



## FCC Test Report

**Report No.:** WVK-ESH-P21051909B-11

**FCC ID:** 2AQOB-LWF1V2

**Product:** WIFI CEILING SPEAKER V2

**Model:** LWF1V2, LWF1V2/IP

**Received Date:** May.25, 2021

**Test Date:** May.28, 2021 to Jun.22, 2021

**Issued Date:** Jul.14, 2021

**Applicant:** Lithe Audio Ltd.

**Address:** Unit 4 IO Centre, Salbrook Road Industrial Estate, Salbrook Road, Salfords, Redhill, Surrey, RH1 5GJ. UK

**Manufacturer:** Lithe Audio Ltd.

**Address:** Unit 4 IO Centre, Salbrook Road Industrial Estate, Salbrook Road, Salfords, Redhill, Surrey, RH1 5GJ. UK

**Issued By:** BUREAU VERITAS ADT (Shanghai) Corporation

**Lab Address:** No. 829, Xinzhan Road, Shanghai, P.R.China (201612)



Test Lab  
Cert 2343.01

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### Release Control Record

Issue No.	Description	Date Issued
WVK-ESH-P21051909B-11	Original release	Jul.14, 2021



## 1 Certificate of Conformity

**Product:** WIFI CEILING SPEAKER V2

**Brand:** LITHEAUDIO

**Model:** LWF1V2, LWF1V2/IP

**Applicant:** Lithe Audio Ltd.

**Test Date:** May.28, 2021 to Jun.22, 2021

**Standards:** 47 CFR FCC Part 15, Subpart C (Section 15.247)

ANSI C63.10:2013

The above equipment has been tested by **BUREAU VERITAS ADT (Shanghai) Corporation**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

**Prepared by :**

Yuan ZHANG

Project Engineer

, Date:

Jul.14, 2021

**Approved by :**



Daniel SUN

EMC Lab Manager

, Date:

Jul.14, 2021



## 2 Summary of Test Results

The EUT has been tested according to the following specifications:

47 CFR FCC Part 15, Subpart C (SECTION 15.247)			
FCC Clause	Test Item	Result	Remarks
15.203	Antenna Requirement	PASS	No antenna connector is used.
15.207	AC Power Conducted Emission	PASS	Meet the requirement of limit.
15.247(a)(2)	Minimum 6dB Bandwidth	PASS	Meet the requirement of limit.
15.247(b)	Conducted Output Power	PASS	Meet the requirement of limit.
15.247(e)	Power Spectral Density	PASS	Meet the requirement of limit.
15.247(d)	Conducted Band Edges Measurement	PASS	Meet the requirement of limit.
15.247(d)	Conducted Spurious Emissions	PASS	Meet the requirement of limit.
15.247(d)	Emissions in restricted frequency bands	PASS	Meet the requirement of limit.
15.205 / 15.209 / 15.247(d)	Radiated Emissions Measurement	PASS	Meet the requirement of limit.

Note: We verified that the power of the module is slightly less than that of the original case, so we quoted the data of the conducted part of original case.



## 2.1 Test Instruments

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Next Cal.
Hybrid Antenna(25MHz-1.5GHz)	Schwarzbeck	VULB9168	E1A1012	Jul.29, 20	Jul.28, 22
Horn Antenna(1GHz -18GHz)	Schwarzbeck	BBHA9120D	E1A1017	Aug.25, 20	Aug.24, 22
Double Ridge Horn Antenna(18G-40G)	COM-POWER	AH-840	E1A1040	Jul.15, 20	Jul.14, 22
Pre-Amplifier(100kHz-1.3GHz)	Agilent	8447D	E1A2001	Apr.19, 21	Apr.18, 22
Pre-Amplifier(0.5GHz-18GHz)	EMCI	EMC184045SE	E1A2009	Jul.05, 21	Jul.04, 22
Pre-Amplifier(18GHz-40GHz)	EMCI	EMC051845SE	E1A2008	Jul.05, 21	Jul.04, 22
EMI test receiver	R&S	ESR7	E1R1005	Apr.19, 21	Apr.18, 22
Spectrum Analyzer	Keysight	N9030B	E1S1003	Jul.23, 20	Jul.22, 21
Spectrum Analyzer	Keysight	N9020A	E1S1004	Mar.02, 21	Mar.01, 22
EMI test receiver	R&S	ESCS30	E1R1001	May.11, 21	May.10, 22
LISN	R&S	ENV216	E1L1011	May.11, 21	May.10, 22
Humidity&Temp Tester	Baolima	WS508	E1H1011	Apr.02, 21	Apr.01, 22
RF Control Unit	Toscend	JS0806-2	E1C5003	N/A	N/A
Test Software	ADT	ADT_COND_V7 .3.1	N/A	N/A	N/A
Test Software	Toscend	JS32-RE	N/A	N/A	N/A
Test Software	Toscend	JS1120	N/A	N/A	N/A
Test Software	Toscend	JS1120-3	N/A	N/A	N/A

## 2.2 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT:

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

Measurement	Frequency	Expanded Uncertainty (k=2) (±)
Conducted Emissions at mains ports	150kHz ~ 30MHz	1.83 dB
Radiated Emissions up to 1 GHz	30MHz ~ 1GHz	5.36 dB
Radiated Emissions above 1 GHz	1GHz ~ 6GHz	3.47 dB
	6GHz ~ 18GHz	3.75 dB
	18GHz ~ 40GHz	3.30 dB

## 2.3 Modification Record

There were no modifications required for compliance.



### 3 General Information

#### 3.1 General Description of EUT

Product	WIFI CEILING SPEAKER V2
Brand	LITHEAUDIO
Model	LWF1V2, LWF1V2/IP
Test Model	LWF1V2
Model Discrepancy	The two models are same as each other except for color of enclosure.
Power Rating	100-240V~, 50/60Hz, 2.0A for adapter; 24.0Vdc for WI-FI CEILING SPEAKERS
Modulation Type	CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM
Modulation Technology	DSSS, OFDM
Operating Frequency	See clause 3.2
Number of Channel	See clause 3.2
Output Power	15.07dBm
Antenna Type	PCB Antenna
Antenna Connector	--
Antenna Gain	Ant1:3.5dBi Ant2:3.5dBi

Note:

1. For more details, please refer to the User's manual of the EUT.
2. The EUT contains the wireless module of model LS9AD-AC11DBT-GV (FCC ID: 2ADBM-LS9ADAC11DBT) supports BT/WIFI function.
3. The wireless module can't support MIMO mode. 2.4G and 5 GHz bands can't operate simultaneously.

Modulation Mode	TX /RX Function
802.11b	1TX / 1RX
802.11g	1TX / 1RX
802.11n (HT20)	1TX / 1RX
802.11n (HT40)	1TX / 1RX



### 3.2 Description of Test Modes

11 channels are provided for 802.11b, 802.11g and 802.11n (HT20) and 7 channels are provided for 802.11n (HT40).

Channel	Frequency	Channel	Frequency
1	2412MHz	7	2442MHz
2	2417MHz	8	2447MHz
3	2422MHz	9	2452MHz
4	2427MHz	10	2457MHz
5	2432MHz	11	2462MHz
6	2437MHz	-	-

### 3.2.1 Test Mode Applicability:

EUT Configure Mode	Applicable to				Description
	RE $\geq$ 1G	RE $<$ 1G	PLC	APCM	
-	✓	✓	✓	✓	-

Where **RE $\geq$ 1G**: Radiated Emission above 1GHz      **RE $\leq$ 1G**: Radiated Emission below 1GHz

**PLC**: Power Line Conducted Emission      **APCM**: Antenna Port Conducted Measurement

#### Radiated Emission Test (Above 1 GHz):

- Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)
-	802.11n (HT20)	1 to 11	1	OFDM	BPSK	6.5

#### Radiated Emission Test (Below 1 GHz):

- Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).

