



# FCC RF Test Report

**APPLICANT** : Espressif Systems (Shanghai) Co.,Ltd.  
**EQUIPMENT** : AI voice development kit  
**BRAND NAME** : ESPRESSIF  
**MODEL NAME** : ESP32-S3-BOX-Lite  
**FCC ID** : Contains FCC ID :2AC7Z-ESPS3WROOM1  
**STANDARD** : FCC Part 15 Subpart C §15.247  
**CLASSIFICATION** : (DTS) Digital Transmission System  
**TEST DATE(S)** : Jun. 29, 2022 ~ Jul. 27, 2022

The product was installed a module during the test: 2.4GHz Wi-Fi & BT IoT Module (Brand Name : ESPRESSIF, Model Name: ESP32-S3-WROOM-1, FCC ID: 2AC7Z-ESPS3WROOM1) during test.

We, Sporton International Inc. (Kunshan), 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 Inc. (Kunshan), the test report shall not be reproduced except in full.

Jason Jia



Approved by: Jason Jia

**Sporton International Inc. (Kunshan)**

**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
FR1N0920-01B	Rev. 01	Initial issue of report	Sep. 02, 2022



### SUMMARY OF TEST RESULT

Report Section	FCC Rule	Description	Limit	Result	Remark
-	15.247(a)(2)	6dB Bandwidth	≥ 0.5MHz	Pass	1
-	-	99% Bandwidth	-	Report Only	1
3.1	15.247(b)	Power Output Measurement	≤ 30dBm	Pass	-
-	15.247(e)	Power Spectral Density	≤ 8dBm/3kHz	Pass	1
-	15.247(d)	Conducted Band Edges	≤ 20dBc	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 1.81 dB at 2389.950 MHz
3.3	15.207	AC Conducted Emission	15.207(a)	Pass	Under limit 12.27 dB at 0.356 MHz
3.4	15.203 & 15.247(b)	Antenna Requirement	15.203 & 15.247(b)	Pass	-

**Remark 1:** All test results were leveraged from module RF report which can refer to Report No.FR1N0920B.

<b>Declaration of Conformity:</b>
The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits.
<b>Comments and Explanations:</b>
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

Espressif Systems (Shanghai) Co.,Ltd.

Suite 204, Block 2, 690 Bibo Road, Zhang Jiang Hi-Tech Park, Shanghai, China

## 1.2 Manufacturer

Espressif Systems (Shanghai) Co.,Ltd.

Suite 204, Block 2, 690 Bibo Road, Zhang Jiang Hi-Tech Park, Shanghai, China

## 1.3 Product Feature of Equipment Under Test

Product Feature	
Equipment	AI voice development kit
Brand Name	ESPRESSIF
Model Name	ESP32-S3-BOX-Lite
FCC ID	Contains FCC ID : 2AC7Z-ESPS3WROOM1
HW Version	V1.3
SW Version	v1.1.3.4
EUT Stage	Identical Prototype

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

## 1.4 Product Specification of Equipment Under Test

Standards-related Product Specification	
Tx/Rx Channel Frequency Range	2412 MHz ~ 2462 MHz
Maximum (Peak) Output Power to antenna	802.11b : 22.75 dBm (0.1884 W) 802.11g : 25.54 dBm (0.3581 W) 802.11n HT20 : 25.17 dBm (0.3289 W) 802.11n HT40 : 25.18 dBm (0.3296 W)
Antenna Type / Gain	PCB Antenna with gain 3.26 dBi
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 Inc. (Kunshan) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

<b>Test Firm</b>	Sporton International Inc. (Kunshan)		
<b>Test Site Location</b>	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		
<b>Test Site No.</b>	<b>Sporton Site No.</b>	<b>FCC Designation No.</b>	<b>FCC Test Firm Registration No.</b>
	CO01-KS 03CH05-KS TH01-KS	CN1257	314309

### 1.7 Test Software

Item	Site	Manufacturer	Name	Version
1.	03CH05-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
- 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

