

FCC PART 15.249

TEST REPORT

For

HHC Changzhou Corp.

No 61, Xinggang Road, Zhonglou District, Changzhou, Jiangsu, China, 213023

FCC ID: 2AEQWCB11HHC007

Report Type: Original Report		Product Type: Control Box	
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Report Number:	RKS161221002-00C		
Report Date:	2016-12-25		
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Manufacturer	HHC Changzhou Corp.
Tested Model	CB11B
Series Model	N/A
Product Type	Control Box
Dimension	170 mm (L) × 94mm (W) × 38 mm (H)
Power input	DC 29V

Adapter Information:

Model: W52RA199-290018

Input: AC 100-240V, 50/60 Hz, 1.5A

Output: DC 29V, 1.8A

**All measurement and test data in this report was gathered from production sample serial number: 20161215014 (Assigned by the BACL. The EUT supplied by the applicant was received on 2016-12-15)*

Objective

This type approval report is prepared on behalf of HHC Changzhou Corp. 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(a), 15.209, 15.215 (c) and 15.249 rules.

Related Submittal(s)/Grant(s)

FCC Part 15.249 DXX submissions with FCC ID: 2AEQWCH10HHC005.

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 radiated and conducted emissions measurement was performed at Bay Area Compliance Lab Corp. (Kunshan). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Measurement Uncertainty

Item		Uncertainty
AC Power Lines Conducted Emissions		3.26 dB
RF conducted test with spectrum		0.9dB
RF Output Power with Power meter		0.5dB
Radiated emission	30MHz~1GHz	5.91dB
	1GHz~6GHz	4.68dB
	6 GHz ~18 GHz	4.92dB
	18 GHz~40 GHz	4.88dB
Occupied Bandwidth		0.5kHz
Temperature		1.0°C
Humidity		6%

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Kunshan) to collect test data is located on the No.248 Chenghu Road,Kunshan,Jiangsu province,China.

Test site at Bay Area Compliance Laboratories Corp. (Kunshan) 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 December 06, 2014. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4.

The Federal Communications Commission has the reports on file and is listed under FCC Registration No.: 815570. 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 in testing mode which was provided by manufacturer, 3 channels are provided for testing:

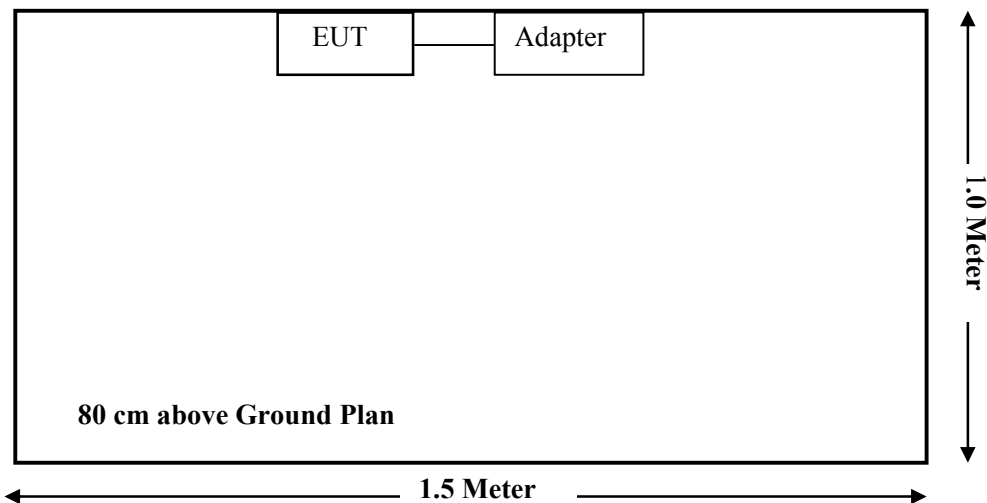
Low Channel: 2402MHz, Middle Channel: 2415MHz, High Channel: 2426 MHz

