TEST REPORT

Date: 2015-03-24
Report No.: 60.870.14.022.06F

Applicant:	Hong Kong RFID Ltd. Unit 11, 9/F, Wah Wai Centre, 38-40 Au Pui Wan Street, Fotan, Shatin, N.T., Hong Kong	
Description of Samples:	Model name:	EMPRESS ACTIVE RFID TAG
	Model no.:	HKRAT-RT02, HKRAT-RT02-Z
	FCCID:	XNO-HKRAT-RT02
Date Samples Received:	2015-03-02	
Date Tested:	2015-03-03 to 2015-03-23	
Investigation Requested:	FCC Part 15 Subpart C, Section 15.249	
Conclusions:	The submitted product COMPLIED with the requirements of Federal Communications Commission [FCC] Rules and Regulations Part 15. The tests were performed in accordance with the standards described above and on Section 2.2 in this Test Report.	
Remarks:	----	

Checked by:

Ray Cheung
Project Engineer
Wireless & Telecom department

Approved by:-

John Zhi
Project Manager
Wireless & Telecom department

CONTENT:

1.0 General Details

1.1 Test Laboratory

TUV SUD Certification and Testing (China) Co., Ltd
Building 12&13, Zhiheng Wisdomland Business Park,
Nantou Checkpoint Road 2, Shenzhen, 518052
Registration Number: 502708

Tested by:

Ray Cheung

1.2 Applicant Details

Applicant

Hong Kong RFID Ltd.
Unit 11, 9/F, Wah Wai Centre, 38-40 Au Pui
Wan Street, Fotan, Shatin, N.T., Hong Kong

Manufacturer

Hong Kong RFID Ltd.
Unit 11, 9/F, Wah Wai Centre, 38-40 Au Pui
Wan Street, Fotan, Shatin, N.T., Hong Kong

1.3 Equipment Under Test [EUT]

Description of EUT

Model Name:	EMPRESS ACTIVE RFID TAG
Model Number:	HKRAT-RT02, HKRAT-RT02-Z
FCCID:	XNO-HKRAT-RT02
Rating:	DC 3V (CR2450 battery)
Antenna Type:	Integral
Antenna Gain:	0 dBi
Operated Frequency:	2402MHz to 2480MHz
No. of Channel:	79
Accessories and Auxiliary Equipment:	ThinkPad Notebook
EUT Exercising Software:	None

General Operation of EUT

The Equipment Under Test (EUT) is a RFID Tag.

As per Client Declaration, the circuit design, PCB Layout, shielding and interfaces of HKRAT-RT02 are identical for HKRAT-RT02-Z, only the Cosmetic are different. So we use the HKRAT-RT02 as a representative model.

1.4 Equipment Modification

No modification was made to the tested unit by TÜV SÜD Hong Kong Ltd.

1.5 Related Submittal(s) Grants

This is a single application of certification for this transmitter.

2.0 Technical Details

2.1 Investigations Requested

Perform ElectroMagnetic Interference measurement in accordance with FCC 47CFR [Codes of Federal Regulations] Part 15 and ANSI C63.4: 2009.

2.2 Test Standards and Results Summary Tables

EMISSION Results Summary				
Test Condition	FCC Test Requirement	Test Result		
		Pass	Failed	N/A
Field Strength of Fundamental and Harmonics	Part 15.249 (a),(e)	☒	☐	☐
Spurious Radiated Emission	Part 15.249 (d) Part 15.209 Part 15.205	☒	☐	☐
Out of Band Emissions	Part 15.249 (d)	☒	☐	☐
Bandwidth Measurement	Part 15.215 (c)	☒	☐	☐
Conducted Emission	Part 15.207	☒	☐	☐

Note: N/A - Not Applicable

3.0 Test Methodology

3.1 Radiated Emission

The sample was placed 0.8m above the ground plane on a standard emission test site *. Measurements in both horizontal and vertical polarities were performed. During the test, each emission was maximized by: having the EUT continuously working, investigated all operating modes, rotated about all 3 axis (X, Y & Z) and considered typical configuration to obtain worst position, manipulating interconnecting cables, rotating turntable, varying antenna height from 1m to 4m in both horizontal and vertical polarizations. The emissions worst-case are shown in Test Results of the following pages.

