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FCC RADIO TEST REPORT

Applicant's company	**Roku, Inc.**
Applicant Address	150 Winchester Circle, Los Gatos, CA 95032
FCC ID	**TC2-N1002**
Manufacturer's company (1)	**Lite-On Network Communication (Dongguan) Limited**
Manufacturer Address	30#Keji Rd., Yin Hu Industrial Area, Qingxi Town, DongGuan City, Guangdong, China
Manufacturer's company (2)	**LITE-ON TECHNOLOGY (Changzhou) CO., LTD**
Manufacturer Address	A9 Building,No.88 Yanghu Road, Wujin Hi-Tech Industrial Development Zone ,Changzhou City, Jiangsu Province 213100 China

Product Name	2 x 2 Wi-Fi Module
Brand Name	Roku
Model No.	WM03, WM04
Test Rule Part(s)	47 CFR FCC Part 15 Subpart E § 15.407
Test Freq. Range	5150 ~ 5250 MHz / 5725 ~ 5850 MHz
Received Date	Jan. 20, 2014
Final Test Date	Jun. 06, 2016
Submission Type	Class II Change

Statement

Test result included is for the IEEE 802.11n and IEEE 802.11a of the product.

The test result in this report refers exclusively to the presented test model / sample.

Without written approval of SPORTON International Inc., the test report shall not be reproduced except in full.

The measurements and test results shown in this test report were made in accordance with the procedures and found in compliance with the limit given in **ANSI C63.10-2013**, **47 CFR FCC Part 15 Subpart E, KDB789033 D02 v01r02, KDB662911 D01 v02r01, ET Docket No. 13–49; FCC 16–24.**

The test equipment used to perform the test is calibrated and traceable to NML/ROC.

Testing Laboratory
1190

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History of This Test Report

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR412906-02AB	Rev. 01	Initial issue of report	Jul. 14, 2016

1. VERIFICATION OF COMPLIANCE

Product Name	:	2 x 2 Wi-Fi Module
Brand Name	:	Roku
Model No.	:	WM03, WM04
Applicant	:	Roku, Inc.
Test Rule Part(s)	:	47 CFR FCC Part 15 Subpart E § 15.407

Sporton International as requested by the applicant to evaluate the EMC performance of the product sample received on Jan. 20, 2014 would like to declare that the tested sample has been evaluated and found to be in compliance with the tested rule parts. The data recorded as well as the test configuration specified is true and accurate for showing the sample's EMC nature.

Sam Chen
SPORTON INTERNATIONAL INC.

2. SUMMARY OF THE TEST RESULT

Applied Standard: 47 CFR FCC Part 15 Subpart E			
Part	**Rule Section**	**Description of Test**	**Result**
4.1	15.407(a)	26dB Spectrum Bandwidth and 99% Occupied Bandwidth	Complies
4.2	15.407(e)	6dB Spectrum Bandwidth	Complies
4.3	15.407(a)	Maximum Conducted Output Power	Complies
4.4	15.407(a)	Power Spectral Density	Complies
4.5	15.407(b)	Radiated Emissions	Complies
4.6	15.407(b)	Band Edge Emissions	Complies
4.7	15.407(g)	Frequency Stability	Complies
4.8	15.203	Antenna Requirements	Complies

3. GENERAL INFORMATION

3.1. Product Details

Items	Description
Product Type	IEEE 802.11a: WLAN (1TX, 2RX) IEEE 802.11n: WLAN (2TX, 2RX)
Radio Type	Intentional Transceiver
Power Type	From host system
Modulation	IEEE 802.11a: OFDM IEEE 802.11n: see the below table
Data Modulation	IEEE 802.11a/n: OFDM (BPSK / QPSK / 16QAM / 64QAM)
Data Rate (Mbps)	IEEE 802.11a: OFDM (6/9/12/18/24/36/48/54) IEEE 802.11n: see the below table
Frequency Range	5150 ~ 5250 MHz / 5725 ~ 5850 MHz
Channel Number	9 for 20MHz bandwidth
Channel Band Width (99%)	IEEE 802.11a: 17.28 MHz IEEE 802.11n MCS0 (HT20): 18.06 MHz
Maximum Conducted Output Power	IEEE 802.11a: 18.88 dBm IEEE 802.11n MCS0 (HT20): 21.18 dBm
Carrier Frequencies	Please refer to section 3.4
Antenna	Please refer to section 3.3

Items	Description	
Communication Mode	☒ IP Based (Load Based)	☐ Frame Based
Beamforming Function	☐ With beamforming	☒ Without beamforming
Operate Condition	☒ Indoor	☐ Outdoor

Antenna and Band width

Antenna	Single (TX)	Two (TX)
Band width Mode	20 MHz	20 MHz
IEEE 802.11a	V	X
IEEE 802.11n	X	V

IEEE 11n Spec.

Protocol	Number of Transmit Chains (NTX)	Data Rate / MCS
802.11n (HT20)	2	MCS0-15
Note 1: IEEE Std. 802.11n modulation consists of HT20 (HT: High Throughput). Then EUT supports HT20. Note 2: Modulation modes consist of below configuration: HT20: IEEE 802.11n		

3.2. Accessories

N/A

3.3. Table for Filed Antenna

Ant.	Brand	Model Name	Antenna Type	Connector	Gain (dBi)		Cable length (mm)
					2.4GHz	5GHz	
1	LiteOn	3010000502XD	PIFA Antenna	I-PEX	3.53	3.43	300
2	LiteOn	30100005046D	PIFA Antenna	N/A	3.29	4.26	N/A
3	LiteOn	30100007416D	PIFA Antenna	I-PEX	1.93	3.42	300
4	LiteOn	3010000844HD	PIFA Antenna	I-PEX	3.50	3.10	300
5	LiteOn	30100007826D	PIFA Antenna	I-PEX	1.93	3.41	400
6	LiteOn	3010000845HD	PIFA Antenna	I-PEX	3.23	2.06	550

Note: The EUT has six antennas.

Because Ant.1 and Ant. 3 ~ Ant.6 are the same type antennas, only the higher gain antenna "Ant.1" was tested.

For 2.4GHz function:

For IEEE 802.11b/g mode (1TX/2RX)

Only Chain 1 can be used as transmitting antenna.

Chain 1 and Chain 2 could receive simultaneously.

For IEEE 802.11n mode (2TX/2RX)

Chain 1 and Chain 2 can be used as transmitting/receiving antenna.

Chain 1 and Chain 2 could transmit/receive simultaneously.

For 5GHz function:

For IEEE 802.11a mode (1TX/2RX)

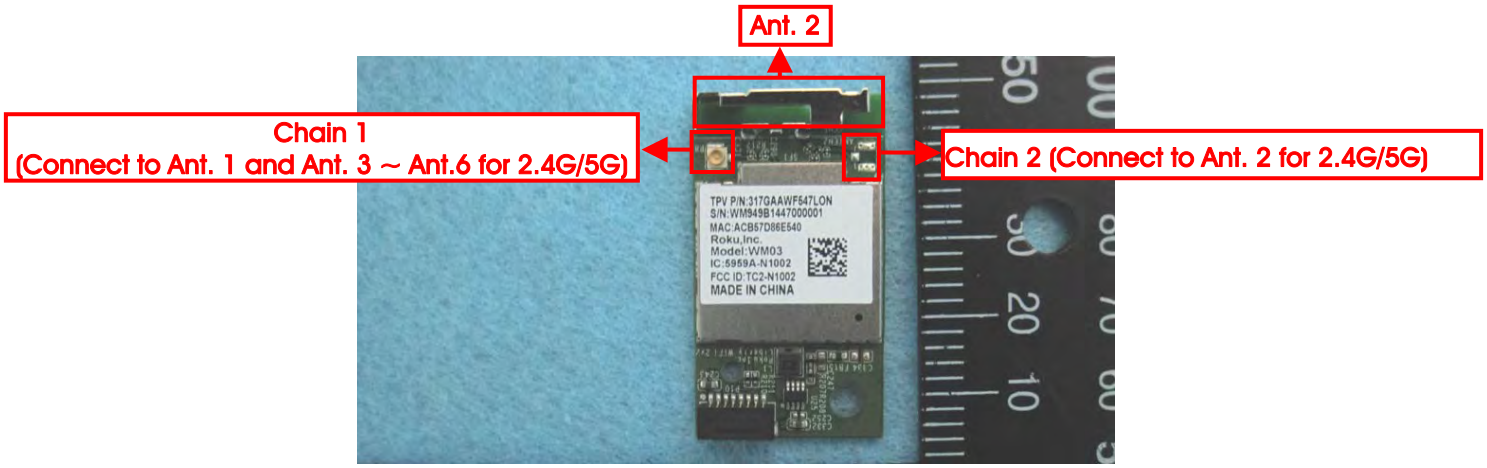
Only Chain 1 can be used as transmitting antenna.

Chain 1 and Chain 2 could receive simultaneously.

For IEEE 802.11n mode (2TX/2RX)

Chain 1 and Chain 2 can be used as transmitting/receiving antenna.

Chain 1 and Chain 2 could transmit/receive simultaneously.



3.4. Table for Carrier Frequencies

The EUT has one bandwidth system.

For 20MHz bandwidth systems, use Channel 36, 40, 44, 48, 149, 153, 157, 161, 165.

Frequency Band	Channel No.	Frequency	Channel No.	Frequency
5150~5250 MHz Band 1	36	5180 MHz	44	5220 MHz
	40	5200 MHz	48	5240 MHz
5725~5850 MHz Band 4	149	5745 MHz	161	5805 MHz
	153	5765 MHz	165	5825 MHz
	157	5785 MHz	-	-

3.5. Table for Test Modes

Preliminary tests were performed in different data rate to find the worst radiated emission. The data rate shown in the table below is the worst-case rate with respect to the specific test item. Investigation has been done on all the possible configurations for searching the worst cases. The following table is a list of the test modes shown in this test report.