EUT Exercise Software

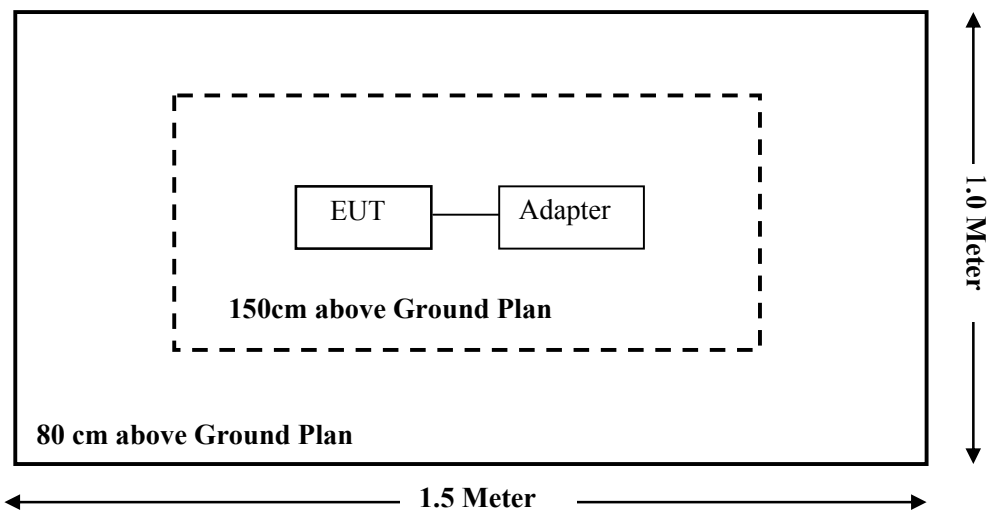
No software was used during the test.

Block Diagram of Test Setup

For Radiated Emissions (Below 1GHz)



For Radiated Emissions (Above 1GHz)



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& Out of Band Emission	Compliance
§15.215 (c)	20 dB Bandwidth	Compliance

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiated Emission Test					
Rohde & Schwarz	EMI Test Receiver	ESCI	100195	2016-11-25	2017-11-24
Rohde & Schwarz	Signal Analyzer	FSIQ26	100048	2016-11-25	2017-11-24
Sunol Sciences	Broadband Antenna	JB3	A090314-2	2016-01-09	2019-01-08
ETS	Horn Antenna	3115	6229	2016-01-11	2019-01-10
Sonoma Instrument	Amplifier	330	171377	2016-12-12	2017-12-11
Narda	Pre-amplifier	AFS42-00101800	2001270	2016-12-12	2017-12-11
R&S	Auto test Software	EMC32	100361	/	/
Haojintech	Coaxial Cable	Cable-1	001	2016-12-12	2017-12-11
Haojintech	Coaxial Cable	Cable-2	002	2016-12-12	2017-12-11
Haojintech	Coaxial Cable	Cable-3	003	2016-12-12	2017-12-11
MICRO-COAX	Coaxial Cable	Cable-4	004	2016-12-12	2017-12-11
MICRO-COAX	Coaxial Cable	Cable-5	005	2016-12-12	2017-12-11
RF Conducted Test					
Rohde & Schwarz	FSV40 Signal Analyzer	FSV40	101116	2016-07-04	2017-07-03
HHC	RF Cable	N/A	N/A	2016-12-16	2017-12-15
Conducted Emission Test					
Rohde & Schwarz	EMI Test Receiver	ESCS30	834115/007	2016-11-25	2017-11-24
Rohde & Schwarz	LISN	ESH3-Z5	862770/011	2016-10-10	2017-10-09
Rohde & Schwarz	LISN	ENV216	3560655016	2016-11-25	2017-11-24
Rohde & Schwarz	CE Test software	EMC 32	100357	/	/
MICRO-COAX	Coaxial Cable	Cable-6	006	2016-09-08	2017-09-07

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 a PCB antenna arrangement and antenna gain is 2.0dBi, which was permanently attached, fulfill the requirement of this section, please refer to the EUT photos.