#### Power Line Conducted Emission Test:

- Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)
-	802.11b	1 to 11	1	DSSS	DBPSK	1.0



### Antenna Port Conducted Measurement

- Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
- Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	MODE	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION TECHNOLOGY	MODULATION TYPE	DATA RATE (Mbps)
-	802.11b	1 to 11	1, 6, 11	DSSS	DBPSK	1.0
-	802.11g	1 to 11	1, 6, 11	OFDM	BPSK	6.0
-	802.11n (HT20)	1 to 11	1, 6, 11	OFDM	BPSK	6.5
-	802.11n (HT40)	3 to 9	3, 6, 9	OFDM	BPSK	13.5

#### **3.2.2 Test Condition:**

Applicable to	Normal Environmental Conditions	Normal Input Power
<b>RE <math>\geq</math> 1G</b>	25deg. C, 60%RH	120Vac, 60Hz
<b>RE <math>&lt;</math> 1G</b>	25deg. C, 60%RH	120Vac, 60Hz
<b>PLC</b>	25deg. C, 60%RH	120Vac, 60Hz
<b>APCM</b>	25deg. C, 60%RH	120Vac, 60Hz



### **3.3 Description of Support Units**

The EUT has been tested as an independent unit together with other necessary accessories or support units.

### **3.4 General Description of Applied Standards**

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standard:

**FCC Part 15, Subpart C (15.247)**

**KDB 558074 D01 DTS Meas Guidance v05r02**

**ANSI C63.10:2013**

All related test items have been performed and recorded as per the above standard.



## 4 Test Procedure and Results

### 4.1 AC Power Conducted Emission

#### 4.1.1 Limits

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15 - 0.5	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30.0	60	50

Note: 1. The lower limit shall apply at the transition frequencies.

2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50MHz.

#### 4.1.2 Test Procedures

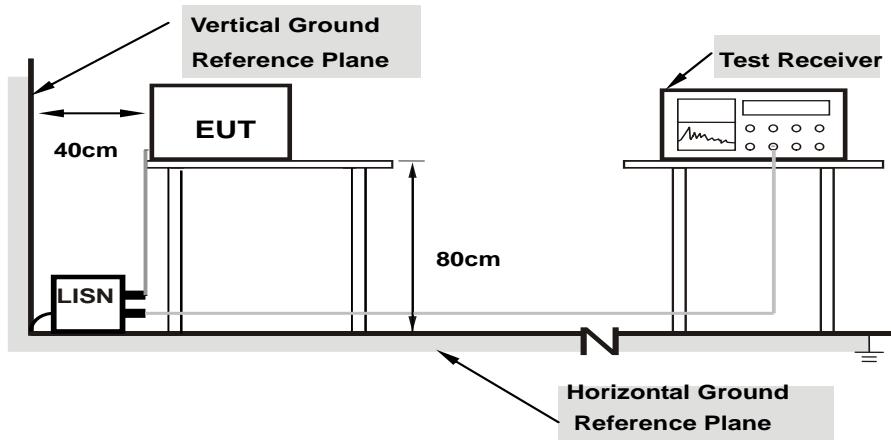
- a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.
- b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- c. The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

**NOTE:** The resolution bandwidth and video bandwidth of test receiver is 9kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15MHz-30MHz.

#### 4.1.3 Deviation from Test Standard

No deviation.

#### 4.1.4 Test Setup



Note: 1. Support units were connected to second LISN.

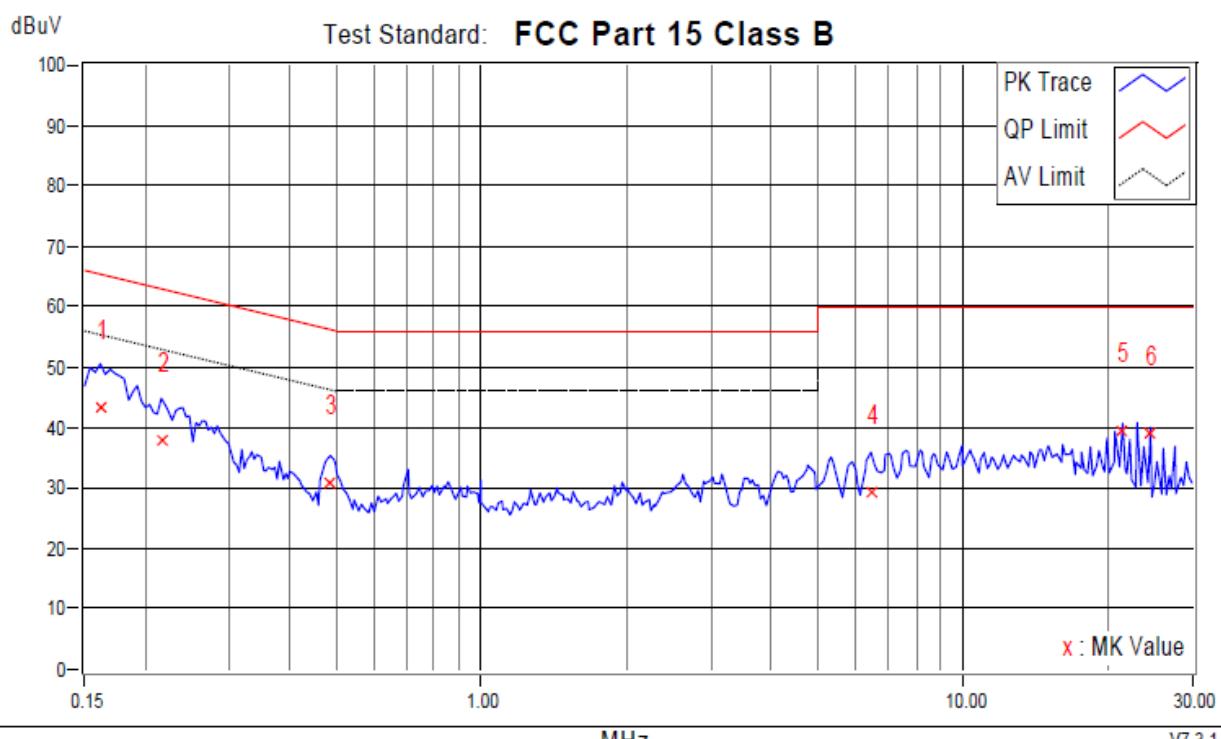
For the actual test configuration, please refer to the attached file (Test Setup Photo).

#### 4.1.5 EUT Operating Conditions

Same as 4.1.6.

#### 4.1.6 Test Results

Phase	Line (L)	Detector Function	Quasi-Peak (QP) / Average (AV)
Power supply	AC 120V, 60Hz		