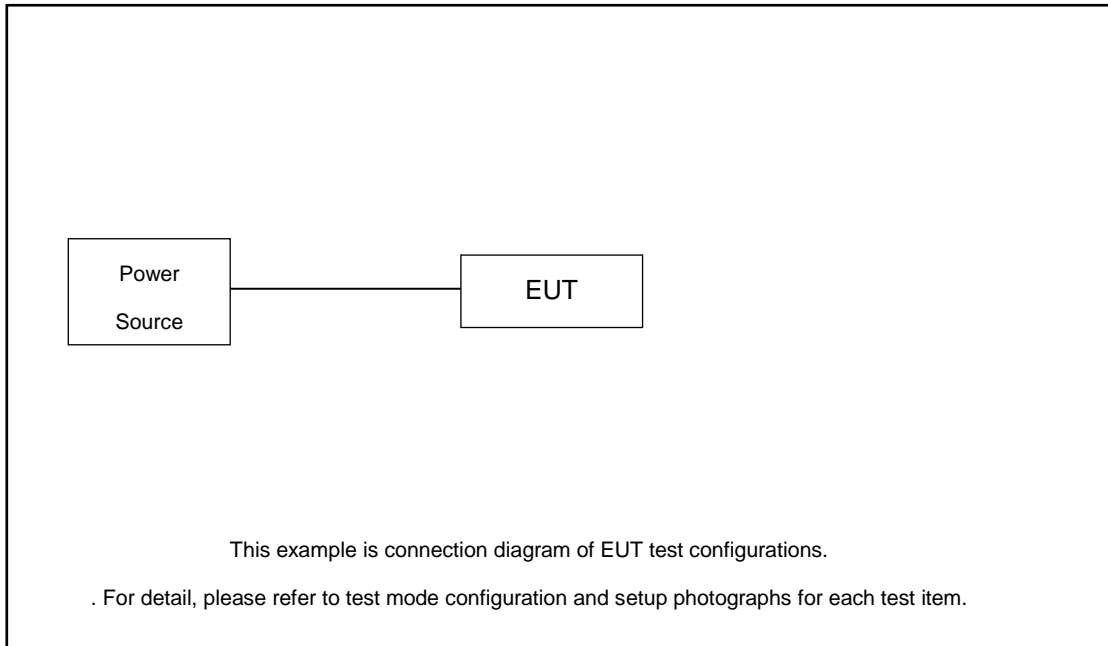
Final test modes are considering the modulation and worse data rates as below table.

Modulation	Data Rate
802.11g	6 Mbps
802.11n	MCS0

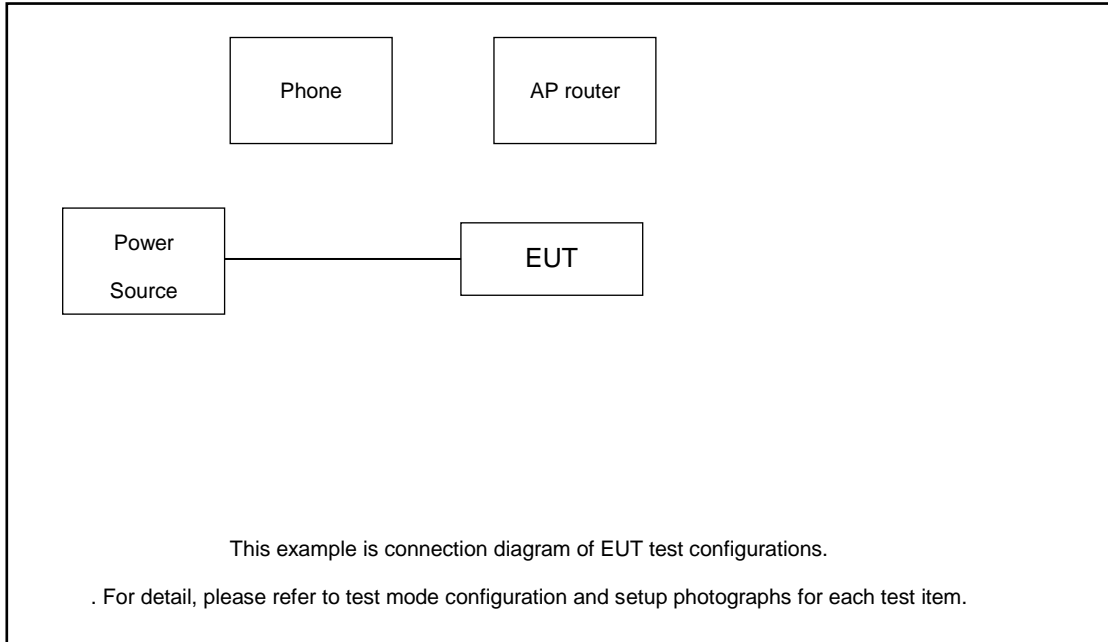
Test Cases	
AC Conducted Emission	Mode 1 :Bluetooth LE Link + WLAN Link(2.4G) + USB Cable(Charging from Adapter)
<b>Remark:</b> For Radiated Test Cases, The tests were performance with Adapter, USB Cable.	