Test Items	Mode		Data Rate	Channel	Chain
Max. Conducted Output Power	11a/BPSK	Band 4	6Mbps	149/157/165	1
	11n HT20	Band 4	MCS0	149/157/165	1+2
Power Spectral Density	11a/BPSK	Band 4	6Mbps	149/157/165	1
	11n HT20	Band 4	MCS0	149/157/165	1+2
26dB Spectrum Bandwidth & 99% Occupied Bandwidth Measurement	11a/BPSK	Band 4	6Mbps	149/157/165	1
	11n HT20	Band 4	MCS0	149/157/165	1+2
6dB Spectrum Bandwidth Measurement	11a/BPSK	Band 4	6Mbps	149/157/165	1
	11n HT20	Band 4	MCS0	149/157/165	1+2
Radiated Emission Below 1GHz	Normal Link		-	-	-
Radiated Emission Above 1GHz	11a/BPSK	Band 4	6Mbps	149/157/165	1
	11n HT20	Band 4	MCS0	149/157/165	1+2
Band Edge Emission	11a/BPSK	Band 4	6Mbps	149/157/165	1
	11n HT20	Band 4	MCS0	149/157/165	1+2
Frequency Stability	20 MHz	Band 4	-	40/157	1

The following test modes were performed for all tests:

For Radiated Emission test<Below 1GHz>:

Test Mode 1. EUT 2 in Y axis - Normal Link- 2.4G

Test Mode 2. EUT 2 in Z axis - Normal Link- 2.4G

Mode 2 has been evaluated to be the worst case between Mode 1~2, thus measurement for Mode 3 will follow this same test mode.

Test Mode 3. EUT 2 in Z axis - Normal Link- 5G

Mode 3 has been evaluated to be the worst case among Mode 1~3, thus measurement for Mode 4 will follow this same test mode.

Test Mode 4. EUT 3 in Z axis - Normal Link- 2.4G

Mode 2 generated the worst test result, so it was recorded in this report.

For Radiated Emission test<Above 1GHz>:

The EUT was performed at Y axis and Z axis position for Radiated emission above 1GHz test, and the worst case was found at Z axis. So the measurement will follow this same test configuration.

Test Mode: CTX - Place EUT 2 in Z axis

3.6. Table for Testing Locations

Test Site Location					
Address:	No.8, Lane 724, Bo-ai St., Jhubei City, Hsinchu County 302, Taiwan, R.O.C.				
TEL:	886-3-656-9065				
FAX:	886-3-656-9085				
Test Site No.	**Site Category**	**Location**	**FCC Designation No.**	**IC File No.**	**VCCI Reg. No**
03CH01-CB	SAC	Hsin Chu	TW0006	IC 4086D	-
TH01-CB	OVEN Room	Hsin Chu	-	-	-

Open Area Test Site (OATS); Semi Anechoic Chamber (SAC).

3.7. Table for Multiple Listing

The model names in the following table are all refer to the identical product.

Brand Name	EUT	Model Name	SKU	Metal Ring	Photo
Roku	EUT 1	WM03	6Pin connector	V	
	EUT 2		8Pin connector	V	
	EUT 3	WM04	6Pin connector	X	

From the above EUT 2 and EUT 3 was selected as representative model for the test and its data was recorded in this report.

3.8. Table for Class II Change

This product is an extension of original one reported under Sporton project number: FR412906AA and FR412906AB

Below is the table for the change of the product with respect to the original one.

Modifications	Performance Checking
Updating Manufacturer Name and Address. Adding four same type antennas with lower gain (model: 30100007416D, 3010000844HD, 30100007826D and 3010000845HD). Removing Chain 2 connector. Adding a latch connector for model: WM03 (8pin) /WM04.	Do not effect the test results.
Adding P10 second source for S1015-08RVB-SB3-KH for model: WM03/WM04. Adding the components R195, TP32 for model: WM03. Removing the components from R209, R200 for model: WM03. Adding 8Pin connector for model: WM03.	Radiated Emission Below 1GHz
Updating 5GHz Band 1 to “New Rules” from “Old Rules”.	After evaluating, it's not necessary to re-test all test items for 5GHz Band 1 updating to "New Rules" due to the same power as original filing.
Updating test rule of 5GHz band 4 to “15.407 (b)(4)(i) of New Rules (ET Docket No. 13–49; FCC 16–24)” from “Old Rules”.	26dB Spectrum Bandwidth and 99% Occupied Bandwidth. 6dB Spectrum Bandwidth. Maximum Conducted Output Power. Power Spectral Density. Radiated Emissions Above 1GHz. Band Edge Emissions. Frequency Stability.

3.9. Table for Supporting Units

For Test Site No: 03CH01-CB <Below 1GHz>

Support Unit	Brand	Model	FCC ID
Notebook	DELL	E4300	DoC
Fixture	Liteon	TB006	N/A
Mouse	Logitech	M-U0026	DoC
Earphone	SHYARO CHI	MIC-04	N/A
WLAN AP	D-LINK	DIR860L	KA2IR860LA1

For Test Site No: TH01-CB and 03CH01-CB <Above 1GHz>

Support Unit	Brand	Model	FCC ID
Notebook	DELL	E4300	DoC
Fixture	Liteon	TB006_USB_3.3V	N/A

3.10. Table for Parameters of Test Software Setting

During testing, Channel and Power Controlling Software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product.

Test Software Version	Mtool_2.0.0.3		
Mode	Test Frequency (MHz)		
	NCB: 20MHz		
	5745 MHz	5785 MHz	5825 MHz
802.11a	74	74	74
802.11n MCS0 HT20	74	74	74

3.11. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

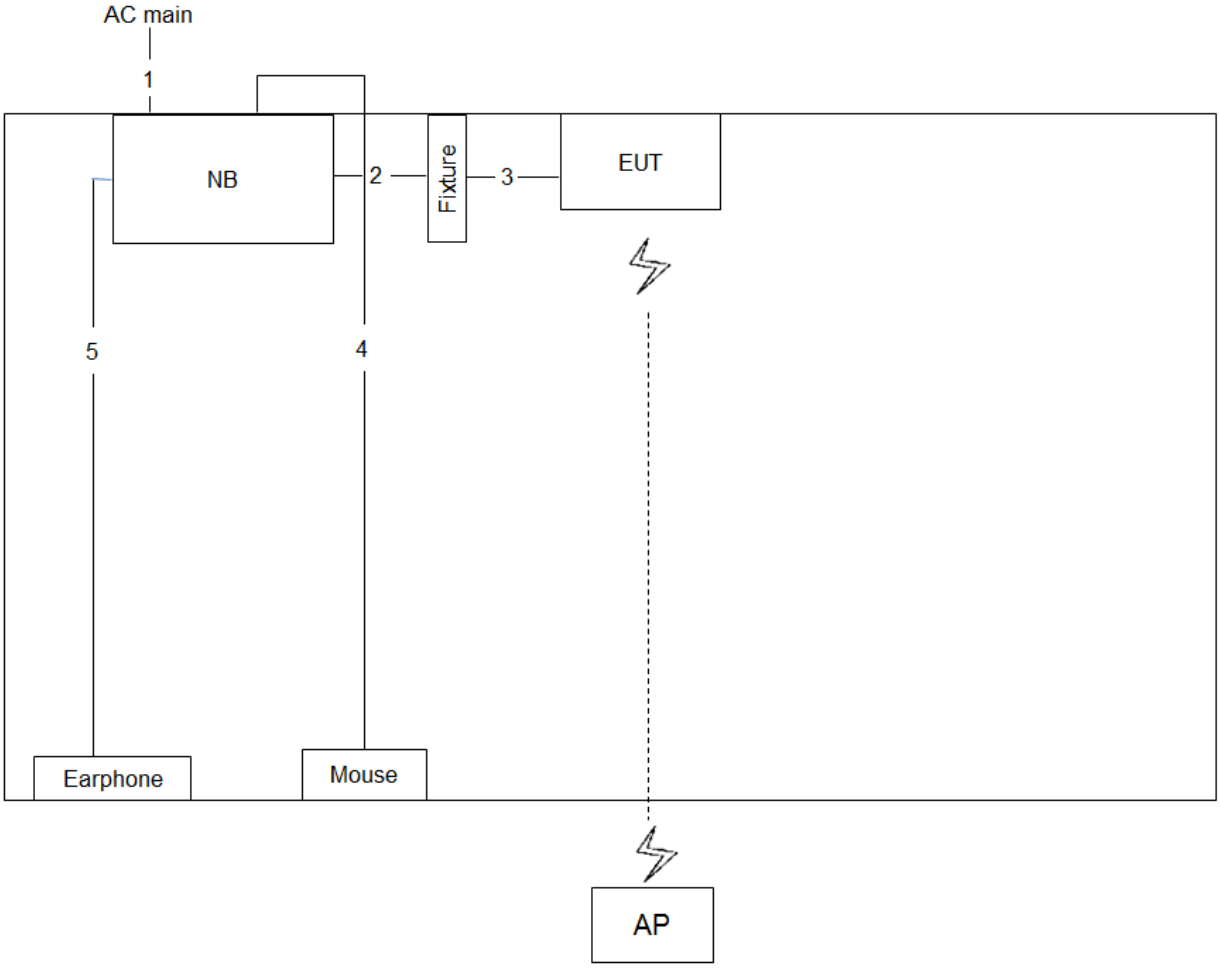
3.12. Duty Cycle

Mode	On Time (ms)	On+Off Time (ms)	Duty Cycle (%)	Duty Factor (dB)	1/T Minimum VBW (kHz)
802.11a	2.070	2.090	99.04%	0.04	0.01
802.11n MCS0 HT20	1.910	1.930	98.96%	0.05	0.01

