

FCC PART 15.249

TEST REPORT

For

ChicagoTronics, Inc.

1736 W. Pierce Ave, Chicago, IL 60622 United States

FCC ID: 2AHKSREV

Report Type: Original Report		Product Type: 2016 Wireless 5-button USB dongle	
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Report Number:	RDG160315006-00		
Report Date:	2016-03-24		
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Note: This test report is prepared for the customer shown above and for the device described herein. It may not be duplicated or used in part without prior written consent from Bay Area Compliance Laboratories Corp. (Dongguan).

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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

The *ChicagoTronics, Inc.*'s product, model number: *CTW001(FCC ID: 2AHKSREV)* (the "EUT") in this report was a *2016 Wireless 5-button USB dongle*, which was measured approximately:19.10 mm (L) x 14.65 mm (W) x 6.10 mm (H), rated input voltage: DC5.0V from system.

All measurement and test data in this report was gathered from production sample serial number: 160315006 (Assigned byBACL, Dongguan). The EUT was received on 2016-03-16.

Objective

This type approval report is prepared on behalf of *ChicagoTronics, Inc.* 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, 15.209 and 15.249 rules.

Related Submittal(s)/Grant(s)

Submitted with the Part of a system with ID: 2AHKSCTW001.

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices.

All emissions measurement was performed and 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 06, 2015.

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 by software, the maximum power output configured by default setting and switched the channels by software.

Below is the channels employed:

Channel Number	Frequency (MHz)	Channel Number	Frequency (MHz)
1	2408	18	2442
2	2410	19	2444
3	2412	20	2446
~	~	~	~
16	2438	33	2472
17	2440	34	2474

Channel 1, 17, 34 were selected to test.

EUT Exercise Software

The software “H41 RF Test&EMI Mode” was used for testing, which was provided by manufacturer.

Equipment Modifications

No modifications were made to the EUT.

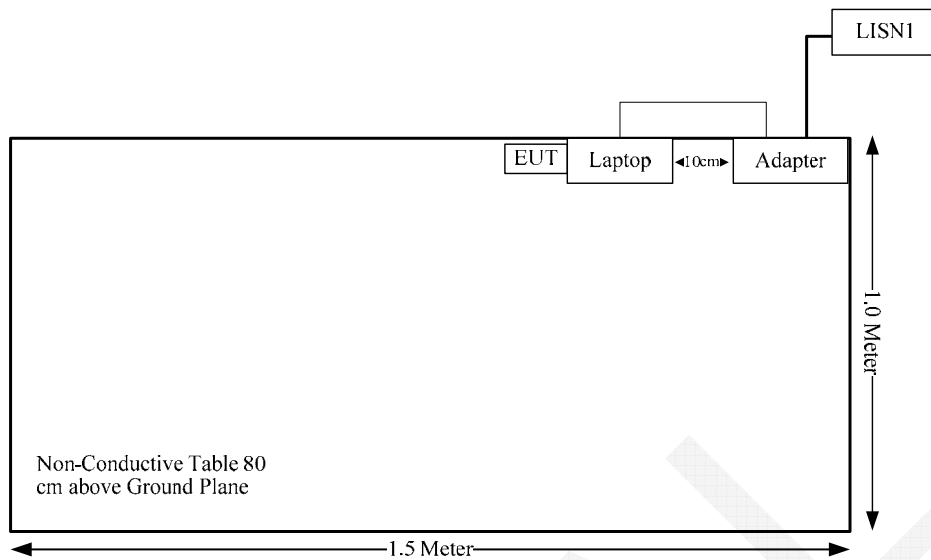
Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
Lenovo	Laptop	G510	CB30920865

External I/O Cable

Cable Description	Shielding Type	Ferrite Core	Length (m)	From	To
Adapter DC Cable	Yes	No	1.5	Adapter	Laptop

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

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 an internal antenna, the antenna gain is 0dBi, 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:

