

CAPSTONE COMPANIES, INC.

RF TEST REPORT

Report Type:

FCC Part 15.407 RF report

Model:

Standard Mirror,
Wardrobe Mirror

REPORT NUMBER:

210601768SHA-004

ISSUE DATE:

October 18, 2021

DOCUMENT CONTROL NUMBER:

TTRF15.407_V1 © 2017 Intertek



Applicant: CAPSTONE COMPANIES, INC.
431 FAIRWAY DRIVE, SUITE 200, DEERFIELD BEACH, FL 33441 USA

Manufacturer: PRO CONCEPT MANUFACTURER CO., LTD.
88/1 MOO 12, SOI PETCHKASEM 120,PETCHKASEM RD. OM NOI,
KRATUMBAN, SAMUTSAKORN THAILAND 74130

FCC ID: 2A3GYCAP-1807

SUMMARY:

The equipment complies with the requirements according to the following standard(s) or Specification:
47CFR Part 15 (2020): Radio Frequency Devices (Subpart C)
ANSI C63.10 (2013): American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

PREPARED BY:

REVIEWED BY:



Project Engineer
Eric Li

Reviewer
Daniel Zhao

This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to permit copying or distribution of this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.

TEST REPORT

Content

REVISION HISTORY	5
MEASUREMENT RESULT SUMMARY	6
1 GENERAL INFORMATION	7
1.1 DESCRIPTION OF EQUIPMENT UNDER TEST (EUT)	7
1.2 TECHNICAL SPECIFICATION	7
1.3 DESCRIPTION OF TEST FACILITY	8
2 TEST SPECIFICATIONS	9
2.1 STANDARDS OR SPECIFICATION	9
2.2 MODE OF OPERATION DURING THE TEST.....	9
2.3 TEST SOFTWARE LIST	11
2.4 TEST PERIPHERALS LIST	11
2.5 TEST ENVIRONMENT CONDITION:.....	11
2.6 INSTRUMENT LIST	12
2.7 MEASUREMENT UNCERTAINTY	14
3 26 DB BANDWIDTH & 99% OCCUPIED BANDWIDTH	15
3.1 LIMIT	15
3.2 MEASUREMENT PROCEDURE	15
3.3 TEST CONFIGURATION	16
3.4 THE RESULTS OF 26 DB BANDWIDTH & 99% OCCUPIED BANDWIDTH.....	16
4 MINIMUM 6DB BANDWIDTH	17
4.1 LIMIT	17
4.2 MEASUREMENT PROCEDURE	17
4.3 TEST CONFIGURATION	17
4.4 THE RESULTS OF MINIMUM 6dB BANDWIDTH	17
5 MAXIMUM CONDUCTED OUTPUT POWER AND E.I.R.P.	18
5.1 LIMIT	18
5.2 MEASUREMENT PROCEDURE	19
5.3 TEST CONFIGURATION	20
5.4 TEST RESULTS OF MAXIMUM CONDUCTED OUTPUT POWER AND E.I.R.P.	20
6 POWER SPECTRUM DENSITY	21
6.1 LIMIT	21
6.2 MEASUREMENT PROCEDURE	22
6.3 TEST CONFIGURATION	23
6.4 TEST RESULTS OF POWER SPECTRUM DENSITY	23
7 RADIATED EMISSIONS	24
7.1 LIMIT	24
7.2 MEASUREMENT PROCEDURE	25
7.3 TEST CONFIGURATION	26
7.4 TEST RESULTS OF RADIATED EMISSIONS	28
8 POWER LINE CONDUCTED EMISSION	38
8.1 MEASUREMENT PROCEDURE	38
8.2 TEST CONFIGURATION	38
8.3 TEST RESULTS OF POWER LINE CONDUCTED EMISSION.....	39

TEST REPORT

9 FREQUENCY STABILITY..... 41

 9.1 LIMIT 41

 9.2 TEST RESULT..... 41

10 ANTENNA REQUIREMENT..... 42

APPENDIX A: TEST RESULTS 43

Revision History

Report No.	Version	Description	Issued Date
210601768SHA-004	Rev. 01	Initial issue of report	October 18, 2021

Measurement result summary

TEST ITEM	FCC REFERANCE	RESULT
26 dB Bandwidth & 99% Occupied Bandwidth	15.407(a)	Pass
Minimum 6dB Bandwidth	15.407(e)	Pass
Maximum Conducted Output Power	15.407(a)	Pass
Power spectral density	15.407(a)	Pass
Radiated emission	15.407(b) 15.205 15.209	Pass
Power line conducted emission	15.407(b) 15.207	Pass
Frequency Stability	15.407(g)	Tested
Antenna requirement	15.203	Pass

Notes: 1: NA =Not Applicable

1 GENERAL INFORMATION

1.1 Description of Equipment Under Test (EUT)

Product name:	Thin Cast Smart Mirror
Type/Model:	Standard Mirror, Wardrobe Mirror
Description of EUT:	EUT is a Smart Mirror with WiFi function and Bluetooth function, there are two models, they are identical except for the size of mirror, so we test Wardrobe Mirror as representative and list the worst results in this report.
Rating:	12.0Vdc, 4.0A, 48.0W
Category of EUT:	Class B
EUT type:	<input type="checkbox"/> Table top <input checked="" type="checkbox"/> Floor standing
Software Version:	/
Hardware Version:	/
Sample Identification No.:	0210919-46-001
Sample received date:	September 26, 2021
Date of test:	September 27, 2021 ~ October 15, 2021

1.2 Technical Specification

Frequency Range:	5150 ~ 5250MHz 5250 ~ 5350MHz 5470 ~ 5725MHz 5725 ~ 5850MHz
Support Standards:	802.11a, 802.11n/ac(HT20), 802.11n/ac(HT40), 802.11ac(VHT80)
Type of Modulation:	OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM)
Channel Number:	For 5150 ~ 5250MHz band: Channel 36 - 48 For 5250 ~ 5350MHz Band: Channel 52 - 64 For 5470 ~ 5725MHz Band: Channel 100 - 140 For 5725 ~ 5850MHz band: Channel 149 - 165
Antenna Information:	PCB antenna, gain is 2dBi

1.3 Description of Test Facility

Name:	Intertek Testing Services Shanghai
Address:	Building 86, No. 1198 Qinzhou Road(North), Shanghai 200233, P.R. China
Telephone:	86 21 61278200
Telefax:	86 21 54262353

The test facility is recognized, certified, or accredited by these organizations:	CNAS Accreditation Lab Registration No. CNAS L0139
	FCC Accredited Lab Designation Number: CN1175
	IC Registration Lab Registration code No.: 2042B-1
	VCCI Registration Lab Registration No.: R-4243, G-845, C-4723, T-2252
	NVLAP Accreditation Lab NVLAP LAB CODE: 200849-0
	A2LA Accreditation Lab Certificate Number: 3309.02

2 TEST SPECIFICATIONS

2.1 Standards or specification

47CFR Part 15 (2020)
ANSI C63.10 (2013)
KDB 558074 (v04)

2.2 Mode of operation during the test

While testing transmitting mode of EUT, the continuously transmission was applied by following software.

Software name	Manufacturer	Version	Supplied by
CMD Command	-	-	Client

The lowest, middle and highest channel were tested as representatives.

