

FCC TEST REPORT

For

Phottix (HK) Ltd.

Phottix Juno TTL Transceiver Flash

Model No.: H0301

Prepared for : Phottix (HK) Ltd.
Address : Unit 1 & 13, 8/F., Block B, Hoi Luen Ind. Centre, 55 Hoi Yuen Rd.,
Kwun Tong, Kln., Hong Kong

Prepared by : Shenzhen LCS Compliance Testing Laboratory Ltd.
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Date of receipt of test sample : January 15, 2019
Number of tested samples : 1
Serial number : Prototype
Date of Test : January 15, 2019 ~ February 28, 2019
Date of Report : February 28, 2019

FCC TEST REPORT

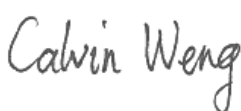
FCC CFR 47 PART 15 C(15.249)

Report Reference No. : LCS190114018AEA
Date of Issue : February 28, 2019
Testing Laboratory Name..... : Shenzhen LCS Compliance Testing Laboratory Ltd.
**Address : 1/F., Xingyuan Industrial Park, Tongda Road, Bao'an Avenue,
Bao'an District, Shenzhen, Guangdong, China**
**Testing Location/ Procedure : Full application of Harmonised standards ■
Partial application of Harmonised standards □
Other standard testing method □**
Applicant's Name..... : Phottix (HK) Ltd.
**Address : Unit 1 & 13, 8/F., Block B, Hoi Luen Ind. Centre, 55 Hoi Yuen Rd.,
Kwun Tong, Kln., Hong Kong**
Test Specification
Standard..... : FCC CFR 47 PART 15 C(15.249)
Test Report Form No. : LCSEMC-1.0
TRF Originator : Shenzhen LCS Compliance Testing Laboratory Ltd.
Master TRF : Dated 2011-03
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EUT Description. : Phottix Juno TTL Transceiver Flash
Trade Mark..... : 
Model/ Type reference : H0301
**Ratings : Input:DC 6V(powered by 4*AA size batteries)
External Power Port:330VDC,60W**
Result : Positive
Compiled by:


Ace Chai / Administrators

Supervised by:


Calvin Weng/ Technique principal

Approved by:


Gavin Liang/ Manager

FCC -- TEST REPORT

Test Report No. : LCS190114018AEA	February 28, 2019 Date of issue
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Type / Model.....	: H0301
EUT.....	: Phottix Juno TTL Transceiver Flash
Applicant.....	: Phottix (HK) Ltd.
Address.....	: Unit 1 & 13, 8/F., Block B, Hoi Luen Ind. Centre, 55 Hoi Yuen Rd., Kwun Tong, Kln., Hong Kong
Telephone.....	: /
Fax.....	: /
Manufacturer.....	: Phottix (HK) Ltd.
Address.....	: Unit 1 & 13, 8/F., Block B, Hoi Luen Ind. Centre, 55 Hoi Yuen Rd., Kwun Tong, Kln., Hong Kong
Telephone.....	: /
Fax.....	: /
Factory.....	: Phottix (HK) Ltd.
Address.....	: Unit 1 & 13, 8/F., Block B, Hoi Luen Ind. Centre, 55 Hoi Yuen Rd., Kwun Tong, Kln., Hong Kong
Telephone.....	: /
Fax.....	: /

Test Result	Positive
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The test report merely corresponds to the test sample.

It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

Revision History

Revision	Issue Date	Revisions	Revised By
000	February 28, 2019	Initial Issue	Gavin Liang

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1. GENERAL INFORMATION

1.1. Description of Device (EUT)

EUT	: Phottix Juno TTL Transceiver Flash
Test Model	: H0301
Power Supply	: Input: DC 6V(powered by 4*AA size batteries) External Power Port:330VDC,60W
Hardware Version	: A0
Software Version	: 1.00
2.4G Function	:
	2409-2474MHz
Frequency Range	: (2409, 2411, 2413, 2415, 2417, 2419, 2421, 2423, 2425, 2427, 2429, 2431, 2433, 2435, 2437, 2439, 2441, 2443, 2445, 2447, 2449, 2451, 2453, 2455, 2457, 2459, 2461, 2463, 2464, 2468, 2470, 2472, 2474)
Channel Number	: 33
Modulation Type	: GFSK
Antenna Description	: PCB Antenna, 3dBi (Max.)

1.2. Host System Configuration List and Details

Manufacturer	Description	Model	Serial Number	Certificate
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1.3. External I/O Cable

I/O Port Description	Quantity	Cable
USB Port	1	N/A

1.4. Description of Test Facility

FCC Registration Number. is 254912.

Industry Canada Registration Number. is 9642A-1.

ESMD Registration Number. is ARCB0108.

UL Registration Number. is 100571-492.

TUV SUD Registration Number. is SCN1081.

TUV RH Registration Number. is UA 50296516-001

NVLAP Registration Code is 600167-0

The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.4:2014 and CISPR 16-1-4:2010 SVSWR requirement for radiated emission above 1GHz.

1.5. Statement of the Measurement Uncertainty

The data and results referenced in this document are true and accurate. The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities. The measurement uncertainty was calculated for all measurements listed in this test report acc. To CISPR 16 – 4 “Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements” and is documented in the LCS quality system acc. To DIN EN ISO/IEC 17025. Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

1.6. Measurement Uncertainty

Test Item		Frequency Range	Uncertainty	Note
Radiation Uncertainty	:	9KHz~30MHz	±3.10dB	(1)
	:	30MHz~200MHz	±2.96dB	(1)
	:	200MHz~1000MHz	±3.10dB	(1)
	:	1GHz~26.5GHz	±3.80dB	(1)
	:	26.5GHz~40GHz	±3.90dB	(1)
Conduction Uncertainty	:	150kHz~30MHz	±1.63dB	(1)
Power disturbance	:	30MHz~300MHz	±1.60dB	(1)

(1). This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2$.

1.7. Description of Test Modes

The EUT has been tested under operating condition.

This test was performed with EUT in X, Y, Z position and the worst case was found when EUT in X position.

Worst-case mode and channel used for 9 KHz-1000 MHz radiated emissions was the mode and channel with the highest output power, that was determined to be 2.4GHz mode(Low Channel).

All test modes were tested, only the result of the worst case was recorded in the report.

Worst-case mode and channel used for 150 KHz-30 MHz power line conducted emissions was the mode and channel with the highest output power that was determined to be TX (1Mbps).

Pre-test AC conducted emission at both voltage AC 120V/60Hz and AC 240V/60Hz, recorded worst case.

1.8. Channel List and Frequency

Channel	Frequency (MHz)
1	2409
2	2437
3	2474

Mode of Operations	Transmitting Frequency (MHz)
GFSK	2409
	2437
	2474
For Radiated Emission	
Test Mode	TX Mode

2. 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.