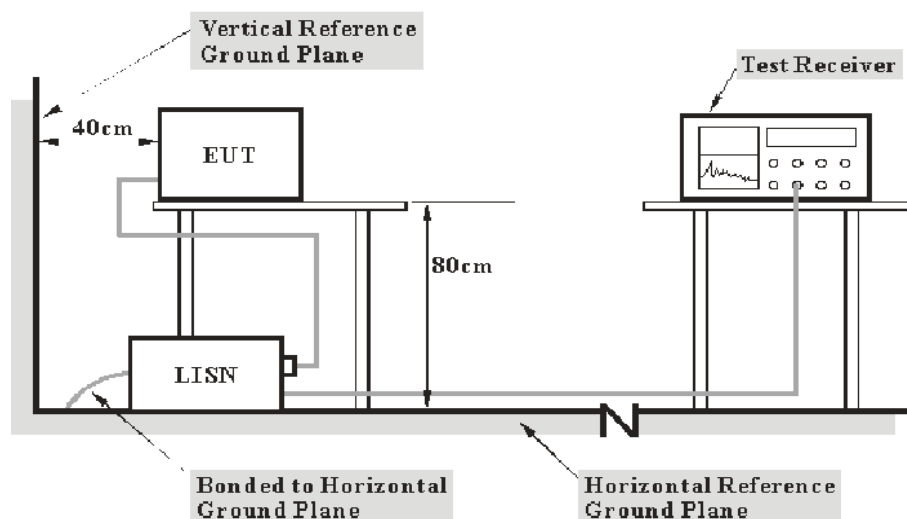
- compliance is deemed to occur if no measured disturbance level, increased by $(U_{lab} - U_{cisp})$, exceeds the disturbance limit;
- non-compliance is deemed to occur if any measured disturbance level, increased by $(U_{lab} - U_{cisp})$, exceeds the disturbance limit.

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 3.12 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 C63.10-2013 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 first 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	2015-12-10	2016-12-09
R&S	L.I.S.N	ESH3-Z5	892107/021	2015-07-16	2016-07-15
R&S	Two-line V-network	ENV 216	3560.6550.12	2015-11-26	2016-11-25
R&S	Test Software	EMC32	Version8.53.0	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:

8.4 dB at 0.187494 MHz in the Line conducted mode

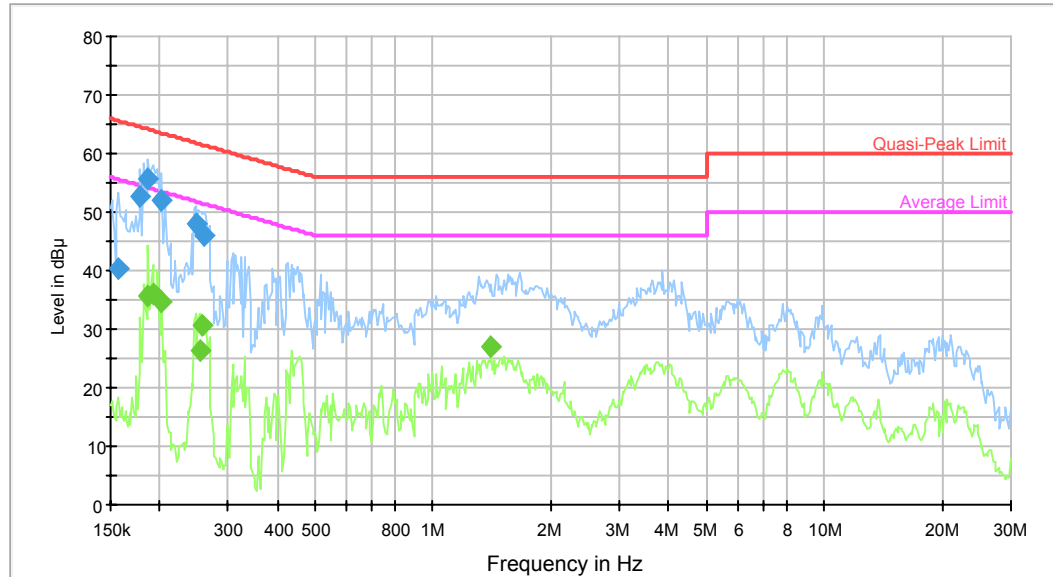
Test Data**Environmental Conditions**

Temperature:	23.5 °C
Relative Humidity:	62 %
ATM Pressure:	100.6 kPa

The testing was performed by Robin Zheng on 2016-03-18.

