



FCC Test Report

Report No.: WVK-ESH-P21051909B-12

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, Xinzhuang Road, Shanghai, P.R.China (201612)



This report is for your exclusive use. Any copying or replication of this report to or for any other person or entity, or use of our name or trademark, is permitted only with our prior written permission. This report sets forth our findings solely with respect to the test samples identified herein. The results set forth in this report are not indicative or representative of the quality or characteristics of the lot from which a test sample was taken or any similar or identical product unless specifically and expressly noted. Our report includes all of the tests requested by you and the results thereof based upon the information that you provided to us. You have 60 days from date of issuance of this report to notify us of any material error or omission caused by our negligence, provided, however, that such notice shall be in writing and shall specifically address the issue you wish to raise. A failure to raise such issue within the prescribed time shall constitute your unqualified acceptance of the completeness of this report, the tests conducted and the correctness of the report contents. Unless specific mention, the uncertainty of measurement has been explicitly taken into account to declare the compliance or non-compliance to the specification. The report must not be used by the client to claim product certification, approval, or endorsement by TAF or any government agencies.



Table of Contents

Release Control Record.....	5
1 Certificate of Conformity	6
2 Summary of Test Results.....	7
2.1 Test Instruments	8
2.2 Measurement Uncertainty	9
2.3 Modification Record	9
3 General Information.....	10
3.1 General Description of EUT.....	10
3.2 Description of Test Modes	11
3.2.1 Test Mode Applicability:	13
3.2.2 Test Condition:	14
3.3 Duty Cycle of Test Signal	15
3.4 Description of Support Units.....	15
3.5 General Description of Applied Standards	15
4 Test Procedure and Results.....	16
4.1 AC Power Conducted Emission.....	16
4.1.1 Limits	16
4.1.2 Test Procedures	16
4.1.3 Deviation from Test Standard.....	16
4.1.4 Test Setup.....	17
4.1.5 EUT Operating Conditions.....	17
4.1.6 Test Results	18
4.2 26dB Emission Bandwidth.....	22
4.2.1 Limit.....	22
4.2.2 Test Setup.....	22
4.2.3 Test Procedures	22
4.2.4 Deviation of Test Standard.....	22
4.2.5 Test Results	23
4.3 Minimum 6dB Bandwidth (5.725-5.85 GHz band).....	24
4.3.1 Limit.....	24
4.3.2 Test Setup.....	24
4.3.3 Test Procedures	24



4.3.4 Deviation of Test Standard.....	24
4.3.5 Test Results	25
4.4 Conducted Output Power.....	26
4.4.1 Limit.....	26
4.4.2 Test Setup.....	26
4.4.3 Test Procedures	26
4.4.4 Deviation of Test Standard.....	26
4.4.5 Test Results	27
4.5 Peak Power spectrum density	30
4.5.1 Limit.....	30
4.5.2 Test Setup.....	30
4.5.3 Test Procedures	30
4.5.4 Deviation of Test Standard.....	30
4.5.5 Test Results	31
4.6 Frequency Stability	32
4.6.1 Test Limit.....	32
4.6.2 Test Setup.....	32
4.6.3 Test Procedures	32
4.6.4 Deviation of Test Standard.....	32
4.6.5 Test Results	33
4.7 Emissions in restricted frequency bands.....	34
4.7.1 Test Limit.....	34
4.7.2 Test Procedure Reference.....	36
4.7.3 Test Procedures	36
4.7.4 Test Setup.....	37
4.7.5 Test Results	38
4.8 Radiated Emission Measurement.....	40
4.8.1 Limits	40
4.8.2 Test Procedures	41
4.8.3 Deviation from Test Standard.....	42
4.8.4 Test Setup.....	43
4.8.5 EUT Operating Conditions.....	44
4.8.6 Test Results	44



5	Pictures of Test Arrangements	50
---	-------------------------------------	----



Release Control Record

Issue No.	Description	Date Issued
WVK-ESH-P21051909B-12	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 Part 15, Subpart E 15.407

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 :

A handwritten signature in black ink, appearing to read 'Yuan Zhang'.

Yuan ZHANG

Project Engineer

, **Date:**

Jul.14, 2021

Approved by :



A handwritten signature in black ink, appearing to read 'Daniel Sun'.

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 E (SECTION 15.407)			
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.
15.407(a)	26dB Emission bandwidth	PASS	Meet the requirement of limit.
15.407(e)	Minimum 6 dB bandwidth (5.725-5.85 GHz band)	PASS	Meet the requirement of limit.
15.407(a)	Maximum Conducted output power	PASS	Meet the requirement of limit.
15.407(a)	Peak Power spectrum density	PASS	Meet the requirement of limit.
15.407(g)	Frequency Stability	PASS	Meet the requirement of limit.
15.205 / 15.209 / 15.407(b)	Emissions in restricted frequency bands	PASS	Meet the requirement of limit.
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	--
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	OFDM
Modulation Technology	802.11a: OFDM (64QAM, 16QAM, QPSK, BPSK), 802.11n: OFDM (BPSK, QPSK, 16QAM, 64QAM), 802.11ac: OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM)
Operating Frequency	5150 ~ 5250MHz, 5250 ~ 5350MHz, 5470 ~ 5725MHz
Number of Channel	See clause 3.2
Output Power	13.11dBm
Antenna Type	PCB Antenna
Antenna Connector	--
Antenna Gain	Ant1:5.9dBi, Ant2:5.9dBi
Product SW/HW version	21.0.200/A
Radio SW/HW version	NA
Test SW version	NA
RF power setting in Test SW	NA

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
802.11a	1TX / 1RX
802.11n/ac (20MHz)	1TX / 1RX
802.11n/ac (40MHz)	1TX / 1RX
802.11ac (80MHz)	1TX / 1RX

3.2 Description of Test Modes

FOR 5150 ~ 5250MHz

4 channels are provided for 802.11a, 802.11n (20MHz):

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
36	5180 MHz	44	5220 MHz
40	5200 MHz	48	5240 MHz

2 channels are provided for 802.11n (40MHz):

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
38	5190 MHz	46	5230 MHz

1 channel is provided for 802.11ac (80MHz):

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
42	5210 MHz		

FOR 5250 ~ 5350MHz

4 channels are provided for 802.11a, 802.11n (20MHz):

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
52	5260 MHz	60	5300 MHz
56	5280 MHz	64	5320 MHz

2 channels are provided for 802.11n (40MHz):

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
54	5270 MHz	62	5310 MHz

1 channel is provided for 802.11ac (80MHz):

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
58	5290 MHz		



FOR 5470 ~ 5725MHz

11 channels are provided for 802.11a, 802.11n (20MHz):

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
100	5500 MHz	124	5620 MHz
104	5520 MHz	128	5640 MHz
108	5540 MHz	132	5660 MHz
112	5560 MHz	136	5680 MHz
116	5580 MHz	140	5700 MHz
120	5600 MHz		

5 channels are provided for 802.11n (40MHz):

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
102	5510 MHz	126	5630 MHz
110	5550 MHz	134	5670 MHz
118	5590 MHz		

2 channel is provided for 802.11ac (80MHz):

CHANNEL	FREQUENCY	CHANNEL	FREQUENCY
106	5530 MHz	122	5610 MHz

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).
- 802.11n mode EIRP power is greater than 802.11ac, so test 11a mode and 11an mode.
- Following channel(s) was (were) selected for the final test as listed below.

