

FCC PART 15.249

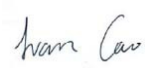
TEST REPORT

For

3Dconnexion

3/5 Avenue des Citronniers, 98000, Monaco

FCC ID: 2AAHQ-RV1

Report Type: Original Report		Product Type: SpaceMouse Wireless Receiver	
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Report Number:	R2XM140126050 -00A		
Report Date:	2014-04-23		
Reviewed By:	Ivan Cao  RF Leader		
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

The *3Dconnexion*'s product, model number: *SpaceMouse Wireless Receiver (FCC ID: 2AAHQ-RV1)* (the "EUT") in this report was a *SpaceMouse Wireless Receiver*, which was measured approximately: 1.9 cm (L) x 1.4 cm (W) x 0.6 cm (H), rated input voltage: DC 5.0 V from USB port.

** All measurement and test data in this report was gathered from production sample serial number: 140126050 (Assigned by BACL.Dongguan). The EUT was received on 2014-01-27.*

Objective

This type approval report is prepared on behalf of *3Dconnexion* in accordance with Part 2-Subpart J, and Part 15-Subparts A, B and C of the Federal Communication Commissions rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.249 rules.

Related Submittal(s)/Grant(s)

No Related Submittal(s)/Grant(s)

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.

All radiated and conducted emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Dongguan).

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Dongguan) to collect test data is located on the No.69 Pulongcun, Puxinhu Industrial Zone, Tangxia, Dongguan, Guangdong, China

Test site at Bay Area Compliance Laboratories Corp. (Dongguan) has been fully described in reports submitted to the Federal Communication Commission (FCC). 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 02, 2012. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2003.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 273710. The test site has been approved by the FCC for public use and is listed in the FCC Public Access Link (PAL) database.

SYSTEM TEST CONFIGURATION

Justification

The system was configured for testing in Engineering Mode, which was provided by the manufacturer.

5 channels are provided for testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2404	2	2425
3	2442	4	2463
5	2477	/	/

EUT was tested with Channel 2404 MHz, 2442 MHz and 2477 MHz

EUT Exercise Software

The software “usbhidio.exe” was used, which was provided by the manufacturer.

Equipment Modifications

No modifications were made to the unit tested.

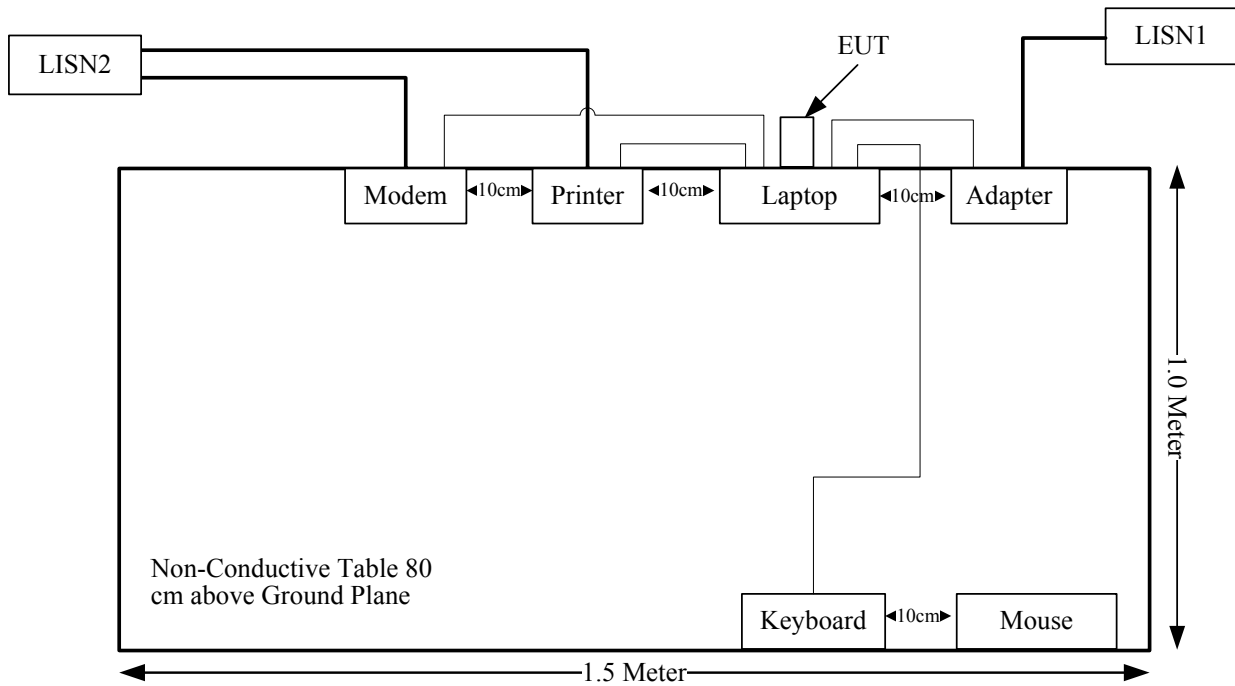
Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
DELL	Laptop	PP11L	QDS-BRCM1017
HP	Printer	C3941A	JPTVOB2337
SAST	Modem	AEM-2100	0293
DELL	Keyboard	L100	CNORH656658907BL05D C
3Dconnexion	Mouse	SpaceMouse Wireless	N/A

