China

FCC/IC- TEST REPORT

Report Number	:	**7088818001181-00**	Date of Issue:	October 31, 2018

Model	:	9290019683
Product Name	:	9290019683
Product Description	:	Hue Engine
FCC ID	:	2AGBW9290019683X
IC	:	20812-9683X
Applicant	:	Philips Lighting(China) Investment Co.,Ltd.
Address	:	Building 9, Lane 888, Tian Lin Road, Min Hang District Shangha, P.R.C.
Production Facility	:	Philips Lighting(China) Investment Co.,Ltd.
Address	:	Building 9, Lane 888, Tian Lin Road, Min Hang District Shangha, P.R.C.

Test Result	:	■ **Positive**	☐ **Negative**
Total pages including Appendices	:	38	

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2 Details about the Test Laboratory

Details about the Test Laboratory
Test Site 1

Company name:	TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch No.16 Lane, 1951 Du Hui Road, Shanghai 201108, P.R. China
FCC Registration No.:	820234
Telephone:	+86 21 6141 0123
Fax:	+86 21 6140 8600

Test Site 2

Company name:	MRT Technology (Suzhou) Co., Ltd. D8 Building, Youxin Industrial Park, No. 2 Tina'ed Wuzhong Economic Development Zone, Suzhou, China
FCC Registration No.:	893164
IC Registration No.:	11384A-1
Telephone:	+86-512-66308358
Fax:	+86-512-66308368

3 Description of the Equipment under Test

Description of the Equipment Under Test

Product: Hue Engine

Model no.: 9290019683

FCC ID: 2AGBW9290019683X

IC: 20812-9683X

Options and accessories: NA

Input Rated Voltage DC 3.3V with power module 24V input
Extreme Voltage NA

RF Transmission Frequency: 2405MHz ~ 2480MHz
No. of Operated Channel: 5

Channel list:

Operation Frequency each of channel	
Channel	**Frequency**
11	2405MHz
15	2425MHz
20	2450MHz
25	2475MHz
26	2480MHz

Radio technology: Zigbee
Modulation: 16-ary orthogonal modulation, O-QPSK PHY
Data speed: 250kbps MAX
Hardware version: HW v1.0
Software version: SW v1.0
Antenna Type: Integrated
Antenna Gain: 3.48dBi
Description of the EUT: The Equipment Under Test (EUT) is a Zigbee Module, the TX and RX frequency range is 2405MHz-2480MHz.

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4 Summary of Test Standards

Test Standards	
FCC Part 15 Subpart C	PART 15 - RADIO FREQUENCY DEVICES Subpart C - Intentional Radiators
RSS-247 Issue 2	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

All the test methods were according to KDB558074 D01 DTS Measurement Guidance v04 and ANSI C63.10 (2013).

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5 Summary of Test Results

Technical Requirements						
FCC Part 15 Subpart C & RSS-210 Issue 2						
Test Condition		Pages	Test Site	Test Result		
				Pass	Fail	N/A
§15.207 RSS-Gen [8.8]	Conducted emission AC power port	---	---	☐	☐	☒
§15.247 (b) (1) RSS-247 [5.4(4)]	Conducted peak output power	11	Site 2	☒	☐	☐
§15.247(a)(1)	20dB bandwidth	---	---	☐	☐	☒
§15.247(a)(1)	Carrier frequency separation	---	---	☐	☐	☒
§15.247(a)(1)(iii)	Number of hopping frequencies	---	---	☐	☐	☒
§15.247(a)(1)(iii)	Dwell Time	---	---	☐	☐	☒
§15.247(e) RSS-247 [5.2]	Power spectral density	12	Site 2	☒	☐	☐
§15.247(a)(2) RSS-247 [5.2]	6dB bandwidth and 99% Occupied Bandwidth	14	Site 2	☒	☐	☐
§15.247(d) RSS-247 [5.5]	Spurious RF conducted emissions	16	Site 2	☒	☐	☐
§15.247(d) & §15.209 RSS-247 [5.5]	Spurious radiated emissions and Band edge for transmitter	20	Site 2	☒	☐	☐
§15.203	Antenna requirement	See note 1		☒	☐	☐

Remark 1: N/A – Not Applicable.
Note 1: §15.203 requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. 15.247(c) (1)(i) requirement: (i) Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.
E.U.T Antenna: The Zigbee module antenna is an integrated PCB antenna, the best-case gain of the antenna is 3.48 dBi.
The antenna of the **Hue Engine**, is permanently attached.
There are no provisions for connection to an external antenna.

Conclusion: The EUT unit complies with the requirement of §15.203.

Note 2: All modes of operation were investigated. For radiated emission test, every axis (X, Y, Z) was also verified. The test results shown in the following sections represent the worst-case emissions.

6 General Remarks

Remarks

This submittal(s) (test report) is intended for FCC ID: 2AGBW9290019683X, IC: 20812-9683X complies with Section 15.207, 15.209, 15.247 of the FCC Part 15, Subpart C Rules and RSS-247 Issue 2.

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SUMMARY:

All tests according to the regulations cited on page 5 were

■ - Performed

☐ - **Not** Performed

The Equipment under Test

■ - **Fulfills** the general approval requirements.

☐ - **Does not** fulfill the general approval requirements.

Sample Received Date:	September 29, 2018
Testing Start Date:	September 30, 2018
Testing End Date:	October 31, 2018

- TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch

Reviewed by: Prepared by:

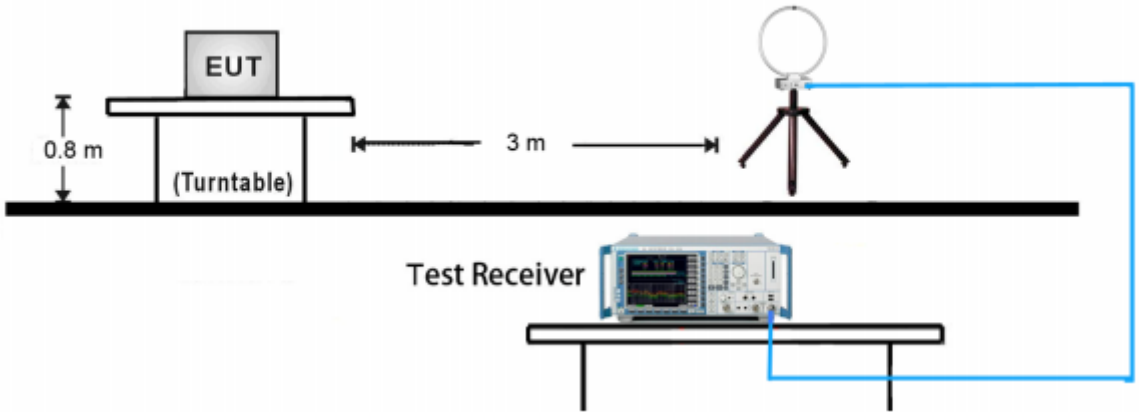
Hui TONG
Review Engineer

Jiaxi XU
Project Engineer

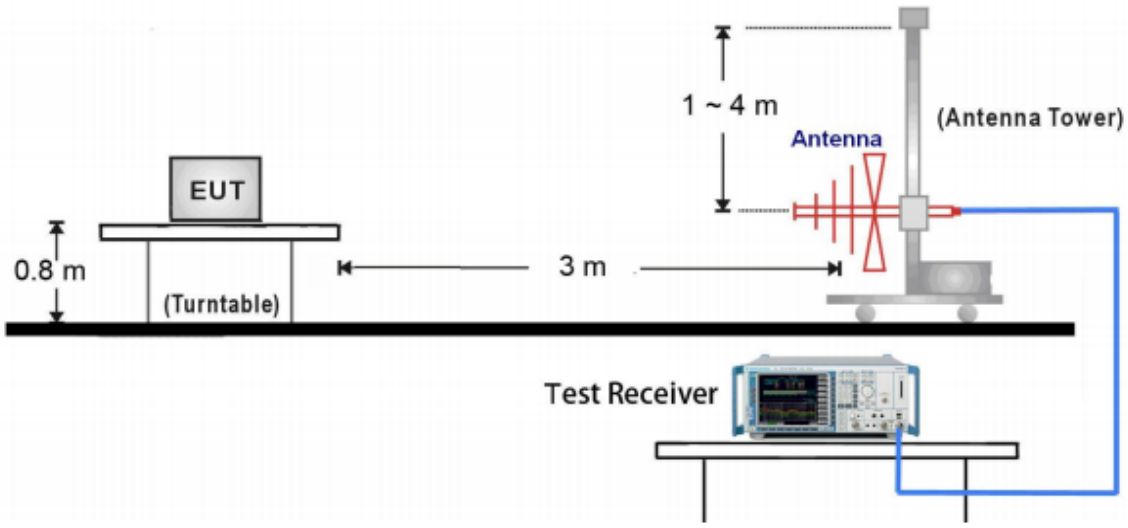
7 Test Setups

7.1 Radiated test setups

9kHz ~ 30MHz Test Setup:



30MHz ~ 1GHz Test Setup:



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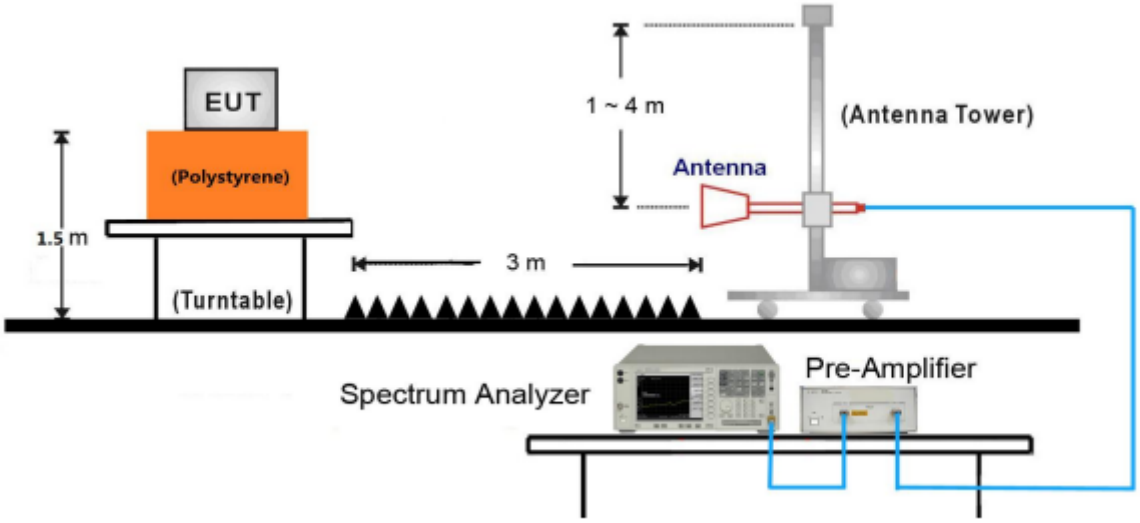
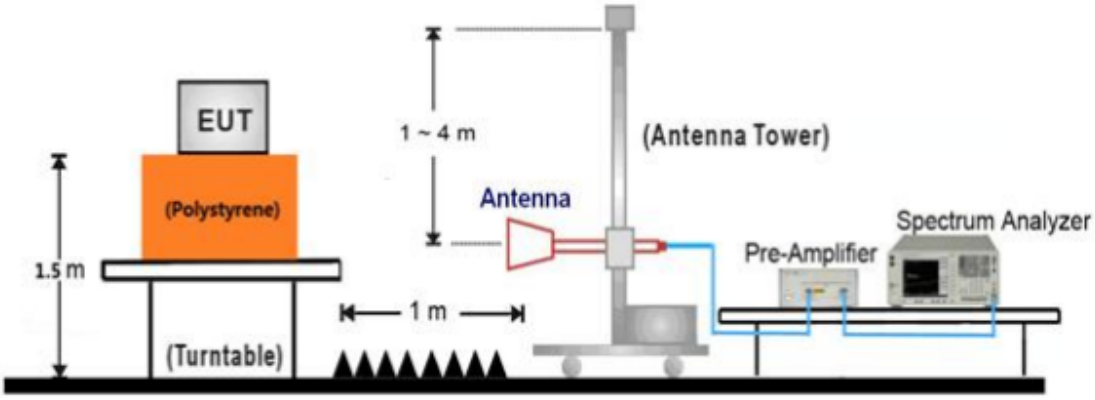
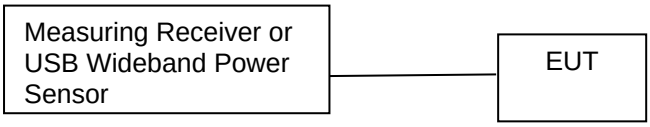
1GHz ~ 18GHz Test Setup:



18GHz ~ 25GHz Test Setup:



7.2 Conducted RF test setups



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8 Systems test configuration

Auxiliary Equipment Used during Test:

DESCRIPTION	MANUFACTURER	MODEL NO.(SHIELD)
Notebook	Lenovo	X240

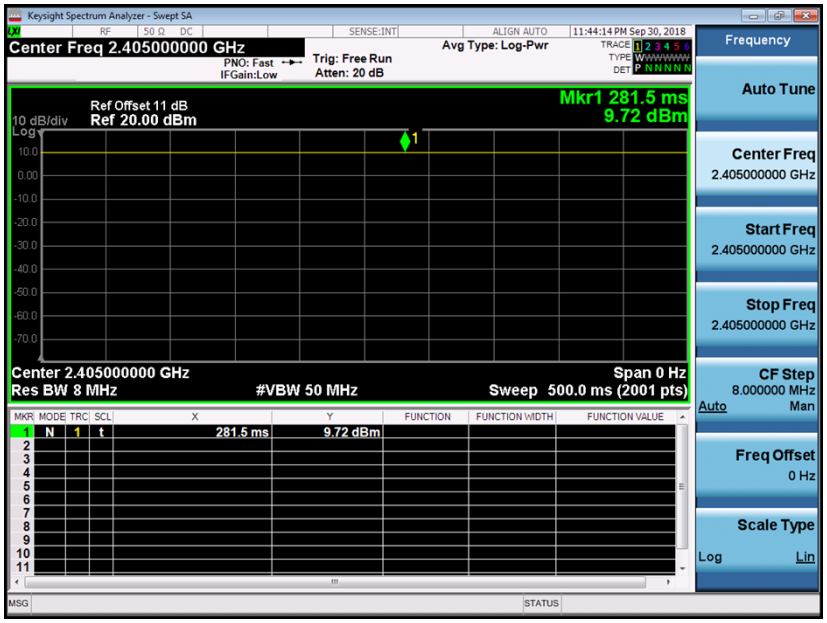
Test channel & mode:
The Hue Engine was configured using a proprietary communication interface provided by the client. The interface allows channel control required to support the evaluation.

Test software	HueApprobationTool.exe

Test mode	Channel	Frequency (MHz)
Tx	11	2405
Tx	20	2450
Tx	26	2480

Device Capabilities
This device contains the following capabilities:
ZigBee Module Device.
Note: The maximum achievable duty cycles was determined based on measurements performed on a spectrum analyzer in zero-span mode with RBW = 8MHz, VBW = 50MHz, and detector = peak per the guidance of Section 6.0 b) of KDB 558074 D01v04. The RBW and VBW were both greater than 50/T, where T is the minimum transmission duration, and the number of sweep points across T was greater than 100. The duty cycles are as follows:

Test Mode	Duty Cycle
O-QPSK	100%



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9 Technical Requirement

9.1 Conducted peak output power

Test Method

KDB 558074 D01 v04 – Section 9.1.3 PKPM1 – Peak Power Method

9.1.3 PKPM1 Peak-reading power meter method:
The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall utilize a fast-responding diode detector.

Limits

Frequency Range MHz	Limit W	Limit dBm
2400-2483.5	≤1	≤30

Test result as below table

Model	Ch.	Freq. (MHz)	Peak Power (dBm)	Limit (dBm)
O-QPSK	11	2405	9.20	30
	18	2450	9.33	30
	26	2480	9.00	30

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9.2 6dB bandwidth and 99% Occupied Bandwidth

Test Method

1. Use the following spectrum analyzer settings:
   RBW=100K, VBW≥3RBW, Sweep = auto, Detector function = peak, Trace = max hold
2. Use the automatic bandwidth measurement capability of an instrument, may be employed using the X dB bandwidth mode with X set to 6 dB, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 dB.
3. Allow the trace to stabilize, record the 6 dB Bandwidth value.

Limit

Limit [kHz]
≥500

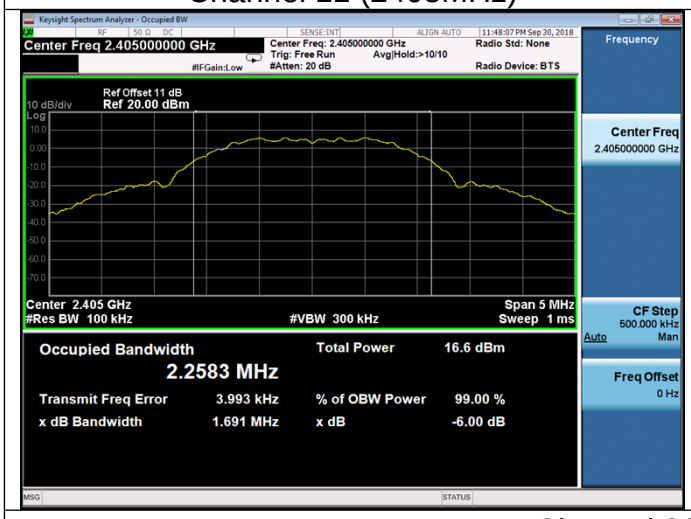
Test result

Test Mode	Channel No.	Freq. (MHz)	6db Bandwidth (MHz)	Limit (MHz)	Result
O-QPSK	11	2405	1.691	≥ 0.5	Pass
	20	2450	1.684	≥ 0.5	Pass
	26	2480	1.666	≥ 0.5	Pass

Test Mode	Channel No.	Freq. (MHz)	99% Bandwidth (MHz)	Limit	Result
O-QPSK	11	2405	2.2583	NA	NA
	20	2450	2.2643		
	26	2480	2.2689		

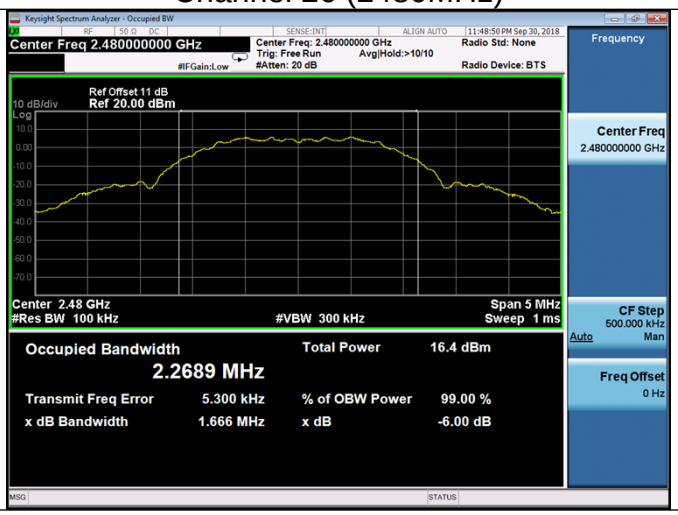
Zigbee O-QPSK 6dB Bandwidth

Channel 11 (2405MHz)



Channel 20 (2450MHz)

Channel 26 (2480MHz)



9.3 Power spectral density

Test Method

This procedure shall be used if maximum peak conducted output power was used to demonstrate compliance:

1. Set analyzer center frequency to DTS channel center frequency. RBW=3kHz, VBW≥3RBW, Span=1.5 times DTS bandwidth, Detector=Peak, Sweep=auto, Trace= max hold.
2. Allow trace to fully stabilize, use the peak marker function to determine the maximum amplitude level within the RBW.
3. Repeat above procedures until other frequencies measured were completed.

Limit

Limit [dBm]
≤8

Test result

Test Mode	Channel No.	Freq. (MHz)	PKPSD (dBm / 10kHz)	Limit (dBm/3kHz)	Result
O-QPSK	11	2405	-5.358	≤8	Pass
	20	2450	-5.616	≤8	Pass
	26	2480	-5.356	≤8	Pass

Zigbee O-QPSK PKPSD	
Channel 11 (2405MHz)	Channel 20 (2450MHz)
Channel 26 (2480MHz)	

9.4 Conducted Band Edge and Out-of-Band Emissions

Test Method

1. Establish a reference level by using the following procedure:
   a. Set RBW=100 kHz. VBW≥3RBW. Detector =peak, Sweep time = auto couple, Trace mode = max hold.
   b. Allow trace to fully stabilize, use the peak marker function to determine the maximum PSD level.
2. Use the maximum PSD level to establish the reference level.
   a. Set the center frequency and span to encompass frequency range to be measured.
   b. Use the peak marker function to determine the maximum amplitude level. Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) are attenuated by at least the minimum requirements, report the three highest emissions relative to the limit.
3. Repeat above procedures until other frequencies measured were completed.