EUT CONFIGURE MODE	MODE	FREQ. BAND (MHz)	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)
-	802.11a	5150-5250	36 to 48	36	OFDM	6.0

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).
- 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)
-	802.11a	36 to 48	36	OFDM	DBPSK	6.0

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)
-	802.11a	36 to 48	36	OFDM	DBPSK	6.0

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	FREQ. BAND (MHz)	AVAILABLE CHANNEL	TESTED CHANNEL	MODULATION	DATA RATE (Mbps)
-	802.11a	5150-5250	36 to 48	36, 40, 48	OFDM	6.0
-	802.11n (20MHz)		36 to 48	36, 40, 48	OFDM	MCS0
-	802.11n (40MHz)		38 to 46	38, 46	OFDM	MCS0
-	802.11ac (80MHz)		42	42	OFDM	MCS0
-	802.11a	5250-5350	52 to 64	52, 60, 64	OFDM	6.0
-	802.11n (20MHz)		52 to 64	52, 60, 64	OFDM	MCS0
-	802.11n (40MHz)		54 to 62	54, 62	OFDM	MCS0
-	802.11ac (80MHz)		58	58	OFDM	MCS0
-	802.11a	5470-5725	100 to 144	100, 116, 140	OFDM	6.0
-	802.11n (20MHz)		100 to 140	100, 116, 140	OFDM	MCS0
-	802.11n (40MHz)		102 to 134	102, 110, 134	OFDM	MCS0
-	802.11ac (80MHz)		106	106	OFDM	MCS0

3.2.2 Test Condition:

Applicable to	Normal Environmental Conditions	Normal Input Power
RE \geq 1G	25deg. C, 60%RH	120Vac, 60Hz
RE < 1G	25deg. C, 60%RH	120Vac, 60Hz
PLC	25deg. C, 60%RH	120Vac, 60Hz
APCM	25deg. C, 60%RH	120Vac, 60Hz



3.3 Duty Cycle of Test Signal

The test data for this section is contained in Test Report Number: CCISE181109004.

3.4 Description of Support Units

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

NO.	PRODUCT	BRAND/ Manufacturer	MODEL NO.
1	PC	ThinkPad	L470
2	Network Cable	--	--

3.5 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 E (15.407)

789033 D02 General U-NII Test Procedures New Rules v01r03

KDB 662911 D01 v02r01

ANSI C63.10:2013

All relaxed 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

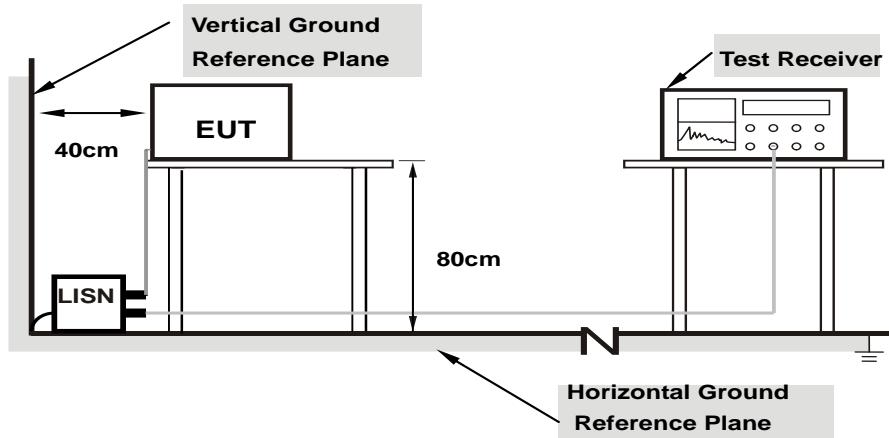
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.
- Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- 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.

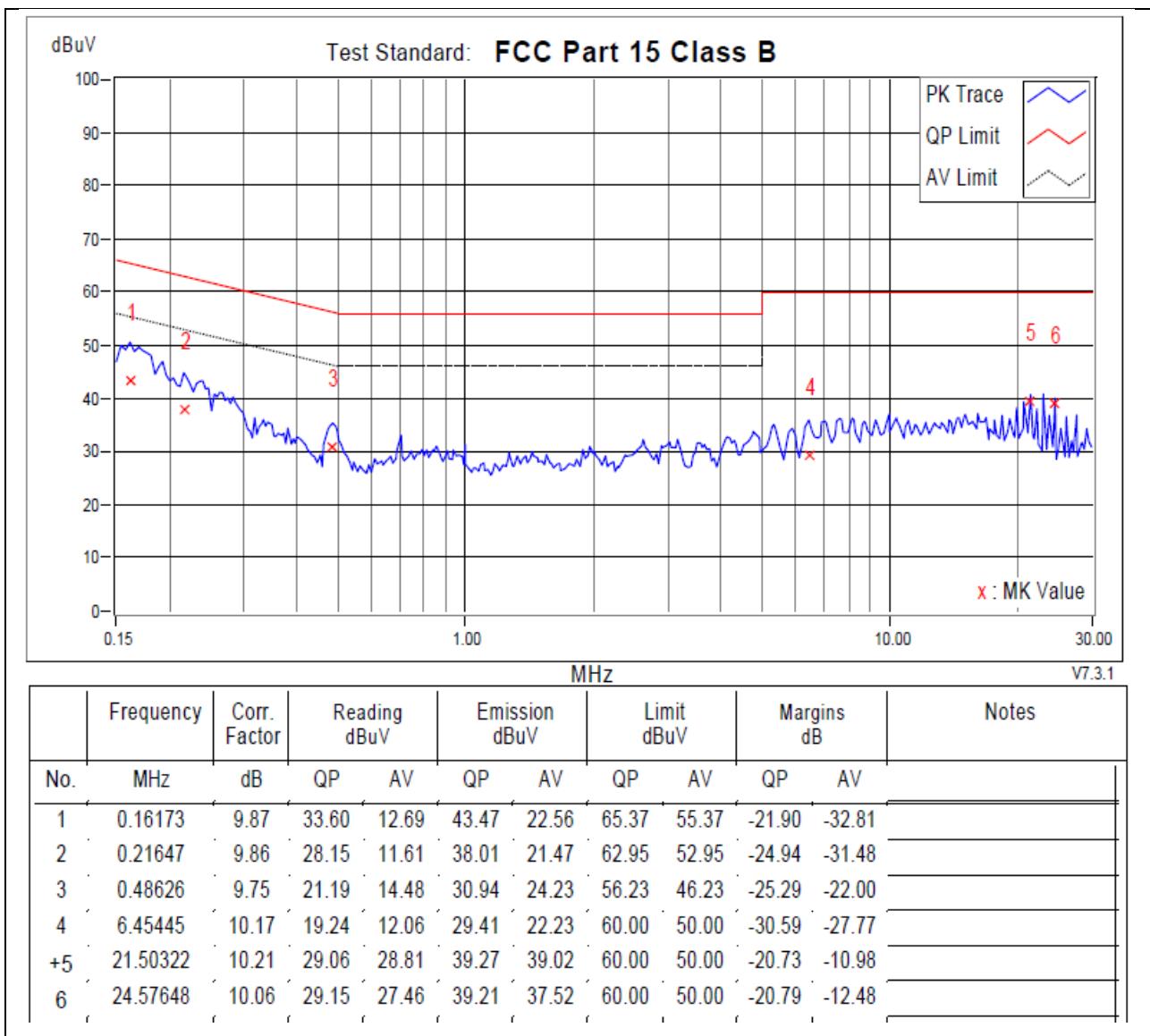
For the actual test configuration, please refer to the attached file (Test Setup Photo).

4.1.5 EUT Operating Conditions

Same as 4.1.6.

