Variant FCC RF Test Report

APPLICANT	:	TP-LINK TECHNOLOGIES CO., LTD.
EQUIPMENT	:	AC1900 Wireless Dual Band Gigabit Access Point
BRAND NAME	:	TP-LINK
MODEL NAME	:	EAP330
FCC ID	:	TE7EAP330
STANDARD	:	FCC Part 15 Subpart C §15.247
CLASSIFICATION	:	(DTS) Digital Transmission System

The product testing was completed on Jul. 25, 2016. We, SPORTON INTERNATIONAL (SHENZHEN) INC., would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL (SHENZHEN) INC., the test report shall not be reproduced except in full.

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Testing Laboratory 2353

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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR640501-01A	Rev. 01	This is a variant report for EAP330. All the test cases were performed on the original test report which can be referred to Sporton Report Number FG640501A. Based on the original test report, only adding the Beamforming power and RSE test data.	Sep. 06, 2016

SUMMARY OF TEST RESULT

Report Section	FCC Rule	IC Rule	Description	Limit	Result	Remark
3.1	15.247(b)	RSS-247 A5.4(4)	Power Output Measurement	≤ 30dBm	Pass	-
3.2	15.247(d)	RSS-247 5.5	Radiated Band Edges and Radiated Spurious Emission	15.209(a) & 15.247(d)	Pass	Under limit 0.27 dB at 2483.830 MHz
3.3	15.203 & 15.247(b)	N/A	Antenna Requirement	N/A	Pass	-

1 General Description

1.1 Applicant

TP-LINK TECHNOLOGIES CO., LTD.
Building 24 (floors 1,3,4,5) and 28 (floors1-4) Central Science and Technology Park, Shennan Rd., Nanshan, Shenzhen, China

1.2 Manufacturer

TP-LINK TECHNOLOGIES CO., LTD.
Building 24 (floors 1,3,4,5) and 28 (floors1-4) Central Science and Technology Park, Shennan Rd., Nanshan, Shenzhen, China

1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	AC1900 Wireless Dual Band Gigabit Access Point
Brand Name	TP-LINK
Model Name	EAP330
FCC ID	TE7EAP330
EUT supports Radios application	WLAN2.4GHz 802.11b/g/n HT20/HT40 WLAN2.4GHz 802.11ac VHT20/VHT40 WLAN5GHz 802.11a/n HT20/HT40 WLAN5GHz 802.11ac VHT20/VHT40/VHT80
EUT Stage	Identical Prototype

Remark: The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

1.4 Product Specification of Equipment Under Test

<table>
<tr><th colspan="2">Standards-related Product Specification</th></tr>
<tr><td>Tx/Rx Channel Frequency Range</td><td>802.11b/g/n/ac : 2412 MHz ~ 2462 MHz</td></tr>
<tr><td>Maximum (Average) Output Power to antenna <TX Beamforming Modes></td><td>MIMO
802.11n HT20 : 25.54 dBm (0.3581 W)
802.11n HT40 : 20.64 dBm (0.1159 W)
802.11ac VHT20 : 25.53 dBm (0.3573 W)
802.11ac VHT40 : 19.96 dBm (0.0991 W)</td></tr>
<tr><td>Antenna Type</td><td><Ant 1>
802.11b/g/n/ac : PIFA Antenna with gain 5.89 dBi
<Ant 2>
802.11b/g/n/ac : PIFA Antenna with gain 4.77 dBi
<Ant 3>
802.11b/g/n/ac : PIFA Antenna with gain 5.14 dBi</td></tr>
<tr><td>TX Beamforming Gain</td><td>MIMO Ant. 1+2+3 : 4.16 dBi</td></tr>
<tr><td>Type of Modulation</td><td>802.11b : DSSS (DBPSK / DQPSK / CCK)
802.11g/n : OFDM (BPSK / QPSK / 16QAM / 64QAM)
802.11ac : OFDM (BPSK / QPSK / 16QAM / 64QAM / 256QAM)</td></tr>
<tr><td>Antenna Function for Transmitter</td><td>
<table>
<tr><th></th><th>Chain Port 0 Ant. 1</th><th>Chain Port 1 Ant. 2</th><th>Chain Port 2 Ant. 3</th></tr>
<tr><td>802.11 b/g/n/ac MIMO</td><td>V</td><td>V</td><td>V</td></tr>
</table>
</td></tr>
</table>

Remark: Only 802.11n and 11ac support TX Beamforming

1.5 Modification of EUT

No modifications are made to the EUT during all test items.

1.6 Testing Location

Test Site	SPORTON INTERNATIONAL (SHENZHEN) INC.
Test Site Location	1F & 2F,Building A, Morning Business Center, No. 4003 ShiGu Rd., Xili Town, Nanshan District, Shenzhen, Guangdong, P. R. China TEL: +86-755-8637-9589 FAX: +86-755-8637-9595
Test Site No.	**Sporton Site No.**
	TH01-SZ

Test Site	SPORTON INTERNATIONAL (SHENZHEN) INC.	
Test Site Location	No. 3 Building, the third floor of south, Shahe River west, Fengzeyuan warehouse, Nanshan District, Shenzhen, Guangdong, P. R. China TEL: +86-755- 3320-2398	
Test Site No.	**Sporton Site No.**	**FCC/IC Registration No.**
	03CH03-SZ	565805/4086F

Note: The test site complies with ANSI C63.4 2014 requirement.

1.7 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 15 Subpart C §15.247
- FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r05
- FCC KDB 662911 D01 Multiple Transmitter Output v02r01.
- FCC KDB 644545 D03 Guidance for IEEE 802 11ac New Rules v01
- ANSI C63.10-2013
- IC RSS-247 Issue 1
- IC RSS-Gen Issue 4

Remark:

1. All test items were verified and recorded according to the standards and without any deviation during the test.
2. This EUT has also been tested and complied with the requirements of FCC Part 15, Subpart B, recorded in a separate test report.

2 Test Configuration of Equipment Under Test

The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: radiated emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower).

The final configuration from all the combinations and the worst-case data rates were investigated by measuring the maximum power across all the data rates and modulation modes under section 2.2.

Based on the worst configuration found above, the RF power setting is set individually to meet FCC compliance limit for the final conducted and radiated tests shown in section 2.3.

2.1 Carrier Frequency and Channel

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
2400-2483.5 MHz	1	2412	7	2442
	2	2417	8	2447
	3	2422	9	2452
	4	2427	10	2457
	5	2432	11	2462
	6	2437		

2.2 Pre-Scanned RF Power

Preliminary tests were performed in different data rate and data rate associated with the highest power were chosen for full test shown in the following tables.