3.2 Field Strength Calculation

The field strength at 3 m was established by adding the meter reading of the spectrum analyzer to the factors associated with antenna correction factor, cable loss, preamplifiers and filter attenuation.

The equation is expressed as follow:

FS = R + System Factor
System Factor = AF + CF + FA – PA

Where FS = Net Field Strength in dBuV/m at 3 meters.
R = Reading of Spectrum Analyzer / Test Receiver in dBuV.
AF = Antenna Factor in dB.
CF = Cable Attenuation Factor in dB.
FA = Filter Attenuation Factor in dB.
PA = Preamplifier Factor in dB.

FA and PA are only be used for the measuring frequency above 1 GHz.

3.3 Conducted Emissions

The EUT was placed on a non-metallic table 0.8m above the horizontal metal reference place and 0.4m from a vertical ground plane which is connected to the horizontal metal ground plane. Meanwhile, the AC main of EUT was connected to the distance of 0.8m line impedance stabilization network (LISN) during measurement.

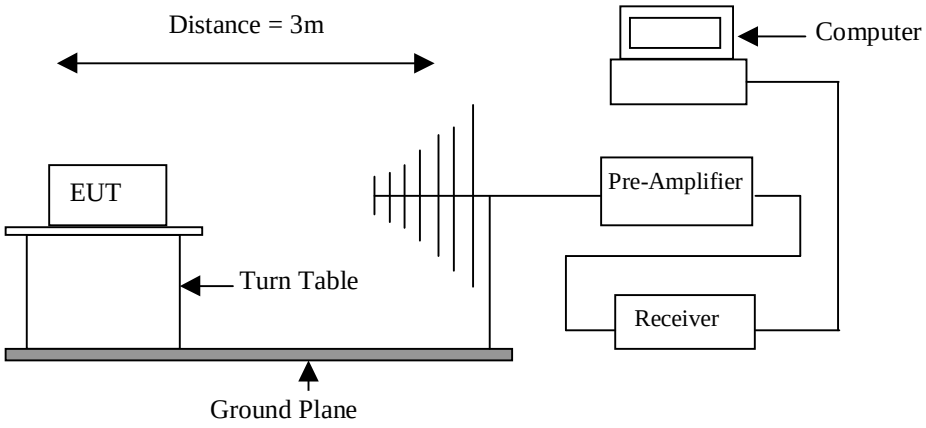
Initial measurements were performed in quasi-peak and average detection modes by the test receiver, any emissions recorded within 30dB of the relevant limit lines were re-measured using quasi-peak and average detection on the live and neutral lines with the worst case recorded in the table of results.

4.0 Test Results

4.1 Field Strength of Fundamental and Harmonics

Test Requirement:	FCC part 15 section 15.249(a)(e)
Test Method:	ANSI C63.4:2009
Test Date:	2015-03-18
Mode of Operation:	Transmitting mode.
Detector Function:	Quasi-peak (Below 1000 MHz) Average and Peak (Above 1000 MHz)
Measurement BW:	120 kHz (Below 1000 MHz) 1 MHz (Above 1000 MHz)

Test Setup:



Results: PASS

Value	Emissions Frequency **MHz**	E-Field Polarity	Reading **dBµV/m**	System Factor **dB**	Field Strength at 3m **dBµV/m**	Limit **dBµV/m**	Delta to Limit **dBµV/m**	Remarks
PK	2402.00	H	61.32	39.00	100.32	114.00	-13.68	Fund.
PK		V	53.76	39.00	92.76	114.00	-21.24	Fund.
PK	2440.00	H	60.77	39.20	99.97	114.00	-14.03	Fund.
PK		V	52.54	39.20	91.74	114.00	-22.26	Fund.
PK	2480.00	H	56.99	39.30	96.29	114.00	-17.71	Fund.
PK		V	52.08	39.30	91.38	114.00	-22.62	Fund.
PK	4803.75	H	44.73	9.10	53.83	74.00	-20.17	Harmonic
PK		V	41.59	9.10	50.69	74.00	-23.31	Harmonic

Remark : - (*) Radiated emissions which fall in the restricted bands as defined in Section 15.205(a).
- All emission more than 20 below the limit which does not be mentioned in the report
- Calculated measurement uncertainty: ±5.0dB

Limits of Field Strength for Fundamental and Harmonics Frequency [Section 15.249 (a)]:

Fundamental Frequency	Field Strength of Fundamental		Field Strength of Harmonics	
[MHz]	[mV/m]	[dBμV/m]	[μV/m]	[dBμV/m]
902 – 928	50	94	500	54
2400 – 2483.5	50	94	500	54

Compliance with the limits in the above table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector.