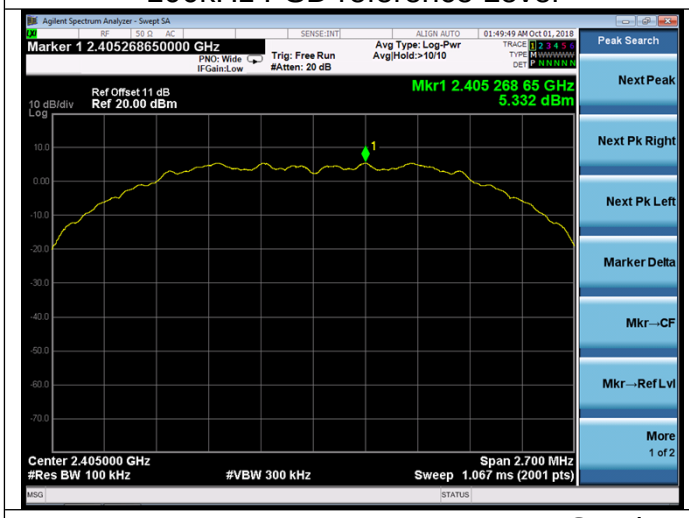
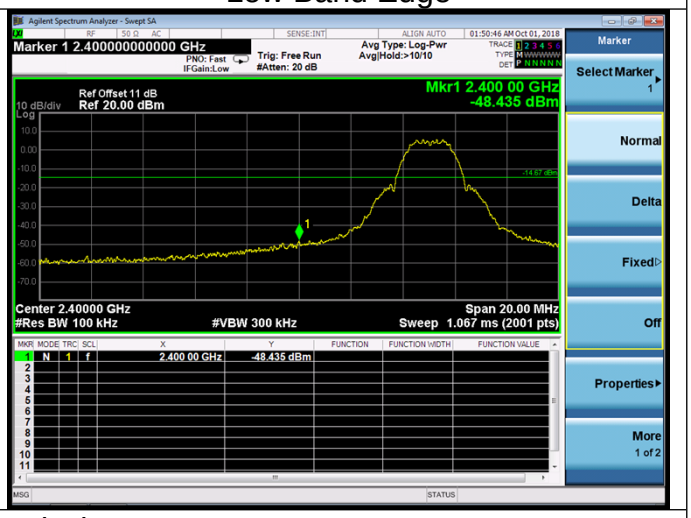
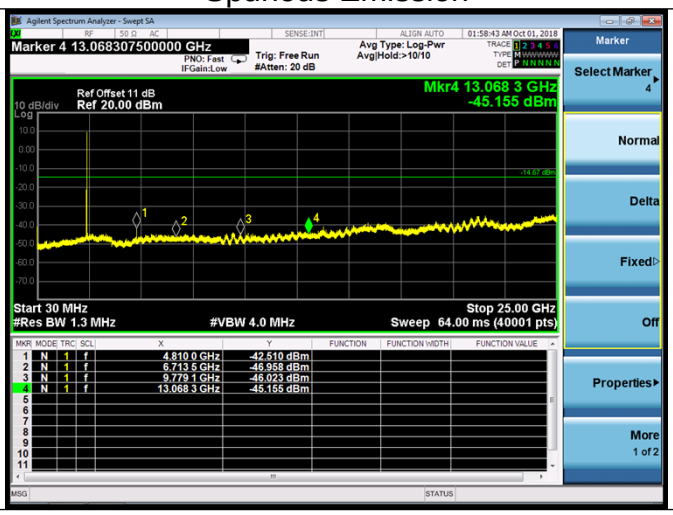
Limit

Frequency Range MHz	Limit (dBc)
30-25000	-20

Test result

Test Mode	Channel No.	Freq. (MHz)	Limit	Result
O-QPSK	11	2405	20dBc	Pass
	20	2450	20dBc	Pass
	26	2480	20dBc	Pass

Spurious RF conducted emissions

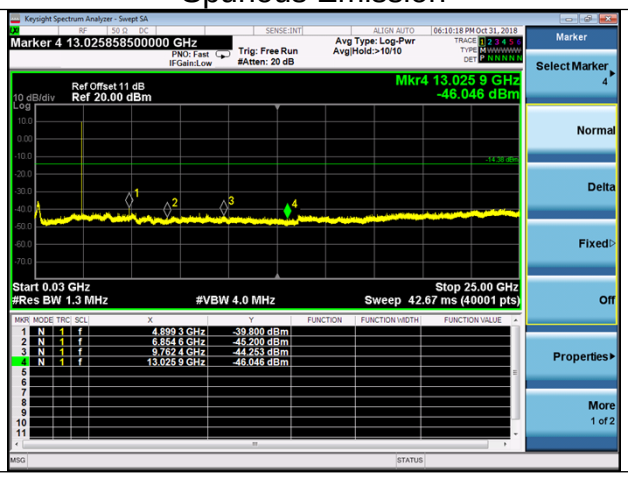
Zigbee O-QPSK Out-of-Band Emissions	
Channel 11 (2405MHz)	
100kHz PSD reference Level	Low Band Edge
	
Spurious Emission	
	

China

Channel 20 (2450MHz)

100kHz PSD reference Level

Spurious Emission

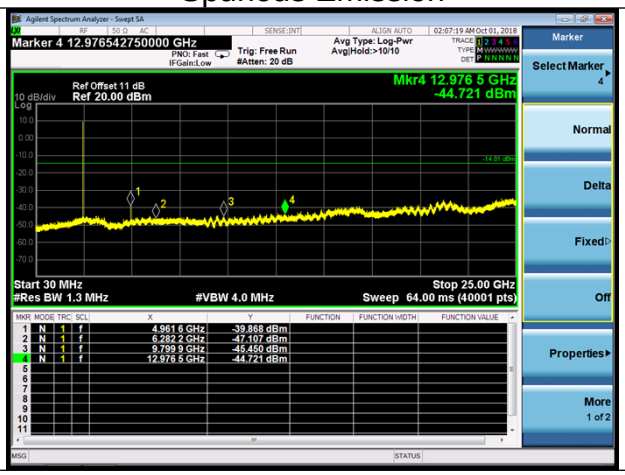


Channel 26 (2480MHz)

100kHz PSD reference Level

High Band Edge

Spurious Emission



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9.5 Spurious radiated emissions for transmitter

Test Method

1: The EUT was place on a turn table which is 1.5m above ground plane for above 1GHz and 0.8m above ground for below 1GHz at 3-meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.

2: The EUT was set 3 meters away from the interference – receiving antenna, which was mounted on the top of a variable – height antenna tower.

3: The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

4: For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

5: Use the following spectrum analyzer settings According to C63.10:

For Above 1GHz

Span = wide enough to capture the peak level of the in-band emission and all spurious

RBW = 1MHz, VBW⩾RBW for peak measurement and VBW = 10Hz for average measurement, Sweep = auto, Detector function = peak, Trace = max hold.

For Below 1GHz

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious

RBW = 100 KHz, VBW⩾RBW for peak measurement, Sweep = auto, Detector function = peak, Trace = max hold.

Note:

1: The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 KHz for Quasi-peak detection (QP) at frequency below 1GHz.

2: The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 3MHz for peak detection (PK) at frequency above 1GHz.

3: The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 3MHz for RMS Average ((duty cycle < 98%) for Average detection (AV) at frequency above 1GHz, then the measurement results was added to a correction factor (20log(1/duty cycle)).

4: The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is 10Hz (duty cycle > 98%) for Average detection (AV) at frequency above 1GHz.

Limit

The radio emission outside the operating frequency band 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. Radiated emissions which fall in the restricted bands, as defined in section15.205, must comply with the radiated emission limits specified in section 15.209.

LIMITS OF RADIATED EMISSION MEASUREMENT (Frequency Range 9kHz-1000MHz)

Frequency MHz	Field Strength uV/m	Measured Distance Meters
0.009~0.490	2400/F (kHz)	300
0.490~1.705	24000/F (kHz)	30
1.705~30	30	30
30~88	100	3
88~216	150	3
216~960	200	3
960~1000	500	3

LIMITS OF RADIATED EMISSION MEASUREMENT (Above 1000MHz)

Frequency MHz	Field Strength (dBuv/m) (at 3M)	
	PEAK	AVERAGE
Above 1000	74	54

Notes:

(1) The limit for radiated test was performed according to FCC PART 15C.
(2) The tighter limit applies at the band edges.
(3) Emission level (dBuV/m)=20logEmission level (uV/m).

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Spurious radiated emissions for transmitter

According to C63.10, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement, so AV emission value did not show in below table if the peak value complies with average limit.

Transmitting spurious emission test result as below:
Remark 1: There are the ambient noise within frequency range 9kHz ~ 30MHz and 18GHz ~ 25GHz, the permissible value is not show in the report.
Remark 2: Average measurement was not performed if peak level lower than average limit.
Remark 3: Other frequency was 20dB below limit line with 1-18GHz, there is not show in the report.

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Test Result

Test mode: Zigbee O-QPSK							
Channel 11 (2405MHz)							
Frequency (MHz)	**Reading Level (dBuV)**	**Factor (dB)**	**Measure Level (dBuV/m)**	**Limit (dBuV/M)**	**Margin (dB)**	**Detector**	**Polarization**
4808.0	40.3	5.9	46.2	74.0	-27.8	Peak	Horizontal
8199.5	35.5	13.1	48.6	74.0	-25.4	Peak	Horizontal
8769.0	36.0	13.2	49.2	82.1	-32.9	Peak	Horizontal
10120.5	35.9	16.9	52.8	82.1	-29.3	Peak	Horizontal
7638.5	36.6	12.6	49.2	74.0	-24.8	Peak	Vertical
8352.5	35.0	12.6	47.6	74.0	-26.4	Peak	Vertical
9840.0	35.5	16.7	52.2	82.1	-29.9	Peak	Vertical
10443.5	33.6	17.2	50.8	82.1	-31.3	Peak	Vertical

Test mode: Zigbee O-QPSK							
Channel 20 (2450MHz)							
Frequency (MHz)	**Reading Level (dBuV)**	**Factor (dB)**	**Measure Level (dBuV/m)**	**Limit (dBuV/M)**	**Margin (dB)**	**Detector**	**Polarization**
4896.0	40.7	6.0	46.7	74.0	-27.3	Peak	Horizontal
7349.5	40.9	12.9	53.8	74.0	-20.2	Peak	Horizontal
9798.0	36.1	16.8	52.9	74.0	-21.1	Peak	Horizontal
4900.0	36.4	6.0	42.4	74.0	-31.6	Peak	Vertical
7350.5	37.5	12.6	50.1	74.0	-23.9	Peak	Vertical
9801.0	35.2	16.8	52.0	74.0	-22.0	Peak	Vertical