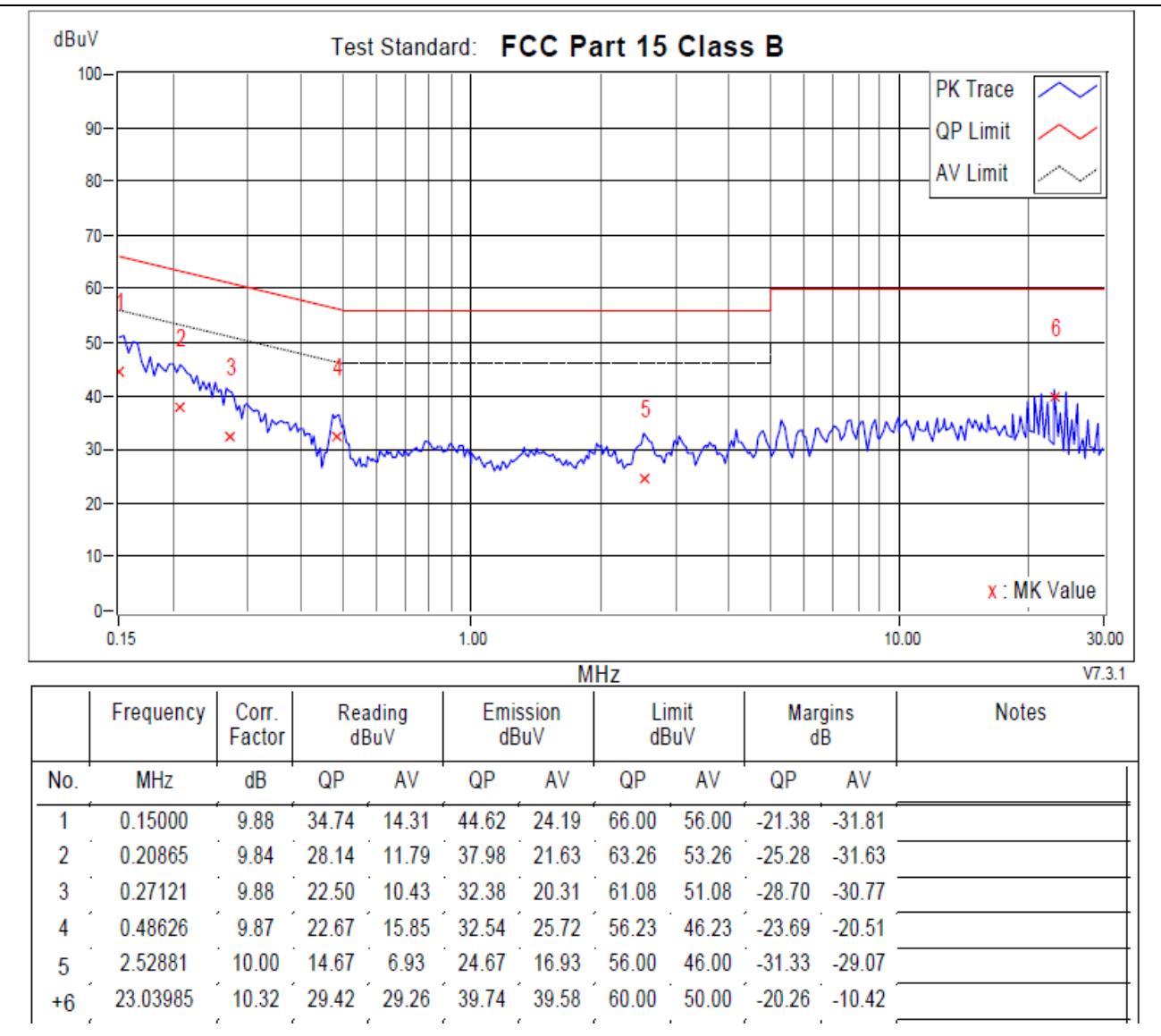


No.	Frequency	Corr. Factor	Reading dBuV		Emission dBuV		Limit dBuV		Margins dB		Notes
	MHz	dB	QP	AV	QP	AV	QP	AV	QP	AV	
1	0.16173	9.87	33.60	12.69	43.47	22.56	65.37	55.37	-21.90	-32.81	
2	0.21647	9.86	28.15	11.61	38.01	21.47	62.95	52.95	-24.94	-31.48	
3	0.48626	9.75	21.19	14.48	30.94	24.23	56.23	46.23	-25.29	-22.00	
4	6.45445	10.17	19.24	12.06	29.41	22.23	60.00	50.00	-30.59	-27.77	
+5	21.50322	10.21	29.06	28.81	39.27	39.02	60.00	50.00	-20.73	-10.98	
6	24.57648	10.06	29.15	27.46	39.21	37.52	60.00	50.00	-20.79	-12.48	

#### REMARKS:

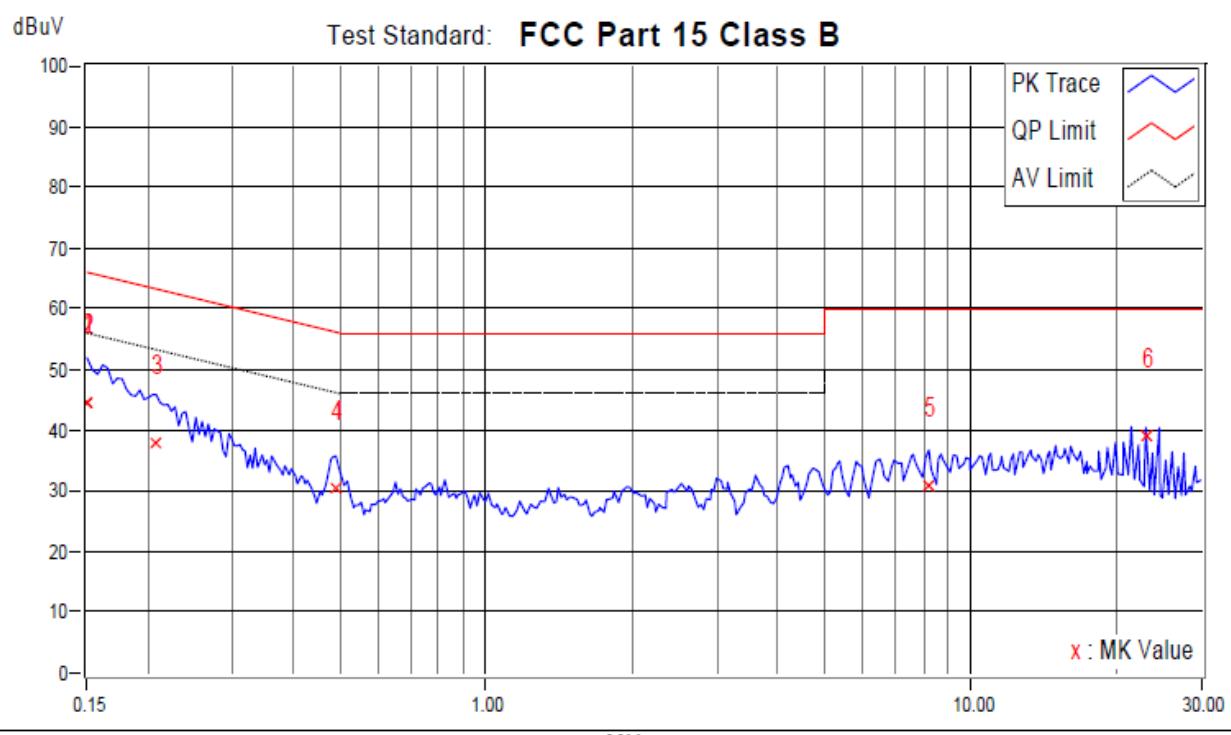
1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level - Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value.

Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)
Power supply	AC 120V, 60Hz		


**REMARKS:**

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level - Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value.