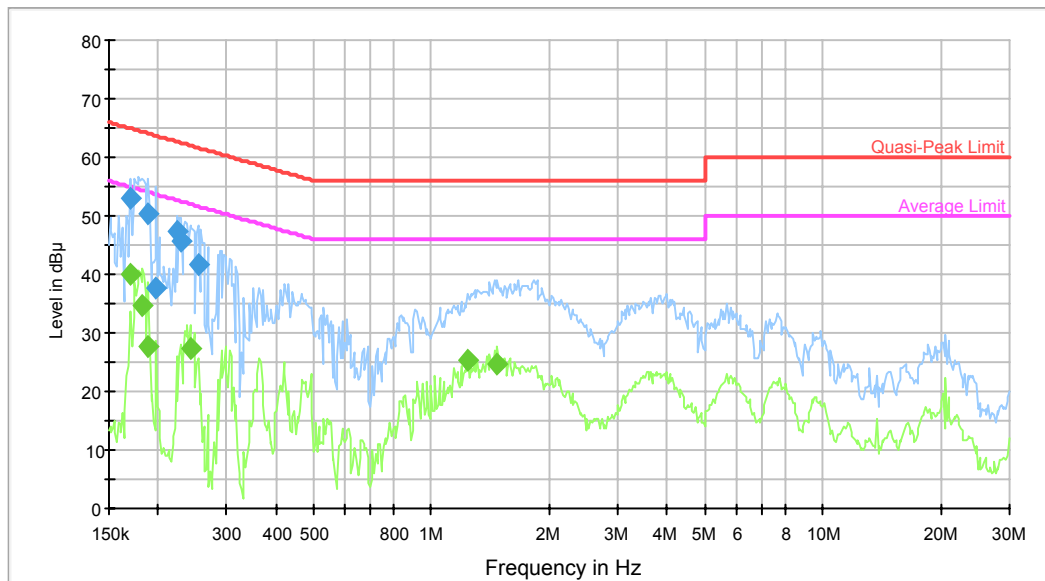
Test Mode: Transmitting

AC120 V, 60 Hz, Line:



Frequency (MHz)	Quasi Peak (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)	Comment
0.157346	40.4	9.000	L1	9.7	25.2	65.6	Compliance
0.178741	52.7	9.000	L1	9.7	11.8	64.5	Compliance
0.187494	55.7	9.000	L1	9.7	8.4	64.1	Compliance
0.203045	51.9	9.000	L1	9.7	11.6	63.5	Compliance
0.247802	47.8	9.000	L1	9.7	14.0	61.8	Compliance
0.259937	46.1	9.000	L1	9.7	15.3	61.4	Compliance

Frequency (MHz)	Average (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dB μ V)	Comment
0.187494	35.7	9.000	L1	9.7	18.4	54.1	Compliance
0.192030	36.1	9.000	L1	9.7	17.8	53.9	Compliance
0.203045	34.8	9.000	L1	9.7	18.7	53.5	Compliance
0.253797	26.4	9.000	L1	9.7	25.2	51.6	Compliance
0.255827	30.5	9.000	L1	9.7	21.1	51.6	Compliance
1.407671	27.2	9.000	L1	9.8	18.8	46.0	Compliance

AC120 V, 60 Hz, Neutral:

Frequency (MHz)	Quasi Peak (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.170396	53.0	9.000	N	9.7	11.9	64.9	Compliance
0.188994	50.3	9.000	N	9.7	13.8	64.1	Compliance
0.198249	37.6	9.000	N	9.7	26.1	63.7	Compliance
0.223418	47.2	9.000	N	9.7	15.5	62.7	Compliance
0.228823	45.8	9.000	N	9.7	16.7	62.5	Compliance
0.253797	41.5	9.000	N	9.7	20.1	61.6	Compliance

Frequency (MHz)	Average (dBμV)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.170396	39.8	9.000	N	9.7	15.1	54.9	Compliance
0.183065	34.5	9.000	N	9.7	19.8	54.3	Compliance
0.188994	27.8	9.000	N	9.7	26.3	54.1	Compliance
0.241949	27.3	9.000	N	9.7	24.7	52.0	Compliance
1.239175	25.5	9.000	N	9.8	20.5	46.0	Compliance
1.476605	24.5	9.000	N	9.8	21.5	46.0	Compliance

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_{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.