<TX Beamforming Modes>

2.4GHz 802.11n HT20								
Data Rate (MHz)	**MCS0**	**MCS1**	**MCS2**	**MCS3**	**MCS4**	**MCS5**	**MCS6**	**MCS7**
Average Power (dBm)	**25.54**	25.47	25.40	25.38	25.39	25.41	25.42	25.37

2.4GHz 802.11n HT40								
Data Rate (MHz)	**MCS0**	**MCS1**	**MCS2**	**MCS3**	**MCS4**	**MCS5**	**MCS6**	**MCS7**
Average Power (dBm)	**20.64**	20.60	20.58	20.50	20.62	20.63	20.58	20.62

2.4GHz 802.11ac VHT20 mode									
Data Rate (MHz)	**MCS0**	**MCS1**	**MCS2**	**MCS3**	**MCS4**	**MCS5**	**MCS6**	**MCS7**	**MCS8**
Average Power (dBm)	**25.53**	25.48	25.42	25.41	25.38	25.42	25.38	25.35	25.35

2.4GHz 802.11ac VHT40 mode										
Data Rate (MHz)	**MCS0**	**MCS1**	**MCS2**	**MCS3**	**MCS4**	**MCS5**	**MCS6**	**MCS7**	**MCS8**	**MCS9**
Average Power (dBm)	**19.96**	19.92	19.92	19.86	19.88	19.86	19.84	19.81	19.86	19.85

Note: MIMO Ant. 1+2+3 is a calculated result from sum of the power MIMO Ant. 1, MIMO Ant. 2 and MIMO Ant. 3.

2.3 Test Mode

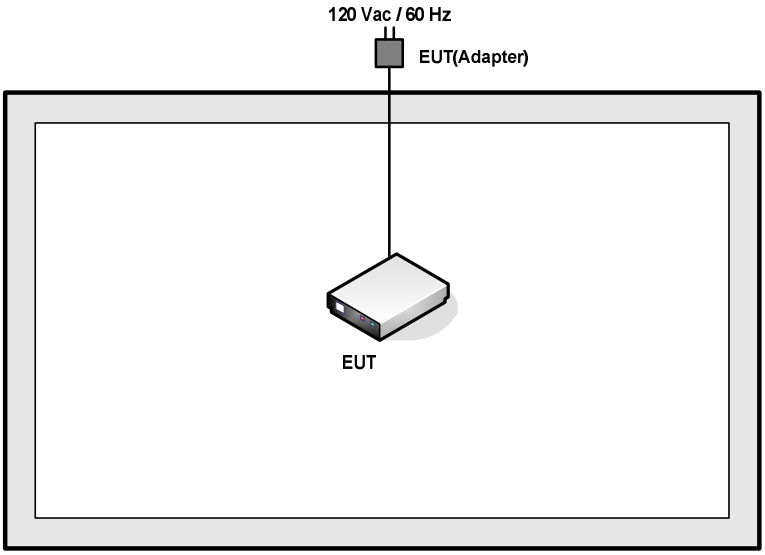
Final test mode of conducted test items and radiated spurious emissions are considering the modulation and worse data rates from the power table described in section 2.2.

<2.4GHz>

Modulation	Data Rate
802.11n HT20	MCS0
802.11n HT40	MCS0
802.11ac VHT20	MCS0
802.11ac VHT40	MCS0

2.4 Connection Diagram of Test System

<WLAN Tx Mode>



2.5 EUT Operation Test Setup

For WLAN RF test items, an engineering test program was provided and enabled to make EUT continuous transmit/receive.

3 Test Result

3.1 Maximum Average Output Power Measurement

3.1.1 Limit of Average Output Power

For systems using digital modulation in the 2400-2483.5MHz, the limit for average output power is 30dBm. If transmitting antenna with directional gain greater than 6dBi is used, the average output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

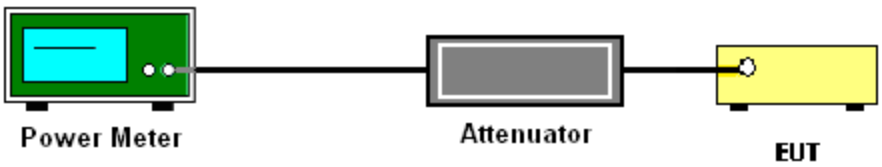
3.1.2 Measuring Instruments

The measuring equipment is listed in the section 4 of this test report.

3.1.3 Test Procedures

1. The testing follows the Measurement Procedure of FCC KDB No. 558074 DTS D01 Meas. Guidance v03r05 section 9.2.3.2 Method AVGPM-G.
2. The RF output of EUT was connected to the power meter by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Measure the conducted output power and record the results in the test report.
5. For MIMO mode, calculation method follows FCC KDB 662911 D01 Multiple Transmitter Output v02r01.

3.1.4 Test Setup



3.1.5 Test Result of Peak Output Power

2.4GHz Band											
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Peak Conducted Power (dBm)				DG (dBi)		
					Ant 1	Ant 2	Ant 3	SUM	Ant 1	Ant 2	Ant 3
HT20	MCS0	3	1	2412	25.34	24.96	25.21	29.94	10.05		
HT20	MCS0	3	6	2437	28.06	27.56	27.76	32.57	10.05		
HT20	MCS0	3	11	2462	27.37	26.78	27.02	31.83	10.05		
HT40	MCS0	3	3	2422	22.51	22.16	22.43	27.14	10.05		
HT40	MCS0	3	6	2437	25.76	25.24	25.54	30.29	10.05		
HT40	MCS0	3	9	2452	26.14	25.84	25.90	30.73	10.05		
VHT20	MCS0	3	1	2412	26.02	25.21	25.34	30.31	10.05		
VHT20	MCS0	3	6	2437	28.14	27.56	27.95	32.66	10.05		
VHT20	MCS0	3	11	2462	23.58	23.14	23.44	28.16	10.05		
VHT40	MCS0	3	3	2422	23.68	23.15	23.52	28.23	10.05		
VHT40	MCS0	3	6	2437	25.65	25.18	25.78	30.32	10.05		
VHT40	MCS0	3	9	2452	23.80	23.36	23.74	28.41	10.05		

3.1.6 Test Result of Average output Power (Reporting Only)

2.4GHz Band												
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Average Conducted Power with Duty Factor (dBm)				Conducted Power Limit (dBm)			Pass /Fail
					Ant 1	Ant 2	Ant 3	SUM	Ant 1	Ant 2	Ant 3	
HT20	MCS0	3	1	2412	14.51	14.13	14.40	19.12	25.95			Pass
HT20	MCS0	3	6	2437	20.79	20.55	20.94	25.54	25.95			Pass
HT20	MCS0	3	11	2462	17.85	17.46	17.78	22.47	25.95			Pass
HT40	MCS0	3	3	2422	11.32	10.82	11.27	15.91	25.95			Pass
HT40	MCS0	3	6	2437	15.54	15.09	15.40	20.12	25.95			Pass
HT40	MCS0	3	9	2452	16.08	15.50	16.02	20.64	25.95			Pass
VHT20	MCS0	3	1	2412	15.43	15.09	15.33	20.06	25.95			Pass
VHT20	MCS0	3	6	2437	20.89	20.51	20.86	25.53	25.95			Pass
VHT20	MCS0	3	11	2462	13.17	12.92	13.10	17.83	25.95			Pass
VHT40	MCS0	3	3	2422	11.37	10.93	11.33	15.98	25.95			Pass
VHT40	MCS0	3	6	2437	15.38	14.88	15.30	19.96	25.95			Pass
VHT40	MCS0	3	9	2452	12.70	11.86	12.25	17.05	25.95			Pass

3.2 Radiated Band Edges and Spurious Emission Measurement

3.2.1 Limit of Radiated band edge and Spurious Emission Measurement

In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. If the output power of this device was measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the restricted bands must also comply with the FCC section 15.209 limits as below.

