Reading Level + Correct Factor.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The Emission above 13GHz were not included is because their levels are too low.

Site : CB1	Time : 2013/09/28 - 14:33
Limit : FCC_SpartC_15.247_H_03M_PK	Margin : 6
Probe : CB1_FCC_EFS_1-18G-1_0901 - VERTICAL	Power : AC 120V/60Hz
EUT : LIFX Module Board	Note : 2440MHz

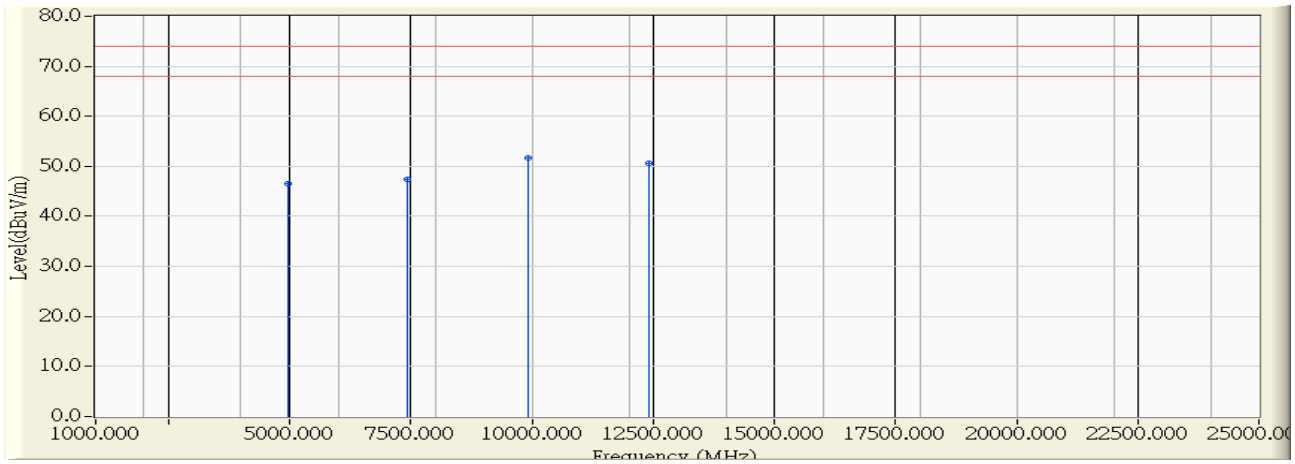


	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Measure Level (dBuV/m)	Margin (dB)	Limit (dBuV/m)	Detector Type
1	4880.000	-0.480	44.430	43.950	-30.050	74.000	PEAK
2	7320.000	5.627	40.920	46.547	-27.453	74.000	PEAK
3	9760.000	9.951	40.560	50.511	-23.489	74.000	PEAK
4	* 12200.000	11.051	40.560	51.611	-22.389	74.000	PEAK

Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. “ * ”, means this data is the worst emission level.
5. Measurement Level = Reading Level + Correct Factor.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The Emission above 13GHz were not included is because their levels are too low.

Site : CB1	Time : 2013/09/28 - 14:39
Limit : FCC_SpartC_15.247_H_03M_PK	Margin : 6
Probe : CB1_FCC_EFS_1-18G-1_0901 - HORIZONTAL	Power : AC 120V/60Hz
EUT : LIFX Module Board	Note : 2480MHz

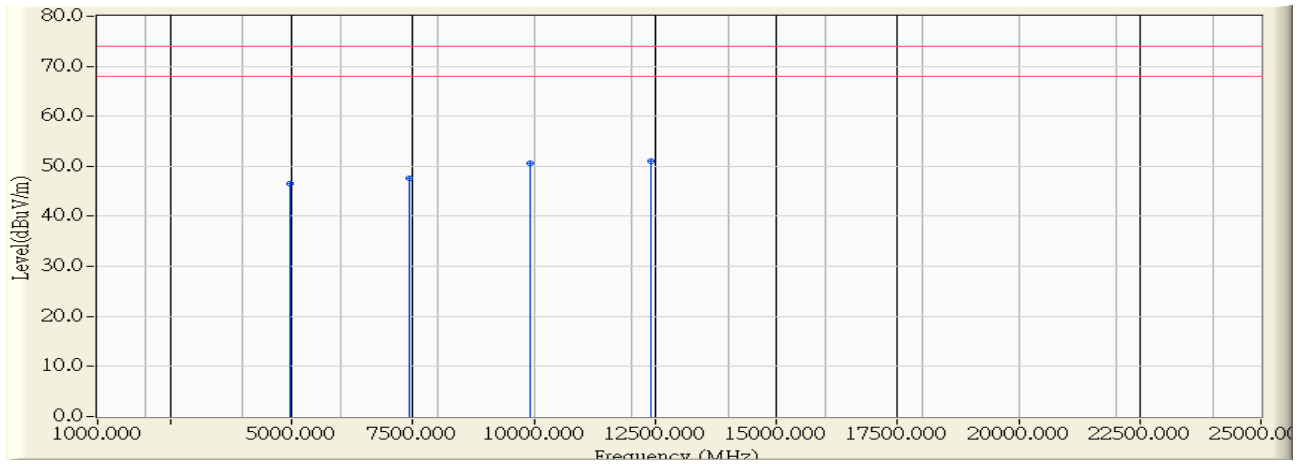


	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Measure Level (dBuV/m)	Margin (dB)	Limit (dBuV/m)	Detector Type
1	4960.000	-0.285	46.730	46.445	-27.555	74.000	PEAK
2	7440.000	5.887	41.530	47.417	-26.583	74.000	PEAK
3	* 9920.000	10.987	40.600	51.587	-22.413	74.000	PEAK
4	12400.000	10.960	39.760	50.720	-23.280	74.000	PEAK

Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. “ * ”, means this data is the worst emission level.
5. Measurement Level = Reading Level + Correct Factor.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The Emission above 13GHz were not included is because their levels are too low.

Site : CB1	Time : 2013/09/28 - 14:42
Limit : FCC_SpartC_15.247_H_03M_PK	Margin : 6
Probe : CB1_FCC_EFS_1-18G-1_0901 - VERTICAL	Power : AC 120V/60Hz
EUT : LIFX Module Board	Note : 2480MHz



	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Measure Level (dBuV/m)	Margin (dB)	Limit (dBuV/m)	Detector Type
1	4960.000	-0.285	46.900	46.615	-27.385	74.000	PEAK
2	7440.000	5.887	41.650	47.537	-26.463	74.000	PEAK
3	9920.000	10.987	39.700	50.687	-23.313	74.000	PEAK
4	* 12400.000	10.960	40.120	51.080	-22.920	74.000	PEAK

Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. “ * ”, means this data is the worst emission level.
5. Measurement Level = Reading Level + Correct Factor.
6. The average measurement was not performed when the peak measured data under the limit of average detection.
7. The Emission above 13GHz were not included is because their levels are too low.

5. RF antenna conducted test

5.1. Test Equipment

The following test equipment is used during the test:

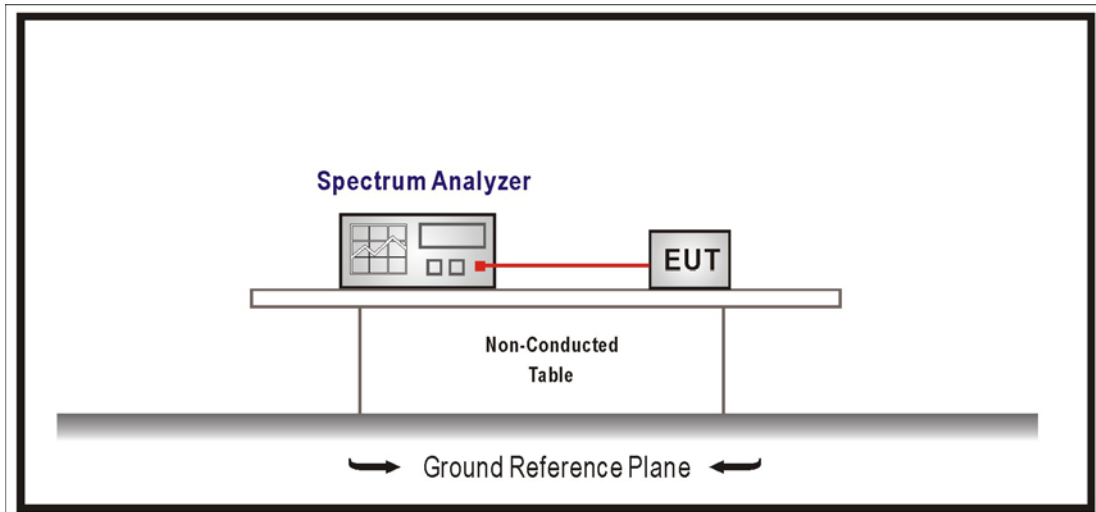
RF antenna conducted test / SR7

Instrument	Manufacturer	Model No.	Serial No	Next Cal. Date
Spectrum Analyzer	Agilent	N9010A-EXA	US47140172	2014/08/05

Note: 1. All equipments that need to calibrate are with calibration period of 1 year.