## 2.3 Connection Diagram of Test System

For Radiated Emission



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.	WLAN AP	D-link	DIR-655	KA21R655B1	N/A	Unshielded,1.8m
2.	Phone	MOTO	XT1952-1	N/A	N/A	N/A
3.	Adapter	MOTO	C-P56	N/A	N/A	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.

For AC power line conducted emissions, the EUT was set to connect with the Phone/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.

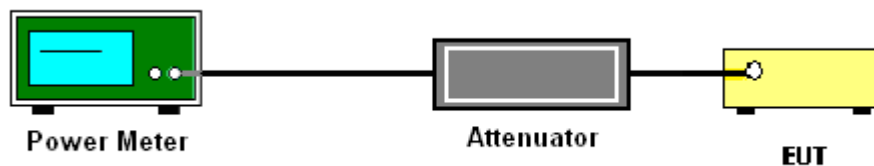
#### 3.1.2 Measuring Instruments

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 11.9.2.3.1 Method AVGPM 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 Single Antenna										
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
					Ant1	Ant1	Ant1	Ant1	Ant1	
11b	1Mbps	1	1	2412	21.72	30.00	3.26	24.98	36.00	Pass
11b	1Mbps	1	6	2437	21.98	30.00	3.26	25.24	36.00	Pass
11b	1Mbps	1	11	2462	22.75	30.00	3.26	26.01	36.00	Pass
11g	6Mbps	1	1	2412	24.05	30.00	3.26	27.31	36.00	Pass
11g	6Mbps	1	6	2437	25.54	30.00	3.26	28.80	36.00	Pass
11g	6Mbps	1	10	2457	24.75	30.00	3.26	28.01	36.00	Pass
11g	6Mbps	1	11	2462	23.56	30.00	3.26	26.82	36.00	Pass
HT20	MCS0	1	1	2412	24.47	30.00	3.26	27.73	36.00	Pass
HT20	MCS0	1	6	2437	25.17	30.00	3.26	28.43	36.00	Pass
HT20	MCS0	1	10	2457	24.82	30.00	3.26	28.08	36.00	Pass
HT20	MCS0	1	11	2462	23.38	30.00	3.26	26.64	36.00	Pass
HT40	MCS0	1	3	2422	23.53	30.00	3.26	26.79	36.00	Pass
HT40	MCS0	1	6	2437	25.18	30.00	3.26	28.44	36.00	Pass
HT40	MCS0	1	8	2447	23.83	30.00	3.26	27.09	36.00	Pass
HT40	MCS0	1	9	2452	23.70	30.00	3.26	26.96	36.00	Pass