Frequency (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

3.2.2 Measuring Instruments

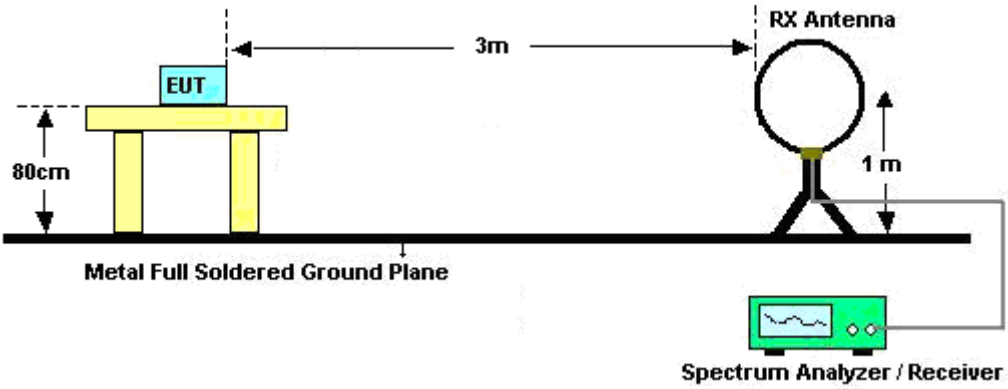
The measuring equipment is listed in the section 4 of this test report.

3.2.3 Test Procedure

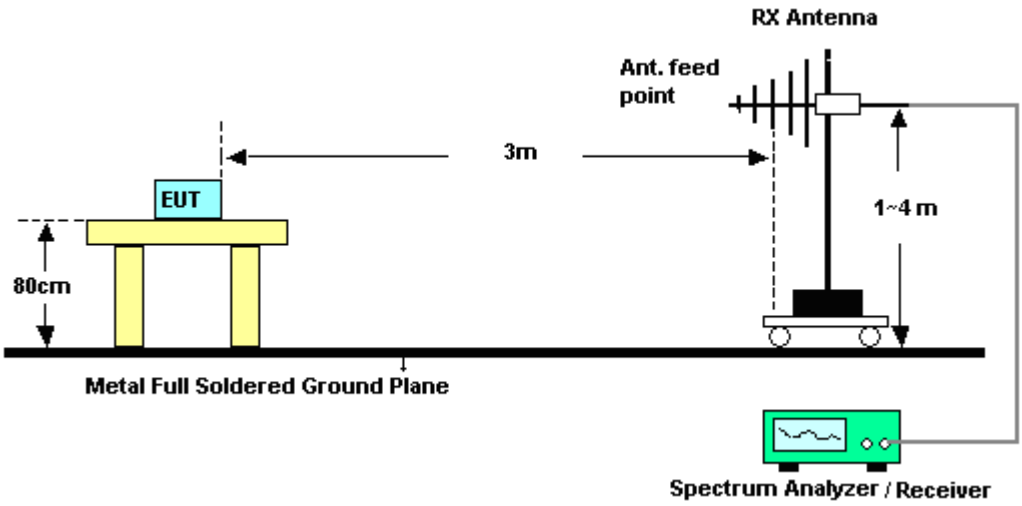
1. The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v03r05.
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
3. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
5. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
6. For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.
7. Use the following spectrum analyzer settings:
   (1) Span shall wide enough to fully capture the emission being measured;
   (2) Set RBW=100 kHz for f < 1 GHz; VBW ≥ RBW; Sweep = auto; Detector function = peak; Trace = max hold;
   (3) Set RBW = 1 MHz, VBW= 3MHz for f ≥ 1 GHz for peak measurement.
   For average measurement:
   - VBW = 10 Hz, when duty cycle is no less than 98 percent.
   - VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

3.2.4 Test Setup

For radiated emissions below 30MHz

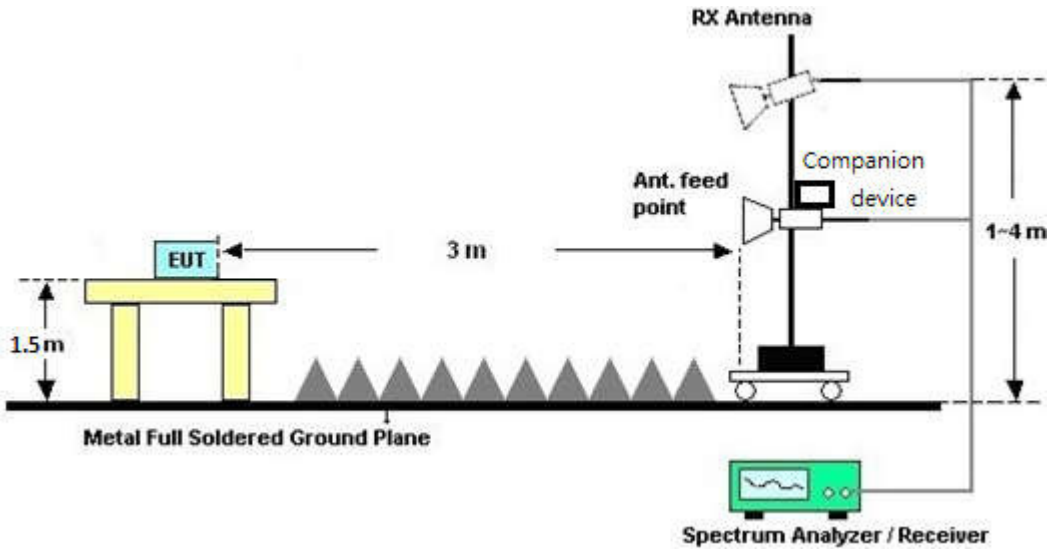


For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz

< TX Beamforming Modes>



3.2.5 Test Results of Radiated Emissions (9kHz ~ 30MHz)

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.

3.2.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix A of this report.

3.2.7 Duty Cycle

Please refer to Appendix B.