External I/O Cable

Cable Description	Shielding Type	Ferrite Core	Length (m)	From Port	To
Parallel Cable	Yes	No	1.2	Parallel Port of Laptop	Printer
Serial Cable	Yes	No	1.2	Serial Port of Laptop	Modem
Keyboard Cable	Yes	Yes	1.5	USB Port of Laptop	Keyboard

Block Diagram of Test Setup



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.203	Antenna Requirement	Compliance
§15.207(a)	Conduction Emissions	Compliance
15.205, §15.209, §15.249	Radiated Emissions	Compliance
§15.215 (c)	20 dB Bandwidth	Compliance
§15.249(d)	Outside of Band Emission (50dB attenuation)	Compliance

FCC§15.203 - ANTENNA REQUIREMENT

Applicable Standard

For intentional device, 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.

Antenna Connector Construction

The EUT has one integral antenna arrangement, which was permanently attached and the antenna gain is 0 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

Result: Compliant.

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC§15.207

Measurement Uncertainty

Compliance or non-compliance with a disturbance limit shall be determined in the following manner:

If U_{lab} is less than or equal to U_{cisp} of Table 1, then:

- compliance is deemed to occur if no measured disturbance level exceeds the disturbance limit;
- non-compliance is deemed to occur if any measured disturbance level exceeds the disturbance limit.

If U_{lab} is greater than U_{cisp} of Table 1, then:

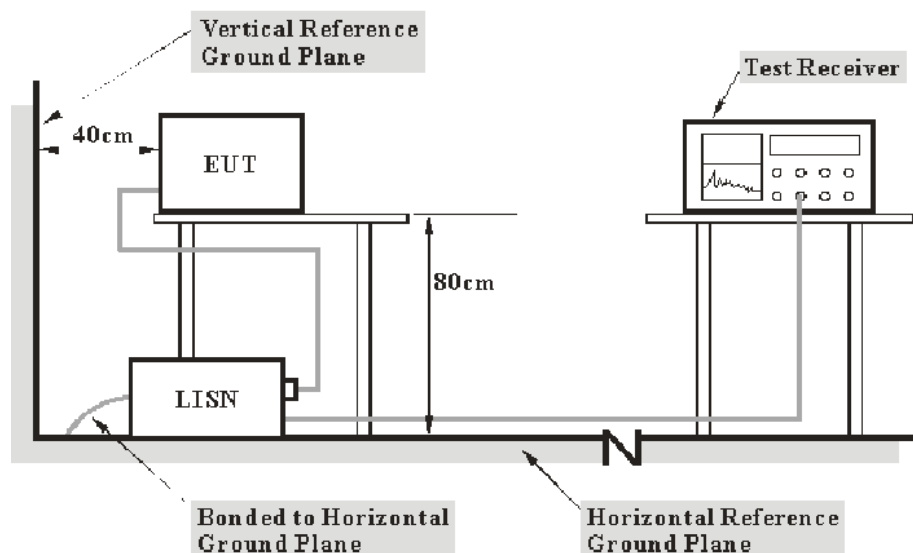
- compliance is deemed to occur if no measured disturbance level, increased by $(U_{lab} - U_{cisp})$, exceeds the disturbance limit;
- non-compliance is deemed to occur if any measured disturbance level, increased by $(U_{lab} - U_{cisp})$, exceeds the disturbance limit.

Based on CISPR 16-4-2-2011, measurement uncertainty of conducted disturbance at mains port using AMN at Bay Area Compliance Laboratories Corp. (Dongguan) is 3.46 dB (150 kHz to 30 MHz).

