HCT CO.,LTD.

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FCC / IC UNII REPORT

Class II Permissive Change

Applicant Name:
LG Electronics Inc.

Address:
222, LG-ro, Jinwi-myeon, Pyeongtaek-si, Gyeonggi-do,451-713, Korea

Date of Issue:
October 15, 2018

Test Site/Location:
HCT CO., LTD., 74,Seoicheon-ro 578beon-gil,Majang-myeo,Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA

Report No.: HCT-RF-1810-FI001-R2

FCC ID:	**BEJLC10SB**
IC:	**2703H-LC10SB**
APPLICANT:	**LG Electronics Inc.**

Model:	LC10S-V
EUT Type:	Silverbox RADIO ASM-RECEIVER
Modulation type	OFDM
FCC Classification:	Unlicensed National Information Infrastructure(UNII)
FCC Rule Part(s):	Part 15.407
IC Rule Part(s):	RSS-247 Issue 2 (February 2017), RSS-Gen Issue 5(April 2018)

Band	Mode	Channel Bandwidth (MHz)	Frequency Range (MHz)	Power (dBm)	Power (W)
UNII1	802.11a	20	5180 – 5240	10.90	0.0123
	802.11n	20	5180 – 5240	10.77	0.0119

Engineering Statement:

The measurements shown in this report were made in accordance with the procedures indicated, and the emissions from thisequipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements, and for the qualifications of all persons taking them. It is further stated that upon the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of the FCC / IC Rules under normal use and maintenance.

Report prepared by : Jung Ki Lim
Engineer of Telecommunication testing center

Approved by : Kwon Jeong
Manager of Telecommunication testing center

Version

TEST REPORT NO.	DATE	DESCRIPTION
HCT-RF-1810-FI001	October 05, 2018	- First Approval Report
HCT-RF-1810-FI001-R1	October 12, 2018	- FCC UNII1, UNII2A band Power and PSD changed to meet IC limits.
HCT-RF-1810-FI001-R2	October 15, 2018	- Revised the section 10.4

Table of Contents

1. GENERAL INFORMATION

Applicant:	LG Electronics Inc.
Address:	222, LG-ro, Jinwi-myeon, Pyeongtaek-si, Gyeonggi-do,451-713, Korea
FCC ID:	BEJLC10SB
IC:	2703H-LC10SB
EUT Type:	Silverbox RADIO ASM-RECEIVER
Model:	LC10S-V
Date(s) of Tests:	September 10, 2018 ~ September 27, 2018
Place of Tests:	HCT Co., Ltd. 74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, Korea

2. EUT DESCRIPTION

Model	LC10S-V	
EUT Type	Silverbox RADIO ASM-RECEIVER	
Power Supply	DC 12.0 V	
Frequency Range	20 MHz BW	5180 MHz - 5240 MHz (UNII 1), 5745 MHz - 5825 MHz (UNII 3)
Modulation Type	OFDM(802.11a, 802.11n)	
Antenna Specification	Antenna type: Dielectric Chip Antenna Peak Gain : UNII 1 : 3.60 dBi , UNII 3 : 2.90 dBi	
PMN	Silverbox RADIO ASM-RECEIVER	
HVIN	LC10S-V	
FVIN	5.90.231.4	
HMN	N/A	

3. TEST METHODOLOGY

The measurement procedure described in FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01 dated December 14, 2017 entitled “Guidelines for Compliance Testing of Unlicensed National Information Infrastructure (U-NII) Devices Part15, Subpart E” and ANSI C63.10(Version : 2013) ‘the American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices’ were used in the measurement.

3.1 EUT CONFIGURATION

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

3.2 EUT EXERCISE

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.407 under the FCC Rules Part 15 Subpart E / RSS-Gen issue 5, RSS-247 issue 2.

3.3 GENERAL TEST PROCEDURES

Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 6.2 of ANSI C63.10. (Version :2013) Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-peak and average detector modes.

Radiated Emissions

The EUT is placed on a turn table, which is 0.8 m above ground plane below 1GHz. Above 1GHz with 1.5m using absorbers between the EUT and receive antenna. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3 m away from the receiving antenna, which varied from 1 m to 4 m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes according to the requirements in Section 8 of ANSI C63.10. (Version: 2013)

Conducted Antenna Terminal

See Section from 8.1 to 8.4.(KDB 789033 D02 v02r01)

3.4 DESCRIPTION OF TEST MODES

The EUT has been tested under operating condition. Test program used to control the EUT for staying in continuous transmitting and receiving mode is programmed.

Channel low, mid and high with highest data rate (worst case) is chosen for full testing.

4. INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipments, which is traceable to recognized national standards.
Especially, all antenna for measurement is calibrated in accordance with the requirements of C63.5 (Version : 2017).

5. FACILITIES AND ACCREDITATIONS

5.1 FACILITIES

The SAC(Semi-Anechoic Chamber) and conducted measurement facility used to collect the radiated data are located at the 74, Seoicheon-ro 578beon-gil,
Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of KOREA.
The site is constructed in conformance with the requirements of ANSI C63.4. (Version :2014) and CISPR Publication 22.
Detailed description of test facility was submitted to the Commission and accepted dated April 02, 2018 (Registration Number: KR0032).
For ISED, test facility was accepted dated December 20, 2016(Registration Number: 5944A-3)

5.2 EQUIPMENT

Radiated emissions are measured with one or more of the following types of Linearly polarized antennas: tuned dipole, bi-conical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements. Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers. Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.
All receiving equipment conforms to CISPR Publication 16-1, “Radio Interference Measuring Apparatus and Measurement Methods.”

6. ANTENNA REQUIREMENTS

According to FCC 47 CFR §15.203, §15.407

“An intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can 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 antennas of this E.U.T are permanently attached.
* The E.U.T Complies with the requirement of §15.203, §15.407 / RSS-Gen

7. MEASUREMENT UNCERTAINTY

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10-2013.

All measurement uncertainty values are shown with a coverage factor of k = 2 to indicate a 95 % level of confidence.

The measurement data shown herein meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and, thus, can be compared directly to specified limits to determine compliance.

Parameter	Expanded Uncertainty (±dB)
Conducted Disturbance (150 kHz ~ 30 MHz)	1.82
Radiated Disturbance (9 kHz ~ 30 MHz)	3.40
Radiated Disturbance (30 MHz ~ 1 GHz)	4.80
Radiated Disturbance (1 GHz ~ 18 GHz)	5.70
Radiated Disturbance (18 GHz ~ 40 GHz)	5.71

8. ADDITIONAL INFORMATION

*** Operating mode**

Mode	Operating Mode
802.11a/n(HT20)	SISO

*** Power Level Setting**

20M BW		
Channel	802.11a	802.11n(HT20)
36	11	11
40	11	11
48	11	11
149	16	13
157	16	15
165	15	14

*** Worst case configuration and mode**

Radiated test

1. All modes of operation were investigated and the worst case configuration results are reported.
2. EUT Axis
   - Radiated Spurious Emissions : X
   - Radiated Restricted Band Edge : X
3. All data rate of operation were investigated and the test results are worst case in lowest datarate of each mode.
   - 802.11a : 6Mbps
   - 802.11n20 : MCS0
4. EUT were tested and the worst case results are reported.

Conducted test

1. The EUT was configured with data rate of highest power.
2. EUT were tested and the worst case results are reported.

9. SUMMARY OF TEST RESULTS

9.1 FCC Part

Test Description	FCC Part Section(s)	Test Limit	Test Condition	Test Result
26dB Bandwidth	§15.407 (for Power Measurement)	N/A	*CONDUCTED	NT Note2
6 dB Bandwidth	§15.407(e)	>500 kHz (5725-5850 MHz)		NT Note2
Maximum Conducted Output Power	§15.407(a)	< 250 mW (5150-5250 MHz) < 250 mW or 11+10 log log $_{10}$ (BW) dBm (5250-5350 MHz) < 250 mW or 11+10 log log $_{10}$ (BW) dBm (5470-5725 MHz) <1 W (5725-5850 MHz)		NT Note2
Peak Power Spectral Density	§15.407(a)	<11 dBm/ MHz (5150-5250 MHz) <11 dBm/ MHz (5250-5350 MHz) <11 dBm/ MHz (5470-5725 MHz) <30 dBm/500 kHz(5725-5850 MHz)		NT Note2
Frequency Stability	§15.407(g)	N/A		NT Note2
AC Conducted Emissions 150 kHz-30 MHz	15.207	<FCC 15.207 limits		NA Note1
Undesirable Emissions	§15.407(b)	<-27 dBm/MHz EIRP (UNII1, 2A, 2C) cf. Section 9.8.1 (UNII 3)	RADIATED	PASS
General Field Strength Limits(Restricted Bands and Radiated Emission Limits)	15.205, 15.407(b)(5), (6)	Emissions in restricted bands must meet the radiated limits detailed in 15.209		PASS

Note:

1. This device is installed in a car. Therefore the power source is a battery of car.
2. NT = Not Tested, NA = Not Applicable
3. C2PC models are electrically identical to the Original models.

   The Product Equality Declaration includes detailed information about the changes between the devices.
4. * CONDUCTED : Conducted test was performed only UNII 1 Band

9.2 IC Part

Test Description	IC Part Section(s)	Test Limit	Test Condition	Test Result
99% Bandwidth	RSS-GEN, 6.7	N/A	*CONDUCTED	NT Note2
6 dB Bandwidth	RSS-247, 6.2.4.1	> 500 kHz (5725~5850 MHz)		NT Note2
Maximum Conducted Output Power,	RSS-247, 6.2	< 250 mW or 11+10 log $_{10}$ (BW) dBm (5470-5600, 5650-5725 MHz) Whichever power is less		NT Note2
	RSS-247, 6.2.4 1	<1 W (5725-5850 MHz)		
Maximum e.i.r.p	RSS-247, 6.2	< 30 mW or 1.76+10 log $_{10}$ (BW) dBm (5150-5250 MHz) < 30 mW or 1.76+10 log $_{10}$ (BW) dBm (5250-5350 MHz) < 1 W or 17+10 log $_{10}$ (BW) dBm (5470-5725 MHz) Whichever power is less		NT Note2
Power Spectral Density	RSS-247 6.2	<10 dBm/ MHz(e.i.r.p.) (5150-5250 MHz) <11 dBm/MHz(Conducted) (5250-5350 MHz, 5470-5600 MHz, 5650-5725 MHz)		NT Note2
	RSS-247, 6.2.4 1	<30 dBm/500 kHz(Conducted) (5725-5850 MHz)		
Frequency Stability	RSS-GEN 8.11	should be kept within at least the central 80% of its permitted operating frequency band in order to minimize the possibility of out-of-band operation.		NT Note2
AC Conducted Emissions 150 kHz-30 MHz	RSS-GEN, 8.8	RSS-GEN section 8.8 table 4		NA Note1
Undesirable Emissions	RSS-247, 6.2.1 2	26 dBc at 5250~5350 MHz (5150~5350 MHz)		PASS
	RSS-247, 6.2	<-27 dBm/ MHz EIRP (5150-5350 MHz, 5470-5725 MHz)	RADIATED	PASS
	RSS-247, 6.2.4 2	cf. Section 9.8.1 (UNII 3)		
General Field Strength Limits(Restricted Bands and Radiated Emission Limits)	RSS-Gen, 8.9 RSS-Gen, 8.10	RSS-Gen section 8.9 table 5, 6 section 8.10 table 7		PASS
Receiver Spurious Emissions	RSS-GEN, 5 RSS-GEN, 7.3	RSS-GEN section 7.3 table 3		PASS

