



FCC RF Test Report

APPLICANT : Honeywell International Inc.
Honeywell Safety and Productivity Solutions

EQUIPMENT : RT10A

BRAND NAME : Honeywell

MODEL NAME : RT10AL0N

FCC ID : HD5-RT10AL0N

STANDARD : FCC Part 15 Subpart C §15.247

CLASSIFICATION : (DTS) Digital Transmission System

The product was received on May 23, 2020 and testing was completed on Aug. 25, 2020. We, Sporton International (Kunshan) Inc., would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International (Kunshan) Inc., the test report shall not be reproduced except in full.

Jason Jia

Reviewed by: Jason Jia / Supervisor

James Huang

Approved by: James Huang / Manager



Sporton International (Kunshan) Inc.

**No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300
People's Republic of China**



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REVISION HISTORY

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FR052309C	Rev. 01	Initial issue of report	Aug. 27, 2020



SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit	Result	Remark
-	15.247(a)(2)	6dB Bandwidth	$\geq 0.5\text{MHz}$	Pass	1
3.1	15.247(b)	Power Output Measurement	$\leq 30\text{dBm}$	Pass	-
-	15.247(e)	Power Spectral Density	$\leq 8\text{dBm}/3\text{kHz}$	Pass	1
-	15.247(d)	Conducted Band Edges	$\leq 20\text{dBc}$	Pass	1
		Conducted Spurious Emission		Pass	1
3.2	15.247(d)	Radiated Band Edges and Radiated Spurious Emission	15.209(a) & 15.247(d)	Pass	Under limit 3.31 dB at 2483.500 MHz
3.3	15.207	AC Conducted Emission	15.207(a)	Pass	Under limit 6.15 dB at 17.475 MHz
3.4	15.203 & 15.247(b)	Antenna Requirement	N/A	Pass	-
Remark 1: All conducted test items were leveraged from module RF report which can refer to Report No. "RF171130C26-5"					

Declaration of Conformity:

The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers.

Comments and Explanations:

The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.



1 General Description

1.1 Applicant

Honeywell International Inc.
Honeywell Safety and Productivity Solutions
9680 Old Bailes Rd. Fort Mill, SC 29707 United States

1.2 Manufacturer

Honeywell International Inc.
Honeywell Safety and Productivity Solutions
9680 Old Bailes Rd. Fort Mill, SC 29707 United States

1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	RT10A
Brand Name	Honeywell
Model Name	RT10AL0N
FCC ID	HD5-RT10AL0N
EUT supports Radios application	WLAN 2.4GHz 802.11b/g/n HT20 WLAN 5GHz 802.11a/n HT20/HT40 WLAN 5GHz 802.11ac VHT20/VHT40/VHT80 Bluetooth BR/EDR/LE NFC
HW Version	V1.0
SW Version	WLAN.HL.1.0.1.c2.3
EUT Stage	Identical Prototype

Remark:

1. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.
2. This product installed a RF module (Brand Name: Honeywell, Model Name: SOM660W, FCC ID: HD5-660W) during the test, only Conducted power, Conduction and RSE test items are tested in this report, all the other test results are referred to module RF report "RF171130C26-5".

1.4 Product Specification of Equipment Under Test

Standards-related Product Specification			
Tx/Rx Channel Frequency Range	2412 MHz ~ 2462 MHz		
Maximum (Peak) Output Power to antenna	<MIMO Ant.1+2> 802.11b : 21.30 dBm (0.1349 W) 802.11g : 25.96 dBm (0.3945 W) 802.11n HT20 : 25.70 dBm (0.3715 W)		
Antenna Type / Gain	Antenna 1: PIFA Antenna type with gain 1.40 dBi Antenna 2: IFA Antenna type with gain 1.80 dBi		
Antenna Function for Transmitter		Ant. 1	Ant. 2
	802.11b/g/n MIMO	V	V
Type of Modulation	802.11b : DSSS (DBPSK / DQPSK / CCK) 802.11g/n : OFDM (BPSK / QPSK / 16QAM / 64QAM)		

1.5 Modification of EUT

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

1.6 Testing Location

Sporton International (Kunshan) Inc. is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

Test Firm	Sporton International (Kunshan) Inc.		
Test Site Location	No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China TEL : +86-512-57900158 FAX : +86-512-57900958		
Test Site No.	Sporton Site No.	FCC Designation No.	FCC Test Firm Registration No.
	TH01-KS CO01-KS 03CH06-KS	CN1257	314309

1.7 Test Software

Item	Site	Manufacture	Name	Version
1.	03CH06-KS	AUDIX	E3	6.2009-8-24a1
2.	CO01-KS	AUDIX	E3	6.2009-8-24



1.8 Applicable Standards

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

- ♦ 47 CFR Part 15 Subpart C §15.247
- ♦ FCC KDB 558074 D01 15.247 Meas Guidance v05r02
- ♦ FCC KDB 662911 D01 Multiple Transmitter Output v02r01.
- ♦ ANSI C63.10-2013

Remark:

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

2 Test Configuration of Equipment Under Test

- a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: conduction emission (150 kHz to 30 MHz), radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower). For radiated measurement, pre-scanned in three orthogonal panels, X, Y, Z. The worst cases (Y plane) were recorded in this report.
- b. AC power line Conducted Emission was tested under maximum output power.

2.1 Carrier Frequency and Channel

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

2.2 Test Mode

Final test modes are considering the modulation and worse data rates as below table.