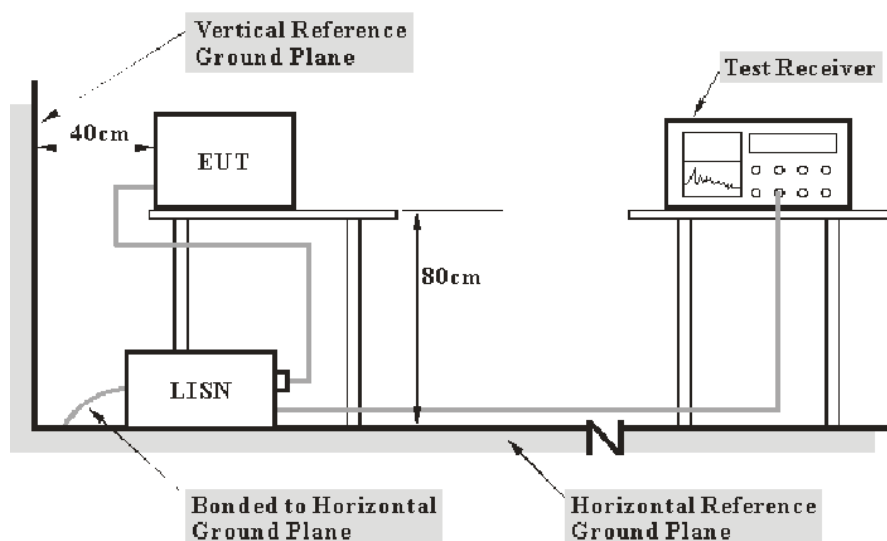
Result: Compliant.

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC§15.207

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.

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 was connected to the outlet of the 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 Factor & Margin Calculation

The Corrected factor is calculated by adding LISN VDF (Voltage Division Factor), Cable Loss and Transient Limiter Attenuation. The basic equation is as follows:

$$\text{Correction Factor} = \text{LISN VDF} + \text{Cable Loss}$$

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

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

Test Results Summary

According to the recorded data in following table, the EUT complied with the FCC Part 15.207.

Refer to CISPR16-4-2:2011 and CISPR 16-4-1:2009, the measured level complies with the limit if

$$L_m + U_{(Lm)} \leq L_{lim} + U_{cispr}$$

In BACL, $U_{(Lm)}$ is less than U_{cispr} , if L_m is less than L_{lim} , it implies that the EUT complies with the limit.