Limit Requirement under Section 15.249 (e) :
According to section 15.249 (e), for frequencies above 1000MHz, the above field strength limits is 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 20dB under any condition of modulation.

Limit for Radiated Emission [Section 15.209]:

Frequency (MHz)	Field Strength [μV/m]	Field Strength [dBμV/m]
30-88	100	40.0
88-216	150	43.5
216-960	200	46.0
Above 960	500	54.0

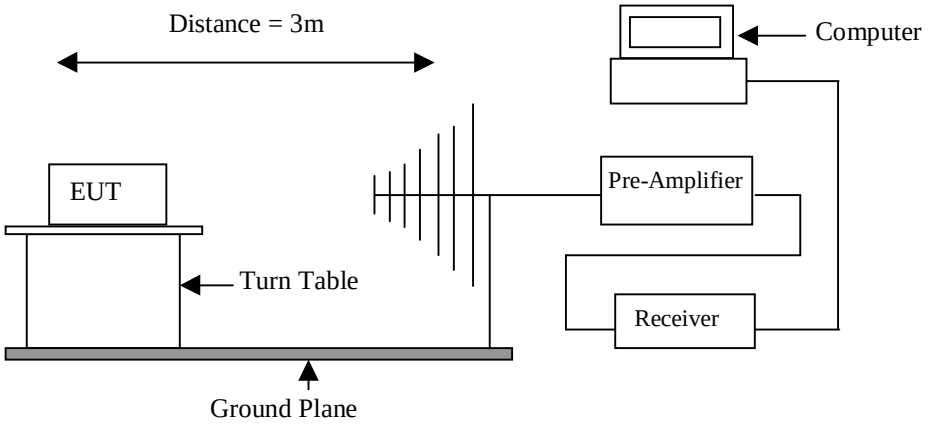
Radiated emissions, which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209.

The emission limits shown in the above table are based on measurement employing a CISPR quasi-peak detector and above 1000MHz are based on measurements employing an average detector.

4.2 Spurious Radiated Emission

Test Requirement:	FCC part 15 section 15.249(d),15.209
Test Method:	ANSI C63.4:2009
Test Date:	2015-03-18
Mode of Operation:	Transmitting Mode
Detector Function:	Quasi-peak (Below 1000 MHz) Average and Peak (Above 1000 MHz)
Measurement BW:	120 kHz (Below 1000 MHz) 1 MHz (Above 1000 MHz)

Test Setup:



Results: PASS

Spurious Radiated Emissions							
Frequency MHz	Polarity	Reading dBuV	Factor dB/m	Measurement dBuV/m	Limit dBmV/m	Margin dB	Detector
38.912	V	21.16	14.1	35.26	40.0	-4.74	QP
43.762	V	17.44	15.2	32.64	40.0	-7.36	QP
86.018	V	19.87	10.8	30.67	40.0	-9.33	QP
124.999	V	25.94	11.3	37.24	43.5	-6.26	QP
433.035	V	12.54	18.4	30.94	46.0	-15.06	QP
82.016	H	16.69	10.0	26.69	40.0	-10.31	QP
124.999	H	19.57	11.3	30.87	43.5	-12.63	QP
199.811	H	19.33	13.5	32.83	43.5	-10.67	QP
266.619	H	20.34	14.7	35.04	46	-10.96	QP

Note:
- No further spurious emissions found between 30MHz and lowest internal used / generated frequency.
- The result shown the worst case of the operating frequency.
- All emission more than 20 below the limit which does not be mentioned in the report.
- Result data graph is shown at the next pages for reference.

Remark :
- (*) Radiated emissions which fall in the restricted bands as defined in Section 15.205(a).
- Calculated measurement uncertainty: ±5.0dB.