4.1.6 Test Results

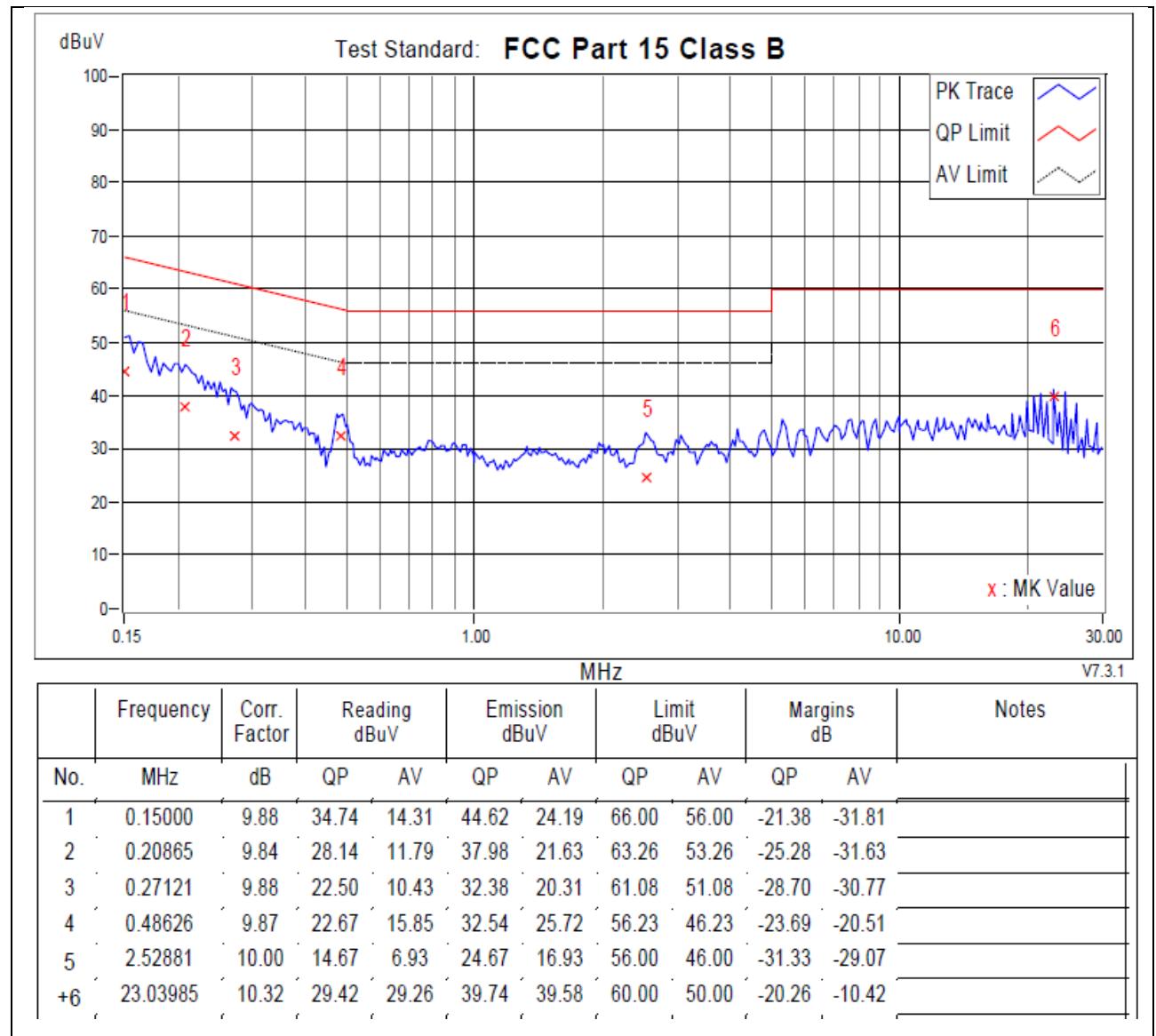
Phase	Line (L)	Detector Function	Quasi-Peak (QP) / Average (AV)
Power supply	AC 120V, 60Hz		



REMARKS:

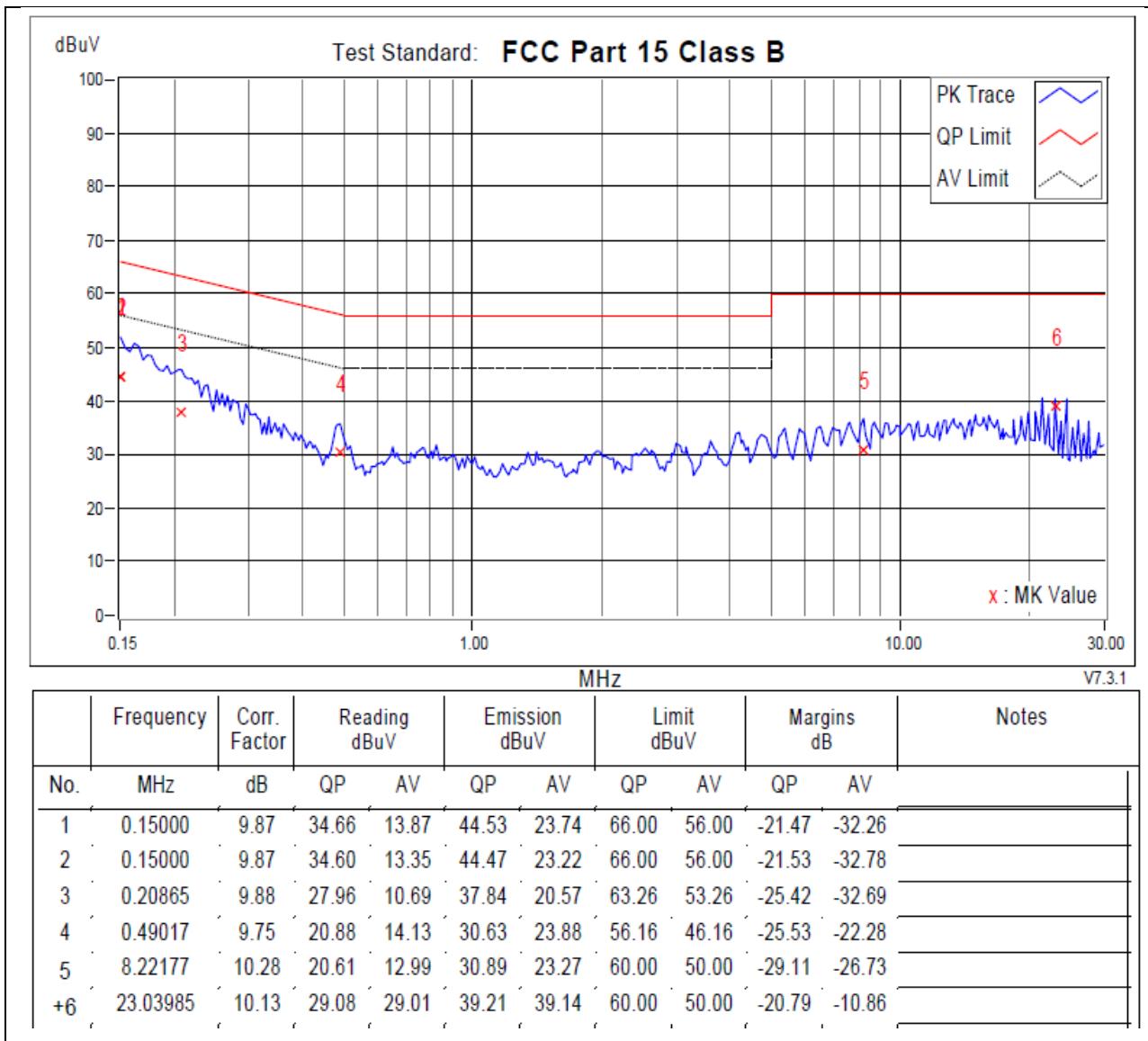
1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level - Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value.