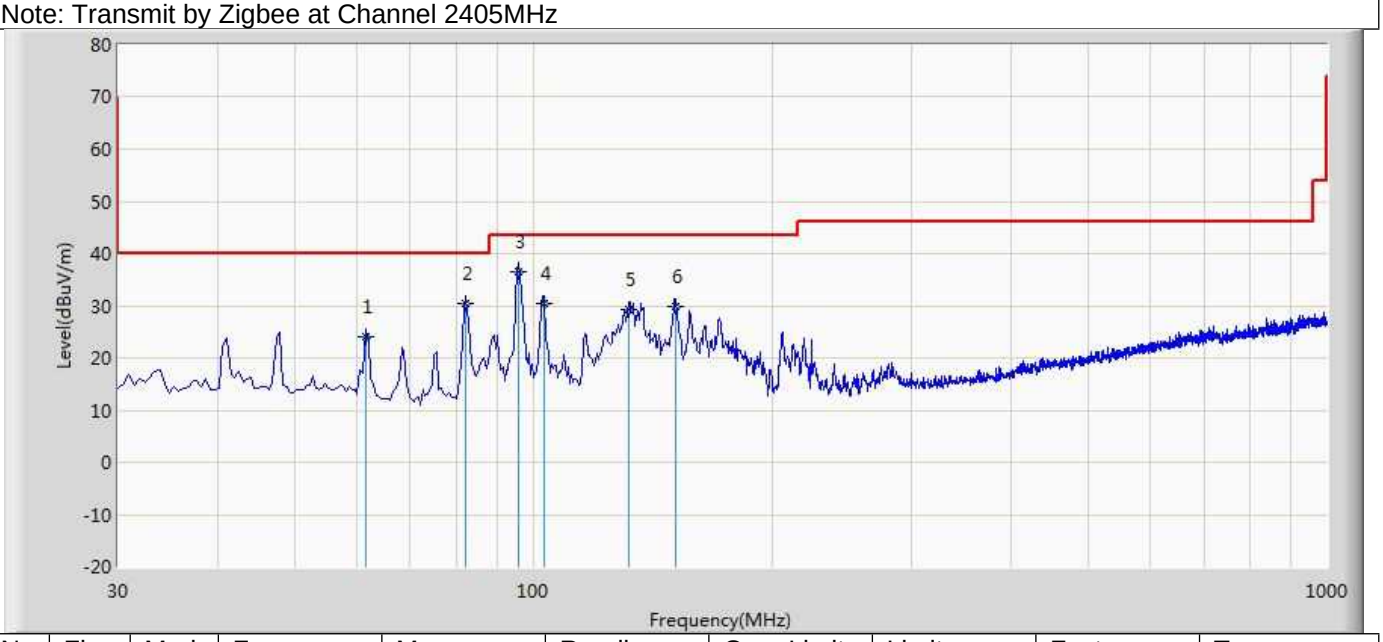
Test mode: Zigbee O-QPSK							
Channel 26 (2480MHz)							
Frequency (MHz)	**Reading Level (dBuV)**	**Factor (dB)**	**Measure Level (dBuV/m)**	**Limit (dBuV/M)**	**Margin (dB)**	**Detector**	**Polarization**
4961.0	40.2	6.1	46.3	74.0	-27.7	Peak	Horizontal
7511.0	36.3	12.7	49.0	74.0	-25.0	Peak	Horizontal
8786.0	37.0	13.3	50.3	81.8	-31.5	Peak	Horizontal
10018.5	35.9	16.6	52.5	81.8	-29.3	Peak	Horizontal
7511.0	36.2	12.7	48.9	74.0	-25.1	Peak	Vertical
8284.5	36.6	12.7	49.3	74.0	-24.7	Peak	Vertical
9704.0	34.9	15.5	50.4	81.8	-31.4	Peak	Vertical
10078.0	33.9	17.0	50.9	81.8	-30.9	Peak	Vertical

Remark:

(1) Emission level= Original Receiver Reading + Correct Factor
(2) Correct Factor = Antenna Factor + Cable Loss -Amplifier gain
(3) Margin = limit – Corrected Reading

The worst case of Radiated Emission below 1GHz:

Site: AC1	Time: 2018/09/30 - 20:54
Limit: FCC_Part15.209_RE(3m)	Engineer: Jone Zhang
Probe: VULB 9168 _20-2000MHz	Polarity: Horizontal
EUT: Hue Engine	Power: DC 24V
Note: Transmit by Zigbee at Channel 2405MHz	



No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			61.525	24.130	10.957	-15.870	40.000	13.173	QP
2			82.380	30.312	20.154	-9.688	40.000	10.158	QP
3		*	95.960	36.488	25.726	-7.012	43.500	10.762	QP
4			103.235	30.450	19.053	-13.050	43.500	11.397	QP
5			131.850	29.410	15.437	-14.090	43.500	13.973	QP
6			151.250	29.811	14.526	-13.689	43.500	15.285	QP

Note 1: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)
Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)
Note 2: The test trace is same as the ambient noise and the amplitude of the emissions are attenuated more than 20dB below the permissible (the test frequency range: 9kHz ~ 30MHz, 18GHz ~ 25GHz), therefore no data appear in the report.

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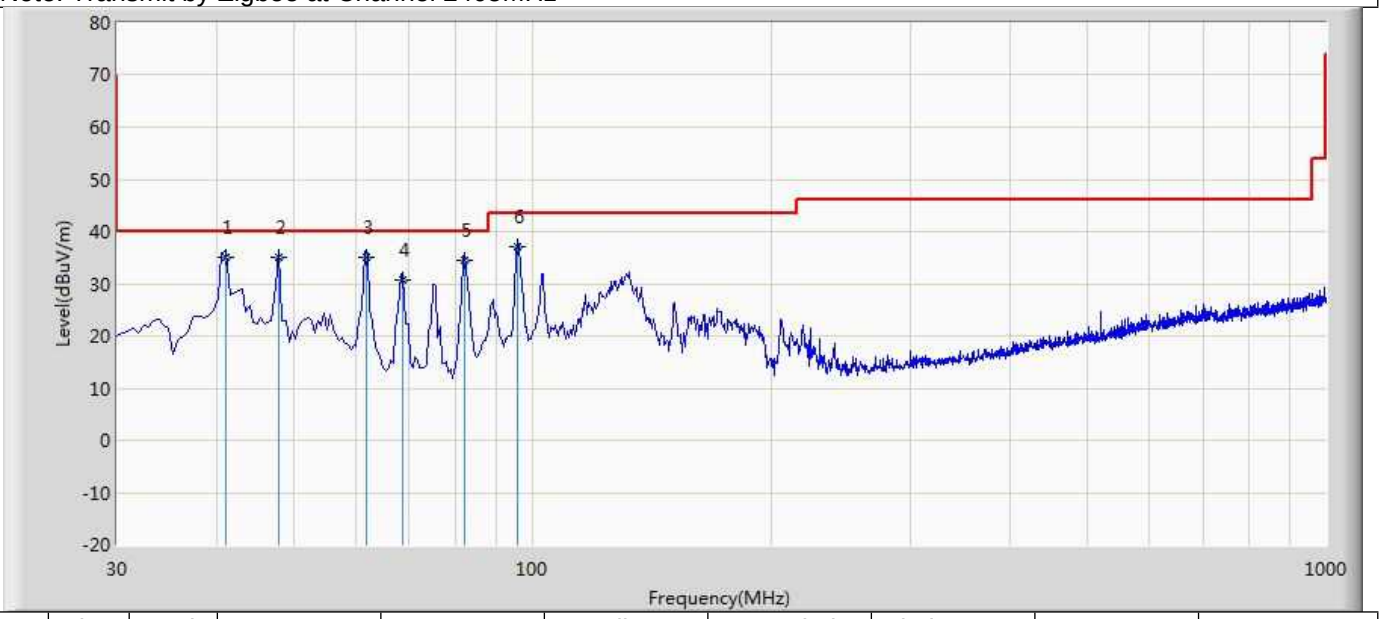
Site: AC1	Time: 2018/09/30 - 20:56
Limit: FCC_Part15.209_RE(3m)	Engineer: Jone Zhang
Probe: VULB 9168 _20-2000MHz	Polarity: Vertical
EUT: Hue Engine	Power: DC 24V
Note: Transmit by Zigbee at Channel 2405MHz	



No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		*	41.155	35.115	20.563	-4.885	40.000	14.552	QP
2			47.945	34.985	20.759	-5.015	40.000	14.226	QP
3			61.965	34.992	21.900	-5.008	40.000	13.092	QP
4			68.800	30.749	18.937	-9.251	40.000	11.812	QP
5			82.380	34.442	24.284	-5.558	40.000	10.158	QP
6			95.960	37.066	26.304	-6.434	43.500	10.762	QP

Note 1: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)
Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)
Note 2: The test trace is same as the ambient noise and the amplitude of the emissions are attenuated more than 20dB below the permissible (the test frequency range: 9kHz ~ 30MHz, 18GHz ~ 25GHz), therefore no data appear in the report.

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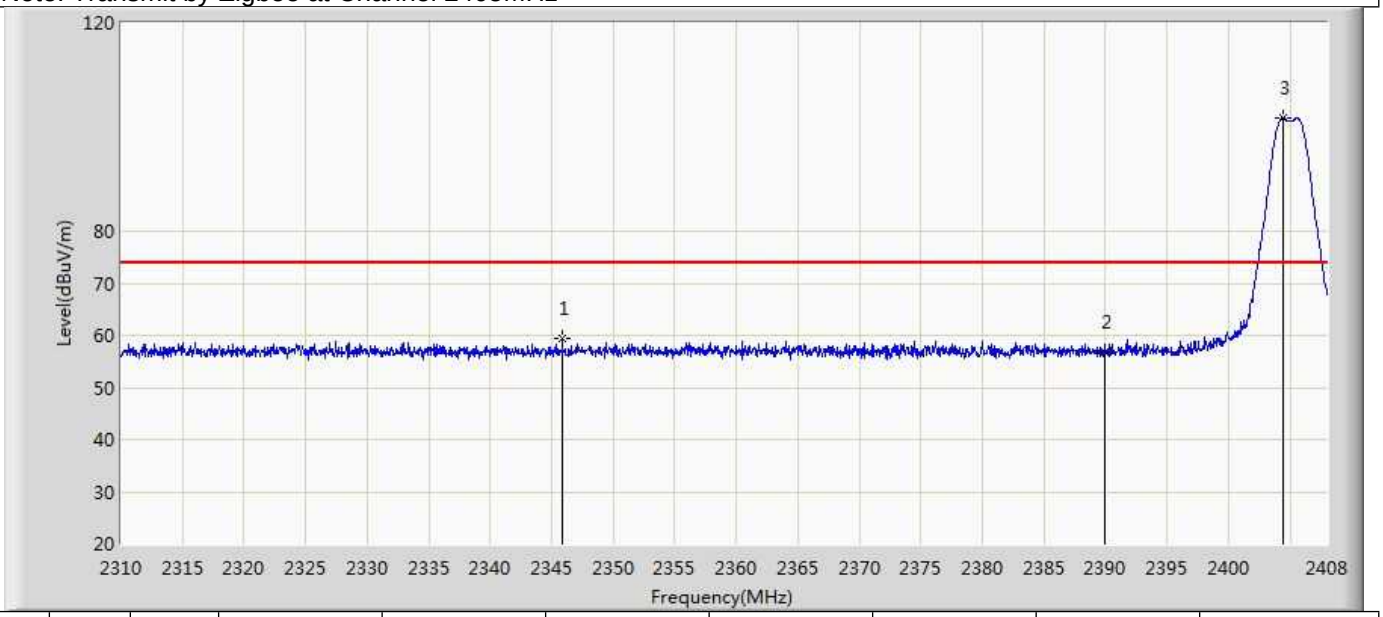
Radiated Restricted Band Edge Measurement
Test Result:

Site: AC1	Time: 2018/09/30 - 18:42
Limit: FCC_Part15.209_RE(3m)	Engineer: Jone Zhang
Probe: BBHA9120D_1-18GHz	Polarity: Horizontal
EUT: Hue Engine	Power: DC 24V
Note: Transmit by Zigbee at Channel 2405MHz	



No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			2345.868	59.331	26.919	-14.669	74.000	32.412	PK
2			2390.000	56.731	24.404	-17.269	74.000	32.327	PK
3		*	2404.423	101.657	69.358	N/A	N/A	32.300	PK

Note: Measure Level (dBµV/m) = Reading Level (dBµV) + Factor (dB)
Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

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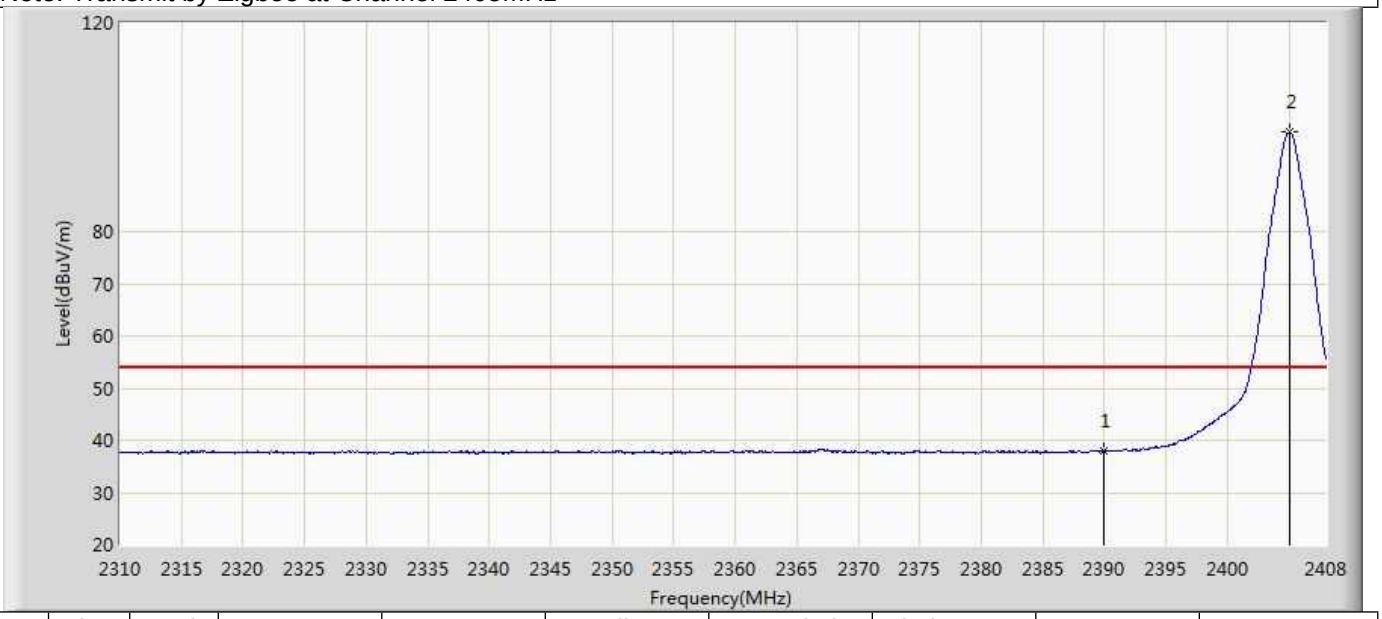
Site: AC1	Time: 2018/09/30 - 18:56
Limit: FCC_Part15.209_RE(3m)	Engineer: Jone Zhang
Probe: BBHA9120D_1-18GHz	Polarity: Horizontal
EUT: Hue Engine	Power: DC 24V
Note: Transmit by Zigbee at Channel 2405MHz	



No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			2390.000	38.037	5.710	-15.963	54.000	32.327	AV
2		*	2405.060	99.025	66.727	N/A	N/A	32.298	AV

Note: Measure Level (dBµV/m) = Reading Level (dBµV) + Factor (dB)
Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

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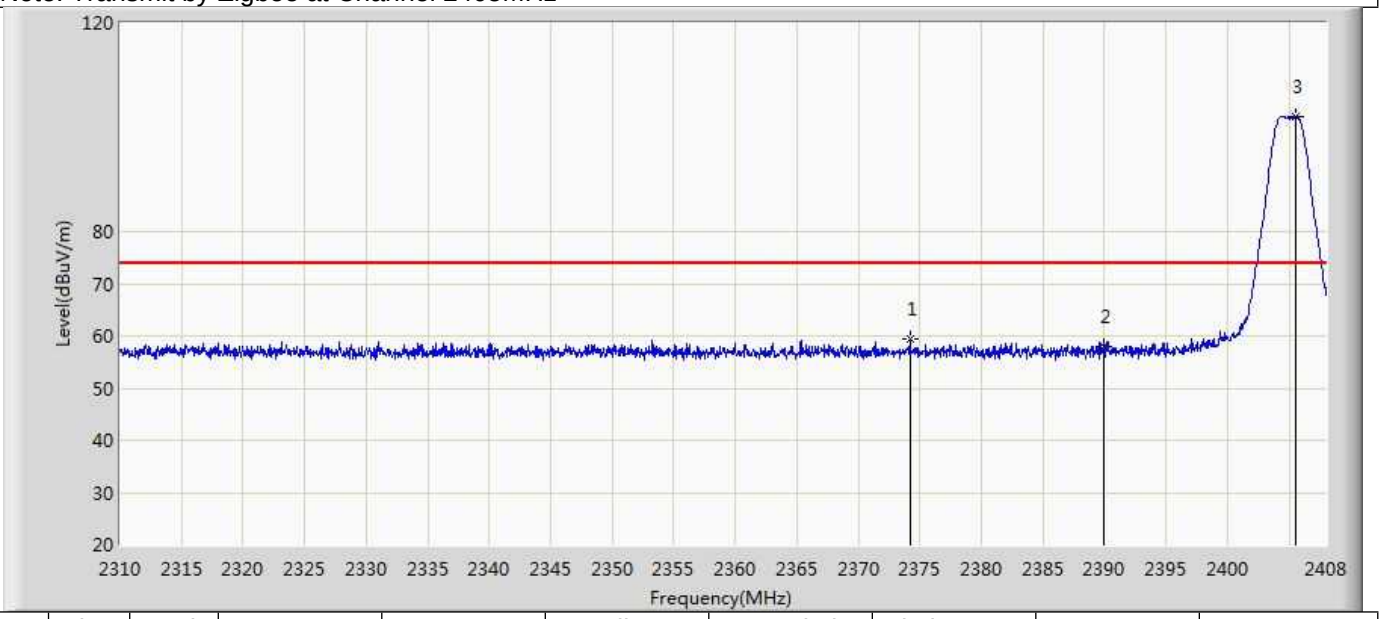
Site: AC1	Time: 2018/09/30 - 18:59
Limit: FCC_Part15.209_RE(3m)	Engineer: Jone Zhang
Probe: BBHA9120D_1-18GHz	Polarity: Vertical
EUT: Hue Engine	Power: DC 24V
Note: Transmit by Zigbee at Channel 2405MHz	



No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			2374.190	59.420	27.070	-14.580	74.000	32.350	PK
2			2390.000	57.873	25.546	-16.127	74.000	32.327	PK
3		*	2405.599	102.131	69.834	N/A	N/A	32.297	PK

Note: Measure Level (dBµV/m) = Reading Level (dBµV) + Factor (dB)
Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

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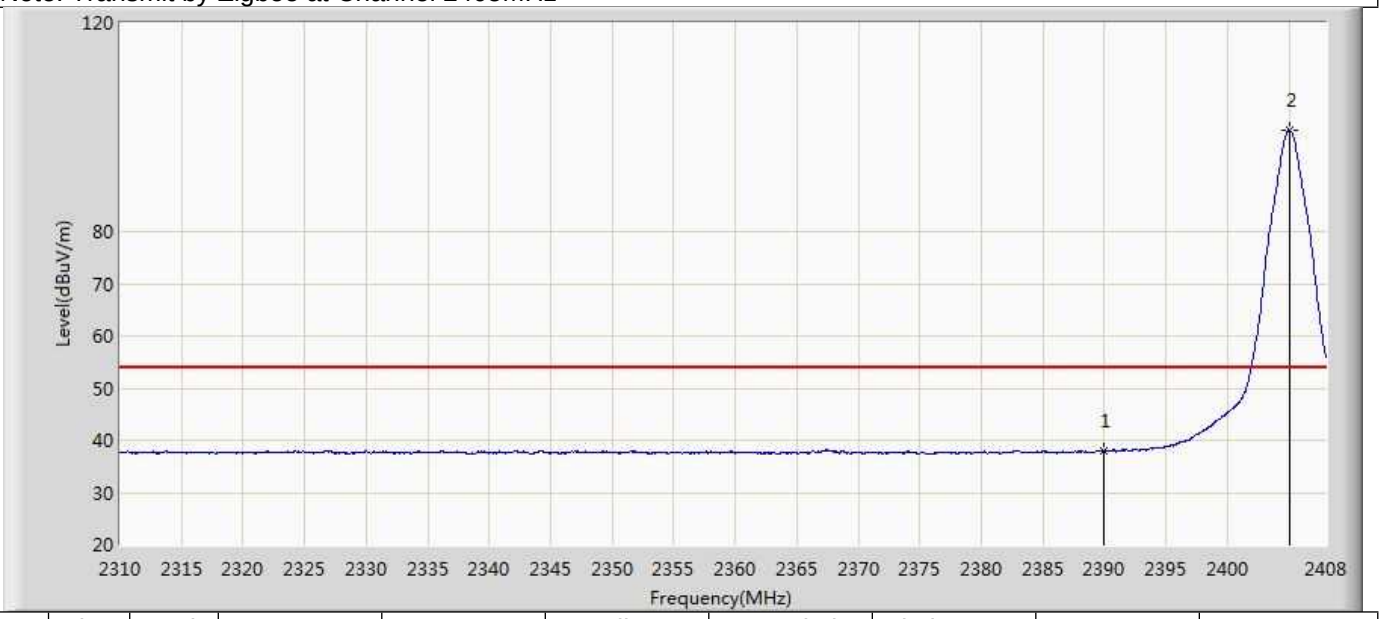
Site: AC1	Time: 2018/09/30 - 19:01
Limit: FCC_Part15.209_RE(3m)	Engineer: Jone Zhang
Probe: BBHA9120D_1-18GHz	Polarity: Vertical
EUT: Hue Engine	Power: DC 24V
Note: Transmit by Zigbee at Channel 2405MHz	