The radiated testing was performed at an antenna-to-EUT distance of 3 meters. All radiated and conducted emissions measurement was performed at Shenzhen LCS Compliance Testing Laboratory Ltd.

2.1. EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

2.2. EUT Exercise

The EUT was operated in the engineering mode to fix the TX frequency that was for the purpose of the measurements.

According to its specifications, the EUT must comply with the requirements of the Section 15.203, 15.205, 15.207, 15.209 and 15.249 under the FCC Rules Part 15 Subpart C.

2.3. General Test Procedures

2.3.1 Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 6.2.1 of ANSI C63.10-2013 Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using Quasi-peak and average detector modes.

2.3.2 Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna, which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the maximum emissions, exploratory radiated emission measurements were made according to the requirements in Section 6.3 of ANSI C63.10-2013.

3. SYSTEM TEST CONFIGURATION

3.1. Justification

The system was configured for testing in a continuous transmits condition.

3.2. EUT Exercise Software

The system was configured for testing in a continuous transmits condition and change test channels by press the key on the EUT. (Hold on the key S1, and then the EUT enter into engineering mode. Each time S1 is pressed, it will switch between low, middle and high channels in sequence.)

3.3. Special Accessories

N/A

3.4. Block Diagram/Schematics

Please refer to the related document

3.5. Equipment Modifications

Shenzhen LCS Compliance Testing Laboratory Ltd. has not done any modification on the EUT.

3.6. Test Setup

Please refer to the test setup photo.

4. SUMMARY OF TEST RESULTS

Applied Standard: FCC Part 15 Subpart C		
FCC Rules	Description of Test	Result
§15.205(a), §15.209(a), §15.249(a), §15.249(c)	Radiated Emissions Measurement	Compliant
§15.215(c)	20 dB Bandwidth Measurement	Compliant
§15.205, §15.249(d)	Emissions at Restricted Band	Compliant
§15.207(a)	AC Line Conducted Emissions	Compliant
§15.203	Antenna Requirements	Compliant

Remark:

Note 1 --- Test results inside test report.

5. TEST RESULT

5.1. Radiated Emission Measurement

5.1.1. Standard Applicable

1. According to §15.249 (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.

Frequencies (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009~0.490	2400/F(KHz)	300
0.490~1.705	24000/F(KHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

2. According to §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		Field strength of harmonics	
	millivolts/meter	dBuV/m	microvolts/meter	dBuV/m
902-928 MHz	50	94	500	54
2400-2483.5 MHz	50	94	500	54
5725-5875 MHz	50	94	500	54
24.0-24.25 GHz	250	108	2500	68

As shown in §15.35(b), for frequencies above 1000 MHz, the field strength limits in paragraphs (a) and (b) of this section are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For point-to-point operation under paragraph (b) of this section, the peak field strength shall not exceed 2500 millivolts/meter at 3 meters along the antenna azimuth.

5.1.2. Measuring Instruments and Setting

Please refer to equipment's list in this report. The following table is the setting of spectrum analyzer and receiver.

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	10th carrier harmonic
RB / VB (Emission in restricted band)	1MHz / 3MHz for Peak, 1 MHz / 10Hz for Average
RB / VB (Emission in non-restricted band)	1MHz / 3MHz for Peak, 1 MHz / 10Hz for Average

Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RB/VB 200Hz/1KHz for QP/Average
Start ~ Stop Frequency	150kHz~30MHz / RB/VB 9kHz/30KHz for QP/Average
Start ~ Stop Frequency	30MHz~1000MHz / RB/VB 120kHz/1MHz for QP

5.1.3. Test Procedures

1) Sequence of testing 9 kHz to 30 MHz

Setup:

- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
- If the EUT is a tabletop system, a rotatable table with 0.8 m height is used.
- If the EUT is a floor standing device, it is placed on the ground.
- Auxiliary equipment and cables were positioned to simulate normal operation conditions.
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- The measurement distance is 3 meter.
- The EUT was set into operation.

Premeasurement:

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna height is 0.8 meter.
- At each turntable position the analyzer sweeps with peak detection to find the maximum of all emissions

Final measurement:

- Identified emissions during the premeasurement the software maximizes by rotating the turntable position (0° to 360°) and by rotating the elevation axes (0° to 360°).
- The final measurement will be done in the position (turntable and elevation) causing the highest emissions with QPK detector.
- The final levels, frequency, measuring time, bandwidth, turntable position, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

2) Sequence of testing 30 MHz to 1 GHz

Setup:

- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
- If the EUT is a tabletop system, a table with 0.8 m height is used, which is placed on the ground plane.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables were positioned to simulate normal operation conditions
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- The measurement distance is 3 meter.
- The EUT was set into operation.

Premeasurement:

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height changes from 1 to 3 meter.
- At each turntable position, antenna polarization and height the analyzer sweeps three times in peak to find the maximum of all emissions.

Final measurement:

- The final measurement will be performed with minimum the six highest peaks.
- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position ($\pm 45^\circ$) and antenna movement between 1 and 4 meter.
- The final measurement will be done with QP detector with an EMI receiver.
- The final levels, frequency, measuring time, bandwidth, antenna height, antenna polarization, turntable angle, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

3) Sequence of testing 1 GHz to 18 GHz

Setup:

- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables were positioned to simulate normal operation conditions
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- The measurement distance is 3 meter.
- The EUT was set into operation.

Premeasurement:

- The turntable rotates from 0° to 315° using 45° steps.
- The antenna is polarized vertical and horizontal.
- The antenna height scan range is 1 meter to 2.5 meter.
- At each turntable position and antenna polarization the analyzer sweeps with peak detection to find the maximum of all emissions.

Final measurement:

- The final measurement will be performed with minimum the six highest peaks.
- According to the maximum antenna and turntable positions of premeasurement the software maximize the peaks by changing turntable position ($\pm 45^\circ$) and antenna movement between 1 and 4 meter. This procedure is repeated for both antenna polarizations.
- The final measurement will be done in the position (turntable, EUT-table and antenna polarization) causing the highest emissions with Peak and Average detector.
- The final levels, frequency, measuring time, bandwidth, turntable position, EUT-table position, antenna polarization, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement with marked maximum final measurements and the limit will be stored.

4) Sequence of testing above 18 GHz

Setup:

- The equipment was set up to simulate a typical usage like described in the user manual or described by manufacturer.
- If the EUT is a tabletop system, a rotatable table with 1.5 m height is used.
- If the EUT is a floor standing device, it is placed on the ground plane with insulation between both.
- Auxiliary equipment and cables were positioned to simulate normal operation conditions
- The AC power port of the EUT (if available) is connected to a power outlet below the turntable.
- The measurement distance is 1 meter.
- The EUT was set into operation.