3.13. Test Configurations

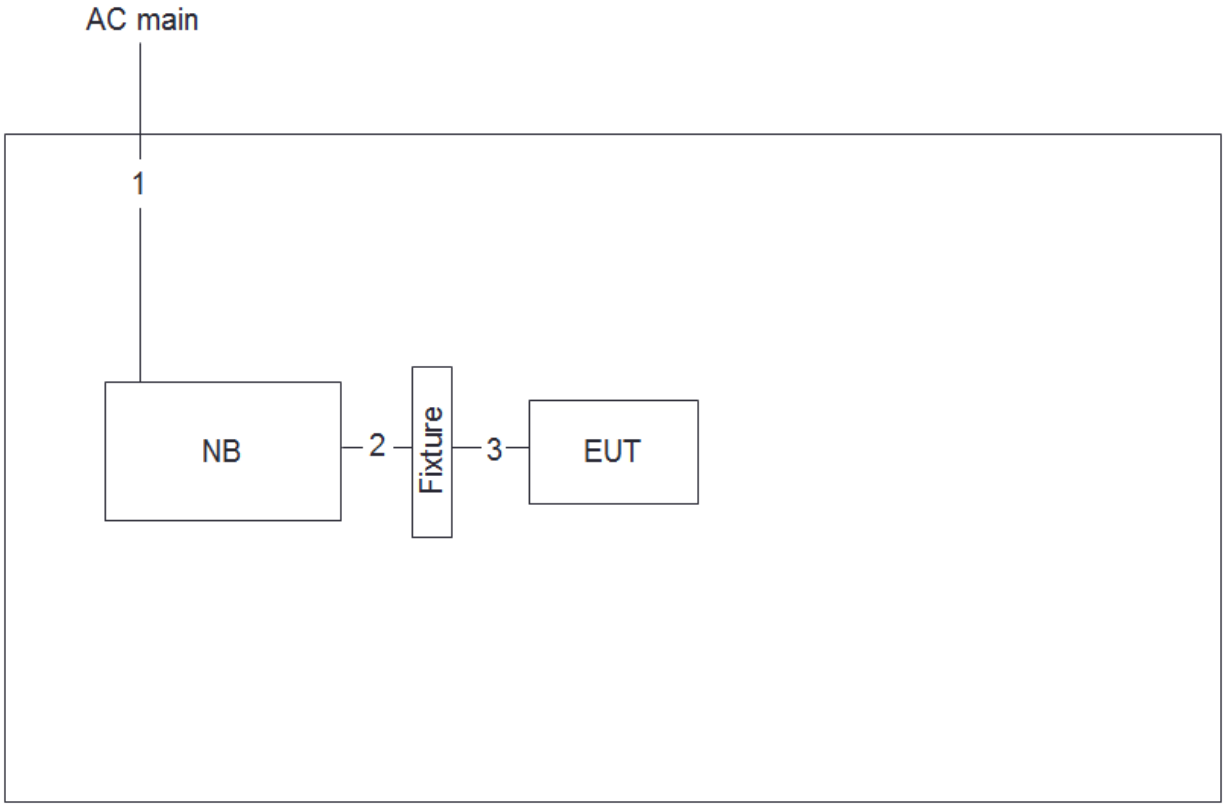
3.13.1. Radiation Emissions Test Configuration

Test Configuration: 30MHz ~1GHz



Item	Connection	Shielded	Length
1	AC Power cable	No	2.6m
2	USB cable	Yes	0.2m
3	8Pin cable	No	0.13m
4	USB cable	Yes	1.8m
5	Audio cable	No	1.1m

Test Configuration: above 1GHz



Item	Connection	Shielded	Length
1	AC Power cable	No	2.6m
2	USB cable	Yes	0.2m
3	8Pin cable	No	0.13m

4. TEST RESULT

4.1. 26dB Bandwidth and 99% Occupied Bandwidth Measurement

4.1.1. Limit

No restriction limits.

4.1.2. Measuring Instruments and Setting

Please refer to section 5 of equipments list in this report. The following table is the setting of the spectrum analyzer.

26dB Bandwidth	
Spectrum Parameters	**Setting**
Attenuation	Auto
Span Frequency	> 26dB Bandwidth
RBW	Approximately 1% of the emission bandwidth
VBW	VBW > RBW
Detector	Peak
Trace	Max Hold
Sweep Time	Auto
99% Occupied Bandwidth	
Spectrum Parameters	**Setting**
Span	1.5 times to 5.0 times the OBW
RBW	1 % to 5 % of the OBW
VBW	≥ 3 x RBW
Detector	Peak
Trace	Max Hold

4.1.3. Test Procedures

For Radiated 26dB Bandwidth and 99% Occupied Bandwidth Measurement:

1. The transmitter was radiated to the spectrum analyzer in peak hold mode.
2. 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%.

4.1.4. Test Setup Layout

For Radiated 26dB Bandwidth and 99% Occupied Bandwidth Measurement:

This test setup layout is the same as that shown in section 4.5.4.

4.1.5. Test Deviation

There is no deviation with the original standard.

4.1.6. EUT Operation during Test

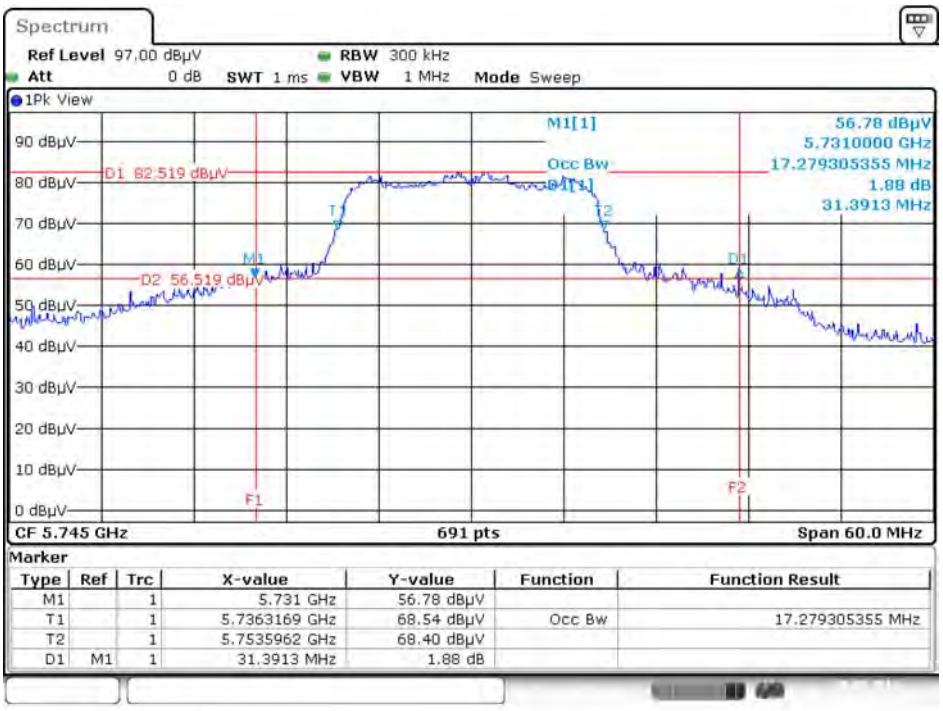
The EUT was programmed to be in continuously transmitting mode.

4.1.7. Test Result of 26dB Bandwidth and 99% Occupied Bandwidth

Temperature	24°C	Humidity	60%
Test Engineer	Clemens Fang		

Mode	Frequency	26dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)
802.11a	5745 MHz	31.39	17.28
	5785 MHz	24.52	16.93
	5825 MHz	29.48	17.02
802.11n MCS0 HT20	5745 MHz	33.13	18.06
	5785 MHz	30.26	17.63
	5825 MHz	28.43	18.06

26dB Bandwidth and 99% Occupied Bandwidth Plot on Configuration IEEE 802.11a / Chain 1 / 5745 MHz



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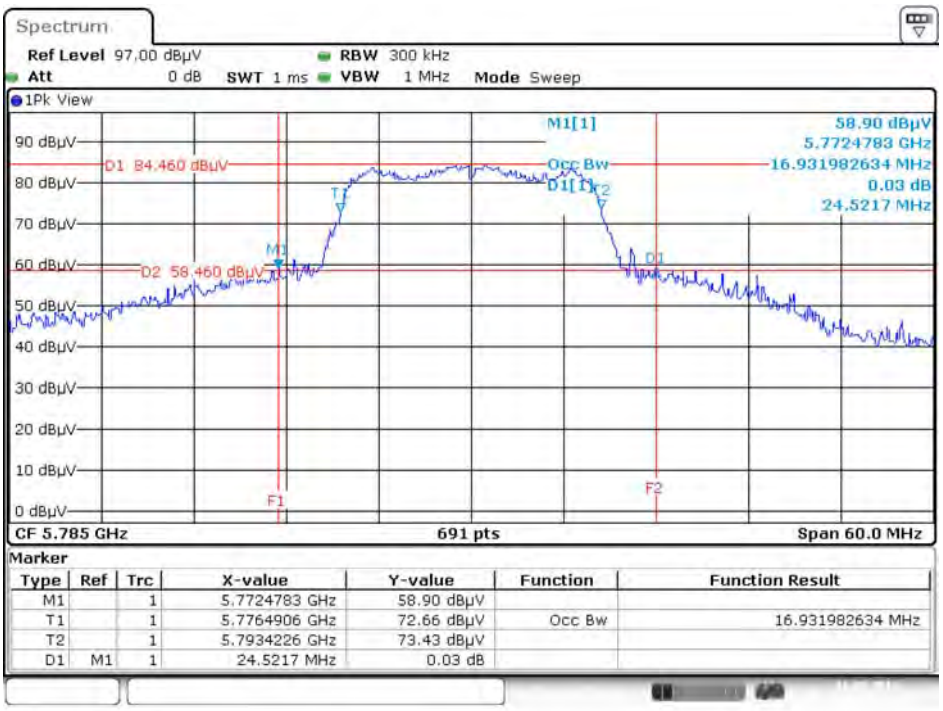
26dB Bandwidth and 99% Occupied Bandwidth Plot on Configuration IEEE 802.11a / Chain 1 / 5785 MHz



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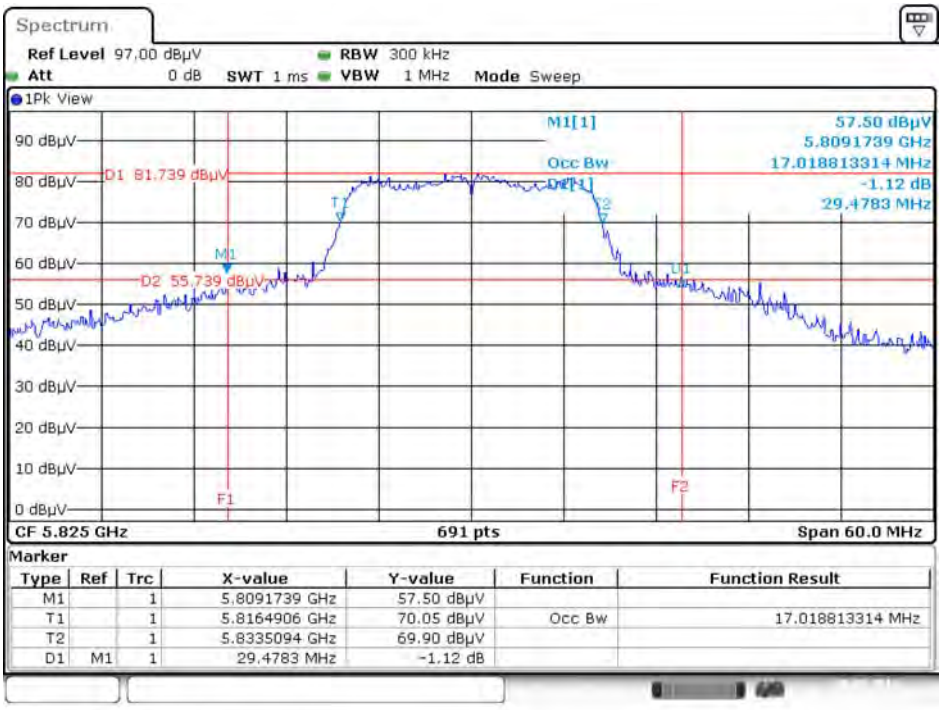
26dB Bandwidth and 99% Occupied Bandwidth Plot on Configuration IEEE 802.11a / Chain 1 / 5825 MHz