No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1			2390.000	37.960	5.633	-16.040	54.000	32.327	AV
2		*	2405.060	99.327	67.029	N/A	N/A	32.298	AV

Note: Measure Level (dBµV/m) = Reading Level (dBµV) + Factor (dB)
Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

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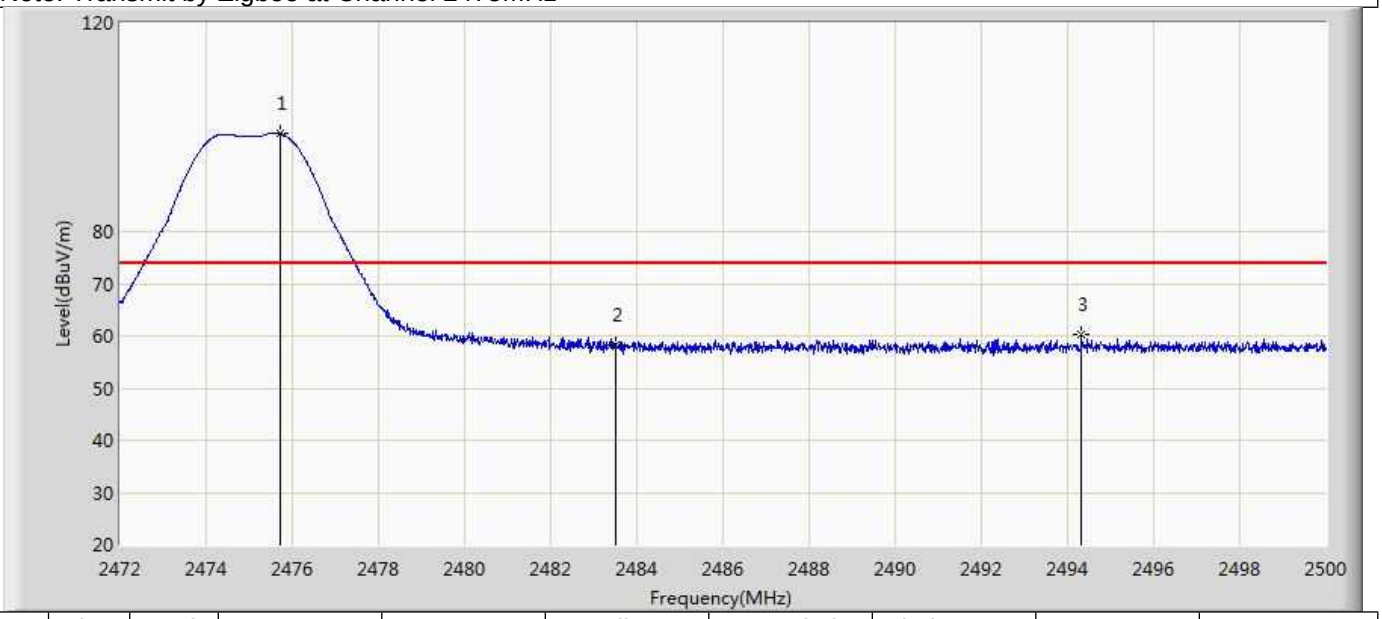
Site: AC1	Time: 2018/09/30 - 19:02
Limit: FCC_Part15.209_RE(3m)	Engineer: Jone Zhang
Probe: BBHA9120D_1-18GHz	Polarity: Horizontal
EUT: Hue Engine	Power: DC 24V
Note: Transmit by Zigbee at Channel 2475MHz	



No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		*	2475.724	98.824	66.511	N/A	N/A	32.314	PK
2			2483.500	58.162	25.823	-15.838	74.000	32.340	PK
3			2494.330	60.434	28.052	-13.566	74.000	32.381	PK

Note: Measure Level (dBµV/m) = Reading Level (dBµV) + Factor (dB)
Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

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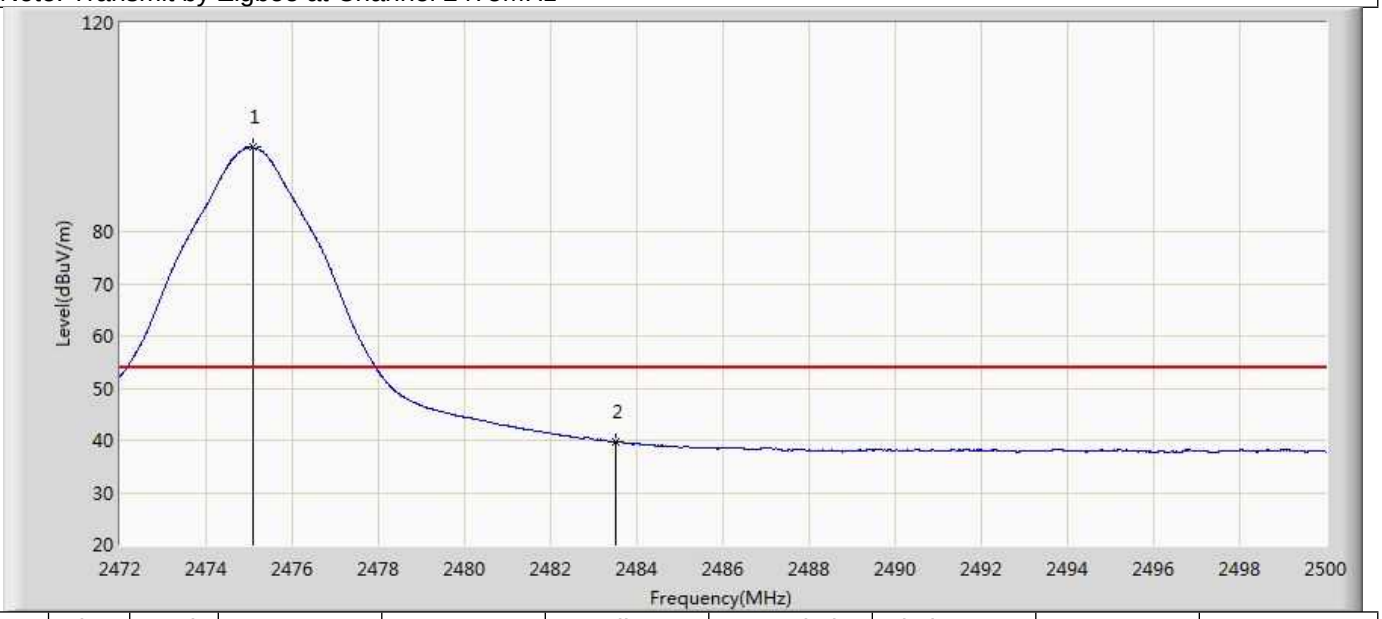
Site: AC1	Time: 2018/09/30 - 19:08
Limit: FCC_Part15.209_RE(3m)	Engineer: Jone Zhang
Probe: BBHA9120D_1-18GHz	Polarity: Horizontal
EUT: Hue Engine	Power: DC 24V
Note: Transmit by Zigbee at Channel 2475MHz	



No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		*	2475.080	96.090	63.778	N/A	N/A	32.311	AV
2			2483.500	39.638	7.299	-14.362	54.000	32.340	AV

Note: Measure Level (dBμV/m) = Reading Level (dBμV) + Factor (dB)
Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

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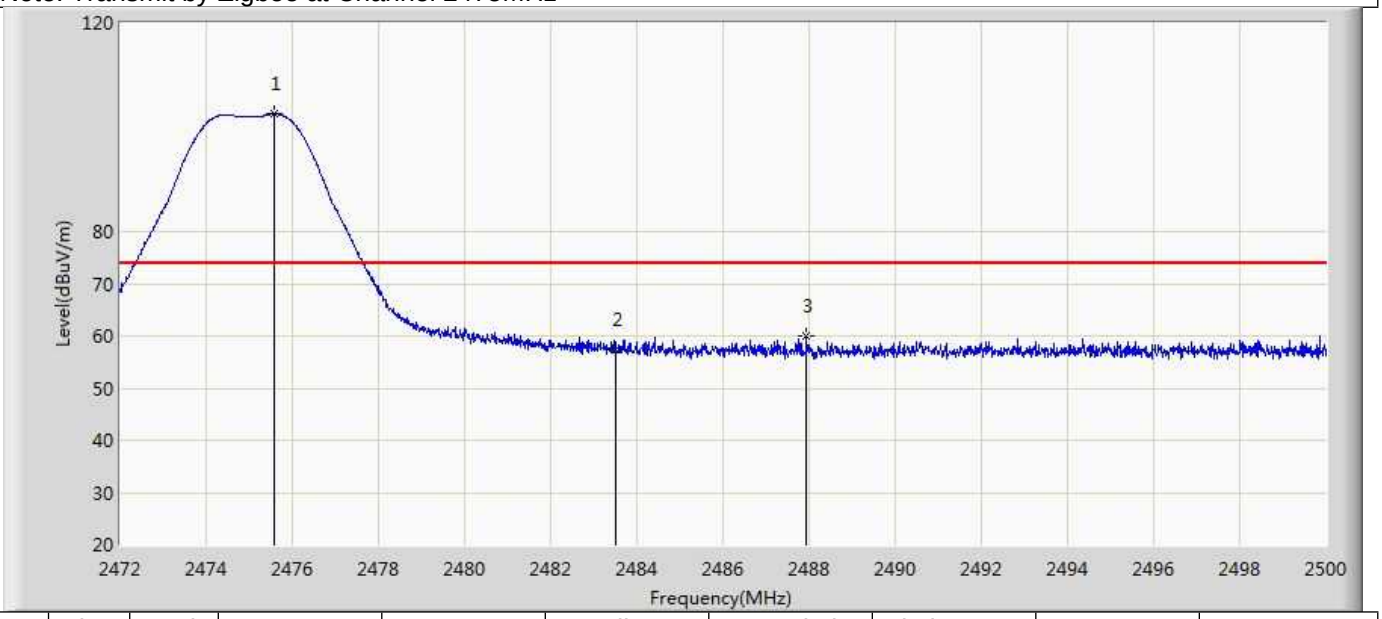
Site: AC1	Time: 2018/09/30 - 19:09
Limit: FCC_Part15.209_RE(3m)	Engineer: Jone Zhang
Probe: BBHA9120D_1-18GHz	Polarity: Vertical
EUT: Hue Engine	Power: DC 24V
Note: Transmit by Zigbee at Channel 2475MHz	