3.2.8 Test Result of Radiated Spurious Emission (30MHz ~ 10th Harmonic)

Please refer to Appendix A of this report.

3.3 Antenna Requirements

3.3.1 Standard Applicable

If directional gain of transmitting Antennas is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi. For the fixed point-to-point operation, the power shall be reduced by one dB for every 3 dB that the directional gain of the Antenna exceeds 6 dBi. 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 FCC rule.

3.3.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.3.3 Antenna Gain

TX Beamforming modes

FCC KDB 662911 D01 Multiple Transmitter Output v02r01

For CDD transmissions, directional gain is calculated as

$$DirectionalGain = 10 \cdot \log\left[\frac{\sum_{j=1}^{N_{SS}}\left\{\sum_{k=1}^{N_{ANT}} g_{j,k}\right\}^2}{N_{ANT}}\right]$$

where

Each antenna is driven by no more than one spatial stream;

N_{SS} = the number of independent spatial streams of data;

N_{ANT} = the total number of antennas

$g_{j,k} = 10^{G_k/20}$ if the kth antenna is being fed by spatial stream j, or zero if it is not;

G_k is the gain in dBi of the kth antenna.

The EUT supports beamforming for 802.11ac modes.

The directional gain calculation is following F)2)e)ii) of KDB 662911 D01 v02r01.

The power and PSD limit should be modified if the directional gain of EUT is over 6 dBi,

The directional gain “DG” is calculated as following table.

2.4G Band Antenna	DG for Power (dBi)	DG for PSD (dBi)	Power Limit Reduction (dB)	PSD Limit Reduction (dB)
1	5.89	5.89	0.00	0.00
2	4.77	4.77	0.00	0.00
3	5.14	5.14	0.00	0.00
1+2	8.36	8.36	2.36	2.36
1+3	8.53	8.53	2.53	2.53
2+3	7.97	7.97	1.97	1.97
1+2+3	10.05	10.05	4.05	4.05

Power Limit Reduction = DG(Power) – 6dBi, (min = 0)

PSD Limit Reduction = DG(PSD) – 6dBi, (min = 0)

4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Pulse Power Senor	Anritsu	MA2411B	1207253	30MHz~40GHz	Jan. 12, 2016	Jul. 25, 2016	Jan. 11, 2017	Conducted (TH01-SZ)
Power Meter	Anritsu	ML2495A	1218010	50MHz Bandwidth	Jan. 12, 2016	Jul. 25, 2016	Jan. 11, 2017	Conducted (TH01-SZ)
EMI Test Receiver&SA	KEYSIGHT	N9038A	MY54450083	20Hz~8.4GHz	May 07, 2016	Jul. 19, 2016	May 06, 2017	Radiation (03CH03-SZ)
EXA Spectrum Anaiyzer	KEYSIGHT	N9010A	MY55150246	10Hz~44GHz;	May 07, 2016	Jul. 19, 2016	May 06, 2017	Radiation (03CH03-SZ)
Loop Antenna	R&S	HFH2-Z2	100354	9kHz~30MHz	May 07, 2016	Jul. 19, 2016	May 06, 2017	Radiation (03CH03-SZ)
Bilog Antenna	TeseQ	CBL6112D	35408	30MHz~2GHz	May 21, 2016	Jul. 19, 2016	May 20, 2017	Radiation (03CH03-SZ)
Double Ridge Horn Antenna	SCHWARZBECK	BBHA9120D	9120D-1355	1GHz~18GHz	May 07, 2016	Jul. 19, 2016	May 06, 2017	Radiation (03CH03-SZ)
SHF-EHF Horn	com-power	AH-840	101071	18GHz~40GHz	Aug. 19, 2015	Jul. 19, 2016	Aug. 18, 2016	Radiation (03CH03-SZ)
Amplifier	PREAMPLIFIER	BPA-530	102210	0.01Hz ~3000MHz	Oct. 20, 2015	Jul. 19, 2016	Oct. 19, 2016	Radiation (03CH03-SZ)
Amplifier	Agilent Technologies	83017A	MY39501302	500MHz~26.5GHz	Jan. 12, 2016	Jul. 19, 2016	Jan. 11, 2017	Radiation (03CH03-SZ)
HF Amplifier	MITEQ	AMF-7D-00101800-30-10P-R	1943528	1GHz~18GHz	Oct. 20, 2015	Jul. 19, 2016	Oct. 19, 2016	Radiation (03CH03-SZ)
HF Amplifier	MITEQ	TTA1840-35-HG	1871923	18GHz~40GHz	Jul. 18, 2016	Jul. 19, 2016	Jul. 17, 2017	Radiation (03CH03-SZ)
AC Power Source	Chroma	61601	616010001985	N/A	NCR	Jul. 19, 2016	NCR	Radiation (03CH03-SZ)
Turn Table	EM	EM1000	N/A	0~360 degree	NCR	Jul. 19, 2016	NCR	Radiation (03CH03-SZ)
Antenna Mast	EM	EM1000	N/A	1 m~4 m	NCR	Jul. 19, 2016	NCR	Radiation (03CH03-SZ)

NCR: No Calibration Required

5 Uncertainty of Evaluation

Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	5.0 dB

Uncertainty of Radiated Emission Measurement (1GHz ~ 18GHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	4.8 dB

Uncertainty of Radiated Emission Measurement (18GHz ~ 40GHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	5.0dB

Appendix A. Radiated Spurious Emission

2.4GHz 2400~2483.5MHz

WIFI 802.11n HT20 (Band Edge @ 3m)

WIFI Ant. 1+2+3	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11n HT20 CH 01 2412MHz		2389.17	67.57	-6.43	74	70.44	27.29	4.86	35.02	171	238	P	H
		2388.855	52.74	-1.26	54	55.61	27.29	4.86	35.02	171	238	A	H
	*	2412	110.81	-	-	113.6	27.33	4.88	35	171	238	P	H
	*	2412	103.5	-	-	106.29	27.33	4.88	35	171	238	A	H
		2389.17	59.44	-14.56	74	62.31	27.29	4.86	35.02	170	201	P	V
		2390	46.43	-7.57	54	49.28	27.29	4.86	35	170	201	A	V
	*	2412	105.96	-	-	108.75	27.33	4.88	35	170	201	P	V
	*	2412	97.79	-	-	100.58	27.33	4.88	35	170	201	A	V
802.11n HT20 CH 06 2437MHz		2387.28	66.83	-7.17	74	69.7	27.29	4.86	35.02	237	245	P	H
		2389.38	48.15	-5.85	54	51.02	27.29	4.86	35.02	237	245	A	H
	*	2437	120.24	-	-	122.93	27.4	4.88	34.97	237	245	P	H
	*	2437	112.54	-	-	115.23	27.4	4.88	34.97	237	245	A	H
		2483.97	64.99	-9.01	74	67.54	27.47	4.9	34.92	237	245	P	H
		2483.5	47.97	-6.03	54	50.52	27.47	4.9	34.92	237	245	A	H
		2387.14	57.16	-16.84	74	60.03	27.29	4.86	35.02	249	203	P	V
		2389.8	42.64	-11.36	54	45.49	27.29	4.86	35	249	203	A	V
	*	2437	114.84	-	-	117.53	27.4	4.88	34.97	249	203	P	V
	*	2437	106.79	-	-	109.48	27.4	4.88	34.97	249	203	A	V
		2485.44	62.2	-11.8	74	64.75	27.47	4.9	34.92	249	203	P	V
		2483.97	45.33	-8.67	54	47.88	27.47	4.9	34.92	249	203	A	V