Table 1 – Values of U_{cisp}

Measurement	U_{cisp}
Conducted disturbance at mains port using AMN (150 kHz to 30 MHz)	3.4 dB

EUT Setup



Note: 1. Support units were connected to second LISN.
 2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The setup of EUT is according with per ANSI C63.4-2003 measurement procedure. The specification used was with the FCC Part 15.207 limits.

The spacing between the peripherals was 10 cm.

The adapter of laptop was connected to a 120 VAC/60 Hz power source

EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

Test Procedure

During the conducted emission test, the adapter of laptop was connected to the outlet of the first LISN and the other support equipments were connected to the outlet of the second LISN.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All data was recorded in the Quasi-peak and average detection mode.

Corrected Amplitude & Margin Calculation

The basic equation is as follows:

$$V_C = V_R + A_C + VDF$$

$$C_f = A_C + VDF$$

Herein,

V_C (cord. Reading): corrected voltage amplitude

V_R : reading voltage amplitude

A_C : attenuation caused by cable loss

VDF: voltage division factor of AMN

C_f : Correction Factor

The “**Margin**” column of the following data tables indicates the degree of compliance within 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:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESCS 30	830245/006	2013-11-20	2014-11-19
R&S	Two-line V-network	ENV216	3560.6550.12	2014-01-22	2015-01-21
R&S	L.I.S.N	ESH3-Z5	100113	N/A	N/A
BACL	Test Software	BACL-EMC	V1.0-2010	N/A	N/A

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Results Summary

According to the recorded data in following table, the EUT complied with the FCC Part 15.207, with the worst margin reading of:

7.84 dB at 0.660 MHz in the **Neutral** conducted mode

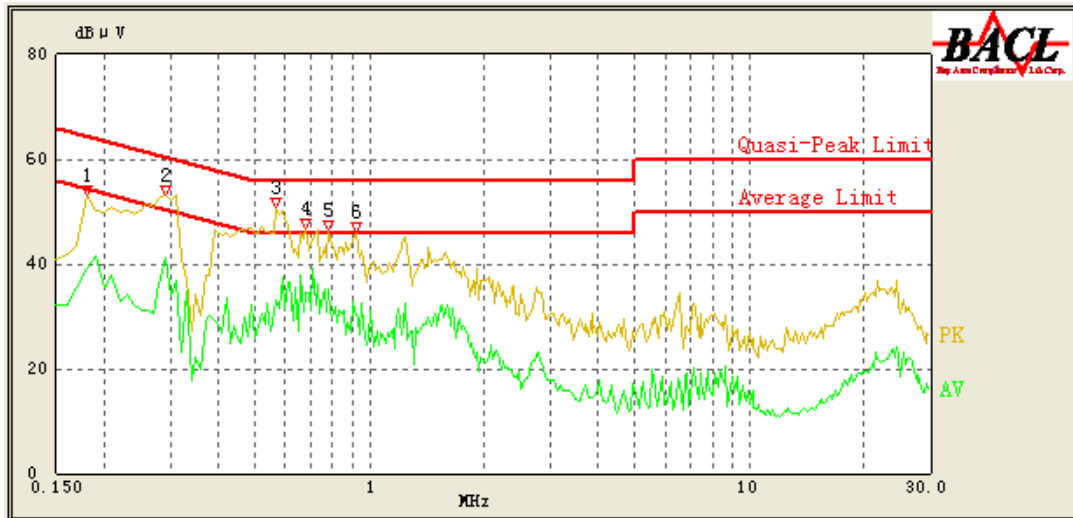
Test Data**Environmental Conditions**

Temperature:	24.8 ° C
Relative Humidity:	54 %
ATM Pressure:	101.5 kPa

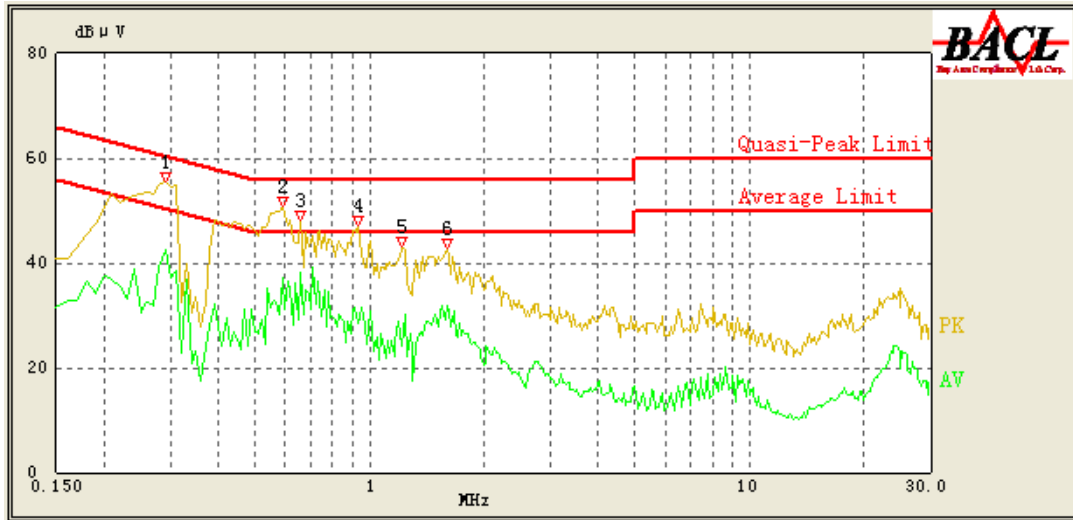
The testing was performed by Ares Liu on 2014-02-27.