5.2. Test Setup

RF Conducted Measurement:



5.3. Limits

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 an RF conducted or radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

5.4. Test Procedure

The EUT was setup according to ANSI C63.4, 2009 and tested according to FHSS test procedure of FCC Public Notice DA 00-705 for compliance to FCC 47CFR 15.247 requirements

Set RBW = 100 kHz, Set VBW > RBW, scan up through 10th harmonic.

5.5. Test Specification

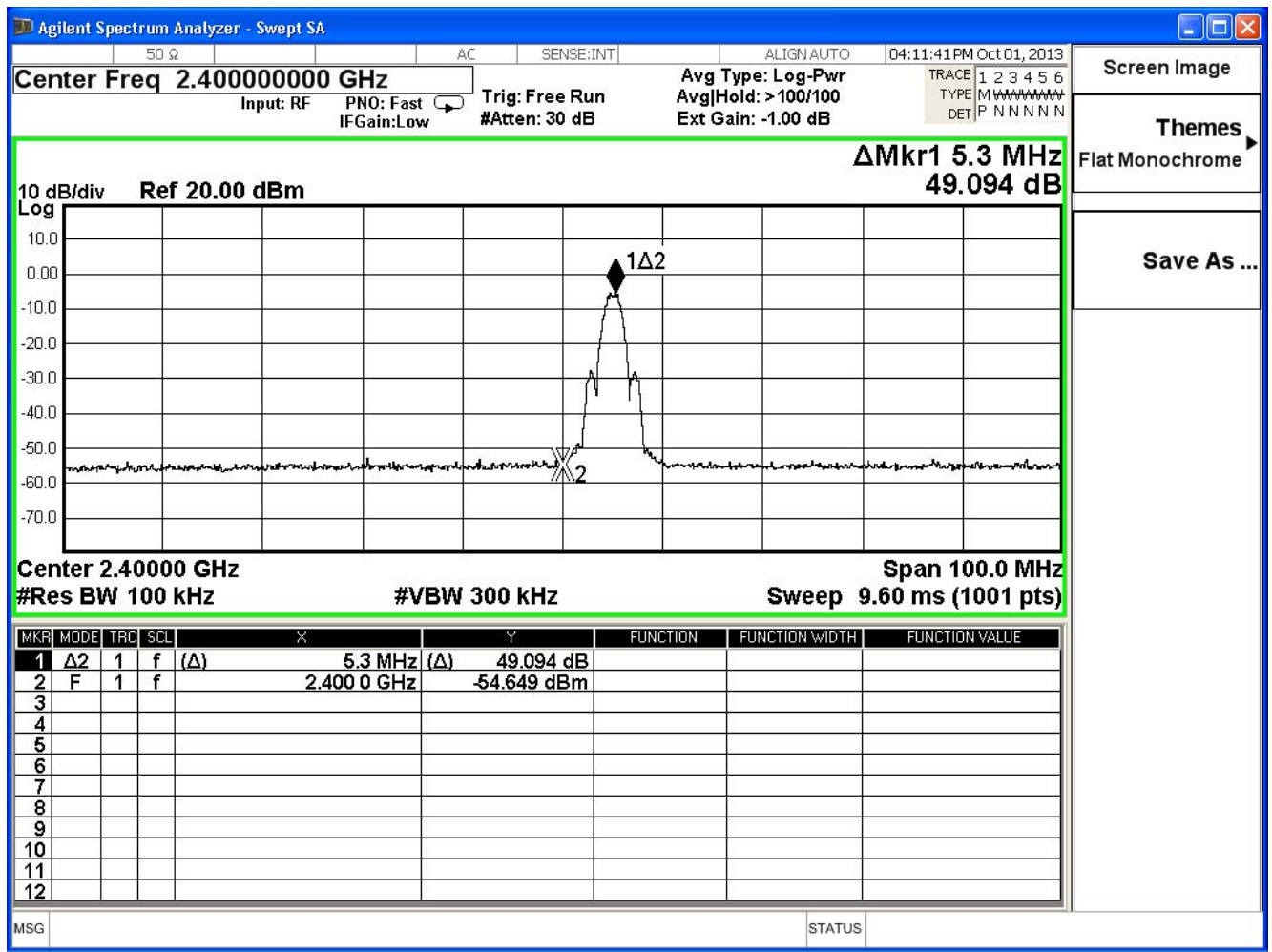
According to FCC Part 15 Subpart C Paragraph 15.247: 2012

5.6. Test Result

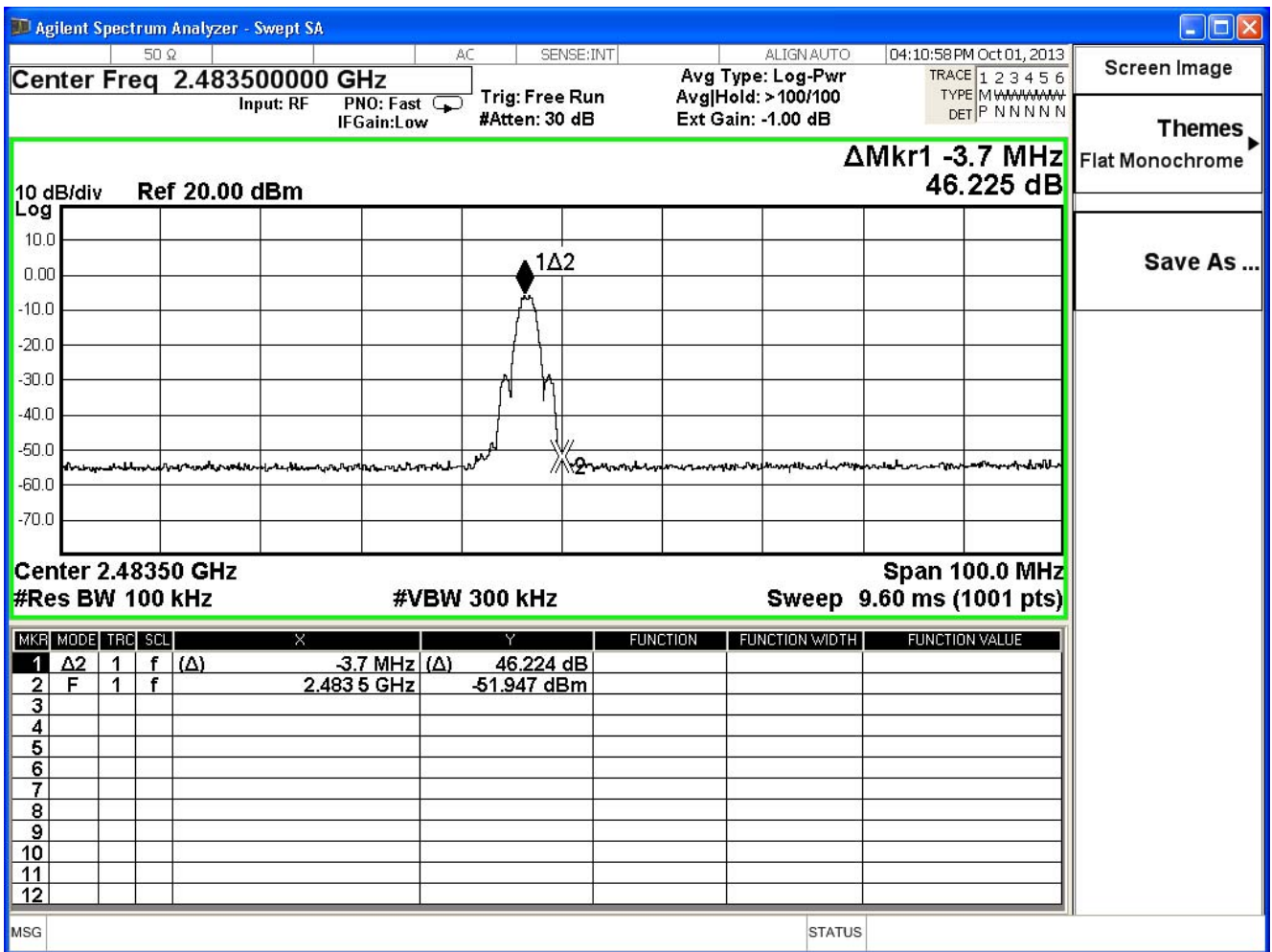
Product	LIFX Module Board		
Test Item	RF antenna conducted test		
Test Mode	Mode 1: Transmit		
Date of Test	2013/10/01	Test Site	SR7