Phase	Line (L)	Detector Function	Quasi-Peak (QP) / Average (AV)
Power supply	AC 240V, 50Hz		

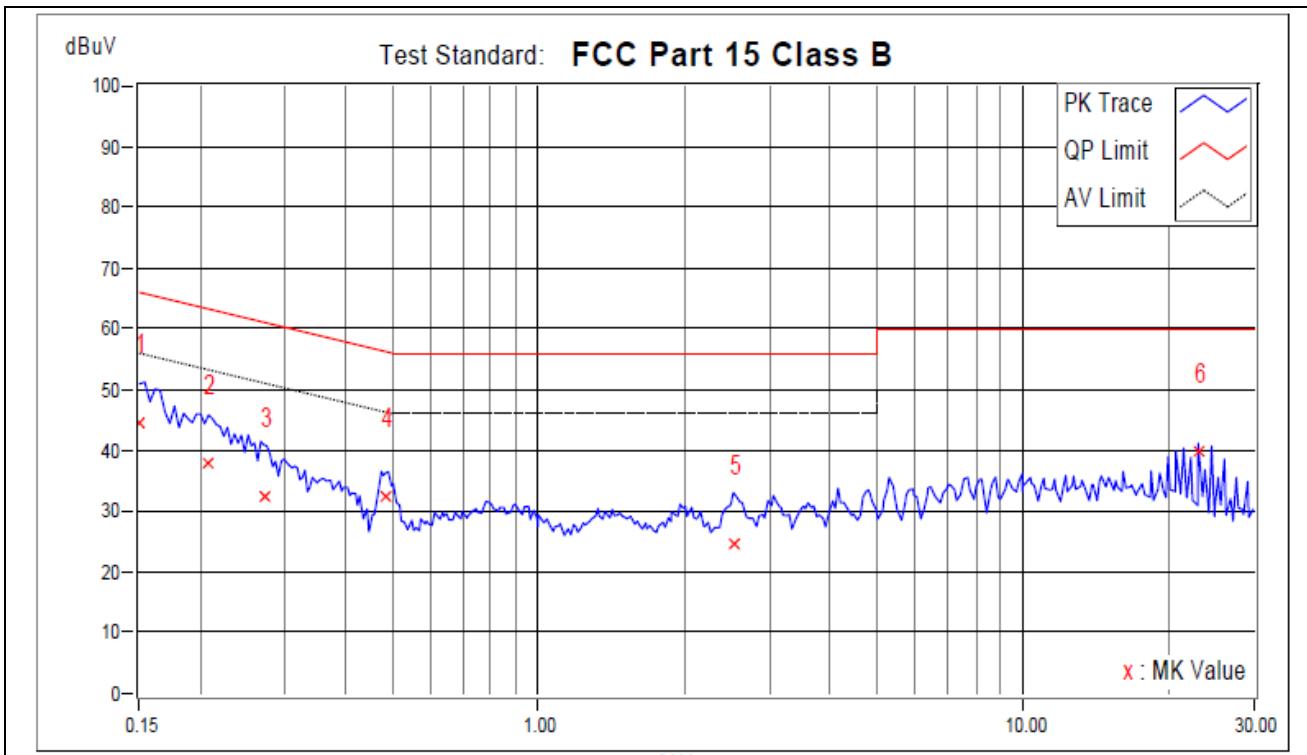


No.	Frequency	Corr. Factor	Reading dBuV		Emission dBuV		Limit dBuV		Margins dB		Notes
	MHz	dB	QP	AV	QP	AV	QP	AV	QP	AV	
1	0.15000	9.87	34.66	13.87	44.53	23.74	66.00	56.00	-21.47	-32.26	
2	0.15000	9.87	34.60	13.35	44.47	23.22	66.00	56.00	-21.53	-32.78	
3	0.20865	9.88	27.96	10.69	37.84	20.57	63.26	53.26	-25.42	-32.69	
4	0.49017	9.75	20.88	14.13	30.63	23.88	56.16	46.16	-25.53	-22.28	
5	8.22177	10.28	20.61	12.99	30.89	23.27	60.00	50.00	-29.11	-26.73	
+6	23.03985	10.13	29.08	29.01	39.21	39.14	60.00	50.00	-20.79	-10.86	

**REMARKS:**

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level - Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value.

Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)
Power supply	AC 240V, 50Hz		



	Frequency	Corr. Factor	Reading dBuV		Emission dBuV		Limit dBuV		Margins dB		Notes
			MHz	dB	QP	AV	QP	AV	QP	AV	
1	0.15000	9.88	34.74	14.31	44.62	24.19	66.00	56.00	-21.38	-31.81	
2	0.20865	9.84	28.14	11.79	37.98	21.63	63.26	53.26	-25.28	-31.63	
3	0.27121	9.88	22.50	10.43	32.38	20.31	61.08	51.08	-28.70	-30.77	
4	0.48626	9.87	22.67	15.85	32.54	25.72	56.23	46.23	-23.69	-20.51	
5	2.52881	10.00	14.67	6.93	24.67	16.93	56.00	46.00	-31.33	-29.07	
+6	23.03985	10.32	29.42	29.26	39.74	39.58	60.00	50.00	-20.26	-10.42	

**REMARKS:**

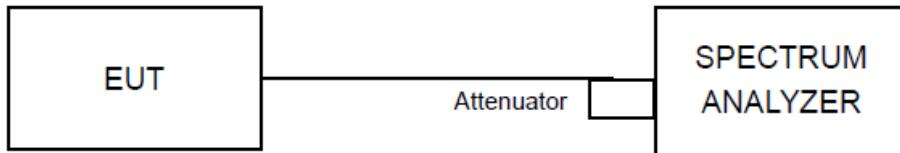
1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level - Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value.

## 4.2 Minimum 6dB Bandwidth

### 4.2.1 Limit

For digital modulation systems, the minimum 6dB bandwidth shall be at least 500 kHz

### 4.2.2 Test Setup



### 4.2.3 Test Procedures

The EUT was tested according to DTS test procedure of "KDB558074 D01 DTS Meas Guidance" for compliance to FCC 47CFR 15.247 requirements (clause 8.2).

The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described above (i.e.,  $RBW = 100 \text{ kHz}$ ,  $VBW \geq 3 \cdot RBW$ , peak detector with maximum hold) is implemented by the instrumentation function.

### 4.2.4 Deviation of Test Standard

No deviation.



#### 4.2.5 Test Results

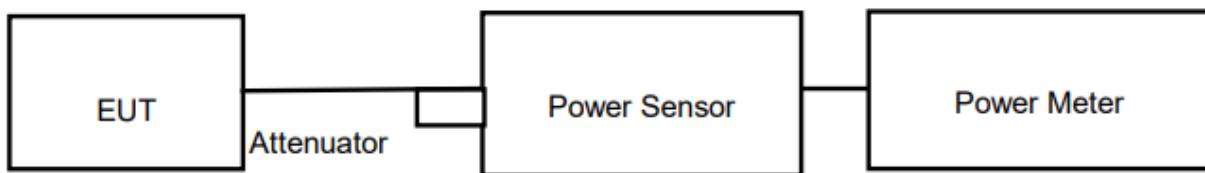
The test data for this section is contained in Test Report Number: CCISE181109003.

### 4.3 Conducted Output Power

#### 4.3.1 Limit

For systems using digital modulation in the 2400 – 2483.5 MHz bands: 1 Watt (30 dBm)

#### 4.3.2 Test Setup



#### 4.3.3 Test Procedures

Method PM is used to perform output power measurement, trigger and gating function of wide band power meter is enabled to measure max output power of TX on burst. Duty factor is not added to measured value.

#### 4.3.4 Deviation of Test Standard

No deviation.

#### 4.3.5 Test Results

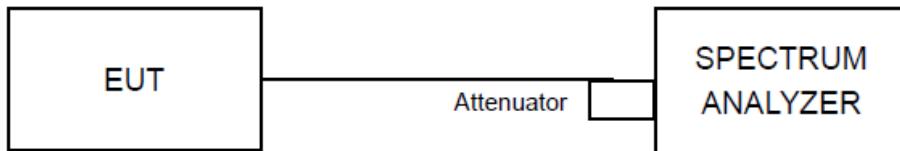
Test Mode	Antenna	Channel [MHz]	Power[dBm]	Limit [dBm]	Verdict
11B	Ant1	2412	15.07	<=30	PASS
	Ant2	2412	14.19	<=30	PASS
	Ant1	2437	14.51	<=30	PASS
	Ant2	2437	14.44	<=30	PASS
	Ant1	2462	14.74	<=30	PASS
	Ant2	2462	14.42	<=30	PASS
11G	Ant1	2412	13.49	<=30	PASS
	Ant2	2412	13.21	<=30	PASS
	Ant1	2437	14.06	<=30	PASS
	Ant2	2437	13.90	<=30	PASS
	Ant1	2462	13.95	<=30	PASS
	Ant2	2462	13.86	<=30	PASS
11N20SISO	Ant1	2412	12.98	<=30	PASS
	Ant2	2412	12.57	<=30	PASS
	Ant1	2437	13.05	<=30	PASS
	Ant2	2437	12.79	<=30	PASS
	Ant1	2462	12.81	<=30	PASS
	Ant2	2462	12.70	<=30	PASS
11N40SISO	Ant1	2422	12.29	<=30	PASS
	Ant2	2422	11.83	<=30	PASS
	Ant1	2437	11.76	<=30	PASS
	Ant2	2437	11.63	<=30	PASS
	Ant1	2452	11.76	<=30	PASS
	Ant2	2452	11.54	<=30	PASS

## 4.4 Power Spectral Density

### 4.4.1 Limit

The Maximum of Power Spectral Density Measurement is 8 dBm in any 3 kHz band.