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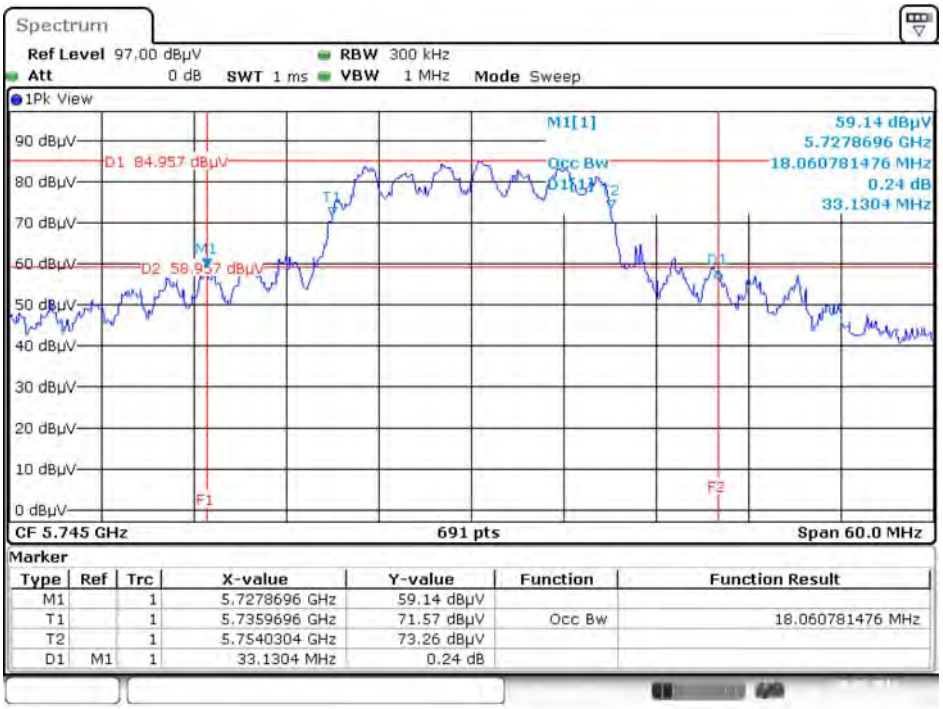
26dB Bandwidth and 99% Occupied Bandwidth Plot on Configuration IEEE 802.11n MCS0 HT20 / Chain 1 + Chain 2 / 5745 MHz



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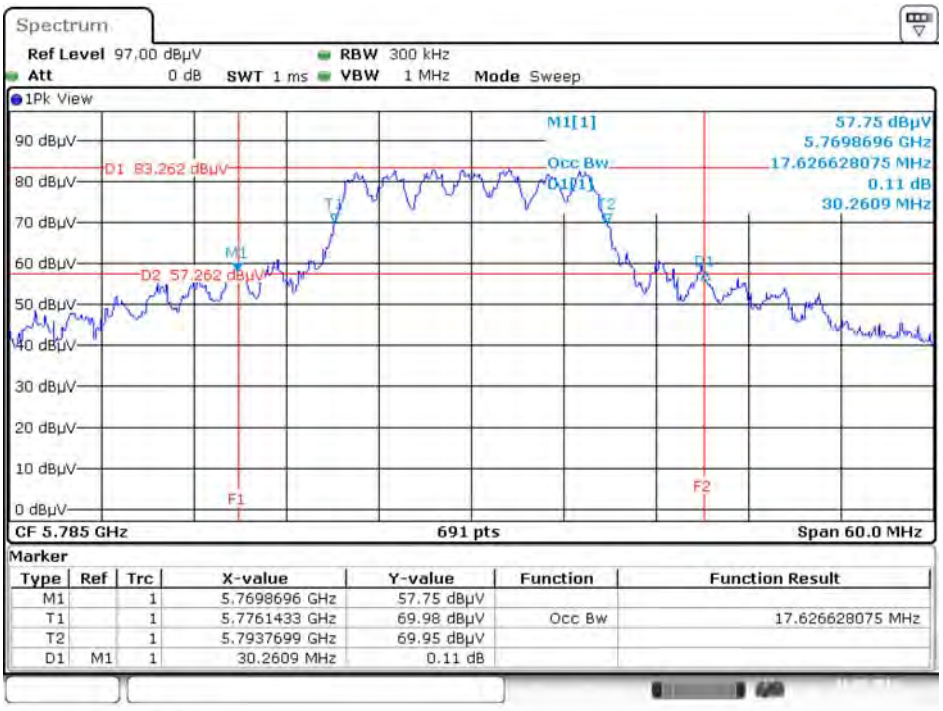
26dB Bandwidth and 99% Occupied Bandwidth Plot on Configuration IEEE 802.11n MCS0 HT20 / Chain 1 + Chain 2 / 5785 MHz



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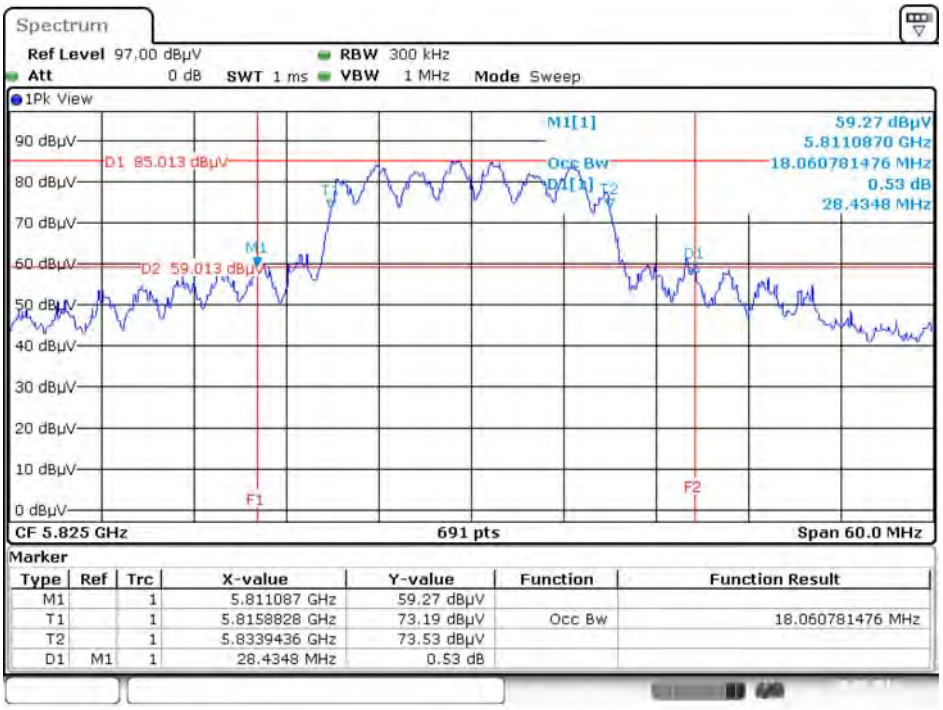
26dB Bandwidth and 99% Occupied Bandwidth Plot on Configuration IEEE 802.11n MCS0 HT20 / Chain 1 + Chain 2 / 5825 MHz



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4.2. 6dB Spectrum Bandwidth Measurement

4.2.1. Limit

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

4.2.2. Measuring Instruments and Setting

Please refer to section 5 of equipments list in this report. The following table is the setting of spectrum analyzer.

6dB Spectrum Bandwidth	
Spectrum Parameters	**Setting**
Attenuation	Auto
Span Frequency	> 6dB Bandwidth
RBW	100kHz
VBW	≥ 3 x RBW
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

4.2.3. Test Procedures

For Radiated 6dB Bandwidth Measurement:

1. The transmitter was radiated to the spectrum analyzer in peak hold mode.
2. Test was performed in accordance with KDB789033 D02 v01r02 for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices - section (C) Emission Bandwidth.
3. Multiple antenna system was performed in accordance with KDB662911 D01 v02r01 Emissions Testing of Transmitters with Multiple Outputs in the Same Band.
4. Measured the spectrum width with power higher than 6dB below carrier.

4.2.4. Test Setup Layout

For Radiated 6dB Bandwidth Measurement:

This test setup layout is the same as that shown in section 4.5.4.

4.2.5. Test Deviation

There is no deviation with the original standard.