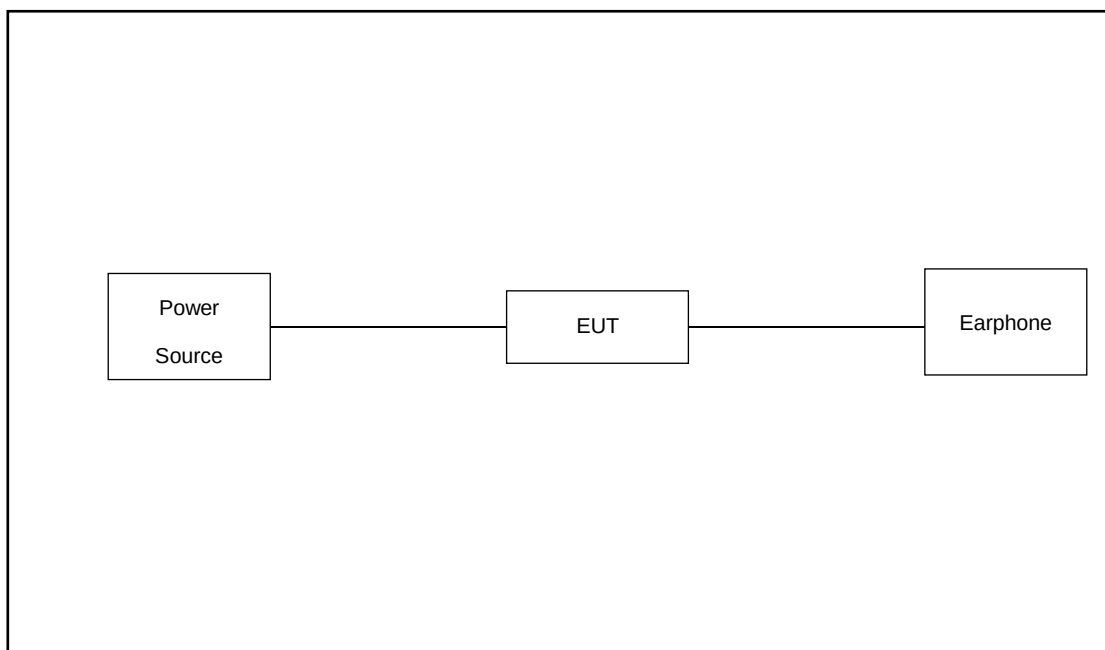
MIMO Antenna

Modulation	Data Rate
802.11b	1 Mbps
802.11g	6 Mbps
802.11n HT20	MCS0

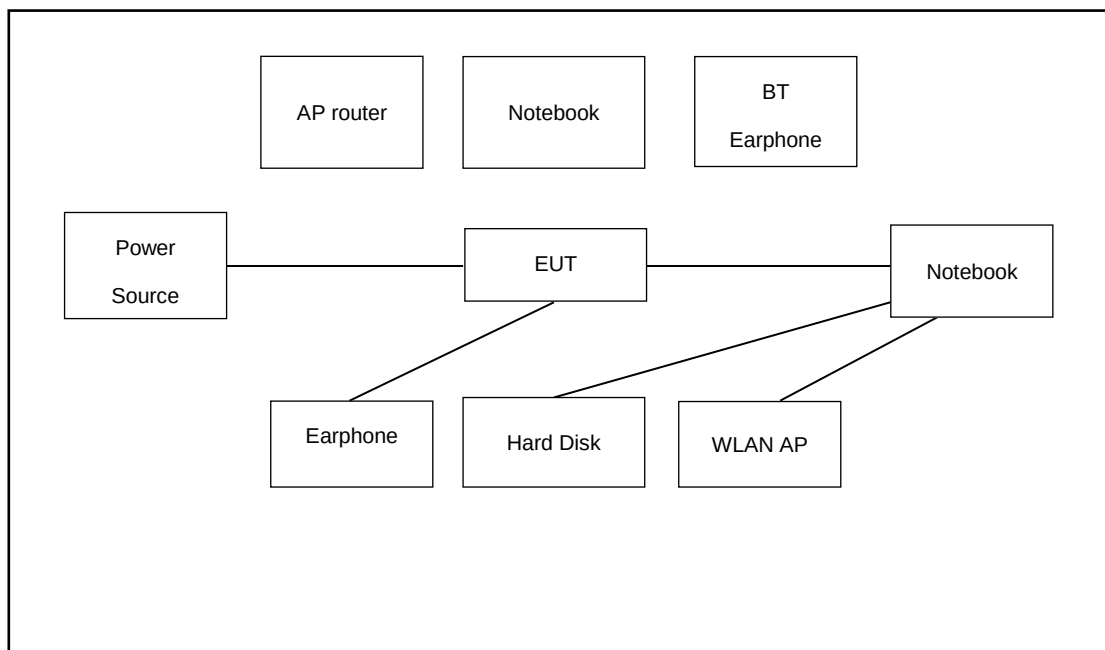
Test Cases	
AC Conducted Emission	Mode 1 : Bluetooth Link + WLAN Link (2.4G) + smart Reader With Read Card + USB Link With NB (Type-c Port) + USB Link With U Disk + Adaptor + Earphone + Battery 1
Remark: For Radiated Test Cases, The tests were performed with Adapter, Earphone and Battery 1.	

2.3 Connection Diagram of Test System

For Radiation



For Conducted Emission



2.4 Support Unit used in test configuration and system

Item	Equipment	Trade Name	Model Name	FCC ID	Data Cable	Power Cord
1.	BT Earphone	Lenovo	LBH308	N/A	N/A	N/A
2.	Notebook	Lenovo	V130-15IKB005	N/A	N/A	shielded cable DC O/P 1.8m , Unshielded AC I/P cable 1.8m
3.	Notebook	Lenovo	G480	QDS-BRCM1050I	N/A	shielded cable DC O/P 1.8m , Unshielded AC I/P cable 1.8m
4.	Router	D-Link	DIR-655	KA21R655B1	N/A	Unshielded,1.8m
5.	SD Card	Kingston	8GB	N/A	N/A	N/A
6.	Hard Disk	Lenovo	F310	DoC	Shielded, 1.2m	N/A
7.	U Disk	Kingston	N/A	N/A	N/A	N/A
8.	Earphone	Lenovo	P121	N/A	Unshielded,1.2m	N/A

2.5 EUT Operation Test Setup

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

For AC power line conducted emissions, the EUT was set to connect with the WLAN AP under large package sizes transmission.

3 Test Result

3.1 Output Power Measurement

3.1.1 Limit of Output Power

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

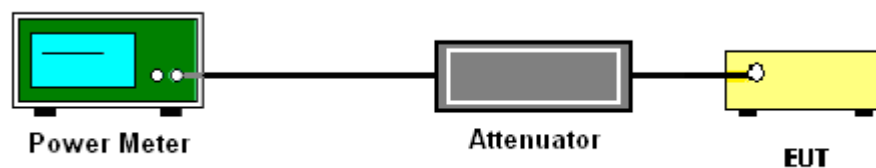
3.1.2 Measuring Instruments

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

3.1.3 Test Procedures

1. The testing follows the Measurement Procedure of ANSI C63.10-2013 clause 11.9.1.3 PKPM1 Peak power meter or ANSI C63.10-2013 clause 11.9.2.3.2 Method AVGPM-G method.
2. The RF output of EUT was connected to the power meter by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Measure the conducted output power and record the results in the test report.
5. For MIMO mode, calculation method follows FCC KDB 662911 D01 Multiple Transmitter Output v02r01.

3.1.4 Test Setup





3.1.5 Test Result of Peak Output Power

2.4GHz Band																
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Peak Conducted Power (dBm)			Conducted Power Limit (dBm)		DG (dBi)		EIRP Power (dBm)		EIRP Power Limit (dBm)		Pass /Fail
					Ant 1	Ant 2	SUM	Ant 1	Ant 2	Ant 1	Ant 2	Ant 1	Ant 2	Ant 1	Ant 2	
11b	1Mbps	2	1	2412	18.33	18.25	21.30	30.00		1.80		23.10		36.00		Pass
11b	1Mbps	2	6	2437	18.15	18.23	21.20	30.00		1.80		23.00		36.00		Pass
11b	1Mbps	2	11	2462	17.98	18.02	21.01	30.00		1.80		22.81		36.00		Pass
11g	6Mbps	2	1	2412	22.94	22.42	25.70	30.00		1.80		27.50		36.00		Pass
11g	6Mbps	2	6	2437	22.75	23.14	25.96	30.00		1.80		27.76		36.00		Pass
11g	6Mbps	2	11	2462	23.01	22.16	25.62	30.00		1.80		27.42		36.00		Pass
HT20	MCS0	2	1	2412	21.90	21.29	24.62	30.00		1.80		26.42		36.00		Pass
HT20	MCS0	2	6	2437	22.52	22.85	25.70	30.00		1.80		27.50		36.00		Pass
HT20	MCS0	2	11	2462	20.68	20.00	23.36	30.00		1.80		25.16		36.00		Pass

Note: Measured power (dBm) has offset with cable loss.