Test Mode: Transmitting

AC 120 V, 60 Hz, Line:



Frequency (MHz)	Cord. Reading (dB μ V)	Correction Factor (dB)	Limit (dB μ V)	Margin (dB)	Detector (PK/AV/QP)
0.180	44.04	9.64	64.49	20.45	QP
0.180	39.27	9.64	54.49	15.22	AV
0.290	49.33	9.69	60.52	11.19	QP
0.290	41.06	9.69	50.52	9.46	AV
0.570	47.15	9.66	56.00	8.85	QP
0.570	33.29	9.66	46.00	12.71	AV
0.680	40.29	9.67	56.00	15.71	QP
0.680	34.58	9.67	46.00	11.42	AV
0.780	40.72	9.67	56.00	15.28	QP
0.780	35.29	9.67	46.00	10.71	AV
0.920	40.88	9.68	56.00	15.12	QP
0.910	31.22	9.68	46.00	14.78	AV

AC 120 V, 60 Hz, Neutral:

Frequency (MHz)	Cord. Reading (dBμV)	Correction Factor (dB)	Limit (dBμV)	Margin (dB)	Detector (PK/AV/QP)
0.290	51.32	9.68	60.52	9.20	QP
0.290	42.37	9.68	50.52	8.15	AV
0.590	46.28	9.67	56.00	9.72	QP
0.590	37.31	9.67	46.00	8.69	AV
0.660	42.93	9.67	56.00	13.07	QP
0.660	38.16	9.67	46.00	7.84	AV
0.930	42.09	9.69	56.00	13.91	QP
0.930	28.63	9.69	46.00	17.37	AV
1.220	37.92	9.69	56.00	18.08	QP
1.220	24.26	9.69	46.00	21.74	AV
1.600	39.01	9.68	56.00	16.99	QP
1.600	31.82	9.68	46.00	14.18	AV

FCC§15.205, §15.209&§15.249- RADIATED EMISSIONS

Applicable Standard

As per FCC§15.249 (a), except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902–928 MHz	50	500
2400–2483.5 MHz	50	500
5725–5875 MHz	50	500
24.0–24.25 GHz	250	2500

As per FCC§15.249 (c), Field strength limits are specified at a distance of 3 meters.

(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

Measurement Uncertainty

Compliance or non- compliance with a disturbance limit shall be determined in the following manner:

If U_{lab} is less than or equal to U_{cisprr} of Table 1, then:

- compliance is deemed to occur if no measured disturbance level exceeds the disturbance limit;
- non - compliance is deemed to occur if any measured disturbance level exceeds the disturbance limit.

If U_{lab} is greater than U_{cisprr} of Table 1, then:

- compliance is deemed to occur if no measured disturbance level, increased by $(U_{lab} - U_{cisprr})$, exceeds the disturbance limit;
- non - compliance is deemed to occur if any measured disturbance level, increased by $(U_{lab} - U_{cisprr})$, exceeds the disturbance limit.