4.2.6. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

4.2.7. Test Result of 6dB Spectrum Bandwidth

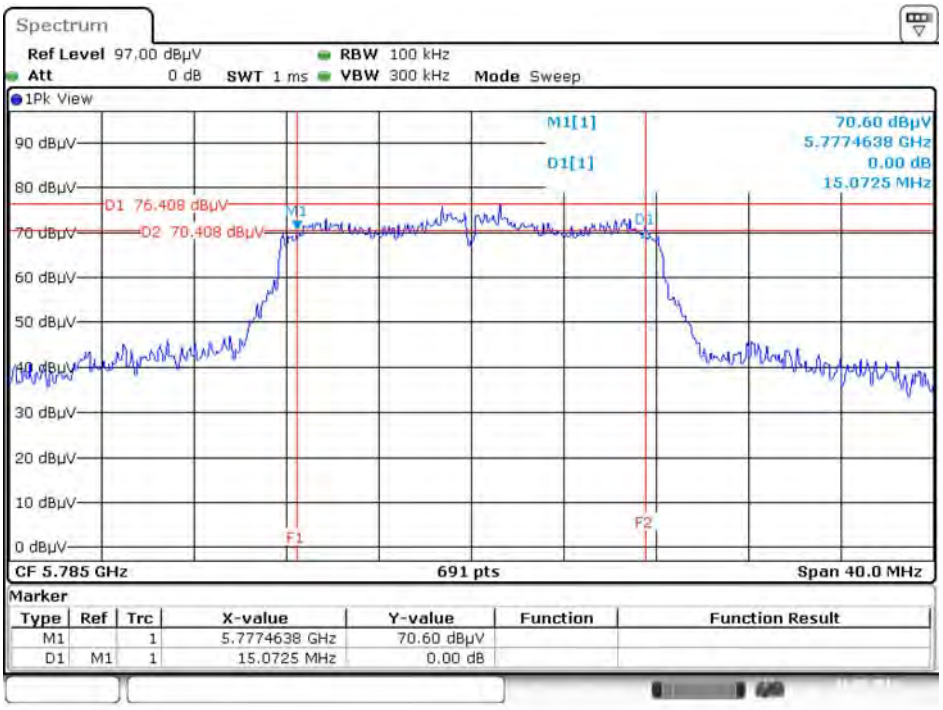
Temperature	24°C	Humidity	60%
Test Engineer	Clemens Fang		

Mode	Frequency	6dB Bandwidth (MHz)	Min. Limit (kHz)	Test Result
802.11a	5745 MHz	16.29	500	Complies
	5785 MHz	15.07	500	Complies
	5825 MHz	15.07	500	Complies
802.11n MCS0 HT20	5745 MHz	16.35	500	Complies
	5785 MHz	15.13	500	Complies
	5825 MHz	16.00	500	Complies

Note: All the test values were listed in the report.

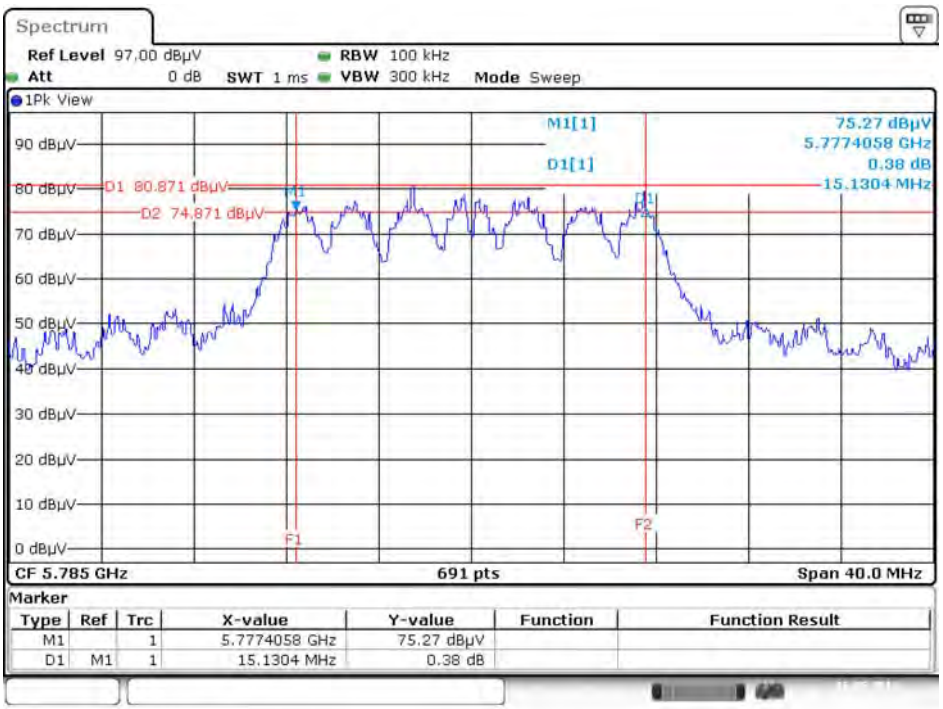
For plots, only the channel with worse result was shown.

6 dB Bandwidth Plot on Configuration IEEE 802.11a / Chain 1 / 5785 MHz



Date: 16.MAY.2016 17:19:48

6 dB Bandwidth Plot on Configuration IEEE 802.11n MCS0 HT20 / Chain 1 + Chain 2 / 5785 MHz



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4.3. Maximum Conducted Output Power Measurement

4.3.1. Limit

Frequency Band		Limit
☒	5.725~5.85 GHz	The maximum conducted output power over the frequency band of operation shall not exceed 1 W (30dBm). If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. However, fixed point-to-point U-NII devices operating in this band may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter conducted power.

4.3.2. Measuring Instruments and Setting

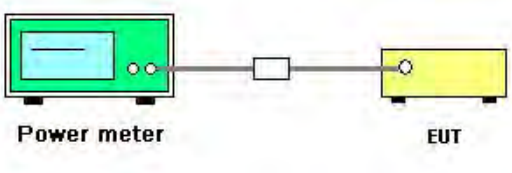
Please refer to section 5 of equipments list in this report. The following table is the setting of the power meter.

Power Meter Parameter	Setting
Bandwidth	50MHz bandwidth is greater than the EUT emission bandwidth
Detector	AVERAGE

4.3.3. Test Procedures

1. The transmitter output (antenna port) was connected to the power meter.
2. Test was performed in accordance with KDB789033 D02 v01r02 for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices - section (E) Maximum conducted output power =>3. Measurement using a Power Meter (PM) =>b) Method PM-G (Measurement using a gated RF average power meter).
3. Multiple antenna systems was performed in accordance with KDB662911 D01 v02r01 Emissions Testing of Transmitters with Multiple Outputs in the Same Band.
4. When measuring maximum conducted output power with multiple antenna systems,add every result of the values by mathematic formula.

4.3.4. Test Setup Layout



4.3.5. Test Deviation

There is no deviation with the original standard.

4.3.6. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

4.3.7. Test Result of Maximum Conducted Output Power

Temperature	24°C	Humidity	60%
Test Engineer	Clemens Fang	Test Date	May 16, 2016 ~ May 28, 2016

Mode	Frequency	Conducted Power (dBm)	Max. Limit (dBm)	Result
802.11a	5745 MHz	18.42	18.42	Complies
	5785 MHz	18.88	18.88	Complies
	5825 MHz	18.26	18.26	Complies

Mode	Frequency	Conducted Power (dBm)			Max. Limit (dBm)	Result
		Chain 1	Chain 2	Total		
802.11n MCS0 HT20	5745 MHz	17.69	16.46	20.13	30.00	Complies
	5785 MHz	18.46	17.85	21.18	30.00	Complies
	5825 MHz	17.56	16.42	20.04	30.00	Complies

4.4. Power Spectral Density Measurement

4.4.1. Limit

The following table is power spectral density limits and decrease power density limit rule refer to section 4.3.1.

Frequency Band		Limit
☒	5.725~5.85 GHz	30 dBm/500kHz

4.4.2. Measuring Instruments and Setting

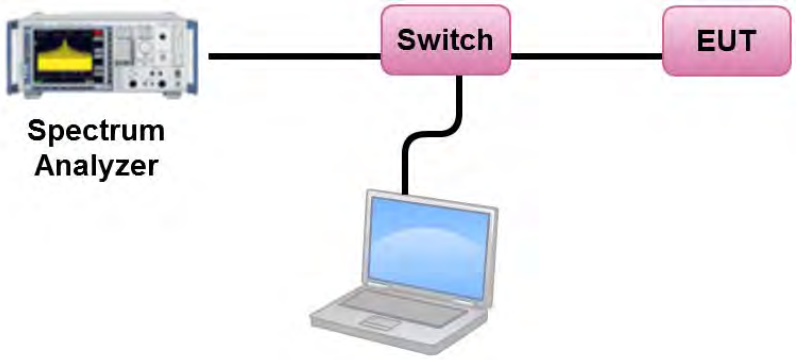
Please refer to section 5 of equipments list in this report. The following table is the setting of the spectrum analyzer.

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	Encompass the entire emissions bandwidth (EBW) of the signal
RBW	1000 kHz
VBW	3000 kHz
Detector	RMS
Trace	AVERAGE
Sweep Time	Auto
Trace Average	100 times
Note: If measurement bandwidth of Maximum PSD is specified in 500 kHz, add 10log(500kHz/RBW) to the measured result, whereas RBW (< 500 kHz) is the reduced resolution bandwidth of the spectrum analyzer set during measurement.	

4.4.3. Test Procedures

1. The transmitter output (antenna port) was connected RF switch to the spectrum analyzer.
2. Test was performed in accordance with KDB789033 D02 v01r02 for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices - section (F) Maximum Power Spectral Density (PSD).
3. Multiple antenna systems was performed in accordance KDB662911 D01 v02r01 in-Band Power Spectral Density (PSD) Measurements and sum the spectra across the outputs.
4. For 5.725~5.85 GHz, the measured result of PSD level must add 10log(500kHz/RBW) and the final result should ≤ 30 dBm.

4.4.4. Test Setup Layout



4.4.5. Test Deviation

There is no deviation with the original standard.

4.4.6. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

4.4.7. Test Result of Power Spectral Density

Temperature	24°C	Humidity	60%
Test Engineer	Clemens Fang		

Configuration IEEE 802.11a / Chain 1

Channel	Frequency	Power Density (dBm/MHz)	10log(500kHz/RBW) Factor (dB)	Power Density (dBm/500kHz)	Power Density Limit (dBm/500kHz)	Result
149	5745 MHz	5.29	-3.01	2.28	30.00	Complies
157	5785 MHz	5.87	-3.01	2.86	30.00	Complies
165	5825 MHz	5.15	-3.01	2.14	30.00	Complies

Configuration IEEE 802.11n MCS0 HT20 / Chain 1 + Chain 2

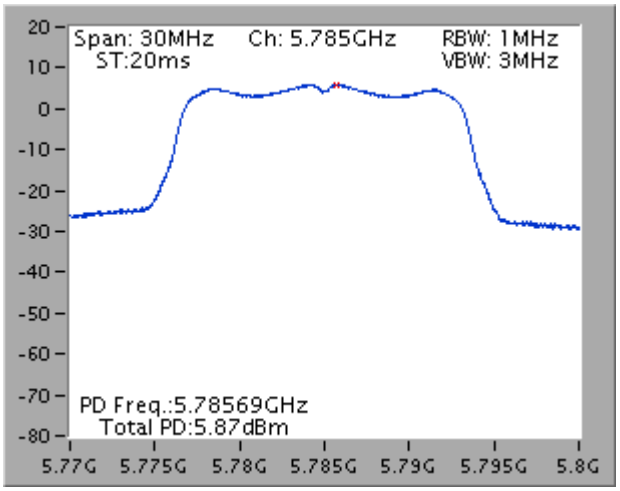
Channel	Frequency	Power Density (dBm/MHz)	10log(500kHz/RBW) Factor (dB)	Power Density (dBm/500kHz)	Power Density Limit (dBm/500kHz)	Result
149	5745 MHz	6.91	-3.01	3.90	29.12	Complies
157	5785 MHz	8.13	-3.01	5.12	29.12	Complies
165	5825 MHz	6.92	-3.01	3.91	29.12	Complies

Note: $DirectionalGain = 10 \cdot \log\left[\frac{\sum_{j=1}^{N_{SS}}\left\{\sum_{k=1}^{N_{ANT}} g_{j,k}\right\}^2}{N_{ANT}}\right]$ =6.88 dBi, so limit=30-(6.88-6)=29.12 dBm/500kHz.