### 4.4.2 Test Setup



### 4.4.3 Test Procedures

The power output per FCC § 15.247(e) was tested according to DTS test procedure of “KDB558074 D01 DTS Meas Guidance” (clause 10.5) for compliance to FCC 47CFR 15.247 requirements.

- a) Measure the duty cycle (x) of the transmitter output signal.
- b) Set instrument center frequency to DTS channel center frequency.
- c) Set span to at least 1.5 OBW.
- d) Set RBW to:  $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$ .
- e) Set VBW  $\geq 3 \text{ RBW}$ .
- f) Detector = power averaging (RMS) or sample detector (when RMS not available).
- g) Ensure that the number of measurement points in the sweep  $\geq 2 \text{ span/RBW}$ .
- h) Sweep time = auto couple.
- i) Do not use sweep triggering. Allow sweep to “free run”.
- j) Employ trace averaging (RMS) mode over a minimum of 100 traces.
- k) Use the peak marker function to determine the maximum amplitude level.
- l) Add  $10 \log (1/x)$ , where x is the duty cycle measured in step (a), to the measured PSD to compute the average PSD during the actual transmission time.
- m) If resultant value exceeds the limit, then reduce RBW (no less than 3 kHz) and repeat (note that this may require zooming in on the emission of interest and reducing the span in order to meet the minimum measurement point requirement as the RBW is reduced).

### 4.4.4 Deviation of Test Standard

No deviation.



#### 4.4.5 Test Results

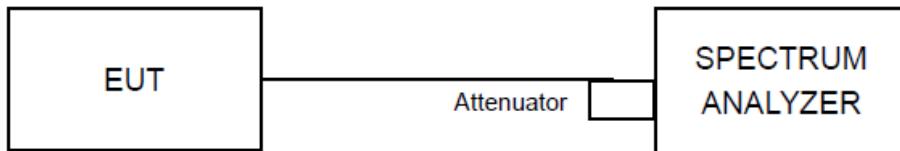
The test data for this section is contained in Test Report Number: CCISE181109003.

## 4.5 Conducted Band Edges Measurement

### 4.5.1 Limit

Below 30 dB of the highest emission level of operating band (in 100 kHz Resolution Bandwidth).

### 4.5.2 Test Setup



### 4.5.3 Test Procedures

The EUT was tested according to DTS test procedure of “KDB558074 D01 DTS Meas Guidance” (clause 11.0) for compliance to FCC 47CFR 15.247 requirements.

#### MEASUREMENT PROCEDURE REF

1. Set the RBW = 100 kHz.
2. Set the VBW  $\geq$  300 kHz.
3. Detector = peak.
4. Sweep time = auto couple.
5. Trace mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.

#### MEASUREMENT PROCEDURE OOB

1. Set RBW = 100 kHz.
2. Set VBW  $\geq$  300 kHz.
3. Detector = peak.
4. Sweep = auto couple.
5. Trace Mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum amplitude level.

### 4.5.4 Deviation of Test Standard

No deviation.



#### 4.5.5 Test Results

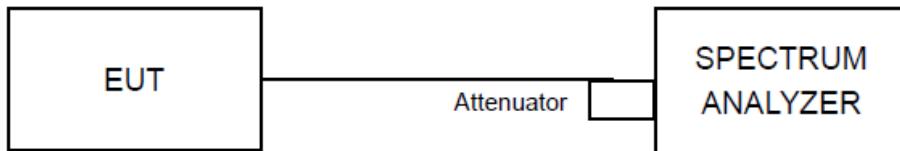
The test data for this section is contained in Test Report Number: CCISE181109003.

## 4.6 Conducted Spurious Emissions

### 4.6.1 Limit

Below 30 dB of the highest emission level of operating band (in 100 kHz Resolution Bandwidth).

### 4.6.2 Test Setup



### 4.6.3 Test Procedures

The EUT was tested according to DTS test procedure of “KDB558074 D01 DTS Meas Guidance” (clause 11.0) for compliance to FCC 47CFR 15.247 requirements.

#### MEASUREMENT PROCEDURE REF

1. Set the RBW = 100 kHz.
2. Set the VBW  $\geq$  300 kHz.
3. Detector = peak.
4. Sweep time = auto couple.
5. Trace mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.

#### MEASUREMENT PROCEDURE OOB

1. Set RBW = 100 kHz.
2. Set VBW  $\geq$  300 kHz.
3. Detector = peak.
4. Sweep = auto couple.
5. Trace Mode = max hold.
6. Allow trace to fully stabilize.
7. Use the peak marker function to determine the maximum amplitude level.

### 4.6.4 Deviation of Test Standard

No deviation.



#### 4.6.5 Test Results

The test data for this section is contained in Test Report Number: CCISE181109003.

## 4.7 Emissions in restricted frequency bands

### 4.7.1 Test Limit

#### For 15.205 requirement:

Radiated emissions which fall in the restricted bands, as defined in Section 15.205(a) of FCC part15, must also comply with the radiated emission limits specified in Section 15.209(a).

Frequency (MHz)	Frequency (MHz)	Frequency (MHz)	Frequency (GHz)
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
1 0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	(2)
13.36 - 13.41	--	--	--



All out of band emissions appearing in a restricted band as specified in Section 15.205 of the Title 47CFR must not exceed the limits shown in Table per Section 15.209.

<b>FCC Part 15 Subpart C Paragraph 15.209</b>		
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
Above 960	500	3

#### **4.7.2 Test Procedure Reference**

ANSI C63.10 Section 6.3 (General Requirements)

ANSI C63.10 Section 6.6 (Standard test method above 1GHz)

#### **4.7.3 Test Procedures**

##### **Peak Field Strength Measurements**

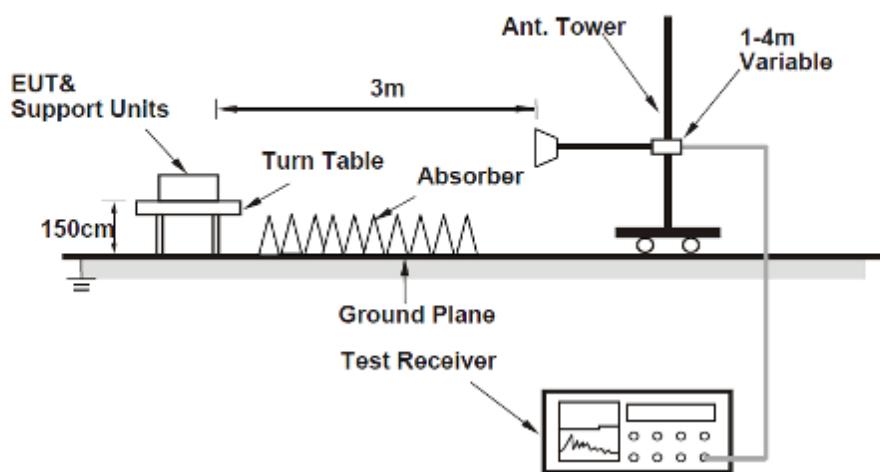
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