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


REMARKS:

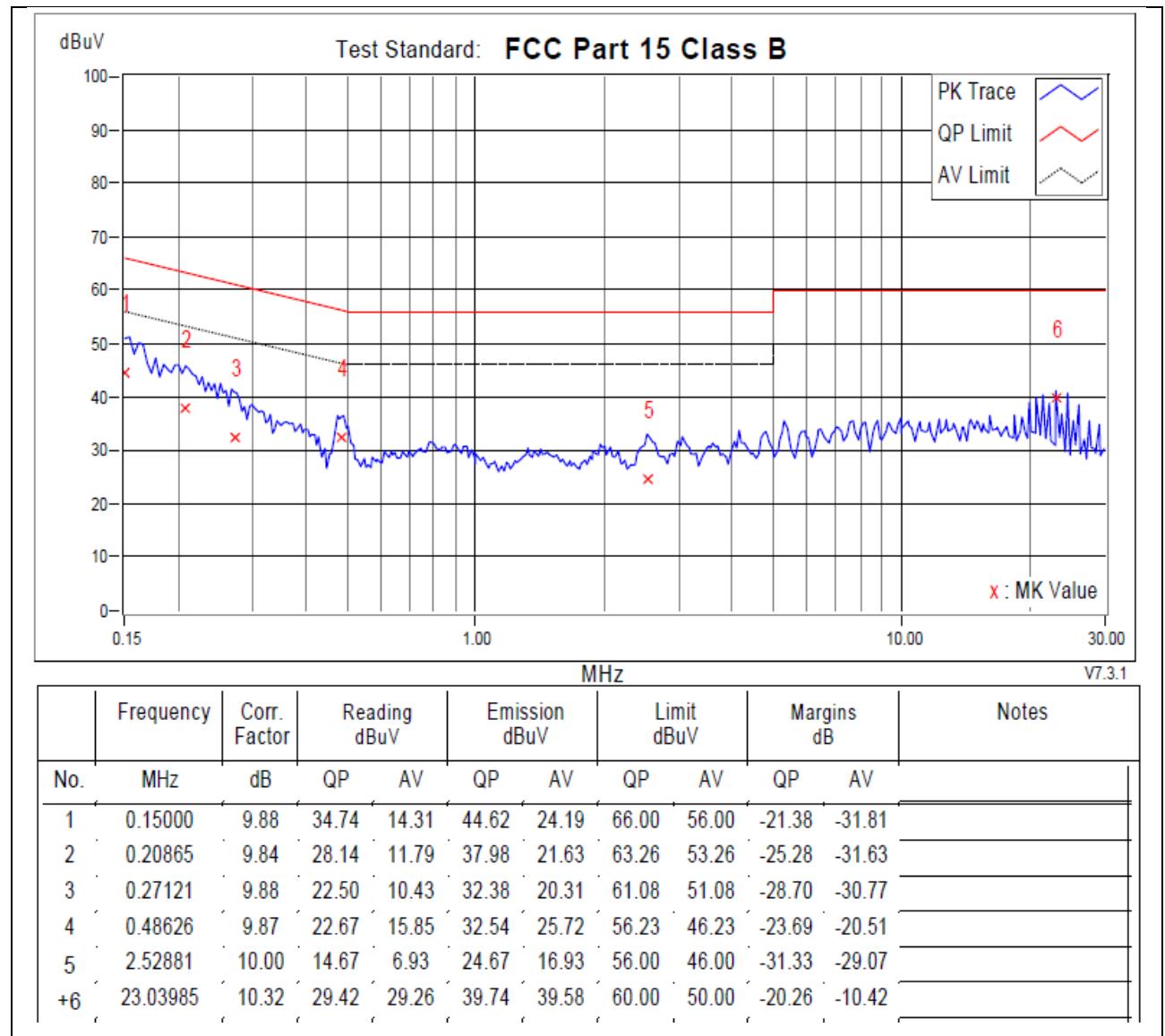
1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level - Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value.

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


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		


REMARKS:

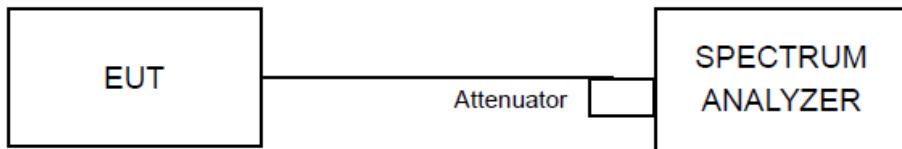
1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level - Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value.

4.2 26dB Emission Bandwidth

4.2.1 Limit

No limit requirement.

4.2.2 Test Setup



4.2.3 Test Procedures

1. Set RBW = approximately 1% of the emission bandwidth.
2. Set the VBW > RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Measure the maximum width of the emission that is 26 dB down from the peak of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%.

4.2.4 Deviation of Test Standard

No deviation.



4.2.5 Test Results

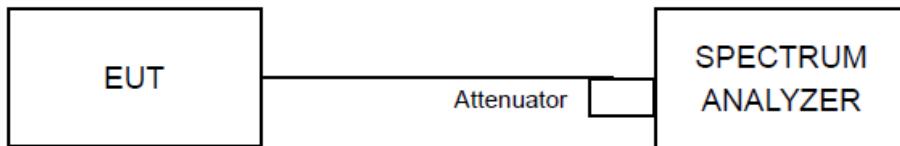
The test data for this section is contained in Test Report Number: CCISE181109004.

4.3 Minimum 6dB Bandwidth (5.725-5.85 GHz band)

4.3.1 Limit

Within the 5.725-5.85 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

4.3.2 Test Setup



4.3.3 Test Procedures

1. Set RBW = 100 kHz.
2. Set the video bandwidth (VBW) ≥ 3 RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

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 kHz, VBW ≥ 3 · RBW, peak detector with maximum hold) is implemented by the instrumentation function.

4.3.4 Deviation of Test Standard

No deviation.



4.3.5 Test Results

The test data for this section is contained in Test Report Number: CCISE181109004.

4.4 Conducted Output Power

4.4.1 Limit

Frequency band (MHz)	EUT Category		Limit
5150-5250	Outdoor Access Point		1 Watt (30 dBm) (Max. e.i.r.p \leq 125mW(21 dBm) at any elevation angle above 30 degrees as measured from the horizon)
	Fixed point-to-point Access Point		1 Watt (30 dBm)
	Indoor Access Point		1 Watt (30 dBm)
	✓	Client devices	250mW (24 dBm)
5250-5350	✓		250mW (24 dBm) or 11 dBm+10 log B*
5470-5725	✓		250mW (24 dBm) or 11 dBm+10 log B*
5725-5850	✓		1 Watt (30 dBm)

Note: Where B is the 26dB emission bandwidth in MHz.

4.4.2 Test Setup



4.4.3 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.

4.4.4 Deviation of Test Standard

No deviation.