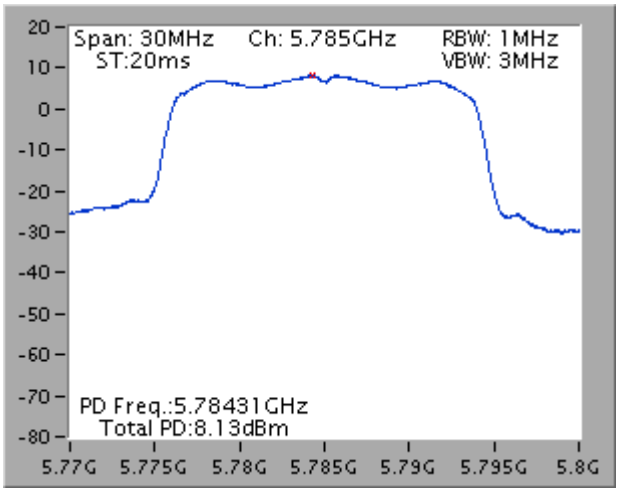
Note: All the test values were listed in the report.

For plots, only the channel with worse result was shown.

Power Density Plot on Configuration IEEE 802.11a / Chain 1 / 5785 MHz



Power Density Plot on Configuration IEEE 802.11n MCS0 HT20 / Chain 1 + Chain 2 / 5785 MHz



4.5. Radiated Emissions Measurement

4.5.1. Limit

For transmitters operating in the 5.725-5.85 GHz band: 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.

In addition, In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

Frequencies (MHz)	Field Strength (micorvolts/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

4.5.2. Measuring Instruments and Setting

Please refer to section 5 of equipments list in this report. The following table is the setting of spectrum analyzer and receiver.

Spectrum Parameter	Setting
Attenuation	Auto
Start Frequency	1000 MHz
Stop Frequency	40 GHz
RBW / VBW (Emission in restricted band)	1MHz / 3MHz for Peak, 1MHz / 1/T for Average
RBW / VBW (Emission in non-restricted band)	1MHz / 3MHz for peak

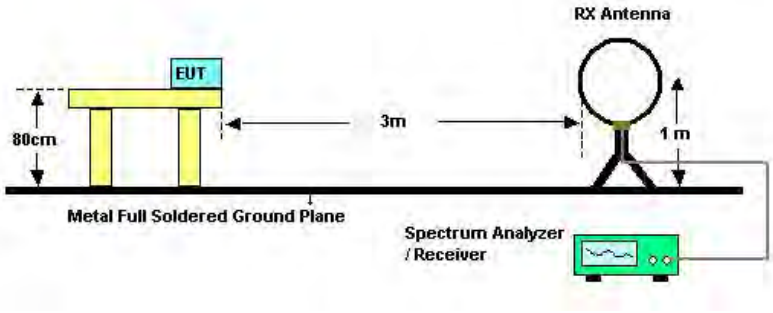
Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9kHz~150kHz / RBW 200Hz for QP
Start ~ Stop Frequency	150kHz~30MHz / RBW 9kHz for QP
Start ~ Stop Frequency	30MHz~1000MHz / RBW 120kHz for QP

4.5.3. Test Procedures

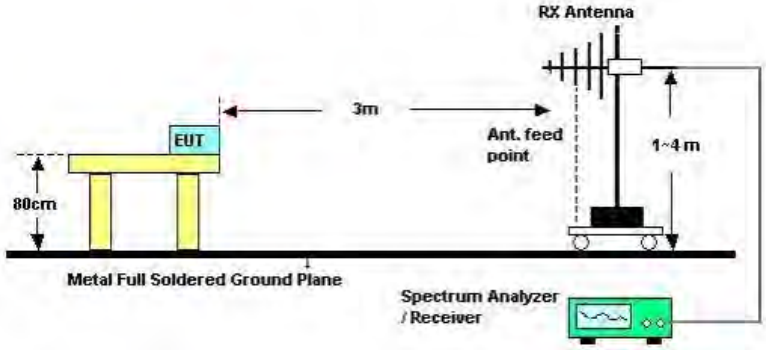
1. Configure the EUT according to ANSI C63.10. The EUT was placed on the top of the turntable 1.5 meter above ground. The phase center of the receiving antenna mounted on the top of a height-variable antenna tower was placed 1m & 3m far away from the turntable.
2. Power on the EUT and all the supporting units. The turntable was rotated by 360 degrees to determine the position of the highest radiation.
3. The height of the broadband receiving antenna was varied between one meter and four meters above ground to find the maximum emissions field strength of both horizontal and vertical polarization.
4. For each suspected emissions, the antenna tower was scan (from 1 M to 4 M) and then the turntable was rotated (from 0 degree to 360 degrees) to find the maximum reading.
5. Set the test-receiver system to Peak or CISPR quasi-peak Detect Function with specified bandwidth under Maximum Hold Mode.
6. For emissions above 1GHz, use 1MHz VBW and 3MHz RBW for peak reading. Then 1MHz RBW and 1/T VBW for average reading in spectrum analyzer.
7. If the emissions level of the EUT in peak mode was 3 dB lower than the average limit specified, then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions which do not have 3 dB margin will be repeated one by one using the quasi-peak method for below 1GHz.
8. For testing above 1GHz, the emissions level of the EUT in peak mode was lower than average limit (that means the emissions level in peak mode also complies with the limit in average mode), then testing will be stopped and peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
9. In case the emission is lower than 30MHz, loop antenna has to be used for measurement and the recorded data should be QP measured by receiver. High – Low scan is not required in this case.

4.5.4. Test Setup Layout

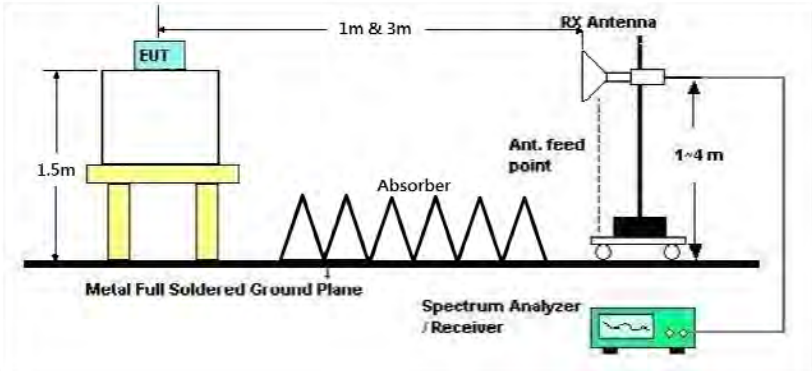
For Radiated Emissions: 9kHz ~30MHz



For Radiated Emissions: 30MHz~1GHz



For Radiated Emissions: Above 1GHz



4.5.5. Test Deviation

There is no deviation with the original standard.

4.5.6. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

4.5.7. Results of Radiated Emissions (9kHz~30MHz)

Temperature	24°C	Humidity	58%
Test Engineer	Peter Wu	Configurations	Normal Link
Test Date	Jun. 06, 2016		

Freq. (MHz)	Level (dBuV)	Over Limit (dB)	Limit Line (dBuV)	Remark
-	-	-	-	See Note

Note:

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

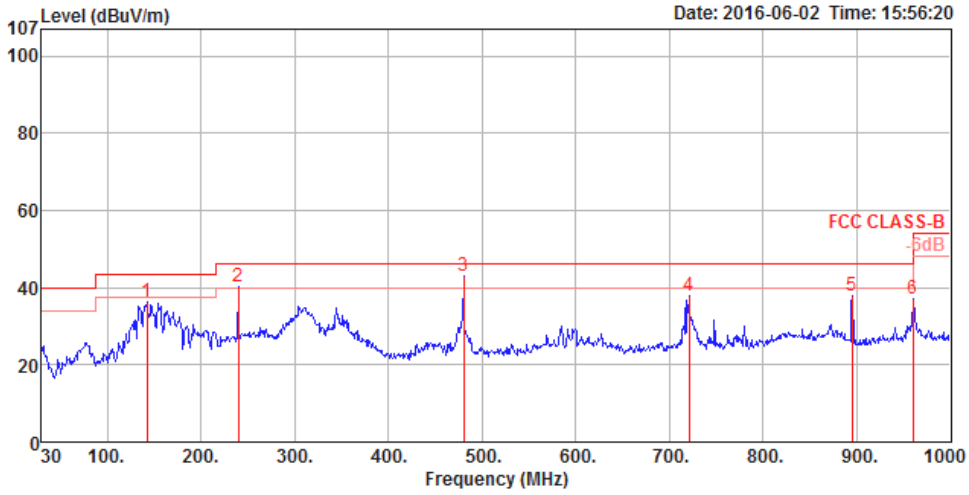
Distance extrapolation factor = 40 log (specific distance / test distance) (dB);

Limit line = specific limits (dBuV) + distance extrapolation factor.