802.11n HT20 CH 11 2462MHz	*	2462	116.42	-	-	119.04	27.43	4.9	34.95	227	231	P	H
	*	2462	107.88	-	-	110.5	27.43	4.9	34.95	227	231	A	H
		2486.88	68.4	-5.6	74	70.95	27.47	4.9	34.92	227	231	P	H
		2483.52	51.17	-2.83	54	53.72	27.47	4.9	34.92	227	231	A	H
	*	2462	108.97	-	-	111.59	27.43	4.9	34.95	150	185	P	V
	*	2462	100.6	-	-	103.22	27.43	4.9	34.95	150	185	A	V
		2483.6	61.9	-12.1	74	64.45	27.47	4.9	34.92	150	185	P	V
		2483.52	45.71	-8.29	54	48.26	27.47	4.9	34.92	150	185	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz

WIFI 802.11n HT20 (Harmonic @ 3m)

WIFI Ant. 1+2+3	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11n HT20 CH 01 2412MHz		4824	39.75	-34.25	74	58.61	32.56	6.97	58.39	250	0	P	H
		4824	39.62	-34.38	74	58.48	32.56	6.97	58.39	250	0	P	V
802.11n HT20 CH 06 2437MHz		4874	44.34	-29.66	74	63.35	32.66	6.99	58.66	250	0	P	H
		7311	49.52	-24.48	74	61.55	37.66	8.93	58.62	150	0	P	H
		4874	46.06	-27.94	74	65.07	32.66	6.99	58.66	250	0	P	V
		7311	50.62	-23.38	74	62.65	37.66	8.93	58.62	150	0	P	V
802.11n HT20 CH 11 2462MHz		4924	45.09	-28.91	74	63.85	32.76	7	58.52	250	0	P	H
		7386	45.52	-28.48	74	57.23	37.68	9.15	58.54	150	0	P	H
		4924	40.27	-33.73	74	59.03	32.76	7	58.52	250	0	P	V
		7386	47.94	-26.06	74	59.65	37.68	9.15	58.54	150	0	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz
WIFI 802.11n HT40 (Band Edge @ 3m)

WIFI Ant. 1+2+3	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11n HT40 CH 03 2422MHz		2388.12	65.99	-8.01	74	68.86	27.29	4.86	35.02	242	231	P	H
		2388.82	53.33	-0.67	54	56.2	27.29	4.86	35.02	242	231	P	H
	*	2422	109.67	-	-	112.4	27.36	4.88	34.97	242	231	P	H
	*	2422	99.83	-	-	102.56	27.36	4.88	34.97	242	231	A	H
		2499.51	52.06	-21.94	74	54.54	27.5	4.92	34.9	242	231	P	H
		2487.96	40.39	-13.61	54	42.91	27.5	4.9	34.92	242	231	A	H
		2386.86	73.31	-0.69	74	76.18	27.29	4.86	35.02	158	197	P	V
		2388.12	50.42	-3.58	54	53.29	27.29	4.86	35.02	158	197	A	V
	*	2422	103	-	-	105.73	27.36	4.88	34.97	158	197	P	V
	*	2422	94.61	-	-	97.34	27.36	4.88	34.97	158	197	A	V
		2484.53	59.45	-14.55	74	62	27.47	4.9	34.92	158	197	P	V
		2486.07	40.72	-13.28	54	43.27	27.47	4.9	34.92	158	197	A	V
802.11n HT40 CH 06 2437MHz		2386.44	66.03	-7.97	74	68.9	27.29	4.86	35.02	176	222	P	H
		2388.4	52.97	-1.03	54	55.84	27.29	4.86	35.02	176	222	A	H
	*	2437	112.11	-	-	114.8	27.4	4.88	34.97	176	222	P	H
	*	2437	103.52	-	-	106.21	27.4	4.88	34.97	176	222	A	H
		2484.25	65.73	-8.27	74	68.28	27.47	4.9	34.92	176	222	P	H
		2483.76	50.07	-3.93	54	52.62	27.47	4.9	34.92	176	222	A	H
		2388.4	64.35	-9.65	74	67.22	27.29	4.86	35.02	218	197	P	V
		2389.94	48.63	-5.37	54	51.48	27.29	4.86	35	218	197	A	V
	*	2437	107.49	-	-	110.18	27.4	4.88	34.97	218	197	P	V
	*	2437	98.98	-	-	101.67	27.4	4.88	34.97	218	197	A	V
		2483.62	68.44	-5.56	74	70.99	27.47	4.9	34.92	218	197	P	V
		2483.5	49.61	-4.39	54	52.16	27.47	4.9	34.92	218	197	A	V

802.11n HT40 CH 09 2452MHz		2389.52	58.12	-15.88	74	60.99	27.29	4.86	35.02	231	244	P	H
		2384.48	43.43	-10.57	54	46.33	27.26	4.86	35.02	231	244	A	H
	*	2452	110.38	-	-	113.03	27.4	4.9	34.95	231	244	P	H
	*	2452	100.83	-	-	103.48	27.4	4.9	34.95	231	244	A	H
		2488.8	72.81	-1.19	74	75.31	27.5	4.92	34.92	231	244	P	H
		2483.83	53.73	-0.27	54	56.28	27.47	4.9	34.92	231	244	A	H
		2389.24	50.31	-23.69	74	53.18	27.29	4.86	35.02	169	202	P	V
		2389.38	39.11	-14.89	54	41.98	27.29	4.86	35.02	169	202	A	V
	*	2452	104.87	-	-	107.52	27.4	4.9	34.95	169	202	P	V
	*	2452	96.35	-	-	99	27.4	4.9	34.95	169	202	A	V
		2483.97	68.32	-5.68	74	70.87	27.47	4.9	34.92	169	202	P	V
		2484.46	51.76	-2.24	54	54.31	27.47	4.9	34.92	169	202	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz

WIFI 802.11n HT40 (Harmonic @ 3m)