Frequency Band (MHz)	Mode	Lowest (MHz)	Middle (MHz)	Highest (MHz)
5150~5250MHz	802.11a	5180	5220	5240
	802.11n20	5180	5220	5240
	802.11n40	5190	/	5230
	802.11ac80	5210	/	/
5250~5350MHz	802.11a	5260	5300	5320
	802.11n20	5260	5300	5320
	802.11n40	5270	/	5310
	802.11ac80	5290	/	/
5470~5725MHz	802.11a	5500	5580	5700
	802.11n20	5500	5580	5700
	802.11n40	5510	5550	5670
	802.11ac80	5530	/	5610
5725~5850MHz	802.11a	5745	5785	5825
	802.11n20	5745	5785	5825
	802.11n40	5755	/	5795
	802.11ac80	5775	/	/

Note: 802.11ac(VHT20) is similar as 802.11n(HT20), and 802.11n(HT20) is the worse after checked, so only 802.11n(HT20) was chosen to do the tests. It is the same to 802.11ac(VHT40) and 802.11n(HT40).

TEST REPORT

Data rate and Power setting:

The pre-scan for the conducted power with all data rates in each modulation and band was used, and the worst case was found and used in all test cases. After this pre-scan, we choose the following table of the data rate as the worst case.

Frequency Band (MHz)	Mode	Worst case data rate	Power Setting
5150~5250	802.11a	6Mbps	13
	802.11n20	MCS0	13
	802.11n40	MCS0	13
	802.11ac80	MCS0	13
5250~5350	802.11a	6Mbps	13
	802.11n20	MCS0	13
	802.11n40	MCS0	13
	802.11ac80	MCS0	13
5500~5725	802.11a	6Mbps	13
	802.11n20	MCS0	13
	802.11n40	MCS0	13
	802.11ac80	MCS0	13
5725~5850	802.11a	6Mbps	13
	802.11n20	MCS0	13
	802.11n40	MCS0	13
	802.11ac80	MCS0	13

2.3 Test software list

Test Items	Software	Manufacturer	Version
Conducted emission	ESxS-K1	R&S	V2.1.0
Radiated emission	ES-K1	R&S	V1.71

2.4 Test peripherals list

Item No.	Name	Brand and Model	Description
1	Laptop computer	DELL 5480	-

2.5 Test environment condition:

Test items	Temperature	Humidity
26 dB Bandwidth & 99% Occupied Bandwidth	23°C	52% RH
Minimum 6dB Bandwidth		
Maximum Conducted Output Power		
Power spectral density		
Radiated Emissions in restricted frequency bands	22°C	53% RH
Power line conducted emission	23°C	53% RH

2.6 Instrument list

Conducted Emission					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
<input checked="" type="checkbox"/>	Test Receiver	R&S	ESCS 30	EC 2107	2022-07-14
<input checked="" type="checkbox"/>	A.M.N.	R&S	ESH2-Z5	EC 3119	2021-11-10
<input type="checkbox"/>	A.M.N.	R&S	ENV 216	EC 3393	2022-07-14
<input type="checkbox"/>	A.M.N.	R&S	ENV4200	EC 3558	2022-06-11
Radiated Emission					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
<input checked="" type="checkbox"/>	Test Receiver	R&S	ESIB 26	EC 3045	2022-09-16
<input checked="" type="checkbox"/>	Bilog Antenna	TESEQ	CBL 6112D	EC 4206	2022-09-24
<input checked="" type="checkbox"/>	Pre-amplifier	R&S	AFS42-00101800-25-S-42	EC5262	2022-06-11
<input checked="" type="checkbox"/>	Spectrum Analyzer	Keysight	N9030B	EC 6078	2022-06-11
<input type="checkbox"/>	Horn antenna	R&S	HF 906	EC 3049	2022-01-17
<input type="checkbox"/>	Horn antenna	ETS	3117	EC 4792-1	2021-02-25
<input checked="" type="checkbox"/>	Horn antenna	TOYO	HAP18-26W	EC 4792-3	2022-07-09
<input checked="" type="checkbox"/>	Horn antenna	ETS	3116c	EC5955	2022-05-21
<input checked="" type="checkbox"/>	Active loop antenna	Schwarzbeck	FMZB1519	EC 5345	2022-03-14
RF test					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
<input checked="" type="checkbox"/>	PXA Signal Analyzer	Keysight	N9030A	EC 5338	2022-03-16
<input type="checkbox"/>	Power sensor	Agilent	U2021XA	EC 5338-1	2022-03-16
<input type="checkbox"/>	Vector Signal Generator	Agilent	N5182B	EC 5175	2022-03-16
<input type="checkbox"/>	Universal Radio Communication Tester	R&S	CMW500	EC5944	2021-12-09
<input type="checkbox"/>	MXG Analog Signal Generator	Agilent	N5181A	EC 5338-2	2022-03-16
<input type="checkbox"/>	Mobile Test System	Litepoint	lqxel	EC 5176	2022-01-16
<input type="checkbox"/>	Test Receiver	R&S	ESCI 7	EC 4501	2022-09-16

TEST REPORT

<input type="checkbox"/>	Climate chamber	GWS	MT3065	EC 6021	2022-07-04
<input checked="" type="checkbox"/>	Spectrum Analyzer	Keysight	N9030B	EC 6078	2022-06-11
Tet Site					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
<input checked="" type="checkbox"/>	Shielded room	Zhongyu	-	EC 2838	2022-01-12
<input type="checkbox"/>	Shielded room	Zhongyu	-	EC 2839	2022-01-12
<input checked="" type="checkbox"/>	Semi-anechoic chamber	Albatross project	-	EC 3048	2022-07-14
<input type="checkbox"/>	Fully-anechoic chamber	Albatross project	-	EC 3047	2022-07-14
Additional instrument					
Used	Equipment	Manufacturer	Type	Internal no.	Due date
<input checked="" type="checkbox"/>	Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 3783	2022-03-03
<input type="checkbox"/>	Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 3481	2022-01-05
<input checked="" type="checkbox"/>	Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 3442	2022-01-05
<input checked="" type="checkbox"/>	Therom-Hygrograph	ZJ1-2A	S.M.I.F.	EC 3324	2022-09-05
<input type="checkbox"/>	Pressure meter	YM3	Shanghai Mengde	EC 3320	2022-07-14

TEST REPORT**2.7 Measurement uncertainty**

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

Test item	Measurement uncertainty
Maximum peak output power	$\pm 0.74\text{dB}$
Radiated Emissions in restricted frequency bands below 1GHz	$\pm 4.90\text{dB}$
Radiated Emissions in restricted frequency bands above 1GHz	$\pm 5.02\text{dB}$
Emission outside the frequency band	$\pm 2.89\text{dB}$
Power line conducted emission	$\pm 3.19\text{dB}$

3 26 dB Bandwidth & 99% Occupied Bandwidth

Test result: Pass

3.1 Limit

None

3.2 Measurement Procedure

The EUT was tested according to test procedure of “KDB789033 D02 General UNII Test Procedures New Rules”

26 dB Bandwidth

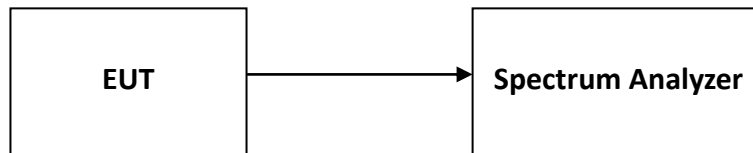
- a) Set RBW = approximately 1% of the emission bandwidth.
- b) Set the VBW > RBW.
- c) Detector = Peak.
- d) Trace mode = max hold.
- e) Measure the maximum width of the emission that is 26 dB down from the maximum of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%.