### **Average Measurements above 1GHz (Method VB)**

8. 1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
9. 2. RBW = 1MHz
10. 3. VBW; If the EUT is configured to transmit with duty cycle  $\geq 98\%$ , set VBW = 10 Hz.
11. If the EUT duty cycle is  $< 98\%$ , set VBW  $\geq 1/T$ . T is the minimum transmission duration.
12. 4. Detector = Peak
13. 5. Sweep time = auto
14. 6. Trace mode = max hold
15. 7. Trace was allowed to stabilize

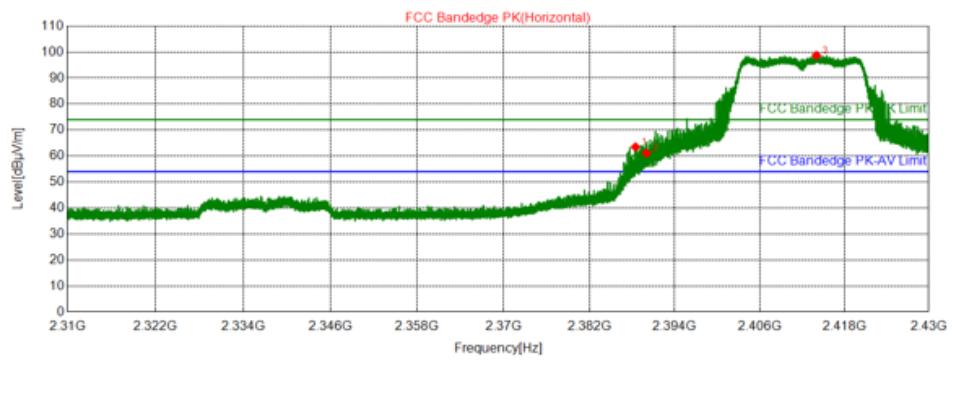
#### **4.7.4 Test Setup**

##### **For Radiated emission above 1GHz**



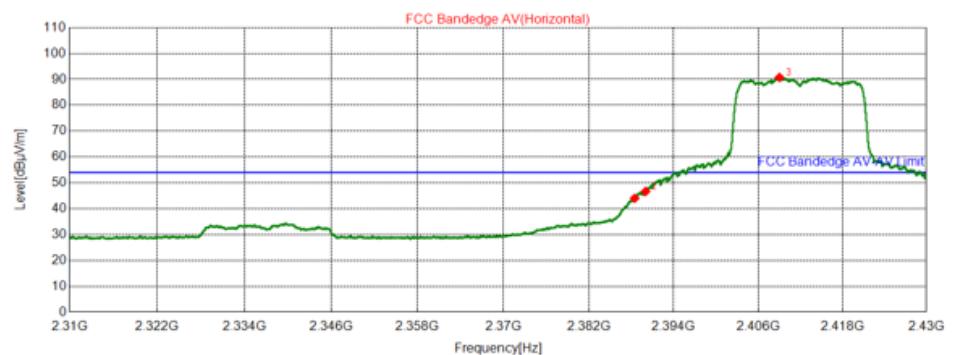
#### 4.7.5 Test Results

##### 802.11n (HT20)-2412MHz/ Horizontal-PK

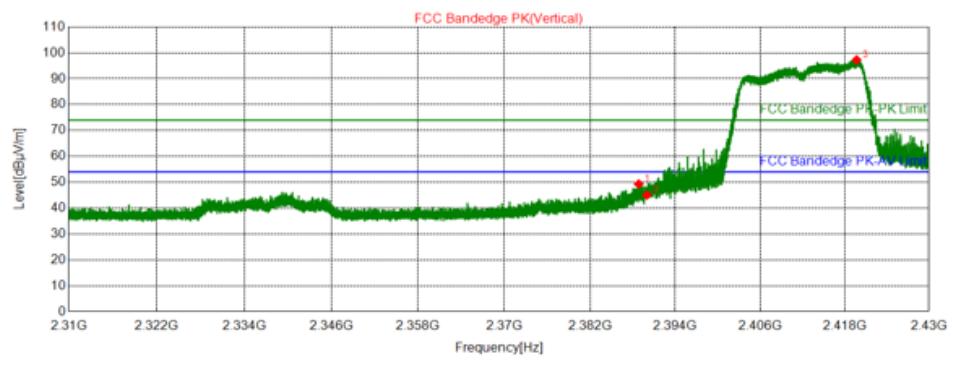


NO.	Freq. [MHz]	Reading [dB <sub>u</sub> V/m]	Level [dB <sub>u</sub> V/m]	Limit [dB <sub>u</sub> V/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	2388.4800	71.02	63.45	74.00	10.55	155	346	Horizontal	PK
2	2390.0100	68.66	61.10	74.00	12.90	155	346	Horizontal	PK
3	2414.0160	106.09	98.68	74.00	-24.68	155	304	Horizontal	PK

##### 802.11n (HT20)-2412MHz/ Horizontal-AV



NO.	Freq. [MHz]	Reading [dB <sub>u</sub> V/m]	Level [dB <sub>u</sub> V/m]	Limit [dB <sub>u</sub> V/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	2388.4800	51.58	44.01	54.00	9.99	155	347	Horizontal	PK
2	2390.0100	54.20	46.64	54.00	7.36	155	347	Horizontal	PK
3	2409.0150	98.16	90.72	54.00	-36.72	155	347	Horizontal	PK

**802.11n (HT20)-2412MHz/ Vertical**


NO.	Freq. [MHz]	Reading [dBuV/m]	Level [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	2388.8460	56.88	49.31	74.00	24.69	155	315	Vertical	PK
2	2390.0040	52.58	45.02	74.00	28.98	155	340	Vertical	PK
3	2419.6920	104.65	97.28	74.00	-23.28	155	315	Vertical	PK



## 4.8 Radiated Emission Measurement

### 4.8.1 Limits

Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table.

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

#### NOTE:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. For frequencies above 1000 MHz, the field strength limits are based on average detector, 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.

### 4.8.2 Test Procedures

#### For Radiated emission below 30MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. The table was rotated 360 degree to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. Both X and Y axes of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and the rotate table was turned from 0 degree to 360 degree to find the maximum reading.
- e. The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

#### Note:

The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.



### For Radiated emission above 30MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters (for below 1 GHz) / 1.5 meters (for above 1 GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. 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.
- d. 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.
- e. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
- f. The test-receiver system was set to peak and average detected function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

#### Note:

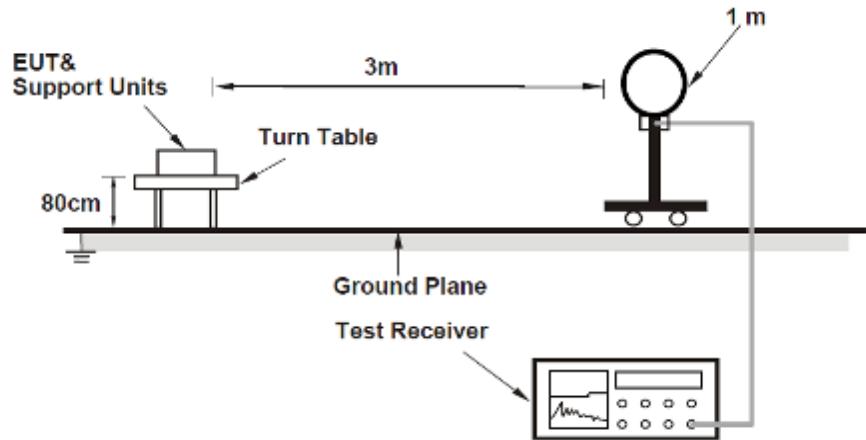
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz & 360 kHz for Quasi-peak detection (QP) at frequency below 1 GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1 GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 1/T for RMS Average (Duty cycle < 98 %) for Peak detection at frequency above 1 GHz.
4. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 10 Hz (Duty cycle  $\geq$  98 %) for Average detection (AV) at frequency above 1 GHz.
5. All modes of operation were investigated and the worst-case emissions are reported.