Note:

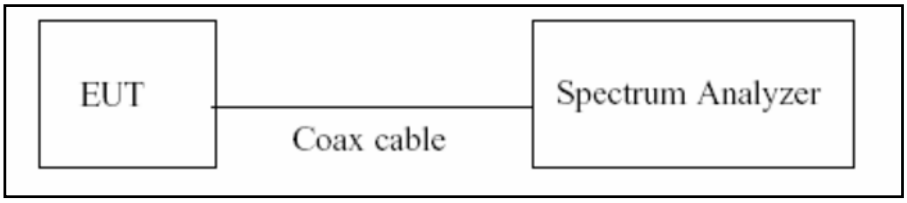
1. This device is installed in a car. Therefore the power source is a battery of car.
2. NT = Not Tested, NA = Not Applicable
3. C2PC models are electrically identical to the Original models.
   The Product Equality Declaration includes detailed information about the changes between the devices.
4. * CONDUCTED : Conducted test was performed only UNII 1 Band

10. TEST RESULT

10.1 DUTY CYCLE

The zero-span mode on a spectrum analyzer or EMI receiver ,if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on and off times of the transmitted signal. Set the center frequency of the instrument to the center frequency of the transmission. Set RBW ≥ EBW if possible; otherwise, set RBW to the largest available value. Set VBW ≥ RBW. Set detector = peak or average. The zero-span measurement method shall not be used unless both RBW and VBW are > 50/*T*, where *T* is defined in section B)1)a), and the number of sweep points across duration *T* exceeds 100. (For example, if VBW and/or RBW are limited to 3 MHz, then the zero-span method of measuring duty cycle shall not be used if *T* ≤ 16.7 microseconds.)

▣ TEST CONFIGURATION



▣ TEST PROCEDURE

The transmitter output is connected to the Spectrum Analyzer. We tested according to the zero-span measurement method, (B.2 in KDB 789033 D02 v02r01)
The largest availble value of RBW is 8 MHz and VBW is 50 MHz. The zero-span method of measuring duty cycle shall not be used if T ≤ 6.25 microseconds. (50/6.25 = 8)
The zero-span method was used becaure all measured T data are > 6.25 microseconds and both RBW and VBW are > 50/*T*.

1. RBW = 8 MHz (the largest availble value)
2. VBW = 8 MHz (≥ RBW)
3. SPAN = 0 Hz
4. Detector = Peak
5. Number of points in sweep > 100
6. Trace mode = Clear write
7. Measure T_{total} and T_{on}
8. Calculate Duty Cycle = T_{on}/ T_{total} and Duty Cycle Factor = 10*log(1/Duty Cycle)

▣ Duty Cycle Factor

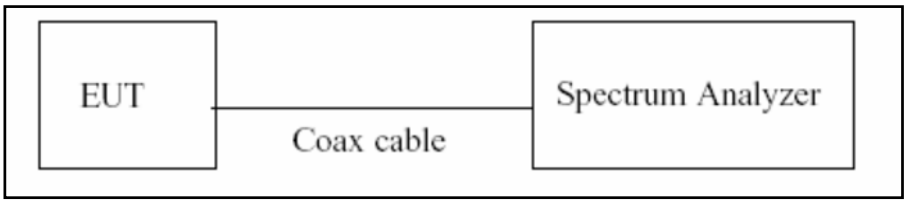
Mode	Data Rate (Mbps)	T_{on} (ms)	T_{total} (ms)	Duty Cycle	Duty Cycle Factor (dB)
802.11a	6	2.070	2.170	0.95391705	0.205
	9	1.380	1.480	0.93243243	0.304
	12	1.050	1.150	0.91304348	0.395
	18	0.705	0.805	0.87577640	0.576
	24	0.530	0.630	0.84126984	0.751
	36	0.363	0.462	0.78571429	1.047
	48	0.276	0.378	0.73015873	1.366
	54	0.248	0.349	0.71060172	1.484
Mode	**MCS INDEX**	**T_{on} (ms)**	**T_{total} (ms)**	**Duty Cycle**	**Duty Cycle Factor (dB)**
802.11n_HT20	0	1.921	2.026	0.94817374	0.231
	1	0.979	1.077	0.90900650	0.414
	2	0.662	0.760	0.87105263	0.600
	3	0.507	0.609	0.83251232	0.796
	4	0.354	0.453	0.78145695	1.071
	5	0.270	0.372	0.72580645	1.392
	6	0.249	0.348	0.71551724	1.454
	7	0.228	0.327	0.69724771	1.566

10.2 EMISSION BANDWIDTH AND MINIMUM EMISSION BANDWIDTH MEASUREMENT FOR FCC

The bandwidth at 26 dB down from the highest in-band spectral density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating at its maximum power control level, as defined in KDB 789033 D02 v02r01, at the appropriate frequencies. The spectrum analyzer's bandwidth measurement function is configured to measure the 26 dB bandwidth.

The 26 dB bandwidth is used to determine the conducted power limits.

▣ TEST CONFIGURATION



▣ TEST PROCEDURE (26dB Bandwidth)

The transmitter output is connected to the Spectrum Analyzer.
The Spectrum Analyzer is set to(C.1 in KDB 789033 D02 v02r01)

1. RBW = approximately 1 % of the emission bandwidth
2. VBW > RBW
3. Detector = Peak
4. Trace mode = max hold
5. Measure the maximum width of the emission that is 26 dB down from the 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 %.

Note : We tested 26 dB bandwidth using the automatic bandwidth measurement capability of a spectrum analyzer. X dB is set 26 dB.

1. In order to simplify the report, attached plots were only the most wide channel.
2. DFS test channels should be defined. So, We performed the OBW test to prove that no part of the fundamental emissions of any channels belong to UNII1 and UNII3 band for DFS.

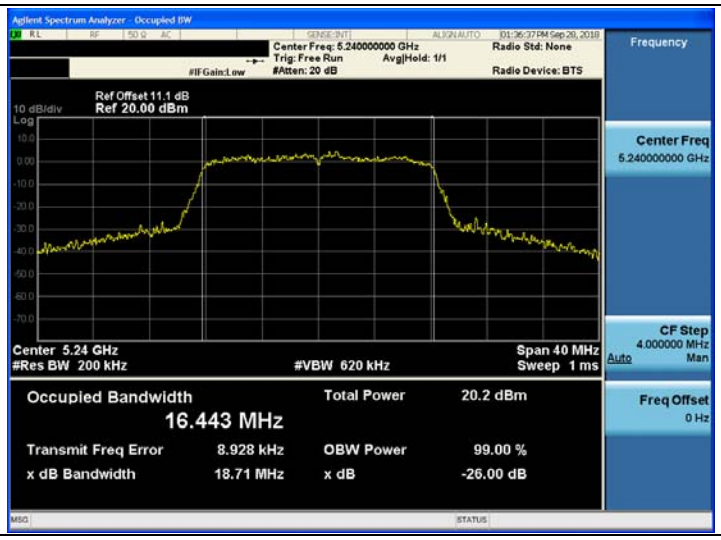
▣ TEST RESULTS for 802.11a

Conducted 26 dB Bandwidth Measurements for 802.11a

802.11a Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5180	36	18.69	N/A	Pass
5200	40	18.70	N/A	Pass
5240	48	18.71	N/A	Pass

▣ TEST Plot for 802.11a

802.11a UNII 1 BAND 26dB Bandwidth (CH 48)



Note : In order to simplify the report, attached plots were only the most wide channel.

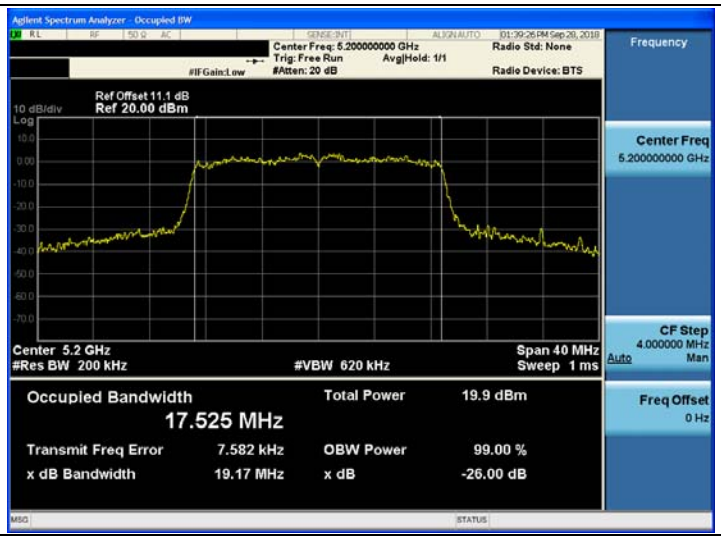
▣ TEST RESULTS for 802.11n_HT20

Conducted 26 dB Bandwidth Measurements for 802.11n_HT20

802.11n_HT20 Mode		Measured Bandwidth [MHz]	Minimum Bandwidth [MHz]	Pass / Fail
Frequency [MHz]	Channel No.			
5180	36	18.99	N/A	Pass
5200	40	19.17	N/A	Pass
5240	48	19.12	N/A	Pass

▣ TEST Plot for 802.11n_HT20

802.11n_HT20 UNII 1 BAND 26dB Bandwidth(CH 40)



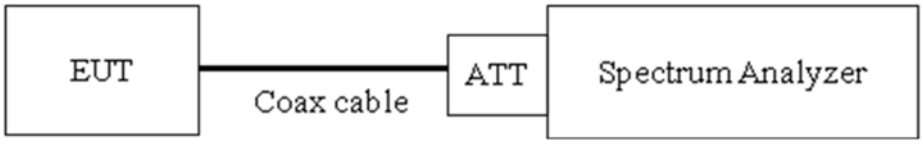
Note : In order to simplify the report, attached plots were only the most wide channel.

10.3 99% BANDWIDTH MEASUREMENT

None; for IC reporting purposes only

The 99 % bandwidth is used to determine the conducted power limits. (For IC).