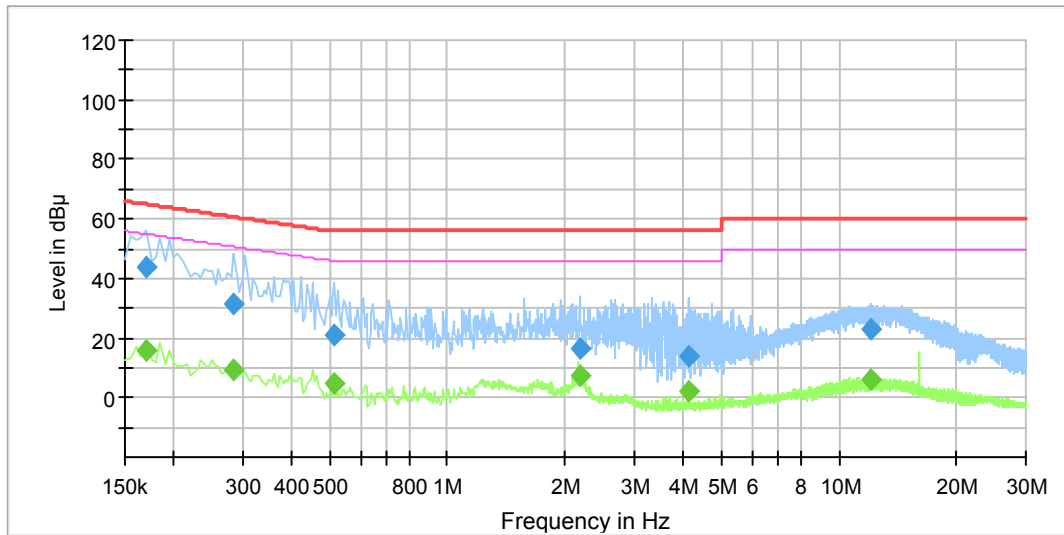
Test Data

Environmental Conditions

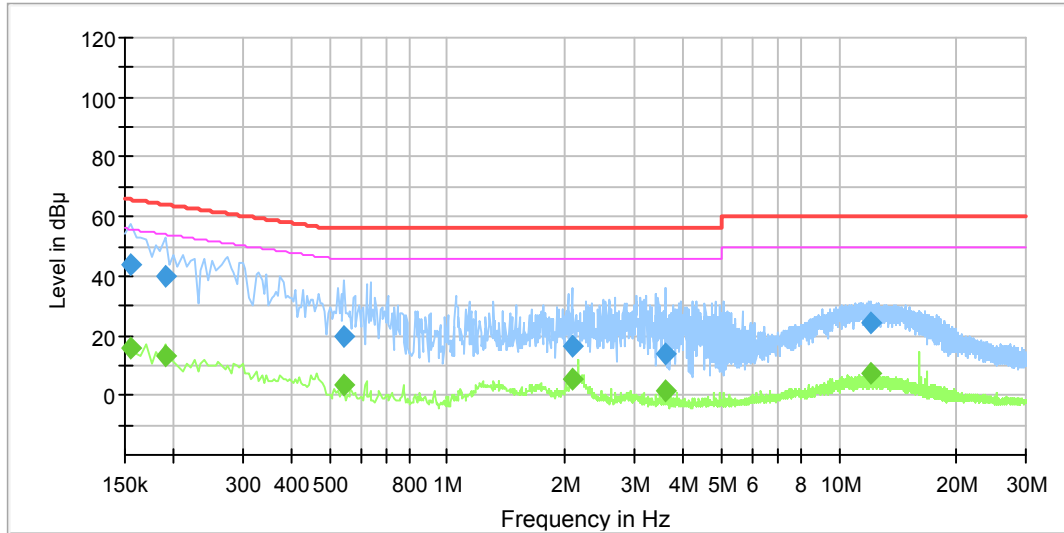
Temperature:	23 °C
Relative Humidity:	55 %
ATM Pressure:	101.1kPa

The testing was performed by Chris Wang on 2016-12-19.

EUT operation mode: Transmitting

AC 120V/60 Hz, Line

Frequency (MHz)	QuasiPeak (dBμV)	Average (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.170000	---	15.83	9.000	L1	10.3	39.13	54.96	Compliance
0.170000	43.71	---	9.000	L1	10.3	21.25	64.96	Compliance
0.285000	---	9.00	9.000	L1	10.3	41.67	50.67	Compliance
0.285000	31.73	---	9.000	L1	10.3	28.94	60.67	Compliance
0.515000	---	4.96	9.000	L1	10.3	41.04	46.00	Compliance
0.515000	20.82	---	9.000	L1	10.3	35.18	56.00	Compliance
2.175000	---	7.15	9.000	L1	10.4	38.85	46.00	Compliance
2.175000	16.43	---	9.000	L1	10.4	39.57	56.00	Compliance
4.140000	---	1.95	9.000	L1	10.5	44.05	46.00	Compliance
4.140000	14.02	---	9.000	L1	10.5	41.98	56.00	Compliance
12.075000	---	6.22	9.000	L1	10.4	43.78	50.00	Compliance
12.075000	23.15	---	9.000	L1	10.4	36.85	60.00	Compliance

AC 120V/60 Hz, Neutral

Frequency (MHz)	QuasiPeak (dBμV)	Average (dB μ V)	Bandwidth (kHz)	Line	Corr. (dB)	Margin (dB)	Limit (dBμV)	Comment
0.155000	---	15.62	9.000	N	10.3	40.11	55.73	Compliance
0.155000	44.02	---	9.000	N	10.3	21.71	65.73	Compliance
0.190000	---	13.01	9.000	N	10.3	41.03	54.04	Compliance
0.190000	39.84	---	9.000	N	10.3	24.20	64.04	Compliance
0.545000	---	3.35	9.000	N	10.3	42.65	46.00	Compliance
0.545000	20.00	---	9.000	N	10.3	36.00	56.00	Compliance
2.075000	---	5.68	9.000	N	10.4	40.32	46.00	Compliance
2.075000	16.55	---	9.000	N	10.4	39.45	56.00	Compliance
3.615000	---	1.72	9.000	N	10.5	44.28	46.00	Compliance
3.615000	14.15	---	9.000	N	10.5	41.85	56.00	Compliance
12.090000	---	7.06	9.000	N	10.5	42.94	50.00	Compliance
12.090000	24.25	---	9.000	N	10.5	35.75	60.00	Compliance

Note:

- 1) Corr. = LISN VDF (Voltage Division Factor) + Cable Loss
- 2) Corrected Amplitude = Reading + Corr.
- 3) Margin = Limit - Corrected Amplitude