Limit of Outside of the Specified Bands [Section 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 section 15.209, whichever is the lesser attenuation

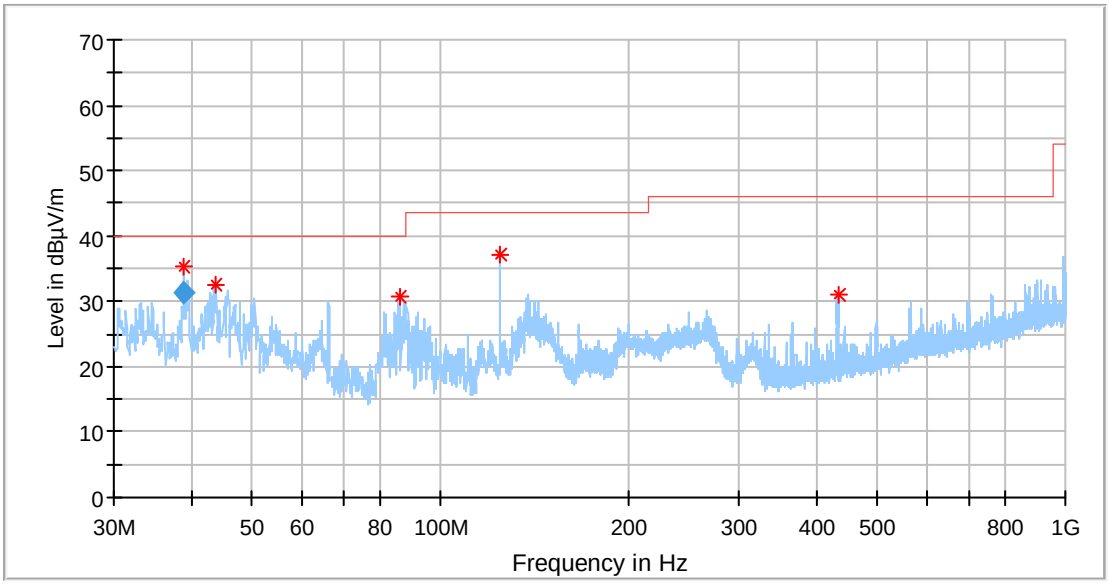
Limit for Radiated Emission [Section 15.209]:

Frequency (MHz)	Field Strength [μV/m]	Field Strength [dBμV/m]
30-88	100	40.0
88-216	150	43.5
216-960	200	46.0
Above 960	500	54.0

Radiated emissions, which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209.

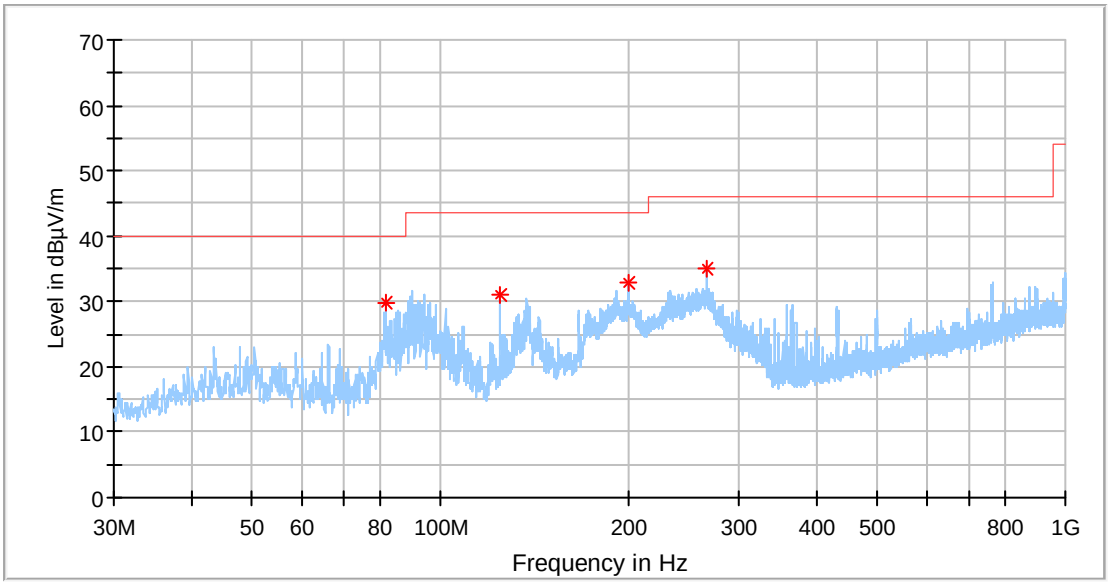
The emission limits shown in the above table are based on measurement employing a CISPR quasi-peak detector and above 1000MHz are based on measurements employing an average detector.