#### 4.8.3 Deviation from Test Standard

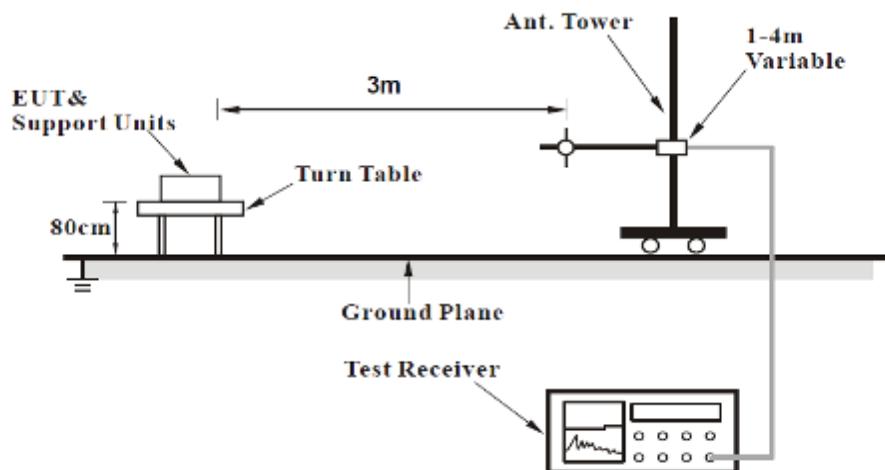
No deviation.

#### 4.8.4 Test Setup

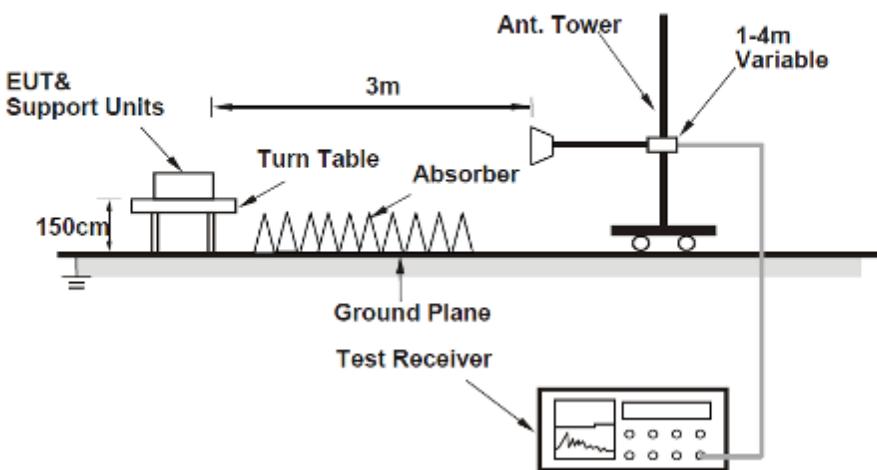
For Radiated emission below 30MHz



For Radiated emission 30MHz to 1GHz



**For Radiated emission above 1GHz**



For the actual test configuration, please refer to the attached file (Test Setup Photo).

#### 4.8.5 EUT Operating Conditions

- Placed the EUT on a testing table.
- Use the software to control the EUT under transmission condition continuously at specific channel frequency.

#### 4.8.6 Test Results

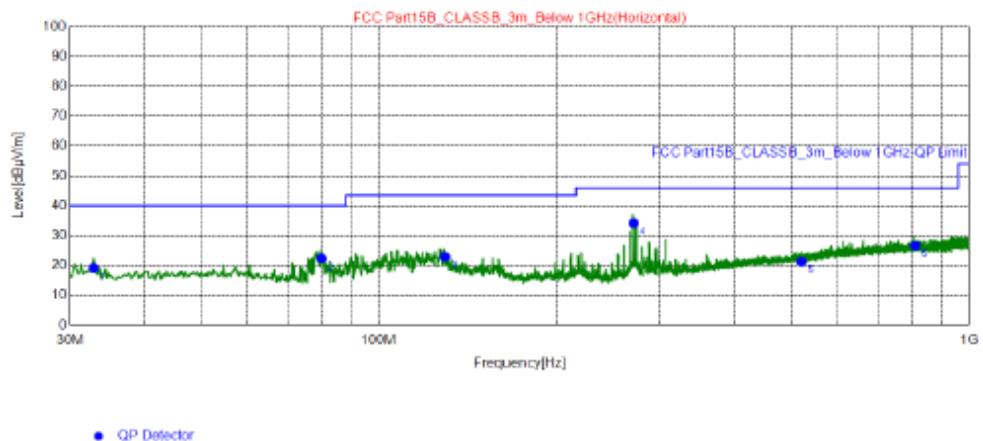
##### Radiated Emissions Range 9kHz~30MHz

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

### Radiated Emissions Range 30MHz~1GHz

<b>Mode</b>	802.11b-2412MHz	<b>Detector Function</b>	Quasi-Peak (QP)
<b>Frequency Range</b>	30MHz ~ 1GHz	<b>Antenna Polarity</b>	Horizontal
Power supply	AC 120V, 60Hz		

#### Test Graph



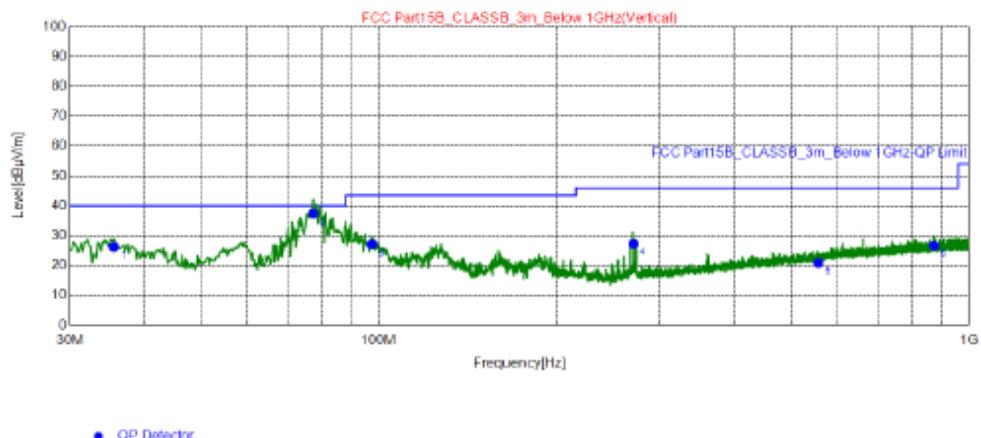
#### Final Data List

NO.	Freq. [MHz]	QP Reading [dB $\mu$ V/m]	Factor [dB]	QP Value [dB $\mu$ V/m]	QP Limit [dB $\mu$ V/m]	QP Margin [dB]	Height [cm]	Angle [°]	Polarity
1	32.91	30.38	-11.31	19.07	40.00	20.93	100	84	Horizontal
2	80.05	36.69	-14.33	22.36	40.00	17.64	100	151	Horizontal
3	129.5	34.35	-11.46	22.89	43.50	20.61	200	309	Horizontal
4	270.3	43.83	-9.62	34.21	46.00	11.79	100	173	Horizontal
5	520.0	25.53	-4.20	21.33	46.00	24.67	200	114	Horizontal
6	811.0	26.7	-0.08	26.62	46.00	19.38	200	195	Horizontal