FCC§15.205, §15.209&§15.249- RADIATED EMISSIONS& OUT OF BAND EMISSION

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:

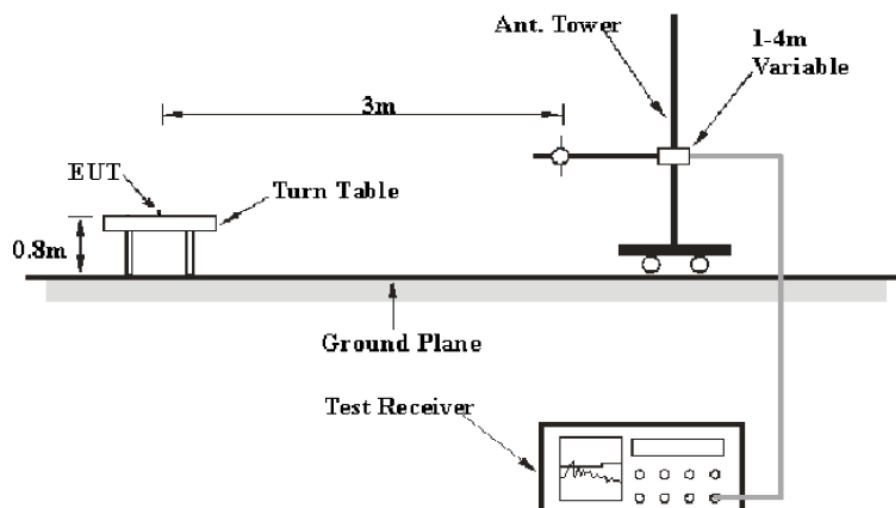
Fundamental frequency	Field strength of fundamental (millivolts/meter)	Field strength of harmonics (microvolts/meter)
902–928 MHz	50	500
2400–2483.5 MHz	50	500
5725–5875 MHz	50	500
24.0–24.25 GHz	250	2500

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

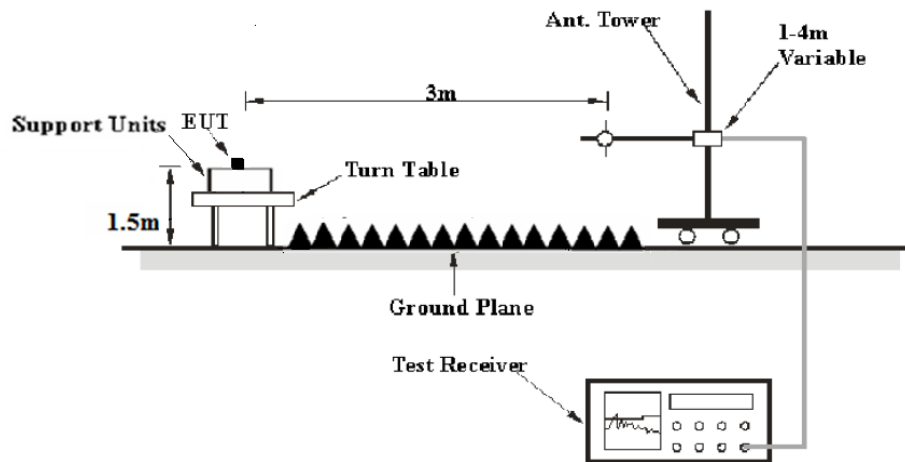
(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

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.

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

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

Frequency Range	RBW	Video B/W	Duty cycle	Detector
1GHz – 25GHz	1MHz	3 MHz	Any	PK
	1MHz	10 Hz	>98%	Ave.
	1MHz	1/T	<98%	

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 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:

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

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:	24.6°C
Relative Humidity:	52%
ATM Pressure:	101.2 kPa

The testing was performed by Chris Wang on 2016-12-19.