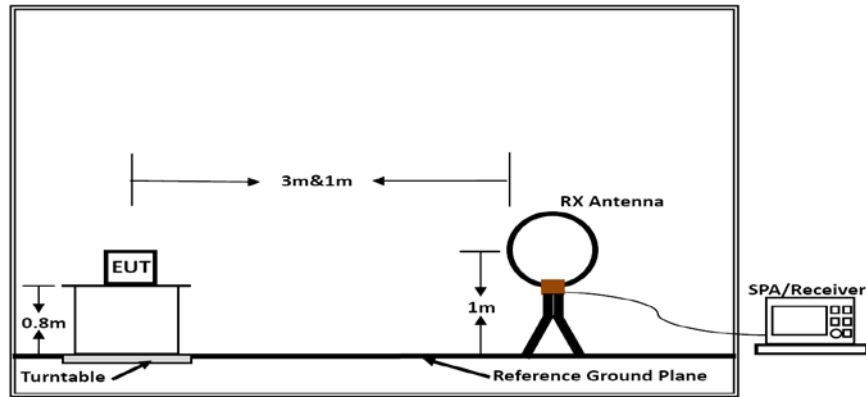
Premeasurement:

- The antenna is moved spherical over the EUT in different polarizations of the antenna.

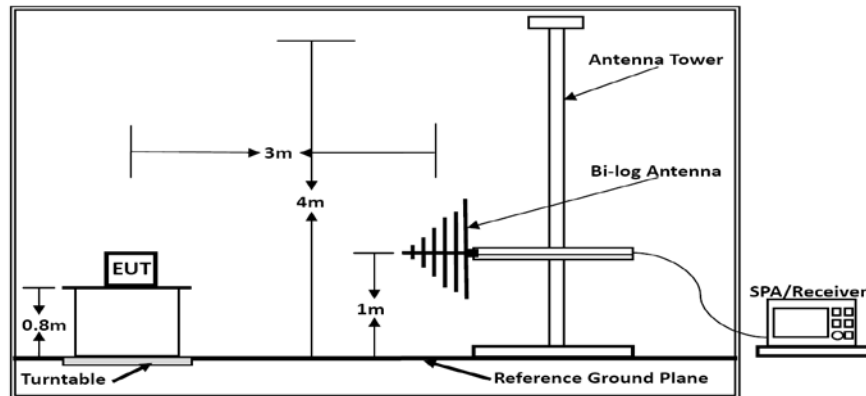
Final measurement:

- The final measurement will be performed at the position and antenna orientation for all detected emissions that were found during the premeasurements with Peak and Average detector.
- The final levels, frequency, measuring time, bandwidth, correction factor, margin to the limit and limit will be recorded. Also a plot with the graph of the premeasurement and the limit will be stored.

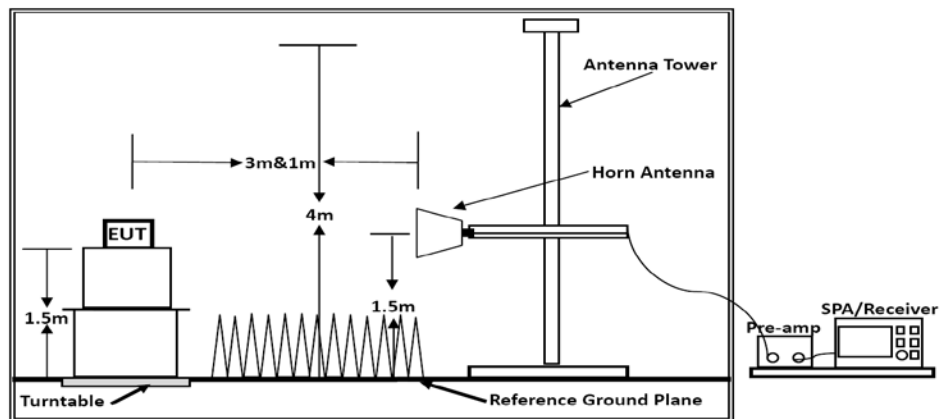
5.1.4. Test Setup Layout



Below 30MHz



Below 1GHz



Above 1GHz

Above 18 GHz shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade from 3m to 1m.

Distance extrapolation factor = $20 \log (\text{specific distance [3m]} / \text{test distance [1m]})$ (dB);

Limit line = specific limits (dBuV) + distance extrapolation factor [6 dB].

5.1.5. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

5.1.6. Results of Radiated Emissions (9 KHz~30MHz)

Temperature	24.1℃	Humidity	53.6%
Test Engineer	Tom Liu	Configurations	Low Channel

Freq. (MHz)	Level (dBuV)	Over Limit (dB)	Over Limit (dB)	Remark
-	-	-	-	See Note

Note:

The amplitude of spurious emissions which are attenuated by more than 20 dB below the permissible value has no need to be reported.

Distance extrapolation factor = $40 \log (\text{specific distance} / \text{test distance})$ (dB);

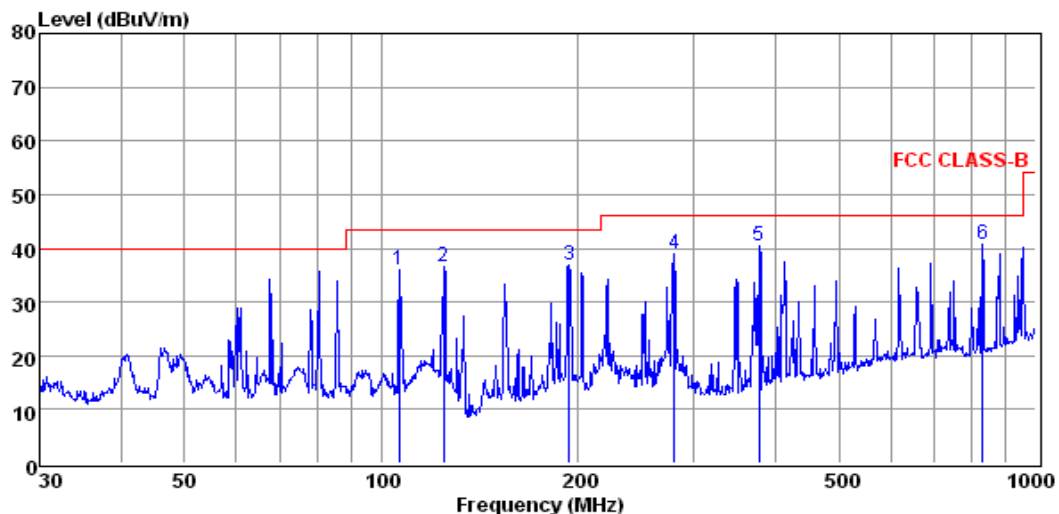
Limit line = specific limits (dBuV) + distance extrapolation factor.