3.1.6 Test Result of Average Output Power (Reporting Only)

2.4GHz Band Single Antenna												
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Duty Factor (dB)	Average Conducted Power with duty factor (dBm)			DG (dBi)		EIRP Power (dBm)	
						Ant1	Ant2	SUM	Ant1	Ant2	Ant1	Ant2
11b	1Mbps	1	1	2412	0.00	19.08	-		3.26	-	22.34	-
11b	1Mbps	1	6	2437	0.00	19.23	-		3.26	-	22.49	-
11b	1Mbps	1	11	2462	0.00	19.91	-		3.26	-	23.17	-
11g	6Mbps	1	1	2412	0.00	15.52	-		3.26	-	18.78	-
11g	6Mbps	1	6	2437	0.00	18.59	-		3.26	-	21.85	-
11g	6Mbps	1	11	2462	0.00	14.52	-		3.26	-	17.78	-
HT20	MCS0	1	1	2412	0.00	16.39	-		3.26	-	19.65	-
HT20	MCS0	1	6	2437	0.00	17.64	-		3.26	-	20.90	-
HT20	MCS0	1	11	2462	0.00	13.95	-		3.26	-	17.21	-
HT40	MCS0	1	3	2422	0.00	14.41	-		3.26	-	17.67	-
HT40	MCS0	1	6	2437	0.00	17.05	-		3.26	-	20.31	-
HT40	MCS0	1	9	2452	0.00	14.00	-		3.26	-	17.26	-



### 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.

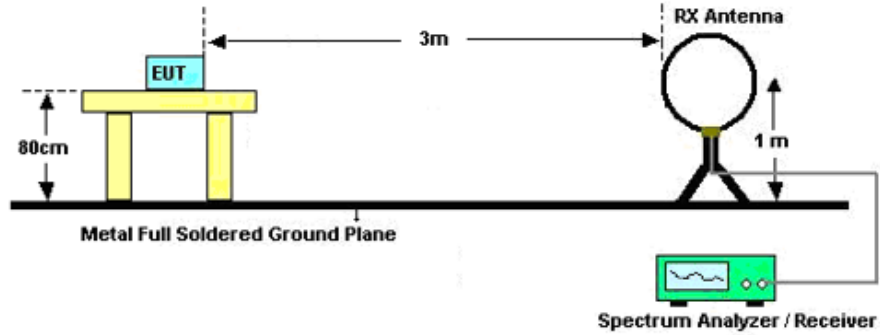


### 3.2.3 Test Procedures

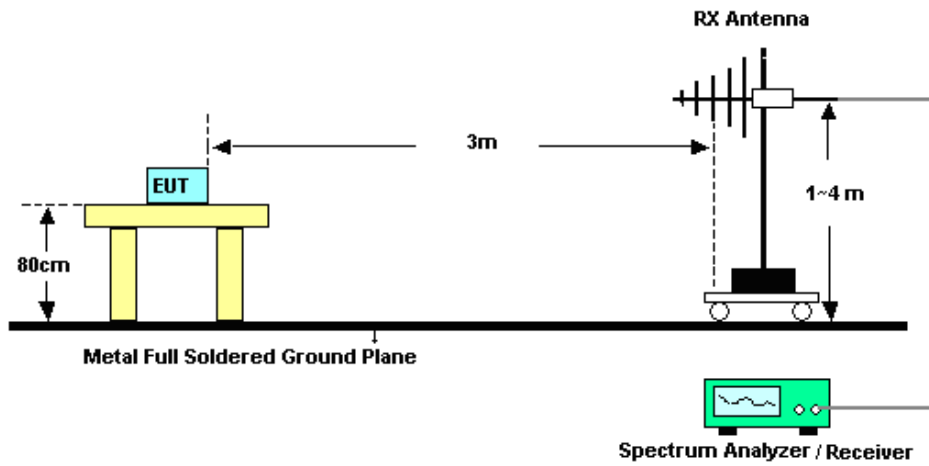
1. The testing follows ANSI C63.10-2013 clause 11.11 & 11.12
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better 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 peak 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