▣ TEST CONFIGURATION



▣ TEST PROCEDURE

The transmitter output is connected to the spectrum analyzer. The RBW is set to as close to 1% of the selected span. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

RBW = RBW shall be in the range of 1 % ~ 5 % of the actual occupied / x dB bandwidth
VBW ≥ 3 x RBW
Detector = Peak
Trace mode = max hold
Sweep = auto couple
Allow the trace to stabilize

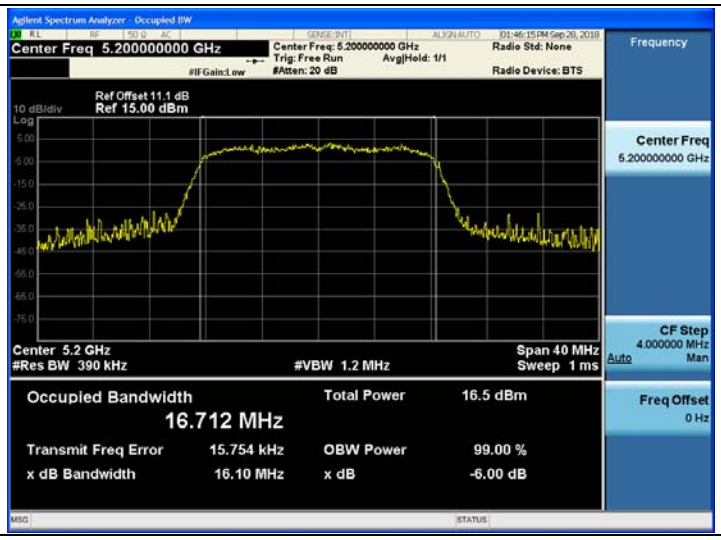
▣ TEST RESULTS for _802.11a

99% Bandwidth Measurements for 802.11a

802.11a Mode		Measured Bandwidth [MHz]
Frequency [MHz]	Channel No.	
5180	36	16.70
5200	40	16.71
5240	48	16.70

▣ TEST Plot for _802.11a

802.11a UNII 1 BAND 99% Bandwidth (CH 40)



Note : In order to simplify the report, attached plots were only the most wide channel.

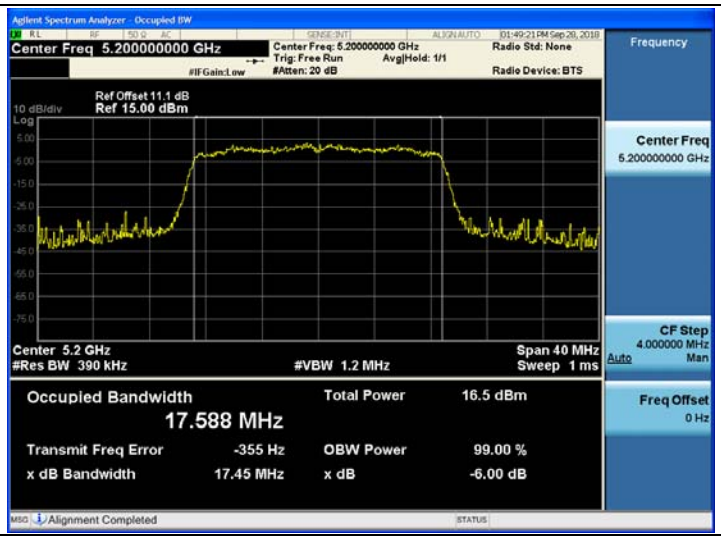
▣ TEST RESULTS for _802.11n_HT20

99% Bandwidth Measurements for 802.11n_HT20

802.11n_HT20 Mode		Measured Bandwidth [MHz]
Frequency [MHz]	Channel No.	
5180	36	17.58
5200	40	17.59
5240	48	17.58

▣ TEST Plot for Internal Ant_802.11n_HT20

802.11n_HT20 UNII 1 BAND 99% Bandwidth(CH 40)



Note : In order to simplify the report, attached plots were only the most wide channel.

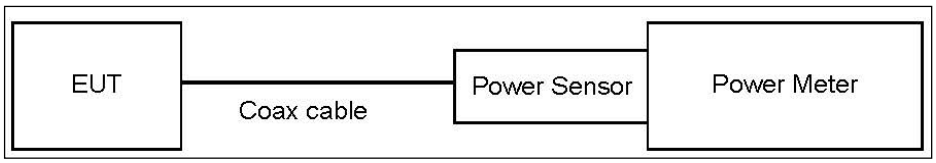
10.4 OUTPUT POWER MEASUREMENT

A transmitter antenna terminal of EUT is connected to the input of a Power meter or Spectrum Analyzer .Measurement is made while the EUT is operating in transmission mode at the appropriate frequencies.

▣ LIMIT

Band	Mode	Limit
UNII 1	802.11a,n	IC : 30mW e.i.r.p (=14.77dBm) FCC : 250mW (=23.98dBm)

▣ TEST CONFIGURATION(20 MHz BW)



▣ TEST PROCEDURE(20 MHz BW)

▪ Average Power (Procedure E.3.a in KDB 789033 D02 v02r01).

1. Measure the duty cycle.
2. Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.
3. Add 10 log (1/x), where x is the duty cycle, to the measured power in order to compute the average power during the actual transmission times.

Note :

Actual value of loss for the attenuator and cable combination is below table.

Band	Loss(dB)
UNII 1	11.1

▣ TEST RESULTS(IC)

802.11a (UNII 1)

Conducted Output Power Measurements (802.11a Mode: 5180~5240)

802.11a Mode		Rate (Mbps)	Measured Power(dBm)	Ant Gain(dBi)	Duty Cycle Factor (dB)	E.I.R.P (dBm)	Limit (dBm)
Frequency [MHz]	Channel No.						
5180	36	6	10.69	3.60	0.20	14.49	14.77
		9	10.60	3.60	0.30	14.50	14.77
		12	10.46	3.60	0.40	14.46	14.77
		18	10.25	3.60	0.58	14.43	14.77
		24	10.08	3.60	0.75	14.43	14.77
		36	9.74	3.60	1.05	14.39	14.77
		48	9.44	3.60	1.37	14.41	14.77
		54	9.27	3.60	1.48	14.35	14.77
5200	40	6	10.68	3.60	0.20	14.48	14.77
		9	10.54	3.60	0.30	14.44	14.77
		12	10.31	3.60	0.40	14.31	14.77
		18	10.17	3.60	0.58	14.35	14.77
		24	9.97	3.60	0.75	14.32	14.77
		36	9.67	3.60	1.05	14.32	14.77
		48	9.40	3.60	1.37	14.37	14.77
		54	9.24	3.60	1.48	14.32	14.77
5240	48	6	10.60	3.60	0.20	14.40	14.77
		9	10.50	3.60	0.30	14.40	14.77
		12	10.35	3.60	0.40	14.35	14.77
		18	10.15	3.60	0.58	14.33	14.77
		24	9.96	3.60	0.75	14.31	14.77
		36	9.65	3.60	1.05	14.30	14.77
		48	9.40	3.60	1.37	14.37	14.77
		54	9.30	3.60	1.48	14.38	14.77

802.11n _HT20 (UNII 1)

Conducted Output Power Measurements (802.11n_HT20 Mode: 5180~5240)

802.11n_HT20 Mode		MCS Index	Measured Power(dBm)	Ant Gain(dBi)	Duty Cycle Factor (dB)	E.I.R.P (dBm)	Limit (dBm)
Frequency [MHz]	Channel No.						
5180	36	0	10.52	3.60	0.23	14.35	14.77
		1	10.22	3.60	0.41	14.23	14.77
		2	10.13	3.60	0.60	14.33	14.77
		3	9.95	3.60	0.80	14.35	14.77
		4	9.64	3.60	1.07	14.31	14.77
		5	9.29	3.60	1.39	14.28	14.77
		6	9.17	3.60	1.45	14.22	14.77
		7	9.06	3.60	1.57	14.23	14.77
5200	40	0	10.53	3.60	0.23	14.36	14.77
		1	10.29	3.60	0.41	14.30	14.77
		2	10.07	3.60	0.60	14.27	14.77
		3	9.83	3.60	0.80	14.23	14.77
		4	9.49	3.60	1.07	14.16	14.77
		5	9.20	3.60	1.39	14.19	14.77
		6	9.11	3.60	1.45	14.16	14.77
		7	8.98	3.60	1.57	14.15	14.77
5240	48	0	10.54	3.60	0.23	14.37	14.77
		1	10.25	3.60	0.41	14.26	14.77
		2	10.10	3.60	0.60	14.30	14.77
		3	9.89	3.60	0.80	14.29	14.77
		4	9.56	3.60	1.07	14.23	14.77
		5	9.21	3.60	1.39	14.20	14.77
		6	9.12	3.60	1.45	14.17	14.77
		7	9.01	3.60	1.57	14.18	14.77

▣ TEST RESULTS(FCC)

802.11a (UNII 1)

Conducted Output Power Measurements (802.11a Mode: 5180~5240)

802.11a Mode		Rate (Mbps)	Measured Power(dBm)	Duty Cycle Factor (dB)	Result (dBm)	Limit (dBm)
Frequency [MHz]	Channel No.					
5180	36	6	10.69	0.20	10.89	23.98
		9	10.60	0.30	10.90	23.98
		12	10.46	0.40	10.86	23.98
		18	10.25	0.58	10.83	23.98
		24	10.08	0.75	10.83	23.98
		36	9.74	1.05	10.79	23.98
		48	9.44	1.37	10.81	23.98
		54	9.27	1.48	10.75	23.98
5200	40	6	10.68	0.20	10.88	23.98
		9	10.54	0.30	10.84	23.98
		12	10.31	0.40	10.71	23.98
		18	10.17	0.58	10.75	23.98
		24	9.97	0.75	10.72	23.98
		36	9.67	1.05	10.72	23.98
		48	9.40	1.37	10.77	23.98
		54	9.24	1.48	10.72	23.98
5240	48	6	10.60	0.20	10.80	23.98
		9	10.50	0.30	10.80	23.98
		12	10.35	0.40	10.75	23.98
		18	10.15	0.58	10.73	23.98
		24	9.96	0.75	10.71	23.98
		36	9.65	1.05	10.70	23.98
		48	9.40	1.37	10.77	23.98
		54	9.30	1.48	10.78	23.98

802.11n _HT20 (UNII 1)

Conducted Output Power Measurements (802.11n_HT20 Mode: 5180~5240)