Vertical



Remark: No significant emissions were detected above 1 GHz except the related operating frequency.

Horizontal



Remark: No significant emissions were detected above 1 GHz except the related operating frequency.

4.3 Out of Band Emissions

Test Requirement:	FCC part 15 section 15.249 (d)
Test Method:	ANSI C63.4:2009
Test Date:	2015-03-18
Mode of Operation:	Transmitting mode.
Detector Function:	Peak

Results: PASS

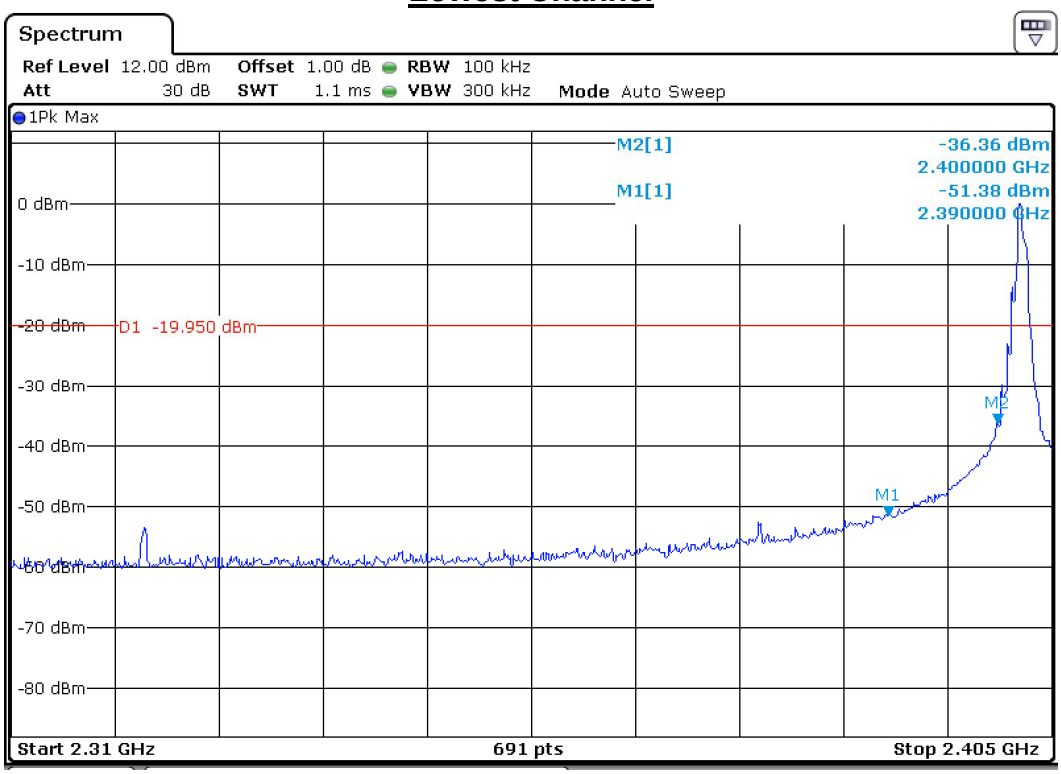
Refer to the data graph, the lower and higher edge of the specified frequency bands fulfill the general radiated emission limits in section 15.209. Therefore, the EUT meets the requirement of section 15.249 (d).

Limit for Out of Band Emissions [Section 15.249 (d)]