Channel No.	Frequency (MHz)	Measure Level (dBc)	Limit (dBc)	Result
1	2405	49.09	≥ 20	Pass
16	2480	46.23	≥ 20	Pass

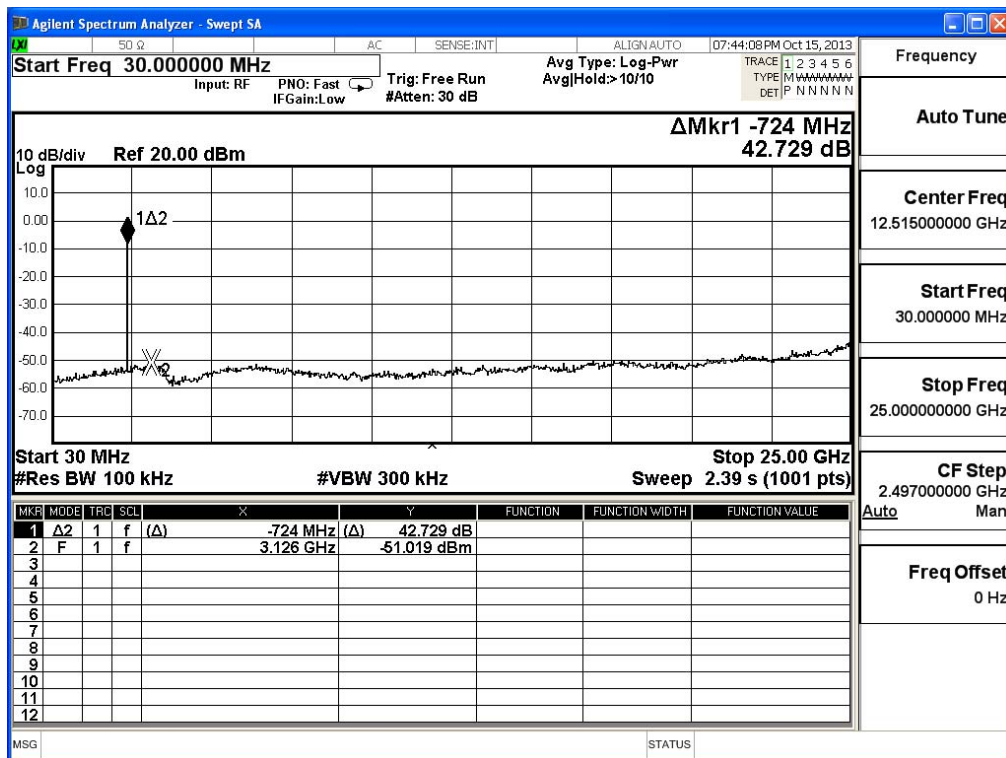
Channel 1



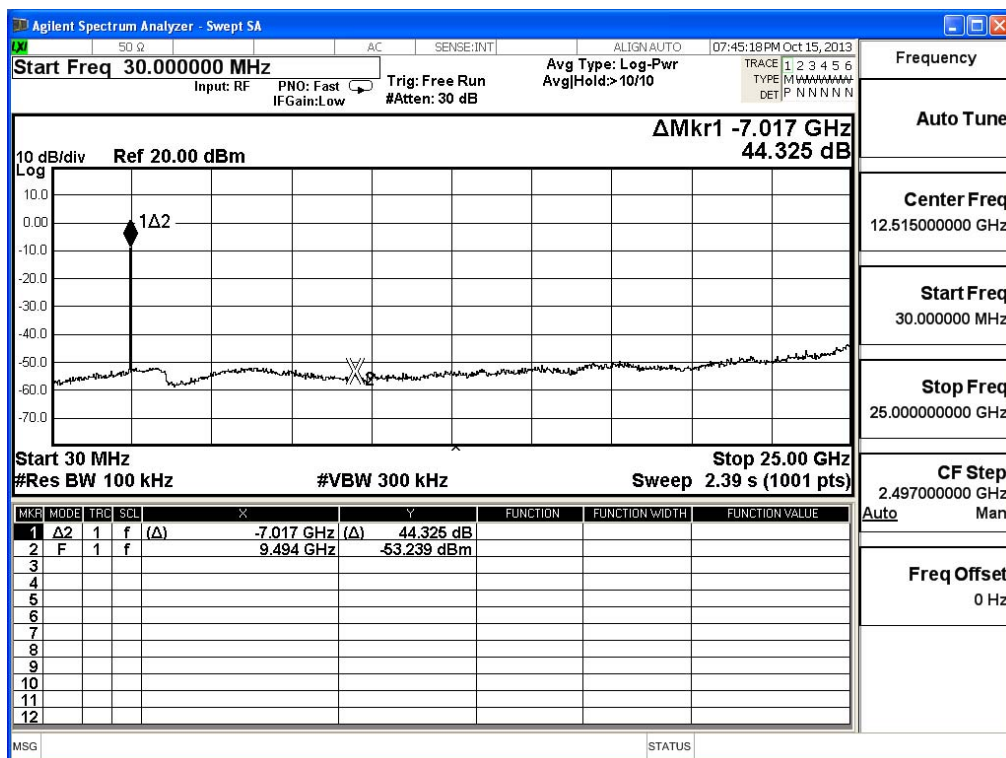
Channel 16



2405MHz (30MHz-25GHz)-Zigbee



2480MHz (30MHz-25GHz) - Zigbee



6. Band Edge

6.1. Test Equipment

The following test equipments are used during the test:

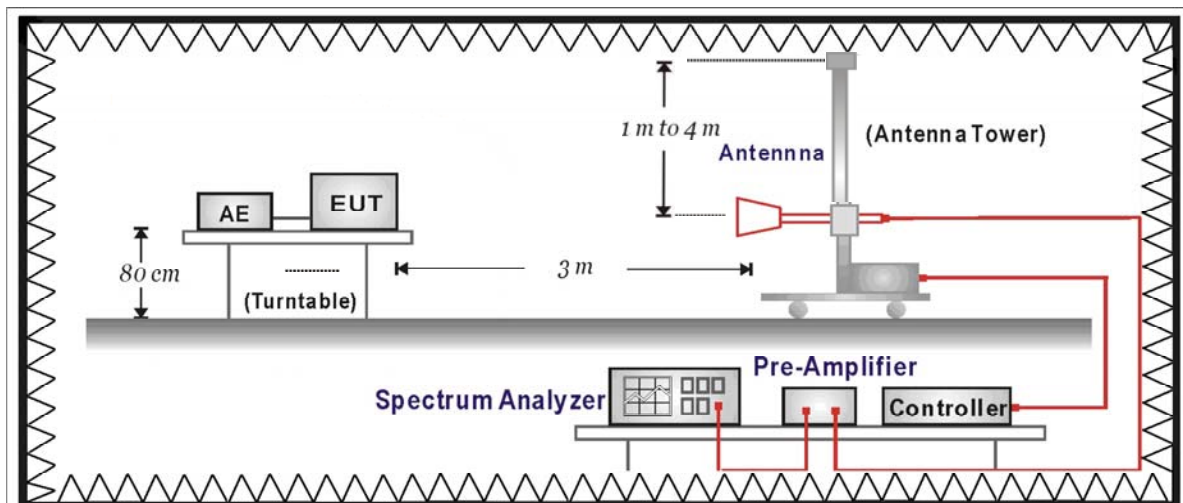
Band Edge / CB1

Instrument	Manufacturer	Model No.	Serial No	Next Cal. Date
Double Ridged Guide Horn Antenna	Schwarzback	BBHA 9120	D743	2014/02/17
Spectrum Analyzer	Agilent	E4440A	MY46187335	2014/01/27
k Type Cable	Huber Suhner	Sucoflex 102	25623/2	2014/02/21

Note: 1. All equipments that need to calibrate are with calibration period of 1 year.

6.2. Test Setup

RF Radiated Measurement:



6.3. Limits

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 20dB below the level of the fundamental or to the general radiated emission limits in paragraph 15.209, whichever is the lesser attenuation.

6.4. Test Procedure

The EUT was setup according to ANSI C63.4, 2009 and tested according to FHSS test procedure of FCC Public Notice DA 00-705 for compliance to FCC 47CFR 15.247 requirements

The EUT and its simulators are placed on a turn table which is 0.8 meter above ground. The turn table can rotate 360 degrees to determine the position of the maximum emission level. The EUT was positioned such that the distance from antenna to the EUT was 3 meters.

The antenna can move up and down between 1 meter and 4 meters to find out the maximum emission level.