Based on CISPR 16-4-2: 2011, measurement uncertainty of radiated emission at a distance of 3m at Bay Area Compliance Laboratories Corp. (Dongguan) is:

30M~200MHz: 5.0 dB

200M~1GHz: 6.2 dB

1G~6GHz: 4.45 dB

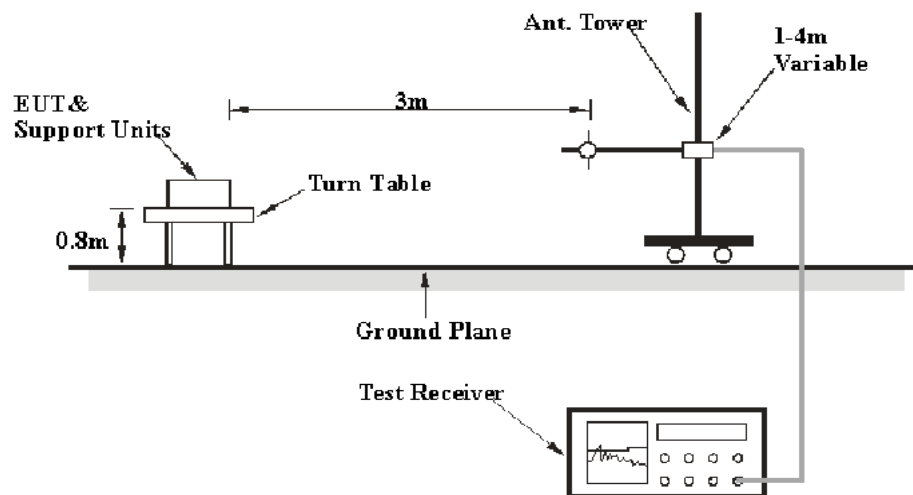
6G~18GHz: 5.23 dB

Table 1 – Values of U_{cispr}

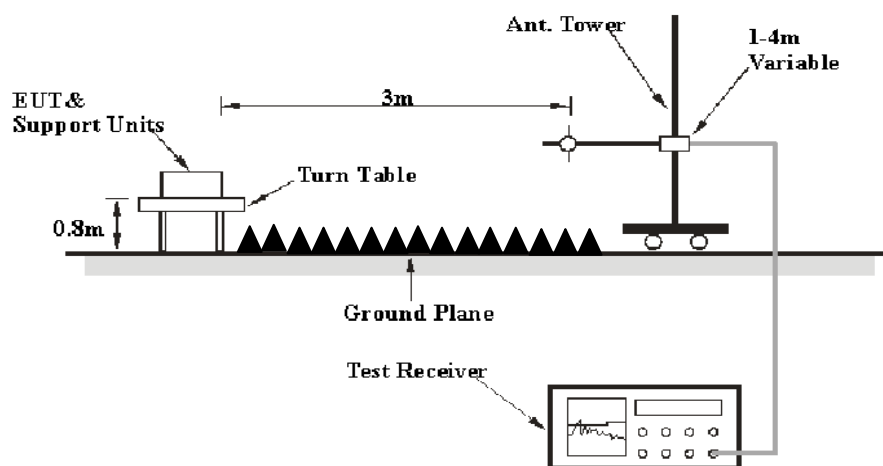
Measurement	U_{cispr}
Radiated disturbance (electric field strength at an OATS or in a SAC) (30 MHz to 1000 MHz)	6.3 dB
Radiated disturbance (electric field strength in a FAR) (1 GHz to 6 GHz)	5.2 dB
Radiated disturbance (electric field strength in a FAR) (6 GHz to 18 GHz)	5.5 dB

EUT Setup

Below 1 GHz:



Above 1 GHz:



The radiated emission and out of band emission tests were performed in the 3 meters chamber test site, using the setup accordance with the ANSI C63.4-2003. The specification used was the FCC 15.209/15.205 and FCC 15.249 limits.

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

The adapter of laptop was connected to a 120 VAC/60 Hz power source

Test Equipment Setup

The system was investigated from 30 MHz to 25 GHz.

During the radiated emission test, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

Frequency Range	RBW	Video B/W	IF B/W	Detector
30 MHz – 1000 MHz	120 kHz	300 kHz	120kHz	QP
Above 1 GHz	1MHz	3 MHz	/	PK
	1MHz	10 Hz	/	Ave.

Test Procedure

For the radiated emissions test, the adapter of laptop was connected to the first AC floor outlet and the other support equipments were connected to the second AC floor outlet.

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

All data was recorded in the Quasi-peak detection mode from 30MHz to 1GHz, Peak and average detection mode above 1 GHz.