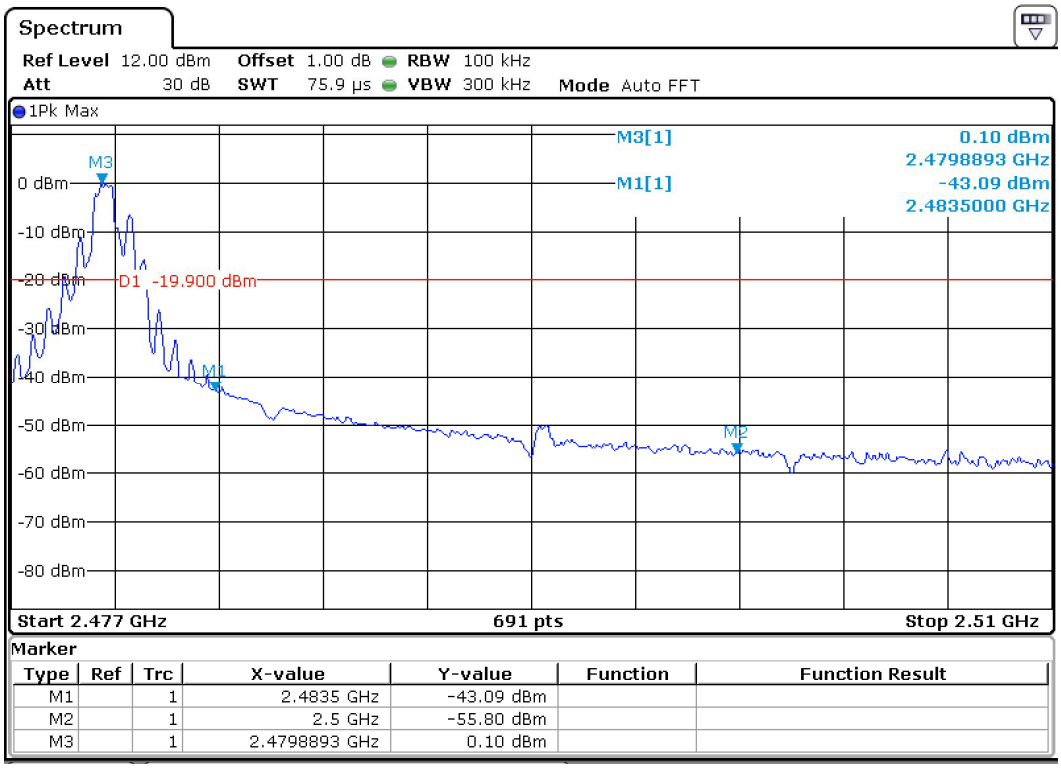
Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in section 15.209, whichever is the lesser attenuation.

Test Result: Result data graph is shown at the next pages for reference.

Lowest Channel



Highest Channel



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4835 GHz	-43.09 dBm		
M2		1	2.5 GHz	-55.80 dBm		
M3		1	2.4798893 GHz	0.10 dBm		

4.4 Bandwidth Measurement

Test Requirement:	FCC part 15 section 15.215 (c)
Test Method:	ANSI C63.4:2009
Test Date:	2015-03-18
Mode of Operation:	Transmitting mode.
Detector Function:	Peak

Results: PASS

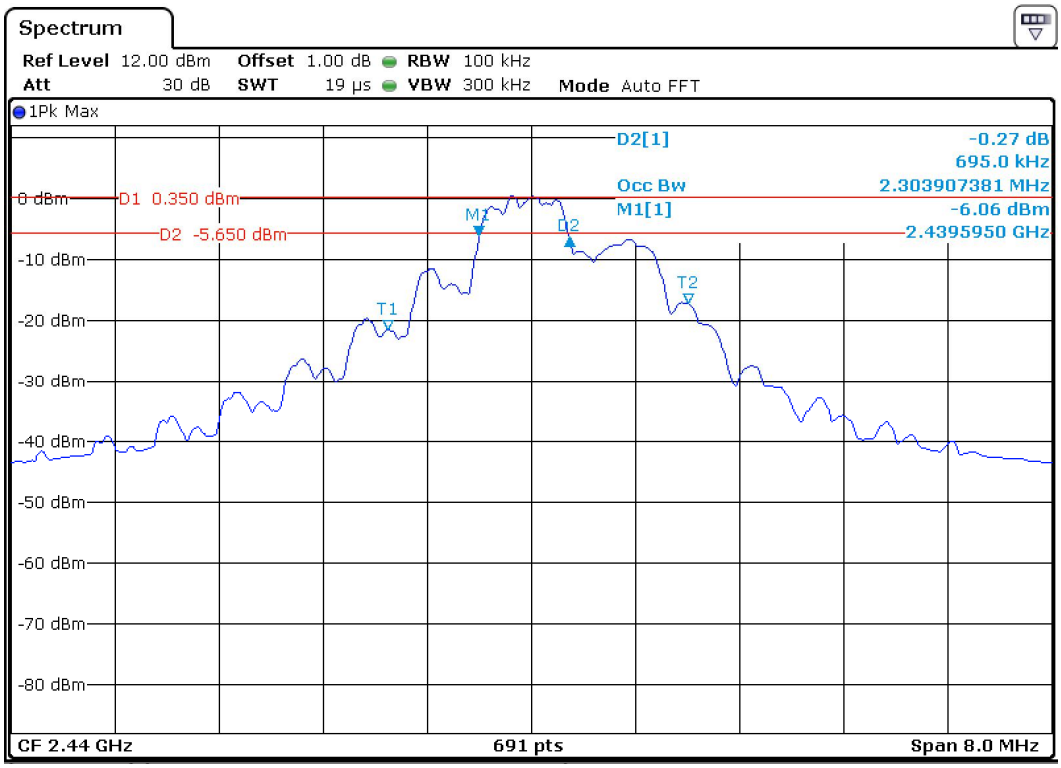
Refer to the data graph, the 20dB points of Low Channel, Mid Channel and High Channel. All channels within the operation bandwidth when equipment is operated. Therefore, the EUT meets the requirement of section 15.215(c).