802.11n_HT20 Mode		MCS Index	Measured Power(dBm)	Duty Cycle Factor (dB)	Result (dBm)	Limit (dBm)
Frequency [MHz]	Channel No.					
5180	36	0	10.52	0.23	10.75	23.98
		1	10.22	0.41	10.63	23.98
		2	10.13	0.60	10.73	23.98
		3	9.95	0.80	10.75	23.98
		4	9.64	1.07	10.71	23.98
		5	9.29	1.39	10.68	23.98
		6	9.17	1.45	10.62	23.98
		7	9.06	1.57	10.63	23.98
5200	40	0	10.53	0.23	10.76	23.98
		1	10.29	0.41	10.70	23.98
		2	10.07	0.60	10.67	23.98
		3	9.83	0.80	10.63	23.98
		4	9.49	1.07	10.56	23.98
		5	9.20	1.39	10.59	23.98
		6	9.11	1.45	10.56	23.98
		7	8.98	1.57	10.55	23.98
5240	48	0	10.54	0.23	10.77	23.98
		1	10.25	0.41	10.66	23.98
		2	10.10	0.60	10.70	23.98
		3	9.89	0.80	10.69	23.98
		4	9.56	1.07	10.63	23.98
		5	9.21	1.39	10.60	23.98
		6	9.12	1.45	10.57	23.98
		7	9.01	1.57	10.58	23.98

10.5 POWER SPECTRAL DENSITY

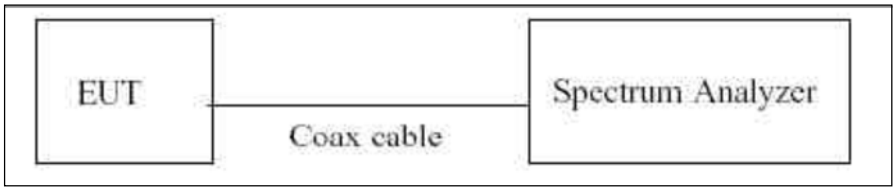
The peak power density is measured with a spectrum analyzer connected to the antenna terminal while the EUT is operating in transmission mode at the appropriate frequencies.

▣ Limit

Power Spectral Density

Band	Mode	Limit
UNII 1	802.11a,n	11 dBm/MHz

▣ TEST CONFIGURATION



▣ TEST PROCEDURE

We tested according to Method in KDB 789033 D02 v02r01.

The spectrum analyzer is set to :

1. Set span to encompass the entire emission bandwidth(EBW) of the signal.
2. RBW = 1 MHz(510 kHz for UNII 3)
3. VBW ≥ 3 MHz
4. Number of points in sweep ≥ 2*span/RBW.
5. Sweep time = auto.
6. Detector = RMS(i.e., power averaging), if available. Otherwise, use sample detector mode.
7. Do not use sweep triggering. Allow the sweep to “free run”.
8. Trace average at least 100 traces in power averaging(RMS) mode
9. Use the peak search function on the spectrum analyzer to find the peak of the spectrum.
10. If Method SA-2 was used, add 10 log(1/x), where x is the duty cycle, to the peak of the spectrum.

▣ SAMPLE CALCULATION

PSD = Reading Value + ATT loss + Cable loss(1 ea) + Duty Cycle Factor

Ex) PSD = -3 dBm + 10 dB + 0.8 dB + 0.2 dB = 8.0 dBm

Note :

1. Spectrum reading values are not plot data. The PSD results in plot is already including the actual values of loss for the attenuator and cable combination.
2. Spectrum offset = Attenuator loss + Cable loss

Band	Loss(dB)
UNII 1	11.1

(Actual value of loss for the attenuator and cable combination)

▣ TEST RESULTS

Conducted Power Density Measurements

Frequency (MHz)	Channel No.	Mode	Test Result				
			Measured Power Density (dBm)	Duty Cycle Factor (dB)	Measured Power Density(dBm) + Duty Cycle Factor	Limit (dBm)	Pass/Fail
5180	36	802.11a	-0.342	0.304	-0.038	11	Pass
5200	40		-0.330	0.205	-0.125		Pass
5240	48		-0.176	0.205	0.029		Pass

▣ TEST Plot for 802.11a 20 MHz BW

802.11a UNII 1 BAND PSD CH 48

▣ TEST RESULTS

Conducted Power Density Measurements

Frequency (MHz)	Channel No.	Mode	Test Result				
			Measured Power Density (dBm)	Duty Cycle Factor (dB)	Measured Power Density(dBm) + Duty Cycle Factor	Limit (dBm)	Pass/Fail
5180	36	802.11n_ HT20	-0.657	0.231	-0.426	11	Pass
5200	40		-0.668	0.231	-0.437		Pass
5240	48		-0.392	0.231	-0.161		Pass

▣ TEST Plot for 802.11n_HT20

802.11n_HT20 UNII 1 BAND PSD CH 48

10.6 FREQUENCY STABILITY

The EUT was placed inside an environmental chamber as the temperature in the chamber was varied between -30 ℃ and 50 ℃. The temperature was incremented by 10 ℃ intervals and the unit was allowed to stabilize at each temperature before each measurement. The center frequency of the transmitting channel was evaluated at each temperature and the frequency deviation from the channel's center frequency was recorded.

20 MHz BW_ Startup

OPERATING BAND: UNII Band 1
OPERATING FREQUENCY: 5,180,000,000 Hz
CHANNEL: 36
REFERENCE VOLTAGE: 12.0 VDC

Voltage (%)	Power (VDC)	Temp. (℃)	Frequency (kHz)	Frequency Error (kHz)
100%	12.00	+20(Ref)	5180036.00	36.00
100%		-30	5180028.95	28.95
100%		-20	5180030.14	30.14
100%		-10	5180031.38	31.38
100%		0	5180033.58	33.58
100%		+10	5180035.62	35.62
100%		+30	5180039.12	39.12
100%		+40	5180044.38	44.38
100%		+50	5180036.78	36.78
Min	9.00	+20	5180040.34	40.34
Max.	16.00	+20	5180038.72	38.72

2 minutes

OPERATING BAND: UNII Band 1

OPERATING FREQUENCY: 5,180,000,000 Hz

CHANNEL: 36

REFERENCE VOLTAGE: 12.0 VDC

Voltage (%)	Power (VDC)	Temp. (℃)	Frequency (kHz)	Frequency Error (kHz)
100%	12.00	+20(Ref)	5180029.61	29.61
100%		-30	5180031.11	31.11
100%		-20	5180031.31	31.31
100%		-10	5180035.35	35.35
100%		0	5180037.37	37.37
100%		+10	5180039.38	39.38
100%		+30	5180040.40	40.40
100%		+40	5180042.44	42.44
100%		+50	5180045.46	45.46
Min	9.00	+20	5180035.61	35.61
Max.	16.00	+20	5180033.49	33.49

5 minutes

OPERATING BAND: UNII Band 1

OPERATING FREQUENCY: 5,180,000,000 Hz

CHANNEL: 36

REFERENCE VOLTAGE: 12.0 VDC

Voltage (%)	Power (VDC)	Temp. (℃)	Frequency (kHz)	Frequency Error (kHz)
100%	12.00	+20(Ref)	5180029.64	29.64
100%		-30	5180031.00	31.00
100%		-20	5180030.32	30.32
100%		-10	5180033.34	33.34
100%		0	5180037.37	37.37
100%		+10	5180038.39	38.39
100%		+30	5180039.40	39.40
100%		+40	5180043.42	43.42
100%		+50	5180047.48	47.48
Min	9.00	+20	5180038.66	38.66
Max.	16.00	+20	5180040.49	40.49

10 minutes

OPERATING BAND: UNII Band 1

OPERATING FREQUENCY: 5,180,000,000 Hz

CHANNEL: 36

REFERENCE VOLTAGE: 12.0 VDC

Voltage (%)	Power (VDC)	Temp. (℃)	Frequency (kHz)	Frequency Error (kHz)
100%	12.00	+20(Ref)	5180029.50	29.50
100%		-30	5180031.00	31.00
100%		-20	5180032.31	32.31
100%		-10	5180033.33	33.33
100%		0	5180037.37	37.37
100%		+10	5180039.39	39.39
100%		+30	5180040.41	40.41
100%		+40	5180043.44	43.44
100%		+50	5180045.48	45.48
Min	9.00	+20	5180041.68	41.68
Max.	16.00	+20	5180045.36	45.36

Note 1.

Based on the results of the frequency stability test shown above the frequency deviation results measured are very small. As such it is determined that the channels at the band edge would remain in-band when the maximum measured frequency error noted during the frequency stability tests is applied. Therefore the device is determined to remain operating in band over the temperature and voltage range as tested.

Note 2.

Voltage variations were tested in Min and Max conditions declared by the manufacturer.

10.7 RADIATED MEASUREMENT

10.7.1 RADIATED SPURIOUS EMISSIONS.

Test Requirements and limit, §15.205, §15.209, §15.407

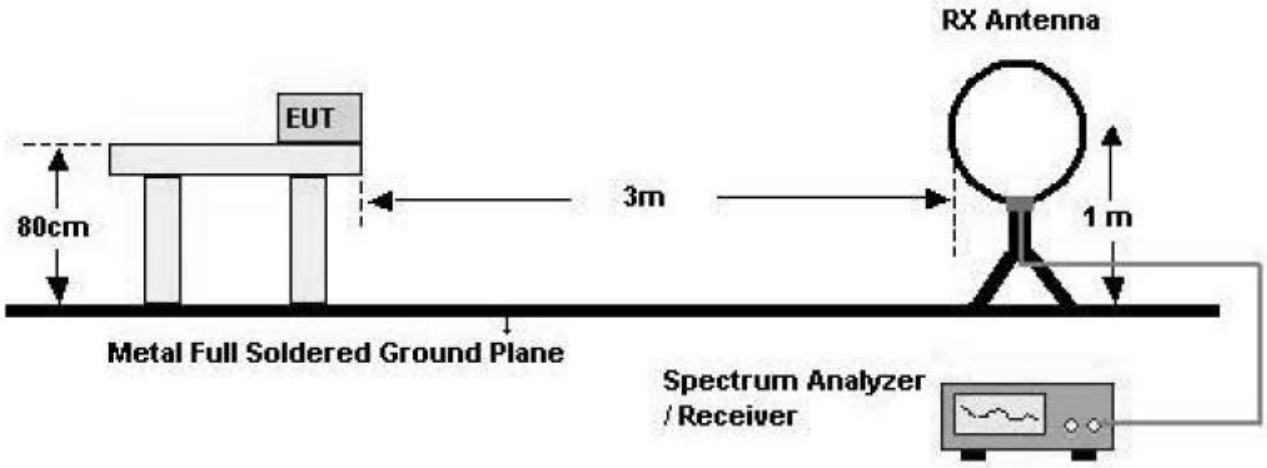
Frequency (MHz)	Field Strength (uV/m)	Measurement Distance (m)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