Test Mode: Transmitting

30MHz-25GHz:**Field Strength of Peak Emission**

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB)	Corrected Amplitude (dBμV/m)	FCC Part 15.249/205/209	
	Reading (dBμV)	Detector (PK/QP/Ave.)		Height (cm)	Polar (H/V)			Limit (dB μ V/m)	Margin (dB)
Low Channel (2402.00MHz)									
879.00	41.96	QP	92	1.0	V	-1.01	40.95	46.00	5.05
2402.00	95.46	PK	39	1.5	H	-6.19	89.27	114.00	24.73
2402.00	95.60	PK	39	1.5	V	-6.19	89.41	114.00	24.59
2390.00	62.75	PK	270	2.5	H	-6.22	56.53	74.00	17.47
2390.00	62.47	PK	270	2.5	V	-6.22	56.25	74.00	17.75
2400.00	62.21	PK	301	1.5	H	-6.19	56.02	74.00	13.98
2400.00	61.97	PK	301	1.5	V	-6.19	55.78	74.00	14.22
4804.00	43.05	PK	344	1.8	H	1.61	44.66	74.00	29.34
4804.00	42.86	PK	344	1.8	V	1.61	44.47	74.00	29.53
7206.00	40.03	PK	132	1.9	H	7.55	47.58	74.00	26.42
7206.00	39.47	PK	132	1.9	V	7.55	47.02	74.00	26.98
Middle Channel (2415.00MHz)									
879.00	41.89	QP	92	1.0	V	-1.01	40.88	46.00	5.12
2415.00	95.15	PK	243	1.7	H	-6.16	88.99	114.00	25.03
2415.00	95.54	PK	243	1.7	V	-6.16	89.38	114.00	24.64
4830.00	42.40	PK	97	1.3	H	1.67	44.07	74.00	29.93
4830.00	42.21	PK	97	1.3	V	1.67	43.88	74.00	30.12
7245.00	39.21	PK	354	1.1	H	7.59	46.80	74.00	27.20
7245.00	39.30	PK	354	1.1	V	7.59	46.89	74.00	27.11
High Channel (2426.00MHz)									
879.00	41.98	QP	92	1.0	V	-1.01	40.97	46.00	5.03
2426.00	95.57	PK	5	2.3	H	-6.14	89.43	114.00	24.61
2426.00	95.64	PK	5	2.3	V	-6.14	89.50	114.00	24.54
2483.50	48.63	PK	216	2.1	H	-6.01	42.62	74.00	31.38
2483.50	47.98	PK	216	2.1	V	-6.01	41.97	74.00	32.03
4852.00	43.02	PK	44	1.1	H	1.72	44.74	74.00	29.26
4852.00	42.96	PK	44	1.1	V	1.72	44.68	74.00	29.32
7278.00	39.35	PK	151	2.2	H	7.62	46.97	74.00	27.03
7278.00	38.80	PK	151	2.2	V	7.62	46.42	74.00	27.58

Note:

Corrected Amplitude = Corrected Factor + Reading

Corrected Factor = Antenna factor (Rx) + cable loss – amplifier factor

Margin = Limit - Corr. Amplitude

Field Strength of Average Emission

Frequency (MHz)	Peak Measurement@3m (dBμV/m)	Polar (H/V)	Duty Cycle	Duty Cycle Correction Factor (dB)	Corrected Amplitude (dBμV/m)	FCC Part 15.249/205/209	
						Limit (dBμV/m)	Margin (dB)
Low Channel (2402.00 MHz)							
2402.00	89.27	H	0.2450	-12.22	77.05	94.00	16.95
2402.00	89.41	V	0.2450	-12.22	77.19	94.00	16.81
2390.00	56.53	H	0.2450	-12.22	44.31	54.00	9.69
2390.00	56.25	V	0.2450	-12.22	44.03	54.00	9.97
2400.00	56.02	H	0.2450	-12.22	43.80	54.00	10.20
2400.00	55.78	V	0.2450	-12.22	43.56	54.00	10.44
4804.00	44.66	H	0.2450	-12.22	32.44	54.00	21.56
4804.00	44.47	V	0.2450	-12.22	32.25	54.00	21.75
7206.00	47.58	H	0.2450	-12.22	35.36	54.00	18.64
7206.00	47.02	V	0.2450	-12.22	34.80	54.00	19.20
Middle Channel (2415.00MHz)							
2415.00	88.99	H	0.2450	-12.22	76.77	94.00	17.23
2415.00	89.38	V	0.2450	-12.22	77.16	94.00	16.84
4830.00	44.07	H	0.2450	-12.22	31.85	54.00	22.15
4830.00	43.88	V	0.2450	-12.22	31.66	54.00	22.34
7245.00	46.80	H	0.2450	-12.22	34.58	54.00	19.42
7245.00	46.89	V	0.2450	-12.22	34.67	54.00	19.33
High Channel (2426.00MHz)							
2426.00	89.43	H	0.2450	-12.22	77.21	94.00	16.79
2426.00	89.50	V	0.2450	-12.22	77.28	94.00	16.72
2483.50	42.62	H	0.2450	-12.22	30.40	54.00	23.60
2483.50	41.97	V	0.2450	-12.22	29.75	54.00	24.25
4852.00	44.74	H	0.2450	-12.22	32.52	54.00	21.48
4852.00	44.68	V	0.2450	-12.22	32.46	54.00	21.54
7278.00	46.97	H	0.2450	-12.22	34.75	54.00	19.25
7278.00	46.42	V	0.2450	-12.22	34.20	54.00	19.80