Corrected Amplitude & Margin Calculation

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

$$\text{Corrected Amplitude} = \text{Meter Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

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 limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Limit} - \text{Extrapolation result}$$

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESCI	100224	2013-05-06	2014-05-05
Sunol Sciences	Antenna	JB3	A060611-1	2011-09-06	2014-09-05
HP	Amplifier	8447E	2434A02181	2013-09-06	2014-09-05
ETS LINDGREN	Horn Antenna	3115	000 527 35	2012-09-06	2015-09-05
Mini-Circuit	Amplifier	ZVA-213-S+	054201245	2014-02-19	2015-02-18
R&S	Spectrum Analyzer	FSP 38	100478	2013-06-16	2014-06-15
Ducommun Technologies	Horn Antenna	ARH-4223-02	1007726-01 1304	2013-06-16	2014-06-15
Quinstar	Amplifier	QLW-18405536-JO	15964001001	2013-09-06	2014-09-05

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Results Summary

According to the data in the following table, the EUT complied with the FCC Part 15.209 & 15.205 & 15.249, with the worst margin reading of:

4.53 dB at 4954 MHz in the Vertical polarization

Test Data**Environmental Conditions**

Temperature:	23 °C
Relative Humidity:	67 %
ATM Pressure:	100.8 kPa

The testing was performed by Ares Liu on 2014-03-20.

Test Mode: Transmitting

Frequency (MHz)	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	Detector (PK/QP/AV)	Polar (H/V)	Factor (dB(1/m))					
Low Channel: 2404 MHz									
2404	93.67	PK	H	25.65	4.42	27.32	96.42	114.00	17.58
2404	66.23	AV	H	25.65	4.42	27.32	68.98	94.00	25.02
2404	94.06	PK	V	25.65	4.42	27.32	96.81	114.00	17.19
2404	67.44	AV	V	25.65	4.42	27.32	70.19	94.00	23.81
2390	36.54	PK	V	25.61	4.39	27.32	39.22	74.00	34.78
2390	25.47	AV	V	25.61	4.39	27.32	28.15	54.00	25.85
4808	44.38	PK	V	30.60	5.99	27.41	53.56	74.00	20.44
4808	38.67	AV	V	30.60	5.99	27.41	47.85	54.00	6.15
7212	38.24	PK	V	34.11	7.45	25.91	53.89	74.00	20.11
7212	24.67	AV	V	34.11	7.45	25.91	40.32	54.00	13.68
1062	44.21	PK	V	22.46	2.63	26.59	42.71	74.00	31.29
1062	25.13	AV	V	22.46	2.63	26.59	23.63	54.00	30.37
2491	38.63	PK	V	25.88	4.51	27.37	41.65	74.00	32.35
2491	24.13	AV	V	25.88	4.51	27.37	27.15	54.00	26.85
52.3	30.5	QP	V	8.07	0.92	21.41	18.08	40.00	21.92
Middle Channel: 2442 MHz									
2442	92.55	PK	H	25.75	4.4	27.34	95.36	114.00	18.64
2442	65.14	AV	H	25.75	4.4	27.34	67.95	94.00	26.05
2442	93.67	PK	V	25.75	4.4	27.34	96.48	114.00	17.52
2442	66.04	AV	V	25.75	4.4	27.34	68.85	94.00	25.15
4884	43.64	PK	V	30.80	6.08	27.42	53.10	74.00	20.90
4884	38.25	AV	V	30.80	6.08	27.42	47.71	54.00	6.29
7326	38.13	PK	V	34.38	7.52	25.88	54.15	74.00	19.85
7326	24.71	AV	V	34.38	7.52	25.88	40.73	54.00	13.27
1062	44.51	PK	V	22.46	2.63	26.59	43.01	74.00	30.99
1062	25.28	AV	V	22.46	2.63	26.59	23.78	54.00	30.22
2491	37.65	PK	V	25.88	4.51	27.37	40.67	74.00	33.33
2491	24.32	AV	V	25.88	4.51	27.37	27.34	54.00	26.66
52.5	30.7	QP	V	8.03	0.92	21.41	18.24	40.00	21.76
162.89	31.5	QP	V	12.58	1.56	21.44	24.2	43.50	19.30
High Channel: 2477 MHz									
2477	92.74	PK	H	25.84	4.47	27.36	95.69	114.00	18.31
2477	65.28	AV	H	25.84	4.47	27.36	68.23	94.00	25.77
2477	93.67	PK	V	25.84	4.47	27.36	96.62	114.00	17.38
2477	66.11	AV	V	25.84	4.47	27.36	69.06	94.00	24.94
2483.5	37.52	PK	V	25.86	4.49	27.36	40.51	74.00	33.49
2483.5	26.57	AV	V	25.86	4.49	27.36	29.56	54.00	24.44
4954	44.69	PK	V	30.98	5.88	27.43	54.12	74.00	19.88
4954	40.04	AV	V	30.98	5.88	27.43	49.47	54.00	4.53
7431	36.04	PK	V	34.63	7.57	25.95	52.29	74.00	21.71
7431	25.17	AV	V	34.63	7.57	25.95	41.42	54.00	12.58
1062	44.37	PK	V	22.46	2.63	26.59	42.87	74.00	31.13
1062	25.09	AV	V	22.46	2.63	26.59	23.59	54.00	30.41
2491	36.84	PK	V	25.88	4.51	27.37	39.86	74.00	34.14
2491	24.66	AV	V	25.88	4.51	27.37	27.68	54.00	26.32
52.5	30.4	QP	V	8.03	0.92	21.41	17.94	40.00	22.06