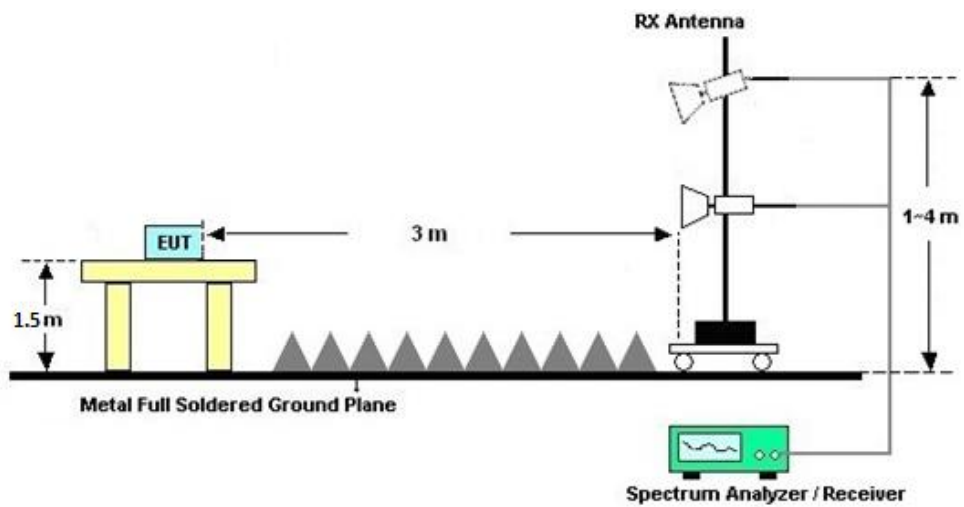
For radiated emissions below 30MHz



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&C.

### **3.2.7 Duty Cycle**

Please refer to Appendix D.

### **3.2.8 Test Result of Radiated Spurious Emission (30MHz ~ 10th Harmonic or 40GHz, whichever is lower)**

Please refer to Appendix B&C.





### 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 (dBµV)	
	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.