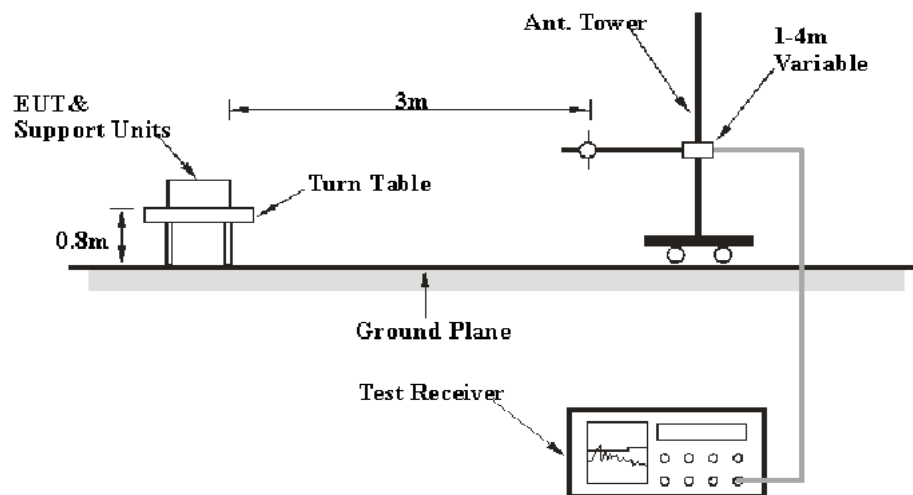
Based on CISPR 16-4-2: 2011, measurement uncertainty of radiated emission at a distance of 3m at Bay Area Compliance Laboratories Corp. (Dongguan) is: 30M~200MHz: 4.58 dB for Horizontal, 4.59 dB for Vertical; 200M~1GHz: 4.83 dB for Horizontal, 5.85 dB for Vertical; 1G~6GHz: 4.45 dB, 6G~18GHz: 5.23 dB

Table 1 – Values of U_{cispr}

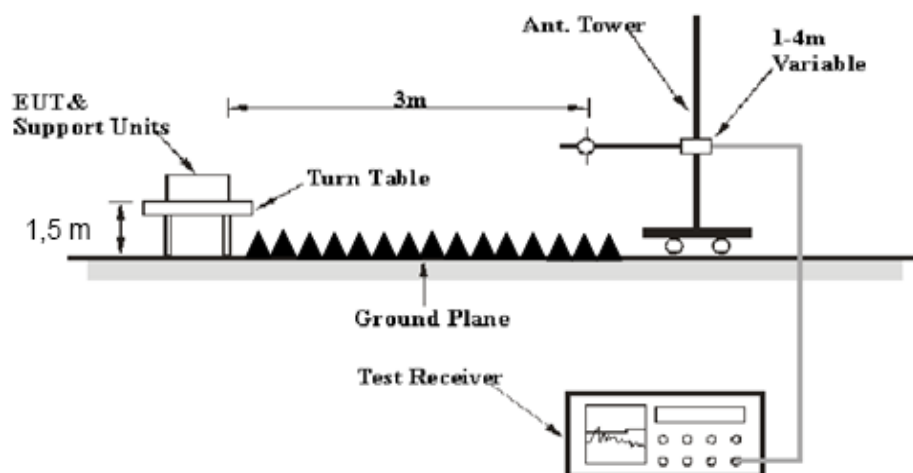
Measurement	U_{cispr}
Radiated disturbance (electric field strength at an OATS or in a SAC) (30 MHz to 1000 MHz)	6.3 dB
Radiated disturbance (electric field strength in a FAR) (1 GHz to 6 GHz)	5.2 dB
Radiated disturbance (electric field strength in a FAR) (6 GHz to 18 GHz)	5.5 dB

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 C63.10-2013 The specification used was the FCC 15.209/15.205 and FCC 15.249 limits.