4.4.5 Test Results

Test Mode	Antenna	Channel [MHz]	Result [dBm]	Limit [dBm]	Verdict
11A	Ant1	5180	12.31	<=24	PASS
	Ant2	5180	12.14	<=24	PASS
	Ant1	5200	12.21	<=24	PASS
	Ant2	5200	13.11	<=24	PASS
	Ant1	5240	11.96	<=24	PASS
	Ant2	5240	12.25	<=24	PASS
	Ant1	5260	12.29	<=24	PASS
	Ant2	5260	11.39	<=24	PASS
	Ant1	5280	12.18	<=24	PASS
	Ant2	5280	11.62	<=24	PASS
	Ant1	5320	11.94	<=24	PASS
	Ant2	5320	11.98	<=24	PASS
	Ant1	5500	11.48	<=24	PASS
	Ant2	5500	11.47	<=24	PASS
	Ant1	5580	10.93	<=24	PASS
	Ant2	5580	12.60	<=24	PASS
	Ant1	5700	12.01	<=24	PASS
	Ant2	5700	11.90	<=24	PASS
11N20SISO	Ant1	5180	11.12	<=24	PASS
	Ant2	5180	11.61	<=24	PASS
	Ant1	5200	10.74	<=24	PASS
	Ant2	5200	12.22	<=24	PASS
	Ant1	5240	11.74	<=24	PASS
	Ant2	5240	11.17	<=24	PASS
	Ant1	5260	12.04	<=24	PASS
	Ant2	5260	11.37	<=24	PASS
	Ant1	5280	11.42	<=24	PASS
	Ant2	5280	11.61	<=24	PASS
	Ant1	5320	11.88	<=24	PASS
	Ant2	5320	10.08	<=24	PASS
	Ant1	5500	10.41	<=24	PASS
	Ant2	5500	9.58	<=24	PASS
	Ant1	5580	10.14	<=24	PASS
	Ant2	5580	10.67	<=24	PASS
	Ant1	5700	10.75	<=24	PASS

	Ant2	5700	9.15	<=24	PASS
11N40SISO	Ant1	5190	11.07	<=24	PASS
	Ant2	5190	11.03	<=24	PASS
	Ant1	5230	11.20	<=24	PASS
	Ant2	5230	11.72	<=24	PASS
	Ant1	5270	11.67	<=24	PASS
	Ant2	5270	11.01	<=24	PASS
	Ant1	5310	11.39	<=24	PASS
	Ant2	5310	10.20	<=24	PASS
	Ant1	5510	9.95	<=24	PASS
	Ant2	5510	9.49	<=24	PASS
	Ant1	5550	10.40	<=24	PASS
	Ant2	5550	10.68	<=24	PASS
	Ant1	5670	10.84	<=24	PASS
	Ant2	5670	10.65	<=24	PASS
11AC20SISO	Ant1	5180	11.06	<=24	PASS
	Ant2	5180	10.69	<=24	PASS
	Ant1	5200	10.82	<=24	PASS
	Ant2	5200	10.76	<=24	PASS
	Ant1	5240	10.90	<=24	PASS
	Ant2	5240	11.30	<=24	PASS
	Ant1	5260	11.32	<=24	PASS
	Ant2	5260	11.66	<=24	PASS
	Ant1	5280	11.45	<=24	PASS
	Ant2	5280	10.71	<=24	PASS
	Ant1	5320	12.10	<=24	PASS
	Ant2	5320	10.00	<=24	PASS
	Ant1	5500	10.63	<=24	PASS
	Ant2	5500	9.59	<=24	PASS
	Ant1	5580	10.22	<=24	PASS
	Ant2	5580	10.75	<=24	PASS
	Ant1	5700	10.98	<=24	PASS
	Ant2	5700	11.17	<=24	PASS
11AC40SISO	Ant1	5190	11.31	<=24	PASS
	Ant2	5190	11.30	<=24	PASS
	Ant1	5230	11.49	<=24	PASS
	Ant2	5230	10.85	<=24	PASS
	Ant1	5270	11.21	<=24	PASS
	Ant2	5270	10.90	<=24	PASS

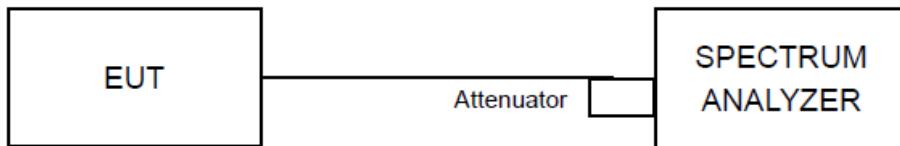
11AC80SISO	Ant1	5310	11.74	<=24	PASS
	Ant2	5310	10.15	<=24	PASS
	Ant1	5510	10.07	<=24	PASS
	Ant2	5510	10.01	<=24	PASS
	Ant1	5550	10.00	<=24	PASS
	Ant2	5550	10.87	<=24	PASS
	Ant1	5670	10.11	<=24	PASS
	Ant2	5670	10.74	<=24	PASS
	Ant1	5210	8.91	<=24	PASS
	Ant2	5210	9.02	<=24	PASS
	Ant1	5290	9.56	<=24	PASS
	Ant2	5290	8.70	<=24	PASS
	Ant1	5530	8.46	<=24	PASS
	Ant2	5530	8.10	<=24	PASS
	Ant1	5610	8.34	<=24	PASS
	Ant2	5610	8.61	<=24	PASS

4.5 Peak Power spectrum density

4.5.1 Limit

Frequency band (MHz)	EUT Category		Limit	
5150-5250	Outdoor Access Point		17dBm/ MHz	
	Fixed point-to-point Access Point			
	Indoor Access Point			
	√	Client devices	11dBm/ MHz	
5250-5350	√		11dBm/ MHz	
5470-5725	√		11dBm/ MHz	
5725-5850	√		30dBm/ 500kHz	

4.5.2 Test Setup



4.5.3 Test Procedures

Using method SA-2

- 1) Set span to encompass the entire emission bandwidth (EBW) of the signal.
- 2) Set RBW = 1 MHz, Set VBW \geq 3 MHz, Detector = RMS
- 3) Set Channel power measure = 1MHz
- 4) Sweep time = auto, trigger set to “free run”.
- 5) Trace average at least 100 traces in power averaging mode.
- 6) Add $10 \log (1/x)$, where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times (because the measurement represents an average over both the on and off times of the transmission).
- 7) Record the max value.

4.5.4 Deviation of Test Standard

No deviation.



4.5.5 Test Results

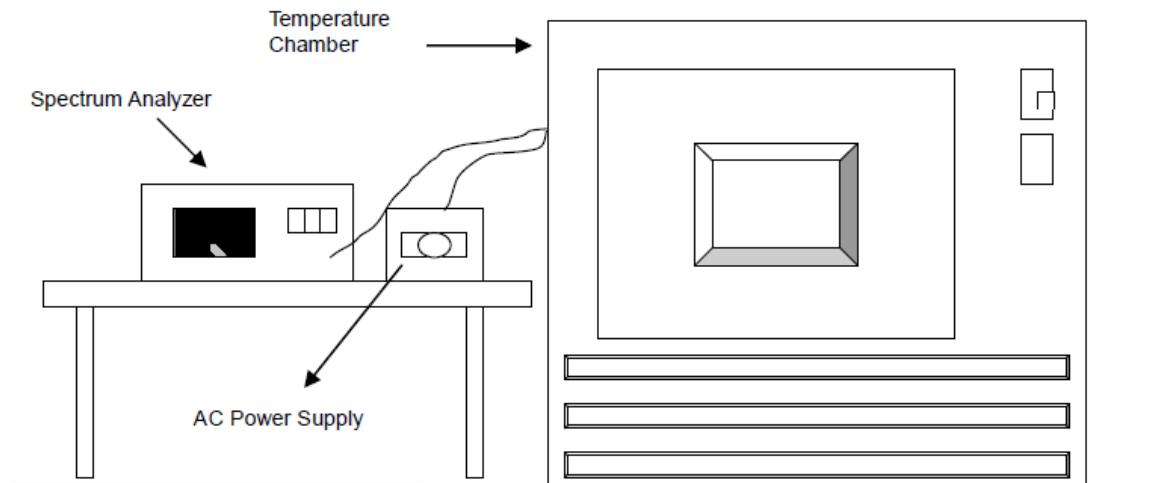
The test data for this section is contained in Test Report Number: CCISE181109004.