#### REMARKS:

1. Emission Level(dBuV/m) = Spectrum reading (dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value =Limit value – Emission Level

<b>Mode</b>	802.11b-2412MHz	<b>Detector Function</b>	Quasi-Peak (QP)
<b>Frequency Range</b>	30MHz ~ 1GHz	<b>Antenna Polarity</b>	Vertical
Power supply	AC 120V, 60Hz		

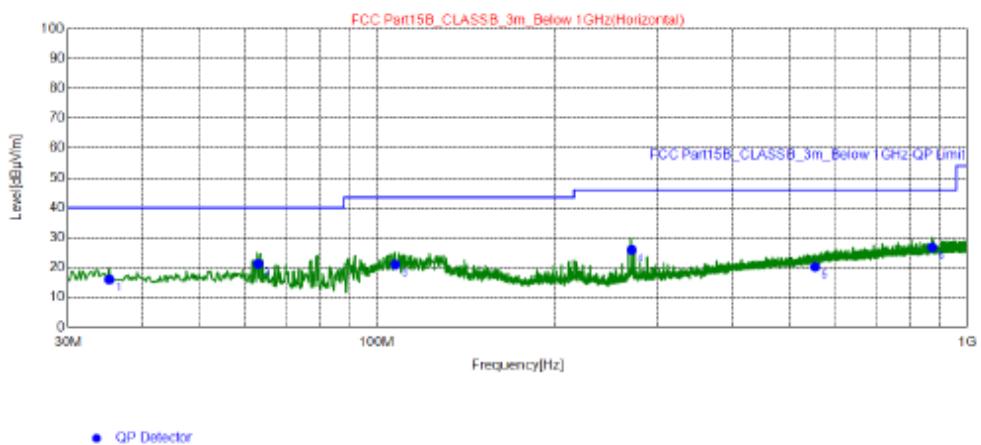
**Test Graph**

**Final Data List**

NO.	Freq. [MHz]	QP Reading [dB $\mu$ V/m]	Factor [dB]	QP Value [dB $\mu$ V/m]	QP Limit [dB $\mu$ V/m]	QP Margin [dB]	Height [cm]	Angle [°]	Polarity
1	35.62	37.23	-10.97	26.26	40.00	13.74	100	149	Vertical
2	77.53	51.26	-13.76	37.50	40.00	2.50	100	46	Vertical
3	97.51	42.33	-15.20	27.13	43.50	16.37	100	28	Vertical
4	270.3	36.93	-9.62	27.31	46.00	18.69	100	105	Vertical
5	556.1	24.48	-3.54	20.94	46.00	25.06	100	360	Vertical
6	873.1	26.12	0.54	26.66	46.00	19.34	100	202	Vertical

**REMARKS:**

1. Emission Level(dBuV/m) = Original Spectrum reading (dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value =Limit value – Emission Level

<b>Channel</b>	802.11b-2412MHz	<b>Detector Function</b>	Quasi-Peak (QP)
<b>Frequency Range</b>	30MHz ~ 1GHz	<b>Antenna Polarity</b>	Horizontal
Power supply	AC 240V, 50Hz		

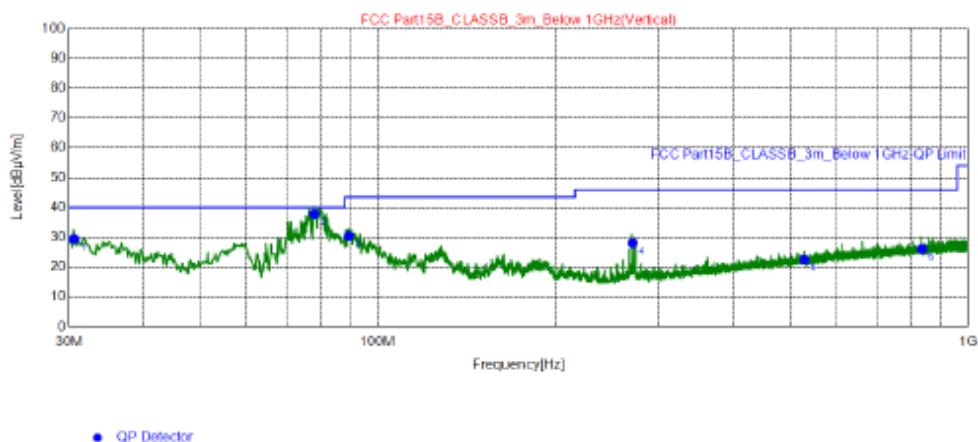
**Test Graph**

**Final Data List**

NO.	Freq. [MHz]	QP Reading [dB $\mu$ V/m]	Factor [dB]	QP Value [dB $\mu$ V/m]	QP Limit [dB $\mu$ V/m]	QP Margin [dB]	Height [cm]	Angle [°]	Polarity
1	35.23	26.98	-11.02	15.96	40.00	24.04	200	143	Horizontal
2	62.98	32.08	-10.80	21.28	40.00	18.72	200	31	Horizontal
3	107.6	35.05	-14.03	21.02	43.50	22.48	200	243	Horizontal
4	270.3	35.5	-9.62	25.88	46.00	20.12	200	50	Horizontal
5	553.0	23.86	-3.61	20.25	46.00	25.75	200	105	Horizontal
6	873.5	26.21	0.54	26.75	46.00	19.25	200	254	Horizontal

**REMARKS:**

1. Emission Level(dBuV/m) = Spectrum reading (dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Limit value – Emission Level

<b>Channel</b>	802.11b-2412MHz	<b>Detector Function</b>	Quasi-Peak (QP)
<b>Frequency Range</b>	30MHz ~ 1GHz	<b>Antenna Polarity</b>	Vertical
Power supply	AC 240V, 50Hz		

**Test Graph**

**Final Data List**

NO.	Freq. [MHz]	QP Reading [dB $\mu$ V/m]	Factor [dB]	QP Value [dB $\mu$ V/m]	QP Limit [dB $\mu$ V/m]	QP Margin [dB]	Height [cm]	Angle [°]	Polarity
1	30.58	41	-11.59	29.41	40.00	10.59	100	172	Vertical
2	78.11	51.77	-13.89	37.88	40.00	2.12	100	246	Vertical
3	89.36	46.25	-15.80	30.45	43.50	13.05	100	113	Vertical
4	270.3	37.75	-9.62	28.13	46.00	17.87	100	117	Vertical
5	528.3	26.53	-4.06	22.47	46.00	23.53	100	246	Vertical
6	835.6	25.97	0.13	26.10	46.00	19.90	100	187	Vertical

**REMARKS:**

1. Emission Level(dBuV/m) = Original Spectrum reading (dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Limit value – Emission Level



### Radiated Emission Range 1GHz~10th Harmonic

#### 802.11n (HT20)

Channel	TX Channel 1	Detector Function	Peak (PK)
Frequency Range	1GHz ~ 25GHz		Average (AV)

Spurious Emission Level							
No.	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Correction Factor (dB/m)	Antenna Polarity	Detector
1	7237.3000	41.39	74.00	32.61	-4.12	H	PK
2	7237.3000	38.15	54.00	15.85	-4.12	H	AV
3	7237.3000	39.97	74.00	34.03	-4.12	V	PK
4	7237.3000	36.06	54.00	17.94	-4.12	V	AV

#### REMARKS:

1. Emission Level(dBuV/m) = Original Spectrum reading (dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. The other emission levels were very low against the limit.
4. Margin value = Limit value – Emission Level



## 5 Pictures of Test Arrangements

Please refer to the attached file (Test Setup Photo).

We verified that the Emission bandwidth and CSE of the module is slightly less than that of the original case, please see the appendix spot check data.

----- END -----