No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		*	2475.584	102.483	70.170	N/A	N/A	32.313	PK
2			2483.500	57.263	24.924	-16.737	74.000	32.340	PK
3			2487.946	59.928	27.571	-14.072	74.000	32.357	PK

Note: Measure Level (dBµV/m) = Reading Level (dBµV) + Factor (dB)
Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

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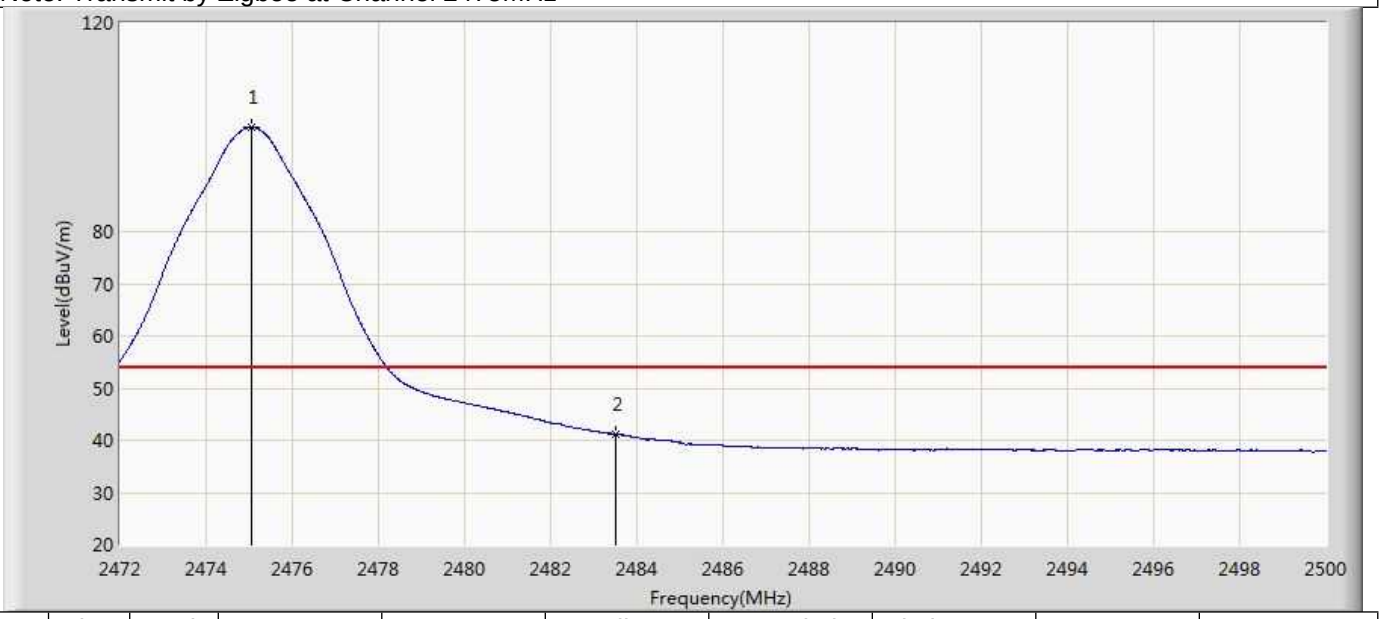
Site: AC1	Time: 2018/09/30 - 19:10
Limit: FCC_Part15.209_RE(3m)	Engineer: Jone Zhang
Probe: BBHA9120D_1-18GHz	Polarity: Vertical
EUT: Hue Engine	Power: DC 24V
Note: Transmit by Zigbee at Channel 2475MHz	



No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		*	2475.052	99.954	67.642	N/A	N/A	32.311	AV
2			2483.500	41.223	8.884	-12.777	54.000	32.340	AV

Note: Measure Level (dBµV/m) = Reading Level (dBµV) + Factor (dB)
Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

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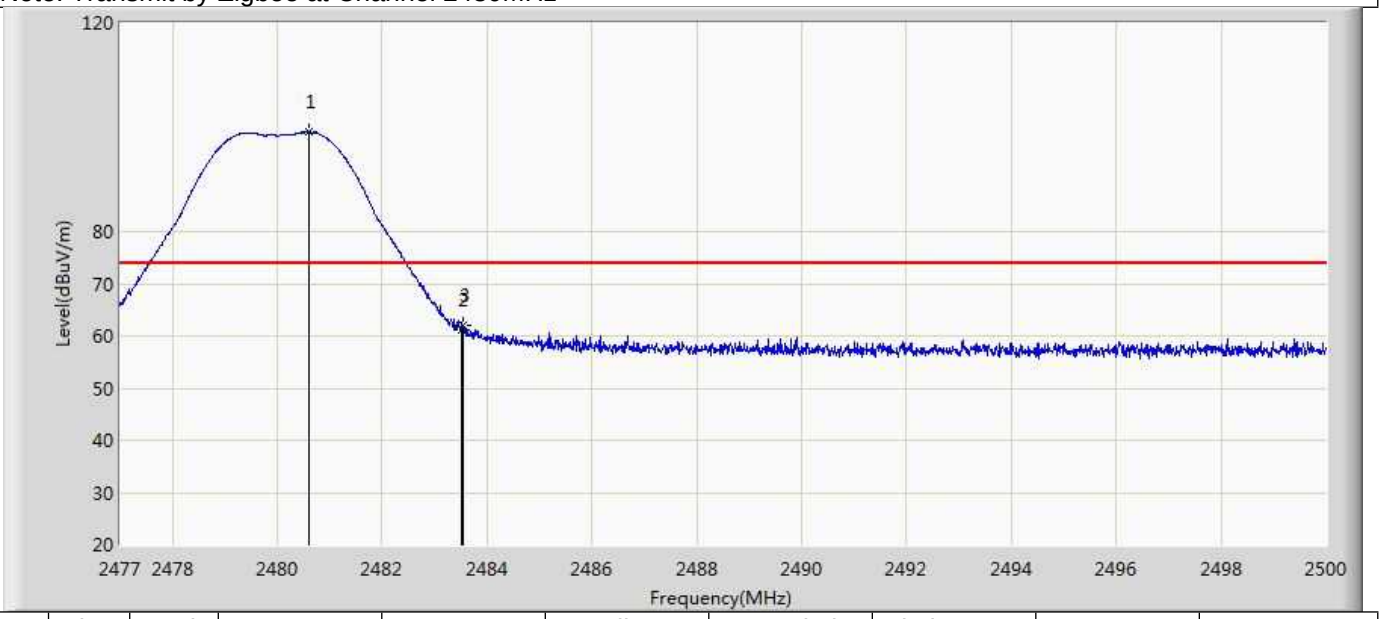
Phone: +86 21 61410123, Fax:+86 21 61408600

Site: AC1	Time: 2018/09/30 - 19:12
Limit: FCC_Part15.209_RE(3m)	Engineer: Jone Zhang
Probe: BBHA9120D_1-18GHz	Polarity: Horizontal
EUT: Hue Engine	Power: DC 24V
Note: Transmit by Zigbee at Channel 2480MHz	



No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		*	2480.611	99.009	66.681	N/A	N/A	32.327	PK
2			2483.500	61.102	28.763	-12.898	74.000	32.340	PK
3			2483.555	61.943	29.604	-12.057	74.000	32.340	PK

Note: Measure Level (dBµV/m) = Reading Level (dBµV) + Factor (dB)
Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

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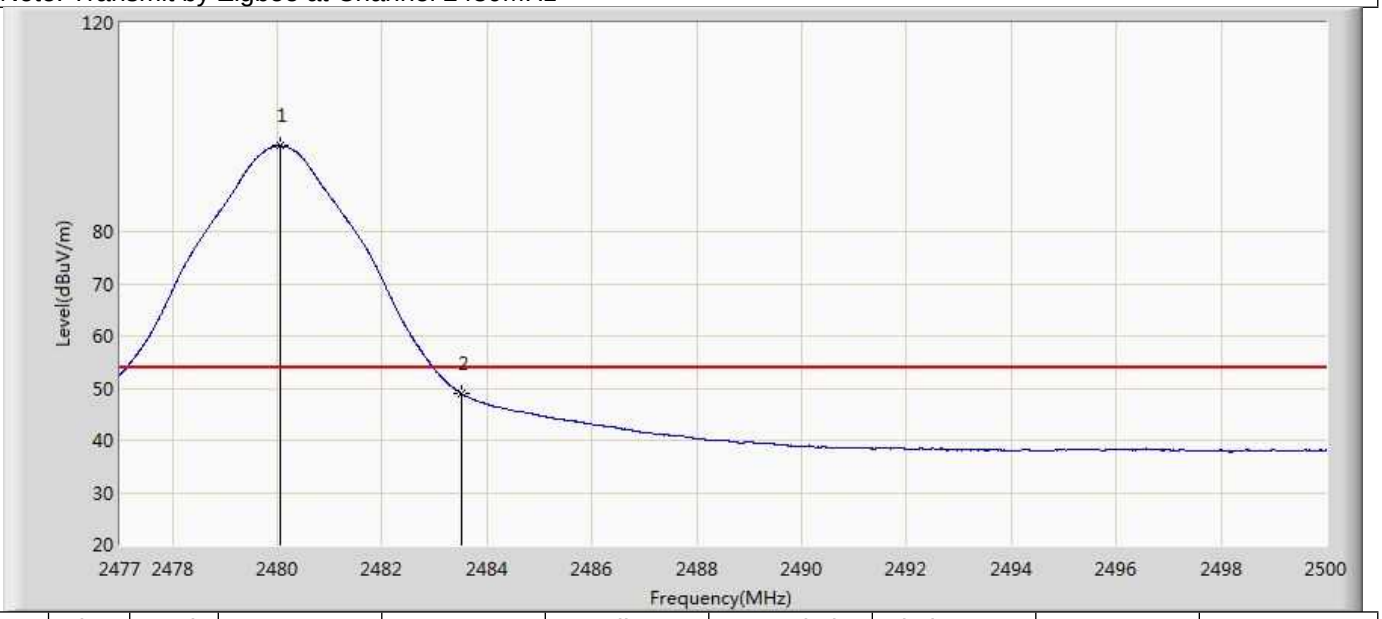
Site: AC1	Time: 2018/09/30 - 19:15
Limit: FCC_Part15.209_RE(3m)	Engineer: Jone Zhang
Probe: BBHA9120D_1-18GHz	Polarity: Horizontal
EUT: Hue Engine	Power: DC 24V
Note: Transmit by Zigbee at Channel 2480MHz	