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	120 kHz	QP
Above 1 GHz	1MHz	3 MHz	/	PK
	1MHz	10 Hz	/	Ave.

Test Procedure

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 30 MHz 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:

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

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESCI	100224	2015-08-03	2016-08-02
Sunol Sciences	Antenna	JB3	A060611-3	2014-11-06	2017-11-05
HP	Amplifier	8447E	2434A02181	2015-09-01	2016-09-01
Agilent	Spectrum Analyzer	E4440A	SG43360054	2015-11-23	2016-11-22
ETS-Lindgren	Horn Antenna	3115	9808-5557	2015-09-06	2018-09-06
Mini-Circuit	Amplifier	ZVA-213-S+	054201245	2016-02-19	2017-02-19
R&S	Spectrum Analyzer	FSP 38	100478	2015-11-23	2016-11-22
Ducommun Technologies	Horn Antenna	ARH-4223-02	1007726-01 1304	2014-06-16	2017-06-15
Quinstar	Amplifier	QLW-18405536-JO	15964001001	2015-09-06	2016-09-06
N/A	Coaxial Cable	14m	N/A	2015-05-06	2016-05-06
N/A	Coaxial Cable	8m	N/A	2015-05-06	2016-05-06

* **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.

Test Data**Environmental Conditions**

Temperature:	24.4 °C
Relative Humidity:	63 %
ATM Pressure:	100.6 kPa

The testing was performed by Robin Zheng on 2016-03-18.

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	Polar (H/V)	Factor (dB(1/m))					
frequency: 2408 MHz									
2408	54.96	PK	H	25.66	3.67	0.00	84.29	114.00	29.71
2408	53.04	AV	H	25.66	3.67	0.00	82.37	94.00	11.63
2408	54.45	PK	V	25.66	3.67	0.00	83.78	114.00	30.22
2408	52.49	AV	V	25.66	3.67	0.00	81.82	94.00	12.18
2400	29.94	PK	V	25.64	3.65	0.00	59.23	74.00	14.77
2400	19.71	AV	V	25.64	3.65	0.00	49.00	54.00	5.00
4816	33.04	PK	V	30.62	5.04	27.41	41.29	74.00	32.71
4816	20.86	AV	V	30.62	5.04	27.41	29.11	54.00	24.89
7224	32.05	PK	V	34.14	6.63	25.90	46.92	74.00	27.08
7224	18.6	AV	V	34.14	6.63	25.90	33.47	54.00	20.53
9632	29.18	PK	V	36.02	8.54	27.50	46.24	74.00	27.76
9632	16.13	AV	V	36.02	8.54	27.50	33.19	54.00	20.81
2773	33.36	PK	V	26.61	4.41	27.54	36.84	74.00	37.16
2773	21.21	AV	V	26.61	4.41	27.54	24.69	54.00	29.31
212	30.1	QP	V	11.29	1.75	21.47	21.67	43.50	21.83
frequency: 2440 MHz									
2440	56.27	PK	H	25.74	3.76	0.00	85.77	114.00	28.23
2440	54.28	AV	H	25.74	3.76	0.00	83.78	94.00	10.22
2440	55.71	PK	V	25.74	3.76	0.00	85.21	114.00	28.79
2440	53.74	AV	V	25.74	3.76	0.00	83.24	94.00	10.76
4880	33.09	PK	V	30.79	5.18	27.42	41.64	74.00	32.36
4880	20.94	AV	V	30.79	5.18	27.42	29.49	54.00	24.51
7320	32.09	PK	V	34.37	6.75	25.88	47.33	74.00	26.67
7320	18.66	AV	V	34.37	6.75	25.88	33.90	54.00	20.10
9760	29.24	PK	V	36.32	8.62	27.21	46.97	74.00	27.03
9760	16.19	AV	V	36.32	8.62	27.21	33.92	54.00	20.08
3157	33.17	PK	V	27.70	6.85	27.40	40.32	74.00	33.68
3157	21.12	AV	V	27.70	6.85	27.40	28.27	54.00	25.73
3240	32.67	PK	V	27.97	6.26	27.34	39.56	74.00	34.44
3240	20.29	AV	V	27.97	6.26	27.34	27.18	54.00	26.82
212	30.1	QP	V	11.29	1.75	21.47	21.67	43.50	21.83
frequency: 2474 MHz									
2474	56.78	PK	H	25.83	3.70	0.00	86.31	114.00	27.69
2474	54.8	AV	H	25.83	3.70	0.00	84.33	94.00	9.67
2474	56.24	PK	V	25.83	3.70	0.00	85.77	114.00	28.23
2474	54.32	AV	V	25.83	3.70	0.00	83.85	94.00	10.15
2483.5	29.48	PK	V	25.86	3.67	0.00	59.01	74.00	14.99
2483.5	17.91	AV	V	25.86	3.67	0.00	47.44	54.00	6.56
4948	33.12	PK	V	30.96	5.37	27.43	42.02	74.00	31.98
4948	20.95	AV	V	30.96	5.37	27.43	29.85	54.00	24.15
7422	32.14	PK	V	34.61	6.87	25.92	47.70	74.00	26.30
7422	18.73	AV	V	34.61	6.87	25.92	34.29	54.00	19.71
9896	29.26	PK	V	36.65	8.69	26.76	47.84	74.00	26.16
9896	16.27	AV	V	36.65	8.69	26.76	34.85	54.00	19.15
3157	33.28	PK	V	27.70	6.85	27.40	40.43	74.00	33.57
3157	21.01	AV	V	27.70	6.85	27.40	28.16	54.00	25.84
212	30.1	QP	V	11.29	1.75	21.47	21.67	43.50	21.83