▣ §15.407,RSS-247, KDB 789033 D02

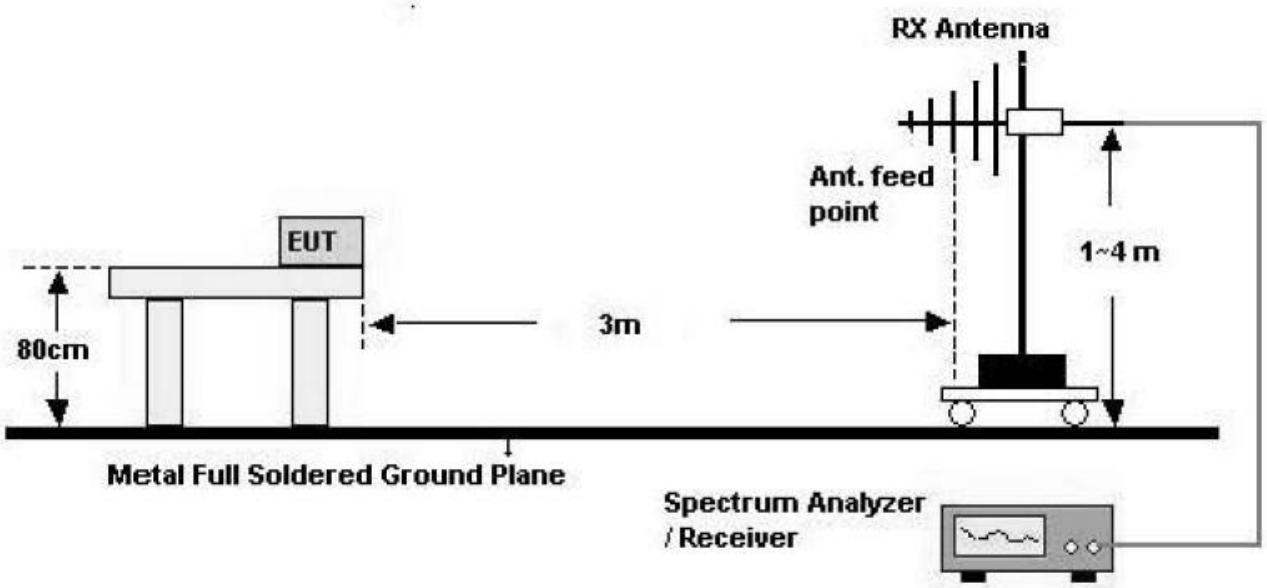
All harmonics that do not lie in a restricted band are subject to a peak limit of -27 dBm/MHz. At a distance of 3 meters the field strength limit in dBμV/m can be determined by adding a “conversion” factor of 95.2 dB to the EIRP limit of -27 dBm/MHz to obtain the limit for out of band spurious emissions of 68.2 dBμV/m. Espectally, for transmitter operating in the 5725 Mhz – 5850 MHz : 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.

Test Configuration

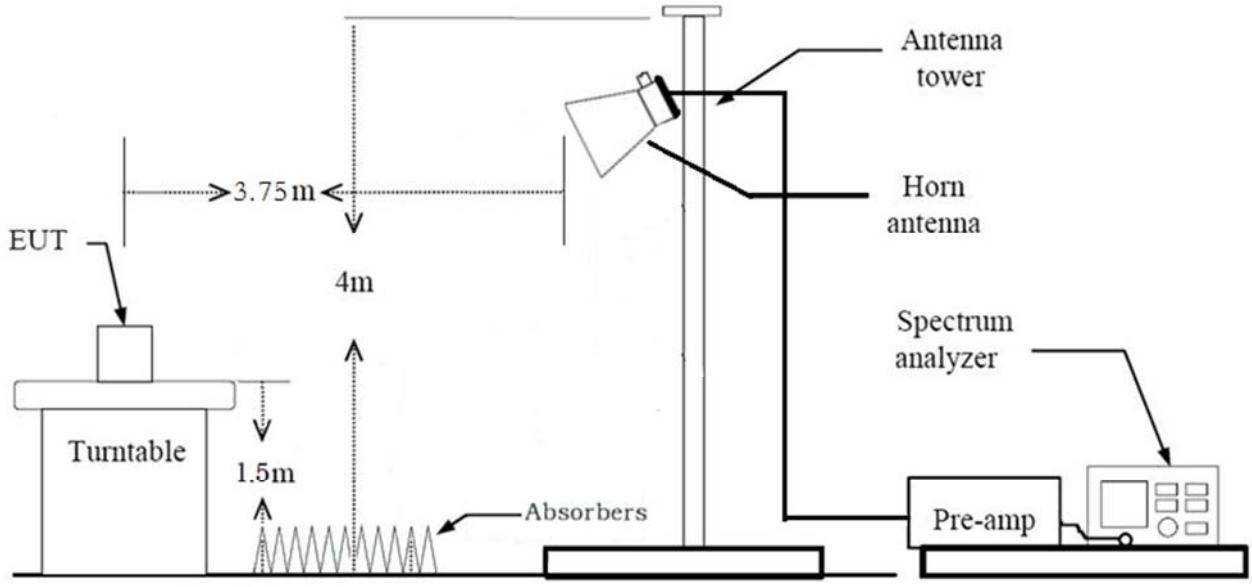
Below 30 MHz



30 MHz - 1 GHz



Above 1 GHz



TEST PROCEDURE USED

ANSI C63.10:2013

Method G)5) in KDB 789033 D02 v02r01 (Peak)

Method G)6)d) in KDB 789033 D02 v02r01 (Average)

. Spectrum setting:

- Peak.

1. RBW = 1 MHz
2. VBW ≥ 3 MHz
3. Detector = Peak
4. Sweep Time = auto
5. Trace mode = max hold
6. Allow sweeps to continue until the trace stabilizes.
7. Note that if the transmission is not continuous, the time required for the trace to stabilize will increase by a factor of approximately 1/x, where x is the duty cycle.

- Average (Method VB :Averaging using reduced video bandwidth)

1. RBW = 1 MHz
2. VBW
   2.1. If the EUT is configured to transmit with duty cycle ≥ 98 percent, set VBW ≤ RBW/100(i.e., 10 kHz) but not less than 10 Hz.
   2.2. If the EUT duty cycle is < 98 percent, set VBW ≥ 1/T, where T is the minimum transmission duration.
3. The analyzer is set to linear detector mode.
4. Detector = Peak.
5. Sweep time = auto.
6. Trace mode = max hold.
7. Allow max hold to run for at least 50 traces if the transmitted signal is continuous or has at least 98 percent duty cycle. For lower duty cycles, increase the minimym number of traces by a factor of 1/x, where x is the duty cycle.

Note :

1. We used the Method VB for 802.11a/n_HT20 mode to perform the average filed strength measurements.
2. The actual setting value of VBW for 802.11a/n_HT20
3. According to SVSWR requirement in ANSI 63.4-2014, We performed the radiated test at 3.75 m distance from center of turn table. So, we applied the distance factor(reference distance : 3 m).
4. Distance extrapolation factor = 20 log (test distance / specific distance) (dB)

Mode	Worst Data rate (Mbps)	T_{on} (ms)	T_{total} (ms)	Duty Cycle (%)	VBW(1/T) (Hz)	The actual setting value of VBW (Hz)
a	**6**	**2.070**	**2.170**	**0.95391705**	**483**	**1000**
n_HT20	**MCS 0**	**1.921**	**2.026**	**0.94817374**	**521**	**1000**

TEST RESULTS

9 kHz – 30MHz

Operation Mode: Normal Mode

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
㎒	dB㎶	dB /m	dB	(H/V)	dB㎶/m	dB㎶/m	dB
No Critical peaks found							

Notes:

1. The reading of emissions are attenuated more than 20 dB below the permissible limits or the field strength is too small to be measured.
2. Distance extrapolation factor = 40 log (specific distance / test distance) (dB)
3. Limit line = specific Limits (dBuV) + Distance extrapolation factor
4. We have done x planes in EUT and horizontal and vertical polarization in detecting antenna.
5. The test results for below 30 MHz is correlated to an open site.
   The result on OATS is about 2 dB higher than semi-anechoic chamber (10 m chamber)

TEST RESULTS

Below 1 GHz

Operation Mode: Normal Mode

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
㎒	dB㎶	dB /m	dB	(H/V)	dB㎶/m	dB㎶/m	dB
No Critical peaks found							

Notes:

1. Measuring frequencies from 30 MHz to the 1 GHz.
2. Radiated emissions measured in frequency range from 30 MHz to 1000 MHz were made with an instrument using Quasi peak detector mode.
3. We have done x planes in EUT and horizontal and vertical polarization in detecting antenna.

Above 1 GHz

Band :	UNII 1
Operation Mode:	802.11 a
Transfer Rate:	6 Mbps
Operating Frequency	5180 MHz
Channel No.	36 Ch

Frequency [MHz]	Reading dBuV	AN.+CL-Amp G.+D.F. [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
10360	30.55	6.89	V	37.44	68.20	30.76	PK
15540	45.12	12.57	V	57.69	73.98	16.29	PK
15540	31.55	12.57	V	44.12	53.98	9.86	AV
10360	30.65	6.89	H	37.54	68.20	30.66	PK
15540	45.87	12.57	H	58.44	73.98	15.54	PK
15540	31.60	12.57	H	44.17	53.98	9.81	AV

*AN. : Antenna Factor / CL : Cable Loss / Amp.G. : Amplifier Gain / D.F. : Distance Factor

Notes:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain + Distance Factor
5. We have done all data rate in 802.11a. Worst case is 6 Mbps in 802.11a.
6. We have done x planes in EUT and horizontal and vertical polarization in detecting antenna.
7. Distance extrapolation factor = 20 log (test distance / specific distance) (dB)

Band :	UNII 1
Operation Mode:	802.11 a
Transfer Rate:	6 Mbps
Operating Frequency	5200 MHz
Channel No.	40 Ch

Frequency [MHz]	Reading dBuV	AN.+CL-Amp G.+D.F. [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
10400	43.62	6.94	V	50.56	68.20	17.64	PK
15600	44.68	11.47	V	56.15	73.98	17.83	PK
15600	30.74	11.47	V	42.21	53.98	11.77	AV
10400	43.71	6.94	H	50.65	68.20	17.55	PK
15600	44.72	11.47	H	56.19	73.98	17.79	PK
15600	30.60	11.47	H	42.07	53.98	11.91	AV

*AN. : Antenna Factor / CL : Cable Loss / Amp.G. : Amplifier Gain / D.F. : Distance Factor

Notes:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain + Distance Factor
5. We have done all data rate in 802.11a. Worst case is 6 Mbps in 802.11a.
6. We have done x planes in EUT and horizontal and vertical polarization in detecting antenna.
7. Distance extrapolation factor = 20 log (test distance / specific distance) (dB)

Band :	UNII 1
Operation Mode:	802.11 a
Transfer Rate:	6 Mbps
Operating Frequency	5240 MHz
Channel No.	48 Ch