WIFI Ant. 1+2+3	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11n		4844	38.15	-35.85	74	58.59	31.07	6.97	58.48	250	0	P	H
HT40		7266	47.66	-26.34	74	61.33	35.91	8.95	58.53	150	0	P	H
CH 03		4844	38.32	-35.68	74	58.76	31.07	6.97	58.48	250	0	P	V
2422MHz		7266	46.25	-27.75	74	59.92	35.91	8.95	58.53	150	0	P	V
802.11n		4874	38.84	-35.16	74	57.85	32.66	6.99	58.66	250	0	P	H
HT40		7311	47.99	-26.01	74	60.02	37.66	8.93	58.62	150	0	P	H
CH 06		4874	39.28	-34.72	74	58.29	32.66	6.99	58.66	250	0	P	V
2437MHz		7311	47.61	-26.39	74	59.64	37.66	8.93	58.62	150	0	P	V
802.11n		4904	40.7	-33.3	74	59.61	32.73	7	58.64	250	0	P	H
HT40		7356	45.8	-28.2	74	57.66	37.67	9.04	58.57	150	0	P	H
CH 09		4904	40.14	-33.86	74	59.05	32.73	7	58.64	250	0	P	V
2452MHz		7356	45.87	-28.13	74	57.73	37.67	9.04	58.57	150	0	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz

WIFI 802.11ac VHT20 (Band Edge @ 3m)

WIFI Ant. 1+2+3	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11ac VHT20 CH 01 2412MHz		2388.65	66.11	-7.89	74	68.98	27.29	4.86	35.02	246	239	P	H
		2390	51.83	-2.17	54	54.68	27.29	4.86	35	246	239	A	H
	*	2412	114.14	-	-	116.93	27.33	4.88	35	246	239	P	H
	*	2412	107.79	-	-	110.58	27.33	4.88	35	246	239	A	H
		2389.70	62.45	-11.55	74	65.32	27.29	4.86	35.02	163	204	P	V
		2390	48.36	-5.64	54	51.21	27.29	4.86	35	163	204	A	V
	*	2412	105.45	-	-	108.24	27.33	4.88	35	163	204	P	V
	*	2412	97.93	-	-	100.72	27.33	4.88	35	163	204	A	V
802.11ac VHT20 CH 06 2437MHz		2389.1	65.3	-8.7	74	68.17	27.29	4.86	35.02	250	228	P	H
		2389.8	48.41	-5.59	54	51.26	27.29	4.86	35	250	228	A	H
	*	2437	121.31	-	-	124	27.4	4.88	34.97	250	228	P	H
	*	2437	113.71	-	-	116.4	27.4	4.88	34.97	250	228	A	H
		2487.82	64.7	-9.3	74	67.22	27.5	4.9	34.92	250	228	P	H
		2483.55	49.59	-4.41	54	52.14	27.47	4.9	34.92	250	228	A	H
		2386.86	59.34	-14.66	74	62.21	27.29	4.86	35.02	150	185	P	V
		2389.8	43.62	-10.38	54	46.47	27.29	4.86	35	150	185	A	V
	*	2437	114.25	-	-	116.94	27.4	4.88	34.97	150	185	P	V
	*	2437	107.12	-	-	109.81	27.4	4.88	34.97	150	185	A	V
		2492.72	58.17	-15.83	74	60.65	27.5	4.92	34.9	150	185	P	V
		2483.55	43.15	-10.85	54	45.7	27.47	4.9	34.92	150	185	A	V

802.11ac VHT20 CH 11 2462MHz	*	2462	114.09	-	-	116.71	27.43	4.9	34.95	192	251	P	H
	*	2462	106.05	-	-	108.67	27.43	4.9	34.95	192	251	A	H
		2483.56	65.9	-8.1	74	68.45	27.47	4.9	34.92	192	251	P	H
		2483.52	52.91	-1.09	54	55.46	27.47	4.9	34.92	192	251	A	H
	*	2462	108.24	-	-	110.86	27.43	4.9	34.95	190	170	P	V
	*	2462	99.96	-	-	102.58	27.43	4.9	34.95	190	170	A	V
		2483.64	65.94	-8.06	74	68.49	27.47	4.9	34.92	190	170	P	V
		2483.52	48.37	-5.63	54	50.85	27.54	4.9	34.92	190	170	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz

WIFI 802.11ac VHT20 (Harmonic @ 3m)

WIFI Ant. 1+2+3	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11ac VHT20 CH 01 2412MHz		4824	40.52	-33.48	74	59.38	32.56	6.97	58.39	250	0	P	H
		4824	40.89	-33.11	74	59.75	32.56	6.97	58.39	250	0	P	V
802.11ac VHT20 CH 06 2437MHz		4874	46.48	-27.52	74	65.49	32.66	6.99	58.66	250	0	P	H
		7311	50.37	-23.63	74	62.4	37.66	8.93	58.62	150	0	P	H
		4874	44.81	-29.19	74	63.82	32.66	6.99	58.66	250	0	P	V
		7311	55.26	-18.74	74	67.29	37.66	8.93	58.62	150	171	P	V
		7311	45.07	-8.93	54	57.1	37.66	8.93	58.62	150	171	A	V
802.11ac VHT20 CH 11 2462MHz		4824	38.15	-35.85	74	57.01	32.56	6.97	58.39	250	0	P	H
		7386	46.08	-27.92	74	57.79	37.68	9.15	58.54	150	0	P	H
		4824	38.13	-35.87	74	56.99	32.56	6.97	58.39	250	0	P	V
		7386	46.93	-27.07	74	58.64	37.68	9.15	58.54	150	0	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz
WIFI 802.11ac VHT40 (Band Edge @ 3m)

WIFI Ant. 1+2+3	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11ac VHT40 CH 03 2422MHz		2388.4	67.62	-6.38	74	70.49	27.29	4.86	35.02	151	243	P	H
		2388.68	52.85	-1.15	54	55.72	27.29	4.86	35.02	151	243	A	H
	*	2422	110.17	-	-	112.9	27.36	4.88	34.97	151	243	P	H
	*	2422	101.49	-	-	104.22	27.36	4.88	34.97	151	243	A	H
		2495.59	51.86	-22.14	74	54.34	27.5	4.92	34.9	151	243	P	H
		2485.72	40.33	-13.67	54	42.88	27.47	4.9	34.92	151	243	A	H
		2383.92	72.19	-1.81	74	75.09	27.26	4.86	35.02	159	195	P	V
		2389.52	48.78	-5.22	54	51.65	27.29	4.86	35.02	159	195	A	V
	*	2422	102.24	-	-	104.97	27.36	4.88	34.97	159	195	P	V
	*	2422	93.64	-	-	96.37	27.36	4.88	34.97	159	195	A	V
		2488.87	56.26	-17.74	74	58.76	27.5	4.92	34.92	159	195	P	V
		2485.51	40.17	-13.83	54	42.72	27.47	4.9	34.92	159	195	A	V
802.11ac VHT40 CH 06 2437MHz		2389.94	64.3	-9.7	74	67.15	27.29	4.86	35	190	243	P	H
		2388.82	53.22	-0.78	54	56.09	27.29	4.86	35.02	190	243	A	H
	*	2437	113.1	-	-	115.79	27.4	4.88	34.97	190	243	P	H
	*	2437	104.6	-	-	107.29	27.4	4.88	34.97	190	243	A	H
		2484.39	63.76	-10.24	74	66.31	27.47	4.9	34.92	190	243	P	H
		2483.69	51.41	-2.59	54	53.96	27.47	4.9	34.92	190	243	A	H
		2389.52	60.96	-13.04	74	63.83	27.29	4.86	35.02	150	268	P	V
		2389.94	45.51	-8.49	54	48.36	27.29	4.86	35	150	268	A	V
	*	2437	103.17	-	-	105.86	27.4	4.88	34.97	150	268	P	V
	*	2437	97.66	-	-	100.35	27.4	4.88	34.97	150	268	A	V
		2485.86	62.85	-11.15	74	65.4	27.47	4.9	34.92	150	268	P	V
		2483.83	44.25	-9.75	54	46.8	27.47	4.9	34.92	150	268	A	V