3.1.6 Test Result of Average output Power (Report only)

2.4GHz Band									
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Duty Factor (dB)		Average Conducted Power (dBm)		
					Ant 1	Ant 2	Ant 1	Ant 2	SUM
11b	1Mbps	2	1	2412	0.00	0.00	15.36	15.26	18.32
11b	1Mbps	2	6	2437	0.00	0.00	15.25	15.33	18.30
11b	1Mbps	2	11	2462	0.00	0.00	14.94	15.08	18.02
11g	6Mbps	2	1	2412	0.19	0.19	14.45	13.90	17.20
11g	6Mbps	2	6	2437	0.19	0.19	14.67	14.71	17.70
11g	6Mbps	2	11	2462	0.19	0.19	13.44	12.85	16.17
HT20	MCS0	2	1	2412	0.21	0.21	12.51	12.02	15.28
HT20	MCS0	2	6	2437	0.21	0.21	14.57	14.69	17.64
HT20	MCS0	2	11	2462	0.21	0.21	10.84	10.43	13.65

Note: Measured power (dBm) has offset with cable loss.

3.2 Radiated Band Edges and Spurious Emission Measurement

3.2.1 Limit of Radiated band edge and Spurious Emission Measurement

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

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 - 960	200	3
Above 960	500	3

3.2.2 Measuring Instruments

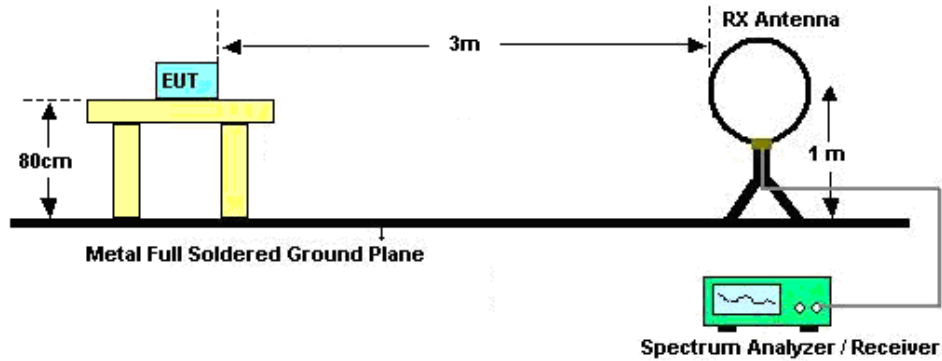
The measuring equipment is listed in the section 4 of this test report.

3.2.3 Test Procedures

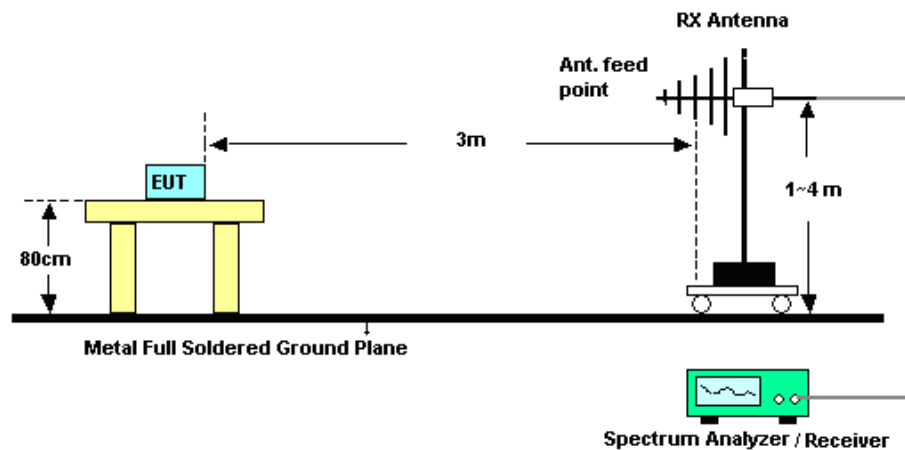
1. The testing follows ANSI C63.10-2013 clause 11.11 & 11.12
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
3. The EUT was placed on a turntable with 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz respectively above ground.
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
5. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
6. For testing below 1GHz, if the emission level of the EUT in peak mode was 3 dB lower than the limit specified, then peak values of EUT will be reported, otherwise, the emissions will be repeated one by one using the CISPR quasi-peak method and reported.
7. For testing above 1GHz, the emission level of the EUT in peak mode was 20dB lower than average limit (that means the emission level in average mode also complies with the limit in average mode), then peak values of EUT will be reported, otherwise, the emissions will be measured in average mode again and reported.
8. Use the following spectrum analyzer settings:
 - (1) Span shall wide enough to fully capture the emission being measured;
 - (2) Set RBW=100 kHz for $f < 1$ GHz; VBW $\geq$ RBW; Sweep = auto; Detector function = peak; Trace = max hold;
 - (3) Set RBW = 1 MHz, VBW= 3MHz for $f \geq 1$ GHz for peak measurement.
For average measurement:
 - VBW = 10 Hz, when duty cycle is no less than 98 percent.
 - VBW $\geq 1/T$, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

3.2.4 Test Setup

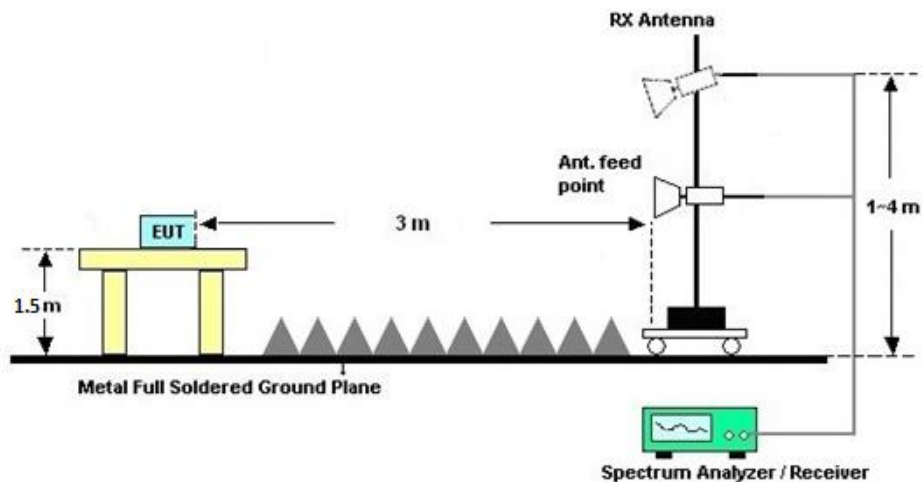
For radiated emissions below 30MHz



For radiated emissions from 30MHz to 1GHz



For radiated emissions above 1GHz





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

The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line was not reported.