5.1.7. Results of Radiated Emissions (30MHz~1GHz)

Temperature	24.1℃	Humidity	53.6%
Test Engineer	Tom Liu	Configurations	Low Channel

Low Channel

Horizontal



Env./Ins: 24.1℃/53.6%

pol: HORIZONTAL

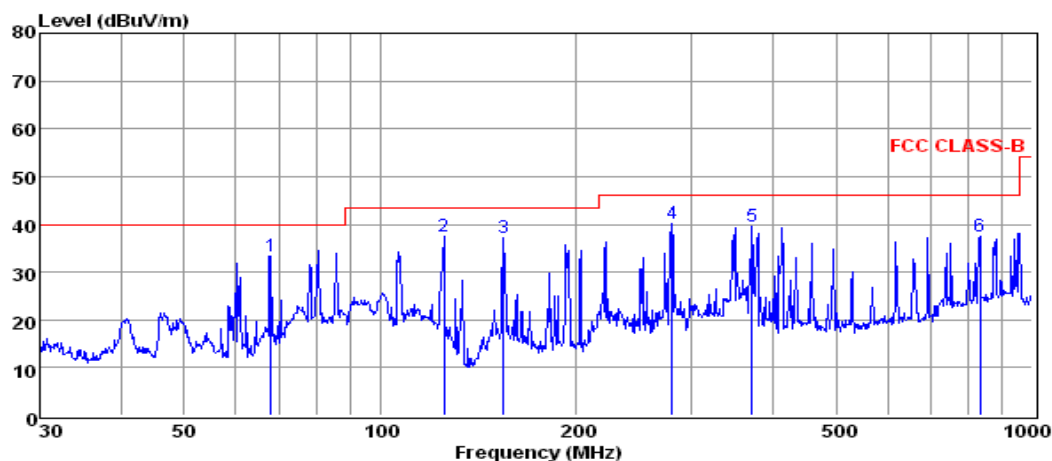
	Freq	Reading	CabLos	Antfac	Measured	Limit	Over	Remark
	MHz	dBuV	dB	dB/m	dBuV/m	dBuV/m	dB	
1	106.39	22.86	0.68	12.58	36.12	43.50	-7.38	QP
2	124.57	26.21	0.71	9.77	36.69	43.50	-6.81	QP
3	193.77	25.54	0.76	10.56	36.86	43.50	-6.64	QP
4	280.02	25.35	1.01	12.67	39.03	46.00	-6.97	QP
5	377.26	24.44	1.30	14.57	40.31	46.00	-5.69	QP
6	830.40	18.58	1.67	20.37	40.62	46.00	-5.38	QP

Note: 1. All readings are Quasi-peak values.

2. Measured= Reading + Antenna Factor + Cable Loss

3. The emission that are 20db below the official limit are not reported

Vertical



Env./Ins: 24.1°C/53.6%

pol: VERTICAL

	Freq	Reading	CabLos	Antfac	Measured	Limit	Over	Remark
	MHz	dBuV	dB	dB/m	dBuV/m	dBuV/m	dB	
1	67.91	23.36	0.51	9.51	33.38	40.00	-6.62	QP
2	125.01	27.11	0.71	9.70	37.52	43.50	-5.98	QP
3	154.28	27.97	0.76	8.44	37.17	43.50	-6.33	QP
4	280.02	26.35	1.01	12.67	40.03	46.00	-5.97	QP
5	372.00	23.91	1.20	14.53	39.64	46.00	-6.36	QP
6	833.32	15.18	1.86	20.40	37.44	46.00	-8.56	QP

Note: 1. All readings are Quasi-peak values.

2. Measured= Reading + Antenna Factor + Cable Loss

3. The emission that are 20db below the official limit are not reported

Note:

- 1). Pre-scan all modes and recorded the worst case results in this report (Low Channel).
- 2). Emission level (dBuV/m) = 20 log Emission level (uV/m).
- 3). Corrected Reading: Antenna Factor + Cable Loss + Read Level = Level.

5.1.8. Results of Radiated Emissions (Above 1GHz)

Field Strength Of Fundamental						
Frequency (MHz)	Pol.	Measure Result (PK, dBuV/m)	Measure Result (AVG, dBuV/m)	Peak Limit (dBuV/m)	AVG Limit (dBuV/m)	Result
2409	H	88.74	84.95	114.00	94.00	Pass
2409	V	88.53	84.40	114.00	94.00	Pass

Freq. MHz	Reading Level dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
4818.27	56.44	33.06	35.04	3.94	58.40	74.00	-15.60	Peak	Horizontal
4818.19	44.13	33.06	35.04	3.94	46.09	54.00	-7.91	Average	Horizontal
4818.27	53.76	33.06	35.04	3.94	55.72	74.00	-18.28	Peak	Vertical
4818.19	39.80	33.06	35.04	3.94	41.76	54.00	-12.24	Average	Vertical

Field Strength Of Fundamental						
Frequency (MHz)	Pol.	Measure Result (PK, dBuV/m)	Measure Result (AVG, dBuV/m)	Peak Limit (dBuV/m)	AVG Limit (dBuV/m)	Result
2437	H	87.88	85.63	114.00	94.00	Pass
2437	V	88.17	85.82	114.00	94.00	Pass

Freq. MHz	Reading Level dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
4874.12	58.67	33.16	35.15	3.96	60.64	74.00	-13.36	Peak	Horizontal
4874.20	41.10	33.16	35.15	3.96	43.07	54.00	-10.93	Average	Horizontal
4874.12	54.86	33.16	35.15	3.96	56.83	74.00	-17.17	Peak	Vertical
4874.20	39.97	33.16	35.15	3.96	41.94	54.00	-12.06	Average	Vertical

Field Strength Of Fundamental						
Frequency (MHz)	Pol.	Measure Result (PK, dBuV/m)	Measure Result (AVG, dBuV/m)	Peak Limit (dBuV/m)	AVG Limit (dBuV/m)	Result
2474	H	88.24	86.72	114.00	94.00	Pass
2474	V	88.39	85.45	114.00	94.00	Pass

Freq. MHz	Reading Level dBuV	Ant. Fac. dB/m	Pre. Fac. dB	Cab. Loss dB	Measured dBuV/m	Limit dBuV/m	Margin dB	Remark	Pol.
4948.15	57.09	33.26	35.14	3.98	59.19	74.00	-14.81	Peak	Horizontal
4948.19	40.98	33.26	35.14	3.98	43.08	54.00	-10.92	Average	Horizontal
4948.15	53.73	33.26	35.14	3.98	55.83	74.00	-18.17	Peak	Vertical
4948.19	40.42	33.26	35.14	3.98	42.52	54.00	-11.48	Average	Vertical

Notes:

1. Measuring frequencies from 9 KHz~10th harmonic (ex. 26GHz), No emission found between lowest internal used/generated frequency to 30MHz.
2. Radiated emissions measured in frequency range from 9 KHz~10th harmonic (ex. 26GHz) were made with an instrument using Peak detector mode.
3. No emission was be recorded above 18GHz means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.