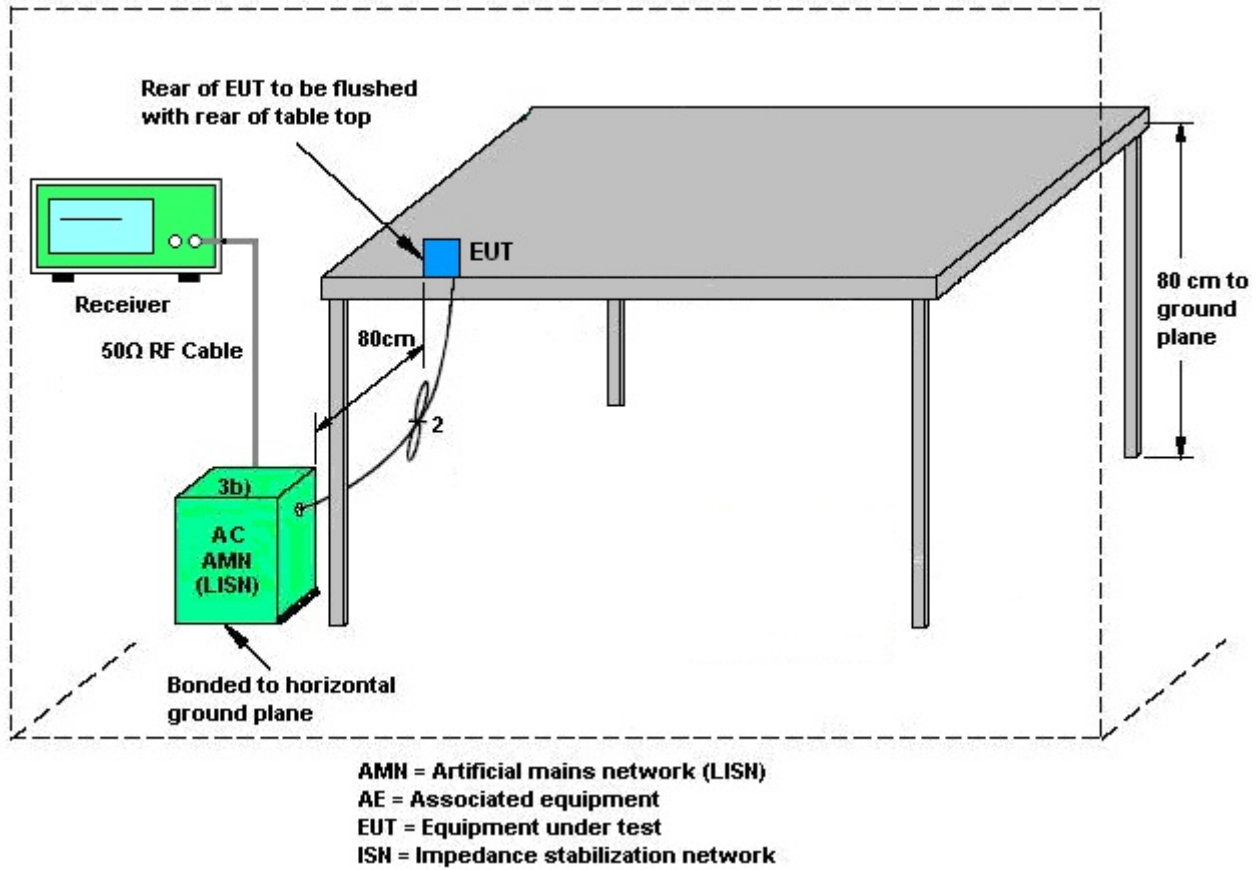
#### 3.3.2 Measuring Instruments

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**

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.



## 4 List of Measuring Equipment

Instrument	Manufacturer	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Pulse Power Sensor	Anritsu	MA2411B	0917070	300MHz~40GHz	Jan. 05, 2022	Jul. 27, 2022	Jan. 04, 2023	Conducted (TH01-KS)
Power Meter	Anritsu	ML2495A	1005002	50MHz Bandwidth	Jan. 05, 2022	Jul. 27, 2022	Jan. 04, 2023	Conducted (TH01-KS)
EMI Test Receiver	Keysight	N9038A	MY56400004	3Hz~8.5GHz;Max 30dBm	Oct. 16, 2021	Jul. 15, 2022	Oct. 15, 2022	Radiation (03CH05-KS)
EXA Spectrum Analyzer	Keysight	N9010A	MY55150244	10Hz~44G,MAX 30dB	Mar 24, 2022	Jul. 15, 2022	Mar 23, 2023	Radiation (03CH05-KS)
Loop Antenna	R&S	HFH2-Z2	100321	9kHz~30MHz	Oct. 30, 2021	Jul. 15, 2022	Oct. 29, 2022	Radiation (03CH05-KS)
Bilog Antenna	TeseQ	CBL6111D	49922	30MHz~1GHz	Jun. 03, 2022	Jul. 15, 2022	Jun. 02, 2023	Radiation (03CH05-KS)
Double Ridge Horn Antenna	ETS-Lindgren	3117	75957	1GHz~18GHz	Nov. 08, 2021	Jul. 15, 2022	Nov. 07, 2022	Radiation (03CH05-KS)
SHF-EHF Horn	Com-power	AH-840	101070	18GHz~40GHz	Jan. 05, 2022	Jul. 15, 2022	Jan. 04, 2023	Radiation (03CH05-KS)
Amplifier	SONOMA	310N	380826	9KHz~1GHz	Jul. 11, 2022	Jul. 15, 2022	Jul. 10, 2023	Radiation (03CH05-KS)
Amplifier	MITEQ	EM18G40GGA	060728	18~40GHz	Jan. 05, 2022	Jul. 15, 2022	Jan. 04, 2023	Radiation (03CH05-KS)
high gain Amplifier	MITEQ	AMF-7D-00101800-30-10P	2012228	1Ghz-18Ghz	Oct. 16, 2021	Jul. 15, 2022	Oct. 15, 2022	Radiation (03CH05-KS)
Amplifier	Keysight	83017A	MY53270316	500MHz~26.5GHz	Oct. 16, 2021	Jul. 15, 2022	Oct. 15, 2022	Radiation (03CH05-KS)
AC Power Source	Chroma	61601	F104090004	N/A	NCR	Jul. 15, 2022	NCR	Radiation (03CH05-KS)
Turn Table	ChamPro	EM 1000-T	060762-T	0~360 degree	NCR	Jul. 15, 2022	NCR	Radiation (03CH05-KS)
Antenna Mast	ChamPro	EM 1000-A	060762-A	1 m~4 m	NCR	Jul. 15, 2022	NCR	Radiation (03CH05-KS)
EMI Receiver	R&S	ESCI7	100768	9kHz~7GHz;	May 24, 2022	Jun. 29, 2022	May 23, 2023	Conduction (CO01-KS)
AC LISN (for auxiliary equipment)	MessTec	AN3016	060103	9kHz~30MHz	Oct. 14, 2021	Jun. 29, 2022	Oct. 13, 2022	Conduction (CO01-KS)
AC LISN	MessTec	AN3016	060105	9kHz~30MHz	May 24, 2022	Jun. 29, 2022	May 23, 2023	Conduction (CO01-KS)
AC Power Source	Chroma	61602	ABP00000811	AC 0V~300V, 45Hz~1000Hz	Oct. 14, 2021	Jun. 29, 2022	Oct. 13, 2022	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 (150 kHz ~ 30 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	2.94dB
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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)