There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

3.2.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix B.

3.2.7 Duty Cycle

Please refer to Appendix C.

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

Please refer to Appendix B.

3.3 AC Conducted Emission Measurement

3.3.1 Limit of AC Conducted Emission

For equipment that 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 the limits in the following table.

Frequency of Emission (MHz)	Conducted Limit (dB μ V)	
	Quasi-Peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

*Decreases with the logarithm of the frequency.

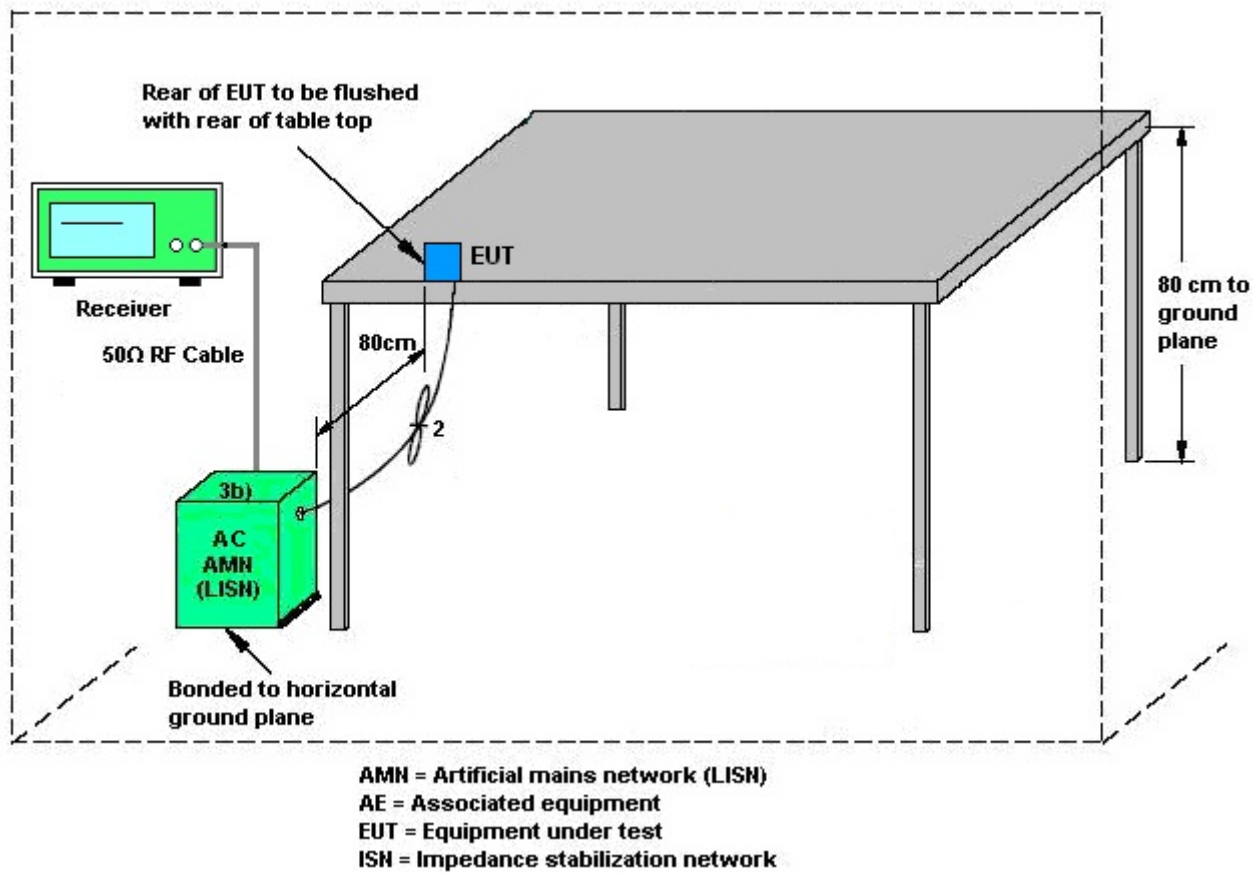
3.3.2 Measuring Instruments

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

3.3.3 Test Procedures

1. The EUT was placed 0.4 meter from the conducting wall of the shielding room, and it was kept at least 80 centimeters from any other grounded conducting surface.
2. Connect EUT to the power mains through a line impedance stabilization network (LISN).
3. All the support units are connecting to the other LISN.
4. The LISN provides 50 ohm coupling impedance for the measuring instrument.
5. The FCC states that a 50 ohm, 50 microhenry LISN should be used.
6. Both sides of AC line were checked for maximum conducted interference.
7. The frequency range from 150 kHz to 30 MHz was searched.
8. Set the test-receiver system to Peak Detect Function and specified bandwidth (IF bandwidth = 9kHz) with Maximum Hold Mode.

3.3.4 Test Setup



3.3.5 Test Result of AC Conducted Emission

Please refer to Appendix A.

3.4 Antenna Requirements

3.4.1 Standard Applicable

If directional gain of transmitting Antennas is greater than 6dBi, the power shall be reduced by the same level in dB comparing to gain minus 6dBi. 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 rule.

3.4.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

3.4.3 Antenna Gain

<CDD Modes >

FCC KDB 662911 D01 Multiple Transmitter Output v02r01

For CDD transmissions, directional gain is calculated as

Directional gain = G_{ANT} + Array Gain, where Array Gain is as follows.

For power spectral density (PSD) measurements on all devices,

Array Gain = $10 \log(N_{ANT}/N_{SS}=1)$ dB.

For power measurements on IEEE 802.11 devices,

Array Gain = 0 dB (i.e., no array gain) for $N_{ANT} \leq 4$.

Directional gain may be calculated by using the formulas applicable to equal gain antennas with G_{ANT} set equal to the gain of the antenna having the highest gain;

The EUT supports CDD mode.

For power, the directional gain G_{ANT} is set equal to the antenna having the highest gain, i.e., F)2)f)i).

For PSD, the directional gain calculation is following F)2)f)ii) of KDB 662911 D01 v02r01.

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

The directional gain "DG" is calculated as following table.