802.11ac VHT40 CH 09 2452MHz		2388.68	52.45	-21.55	74	55.32	27.29	4.86	35.02	167	245	P	H
		2389.52	41.01	-12.99	54	43.88	27.29	4.86	35.02	167	245	A	H
	*	2452	109.02	-	-	111.67	27.4	4.9	34.95	167	245	P	H
	*	2452	100.59	-	-	103.24	27.4	4.9	34.95	167	245	A	H
		2483.62	63.93	-10.07	74	66.48	27.47	4.9	34.92	167	245	P	H
		2483.83	53.18	-0.82	54	55.73	27.47	4.9	34.92	167	245	A	H
		2386.16	51.42	-22.58	74	54.29	27.29	4.86	35.02	234	168	P	V
		2388.96	38.93	-15.07	54	41.8	27.29	4.86	35.02	234	168	A	V
	*	2452	103.78	-	-	106.43	27.4	4.9	34.95	234	168	P	V
	*	2452	95.38	-	-	98.03	27.4	4.9	34.95	234	168	A	V
		2485.37	67.83	-6.17	74	70.38	27.47	4.9	34.92	234	168	P	V
		2483.48	48.94	-5.06	54	51.49	27.47	4.9	34.92	234	168	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												

2.4GHz 2400~2483.5MHz

WIFI 802.11ac VHT40 (Harmonic @ 3m)

WIFI Ant. 1+2+3	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11ac		4844	38.98	-35.02	74	57.9	32.59	6.97	58.48	250	0	P	H
VHT40		7266	46.47	-27.53	74	58.39	37.66	8.95	58.53	150	0	P	H
CH 03		4844	39.15	-34.85	74	58.07	32.59	6.97	58.48	250	0	P	V
2422MHz		7266	46.99	-27.01	74	58.91	37.66	8.95	58.53	150	0	P	V
802.11ac		4874	41.11	-32.89	74	60.12	32.66	6.99	58.66	250	0	P	H
VHT40		7311	46.45	-27.55	74	58.48	37.66	8.93	58.62	150	0	P	H
CH 06		4874	38.48	-35.52	74	57.49	32.66	6.99	58.66	250	0	P	V
2437MHz		7311	47.46	-26.54	74	59.49	37.66	8.93	58.62	150	0	P	V
802.11ac		4904	37.88	-36.12	74	56.79	32.73	7	58.64	250	0	P	H
VHT40		7356	46.19	-27.81	74	58.05	37.67	9.04	58.57	150	0	P	H
CH 09		4904	38.03	-35.97	74	56.94	32.73	7	58.64	250	0	P	V
2452MHz		7356	47.88	-26.12	74	59.74	37.67	9.04	58.57	150	0	P	V
Remark	3. No other spurious found. 4. All results are PASS against Peak and Average limit line.												

Emission below 1GHz

2.4GHz WIFI 802.11n HT40 (LF)

WIFI Ant. 1+2+3	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
2.4GHz 802.11n HT40 LF		31.94	31.74	-8.26	40	37.04	25.86	0.62	31.78	-	-	P	H
		77.53	33.65	-6.35	40	49.55	14.95	0.83	31.68	100	200	P	H
		164.83	34.5	-9	43.5	47.57	17.15	1.15	31.37	-	-	P	H
		486.87	34.98	-11.02	46	40.86	23.29	1.99	31.16	-	-	P	H
		688.63	31.32	-14.68	46	33.02	27.15	2.37	31.22	-	-	P	H
		874.87	34.5	-11.5	46	34.76	28.3	2.71	31.27	-	-	P	H
		33.88	38.46	-1.54	40	44.6	25.02	0.62	31.78	100	120	QP	V
		38.73	38.76	-1.24	40	46.98	22.92	0.62	31.76	100	156	QP	V
		51.34	38.03	-1.97	40	53.06	15.86	0.83	31.72	100	165	QP	V
		63.95	32.42	-7.58	40	50.41	12.88	0.83	31.7	100	0	QP	V
		80.44	35.08	-4.92	40	50.12	15.8	0.83	31.67	100	360	QP	V
		806	41.08	-4.92	46	42.25	27.48	2.59	31.24	-	-	P	V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												

Note symbol

*	**Fundamental Frequency** which can be ignored. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
!	Test result is **over limit** line.
P/A	**P**eak or **A**verage
H/V	**H**orizontal or **V**ertical

A calculation example for radiated spurious emission is shown as below:

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
1		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11b CH 01 2412MHz		2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	P	H
		2390	43.54	-10.46	54	42.6	32.22	4.58	35.86	103	308	A	H

1. Level(dBμV/m) =

Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

2. Over Limit(dB) = Level(dBμV/m) – Limit Line(dBμV/m)

For Peak Limit @ 2390MHz:

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

= 32.22(dB/m) + 4.58(dB) + 54.51(dBμV) – 35.86 (dB)

= 55.45 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 55.45(dBμV/m) – 74(dBμV/m)

= -18.55(dB)

For Average Limit @ 2390MHz:

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Cable Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

= 32.22(dB/m) + 4.58(dB) + 42.6(dBμV) – 35.86 (dB)

= 43.54 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 43.54(dBμV/m) – 54(dBμV/m)