Note:

Average = Peak + Duty Cycle Correction Factor

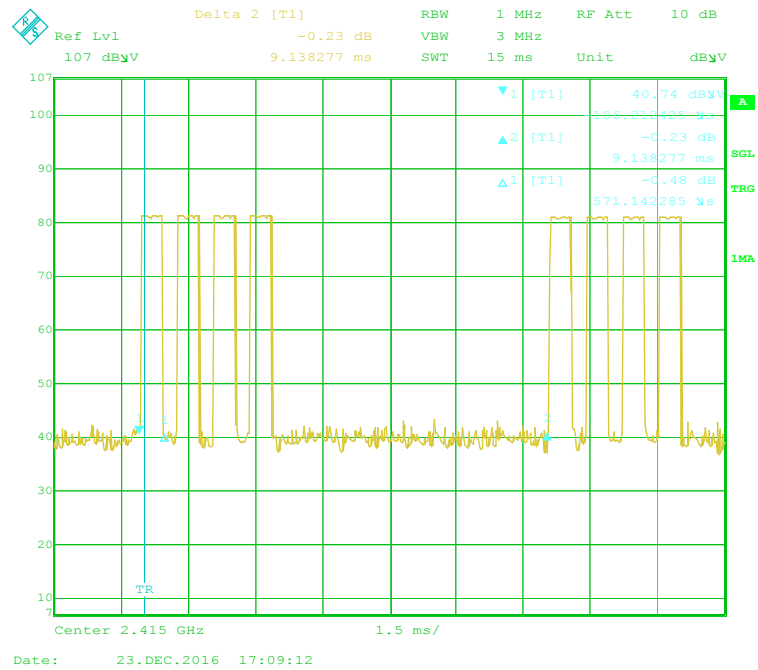
Duty Cycle correction factor=20*log10 (Duty cycle)

Duty cycle

Duty cycle= Ton/ Tp= 4*0.5711ms/ 9.1383ms=0.2450

Test plots:

Duty cycle



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 Data

Environmental Conditions

Temperature:	24.2°C
Relative Humidity:	51 %
ATM Pressure:	101.2kPa

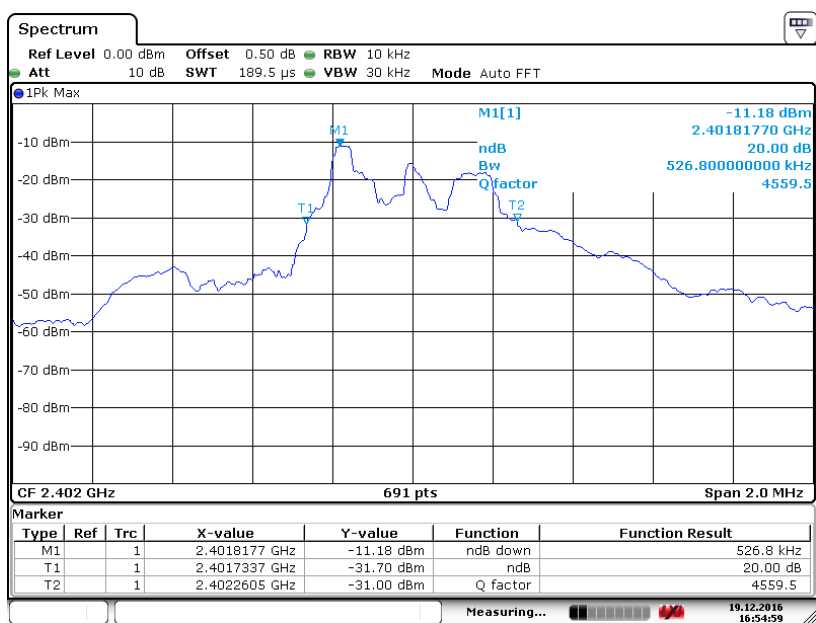
** The testing was performed by Chris Wang on 2016-12-19.*

Test Result: Compliant.