4.5.8. Results of Radiated Emissions (30MHz~1GHz)

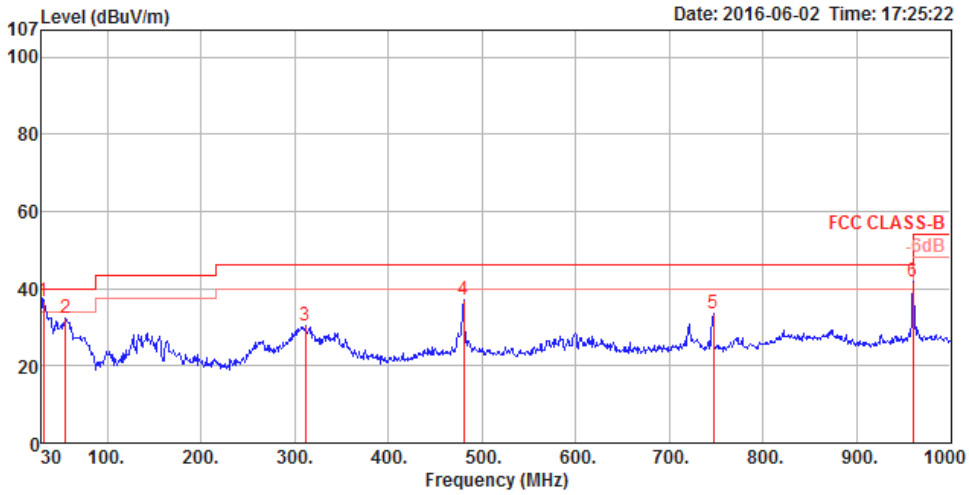
Temperature	24°C	Humidity	58%
Test Engineer	Peter Wu	Configurations	Normal Link

Horizontal



	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	142.52	36.16	43.50	-7.34	49.60	0.94	17.50	31.88	175	166	Peak	HORIZONTAL
2	239.52	40.45	46.00	-5.55	53.25	1.23	17.92	31.95	150	49	Peak	HORIZONTAL
3	480.08	42.95	46.00	-3.05	50.10	1.72	23.41	32.28	100	359	Peak	HORIZONTAL
4	720.64	37.84	46.00	-8.16	42.52	2.13	25.73	32.54	100	134	Peak	HORIZONTAL
5	895.24	37.99	46.00	-8.01	40.80	2.39	27.26	32.46	175	35	Peak	HORIZONTAL
6	960.23	37.16	54.00	-16.84	39.47	2.44	27.72	32.47	100	327	Peak	HORIZONTAL

Vertical



	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	32.06	36.75	40.00	-3.25	43.45	0.53	24.30	31.53	100	221	QP	VERTICAL
2	55.22	32.22	40.00	-7.78	49.76	0.61	13.62	31.77	100	217	Peak	VERTICAL
3	311.30	30.57	46.00	-15.43	41.26	1.39	19.94	32.02	200	299	Peak	VERTICAL
4	480.08	37.17	46.00	-8.83	44.32	1.72	23.41	32.28	300	141	Peak	VERTICAL
5	746.83	33.69	46.00	-12.31	38.11	2.18	25.98	32.58	300	113	Peak	VERTICAL
6	960.23	41.97	54.00	-12.03	44.28	2.44	27.72	32.47	100	0	Peak	VERTICAL

Note:

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

Emission level (dBuV/m) = 20 log Emission level (uV/m).

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

4.5.9. Results for Radiated Emissions (1GHz~40GHz)

Temperature	24°C	Humidity	58%
Test Engineer	Peter Wu	Configurations	IEEE 802.11a CH 149 / Chain 1
Test Date	May 17, 2016 ~ May 18, 2016		

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	11489.56	50.17	54.00	-3.83	36.39	10.51	39.20	35.93	105	290	Average	HORIZONTAL
2	11489.60	65.27	74.00	-8.73	51.49	10.51	39.20	35.93	105	290	Peak	HORIZONTAL

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	11489.08	50.80	54.00	-3.20	37.02	10.51	39.20	35.93	114	351	Average	VERTICAL
2	11490.76	64.05	74.00	-9.95	50.27	10.51	39.20	35.93	114	351	Peak	VERTICAL

Temperature	24°C	Humidity	58%
Test Engineer	Peter Wu	Configurations	IEEE 802.11a CH 157 / Chain 1
Test Date	May 17, 2016 ~ May 18, 2016		

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	11567.16	65.83	74.00	-8.17	52.09	10.51	39.15	35.92	100	45	Peak	HORIZONTAL
2	11568.68	50.99	54.00	-3.01	37.25	10.51	39.15	35.92	100	45	Average	HORIZONTAL

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	11569.40	51.12	54.00	-2.88	37.38	10.51	39.15	35.92	105	175	Average	VERTICAL
2	11569.60	66.38	74.00	-7.62	52.64	10.51	39.15	35.92	105	175	Peak	VERTICAL

Temperature	24°C	Humidity	58%
Test Engineer	Peter Wu	Configurations	IEEE 802.11a CH 165 / Chain 1
Test Date	May 17, 2016 ~ May 18, 2016		

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	11649.16	65.08	74.00	-8.92	51.39	10.51	39.09	35.91	100	46	Peak	HORIZONTAL
2	11649.44	50.47	54.00	-3.53	36.78	10.51	39.09	35.91	100	46	Average	HORIZONTAL

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	11648.52	64.80	74.00	-9.20	51.11	10.51	39.09	35.91	110	175	Peak	VERTICAL
2	11649.88	51.18	54.00	-2.82	37.49	10.51	39.09	35.91	110	175	Average	VERTICAL

Temperature	24°C	Humidity	58%
Test Engineer	Peter Wu	Configurations	IEEE 802.11n MCS0 HT20 CH 149 / Chain 1 + Chain 2
Test Date	May 17, 2016 ~ May 18, 2016		

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	11489.56	50.49	54.00	-3.51	36.71	10.51	39.20	35.93	100	87	Average	HORIZONTAL
2	11489.56	66.08	74.00	-7.92	52.30	10.51	39.20	35.93	100	87	Peak	HORIZONTAL

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	11489.36	68.15	74.00	-5.85	54.37	10.51	39.20	35.93	100	339	Peak	VERTICAL
2	11489.44	51.82	54.00	-2.18	38.04	10.51	39.20	35.93	100	339	Average	VERTICAL

Temperature	24°C	Humidity	58%
Test Engineer	Peter Wu	Configurations	IEEE 802.11n MCS0 HT20 CH 157 / Chain 1 + Chain 2
Test Date	May 17, 2016 ~ May 18, 2016		

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	11569.48	62.14	74.00	-11.86	48.40	10.51	39.15	35.92	100	87	Peak	HORIZONTAL
2	11570.76	46.94	54.00	-7.06	33.20	10.51	39.15	35.92	100	87	Average	HORIZONTAL

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	11569.52	49.78	54.00	-4.22	36.04	10.51	39.15	35.92	100	359	Average	VERTICAL
2	11569.60	63.48	74.00	-10.52	49.74	10.51	39.15	35.92	100	359	Peak	VERTICAL

Temperature	24°C	Humidity	58%
Test Engineer	Peter Wu	Configurations	IEEE 802.11n MCS0 HT20 CH 165 / Chain 1 + Chain 2
Test Date	May 17, 2016 ~ May 18, 2016		

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	11646.96	60.95	74.00	-13.05	47.26	10.51	39.09	35.91	100	85	Peak	HORIZONTAL
2	11648.20	46.53	54.00	-7.47	32.84	10.51	39.09	35.91	100	85	Average	HORIZONTAL

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	11644.56	63.10	74.00	-10.90	49.41	10.51	39.09	35.91	100	359	Peak	VERTICAL
2	11648.20	47.66	54.00	-6.34	33.97	10.51	39.09	35.91	100	359	Average	VERTICAL

Note:

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

Emission level (dBuV/m) = 20 log Emission level (uV/m).

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level.

4.6. Band Edge Emissions Measurement

4.6.1. Limit

For transmitters operating in the 5.725-5.85 GHz band: 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.

In addition, In case the emission fall within the restricted band specified on 15.205(a), then the 15.209(a) limit in the table below has to be followed.

Frequencies (MHz)	Field Strength (micorvolts/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

4.6.2. Measuring Instruments and Setting

Please refer to section 5 of equipments list in this report. The following table is the setting of the spectrum analyzer.

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	100 MHz
RBW / VBW (Emission in restricted band)	1MHz / 3MHz for Peak, 1MHz / 1/T for Average
RBW / VBW (Emission in non-restricted band)	1MHz / 3MHz for Peak

4.6.3. Test Procedures

The test procedure is the same as section 4.5.3.

4.6.4. Test Setup Layout

This test setup layout is the same as that shown in section 4.5.4.

4.6.5. Test Deviation

There is no deviation with the original standard.

4.6.6. EUT Operation during Test

The EUT was programmed to be in continuously transmitting mode.

4.6.7. Test Result of Band Edge and Fundamental Emissions

Temperature	24°C	Humidity	58%
Test Engineer	Peter Wu	Configurations	IEEE 802.11a CH 149, 157, 165 / Chain 1
Test Date	May 17, 2016 ~ May 18, 2016		

Channel 149

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	5572.00	61.11	68.20	-7.09	55.15	8.38	33.99	36.41	293	355	Peak	VERTICAL
2	5744.00	97.56			91.01	8.42	34.50	36.37	293	355	Average	VERTICAL
3	5746.00	106.92			100.36	8.42	34.50	36.36	293	355	Peak	VERTICAL
4	5961.00	60.78	68.20	-7.42	53.62	8.37	35.11	36.32	293	355	Peak	VERTICAL

Item 2, 3 are the fundamental frequency at 5745 MHz.

Channel 157

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	5603.00	61.08	68.20	-7.12	54.93	8.47	34.08	36.40	294	358	Peak	VERTICAL
2	5784.08	96.41			89.76	8.41	34.59	36.35	294	358	Average	VERTICAL
3	5785.00	106.22			99.57	8.41	34.59	36.35	294	358	Peak	VERTICAL
4	5957.00	60.64	68.20	-7.56	53.53	8.37	35.06	36.32	294	358	Peak	VERTICAL

Item 2, 3 are the fundamental frequency at 5785 MHz.

Channel 165

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	5646.00	60.71	68.20	-7.49	54.43	8.45	34.22	36.39	324	243	Peak	HORIZONTAL
2	5824.00	97.83			91.05	8.39	34.73	36.34	324	243	Average	HORIZONTAL
3	5824.00	108.46			101.68	8.39	34.73	36.34	324	243	Peak	HORIZONTAL
4	5962.00	61.00	68.20	-7.20	53.84	8.37	35.11	36.32	324	243	Peak	HORIZONTAL

Item 2, 3 are the fundamental frequency at 5825 MHz.