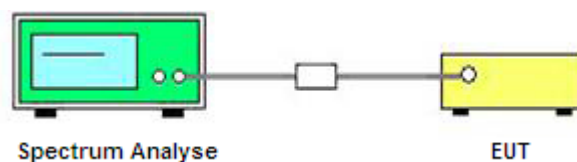
5.2. 99% Occupied Bandwidth and 20 dB Bandwidth Measurement

5.2.1. Standard Applicable

According to § 2.1049 and RSS-Gen section 6.7 “The occupied bandwidth or the “99% emission bandwidth” is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.”

In some cases, the “x dB bandwidth” is required, which is defined as the frequency range between two points, one at the lowest frequency below and one at the highest frequency above the carrier frequency, at which the maximum power level of the transmitted emission is attenuated x dB below the maximum in band power level of the modulated signal, where the two points are on the outskirts of the in-band emission.

5.2.2. Block Diagram of Test Setup



5.2.3. Test Procedure

Use the following spectrum analyzer settings:

Span = 3MHz

RBW = 30 KHz

VBW = 100 KHz

Sweep = auto

Detector function = peak

Trace = max hold

The EUT should be transmitting at its maximum data rate. Allow the trace to stabilize. Use the marker-to-peak function to set the marker to the peak of the emission. Use the marker-delta function to measure 20 dB down one side of the emission. Reset the marker-delta function, and move the marker to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth of the emission. If this value varies with different modes of operation (e.g., data rate, modulation format, etc.), repeat this test for each variation. The limit is specified in one of the subparagraphs of this Section. Submit this plot(s).

5.2.4. Test Result

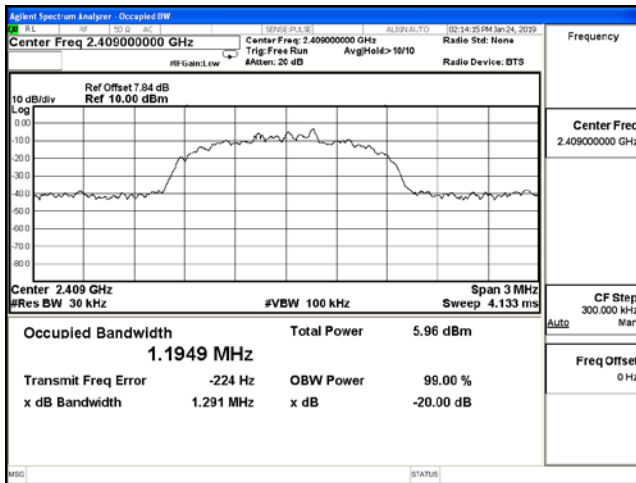
Temperature	24.3°C	Humidity	53.3%
Test Engineer	Tom Liu	Configurations	2.4G (GFSK)

Test Mode	Channel	Frequency (MHz)	99% Bandwidth (MHz)	20dB Bandwidth (MHz)	Limits	Verdict
GFSK	Low	2409	1.1949	1.291	Non-specified	PASS
	Middle	2437	1.2069	1.300		
	High	2474	1.2022	1.296		

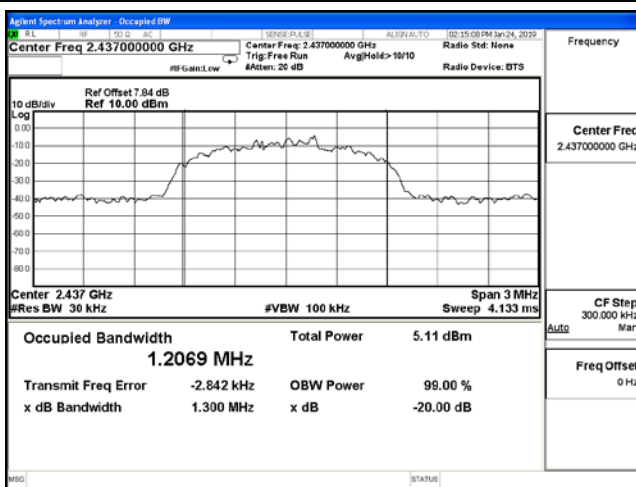
Remark:

1. Test results including cable loss;
2. Please refer to following plots;

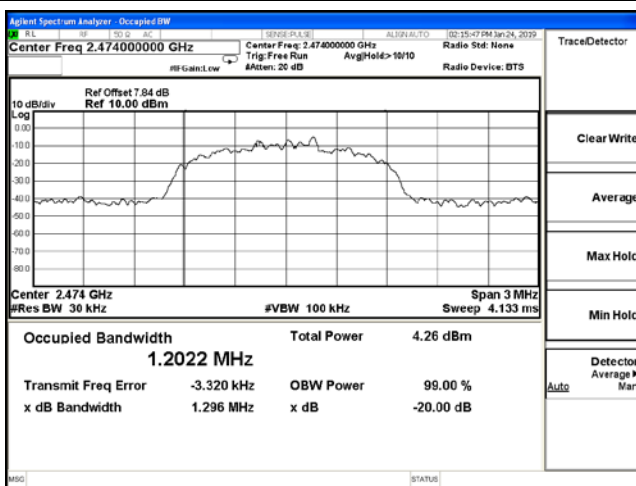
20dB Bandwidth and 99% Bandwidth



Low Channel-2409 MHz



Middle Channel-2437 MHz



High Channel-2474 MHz

5.3. AC Power Line Conducted Emissions

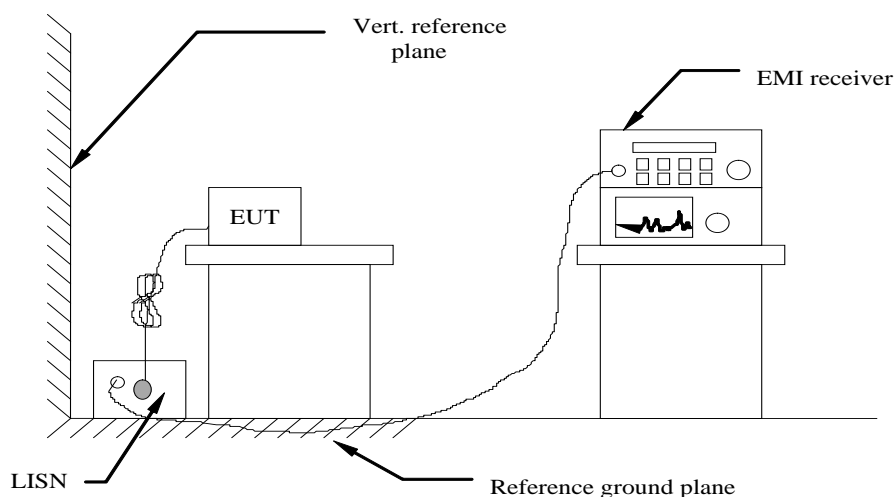
5.3.1 Standard Applicable

According to §15.207 (a): For an intentional radiator which is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed 250 microvolts (The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz). The limits at specific frequency range are listed as follows:

Frequency Range (MHz)	Limits (dB μ V)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

* Decreasing linearly with the logarithm of the frequency

5.3.2 Block Diagram of Test Setup



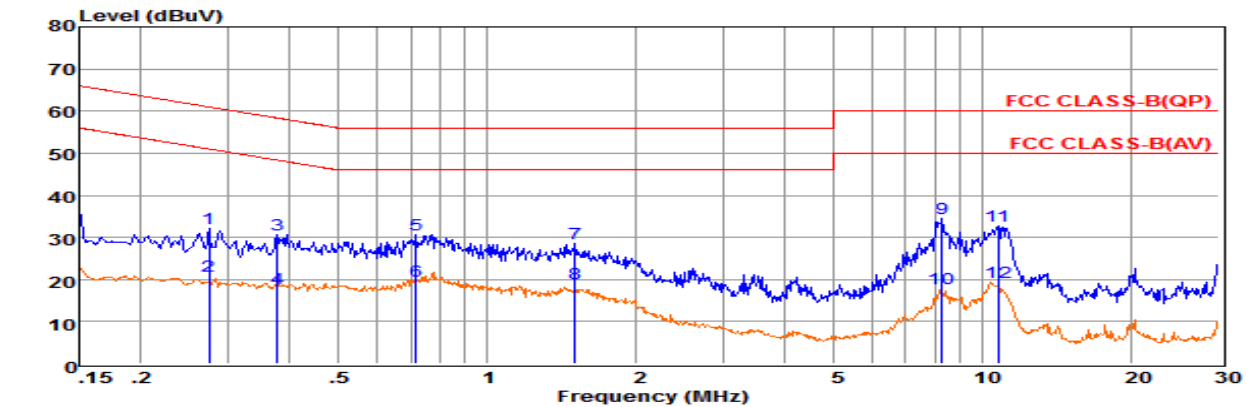
5.3.3 Test Results

PASS.

The test data please refer to following page.

AC Conducted Emission of charge from power adapter mode @ AC 120V/60Hz (worst case)

Line



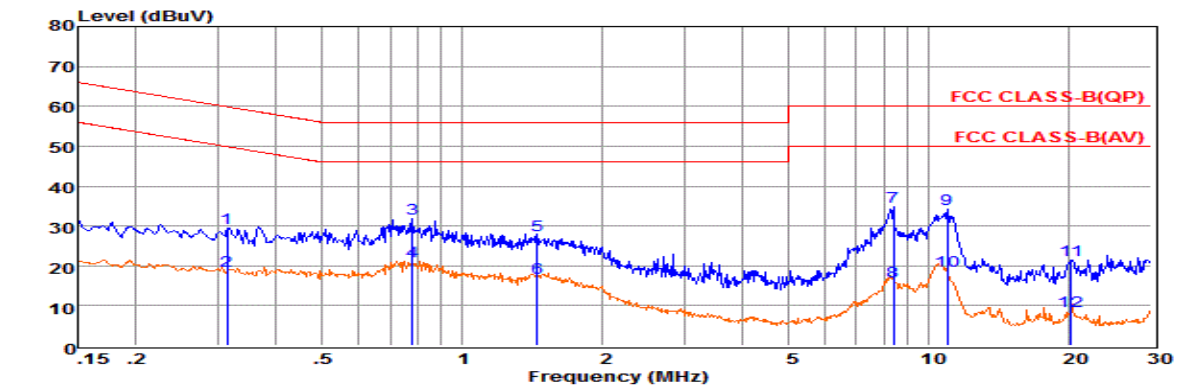
Env. Ins: 24.6*/53.3%

Pol: LINE

	Freq	Reading	LISNFac	CabLos	Aux2Fac	Measured	Limit	Over	Remark
	MHz	dBuV	dB	dB	dB	dBuV	dBuV	dB	
1	0.27	12.40	9.63	0.03	10.00	32.06	60.98	-28.92	QP
2	0.27	1.09	9.63	0.03	10.00	20.75	50.98	-30.23	Average
3	0.38	11.00	9.62	0.04	10.00	30.66	58.34	-27.68	QP
4	0.38	-1.81	9.62	0.04	10.00	17.85	48.34	-30.49	Average
5	0.72	11.02	9.64	0.04	10.00	30.70	56.00	-25.30	QP
6	0.72	-0.17	9.64	0.04	10.00	19.51	46.00	-26.49	Average
7	1.50	8.90	9.64	0.05	10.00	28.59	56.00	-27.41	QP
8	1.50	-0.51	9.64	0.05	10.00	19.18	46.00	-26.82	Average
9	8.28	14.65	9.68	0.07	10.00	34.40	60.00	-25.60	QP
10	8.28	-1.92	9.68	0.07	10.00	17.83	50.00	-32.17	Average
11	10.73	12.96	9.69	0.08	10.00	32.73	60.00	-27.27	QP
12	10.73	-0.49	9.69	0.08	10.00	19.28	50.00	-30.72	Average

Remarks: 1. Measured = Reading + LISNFac + Cable Loss + Aux2 Fac.
 2. The emission levels that are 20dB below the official limit are not reported.