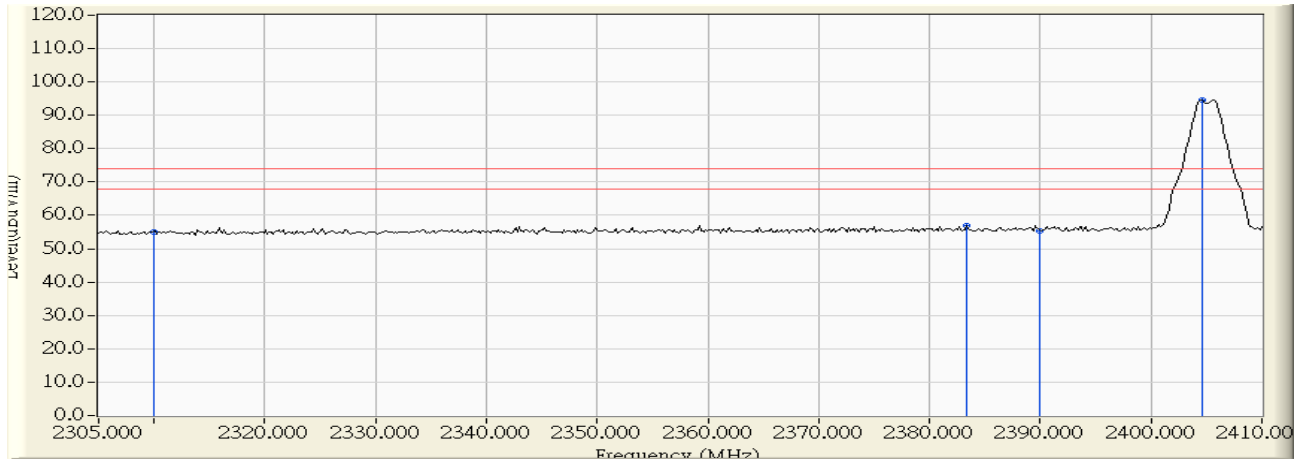
Both horizontal and vertical polarization of the antenna are set on measurement. In order to find the maximum emission, all of the interface cables must be manipulated according to ANSI C63.4:2009 on radiated measurement.

6.5. Test Specification

According to FCC Part 15 Subpart C Paragraph 15.247: 2012

6.6. Test Result

Site : CB1	Time : 2013/09/28 - 11:53
Limit : FCC_SpartC_15.209_03M_PK	Margin : 6
Probe : CB1_FCC_EFS_1-18G-1_0901 - HORIZONTAL	Power : AC 120V/60Hz
EUT : LIFX Module Board	Note : 2405MHz

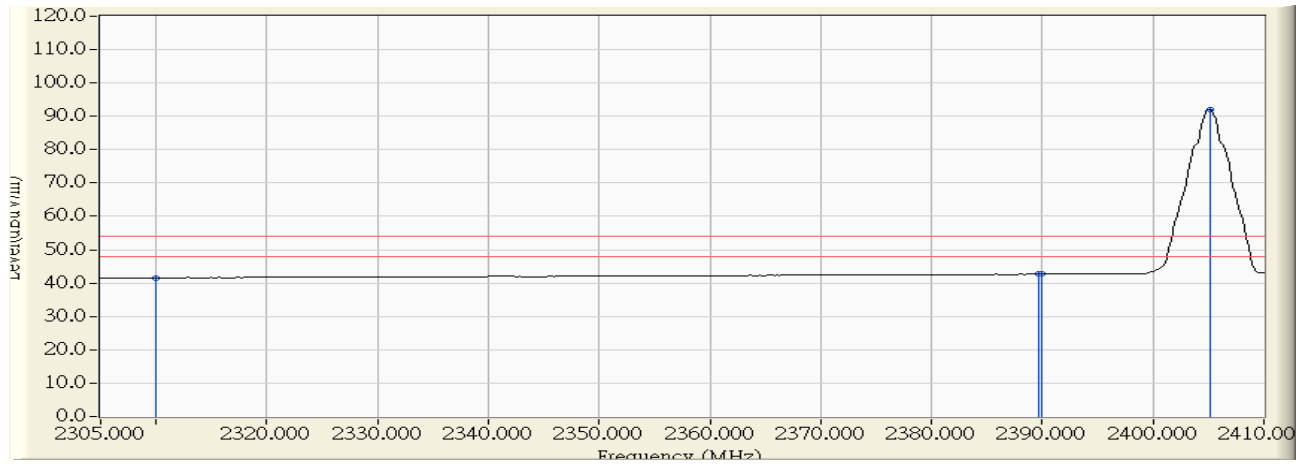


	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Measure Level (dBuV/m)	Margin (dB)	Limit (dBuV/m)	Detector Type
1	2310.000	30.059	25.007	55.066	-18.934	74.000	PEAK
2	2383.400	30.820	26.087	56.907	-17.093	74.000	PEAK
3	2390.000	30.888	24.574	55.462	-18.538	74.000	PEAK
4	* 2404.575	31.039	63.496	94.535	20.535	74.000	PEAK

Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. “ * ”, means this data is the worst emission level.
5. Measure Level = Reading Level + Correct Factor ◦
6. The average measurement was not performed when the peak measured data under the limit of average detection.

Site : CB1	Time : 2013/09/28 - 11:54
Limit : FCC_SpartC_15.209_03M_AV	Margin : 6
Probe : CB1_FCC_EFS_1-18G-1_0901 - HORIZONTAL	Power : AC 120V/60Hz
EUT : LIFX Module Board	Note : 2405MHz

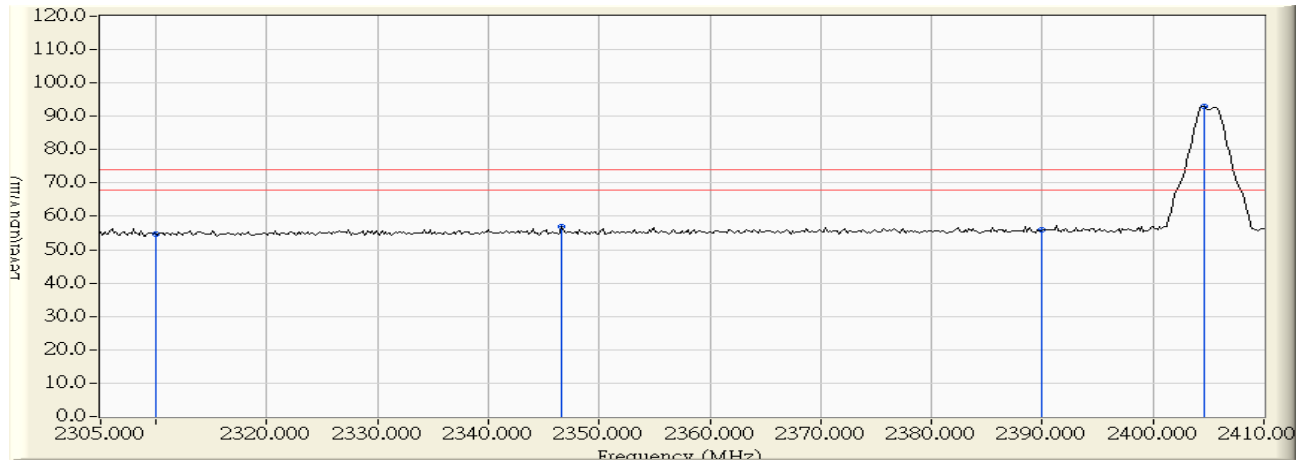


	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Measure Level (dBuV/m)	Margin (dB)	Limit (dBuV/m)	Detector Type
1	2310.000	30.059	11.540	41.599	-12.401	54.000	AVERAGE
2	2389.700	30.885	11.808	42.693	-11.307	54.000	AVERAGE
3	2390.000	30.888	11.779	42.667	-11.333	54.000	AVERAGE
4	* 2405.100	31.045	60.890	91.935	37.935	54.000	AVERAGE

Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. “ * ”, means this data is the worst emission level.
5. Measure Level = Reading Level + Correct Factor ◦
6. The average measurement was not performed when the peak measured data under the limit of average detection.