FCC §15.215(c) – 20 dB BANDWIDTH TESTING**Applicable Standard**

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

Test 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 on the test table without connection to measurement instrument. Turn on the EUT. Then 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 emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSP 38	100478	2013-06-16	2014-06-15

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data**Environmental Conditions**

Temperature:	24.8 °C
Relative Humidity:	61 %
ATM Pressure:	100.6 kPa

* The testing was performed by Ares Liu on 2014-04-22.

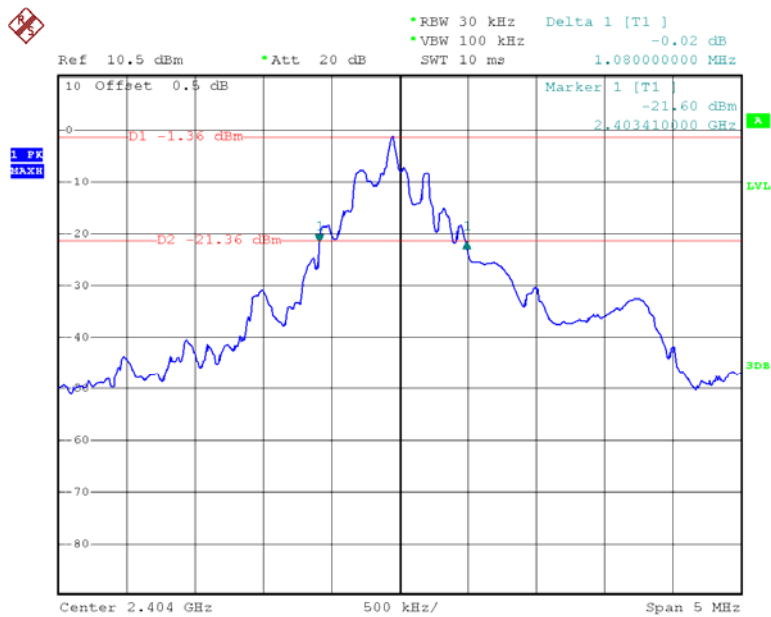
Test Result: Compliance.

Please refer to following tables and plots

Test Mode: Transmitting

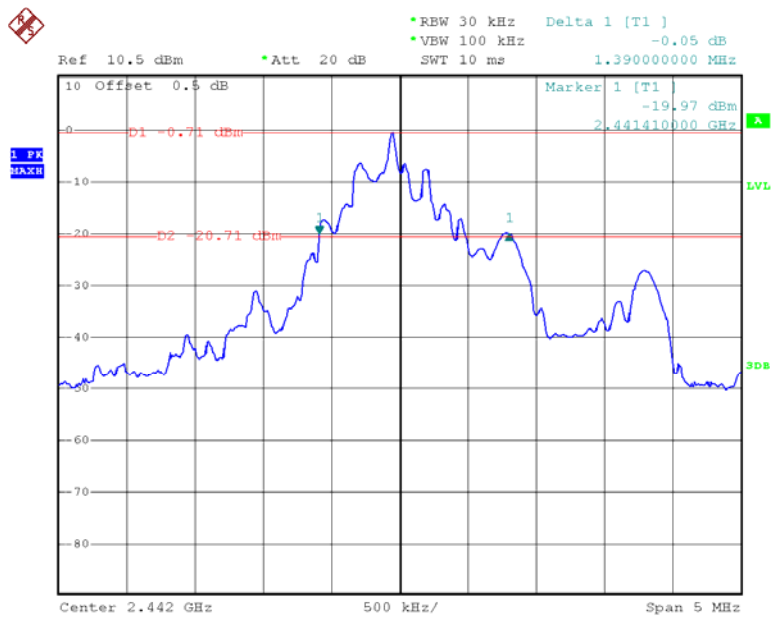
Channel	Frequency (MHz)	20 dB Bandwidth (MHz)
Low	2404	1.08
Middle	2442	1.39
High	2477	1.51