99% Occupied Bandwidth

The following procedure shall be used for measuring (99 %) power bandwidth:

1. Set center frequency to the nominal EUT channel center frequency.
2. Set span = 1.5 times to 5.0 times the OBW.
3. Set RBW = 1 % to 5 % of the OBW
4. Set $VBW \geq 3 \cdot RBW$
5. Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.
6. Use the 99 % power bandwidth function of the instrument (if available).
7. If the instrument does not have a 99 % power bandwidth function, the trace data points are recovered and directly summed in power units. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5 % of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5 % of the total is reached; that frequency is recorded as the upper frequency. The 99% occupied bandwidth is the difference between these two frequencies.

3.3 Test Configuration



3.4 The results of 26 dB Bandwidth & 99% Occupied Bandwidth

Please refer to Appendix.

4 Minimum 6dB Bandwidth

Test result: Pass

4.1 Limit

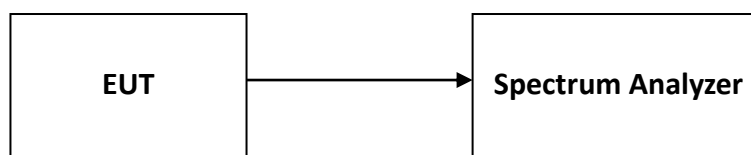
For systems using digital modulation techniques that may operate in the 5725 - 5850 MHz band, the minimum 6 dB bandwidth shall be at least 500 kHz.

4.2 Measurement Procedure

The EUT was tested according to test procedure of “KDB789033 D02 General UNII Test Procedures New Rules”

- a) Set RBW = 100 kHz.
 - b) Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
 - c) Detector = Peak.
 - d) Trace mode = max hold.
 - e) Sweep = auto couple.
 - f) Allow the trace to stabilize.
 - g) 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.
- Note: The automatic bandwidth measurement capability of a spectrum analyzer or EMI receiver may be employed if it implements the functionality described above.

4.3 Test Configuration



4.4 The results of Minimum 6dB Bandwidth

Please refer to Appendix.

5 Maximum conducted output power and e.i.r.p.

Test result: Pass

5.1 Limit

For an outdoor access point operating in the band 5.15-5.25GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1W provided the maximum antenna gain does not exceed 6dBi.

The maximum e.i.r.p. at any elevation angle above 30 degrees from the horizon must not exceed 125mW (21 dBm).

For an indoor access point operating in the band 5.15-5.25GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6dBi.

For fixed point-to-point access points operating in the band 5.15-5.25GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1W.

For client devices in the 5.15-5.25GHz band, the maximum conducted output power over the frequency band of operation shall not exceed 250mW provided the maximum antenna gain does not exceed 6dBi.

For the 5.25-5.35GHz and 5.47-5.725GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250mW or $11\text{dBm} + 10\log B$, where B is the 26dB emission bandwidth in megahertz.

For the band 5.725-5.85GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1W.

For Frequency Band 5150-5250 MHz, the maximum e.i.r.p. shall not exceed 200 mW or $10 + 10 \log_{10} B$, dBm, whichever power is less. B is the 99% emission bandwidth in megahertz.

For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum conducted output power over the frequency bands of operation shall not exceed the lesser of 250 mW or $11 \text{ dBm} + 10 \log B$, where B is the 99% emission bandwidth in megahertz.

For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, The maximum e.i.r.p. shall not exceed 1.0 W or $17 + 10 \log_{10} B$, dBm, whichever is less. B is the 99% emission bandwidth in megahertz.

For the band 5.725-5.85 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W.

TEST REPORT

If transmitting antennas of directional gain greater than 6dBi are used, the maximum conducted output power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

5.2 Measurement Procedure

The EUT was tested according to test procedure of “KDB789033 D02 General UNII Test Procedures New Rules”

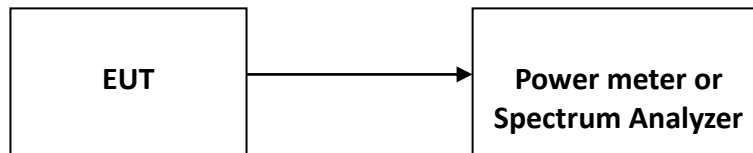
For 802.11a and 802.11n(HT20) mode:

- (i) Measurements may be performed using a wideband RF power meter with a thermocouple detector or equivalent if all of the conditions listed below are satisfied.
The EUT is configured to transmit continuously or to transmit with a constant duty cycle.
At all times when the EUT is transmitting, it must be transmitting at its maximum power control level.
The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five.
- (ii) If the transmitter does not transmit continuously, measure the duty cycle, x , of the transmitter output signal as described in II.B.
- (iii) Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.
- (iv) Adjust the measurement in dBm by adding $10 \log (1/x)$ where x is the duty cycle (e.g., $10 \log (1/0.25)$ if the duty cycle is 25%).

For 802.11n(HT40) and 802.11ac(VHT80):

- (i) Measure the duty cycle, x , of the transmitter output signal as described in II.B.
- (ii) Set span to encompass the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal.
- (iii) Set RBW = 1 MHz.
- (iv) Set VBW \geq 3 MHz.
- (v) Number of points in sweep $\geq 2 \times \text{span} / \text{RBW}$. (This ensures that bin-to-bin spacing is $\leq \text{RBW}/2$, so that narrowband signals are not lost between frequency bins.)
- (vi) Sweep time = auto.
- (vii) Detector = power averaging (rms), if available. Otherwise, use sample detector mode.
- (viii) Do not use sweep triggering. Allow the sweep to “free run.”
- (ix) Trace average at least 100 traces in power averaging (rms) mode; however, the number of traces to be averaged shall be increased above 100 as needed to ensure that the average accurately represents the true average over the on and off periods of the transmitter.
- (x) Compute power by integrating the spectrum across the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal using the instrument’s band power measurement function with band limits set equal to the EBW (or occupied bandwidth) band edges. If the instrument does not have a band power function, sum the spectrum levels (in power units) at 1 MHz intervals extending across the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal.
- (xi) Add $10 \log (1/x)$, where x is the duty cycle, to the measured power 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). For example, add $10 \log (1/0.25) = 6 \text{ dB}$ if the duty cycle is 25%.

5.3 Test Configuration



5.4 Test Results of Maximum conducted output power and e.i.r.p.

Please refer to Appendix.

6 Power spectrum density

Test result: Pass

6.1 Limit

For an outdoor access point operating in the band 5.15-5.25GHz, the maximum power spectral density shall not exceed 17dBm in any 1 megahertz band.

For an indoor access point operating in the band 5.15-5.25GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band.

For client devices in the 5.15-5.25GHz band, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band.

For the 5.25-5.35 GHz and 5.47-5.725GHz bands, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band.

For the band 5.725-5.85GHz, the maximum power spectral density shall not exceed 30dBm in any 500kHz band.

For the 5.15-5.25GHz band, the e.i.r.p. spectral density shall not exceed 10 dBm in any 1.0 MHz band.

For the 5.25-5.35 GHz and 5.47-5.725 GHz bands, the maximum power spectral density shall not exceed 11 dBm in any 1 megahertz band.

For the 5.725-5.85GHz band, the maximum power spectral density shall not exceed 30 dBm in any 500-kHz band.

If the transmitting antenna of directional gain greater than 6dBi is used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi. If there have a beam forming type, the limit should be the less of original and original + (6 - antenna gain - beamforming gain).