<CDD Modes>						
	Ant. 1	Ant. 2	DG for Power	DG for PSD	Power Limit Reduction	PSD Limit Reduction
	(dBi)	(dBi)	(dBi)	(dBi)	(dB)	(dB)
2.4 GHz	1.40	1.80	1.80	4.61	0.00	0.00

Power Limit Reduction = $DG(\text{Power}) - 6\text{dBi}$, (min = 0)

PSD Limit Reduction = $DG(\text{PSD}) - 6\text{dBi}$, (min = 0)



4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Spectrum Analyzer	R&S	FSV40	101040	10Hz~40GHz	Nov. 02, 2019	Aug. 25, 2020	Nov. 01, 2020	Conducted (TH01-KS)
Pulse Power Sensor	Anritsu	MA2411B	0917070	300MHz~40GHz	Jan. 15, 2020	Aug. 25, 2020	Jan. 14, 2021	Conducted (TH01-KS)
Power Meter	Anritsu	ML2495A	1005002	50MHz Bandwidth	Jan. 08, 2020	Aug. 25, 2020	Jan. 07, 2021	Conducted (TH01-KS)
EMI Test Receiver	Keysight	N9038A	MY56400004	3Hz~8.5GHz; Max 30dBm	Oct. 18, 2019	Jul. 09, 2020	Oct. 17, 2020	Radiation (03CH06-KS)
EXA Spectrum Analyzer	Keysight	N9010A	MY55150208	10Hz~44GHz	Apr. 15, 2020	Jul. 09, 2020	Apr. 14, 2021	Radiation (03CH06-KS)
Loop Antenna	R&S	HFH2-Z2	100321	9kHz~30MHz	Nov. 10, 2019	Jul. 09, 2020	Nov. 09, 2020	Radiation (03CH06-KS)
Bilog Antenna	TeseQ	CBL6111D	49921	30MHz~1GHz	May 29, 2020	Jul. 09, 2020	May 28, 2021	Radiation (03CH06-KS)
Double Ridge Horn Antenna	ETS-Lindgren	3117	00218652	1GHz~18GHz	Apr. 27, 2020	Jul. 09, 2020	Apr. 26, 2021	Radiation (03CH06-KS)
SHF-EHF Horn	Com-power	AH-840	101115	18GHz~40GHz	Nov. 10, 2019	Jul. 09, 2020	Nov. 09, 2020	Radiation (03CH06-KS)
Amplifier	SONOMA	310N	187289	9KHz ~1GHZ	Apr. 14, 2020	Jul. 09, 2020	Apr. 13, 2021	Radiation (03CH06-KS)
Amplifier	MITEQ	EM18G40GGA	060728	18~40GHz	Jan. 08, 2020	Jul. 09, 2020	Jan. 07, 2021	Radiation (03CH06-KS)
high gain Amplifier	MITEQ	AMF-7D-00101800-30-10P	2025788	1Ghz-18Ghz	Jan. 02, 2020	Jul. 09, 2020	Jan. 01, 2021	Radiation (03CH06-KS)
Amplifier	Keysight	83017A	MY53270203	500MHz~26.5GHz	Apr. 15, 2020	Jul. 09, 2020	Apr. 14, 2021	Radiation (03CH06-KS)
AC Power Source	Chroma	61601	F104090004	N/A	NCR	Jul. 09, 2020	NCR	Radiation (03CH06-KS)
Turn Table	ChamPro	EM 1000-T	060762-T	0~360 degree	NCR	Jul. 09, 2020	NCR	Radiation (03CH06-KS)
Antenna Mast	ChamPro	EM 1000-A	060762-A	1 m~4 m	NCR	Jul. 09, 2020	NCR	Radiation (03CH06-KS)
EMI Receiver	R&S	ESCI7	100768	9kHz~7GHz;	Apr. 14, 2020	Jul. 03, 2020	Apr. 13, 2021	Conduction (CO01-KS)
AC LISN (for auxiliary equipment)	MessTec	AN3016	060103	9kHz~30MHz	Oct. 18, 2019	Jul. 03, 2020	Oct. 17, 2020	Conduction (CO01-KS)
AC LISN	MessTec	AN3016	060105	9kHz~30MHz	Oct. 28, 2019	Jul. 03, 2020	Oct. 27, 2020	Conduction (CO01-KS)
AC Power Source	Chroma	61602	ABP000000811	AC 0V~300V, 45Hz~1000Hz	Oct. 18, 2019	Jul. 03, 2020	Oct. 17, 2020	Conduction (CO01-KS)

NCR: No Calibration Required

5 Uncertainty of Evaluation

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI 63.10-2013. All the measurement uncertainty value were shown with a coverage $K=2$ to indicate 95% level of confidence. The measurement data show herein meets or exceeds the CISPR measurement uncertainty values specified in CISPR 16-4-2 and can be compared directly to specified limit to determine compliance.

Uncertainty of Conducted Emission Measurement (150kHz ~ 30MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	2.9dB
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Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	5.0dB
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Uncertainty of Radiated Emission Measurement (1000 MHz ~ 18000 MHz)

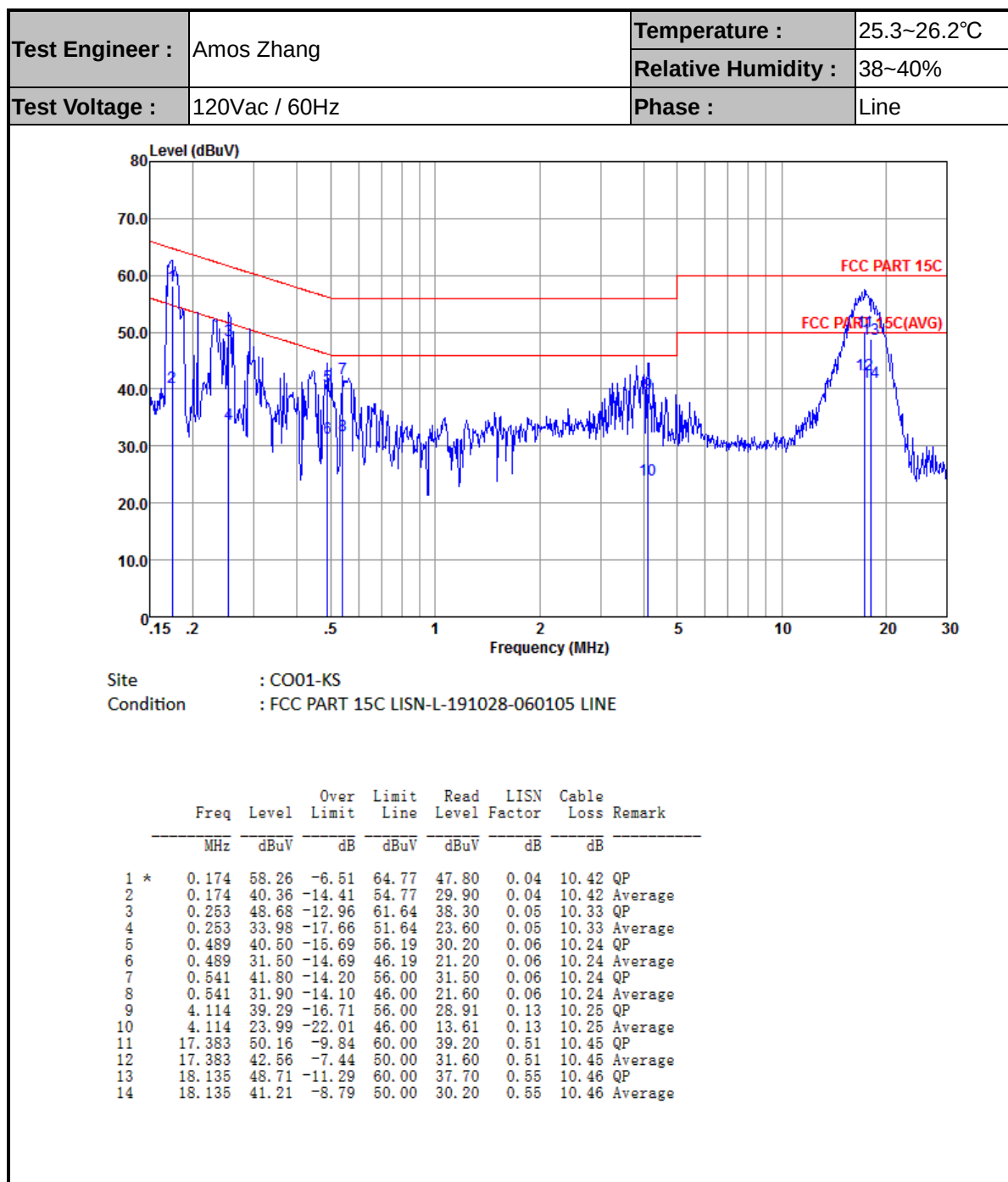
Measuring Uncertainty for a Level of Confidence of 95% ($U = 2Uc(y)$)	5.0dB
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Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)