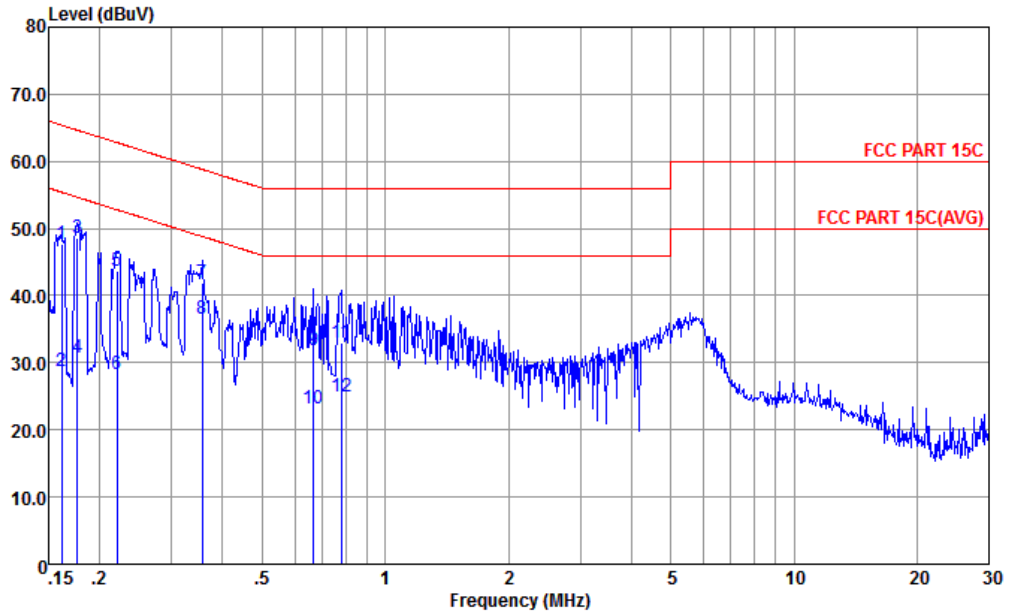
Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	5.0dB
---	-------

----- THE END -----



## 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 :	Line
Remark :	All emissions not reported here are more than 10 dB below the prescribed limit.		