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	FSEM	831259/019	2015-07-28	2016-07-27
E-Microwave	DC Blocking	EMDCB-00036	0E01201047	2015-05-06	2016-05-06
N/A	Coaxial Cable	0.1m	N/A	2015-05-06	2016-05-06

* **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:	23.6°C
Relative Humidity:	55 %
ATM Pressure:	100.6 kPa

* The testing was performed by Robin Zheng on 2016-03-17.

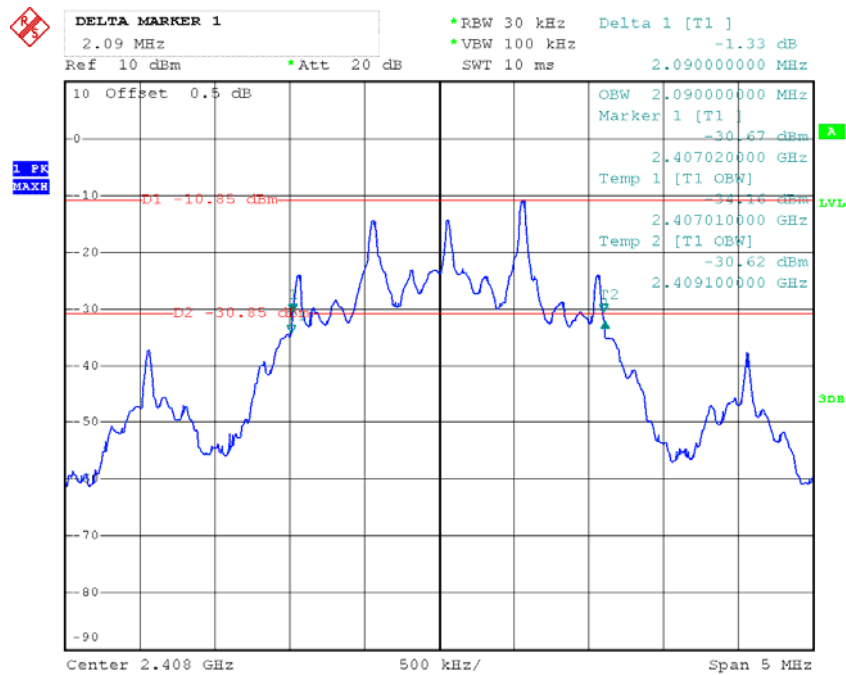
Test Result: Compliant.