Low Channel



Date: 22.APR.2014 05:30:33

Middle Channel



Date: 22.APR.2014 05:33:06

High Channel



Date: 22.APR.2014 05:34:06

FCC§15.249(d) - OUT OF BAND EMISSION (50 dB ATTENUATION)**Applicable Standard**

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation

Test 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 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. Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz 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.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	Spectrum Analyzer	FSP 38	100478	2013-06-16	2014-06-15

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data**Environmental Conditions**

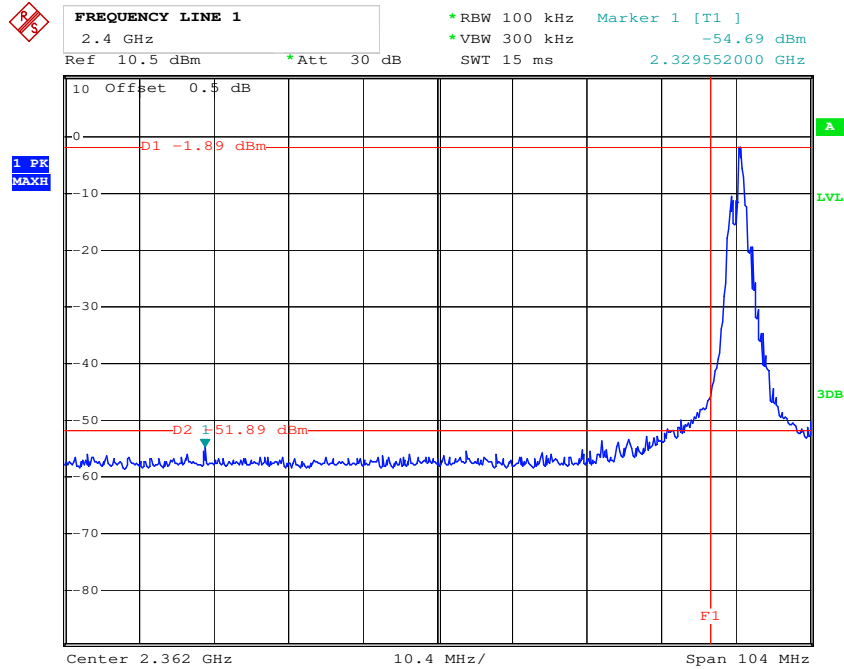
Temperature:	23.8 °C
Relative Humidity:	51 %
ATM Pressure:	101 kPa

* The testing was performed by Ares Liu on 2014-04-22.

Test Result: Compliance.

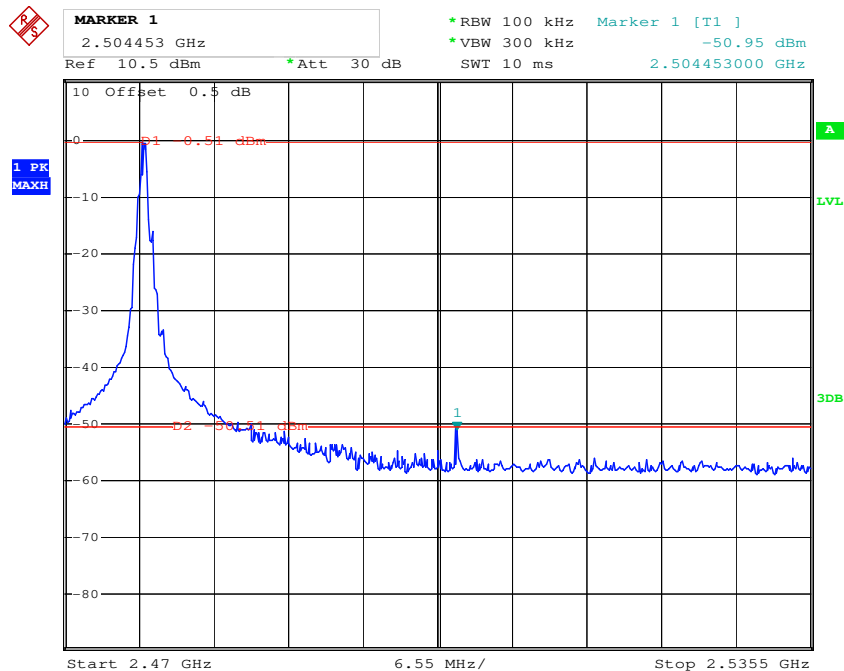
Please refer to the following plots:

Band Edge, Left Side



Date: 22.APR.2014 20:49:54

Band Edge, Right Side



Date: 22.APR.2014 20:52:32

***** END OF REPORT *****