Neutral



Env. Ins: 24.6*/53.3%

Pol: NEUTRAL

	Freq	Reading	LISNFac	CabLos	Aux2Fac	Measured	Limit	Over	Remark
	MHz	dBuV	dB	dB	dB	dBuV	dBuV	dB	
1	0.31	9.91	9.60	0.03	10.00	29.54	59.88	-30.34	QP
2	0.31	-0.82	9.60	0.03	10.00	18.81	49.88	-31.07	Average
3	0.78	12.26	9.63	0.04	10.00	31.93	56.00	-24.07	QP
4	0.78	1.43	9.63	0.04	10.00	21.10	46.00	-24.90	Average
5	1.45	8.00	9.63	0.05	10.00	27.68	46.00	-18.32	QP
6	1.45	-2.67	9.63	0.05	10.00	17.01	56.00	-38.99	Average
7	8.41	14.87	9.71	0.08	10.00	34.66	60.00	-25.34	QP
8	8.41	-3.87	9.71	0.08	10.00	15.92	50.00	-34.08	Average
9	10.96	14.32	9.73	0.09	10.00	34.14	60.00	-25.86	QP
10	10.96	-1.12	9.73	0.09	10.00	18.70	50.00	-31.30	Average
11	20.16	1.51	9.88	0.12	10.00	21.51	60.00	-38.49	QP
12	20.16	-11.39	9.88	0.12	10.00	8.61	50.00	-41.39	Average

Remarks: 1. Measured = Reading + LISNFac + Cable Loss + Aux2 Fac.
 2. The emission levels that are 20dB below the official limit are not reported.

***Note: Pre-scan all modes and recorded the worst case results in this report.

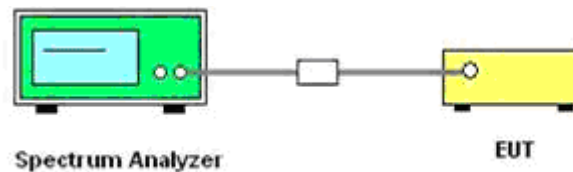
5.4. Results for Band edge Testing

5.4.1 Standard Applicable

According to FCC §15.249 (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.

According to RSS-210 B.10 (b): Emissions radiated outside of the specified frequency bands, except for harmonic emissions, shall be attenuated by at least 50 dB below the level of the fundamental emissions or to the general field strength limits listed in RSS-Gen, whichever is less stringent.

5.4.2. Test Setup Layout



5.4.3. Measuring Instruments and Setting

Please refer to equipment list in this report. The following table is the setting of Spectrum Analyzer.

5.4.4. Test Procedures

According to ANSI C63.10:2013 Field Strength Approach (linear terms):

$$\text{eirp} = p_t \times g_t = (E \times d)^2 / 30$$

Where:

p_t = transmitter output power in watts,

g_t = numeric gain of the transmitting antenna (unitless),

E = electric field strength in V/m,

d = measurement distance in meters (m).

$$\text{erp} = \text{eirp} / 1.64 = (E \times d)^2 / (30 \times 1.64)$$

Where all terms are as previously defined.

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Remove the antenna from the EUT and then connect to a low loss RF cable from the antenna port to an EMI test receiver, then turn on the EUT and make it operate in transmitting mode. Then set it to Low Channel and High Channel within its operating range, and make sure the instrument is operated in its linear range.
3. Set both RBW and VBW of spectrum analyzer for Radiated emissions restricted band RBW=1MHz, VBW=3MHz for peak detector and RBW=1MHz, VBW=1/B for Peak detector.
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.
6. Measure the conducted output power (in dBm) using the detector specified by the appropriate regulatory agency for guidance regarding measurement procedures for determining quasi-peak, peak, and average conducted output power, respectively).

7. Add the maximum transmit antenna gain (in dBi) to the measured output power level to determine the EIRP level (see 12.2.5 for guidance on determining the applicable antenna gain)
8. Add the appropriate maximum ground reflection factor to the EIRP level (6 dB for frequencies ≤ 30 MHz, 4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive and 0 dB for frequencies > 1000 MHz).
9. For devices with multiple antenna-ports, measure the power of each individual chain and sum the EIRP of all chains in linear terms (e.g., Watts, mW).
10. Compare the resultant electric field strength level to the applicable regulatory limit.
11. Perform radiated spurious emission test duress until all measured frequencies were complete.

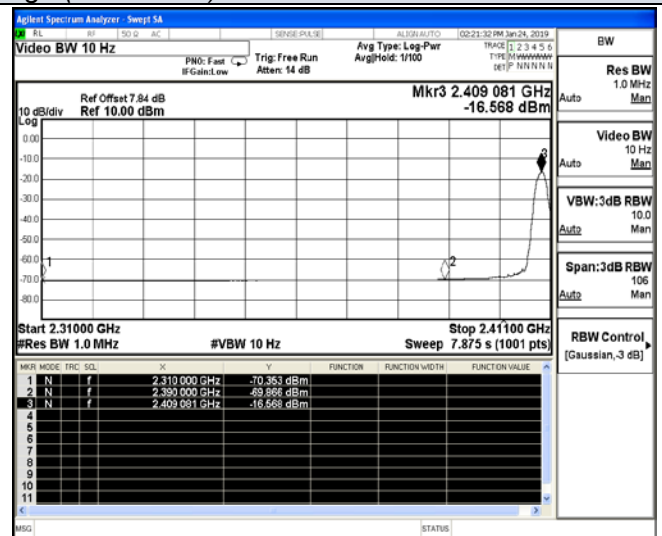
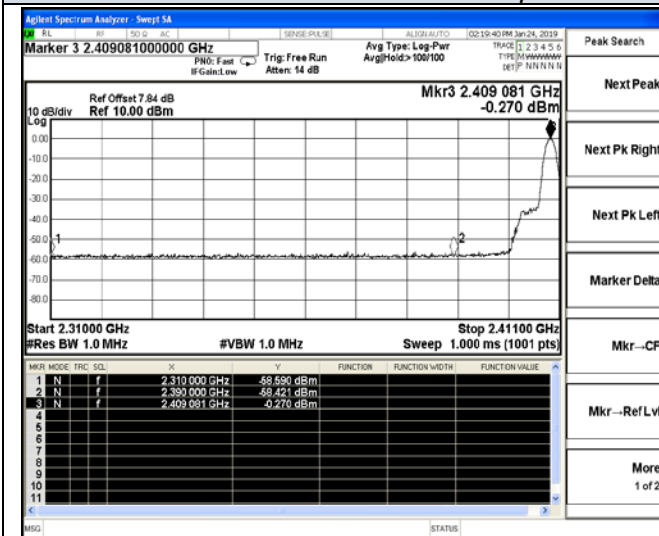
5.4.5. Measuring Instruments and Setting

GFSK						
Freq. MHz	Reading Level dBm	Antenna Gain dBi	Measured E dBuV/m	Limit dBuV/m	Margin dB	Remark
2310.000	-58.590	3.0	39.670	74.00	-34.330	Peak
2310.000	-70.353	3.0	27.907	54.00	-26.093	Average
2390.000	-58.421	3.0	39.839	74.00	-34.161	Peak
2390.000	-68.866	3.0	29.394	54.00	-24.606	Average
2483.500	-57.431	3.0	40.829	74.00	-33.171	Peak
2483.500	-69.221	3.0	29.039	54.00	-24.961	Average
2500.000	-56.365	3.0	41.895	74.00	-32.105	Peak
2500.000	-69.617	3.0	28.643	54.00	-25.357	Average