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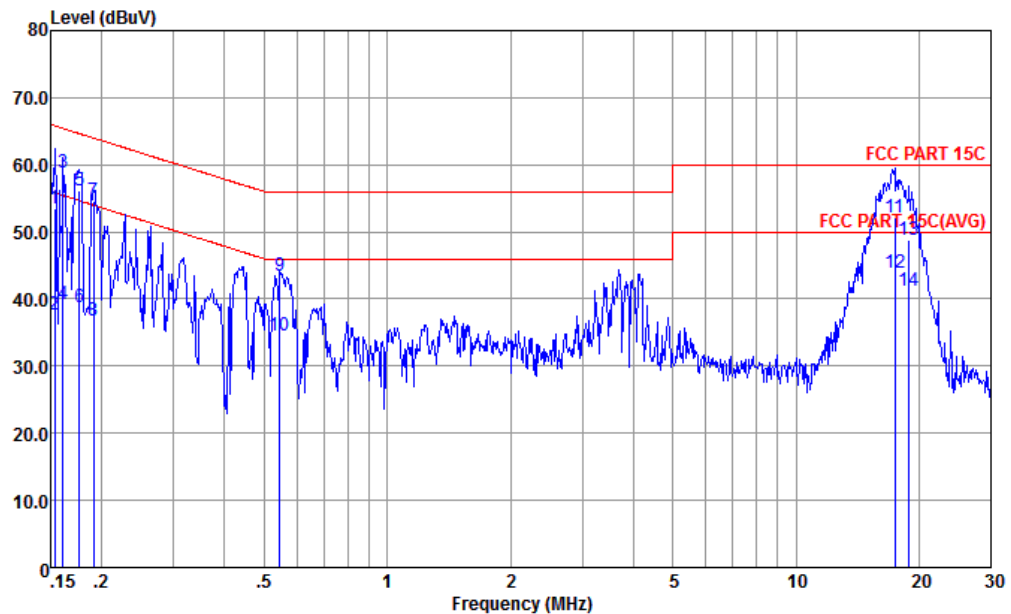


Appendix A. AC Conducted Emission Test Results





Test Engineer :	Amos Zhang	Temperature :	25.3~26.2°C
		Relative Humidity :	38~40%
Test Voltage :	120Vac / 60Hz	Phase :	Neutral



Site : CO01-KS
Condition : FCC PART 15C LISN-N-191028-060105 NEUTRAL

	Freq	Level	Over	Limit	Read	LISN	Cable	
	MHz	dBμV	Limit	Line	Level	Factor	Loss	Remark
			dB	dBμV	dBμV	dB	dB	
1	0.153	53.45	-12.37	65.82	42.90	0.08	10.47	QP
2	0.153	37.75	-18.07	55.82	27.20	0.08	10.47	Average
3	0.161	58.83	-6.60	65.43	48.30	0.08	10.45	QP
4	0.161	39.13	-16.30	55.43	28.60	0.08	10.45	Average
5	0.177	56.09	-8.55	64.64	45.60	0.08	10.41	QP
6	0.177	38.69	-15.95	54.64	28.20	0.08	10.41	Average
7	0.191	54.66	-9.32	63.98	44.20	0.08	10.38	QP
8	0.191	36.66	-17.32	53.98	26.20	0.08	10.38	Average
9	0.546	43.54	-12.46	56.00	33.20	0.10	10.24	QP
10	0.546	34.64	-11.36	46.00	24.30	0.10	10.24	Average
11	17.475	52.05	-7.95	60.00	41.09	0.51	10.45	QP
12 *	17.475	43.85	-6.15	50.00	32.89	0.51	10.45	Average
13	18.920	48.85	-11.15	60.00	37.80	0.58	10.47	QP
14	18.920	41.25	-8.75	50.00	30.20	0.58	10.47	Average

Note:

1. Level(dBμV) = Read Level(dBμV) + LISN Factor(dB) + Cable Loss(dB)
2. Over Limit(dB) = Level(dBμV) – Limit Line(dBμV)



Appendix B. Radiated Spurious Emission

2.4GHz 2400~2483.5MHz

WIFI 802.11b (Band Edge @ 3m)

WIFI Ant.	Note	Frequency	Level	Over Limit	Limit Line	Read Level	Antenna Factor	Cable Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
1+2		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11b CH 01 2412MHz		2389.56	57.97	-16.03	74	52.02	32.2	7.74	33.99	144	51	P	H
		2389.43	47.29	-6.71	54	41.34	32.2	7.74	33.99	144	51	A	H
	*	2412	116.61	-	-	110.66	32.16	7.77	33.98	144	51	P	H
	*	2414	113.19	-	-	107.24	32.16	7.77	33.98	144	51	A	H
		2388.39	54.81	-19.19	74	48.86	32.2	7.74	33.99	222	84	P	V
		2389.17	44.2	-9.8	54	38.25	32.2	7.74	33.99	222	84	A	V
	*	2412	111.96	-	-	106.01	32.16	7.77	33.98	222	84	P	V
	*	2412	108.61	-	-	102.66	32.16	7.77	33.98	222	84	A	V
802.11b CH 11 2462MHz		2485.72	59.29	-14.71	74	53.35	31.99	7.89	33.94	132	49	P	H
		2486.98	49.29	-4.71	54	43.34	31.99	7.89	33.93	132	49	A	H
	*	2462	115.15	-	-	109.21	32.03	7.86	33.95	132	49	P	H
	*	2464	111.92	-	-	105.98	32.03	7.86	33.95	132	49	A	H
		2490.7	54.68	-19.32	74	48.74	31.94	7.93	33.93	100	84	P	V
		2483.5	44.03	-9.97	54	38.09	31.99	7.89	33.94	100	84	A	V
	*	2462	111.17	-	-	105.23	32.03	7.86	33.95	100	84	P	V
	*	2462	107.89	-	-	101.95	32.03	7.86	33.95	100	84	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