4.6 Frequency Stability

4.6.1 Test Limit

The frequency of the carrier signal shall be maintained within band of operation.

4.6.2 Test Setup



4.6.3 Test Procedures

- a. The EUT was placed inside the environmental test chamber and powered by nominal AC voltage.
- b. Turn the EUT on and couple its output to a spectrum analyzer.
- c. Turn the EUT off and set the chamber to the highest temperature specified.
- d. Allow sufficient time for the temperature the chamber to stabilize, turn the EUT on and measure the operating frequency.
- e. Repeat step b and c with the temperature chamber set to the lowest temperature.
- f. The test chamber was allowed to stabilize at 20 degree C for a minimum of 30min. The supply voltage was the adjusted on the EUT from 85% to 115% and the frequency record.

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: CCISE181109004.



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
1.495 - 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.

FCC Part 15 Subpart C Paragraph 15.209		
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

APPLICABLE TO	LIMIT	
789033 D02 General U-NII Test Procedures New Rules v01r03	FIELD STRENGTH AT 3m (dB μ V/m)	
	PK : 74	AV : 54
APPLICABLE TO	EIRP LIMIT (dBm/MHz)	EQUIVALENT FIELD STRENGTH AT 3m (dB μ V/m)
15.407(b)(1)		
15.407(b)(2)	PK : -27	PK : 68.3
15.407(b)(3)		
15.407(b)(4)	Note	Note

Note: All emissions shall be limited to a level of -27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.



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

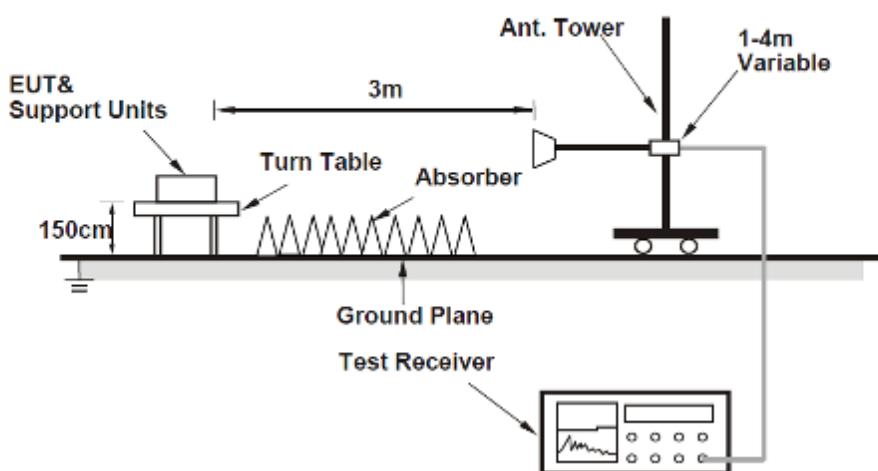
1. Analyzer center frequency was set to the frequency of the radiated spurious emission of interest
2. RBW = 1MHz
3. VBW = 3MHz
4. Detector = peak
5. Sweep time = auto couple
6. Trace mode = max hold
7. Trace was allowed to stabilize

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

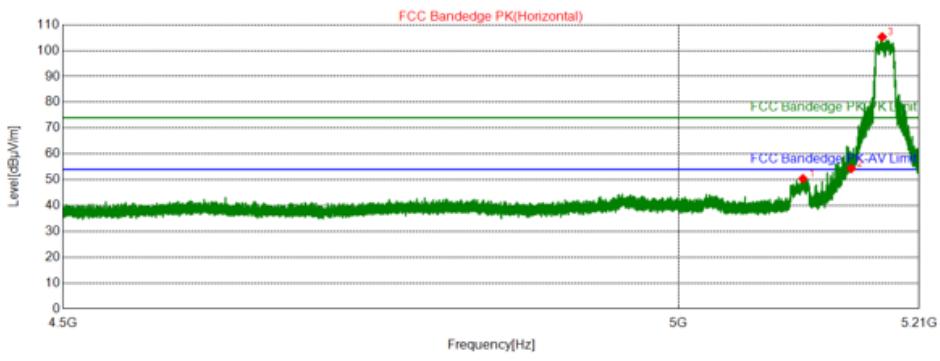
4.7.4 Test Setup

For Radiated emission above 1GHz



4.7.5 Test Results

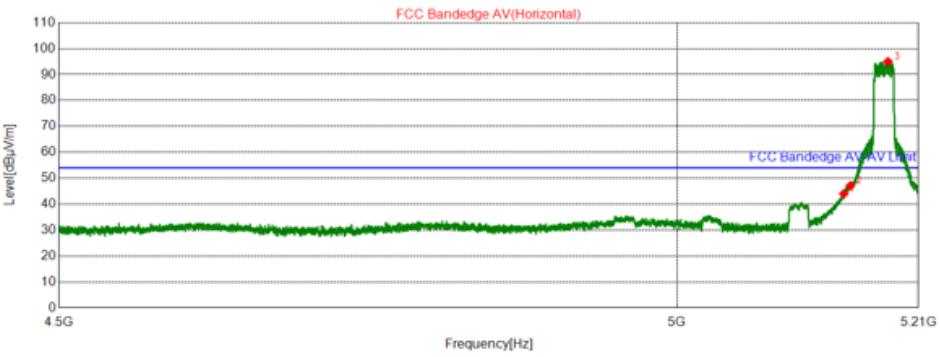
802.11a-5180MHz/ Horizontal-PK



● QP Detector ★ AV Detector

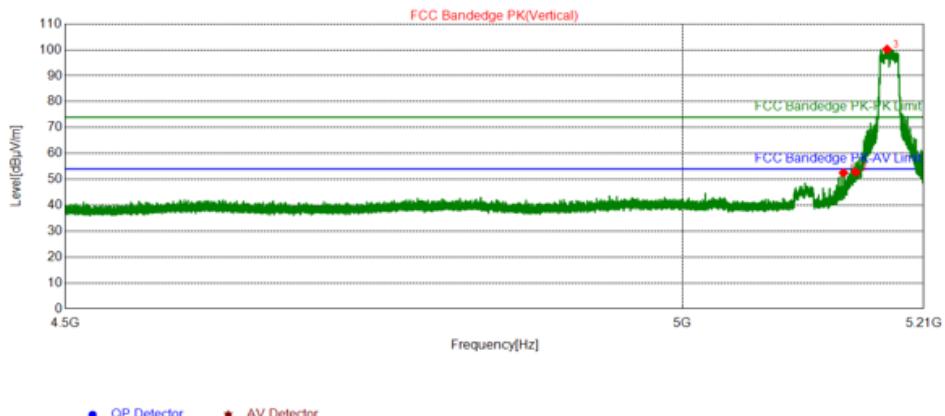
NO.	Freq. [MHz]	Reading [dB μ V/m]	Level [dB μ V/m]	Limit [dB μ V/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	5107.5470	50.91	50.37	74.00	23.63	155	338	Horizontal	PK
2	5150.0050	54.72	54.32	74.00	19.68	155	329	Horizontal	PK
3	5177.2335	105.62	105.28	74.00	-31.28	155	354	Horizontal	PK