Site : CB1	Time : 2013/09/28 - 11:57
Limit : FCC_SpartC_15.209_03M_PK	Margin : 6
Probe : CB1_FCC_EFS_1-18G-1_0901 - VERTICAL	Power : AC 120V/60Hz
EUT : LIFX Module Board	Note : 2405MHz

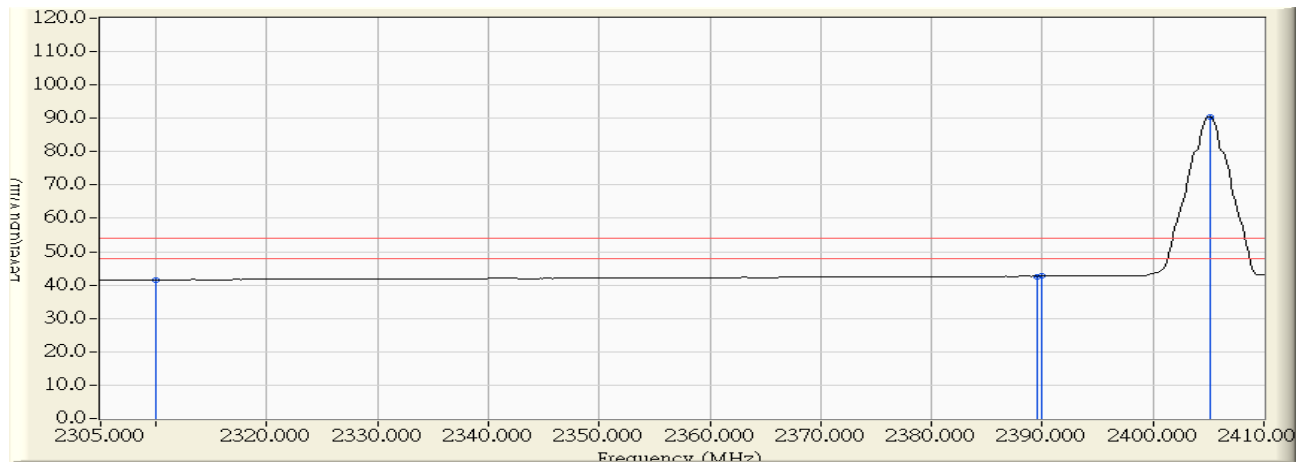


	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Measure Level (dBuV/m)	Margin (dB)	Limit (dBuV/m)	Detector Type
1	2310.000	30.059	24.597	54.656	-19.344	74.000	PEAK
2	2346.650	30.439	26.480	56.919	-17.081	74.000	PEAK
3	2390.000	30.888	25.007	55.895	-18.105	74.000	PEAK
4	* 2404.575	31.039	61.928	92.967	18.967	74.000	PEAK

Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. “ * ”, means this data is the worst emission level.
5. Measure Level = Reading Level + Correct Factor ◦
6. The average measurement was not performed when the peak measured data under the limit of average detection.

Site : CB1	Time : 2013/09/28 - 11:57
Limit : FCC_SpartC_15.209_03M_AV	Margin : 6
Probe : CB1_FCC_EFS_1-18G-1_0901 - VERTICAL	Power : AC 120V/60Hz
EUT : LIFX Module Board	Note : 2405MHz

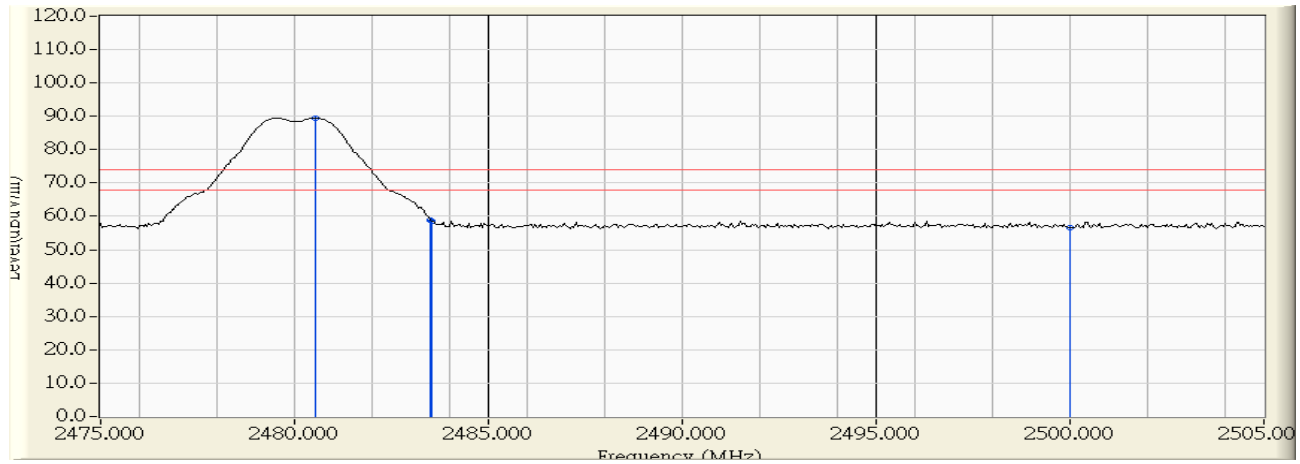


	Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Measure Level (dBuV/m)	Margin (dB)	Limit (dBuV/m)	Detector Type
1	2310.000	30.059	11.543	41.602	-12.398	54.000	AVERAGE
2	2389.525	30.884	11.740	42.623	-11.377	54.000	AVERAGE
3	2390.000	30.888	11.751	42.639	-11.361	54.000	AVERAGE
4	* 2405.100	31.045	59.496	90.541	36.541	54.000	AVERAGE

Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. “ * ”, means this data is the worst emission level.
5. Measure Level = Reading Level + Correct Factor ◦
6. The average measurement was not performed when the peak measured data under the limit of average detection.

Site : CB1	Time : 2013/09/28 - 12:01
Limit : FCC_SpartC_15.209_03M_PK	Margin : 6
Probe : CB1_FCC_EFS_1-18G-1_0901 - HORIZONTAL	Power : AC 120V/60Hz
EUT : LIFX Module Board	Note : 2480MHz

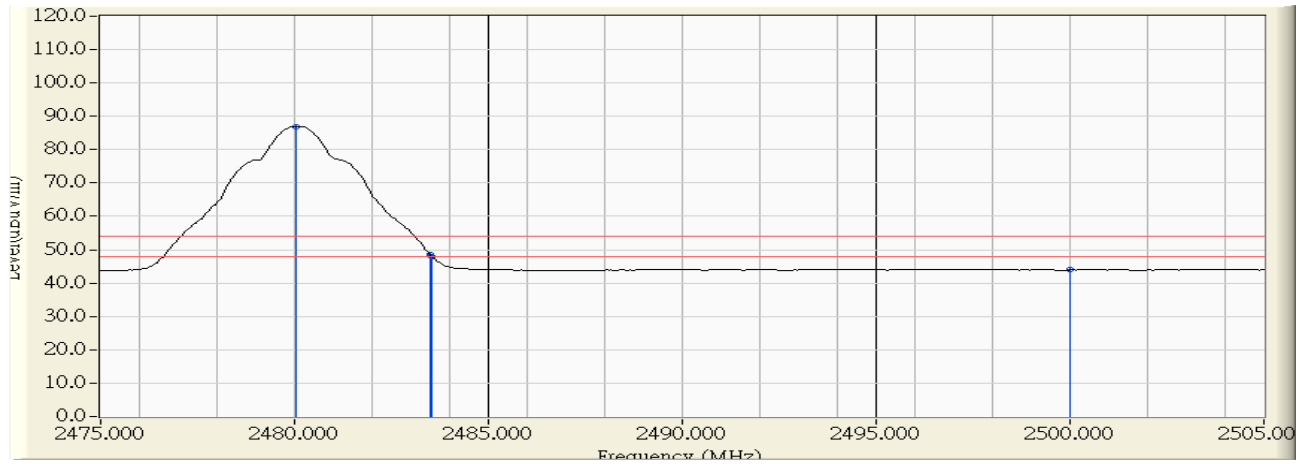


		Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Measure Level (dBuV/m)	Margin (dB)	Limit (dBuV/m)	Detector Type
1	*	2480.550	31.827	57.692	89.519	15.519	74.000	PEAK
2		2483.500	31.858	27.049	58.907	-15.093	74.000	PEAK
3		2483.550	31.859	26.536	58.394	-15.606	74.000	PEAK
4		2500.000	31.988	24.658	56.647	-17.353	74.000	PEAK

Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. “ * ”, means this data is the worst emission level.
5. Measure Level = Reading Level + Correct Factor ◦
6. The average measurement was not performed when the peak measured data under the limit of average detection.