Frequency [MHz]	Reading dBuV	AN.+CL-Amp G.+D.F. [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
10480	43.11	7.65	V	50.76	68.20	17.44	PK
15720	44.15	11.66	V	55.81	73.98	18.17	PK
15720	30.10	11.66	V	41.76	53.98	12.22	AV
10480	43.19	7.65	H	50.84	68.20	17.36	PK
15720	43.63	11.66	H	55.29	73.98	18.69	PK
15720	29.80	11.66	H	41.46	53.98	12.52	AV

*AN. : Antenna Factor / CL : Cable Loss / Amp.G. : Amplifier Gain / D.F. : Distance Factor

Notes:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain + Distance Factor
5. We have done all data rate in 802.11a. Worst case is 6 Mbps in 802.11a.
6. We have done x planes in EUT and horizontal and vertical polarization in detecting antenna.
7. Distance extrapolation factor = 20 log (test distance / specific distance) (dB)

Band :	UNII 1
Operation Mode:	802.11 n_HT20
Transfer MCS Index:	0
Operating Frequency	5180 MHz
Channel No.	36 Ch

Frequency [MHz]	Reading dBuV	AN.+CL-Amp G.+D.F. [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
10360	44.30	6.89	V	51.19	68.20	17.01	PK
15540	45.45	12.57	V	58.02	73.98	15.96	PK
15540	31.45	12.57	V	44.02	53.98	9.96	AV
10360	44.43	6.89	H	51.32	68.20	16.88	PK
15540	45.38	12.57	H	57.95	73.98	16.03	PK
15540	31.57	12.57	H	44.14	53.98	9.84	AV

*AN. : Antenna Factor / CL : Cable Loss / Amp.G. : Amplifier Gain / D.F. : Distance Factor

Notes:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain + Distance Factor
5. We have done all data rate in 802.11n_HT20. Worst case is MCS0 in 802.11n_HT20.
6. We have done x planes in EUT and horizontal and vertical polarization in detecting antenna.
7. Distance extrapolation factor = 20 log (test distance / specific distance) (dB)

Band :	UNII 1
Operation Mode:	802.11 n_HT20
Transfer MCS Index:	0
Operating Frequency	5200 MHz
Channel No.	40 Ch

Frequency [MHz]	Reading dBuV	AN.+CL-Amp G.+D.F. [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
10400	43.81	6.94	V	50.75	68.20	17.45	PK
15600	44.84	11.47	V	56.31	73.98	17.67	PK
15600	30.95	11.47	V	42.42	53.98	11.56	AV
10400	43.65	6.94	H	50.59	68.20	17.61	PK
15600	44.58	11.47	H	56.05	73.98	17.93	PK
15600	31.05	11.47	H	42.52	53.98	11.46	AV

*AN. : Antenna Factor / CL : Cable Loss / Amp.G. : Amplifier Gain / D.F. : Distance Factor

Notes:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain + Distance Factor
5. We have done all data rate in 802.11n_HT20. Worst case is MCS0 in 802.11n_HT20.
6. We have done x planes in EUT and horizontal and vertical polarization in detecting antenna.
7. Distance extrapolation factor = 20 log (test distance / specific distance) (dB)

Band :	UNII 1
Operation Mode:	802.11 n_HT20
Transfer MCS Index:	0
Operating Frequency	5240 MHz
Channel No.	48 Ch

Frequency [MHz]	Reading dBuV	AN.+CL-Amp G.+D.F. [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
10480	43.69	7.65	V	51.34	68.20	16.86	PK
15720	43.94	11.66	V	55.60	73.98	18.38	PK
15720	30.01	11.66	V	41.67	53.98	12.31	AV
10480	43.21	7.65	H	50.86	68.20	17.34	PK
15720	43.92	11.66	H	55.58	73.98	18.40	PK
15720	29.94	11.66	H	41.60	53.98	12.38	AV

*AN. : Antenna Factor / CL : Cable Loss / Amp.G. : Amplifier Gain / D.F. : Distance Factor

Notes:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain + Distance Factor
5. We have done all data rate in 802.11n_HT20. Worst case is MCS0 in 802.11n_HT20.
6. We have done x planes in EUT and horizontal and vertical polarization in detecting antenna.
7. Distance extrapolation factor = 20 log (test distance / specific distance) (dB)

Band :	UNII 3
Operation Mode:	802.11 a
Transfer Rate:	6 Mbps
Operating Frequency	5745MHz
Channel No.	149 Ch

Frequency [MHz]	Reading dBuV	AN.+CL-Amp G.+D.F. [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
11490	42.13	9.31	V	51.44	73.98	22.54	PK
11490	28.66	9.31	V	37.97	53.98	16.01	AV
17235	44.62	14.49	V	59.11	68.20	9.09	PK
11490	42.23	9.31	H	51.54	73.98	22.44	PK
11490	28.70	9.31	H	38.01	53.98	15.97	AV
17235	44.95	14.49	H	59.44	68.20	8.76	PK

*AN. : Antenna Factor / CL : Cable Loss / Amp.G. : Amplifier Gain / D.F. : Distance Factor

Notes:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain + Distance Factor
5. We have done all data rate in 802.11a. Worst case is 6 Mbps in 802.11a.
6. We have done x planes in EUT and horizontal and vertical polarization in detecting antenna.
7. Distance extrapolation factor = 20 log (test distance / specific distance) (dB)

Band :	UNII 3
Operation Mode:	802.11 a
Transfer Rate:	6 Mbps
Operating Frequency	5785 MHz
Channel No.	157 Ch

Frequency [MHz]	Reading dBuV	AN.+CL-Amp G.+D.F. [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
11570	42.98	9.38	V	52.36	73.98	21.62	PK
11570	29.17	9.38	V	38.55	53.98	15.43	AV
17355	43.98	15.74	V	59.72	68.20	8.48	PK
11570	43.10	9.38	H	52.48	73.98	21.50	PK
11570	29.27	9.38	H	38.65	53.98	15.33	AV
17355	44.59	15.74	H	60.33	68.20	7.87	PK

*AN. : Antenna Factor / CL : Cable Loss / Amp.G. : Amplifier Gain / D.F. : Distance Factor

Notes:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain + Distance Factor
5. We have done all data rate in 802.11a. Worst case is 6 Mbps in 802.11a.
6. We have done x planes in EUT and horizontal and vertical polarization in detecting antenna.
7. Distance extrapolation factor = 20 log (test distance / specific distance) (dB)

Band :	UNII 3
Operation Mode:	802.11 a
Transfer Rate:	6 Mbps
Operating Frequency	5825 MHz
Channel No.	165 Ch

Frequency [MHz]	Reading dBuV	AN.+CL-Amp G.+D.F. [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
11650	44.02	8.33	V	52.35	73.98	21.63	PK
11650	29.68	8.33	V	38.01	53.98	15.97	AV
17475	44.43	16.79	V	61.22	68.20	6.98	PK
11650	44.16	8.33	H	52.49	73.98	21.49	PK
11650	30.02	8.33	H	38.35	53.98	15.63	AV
17475	45.02	16.79	H	61.81	68.20	6.39	PK

*AN. : Antenna Factor / CL : Cable Loss / Amp.G. : Amplifier Gain / D.F. : Distance Factor

Notes:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain + Distance Factor
5. We have done all data rate in 802.11a. Worst case is 6 Mbps in 802.11a.
6. We have done x planes in EUT and horizontal and vertical polarization in detecting antenna
7. Distance extrapolation factor = 20 log (test distance / specific distance) (dB)

Band :	UNII 3
Operation Mode:	802.11 n_HT20
Transfer MCS Index:	0
Operating Frequency	5745 MHz
Channel No.	149 Ch

Frequency [MHz]	Reading dBuV	AN.+CL-Amp G.+D.F. [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
11490	42.33	9.31	V	51.64	73.98	22.34	PK
11490	28.61	9.31	V	37.92	53.98	16.06	AV
17235	44.59	14.49	V	59.08	68.20	9.12	PK
11490	42.19	9.31	H	51.50	73.98	22.48	PK
11490	28.65	9.31	H	37.96	53.98	16.02	AV
17235	44.87	14.49	H	59.36	68.20	8.84	PK

*AN. : Antenna Factor / CL : Cable Loss / Amp.G. : Amplifier Gain / D.F. : Distance Factor

Notes:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain + Distance Factor
5. We have done all data rate in 802.11n_HT20. Worst case is MCS0 in 802.11n_HT20.
6. We have done x planes in EUT and horizontal and vertical polarization in detecting antenna.
7. Distance extrapolation factor = 20 log (test distance / specific distance) (dB)

Band :	UNII 3
Operation Mode:	802.11 n_HT20
Transfer MCS Index:	0
Operating Frequency	5785 MHz
Channel No.	157 Ch

Frequency [MHz]	Reading dBuV	AN.+CL-Amp G.+D.F. [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
11570	43.39	9.38	V	52.77	73.98	21.21	PK
11570	29.21	9.38	V	38.59	53.98	15.39	AV
17355	43.51	15.74	V	59.25	68.20	8.95	PK
11570	42.98	9.38	H	52.36	73.98	21.62	PK
11570	29.25	9.38	H	38.63	53.98	15.35	AV
17355	44.59	15.74	H	60.33	68.20	7.87	PK

*AN. : Antenna Factor / CL : Cable Loss / Amp.G. : Amplifier Gain / D.F. : Distance Factor

Notes:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain + Distance Factor
5. We have done all data rate in 802.11n_HT20. Worst case is MCS0 in 802.11n_HT20.
6. We have done x planes in EUT and horizontal and vertical polarization in detecting antenna.
7. Distance extrapolation factor = 20 log (test distance / specific distance) (dB)

Band :	UNII 3
Operation Mode:	802.11 n_HT20
Transfer MCS Index:	0
Operating Frequency	5825 MHz
Channel No.	165 Ch

Frequency [MHz]	Reading dBuV	AN.+CL-Amp G.+D.F. [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
11650	43.87	8.33	V	52.20	73.98	21.78	PK
11650	29.62	8.33	V	37.95	53.98	16.03	AV
17475	44.58	16.79	V	61.37	68.20	6.83	PK
11650	43.85	8.33	H	52.18	73.98	21.80	PK
11650	29.94	8.33	H	38.27	53.98	15.71	AV
17475	44.76	16.79	H	61.55	68.20	6.65	PK