No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		*	2480.059	96.412	64.086	N/A	N/A	32.325	AV
2			2483.500	49.019	16.680	-4.981	54.000	32.340	AV

Note: Measure Level (dBµV/m) = Reading Level (dBµV) + Factor (dB)
Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

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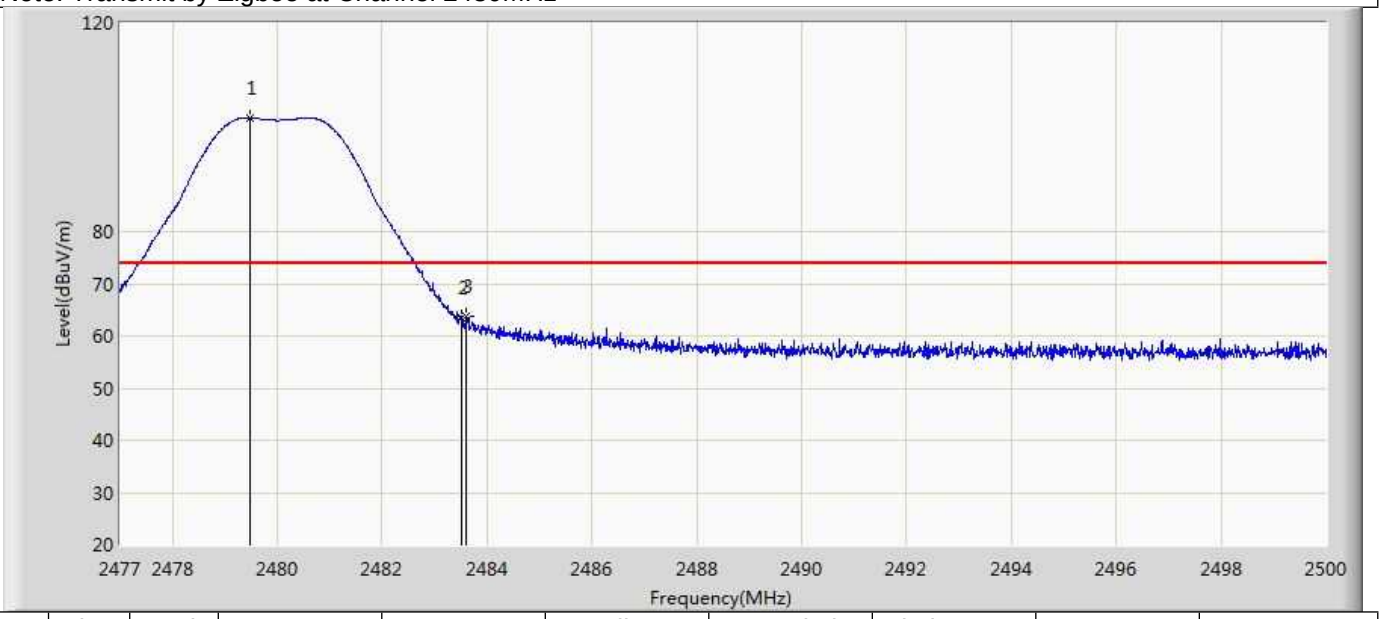
Site: AC1	Time: 2018/09/30 - 19:16
Limit: FCC_Part15.209_RE(3m)	Engineer: Jone Zhang
Probe: BBHA9120D_1-18GHz	Polarity: Vertical
EUT: Hue Engine	Power: DC 24V
Note: Transmit by Zigbee at Channel 2480MHz	



No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		*	2479.472	101.827	69.504	N/A	N/A	32.323	PK
2			2483.500	63.409	31.070	-10.591	74.000	32.340	PK
3			2483.601	63.631	31.291	-10.369	74.000	32.340	PK

Note: Measure Level (dBµV/m) = Reading Level (dBµV) + Factor (dB)
Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

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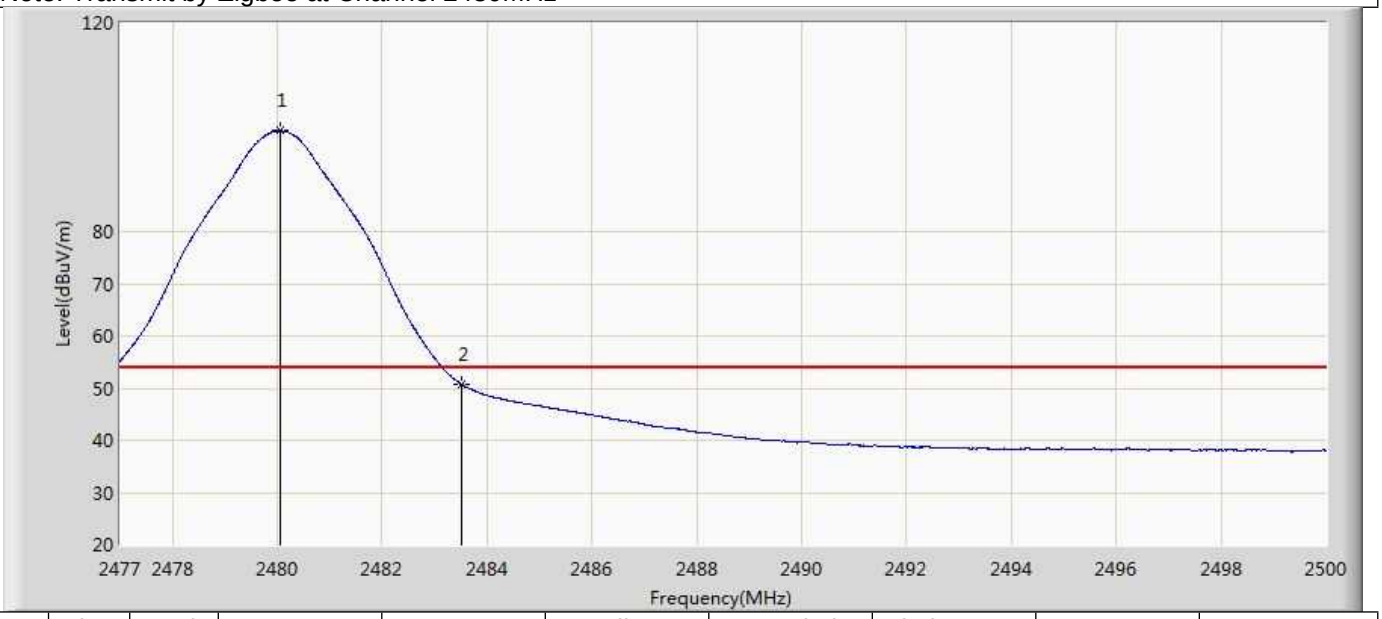
Site: AC1	Time: 2018/09/30 - 19:17
Limit: FCC_Part15.209_RE(3m)	Engineer: Jone Zhang
Probe: BBHA9120D_1-18GHz	Polarity: Vertical
EUT: Hue Engine	Power: DC 24V
Note: Transmit by Zigbee at Channel 2480MHz	



No	Flag	Mark	Frequency (MHz)	Measure Level (dBuV/m)	Reading Level (dBuV)	Over Limit (dB)	Limit (dBuV/m)	Factor (dB)	Type
1		*	2480.048	99.305	66.979	N/A	N/A	32.325	AV
2			2483.500	50.803	18.464	-3.197	54.000	32.340	AV

Note: Measure Level (dBµV/m) = Reading Level (dBµV) + Factor (dB)
Factor (dB) = Cable Loss (dB) + Antenna Factor (dB/m)

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10 Test Equipment List

List of Test Instruments
Test Site1

	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
C	Signal Analyzer	Rohde & Schwarz	FSV40	101091	2019-8-6
RE	EMI Test Receiver	Rohde & Schwarz	ESR3	101906	2019-8-6
	Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9163	848	2021-6-10
	Horn Antenna	Rohde & Schwarz	HF907	102393	2021-4-1
	Pre-amplifier	Rohde & Schwarz	SCU-18D	19006451	2019-8-6
	3m Semi-anechoic chamber	TDK	9X6X6	----	2021-5-10
CE	EMI Test Receiver	Rohde & Schwarz	ESR 3	101907	2019-8-6
	LISN	Rohde & Schwarz	ENV4200	100224	2019-8-6
	LISN	Rohde & Schwarz	ENV216	101924	2019-8-6

Test Site2

Radiated Emissions – AC1

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Broadband TRILOG Antenna	SCHWARZBECK	VULB 9162	MRTTWA00001	1 year	2019/5/22
EMI Test Receiver	R&S	ESR3	MRTTWA00009	1 year	2019/3/19
Acitve Loop Antenna	Schwarzbeck	FMZB 1519B	MRTTWA00002	1 year	2019/4/24
Broadband Horn antenna	SCHWARZBECK	BBHA 9120D	MRTTWA00003	1 year	2019/4/24
Breitband Hornantenna	Schwarzbeck	BBHA 9170	MRTTWA00004	1 year	2019/4/23
Broadband Amplifier	Schwarzbeck	BBV 9721	MRTTWA00006	1 year	2019/4/23
Broadband Preamplifier	SCHWARZBECK	BBV 9718	MRTTWA00005	1 year	2019/4/23
Cable	HUBERSUHNER	SF106	MRTTWA00010	1 year	2019/5/18
Cable	Rosnol	K1K50-UP0264-K1K50-4M	MRTTWA00012	1 year	2019/7/30

Conducted Test Equipment – SR2

Instrument	Manufacturer	Type No.	Asset No.	Cali. Interval	Cali. Due Date
Spectrum Analyzer	KEYSIGHT	N9010A	MRTTWA00012	1 year	2019/7/30
USB Wideband Power Sensor	KEYSIGHT	U2021XA	MRTTWA00015	1 year	2019/3/20

C - Conducted RF tests

- Conducted peak output power
- 6dB bandwidth and 99% Occupied Bandwidth
- Power spectral density*
- Spurious RF conducted emissions
- Conducted Band edge

11 System Measurement Uncertainty

For a 95% confidence level, the measurement expanded uncertainties for defined systems, in accordance with the recommendations of ISO 17025 were:

Test Site1

Items	Extended Uncertainty
Conducted Disturbance at Mains Terminals	150kHz to 30MHz, LISN, ±2.73dB
Radiated Disturbance	30MHz to 1GHz, ±5.03dB (Horizontal) ±5.11dB (Vertical) 1GHz to 18GHz, ±5.15dB (Horizontal) ±5.12dB (Vertical) 18GHz to 25GHz, ±4.76dB

Test Site2

AC Conducted Emission Measurement - SR2

Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)):

150kHz~30MHz: 3.46dB

Radiated Emission Measurement – AC1

Measuring Uncertainty for a Level of Confidence of 95% (U=2Uc(y)):

9kHz ~ 1GHz: 4.18dB

1GHz ~ 25GHz: 4.76dB

THE END

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