Site : CB1	Time : 2013/09/28 - 12:02
Limit : FCC_SpartC_15.209_03M_AV	Margin : 6
Probe : CB1_FCC_EFS_1-18G-1_0901 - HORIZONTAL	Power : AC 120V/60Hz
EUT : LIFX Module Board	Note : 2480MHz

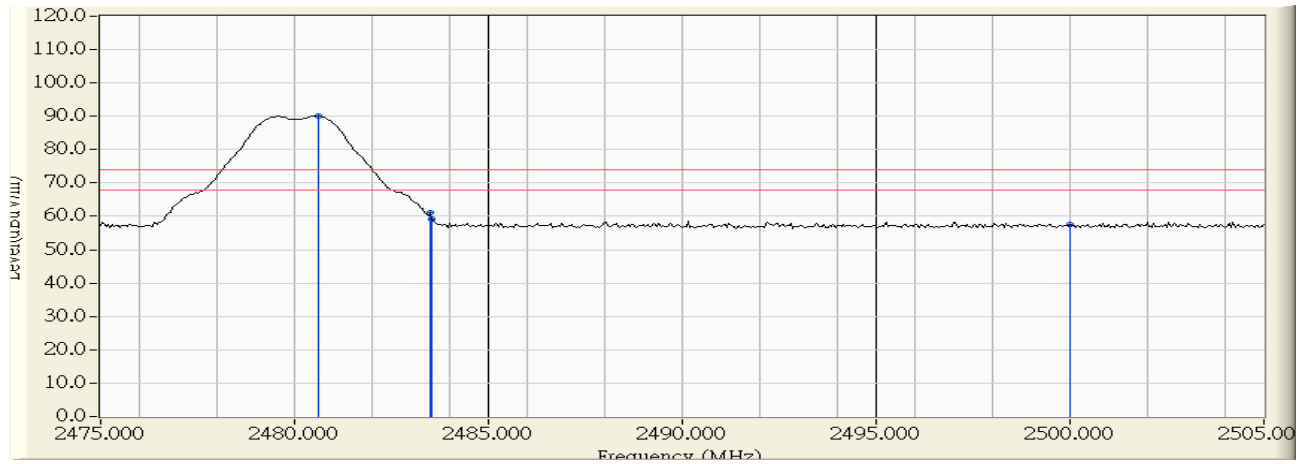


		Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Measure Level (dBuV/m)	Margin (dB)	Limit (dBuV/m)	Detector Type
1	*	2480.050	31.822	55.187	87.009	33.009	54.000	AVERAGE
2		2483.500	31.858	16.763	48.621	-5.379	54.000	AVERAGE
3		2483.550	31.859	16.177	48.035	-5.965	54.000	AVERAGE
4		2500.000	31.988	11.940	43.929	-10.071	54.000	AVERAGE

Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. “ * ”, means this data is the worst emission level.
5. Measure Level = Reading Level + Correct Factor ◦
6. The average measurement was not performed when the peak measured data under the limit of average detection.

Site : CB1	Time : 2013/09/28 - 12:05
Limit : FCC_SpartC_15.209_03M_PK	Margin : 6
Probe : CB1_FCC_EFS_1-18G-1_0901 - VERTICAL	Power : AC 120V/60Hz
EUT : LIFX Module Board	Note : 2480MHz

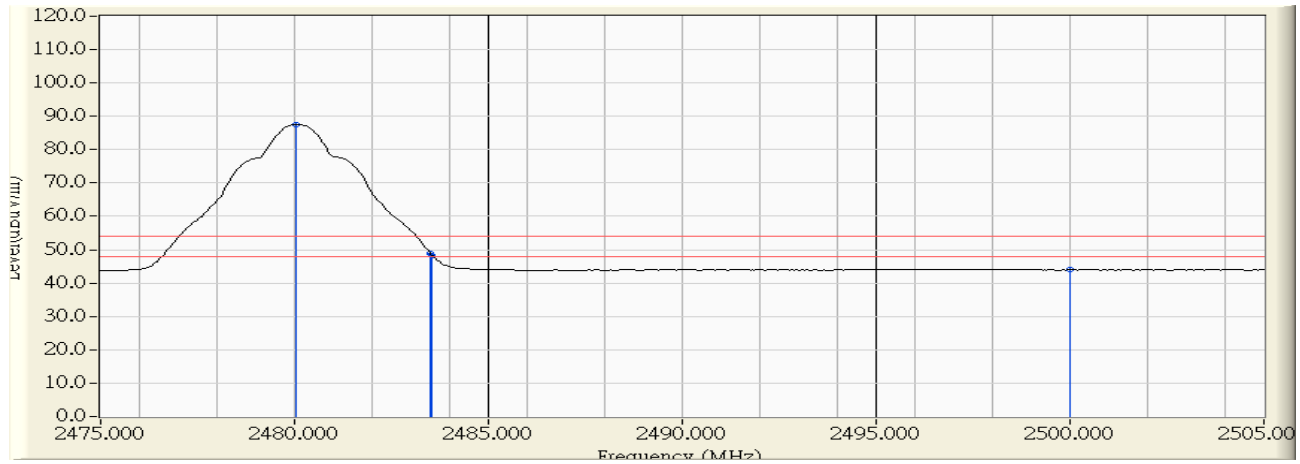


		Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Measure Level (dBuV/m)	Margin (dB)	Limit (dBuV/m)	Detector Type
1	*	2480.600	31.828	58.267	90.095	16.095	74.000	PEAK
2		2483.500	31.858	29.179	61.037	-12.963	74.000	PEAK
3		2483.550	31.859	27.278	59.136	-14.864	74.000	PEAK
4		2500.000	31.988	25.600	57.589	-16.411	74.000	PEAK

Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. “ * ”, means this data is the worst emission level.
5. Measure Level = Reading Level + Correct Factor ◦
6. The average measurement was not performed when the peak measured data under the limit of average detection.

Site : CB1	Time : 2013/09/28 - 12:05
Limit : FCC_SpartC_15.209_03M_AV	Margin : 6
Probe : CB1_FCC_EFS_1-18G-1_0901 - VERTICAL	Power : AC 120V/60Hz
EUT : LIFX Module Board	Note : 2480MHz



		Frequency (MHz)	Correct Factor (dB)	Reading Level (dBuV)	Measure Level (dBuV/m)	Margin (dB)	Limit (dBuV/m)	Detector Type
1	*	2480.050	31.822	55.774	87.596	33.596	54.000	AVERAGE
2		2483.500	31.858	17.191	49.049	-4.951	54.000	AVERAGE
3		2483.550	31.859	16.529	48.387	-5.613	54.000	AVERAGE
4		2500.000	31.988	11.930	43.919	-10.081	54.000	AVERAGE

Note:

1. All readings above 1GHz are performed with peak and/or average measurements as necessary.
2. Peak measurements: RBW = 1MHz, VBW = 3 MHz, Sweep: Auto.
3. Average measurements: RBW = 1MHz, VBW = 10 Hz, Sweep: Auto.
4. “ * ”, means this data is the worst emission level.
5. Measure Level = Reading Level + Correct Factor ◦
6. The average measurement was not performed when the peak measured data under the limit of average detection.

7. Occupied Bandwidth

7.1. Test Equipment

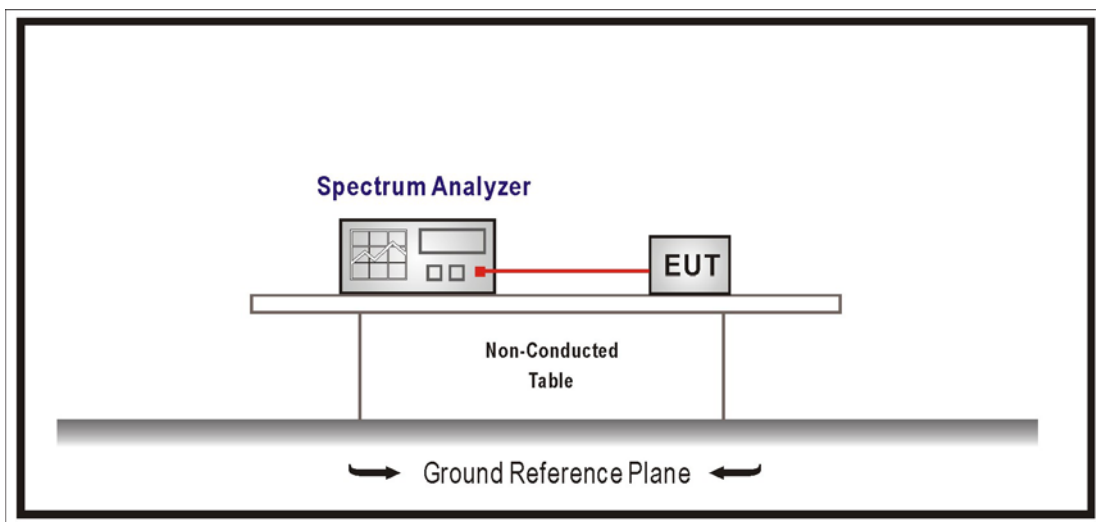
The following test equipment is used during the test:

Occupied Bandwidth / SR7

Instrument	Manufacturer	Model No.	Serial No	Next Cal. Date
Spectrum Analyzer	Agilent	N9010A-EXA	US47140172	2014/08/05

Note: 1. All equipments that need to calibrate are with calibration period of 1 year.

7.2. Test Setup



7.3. Limits

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

For frequency hopping systems operating in the 5725-5850 MHz bands. The maximum 20 dB bandwidth of the hopping channel is 1 MHz.

For 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.

7.4. Test Procedures

The EUT was setup according to ANSI C63.4, 2009 and tested according to FHSS test procedure of FCC Public Notice DA 00-705 for compliance to FCC 47CFR 15.247 requirements

Use the following spectrum analyzer settings:

Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel

RBW \geq 1% of the 20 dB bandwidth, VBW \geq RBW

Sweep = auto, Detector function = peak, Trace = max hold

The EUT should be transmitting at its maximum data rate.