802.11a-5180MHz/ Horizontal-AV

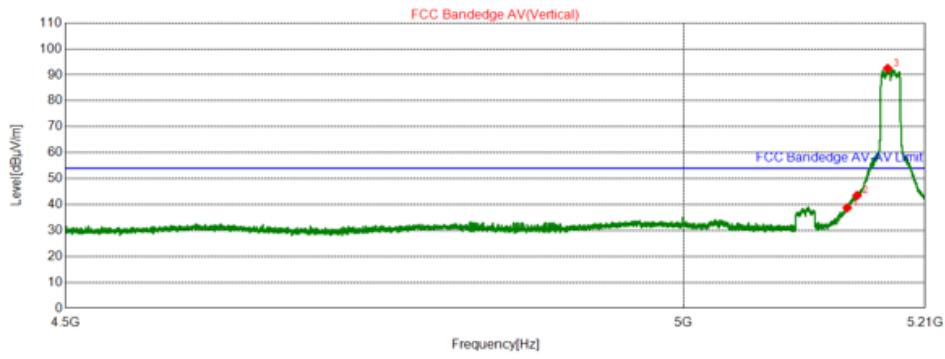


● QP Detector ★ AV Detector

NO.	Freq. [MHz]	Reading [dB μ V/m]	Level [dB μ V/m]	Limit [dB μ V/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	5144.2363	44.42	44.01	54.00	9.99	155	354	Horizontal	PK
2	5150.0050	47.49	47.09	54.00	6.91	155	354	Horizontal	PK
3	5183.1088	95.27	94.95	54.00	-40.95	155	354	Horizontal	PK

802.11a-5180MHz/ Vertical-PK


NO.	Freq. [MHz]	Reading [dB μ V/m]	Level [dB μ V/m]	Limit [dB μ V/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	5139.3550	52.93	52.50	74.00	21.50	155	106	Vertical	PK
2	5150.0050	53.18	52.78	74.00	21.22	155	6	Vertical	PK
3	5177.6595	100.51	100.18	74.00	-26.18	155	6	Vertical	PK

802.11a-5180MHz/ Vertical-AV


NO.	Freq. [MHz]	Reading [dB μ V/m]	Level [dB μ V/m]	Limit [dB μ V/m]	Margin [dB]	Height [cm]	Angle [°]	Polarity	Detector
1	5141.4850	39.17	38.75	54.00	15.25	155	107	Vertical	PK
2	5150.0050	43.88	43.48	54.00	10.52	155	107	Vertical	PK
3	5176.9850	92.85	92.51	54.00	-38.51	155	113	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 (dB_uV/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.

APPLICABLE TO	LIMIT	
789033 D02 General U-NII Test Procedures New Rules v01r03	FIELD STRENGTH AT 3m (dB _u V/m)	
	PK : 74	AV : 54
APPLICABLE TO	EIRP LIMIT (dBm/MHz)	EQUIVALENT FIELD STRENGTH AT 3m (dB _u V/m)
15.407(b)(1)		
15.407(b)(2)	PK : -27	PK : 68.3
15.407(b)(3)		
15.407(b)(4)	Note	Note

Note: All emissions shall be limited to a level of -27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.



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:

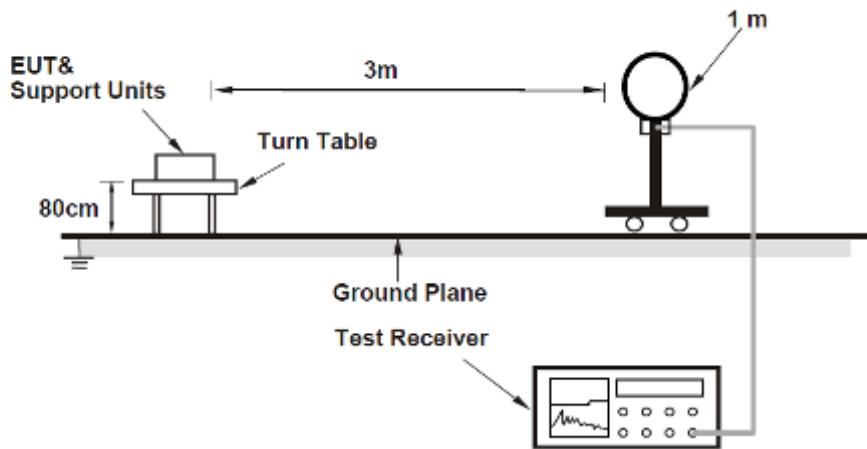
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz & 360 kHz for Quasi-peak detection (QP) at frequency below 1 GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency 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

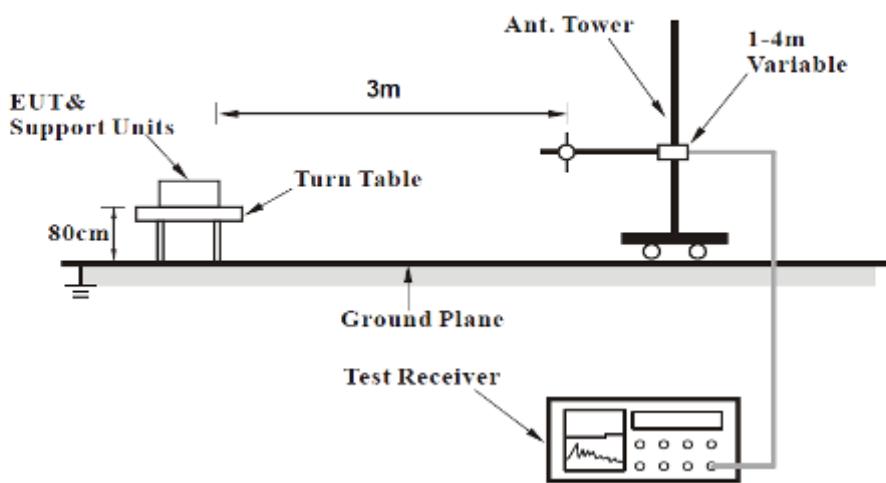
No deviation.

4.8.4 Test Setup

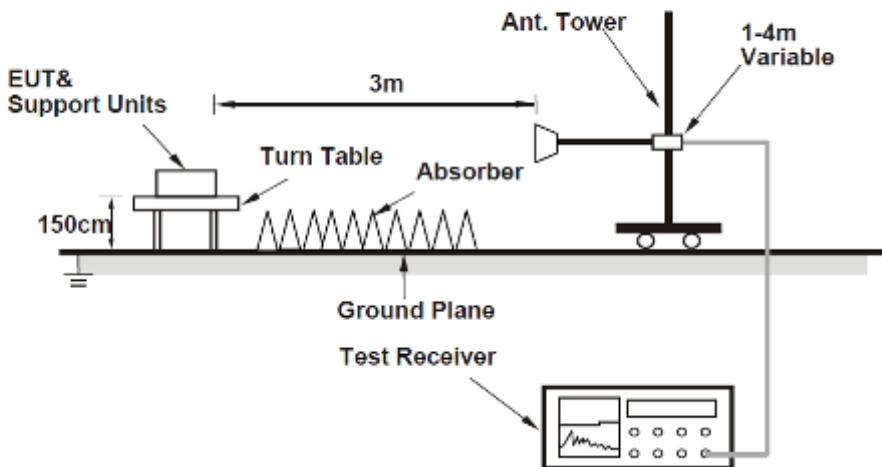
For Radiated emission below 30MHz



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.