2.4GHz 2400~2483.5MHz

WIFI 802.11b (Harmonic @ 3m)

WIFI Ant. 1+2	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11b		4824	46.67	-27.33	74	63.03	35.16	10.96	62.48	300	0	P	H
CH 01		4824	51.6	-22.4	74	67.96	35.16	10.96	62.48	102	27	P	V
2412MHz		4824	47.65	-6.35	54	64.01	35.16	10.96	62.48	102	27	A	V
802.11b		4872	46.08	-27.92	74	62.07	35.17	11.04	62.2	300	0	P	H
CH 06		7308	45.16	-28.84	74	56.95	36.86	13.46	62.11	300	0	P	H
2437MHz		4872	47.69	-26.31	74	63.68	35.17	11.04	62.2	300	360	P	V
		7308	44.32	-29.68	74	56.11	36.86	13.46	62.11	300	360	P	V
802.11b		4926	46.85	-27.15	74	62.64	35.18	11.1	62.07	300	0	P	H
CH 11		7386	44.75	-29.25	74	56.59	36.88	13.54	62.26	300	0	P	H
2462MHz		4926	49.36	-24.64	74	65.15	35.18	11.1	62.07	300	360	P	V
		7386	44.54	-29.46	74	56.38	36.88	13.54	62.26	300	360	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



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

WIFI Ant. 1+2	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11g CH 01 2412MHz		2389.3	64.9	-9.1	74	58.95	32.2	7.74	33.99	112	341	P	H
		2389.95	50.51	-3.49	54	44.56	32.2	7.74	33.99	112	341	A	H
	*	2414	110.41	-	-	104.46	32.16	7.77	33.98	112	341	P	H
	*	2414	102.63	-	-	96.68	32.16	7.77	33.98	112	341	A	H
		2389.56	63.15	-10.85	74	57.2	32.2	7.74	33.99	112	94	P	V
		2389.95	49.42	-4.58	54	43.47	32.2	7.74	33.99	112	94	A	V
	*	2408	108.89	-	-	102.94	32.16	7.77	33.98	112	94	P	V
	*	2408	101.2	-	-	95.25	32.16	7.77	33.98	112	94	A	V
802.11g CH 11 2462MHz		2486.86	65.55	-8.45	74	59.6	31.99	7.89	33.93	132	3	P	H
		2483.5	50.69	-3.31	54	44.75	31.99	7.89	33.94	132	3	A	H
	*	2468	110.44	-	-	104.5	32.03	7.86	33.95	132	3	P	H
	*	2456	102.86	-	-	96.92	32.03	7.86	33.95	132	3	A	H
		2487.1	61.47	-12.53	74	55.52	31.99	7.89	33.93	100	96	P	V
		2485.84	46.2	-7.8	54	40.26	31.99	7.89	33.94	100	96	A	V
	*	2456	107.43	-	-	101.49	32.03	7.86	33.95	100	96	P	V
	*	2456	100.04	-	-	94.1	32.03	7.86	33.95	100	96	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



2.4GHz 2400~2483.5MHz

WIFI 802.11g (Harmonic @ 3m)

WIFI Ant. 1+2	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11g CH 01 2412MHz		4824	41.22	-32.78	74	57.58	35.16	10.96	62.48	300	0	P	H
		4824	41.93	-32.07	74	58.29	35.16	10.96	62.48	300	360	P	V
802.11g CH 06 2437MHz		4872	40.89	-33.11	74	56.88	35.17	11.04	62.2	300	0	P	H
		7308	43.62	-30.38	74	55.41	36.86	13.46	62.11	300	0	P	H
		4872	41.9	-32.1	74	57.89	35.17	11.04	62.2	300	360	P	V
		7308	44.29	-29.71	74	56.08	36.86	13.46	62.11	300	360	P	V
802.11g CH 11 2462MHz		4926	43.3	-30.7	74	59.09	35.18	11.1	62.07	300	0	P	H
		7386	43.52	-30.48	74	55.36	36.88	13.54	62.26	300	0	P	H
		4926	43.01	-30.99	74	58.8	35.18	11.1	62.07	300	360	P	V
		7386	43.5	-30.5	74	55.34	36.88	13.54	62.26	300	360	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



2.4GHz 2400~2483.5MHz

WIFI 802.11n HT20 (Band Edge @ 3m)

WIFI Ant. 1+2	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11n HT20 CH 01 2412MHz		2389.95	64.15	-9.85	74	58.2	32.2	7.74	33.99	142	7	P	H
		2389.95	50.36	-3.64	54	44.41	32.2	7.74	33.99	142	7	A	H
	*	2414	110.21	-	-	104.26	32.16	7.77	33.98	142	7	P	H
	*	2414	102.5	-	-	96.55	32.16	7.77	33.98	142	7	A	H
		2389.95	63.24	-10.76	74	57.29	32.2	7.74	33.99	110	95	P	V
		2389.95	48.06	-5.94	54	42.11	32.2	7.74	33.99	110	95	A	V
	*	2408	106.52	-	-	100.57	32.16	7.77	33.98	110	95	P	V
	*	2408	98.68	-	-	92.73	32.16	7.77	33.98	110	95	A	V
802.11n HT20 CH 11 2462MHz		2484.58	62.46	-11.54	74	56.52	31.99	7.89	33.94	157	50	P	H
		2483.62	50.48	-3.52	54	44.54	31.99	7.89	33.94	157	50	A	H
	*	2460	109.25	-	-	103.31	32.03	7.86	33.95	157	50	P	H
	*	2460	101.48	-	-	95.54	32.03	7.86	33.95	157	50	A	H
		2483.98	57.36	-16.64	74	51.42	31.99	7.89	33.94	100	83	P	V
		2483.5	45.98	-8.02	54	40.04	31.99	7.89	33.94	100	83	A	V
	*	2460	104.97	-	-	99.03	32.03	7.86	33.95	100	83	P	V
	*	2460	97.01	-	-	91.07	32.03	7.86	33.95	100	83	A	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



2.4GHz 2400~2483.5MHz

WIFI 802.11n HT20 (Harmonic @ 3m)

WIFI Ant. 1+2	Note	Frequency (MHz)	Level (dBμV/m)	Over Limit (dB)	Limit Line (dBμV/m)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
802.11n HT20 CH 01 2412MHz		4824	41.62	-32.38	74	57.98	35.16	10.96	62.48	300	0	P	H
		4824	41.37	-32.63	74	57.73	35.16	10.96	62.48	300	360	P	V
802.11n HT20 CH 06 2437MHz		4872	41.25	-32.75	74	57.24	35.17	11.04	62.2	300	0	P	H
		7308	43.15	-30.85	74	54.94	36.86	13.46	62.11	300	0	P	H
		4872	42.23	-31.77	74	58.22	35.17	11.04	62.2	300	360	P	V
		7308	43.38	-30.62	74	55.17	36.86	13.46	62.11	300	360	P	V
802.11n HT20 CH 11 2462MHz		4926	42.27	-31.73	74	58.06	35.18	11.1	62.07	100	360	P	H
		7386	42.39	-31.61	74	54.23	36.88	13.54	62.26	100	360	P	H
		4926	41.97	-32.03	74	57.76	35.18	11.1	62.07	100	360	P	V
		7386	42.2	-31.8	74	54.04	36.88	13.54	62.26	100	360	P	V
Remark	1. No other spurious found. 2. All results are PASS against Peak and Average limit line.												