Limit for Bandwidth [Section 15.215 (c)]

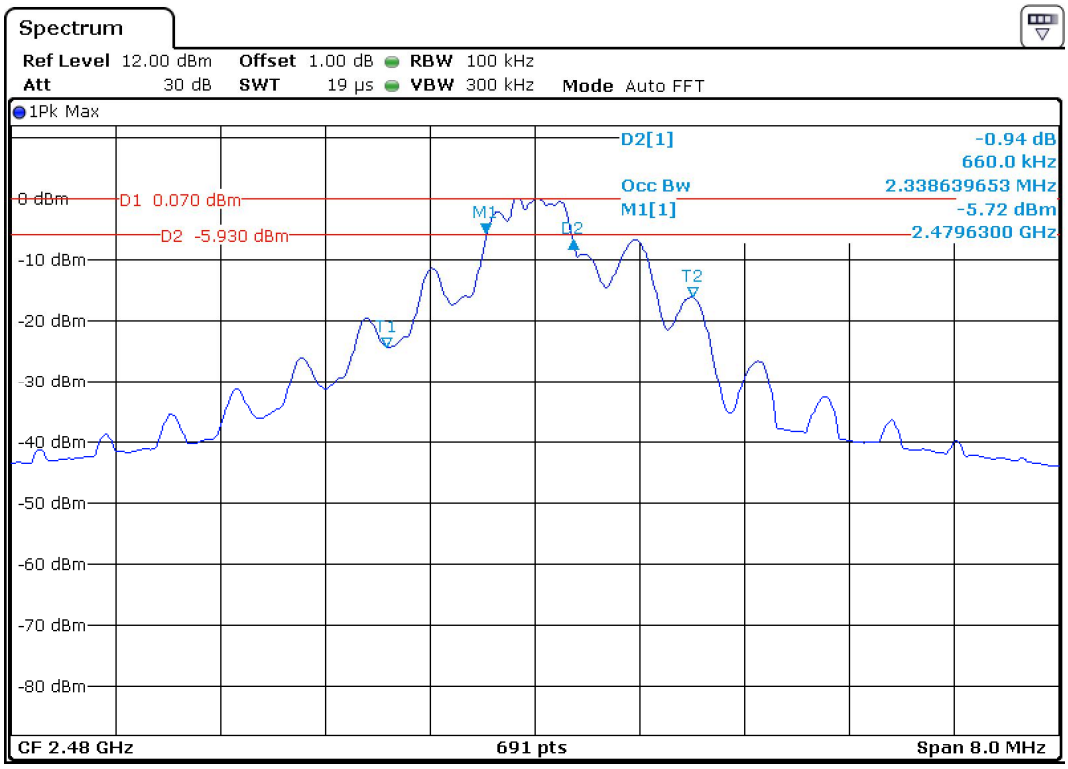
The 20dB bandwidth of the emission shall be within the frequency band designated in the rule section under which the equipment is operated.

Test Result: Result data graph is shown at the next pages for reference.