Temperature	24℃	Humidity	58%
Test Engineer	Peter Wu	Configurations	IEEE 802.11n MCS0 HT20 CH 149, 157, 165 / Chain 1 + Chain 2
Test Date	May 17, 2016 ~ May 18, 2016		

Channel 149

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	5642.00	59.84	68.20	-8.36	53.56	8.45	34.22	36.39	284	246	Peak	HORIZONTAL
2	5744.00	100.03			93.48	8.42	34.50	36.37	284	246	Average	HORIZONTAL
3	5745.00	109.58			103.03	8.42	34.50	36.37	284	246	Peak	HORIZONTAL
4	5934.00	60.39	68.20	-7.81	53.34	8.37	35.01	36.33	284	246	Peak	HORIZONTAL

Item 2, 3 are the fundamental frequency at 5745 MHz.

Channel 157

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	5599.00	60.74	68.20	-7.46	54.59	8.47	34.08	36.40	280	248	Peak	HORIZONTAL
2	5784.00	98.00			91.35	8.41	34.59	36.35	280	248	Average	HORIZONTAL
3	5784.00	107.70			101.05	8.41	34.59	36.35	280	248	Peak	HORIZONTAL
4	5928.00	60.70	68.20	-7.50	53.65	8.37	35.01	36.33	280	248	Peak	HORIZONTAL

Item 2, 3 are the fundamental frequency at 5785 MHz.

Channel 165

	Freq	Level	Limit Line	Over Limit	Read Level	Cable Loss	Antenna Factor	Preamp Factor	A/Pos	T/Pos	Remark	Pol/Phase
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB	dB/m	dB	cm	deg		
1	5618.00	61.13	68.20	-7.07	54.94	8.46	34.13	36.40	325	244	Peak	HORIZONTAL
2	5824.00	95.97			89.19	8.39	34.73	36.34	325	244	Average	HORIZONTAL
3	5826.00	106.55			99.77	8.39	34.73	36.34	325	244	Peak	HORIZONTAL
4	5929.00	61.01	68.20	-7.19	53.96	8.37	35.01	36.33	325	244	Peak	HORIZONTAL

Item 2, 3 are the fundamental frequency at 5825 MHz.

Note:

Emission level (dBuV/m) = 20 log Emission level (uV/m)

Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level

4.7. Frequency Stability Measurement

4.7.1. Limit

In-band emission is maintained within the band of operation under all conditions of normal operation as specified in the user's manual.

The transmitter center frequency tolerance shall be ± 20 ppm maximum for the 5 GHz band (IEEE 802.11n specification).

4.7.2. Measuring Instruments and Setting

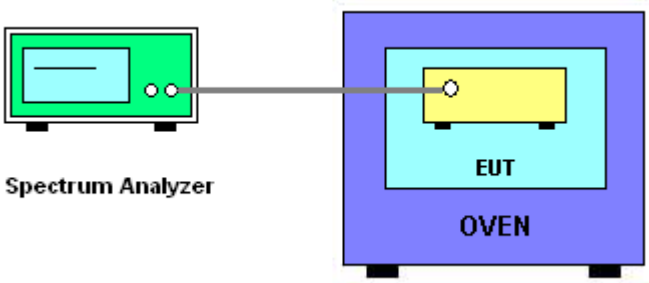
Please refer to section 5 of equipments list in this report. The following table is the setting of the spectrum analyzer.

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	Entire absence of modulation emissions bandwidth
RBW	10 kHz
VBW	10 kHz
Sweep Time	Auto

4.7.3. Test Procedures

1. The transmitter output (antenna port) was connected to the spectrum analyzer.
2. EUT have transmitted absence of modulation signal and fixed channelize.
3. Set the spectrum analyzer span to view the entire absence of modulation emissions bandwidth.
4. Set RBW = 10 kHz, VBW = 10 kHz with peak detector and maxhold settings.
5. fc is declaring of channel frequency. Then the frequency error formula is (fc-f)/fc × 10^6 ppm and the limit is less than ±20ppm (IEEE 802.11nspecification).
6. Allow sufficient time (approximately 30 min) for the temperature of the chamber to stabilize, turn the EUT on and measure the operating frequency after 2, 5, and 10 minutes.
7. The test extreme voltage is to change the primary supply voltage from 85 to 115 percent of the nominal value
8. Extreme temperature is -30°C~50°C.

4.7.4. Test Setup Layout



4.7.5. Test Deviation

There is no deviation with the original standard.

4.7.6. EUT Operation during Test

The EUT was programmed to be in continuously un-modulation transmitting mode.

4.7.7. Test Result of Frequency Stability

Temperature	24°C	Humidity	60%
Test Engineer	Clemens Fang	Test Date	May 16, 2016 ~ May 28, 2016

Mode: 20 MHz / Chain 1

Voltage vs. Frequency Stability

Voltage	Measurement Frequency (MHz)			
(V)	5785 MHz			
	0 Minute	2 Minute	5 Minute	10 Minute
126.50	5784.9591	5784.9580	5784.9565	5784.9545
110.00	5784.9579	5784.9566	5784.9550	5784.9531
93.50	5784.9565	5784.9556	5784.9542	5784.9524
Max. Deviation (MHz)	0.0435	0.0444	0.0458	0.0476
Max. Deviation (ppm)	7.52	7.68	7.92	8.23
Result	Complies			

Temperature vs. Frequency Stability

Temperature	Measurement Frequency (MHz)			
(°C)	5785 MHz			
	0 Minute	2 Minute	5 Minute	10 Minute
-30	5784.9651	5784.9635	5784.9620	5784.9596
-20	5784.9633	5784.9620	5784.9603	5784.9582
-10	5784.9618	5784.9606	5784.9590	5784.9571
0	5784.9604	5784.9590	5784.9571	5784.9549
10	5784.9591	5784.9578	5784.9563	5784.9545
20	5784.9579	5784.9566	5784.9550	5784.9531
30	5784.9565	5784.9554	5784.9540	5784.9524
40	5784.9550	5784.9537	5784.9521	5784.9502
50	5784.9533	5784.9521	5784.9506	5784.9483
Max. Deviation (MHz)	0.0467	0.0479	0.0494	0.0517
Max. Deviation (ppm)	8.07	8.28	8.54	8.94
Result	Complies			

4.8. Antenna Requirements

4.8.1. Limit

Except for special regulations, the Low-power Radio-frequency Devices must not be equipped with any jacket for installing an antenna with extension cable. 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. The manufacturer may design the unit so that the user can replace a broken antenna, but the use of a standard antenna jack or electrical connector is prohibited. Further, this requirement does not apply to intentional radiators that must be professionally installed.

4.8.2. Antenna Connector Construction

Please refer to section 3.3 in this test report; antenna connector complied with the requirements.

5. LIST OF MEASURING EQUIPMENTS

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Remark
BILOG ANTENNA	TESEQ	CBL6112D	37880	20MHz ~ 2GHz	Sep. 03, 2015	Radiation (03CH01-CB)
Loop Antenna	Teseq	HLA 6120	24155	9kHz - 30 MHz	Mar. 16, 2016*	Radiation (03CH01-CB)
Horn Antenna	EMCO	3115	00075790	750MHz ~ 18GHz	Oct. 22, 2015	Radiation (03CH01-CB)
Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170252	15GHz ~ 40GHz	Jul. 21, 2015	Radiation (03CH01-CB)
Pre-Amplifier	Agilent	8447D	2944A10991	0.1MHz ~ 1.3GHz	Mar. 15, 2016	Radiation (03CH01-CB)
Pre-Amplifier	Agilent	8449B	3008A02310	1GHz ~ 26.5GHz	Jan. 18, 2016	Radiation (03CH01-CB)
Pre-Amplifier	WM	TF-130N-R1	923365	26GHz ~ 40GHz	Nov. 13, 2015	Radiation (03CH01-CB)
Spectrum Analyzer	R&S	FSP40	100056	9kHz ~ 40GHz	Oct. 27, 2015	Radiation (03CH01-CB)
EMI Test	R&S	ESCS	100355	9kHz ~ 2.75GHz	May 16, 2016	Radiation (03CH01-CB)
RF Cable-low	Woken	Low Cable-1	N/A	30 MHz ~ 1 GHz	Nov. 02, 2015	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-16	N/A	1 GHz ~ 18 GHz	Nov. 02, 2015	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-17	N/A	1 GHz ~ 18 GHz	Nov. 02, 2015	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-40G-1	N/A	18GHz ~ 40 GHz	Nov. 02, 2015	Radiation (03CH01-CB)
RF Cable-high	Woken	High Cable-40G-2	N/A	18GHz ~ 40 GHz	Nov. 02, 2015	Radiation (03CH01-CB)
Test Software	Audix	E3	6.2009-I0-7	N/A	N/A	Radiation (03CH01-CB)
Spectrum analyzer	R&S	FSV40	100979	9kHz~40GHz	Dec. 09, 2015	Conducted (TH01-CB)
Temp. and Humidity Chamber	Ten Billion	TTH-D3SP	TBN-931011	-30~100 degree	Jun. 02, 2015	Conducted (TH01-CB)
RF Cable-high	Woken	RG402	High Cable-6	1 GHz – 26.5 GHz	Nov. 02, 2015	Conducted (TH01-CB)
RF Cable-high	Woken	RG402	High Cable-7	1 GHz – 26.5 GHz	Nov. 02, 2015	Conducted (TH01-CB)
RF Cable-high	Woken	RG402	High Cable-8	1 GHz – 26.5 GHz	Nov. 02, 2015	Conducted (TH01-CB)
RF Cable-high	Woken	RG402	High Cable-9	1 GHz – 26.5 GHz	Nov. 02, 2015	Conducted (TH01-CB)
RF Cable-high	Woken	RG402	High Cable-10	1 GHz – 26.5 GHz	Nov. 02, 2015	Conducted (TH01-CB)
Power Sensor	Agilent	U2021XA	MY53410001	50MHz~18GHz	Nov. 02, 2015	Conducted (TH01-CB)

Note: Calibration Interval of instruments listed above is one year.

"*" Calibration Interval of instruments listed above is two years.

6. MEASUREMENT UNCERTAINTY

Test Items	Uncertainty	Remark
Radiated Emission (30MHz ~ 1,000MHz)	3.6 dB	Confidence levels of 95%
Radiated Emission (1GHz ~ 18GHz)	3.7 dB	Confidence levels of 95%
Radiated Emission (18GHz ~ 40GHz)	3.5 dB	Confidence levels of 95%
Conducted Emission	1.7 dB	Confidence levels of 95%