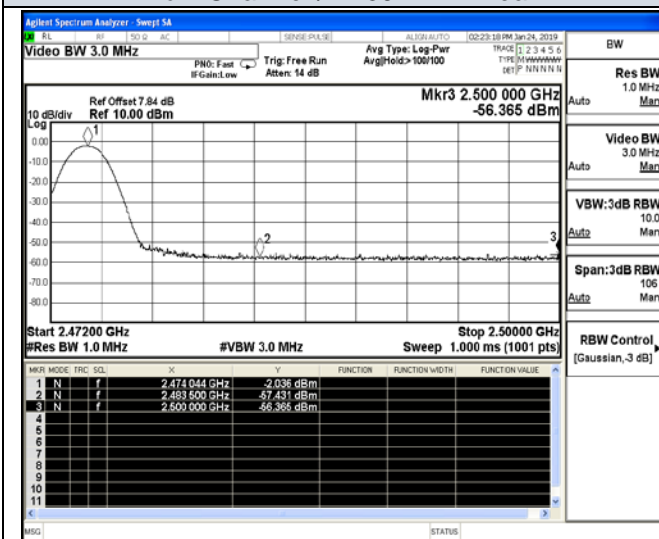
Remark:

1. The other emission levels were very low against the limit.
2. The average measurement was not performed when the peak measured data under the limit of average detection.
3. Detector AV is setting spectrum/receiver. RBW=1MHz/VBW=10Hz/Sweep time=Auto/Detector=Peak;
4. Since the out-of-band characteristics of the EUT transmit antenna will often be unknown, the use of a conservative antenna gain value is necessary. Thus, when determining the EIRP based on the measured conducted power, the upper bound on antenna gain for a device with a single RF output shall be selected as the maximum in-band gain of the antenna across all operating bands, or 2 dBi, whichever is greater. However, for devices that operate in multiple frequency bands while using the same transmit antenna, the highest gain of the antenna within the operating band nearest in frequency to the restricted band emission being measured may be used in lieu of the overall highest gain when the emission is at a frequency that is within 20 percent of the nearest band edge frequency, but in no case shall a value less than 2 dBi be used.
5. Please refer to following test plots;

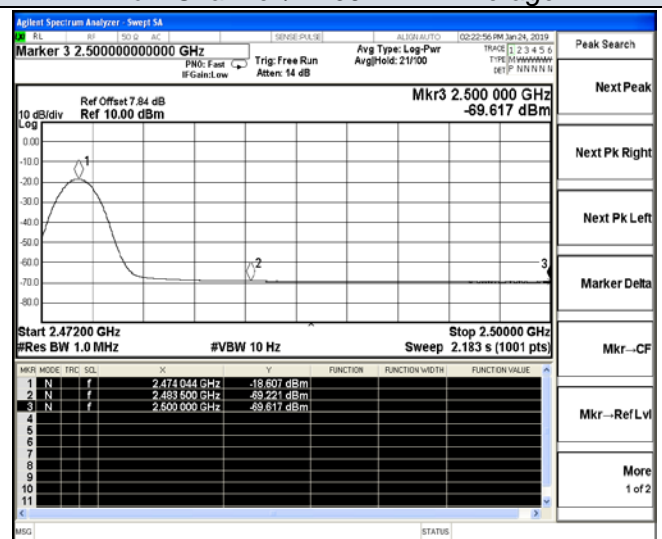
Test plot of Band Edge (Conducted)



Low Channel / 2409MHz - Peak



High Channel / 2474MHz - Peak



High Channel / 2474MHz - Average

5.5. Antenna Requirements

5.5.1 Standard Applicable

According to antenna requirement of §15.203.

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 shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be re-placed by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

5.5.2 Antenna Connected Construction

5.5.2.1. Standard Applicable

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 with the device.

5.5.2.2. Antenna Connector Construction

The directional gains of antenna used for transmitting is 3.0dBi, and the antenna is a PCB antenna connect to PCB board and no consideration of replacement. Please see EUT photo for details.

5.5.2.3. Results: Compliance.

6. LIST OF MEASURING EQUIPMENTS

Item	Equipment	Manufacturer	Model No.	Serial No.	Cal Date	Due Date
1	MXA Signal Analyzer	Agilent	N9020A	MY49100060	2018-11-15	2019-11-14
2	DC Power Supply	Agilent	E3642A	N/A	2018-11-15	2019-11-14
3	Temperature & Humidity Chamber	GUANGZHOU GOGN WEN	GDS-100	70932	2018-10-10	2019-10-09
4	EMI Test Software	AUDIX	E3	-	-	-
5	3m Semi Anechoic Chamber	SIDT FRANKONIA	SAC-3M	03CH03-HY	2018-06-16	2019-06-15
6	Positioning Controller	MF	MF-7082	/	2018-06-16	2019-06-15
7	Active Loop Antenna	SCHWARZBECK	FMZB 1519B	00005	2018-07-26	2019-07-25
8	By-log Antenna	SCHWARZBECK	VULB9163	9163-470	2018-07-26	2019-07-25
9	Horn Antenna	SCHWARZBECK	BBHA 9120D	9120D-1925	2018-07-02	2019-07-01
10	EMI Test Receiver	R&S	ESR 7	101181	2018-06-16	2019-06-15
11	RS SPECTRUM ANALYZER	R&S	FSP40	100503	2018-11-15	2019-11-14
12	AMPLIFIER	QuieTek	QTK	CHM/0809065	2018-11-15	2019-11-14
13	RF Cable-R03m	Jye Bao	RG142	CB021	2018-06-16	2019-06-15
14	RF Cable-HIGH	SUHNER	SUCOFLEX 106	03CH03-HY	2018-06-16	2019-06-15
15	EMI Test Receiver	R&S	ESPI	101840	2018-06-16	2019-06-15
16	Artificial Mains	R&S	ENV216	101288	2018-06-16	2019-06-15
17	10dB Attenuator	SCHWARZBECK	MTS-IMP-136	261115-001-0032	2018-06-16	2019-06-15

Note: All equipment is calibrated through GUANGZHOU LISAI CALIBRATION AND TEST CO.,LTD.

7. TEST SETUP PHOTOGRAPHS OF EUT

Please refer to separated files for Test Setup Photos of the EUT.

8. EXTERIOR PHOTOGRAPHS OF THE EUT

Please refer to separated files for External Photos of the EUT.

9. INTERIOR PHOTOGRAPHS OF THE EUT

Please refer to separated files for Internal Photos of the EUT.

-----THE END OF REPORT-----