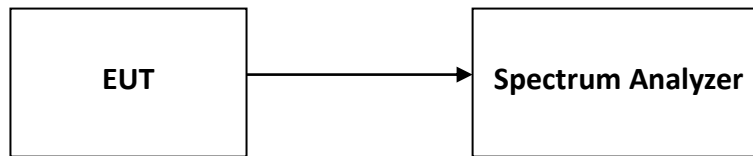
6.2 Measurement Procedure

The EUT was tested according to test procedure of “KDB789033 D02 General UNII Test Procedures New Rules”

1. Create an average power spectrum for the EUT operating mode being tested by following the instructions in II.E.2. for measuring maximum conducted output power using a spectrum analyzer or EMI receiver: select the appropriate test method (SA-1, SA-2, SA-3, or alternatives to each) and apply it up to, but not including, the step labeled, “Compute power....” (This procedure is required even if the maximum conducted output power measurement was performed using a power meter, method PM.)
2. Use the peak search function on the instrument to find the peak of the spectrum and record its value.
3. Make the following adjustments to the peak value of the spectrum, if applicable:
 - a) If Method SA-2 or SA-2 Alternative was used, add $10 \log (1/x)$, where x is the duty cycle, to the peak of the spectrum.
 - b) If Method SA-3 Alternative was used and the linear mode was used in step II.E.2.g)(viii), add 1 dB to the final result to compensate for the difference between linear averaging and power averaging.
4. The result is the Maximum PSD over 1 MHz reference bandwidth.
5. For devices operating in the bands 5.15 5.25 GHz, 5.25 5.35 GHz, and 5.47 5.725 GHz, the above procedures make use of 1 MHz RBW to satisfy directly the 1 MHz reference bandwidth specified in Section 15.407(a)(5). For devices operating in the band 5.725 5.85 GHz, the rules specify a measurement bandwidth of 500 kHz. Many spectrum analyzers do not have 500 kHz RBW, thus a narrower RBW may need to be used. The rules permit the use of a RBWs less than 1 MHz, or 500 kHz, “provided that the measured power is integrated over the full reference bandwidth” to show the total power over the specified measurement bandwidth (i.e., 1 MHz, or 500 kHz). If measurements are performed using a reduced resolution bandwidth (< 1 MHz, or < 500 kHz) and integrated over 1 MHz, or 500 kHz bandwidth, the following adjustments to the procedures apply:
 - a) Set $RBW \geq 1/T$, where T is defined in II.B.I.a).
 - b) Set $VBW \geq 3 RBW$.
 - c) If measurement bandwidth of Maximum PSD is specified in 500 kHz, add $10 \log (500 \text{ kHz}/RBW)$ to the measured result, whereas RBW (<500 kHz) is the reduced resolution bandwidth of the spectrum analyzer set during measurement.
 - d) If measurement bandwidth of Maximum PSD is specified in 1 MHz, add $10 \log (1\text{MHz}/RBW)$ to the measured result, whereas RBW (< 1 MHz) is the reduced resolution bandwidth of spectrum analyzer set during measurement.
 - e) Care must be taken to ensure that the measurements are performed during a period of continuous transmission or are corrected upward for duty cycle.

Note: As a practical matter, it is recommended to use reduced RBW of 100 kHz for steps 5.c) and 5.d) above, since RBW=100 KHZ is available on nearly all spectrum analyzers.

6.3 Test Configuration



6.4 Test Results of Power spectrum density

Please refer to Appendix.

7 Radiated Emissions

Test result: Pass

7.1 Limit

The radiated emissions which fall in the restricted bands, and the radiated emissions below 1GHz, must comply with the radiated emission limits specified showed as below:

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

The radiated emissions which fall outside the restrict bands, should comply with the EIRP limit as below:

For transmitters operating in the 5.15 - 5.25 / 5.25 - 5.35 / 5.47 - 5.725GHz band:

Frequency (MHz)	EIRP Limit (dBm)	Equivalent Field Strength (3m) (dBμV/m)
<5150	-27	68.20
>5350		
<5470		
>5725		

For transmitters operating in the 5.725 - 5.85GHz band:

Frequency (MHz)	EIRP Limit (dBm/MHz)	Equivalent Field Strength (3m) (dBμV/m)
<5650	-27	68.20
5650 ~ 5700	-27 ~ 10	68.20 ~ 105.20
5700 ~ 5720	10 ~ 15.6	105.20 ~ 110.80
5720 ~ 5725	15.6 ~ 27	110.80 ~ 122.20
5850 ~ 5855	27 ~ 15.6	122.20 ~ 110.80
5855 ~ 5875	15.6 ~ 10	110.80 ~ 105.20
5875 ~ 5925	10 ~ -27	105.20 ~ 68.20
>5925	-27	68.20

TEST REPORT**7.2 Measurement Procedure****For Radiated emission below 30MHz:**

- a) a) For desk-top devices the EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz), For the floor-standing devices, the EUT was placed on the top of a rotating table 0.1 meters above the ground at 3 meters 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) 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 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.

NOTE:

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

For Radiated emission above 30MHz:

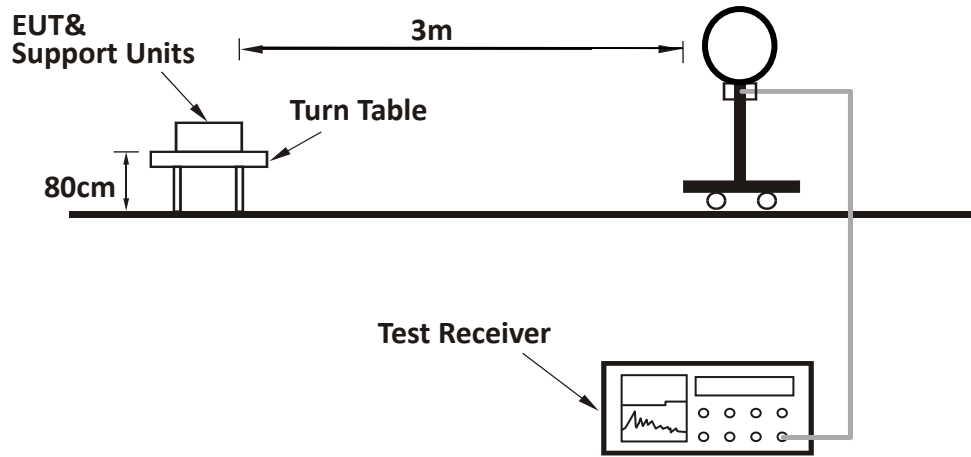
- a) a) For desk-top devices the EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz), For the floor-standing devices, the EUT was placed on the top of a rotating table 0.1 meters above the ground at 3 meters chamber room for test. The table was rotated 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 detect 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:

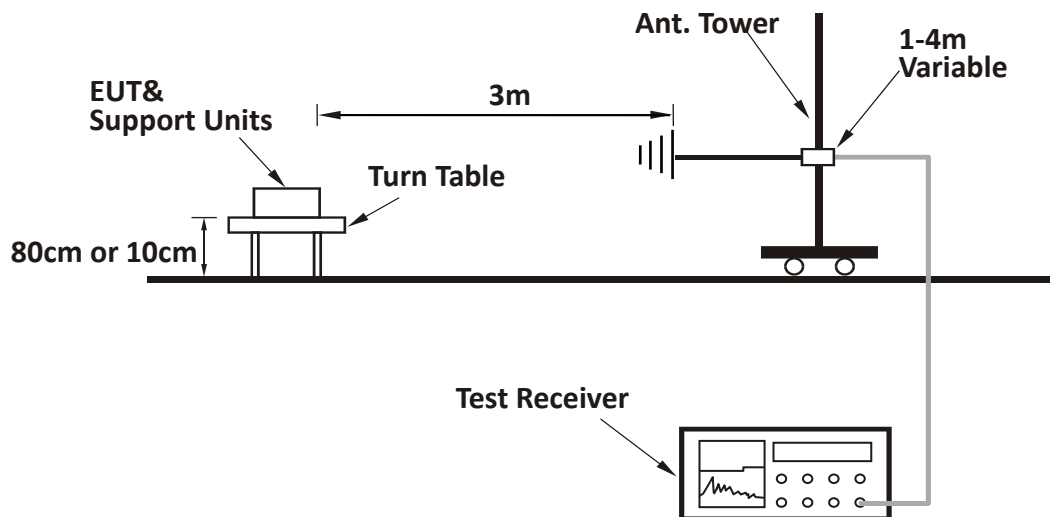
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.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