7.5. Test Specification

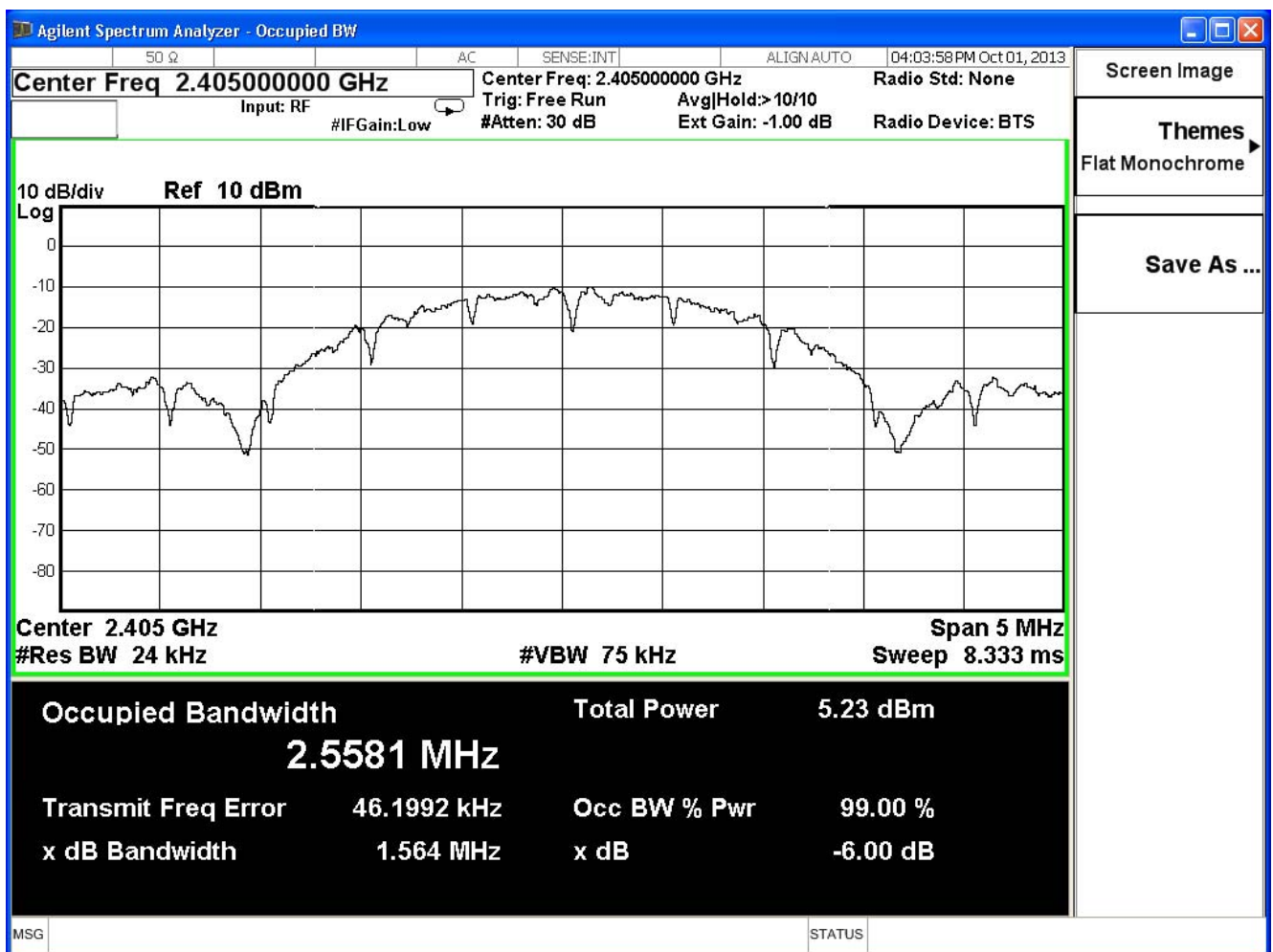
According to FCC Part 15 Subpart C Paragraph 15.247: 2012

7.6. Test Result

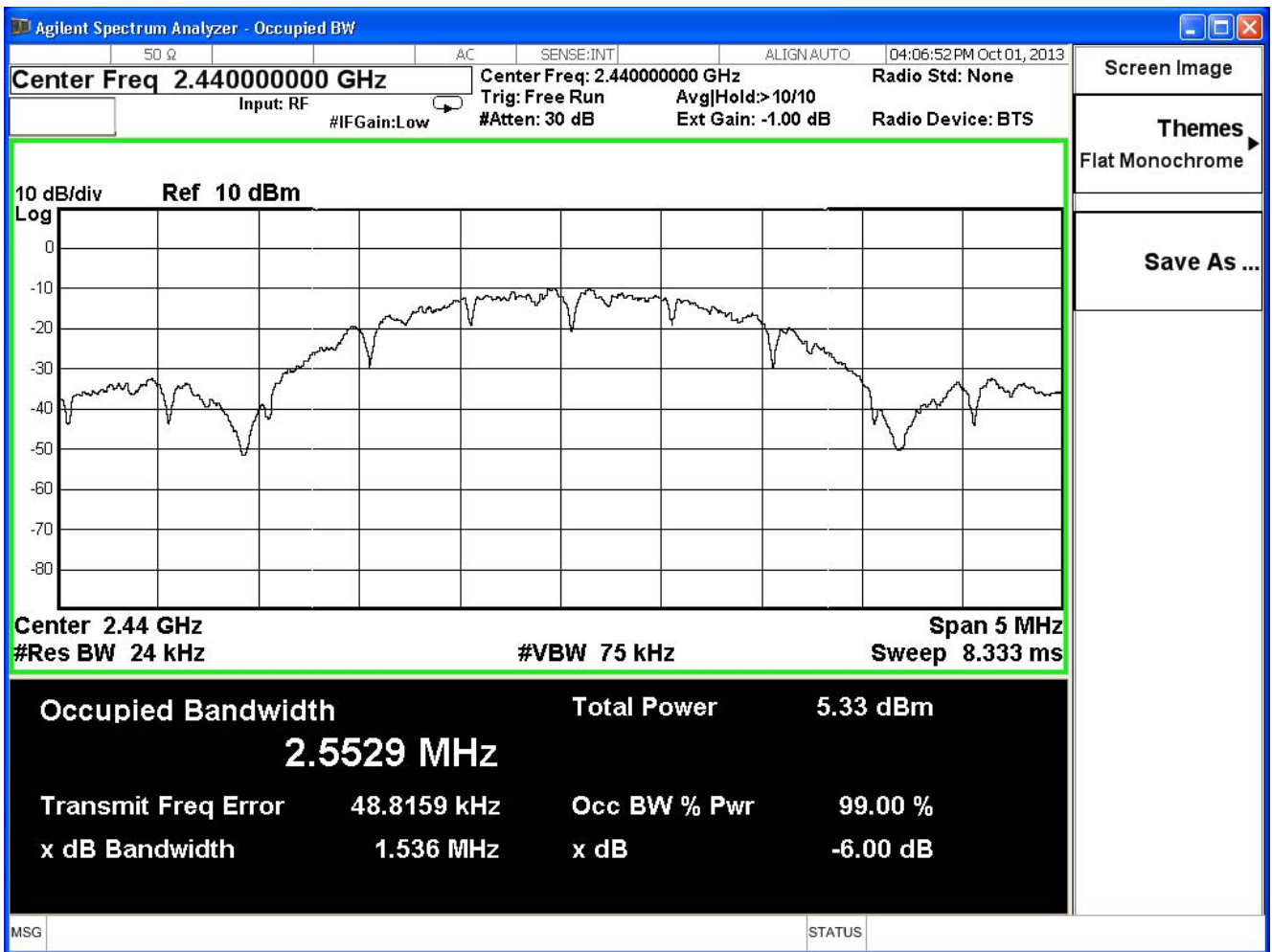
Product	LIFX Module Board		
Test Item	Occupied Bandwidth		
Test Mode	Mode 1: Transmit		
Date of Test	2013/10/01	Test Site	SR7

Channel No.	Frequency (MHz)	Measure Level (MHz)	Required Limit (MHz)	Result
1	2405	1.56	≥ 0.5	Pass
8	2440	1.54	≥ 0.5	Pass
16	2480	1.55	≥ 0.5	Pass