Please refer to following tables and plots

Test Mode: Transmitting

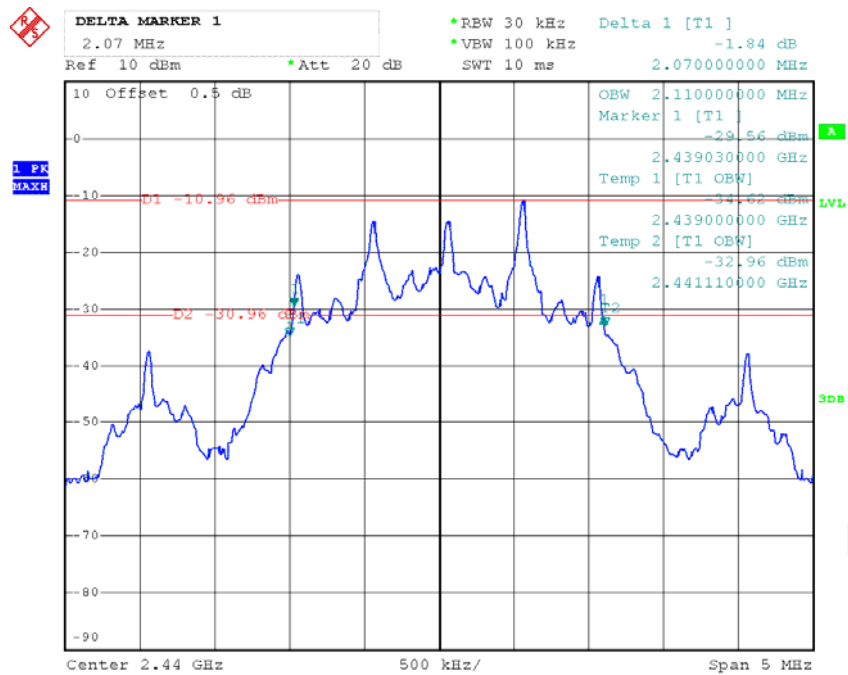
Channel	Frequency (MHz)	20 dB Bandwidth (MHz)
Low	2408	2.09
Middle	2440	2.07
High	2474	2.07

Low Channel



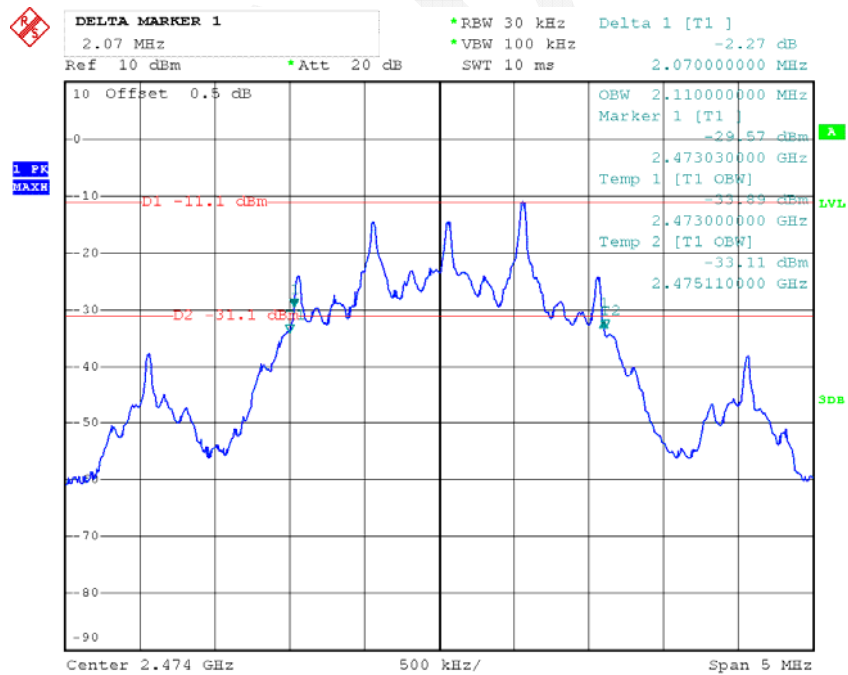
Date: 17.MAR.2016 21:40:28

Middle Channel



Date: 17.MAR.2016 21:43:36

High Channel



Date: 17.MAR.2016 21:47:27

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