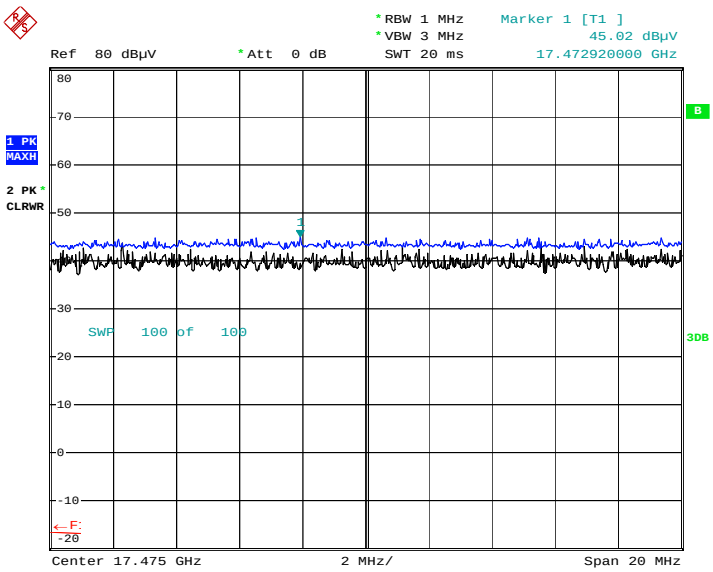
*AN. : Antenna Factor / CL : Cable Loss / Amp.G. : Amplifier Gain / D.F. : Distance Factor

Notes:

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental frequency.
2. Measurements above show only up to 6 maximum emissions noted, or would be lesser if no specific emissions from the EUT are recorded (ie: margin > 20 dB from the applicable limit) and considered that's already beyond the background noise floor.
3. Radiated emissions measured in frequency above 1000MHz were made with an instrument using Peak detector mode and average detector mode of the emission shown in Actual FS column.
4. Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain + Distance Factor
5. We have done all data rate in 802.11n_HT20. Worst case is MCS0 in 802.11n_HT20.
6. We have done x planes in EUT and horizontal and vertical polarization in detecting antenna.
7. Distance extrapolation factor = 20 log (test distance / specific distance) (dB)

▣ RESULT PLOTS

Radiated Spurious Emissions plot –Peak Reading (802.11a, Ch.165 3rd Harmonic, X-H)



Date: 20.SEP.2018 14:05:50

Note : Only the worst case plots for Radiated Spurious Emissions.

10.7.2 RADIATED RESTRICTED BAND EDGE MEASUREMENTS

Test Requirements and limit, §15.247(d) §15.205, §15.209

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in section 15.209(a) (See section 15.205(c)).

Band :	UNII 1
Operation Mode:	802.11 a
Transfer Rate:	6 Mbps
Operating Frequency	5180 MHz
Channel No.	36 Ch

Frequency [MHz]	Reading dBuV	AN.+CL+AMP+ATT. +D.F. [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
5150	57.73	5.75	H	63.48	73.98	10.50	PK
5150	39.41	5.75	H	45.16	53.98	8.82	AV
5150	56.89	5.75	V	62.64	73.98	11.34	PK
5150	39.32	5.75	V	45.07	53.98	8.91	AV

Band :	UNII 1
Operation Mode:	802.11 n_HT20
Transfer MCS Index:	0
Operating Frequency	5180 MHz
Channel No.	36 Ch

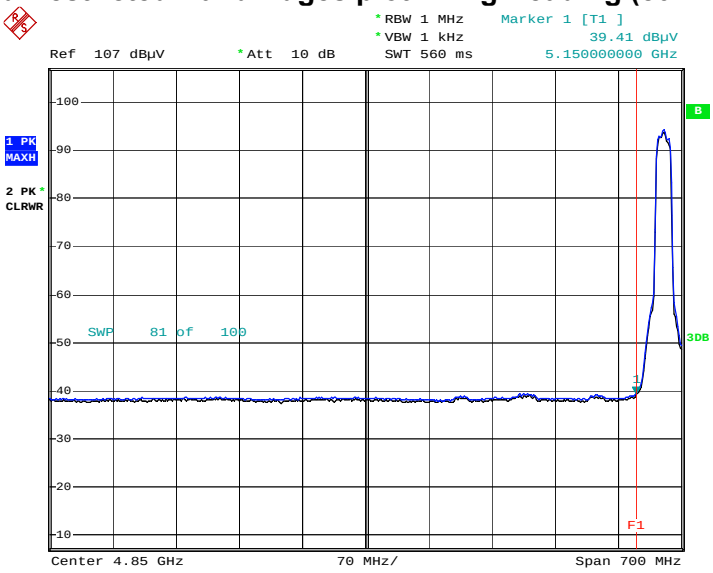
Frequency [MHz]	Reading dBuV	AN.+CL+AMP+ATT. +D.F. [dB]	ANT. POL [H/V]	Total [dBuV/m]	Limit [dBuV/m]	Margin [dB]	Measurement Type
5150	59.07	5.75	H	64.82	73.98	9.16	PK
5150	39.41	5.75	H	45.16	53.98	8.82	AV
5150	56.87	5.75	V	62.62	73.98	11.36	PK
5150	39.30	5.75	V	45.05	53.98	8.93	AV

Notes:

1. Total = Reading Value + Antenna Factor + Cable Loss - Amp Gain + ATT + Distance Factor
2. We have done all data rate in 802.11a/n mode test. . Worst case of EUT is lowest data rate in 802.11a/n.
3. We have done x, planes in EUT and horizontal and vertical polarization in detecting antenna.

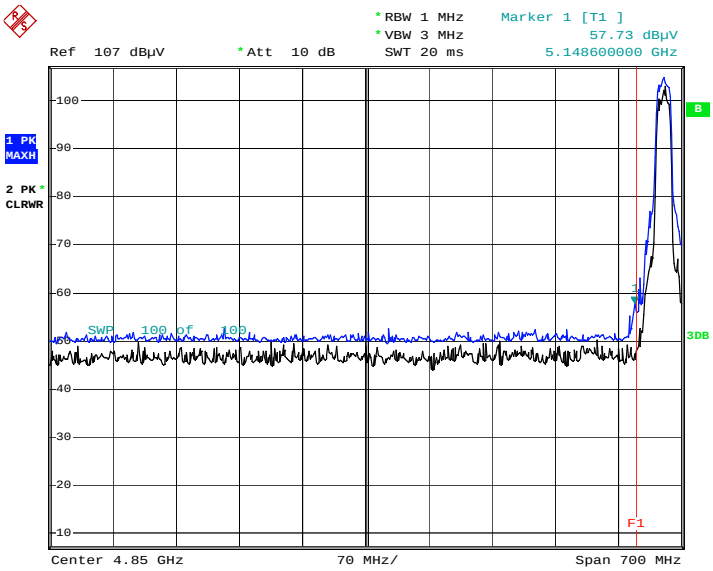
▣ RESULT PLOTS (UNII 1)

Radiated Restricted Band Edges plot – Avg Reading (802.11a, Ch.36, X-H)



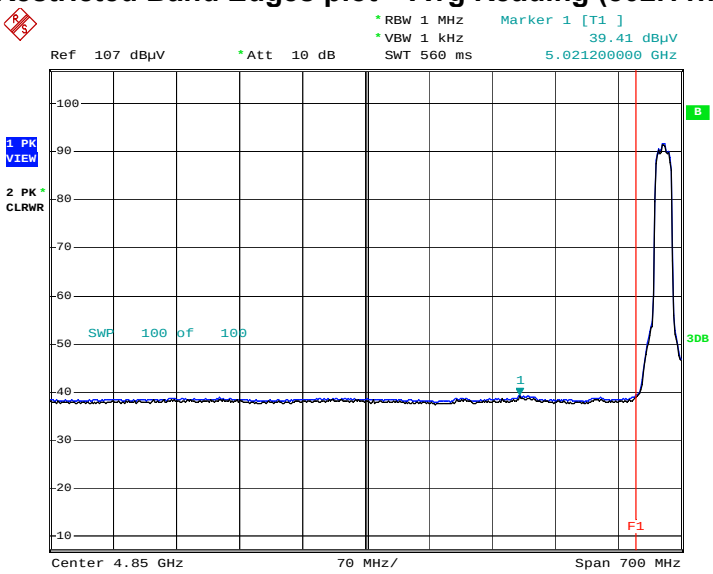
Date: 20.SEP.2018 13:49:59

Radiated Restricted Band Edges plot – Peak Reading (802.11a, Ch.165, X-H)



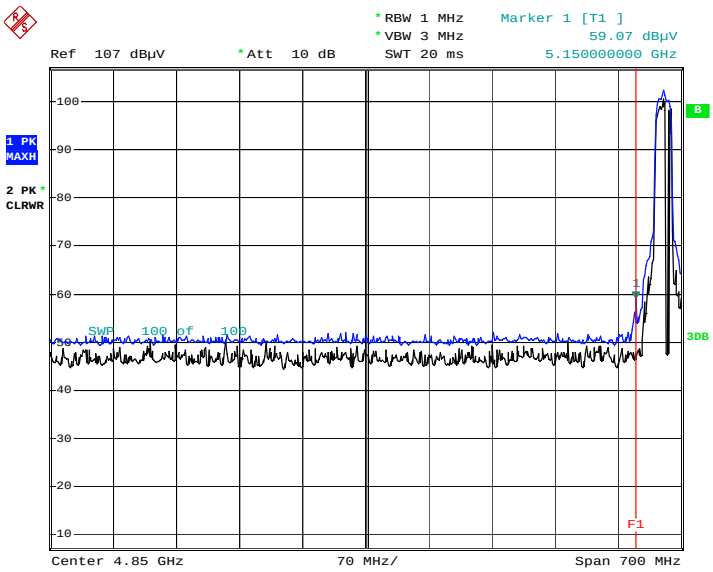
Date: 20.SEP.2018 13:52:11

Radiated Restricted Band Edges plot – Avg Reading (802.11n_HT20Ch.36 X-H)



Date: 20.SEP.2018 13:55:45

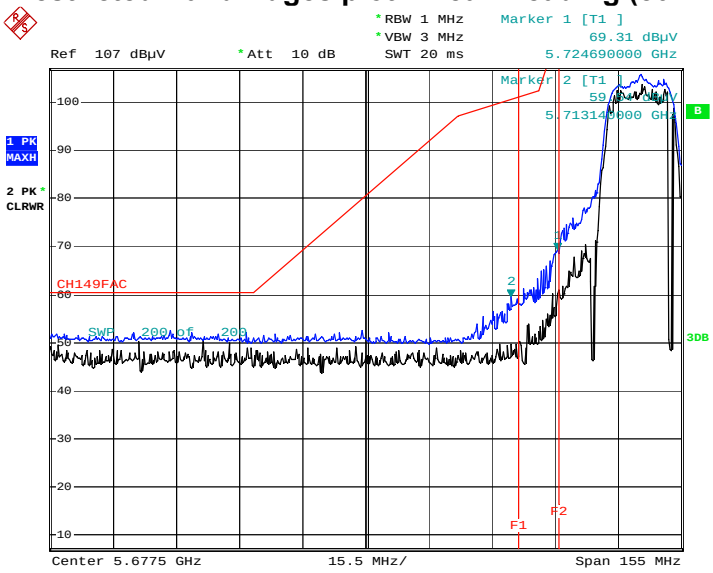
Radiated Restricted Band Edges plot – Peak Reading (802.11n_HT20Ch.36 X-H)