Low Channel – Bandwidth 1.598 MHz



Mid Channel – Bandwidth 2.304MHz



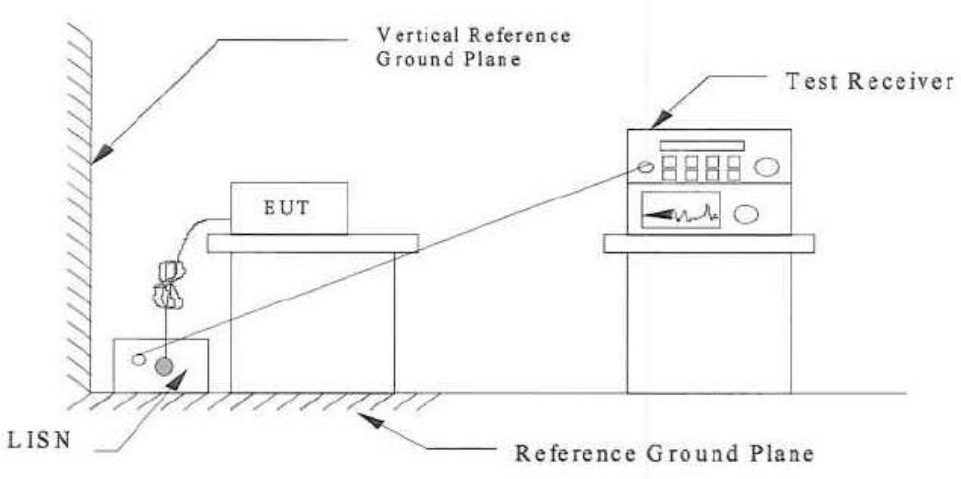
High Channel – Bandwidth 2.339MHz

4.5 Conducted Emissions (0.15MHz to 30MHz)

Test Requirement:	FCC part 15 Section 15.207 Class B
Test Method:	ANSI C63.4:2009
Test Date:	---
Mode of Operation:	---
Detector Function:	Quasi-peak, average
Measurement BW:	9 kHz

Remark : Test not applicable for the battery operating product

Test Setup:



Results: N/A

Limits for Conducted Emission [Section 15.207]:

Frequency Range [MHz]	Quasi-Peak Limit [dBμV]	Average Limit [dBμV]
0.15-0.5	66 to 56*	56 to 46*
0.5-5.0	56	46
5.0-30.0	60	50

* Decreases with the logarithm of the frequency.

Remarks:
Calculated measurement uncertainty: ±2.8dB

5.0 List of Measurement Equipment

	DESCRIPTION	MANUFACTURER	MODEL NO.	SERIAL NO.	CAL. DUE DATE
CE	EMI Test Receiver	Rohde & Schwarz	ESR 3	101782	2015-8-17
	LISN	Rohde & Schwarz	ENV4200	100249	2015-8-17
	LISN	Rohde & Schwarz	ENV216	100326	2015-8-17
	ISN	Rohde & Schwarz	ENY81	100177	2015-8-17
	ISN	Rohde & Schwarz	ENY81-CAT6	101664	2015-8-17
	High Voltage Proble	Rohde & Schwarz	TK9420(VT9420)	9420-58	2015-8-17
	RF Current probe	Rohde & Schwarz	EZ-17	100816	2015-8-17
C	Signal Generator	Rohde & Schwarz	SMB100A	108272	2015-8-17
	Signal Analyzer	Rohde & Schwarz	FSV40	101030	2015-8-17
	Vector Signal Generator	Rohde & Schwarz	SMU 200A	105324	2015-8-17
	RF Switch Module	Rohde & Schwarz	OSP120/OSP-B157	101226/100851	2015-8-17
RE	EMI Test Receiver	Rohde & Schwarz	ESR 26	101269	2015-8-17
	Trilog Super Broadband Test Antenna	Schwarzbeck	VULB 9163	707	2016-8-17
	Horn Antenna	Rohde & Schwarz	HF907	102294	2015-8-17
	Pre-amplifier	Rohde & Schwarz	SCU 18	102230	2015-8-17
	3m Semi-anechoic chamber	TDK	9X6X6	----	2017-5-29

C - Conducted RF tests

- Conducted peak output power
- 6dB bandwidth
- 20dB bandwidth and 99% Occupied Bandwidth
- Carrier frequency separation
- Number of hopping frequencies
- Dwell Time
- Power spectral density*
- Spurious RF conducted emissions
- Band edge