Please refer to following tables and plots

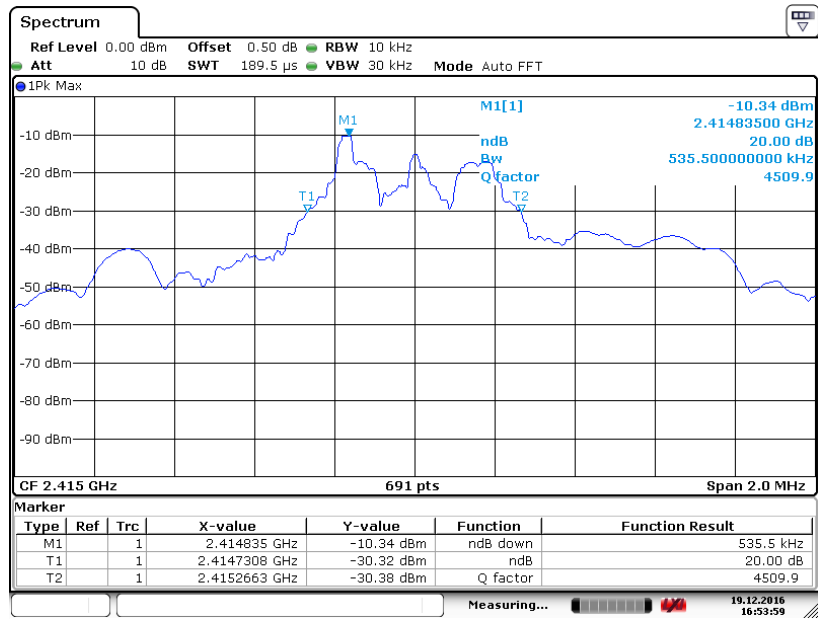
Test Mode: Transmitting

Channel	Frequency (MHz)	20 dB Bandwidth (MHz)
Low	2402.00	0.5268
Middle	2415.00	0.5355
High	2426.00	0.5673

Low Channel

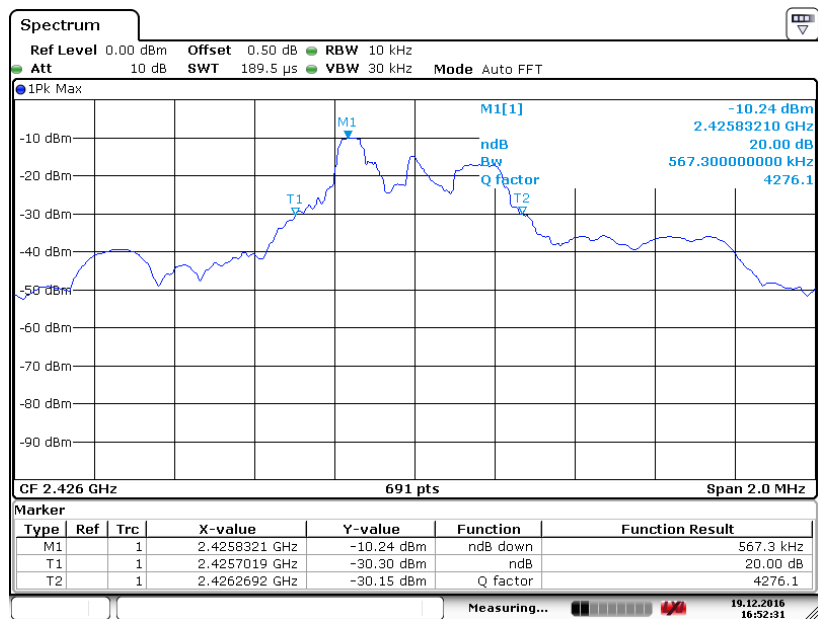
Date: 19.DEC.2016 16:54:59

Middle Channel



Date: 19 DEC 2016 16:53:59

High Channel



Date: 19 DEC 2016 16:52:31

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