7.3 Test Configuration

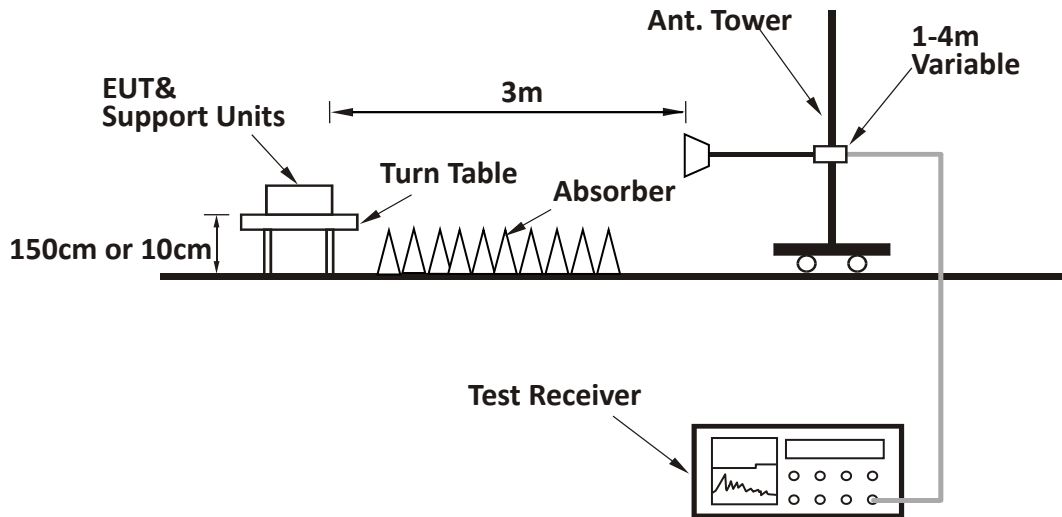
For Radiated emission below 30MHz:



For Radiated emission 30MHz to 1GHz:



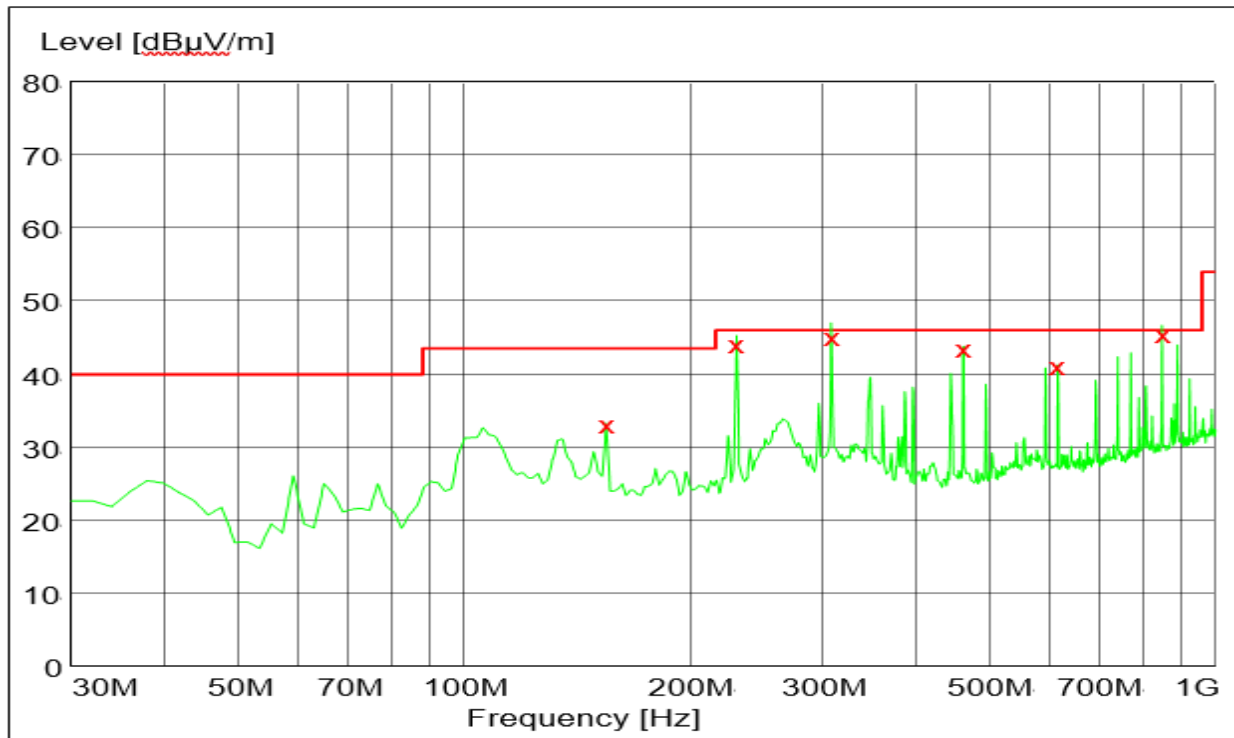
For Radiated emission above 1GHz:



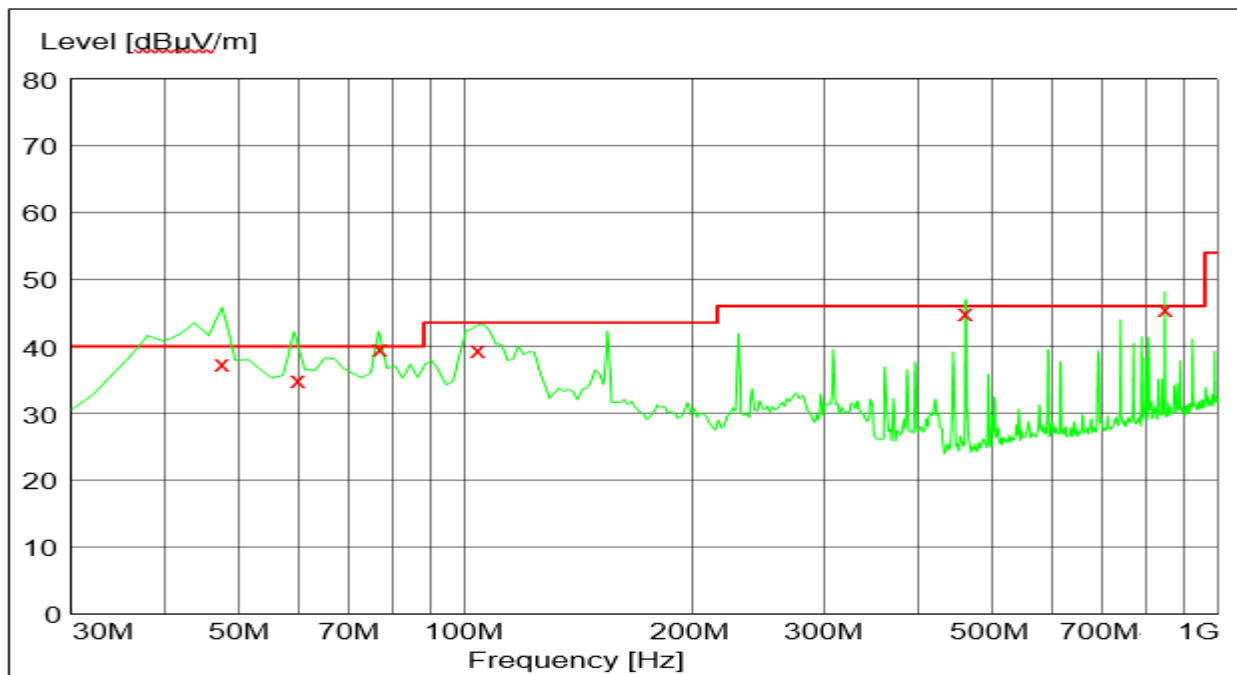
7.4 Test Results of Radiated Emissions

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported. The worst waveform from 30MHz to 1000MHz is listed as below:

Horizontal



Vertical



TEST REPORT

Test data below 1GHz

Antenna	Frequency (MHz)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
H	154.41	33.30	43.50	10.20	PK
H	230.22	44.30	46.00	1.70	QP
H	307.98	45.40	46.00	0.60	QP
H	461.54	43.70	46.00	2.30	PK
H	617.05	41.30	46.00	4.70	PK
H	848.38	45.65	46.00	0.40	QP
V	47.49	37.60	40.00	2.40	QP
V	59.90	35.30	40.00	4.70	QP
V	76.97	39.70	40.00	0.30	QP
V	103.87	39.60	43.50	3.90	QP
V	461.54	45.20	46.00	0.80	QP
V	848.38	45.80	46.00	0.20	QP

TEST REPORT

Test result above 1GHz:

U-NII-1 Band:

802.11a

Channel	Polarity	Frequency (MHz)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
L	H	5150	51.40	74.00	22.60	PK
	V	5150	51.20	74.00	22.80	PK
	H	10360	48.70	74.00	25.30	PK
	V	10360	47.10	74.00	26.90	PK
M	H	5150	51.60	74.00	22.40	PK
	H	10400	47.90	74.00	26.10	PK
	V	10400	46.60	74.00	27.40	PK
H	H	5150	51.10	74.00	22.90	PK
	H	10480	47.60	74.00	26.40	PK
	V	10480	46.50	74.00	27.50	PK

802.11n20

Channel	Polarity	Frequency (MHz)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
L	H	5150	51.50	74.00	22.50	PK
	H	10360	48.30	74.00	25.70	PK
	V	10360	47.40	74.00	26.60	PK
M	H	5150	51.70	74.00	22.30	PK
	H	10400	48.10	74.00	25.90	PK
	V	10400	47.40	74.00	26.60	PK
H	H	5150	51.80	74.00	22.20	PK
	H	10480	48.50	74.00	25.50	PK
	V	10480	47.30	74.00	26.70	PK

TEST REPORT

802.11n40

Channel	Polarity	Frequency (MHz)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
L	H	5150	52.40	74.00	21.60	PK
	H	10380	46.80	74.00	27.20	PK
	V	10380	44.50	74.00	29.50	PK
H	H	5150	50.10	74.00	23.90	PK
	H	10460	48.50	74.00	25.50	PK
	V	10460	47.40	74.00	26.60	PK

802.11ac80

Channel	Polarity	Frequency (MHz)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
L	H	5150	52.60	74.00	21.40	PK
	H	10420	48.20	74.00	25.80	PK
	V	10420	47.70	74.00	26.30	PK

TEST REPORT

U-NII-2A Band:

802.11a

Channel	Polarity	Frequency (MHz)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
L	H	5350	51.70	74.00	22.30	PK
	H	10520	47.10	74.00	26.90	PK
	V	10520	46.50	74.00	27.50	PK
M	H	5350	52.10	74.00	21.90	PK
	H	10600	47.50	74.00	26.50	PK
	V	10600	46.60	74.00	27.40	PK
H	H	5350	52.10	74.00	21.90	PK
	H	10640	48.30	74.00	25.70	PK
	V	10640	47.70	74.00	26.30	PK

802.11n20

Channel	Polarity	Frequency (MHz)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
L	H	5350	52.10	74.00	21.90	PK
	H	10520	48.60	74.00	25.40	PK
	V	10520	47.80	74.00	26.20	PK
M	H	5350	51.90	74.00	22.10	PK
	H	10600	48.10	74.00	25.90	PK
	V	10600	47.70	74.00	26.30	PK
H	H	5350	52.50	74.00	21.50	PK
	H	10640	48.20	74.00	25.80	PK
	V	10640	47.50	74.00	26.50	PK

TEST REPORT

802.11n40

Channel	Polarity	Frequency (MHz)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
L	H	5350	52.20	74.00	21.80	PK
	H	10540	48.80	74.00	25.20	PK
	V	10540	47.90	74.00	26.10	PK
H	H	5350	52.30	74.00	21.70	PK
	H	10620	48.60	74.00	25.40	PK
	V	10620	47.50	74.00	26.50	PK

802.11ac80

Channel	Polarity	Frequency (MHz)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
L	H	5350	52.40	74.00	21.60	PK
	H	10580	48.90	74.00	25.10	PK
	V	10580	48.10	74.00	25.90	PK

TEST REPORT

U-NII-2C Band:

802.11a

Channel	Polarity	Frequency (MHz)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
L	H	5470	62.70	68.20	5.50	PK
	H	11000	48.70	74.00	25.30	PK
	V	11000	48.20	74.00	25.80	PK
M	H	11200	48.50	74.00	25.50	PK
	V	11200	47.90	74.00	26.10	PK
H	H	5725	62.50	68.20	5.70	PK
	H	11400	48.80	74.00	25.20	PK
	V	11400	48.30	74.00	25.70	PK

802.11n20

Channel	Polarity	Frequency (MHz)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
L	H	5470	63.50	68.20	4.70	PK
	H	11000	48.60	74.00	25.40	PK
	V	11000	47.80	74.00	26.20	PK
M	H	11200	48.90	74.00	25.10	PK
	V	11200	48.30	74.00	25.70	PK
H	H	5725	63.40	68.20	4.80	PK
	H	11400	49.30	74.00	24.70	PK
	V	11400	48.70	74.00	25.30	PK

TEST REPORT

802.11n40

Channel	Polarity	Frequency (MHz)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
L	H	5470	64.20	68.20	4.00	PK
	H	11020	48.50	74.00	25.50	PK
	V	11020	47.60	74.00	26.40	PK
M	H	11180	48.80	74.00	25.20	PK
	V	11180	47.90	74.00	26.10	PK
H	H	5725	63.60	68.20	4.60	PK
	H	11340	48.70	74.00	25.30	PK
	V	11340	47.30	74.00	26.70	PK

802.11ac80

Channel	Polarity	Frequency (MHz)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
L	H	5470	63.40	68.20	4.80	PK
	H	11060	48.70	74.00	25.30	PK
	V	11060	48.10	74.00	25.90	PK
H	H	5725	63.80	68.20	4.40	PK
	H	11220	49.20	74.00	24.80	PK
	V	11220	48.50	74.00	25.50	PK

TEST REPORT

U-NII-3 Band:

802.11a

Channel	Polarity	Frequency (MHz)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
L	H	5720	63.80	110.80	47.00	PK
	H	11490	48.20	74.00	25.80	PK
	V	11490	47.70	74.00	26.30	PK
M	H	11570	48.80	74.00	25.20	PK
	V	11570	48.50	74.00	25.50	PK
H	H	5855	63.70	110.80	47.10	PK
	H	11650	48.30	74.00	25.70	PK
	V	11650	47.90	74.00	26.10	PK