Date: 20.SEP.2018 13:54:08

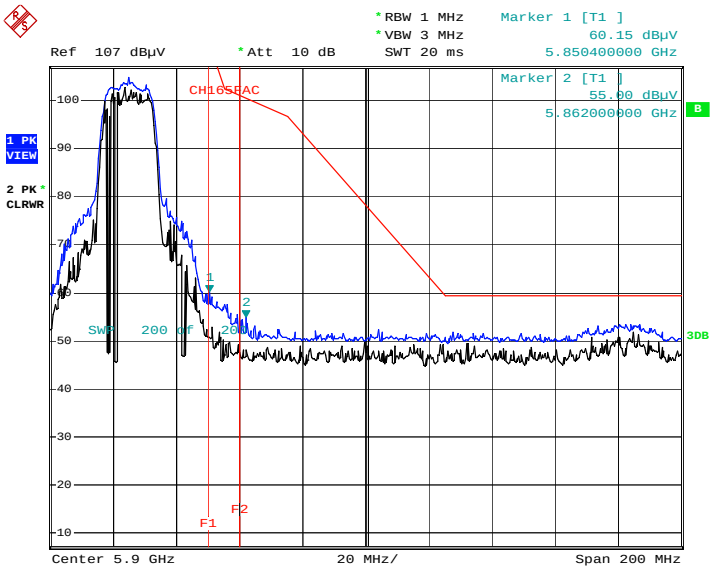
▣ RESULT PLOTS (UNII 3)

Radiated Restricted Band Edges plot – Peak Reading (802.11a, Ch.149, X-H)



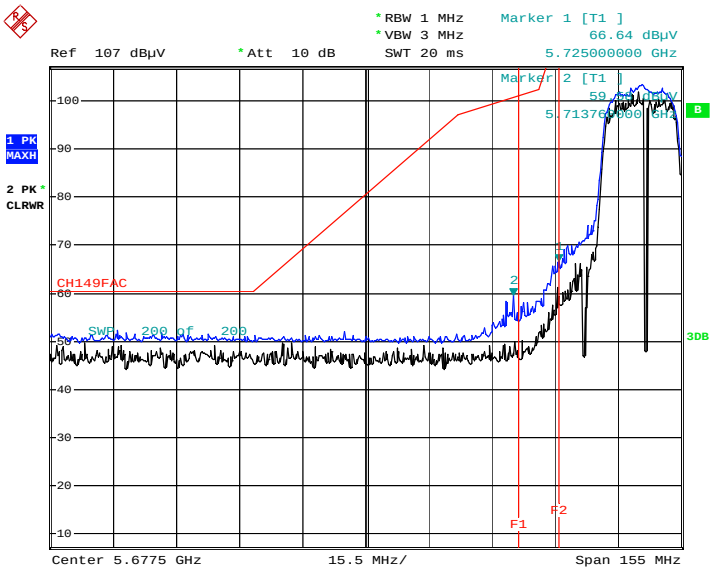
Date: 18.SEP.2018 15:45:31

Radiated Restricted Band Edges plot – Peak Reading (802.11a, Ch.165, X-H)



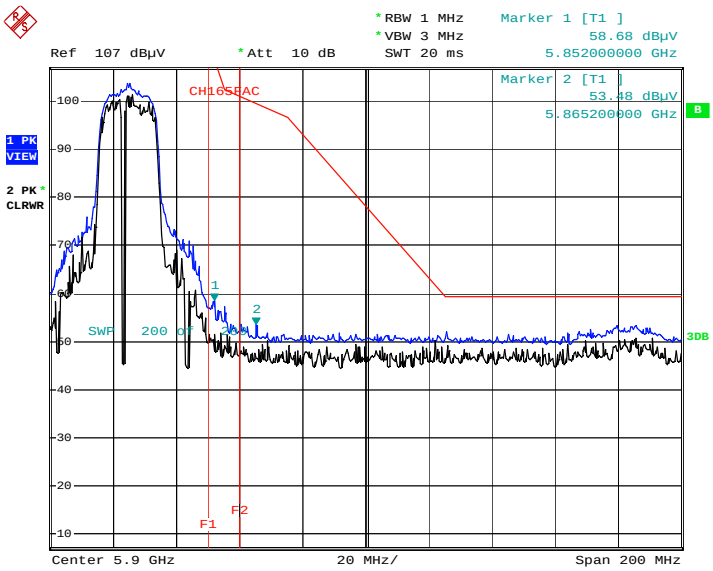
Date: 18.SEP.2018 15:57:30

Radiated Restricted Band Edges plot – Peak Reading (802.11n_HT20, Ch.149 X-H)



Date: 18.SEP.2018 15:48:47

Radiated Restricted Band Edges plot – Peak Reading (802.11n_HT20, Ch.165 X-H)



Date: 18.SEP.2018 15:59:49

10.7.3 RECEIVER SPURIOUS EMISSIONS

IC Rule(s)	**RSS-Gen**
Test Requirements:	**Blow the table**
Operating conditions:	**Under normal test conditions**
Method of testing:	**Radiated**
S/A. Settings:	**F < 1 GHz: RBW: 120 kHz, VBW: 300 kHz (Quasi Peak)** **F > 1 GHz: RBW: 1 MHz, VBW: 1 MHz (Peak)**
Mode of operation:	**Receive**

Frequency (MHz)	Field Strength (microvolts/m at 3 meters)
30 – 88	100
88 - 216	150
216 – 960	200
Above 960	500

Operation Mode: Receive:

30 MHz ~ 1 GHz

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
㎒	dB㎶	dB /m	dB	(H/V)	dB㎶/m	dB㎶/m	dB
No Critical peaks found							

Above 1 GHz

Frequency	Reading	Ant. factor	Cable loss	Ant. POL	Total	Limit	Margin
㎒	dB㎶	dB /m	dB	(H/V)	dB㎶/m	dB㎶/m	dB
No Critical peaks found							

10.8 POWERLINE CONDUCTED EMISSIONS

Test Requirements and limit, §15.207

For an intentional radiator which is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed 250 microvolts (The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz). The limits at specific frequency range is listed as follows:

Frequency Range (MHz)	Limits (dBμV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line (LINE and NEUTRAL) and ground at the power terminals.

Test Configuration

See test photographs attached in Appendix 1 for the actual connections between EUT and support equipment.

TEST PROCEDURE

1. The EUT is placed on a wooden table 80 cm above the reference groundplane.
2. The EUT is connected via LISN to a test power supply.
3. The measurement results are obtained as described below:
4. Detectors – Quasi Peak and Average Detector.

Sample Calculation

Quasi-peak(Final Result) = Reading Value + Correction Factor

Note : We don’t perform powerline conducted emission test. Because this EUT is used with vehicle.

11. LIST OF TEST EQUIPMENT

11.1 LIST OF TEST EQUIPMENT(Conducted Test)

Manufacturer	Model / Equipment	Calibration Date	Calibration Interval	Serial No.
Rohde & Schwarz	ENV216 / LISN	12/20/2017	Annual	102245
Rohde & Schwarz	ESCI / Test Receiver	06/27/2018	Annual	100033
ESPAC	SU-642 /Temperature Chamber	03/30/2018	Annual	0093008124
Agilent	N9020A / Signal Analyzer	06/08/2018	Annual	MY51110085
Agilent	N9030A / Signal Analyzer	11/22/2017	Annual	MY49431210
Agilent	N1911A / Power Meter	04/16/2018	Annual	MY45100523
Agilent	N1921A / Power Sensor	04/16/2018	Annual	MY52260025
Agilent	87300B / Directional Coupler	11/20/2017	Annual	3116A03621
Hewlett Packard	11667B / Power Splitter	06/07/2018	Annual	05001
Hewlett Packard	E3632A / DC Power Supply	06/26/2018	Annual	KR75303960
Agilent	8493C / Attenuator(10 dB)	07/10/2018	Annual	07560
Rohde & Schwarz	EMC32 / Software	N/A	N/A	N/A
HCT CO., LTD.	FCC WLAN&BT&BLE Conducted Test Software v3.0	N/A	N/A	N/A

11.2 LIST OF TEST EQUIPMENT(Radiated Test)

Manufacturer	Model / Equipment	Calibration Date	Calibration Interval	Serial No.
Innco system	CO3000 / Controller(Antenna mast)	N/A	N/A	CO3000-4p
Innco system	MA4640/800-XP-EP / Antenna Position Tower	N/A	N/A	N/A
Emco	2090 / Controller	N/A	N/A	060520
Ets	Turn Table	N/A	N/A	N/A
Rohde & Schwarz	Loop Antenna	08/23/2018	Biennial	1513-175
Schwarzbeck	VULB 9160 / Hybrid Antenna	08/09/2018	Biennial	3368
Schwarzbeck	BBHA 9120D / Horn Antenna	11/21/2017	Biennial	9120D-1191
Schwarzbeck	BBHA9170 / Horn Antenna(15 GHz ~ 40 GHz)	12/04/2017	Biennial	BBHA9170541
Rohde & Schwarz	FSP(9 kHz ~ 30 GHz) / Spectrum Analyzer	09/19/2018	Annual	836650/016
Rohde & Schwarz	FSV40-N / Spectrum Analyzer	09/19/2018	Annual	101068-SZ
Wainwright Instruments	WHKX10-2700-3000-18000-40SS / High Pass Filter	07/16/2018	Annual	4
Wainwright Instruments	WHKX8-6090-7000-18000-40SS / High Pass Filter	07/10/2018	Annual	5
Wainwright Instruments	WRCJV2400/2483.5-2370/2520-60/12SS / Band Reject Filter	06/29/2018	Annual	2
Wainwright Instruments	WRCJV5100/5850-40/50-8EEK / Band Reject Filter	01/03/2018	Annual	2
Api tech.	18B-03 / Attenuator (3 dB)	06/07/2018	Annual	2
WEINSCHEL	56-10 / Attenuator(10 dB)	10/13/2017	Annual	72316
CERNEX	CBLU1183540 / Broadband Low Noise Amplifier	01/03/2018	Annual	24613
CERNEX	CBL06185030 / Broadband Low Noise Amplifier	01/03/2018	Annual	24615
CERNEX	CBL18265035 / Power Amplifier	01/10/2018	Annual	22966
CERNEX	CBL26405040 / Power Amplifier	06/29/2018	Annual	25956

12. APPENDIX A_EUT AND TEST SETUP PHOTO

Please refer to test setup photo file no. as follows;

No.	Description
1	HCT-RF-1810-FI001-P
2	HCT-RF-1810-FI002-P
3	HCT-RF-1810-FI003-P