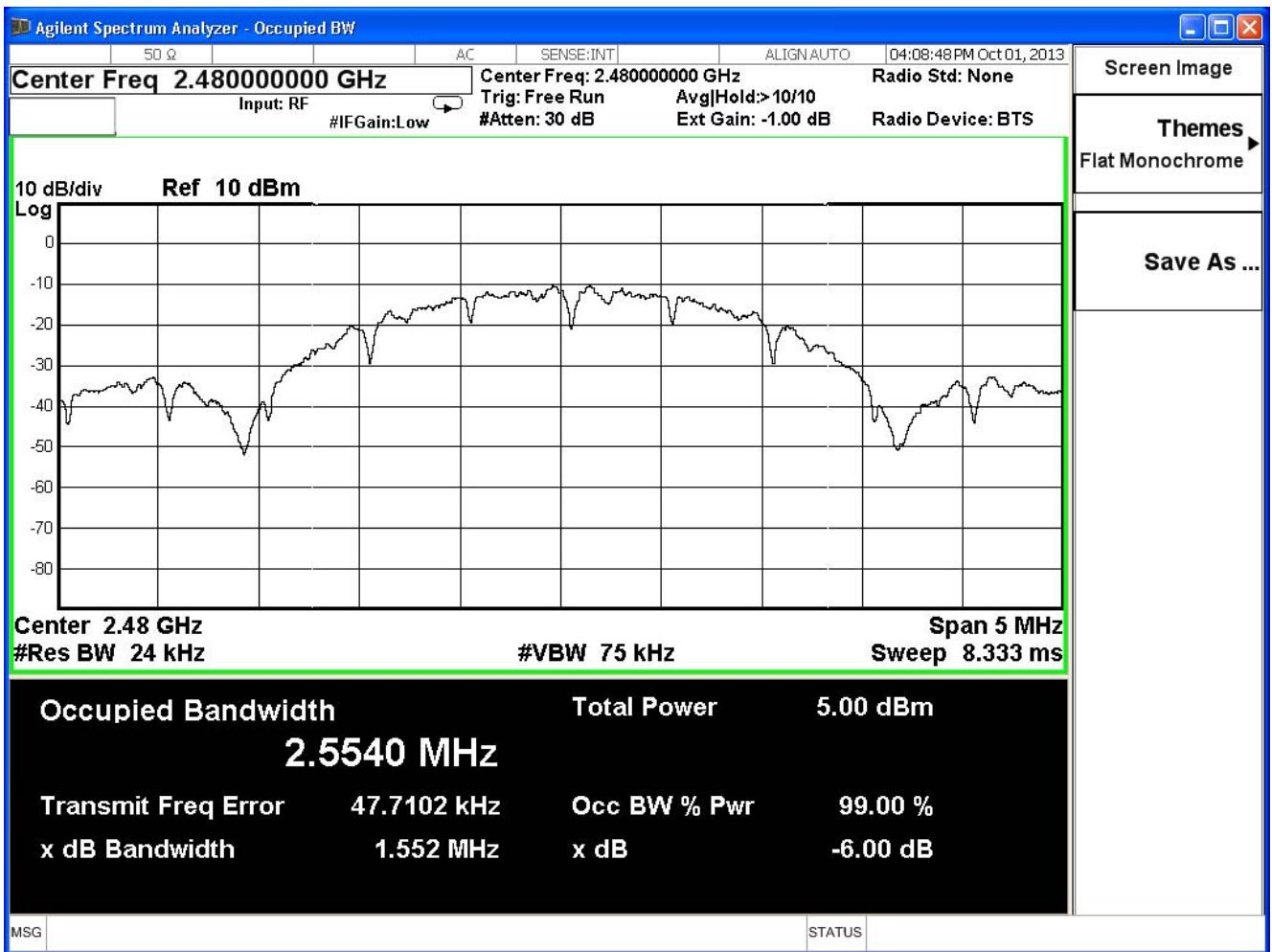
Channel 1



Channel 8



Channel 16



8. Power Density

8.1. Test Equipment

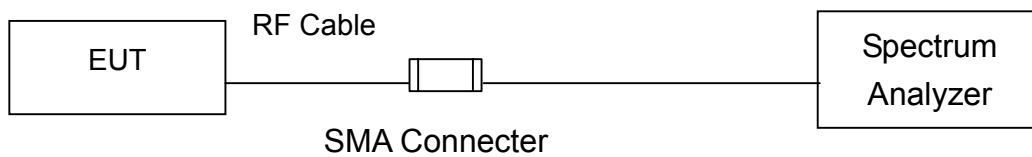
The following test equipment is used during the test:

Power Density / SR7

Instrument	Manufacturer	Model No.	Serial No	Next Cal. Date
Spectrum Analyzer	Agilent	N9010A-EXA	US47140172	2014/08/05

Note: 1. All equipments that need to calibrate are with calibration period of 1 year.

8.2. Test Setup



8.3. Limits

The peak power spectral density conducted from the intentional radiated to the antenna shall not be greater than +8dBm in any 3kHz band during any time interval of continuous transmission.

8.4. Test Procedures

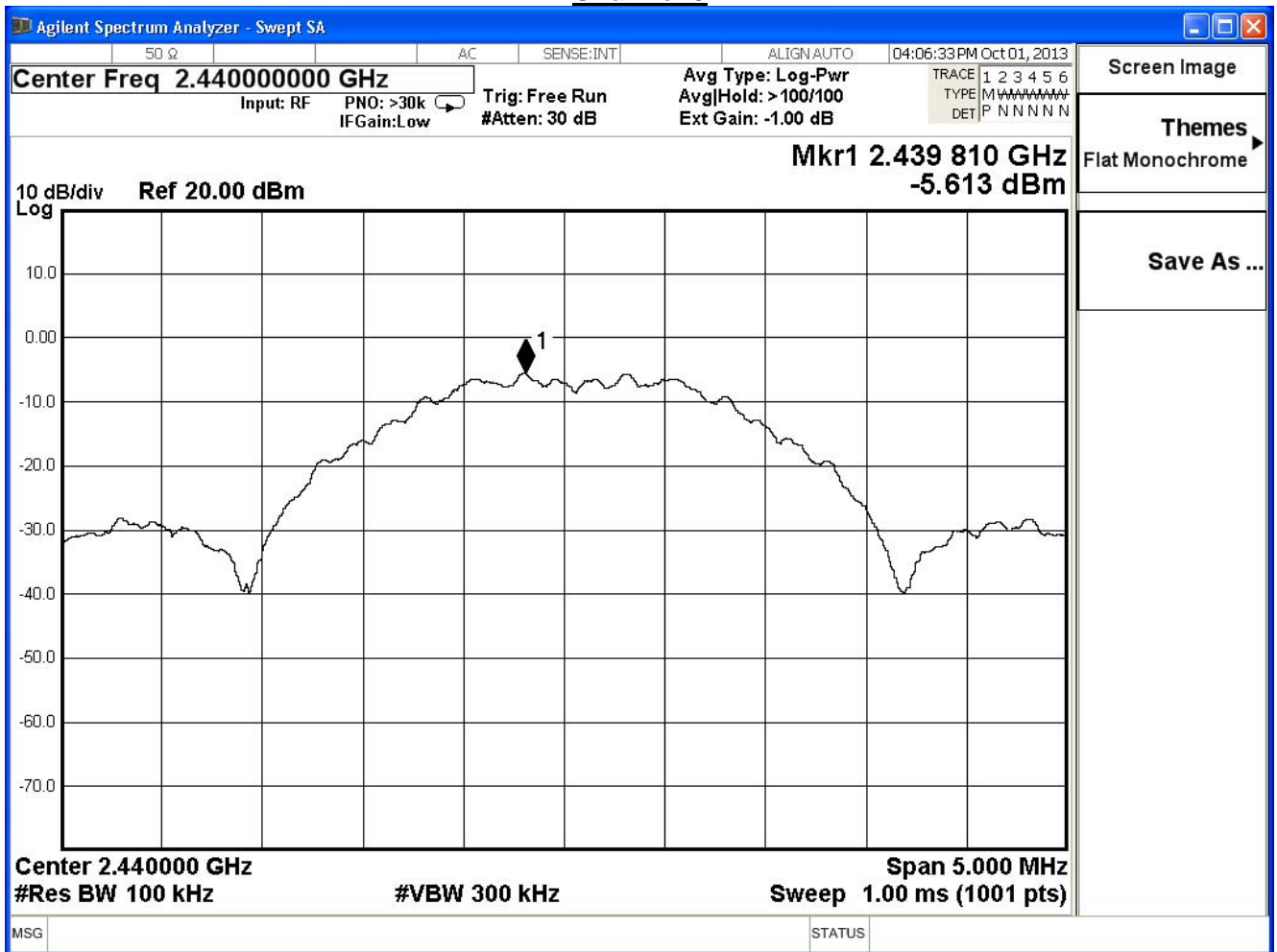
The EUT was setup according to ANSI C63.4: 2009; tested according to DTS test procedure of Jan. 2012 KDB558074 for compliance to FCC 47CFR 15.247 requirements.

Set RBW= 100 kHz, Set VBW= 300 kHz, Sweep time=Auto, Set detector=Peak detector

8.5. Test Specification

According to FCC Part 15 Subpart C Paragraph 15.247: 2012

Channel 8



Channel 16