802.11n20

Channel	Polarity	Frequency (MHz)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
L	H	5720	64.40	110.80	46.40	PK
	H	11490	48.50	74.00	25.50	PK
	V	11490	47.80	74.00	26.20	PK
M	H	11570	48.60	74.00	25.40	PK
	V	11570	47.70	74.00	26.30	PK
H	H	5855	63.80	110.80	47.00	PK
	H	11650	48.60	74.00	25.40	PK
	V	11650	47.80	74.00	26.20	PK

TEST REPORT

802.11n40

Channel	Polarity	Frequency (MHz)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
L	H	5720	65.40	110.80	45.40	PK
	H	11510	48.40	74.00	25.60	PK
	V	11510	47.50	74.00	26.50	PK
H	H	5855	66.30	110.80	44.50	PK
	H	11590	49.20	74.00	24.80	PK
	V	11590	48.30	74.00	25.70	PK

802.11ac80

Channel	Polarity	Frequency (MHz)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
L	H	5720	66.50	110.30	43.80	PK
	H	11550	48.80	74.00	25.20	PK
	V	11550	47.30	74.00	26.70	PK

- Remark: 1. Correct Factor = Antenna Factor + Cable Loss (- Amplifier, for higher than 1GHz), the value was added to Original Receiver Reading by the software automatically.
 2. Corrected Reading = Original Receiver Reading + Correct Factor
 3. Margin = Limit - Corrected Reading
 4. If the PK Corrected Reading is lower than AV limit, the AV test can be elided.

Example: Assuming Antenna Factor = 30.20dB/m, Cable Loss = 2.00dB,
 Gain of Preamplifier = 32.00dB, Original Receiver Reading = 10.00dBuV,
 Limit = 40.00dBuV/m.
 Then Correct Factor = 30.20 + 2.00 – 32.00 = 0.20dB/m;
 Corrected Reading = 10dBuV + 0.20dB/m = 10.20dBuV/m;
 Margin = 40.00dBuV/m - 10.20dBuV/m = 29.80dB.

8 Power line conducted emission

Test result: Pass

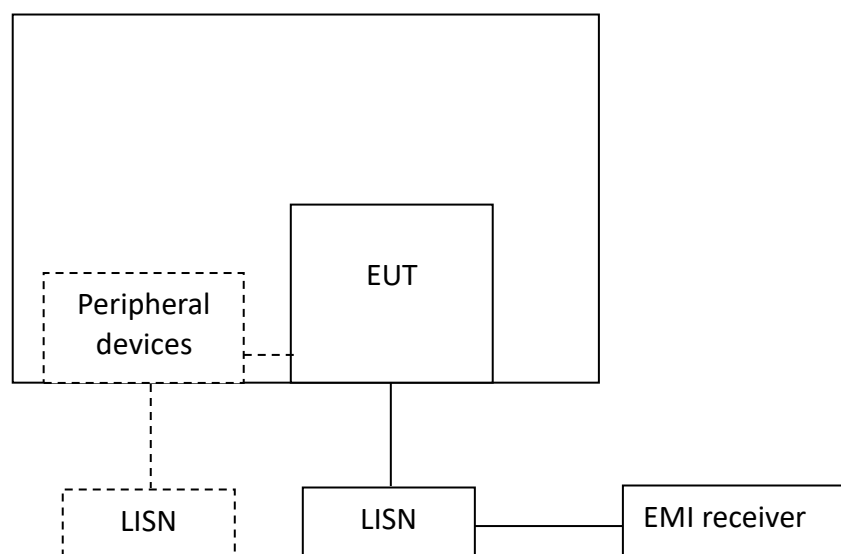
8.1 Measurement Procedure

Measured levels of ac power-line conducted emission shall be the emission voltages from the voltage probe, where permitted, or across the 50 Ω LISN port (to which the EUT is connected), where permitted, terminated into a 50 Ω measuring instrument. All emission voltage and current measurements shall be made on each current-carrying conductor at the plug end of the EUT power cord by the use of mating plugs and receptacles on the LISN, if used. Equipment shall be tested with power cords that are normally supplied or recommended by the manufacturer and that have electrical and shielding characteristics that are the same as those cords normally supplied or recommended by the manufacturer. For those measurements using a LISN, the 50 Ω measuring port is terminated by a measuring instrument having 50 Ω input impedance. All other ports are terminated in 50 Ω loads.

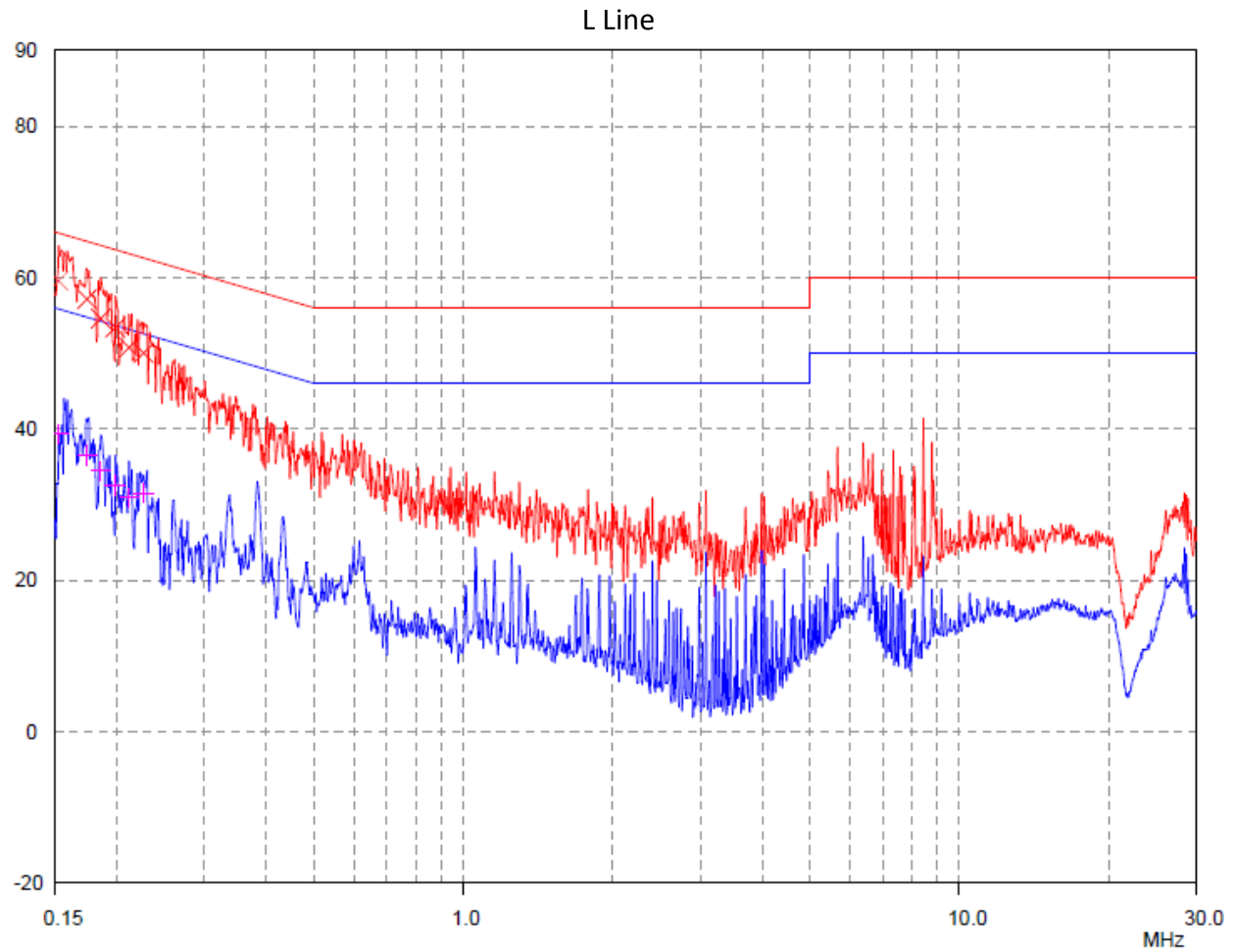
Tabletop devices shall be placed on a platform of nominal size 1 m by 1.5 m, raised 80 cm above the reference ground plane. The vertical conducting plane or wall of an RF-shielded (screened) room shall be located 40 cm to the rear of the EUT. Floor-standing devices shall be placed either directly on the reference ground-plane or on insulating material as described in ANSI C63.4. All other surfaces of tabletop or floor-standing EUTs shall be at least 80 cm from any other grounded conducting surface, including the case or cases of one or more LISNs.