Emission below 1GHz

2.4GHz WIFI 802.11g (LF)

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
1+2		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
2.4GHz 802.11g LF		81.41	29.1	-10.9	40	46.43	14.2	1.53	33.06	-	-	P	H
		118.27	29.99	-13.51	43.5	43.42	17.88	1.75	33.06	-	-	P	H
		151.25	31.3	-12.2	43.5	44.84	17.48	1.98	33	-	-	P	H
		188.11	37.97	-5.53	43.5	52.14	16.58	2.17	32.92	100	0	P	H
		257.95	35.85	-10.15	46	46.57	19.53	2.53	32.78	-	-	P	H
		500.45	26.91	-19.09	46	31.47	24.5	3.44	32.5	-	-	P	H
		83.35	33.76	-6.24	40	50.6	14.6	1.54	32.98	-	-	P	V
		120.21	33.88	-9.62	43.5	47.31	17.86	1.77	33.06	-	-	P	V
		186.17	38.24	-5.26	43.5	52.38	16.63	2.16	32.93	200	360	P	V
		235.64	36.19	-9.81	46	48.1	18.51	2.41	32.83	-	-	P	V
		377.26	31.48	-14.52	46	38.88	22.11	3.02	32.53	-	-	P	V
		443.22	34.22	-11.78	46	39.68	23.48	3.27	32.21	-	-	P	V
Remark	1. No other spurious found. 2. All results are PASS against limit line.												

**Note symbol**

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



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

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Cable	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
1+2		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11b		2390	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	P	H
CH 01													
2412MHz		2390	43.54	-10.46	54	42.6	32.22	4.58	35.86	103	308	A	H

1. Level(dBμV/m) =

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

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

For Peak Limit @ 2390MHz:

1. Level(dBμV/m)

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

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

= 55.45 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 55.45(dBμV/m) – 74(dBμV/m)

= -18.55(dB)

For Average Limit @ 2390MHz:

1. Level(dBμV/m)

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

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

= 43.54 (dBμV/m)

2. Over Limit(dB)

= Level(dBμV/m) – Limit Line(dBμV/m)

= 43.54(dBμV/m) – 54(dBμV/m)

= -10.46(dB)

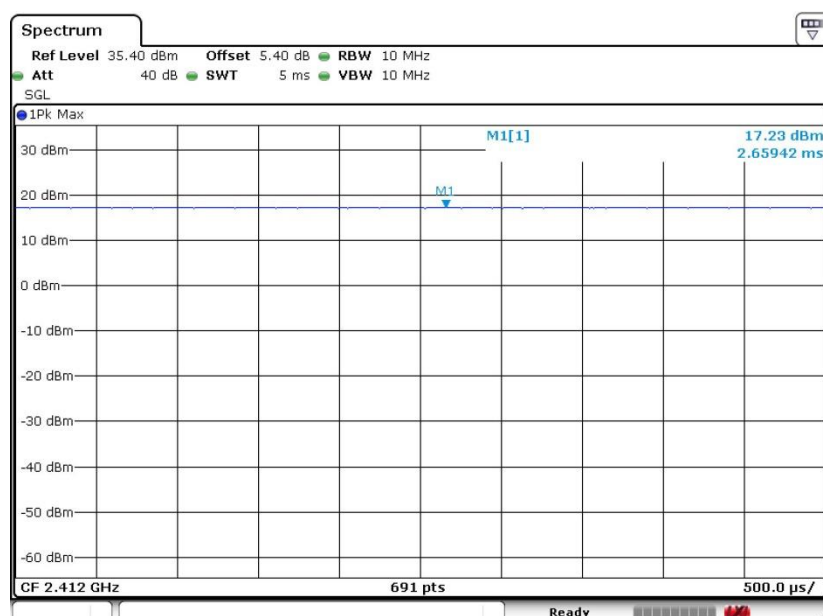
Both peak and average measured complies with the limit line, so test result is “PASS”.



Appendix C. Duty Cycle Plots

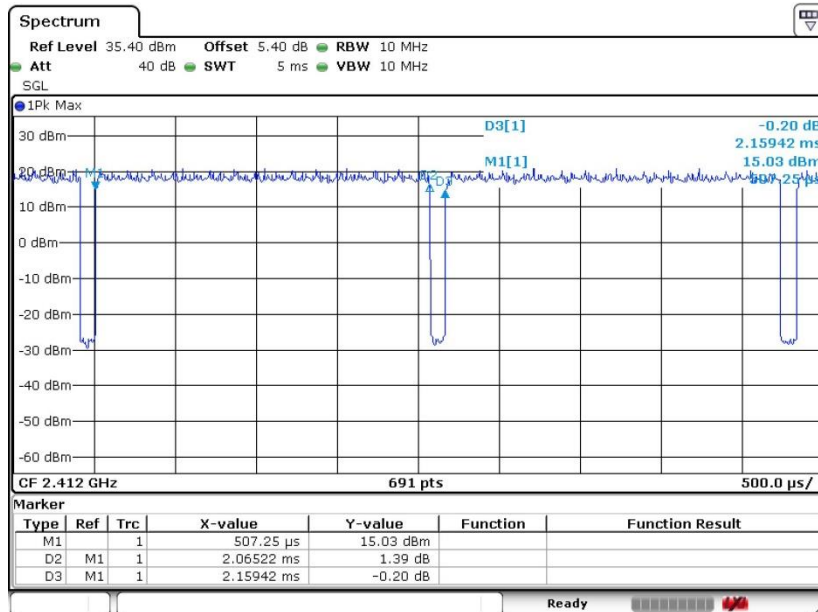
Antenna	Band	Duty Cycle(%)	T(ms)	1/T(kHz)	VBW Setting
1+2	802.11b	100	-	-	10Hz
1+2	802.11g	95.64	2.065	0.484	0.51KHz
1+2	802.11n HT20	95.34	1.928	0.519	0.56KHz

802.11b





802.11g



802.11n HT20