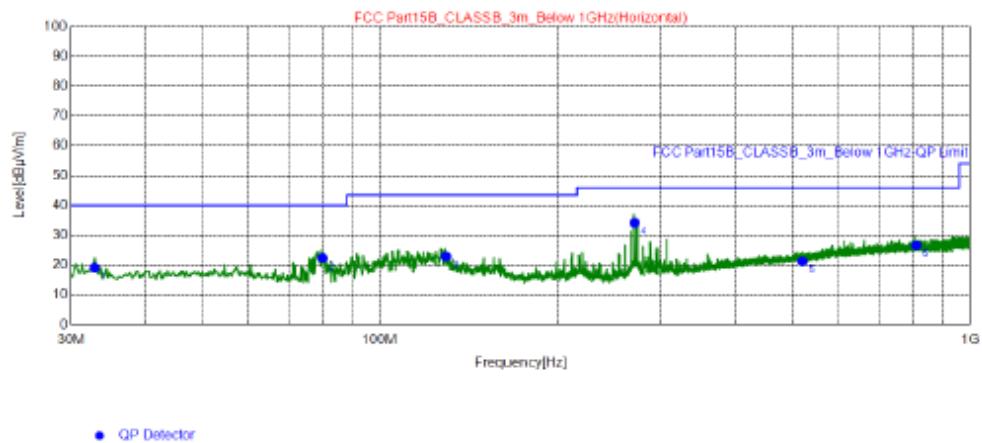
4.8.6 Test Results

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

Mode	802.11a-5180MHz	Detector Function	Quasi-Peak (QP)
Frequency Range	30MHz ~ 1GHz	Antenna Polarity	Horizontal
Power supply	AC 120V, 60Hz		

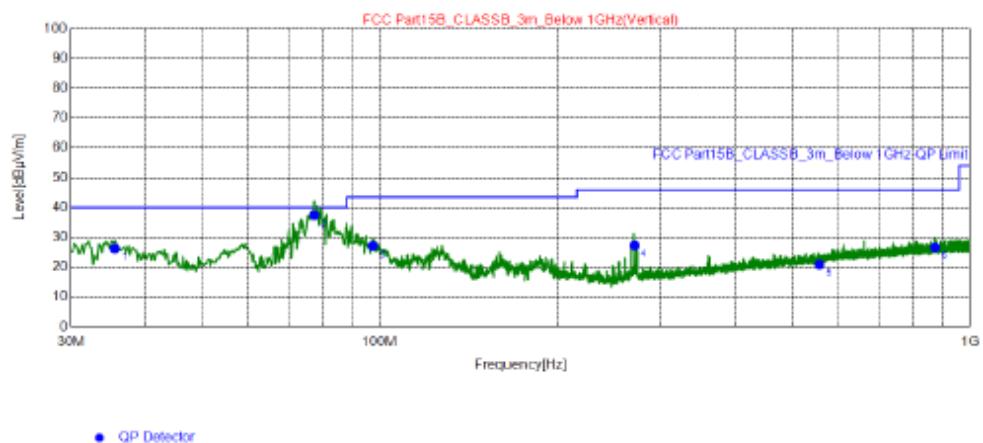
Test Graph

Final Data List

NO.	Freq. [MHz]	QP Reading [dB μ V/m]	Factor [dB]	QP Value [dB μ V/m]	QP Limit [dB μ 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

Mode	802.11a-5180MHz	Detector Function	Quasi-Peak (QP)
Frequency Range	30MHz ~ 1GHz	Antenna Polarity	Vertical
Power supply	AC 120V, 60Hz		

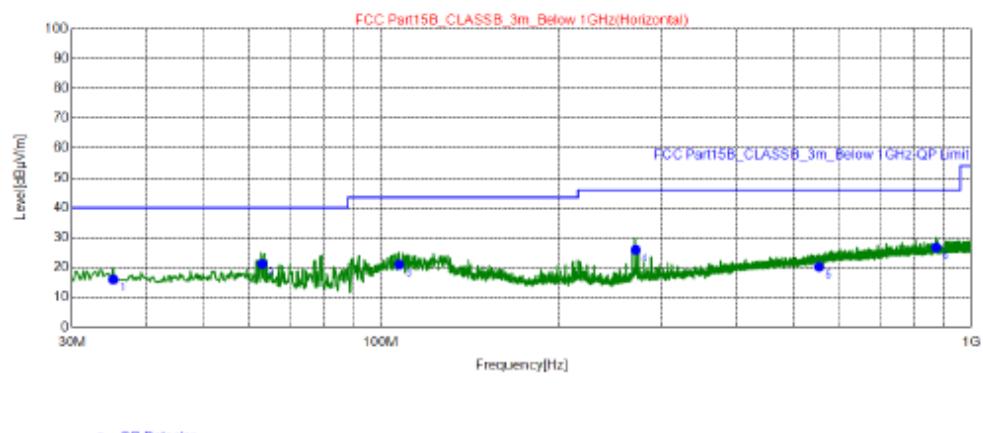
Test Graph

Final Data List

NO.	Freq. [MHz]	QP Reading [dB μ V/m]	Factor [dB]	QP Value [dB μ V/m]	QP Limit [dB μ 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

Channel	802.11a-5180MHz	Detector Function	Quasi-Peak (QP)
Frequency Range	30MHz ~ 1GHz	Antenna Polarity	Horizontal
Power supply	AC 240V, 50Hz		

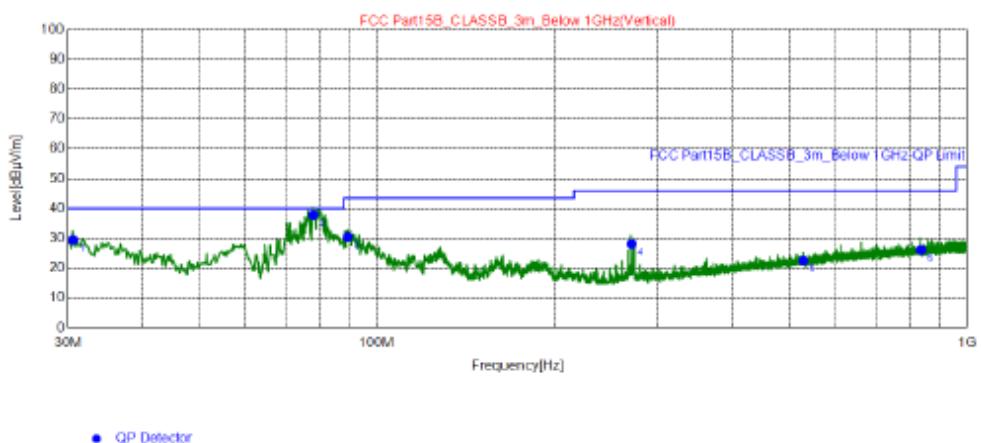
Test Graph

Final Data List

NO.	Freq. [MHz]	QP Reading [dB μ V/m]	Factor [dB]	QP Value [dB μ V/m]	QP Limit [dB μ 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

Channel	802.11a-5180MHz	Detector Function	Quasi-Peak (QP)
Frequency Range	30MHz ~ 1GHz	Antenna Polarity	Vertical
Power supply	AC 240V, 50Hz		

Test Graph

Final Data List

NO.	Freq. [MHz]	QP Reading [dB μ V/m]	Factor [dB]	QP Value [dB μ V/m]	QP Limit [dB μ 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

802.11a

Channel	TX Channel 36	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	10360.2000	48.76	74.00	25.24	1.94	H	PK
2	10360.2000	42.64	54.00	11.36	1.94	H	AV
3	10360.2000	41.45	74.00	32.55	1.94	V	PK
4	10360.2000	34.60	54.00	19.40	1.94	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 -----