The bandwidth of the test receiver is set at 9 kHz.

8.2 Test Configuration



8.3 Test Results of Power line conducted emission

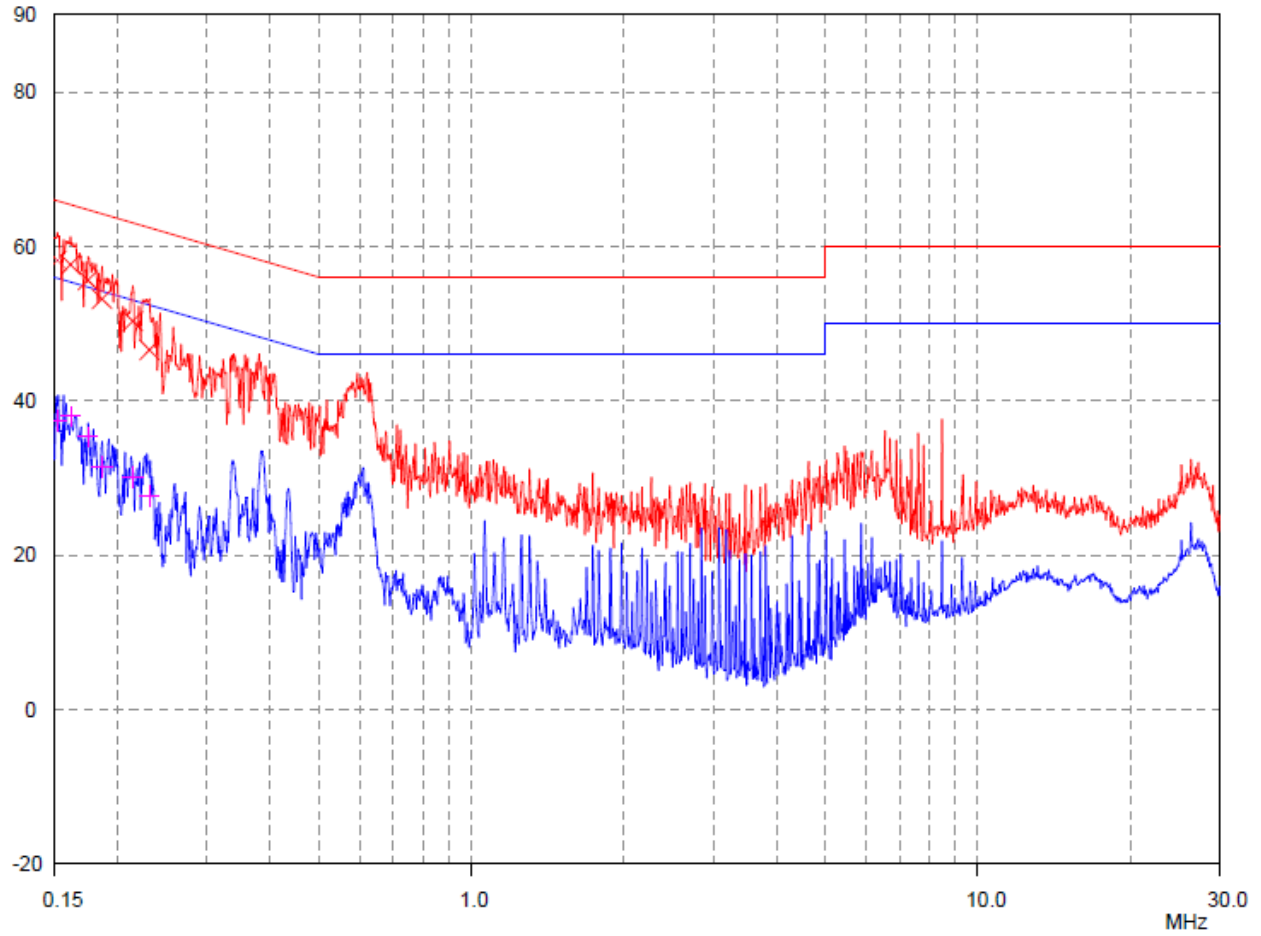


Test Data:

Frequency (MHz)	Quasi-peak			Average		
	level dB(μV)	Limit dB(μV)	Margin (dB)	level dB(μV)	limit dB(μV)	Margin (dB)
0.15	59.56	65.87	6.31	39.31	55.87	16.56
0.17	57.17	64.77	7.60	36.55	54.77	18.22
0.19	54.61	64.24	9.63	34.48	54.24	19.76
0.20	53.41	63.68	10.27	32.62	53.68	21.06
0.21	50.75	63.15	12.40	30.94	53.15	22.21
0.23	50.03	62.59	12.56	31.51	52.59	21.08

TEST REPORT

N Line



Test Data:

Frequency (MHz)	Quasi-peak			Average		
	level dB(μV)	Limit dB(μV)	Margin (dB)	level dB(μV)	limit dB(μV)	Margin (dB)
0.15	58.20	65.90	7.70	37.40	55.90	18.50
0.16	57.64	65.40	7.76	38.01	55.40	17.39
0.17	55.65	64.74	9.09	35.36	54.74	19.38
0.19	53.21	64.21	11.00	31.45	54.21	22.76
0.21	50.33	63.05	12.72	30.17	53.05	22.88
0.23	46.61	62.42	15.81	27.72	52.42	24.70

9 Frequency Stability

Test result: Pass

9.1 Limit

The frequency stability shall be sufficient to ensure that an emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

9.2 Test Result

Frequency Error - Temperature Variation

Supply Voltage DC (V)	Temperature (°C)	Frequency Deviation (Hz)
		Channel (5180MHz)
12	-20	-5
	-10	-5
	0	-5
	10	-3
	20	0
	30	0
	40	-2
	50	-3

Frequency Error - Voltage Variation

Supply Voltage DC (V)	Temperature (°C)	Frequency Deviation (Hz)
		Channel (5180MHz)
10.80	20	-3
12.00		0
13.20		-4

10 Antenna requirement

Requirement:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

Result:

The EUT used an internal PCB antenna, so fulfill these requirements.

Appendix A: Test results

Appendix A1: Test results of Band U-NII-1

Appendix A2: Test results of Band U-NII-2A

Appendix A3: Test results of Band U-NII-2C

Appendix A4: Test results of Band U-NII-3

***** END *****