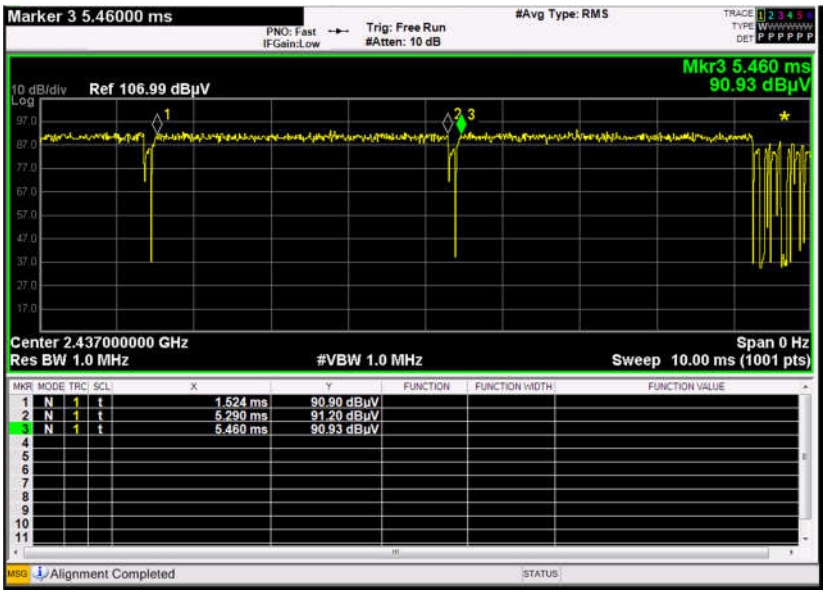
= -10.46(dB)

Both peak and average measured complies with the limit line, so test result is “PASS”.

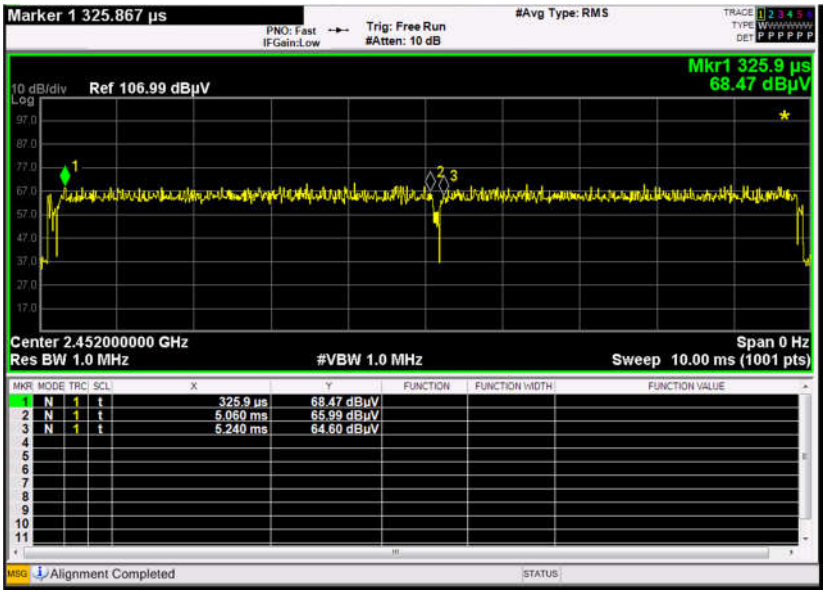
Appendix B. Duty Cycle Plots

Band	Duty Cycle(%)	T(ms)	1/T(kHz)	VBW Setting
2.4GHz 802.11n HT20	95.68	3.766	0.266	300Hz
2.4GHz 802.11n HT40	96.34	4.734	0.211	300Hz
2.4GHz 802.11ac VHT20	96.71	3.816	0.262	300Hz
2.4GHz 802.11ac VHT40	96.61	4.556	0.220	300Hz

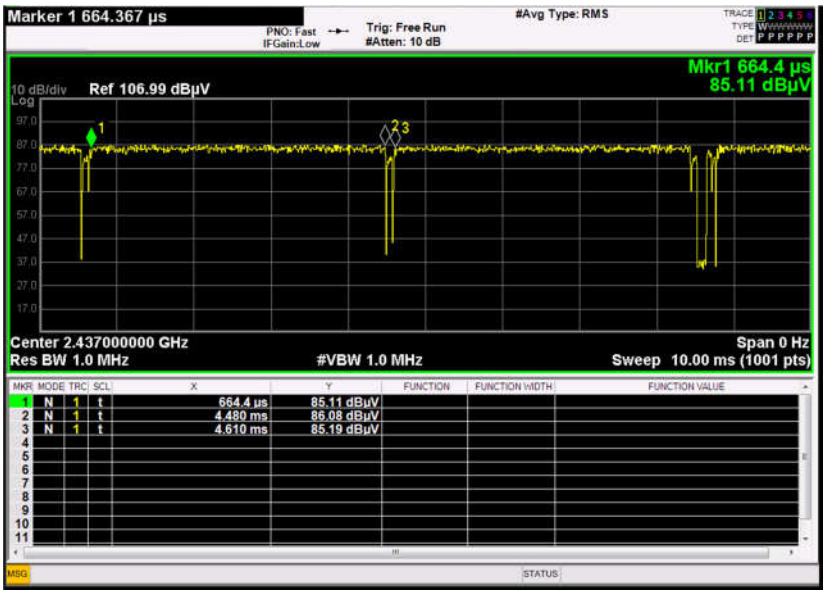
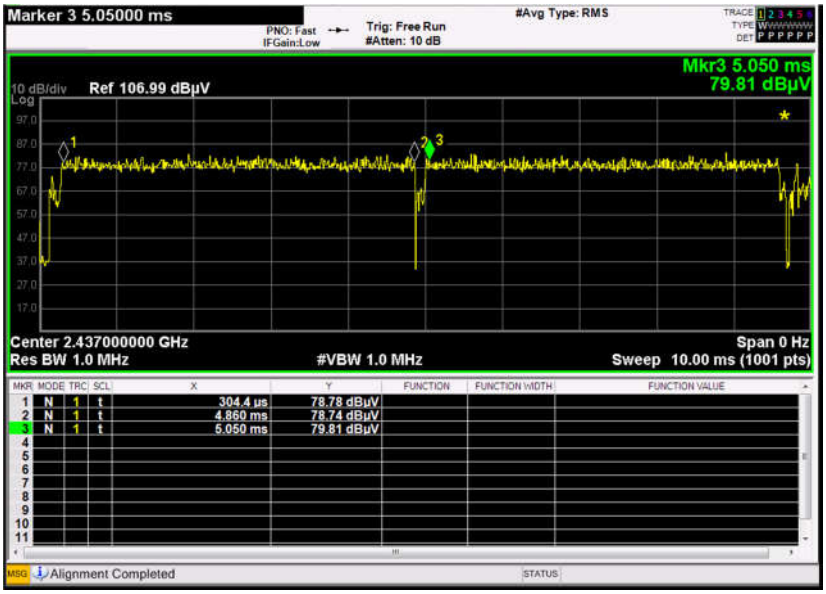
802.11n HT20



802.11n HT40



802.11ac VHT20



802.11ac VHT40