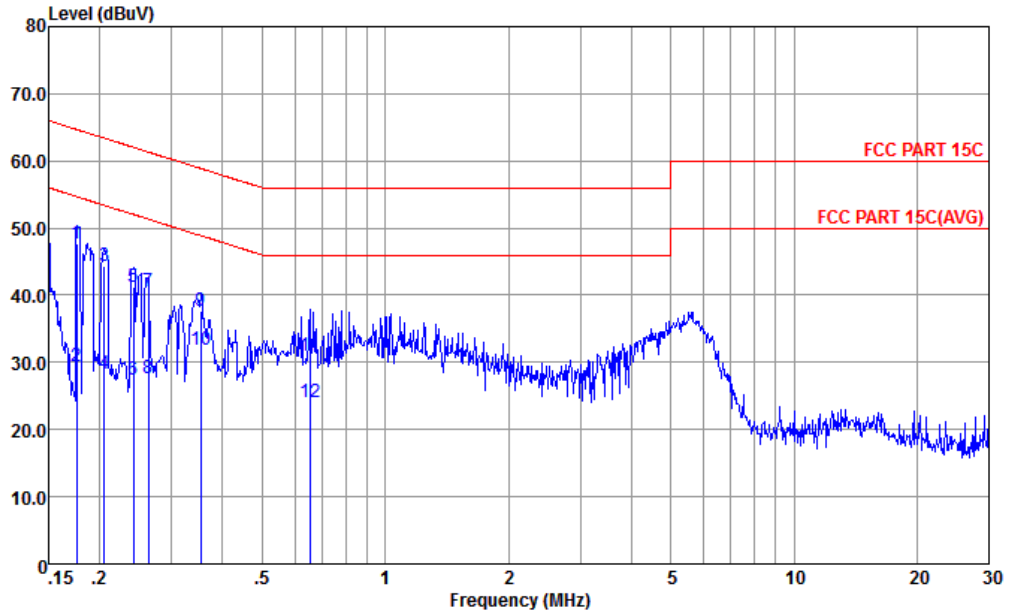


Site : CO01-KS  
 Condition : FCC PART 15C LISN-060105-L LINE

	Freq	Level	Over	Limit	Read	LISN	Cable	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1	0.162	47.67	-17.71	65.38	37.19	0.03	10.45	QP
2	0.162	28.67	-26.71	55.38	18.19	0.03	10.45	Average
3	0.177	48.65	-15.99	64.64	38.21	0.03	10.41	QP
4	0.177	30.65	-23.99	54.64	20.21	0.03	10.41	Average
5	0.221	43.60	-19.19	62.79	33.20	0.05	10.35	QP
6	0.221	28.20	-24.59	52.79	17.80	0.05	10.35	Average
7	0.356	41.86	-16.97	58.83	31.50	0.08	10.28	QP
8 *	0.356	36.56	-12.27	48.83	26.20	0.08	10.28	Average
9	0.668	31.85	-24.15	56.00	21.50	0.11	10.24	QP
10	0.668	23.25	-22.75	46.00	12.90	0.11	10.24	Average
11	0.779	32.95	-23.05	56.00	22.59	0.12	10.24	QP
12	0.779	24.85	-21.15	46.00	14.49	0.12	10.24	Average



Test Engineer :	Amos Zhang	Temperature :	25.3~26.2°C
		Relative Humidity :	38~40%
Test Voltage :	120Vac / 60Hz	Phase :	Neutral
Remark :	All emissions not reported here are more than 10 dB below the prescribed limit.		



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

	Freq	Level	Over	Limit	Read	LISN	Cable	Remark
	MHz	dBuV	dB	dBuV	dBuV	dB	dB	
1 *	0.176	47.72	-16.96	64.68	37.20	0.10	10.42	QP
2	0.176	29.42	-25.26	54.68	18.90	0.10	10.42	Average
3	0.205	44.26	-19.14	63.40	33.80	0.10	10.36	QP
4	0.205	28.26	-25.14	53.40	17.80	0.10	10.36	Average
5	0.242	41.24	-20.80	62.04	30.80	0.10	10.34	QP
6	0.242	27.34	-24.70	52.04	16.90	0.10	10.34	Average
7	0.263	40.63	-20.71	61.34	30.20	0.10	10.33	QP
8	0.263	27.63	-23.71	51.34	17.20	0.10	10.33	Average
9	0.354	37.59	-21.28	58.87	27.21	0.10	10.28	QP
10	0.354	31.89	-16.98	48.87	21.51	0.10	10.28	Average
11	0.654	30.95	-25.05	56.00	20.60	0.11	10.24	QP
12	0.654	24.15	-21.85	46.00	13.80	0.11	10.24	Average

Note:

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



## Appendix B. Radiated Spurious Emission

Test Engineer :	Carry Xu	Temperature :	22~23°C
		Relative Humidity :	41~42%

Band		Power setting
11g Tx	CH01	11
11n(20M) Tx	CH01	6





2.4GHz 2400~2483.5MHz

WIFI 802.11g (Band Edge @ 3m)

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
1		( MHz )	( dBμV/m )	( dB )	( dBμV/m )	( dBμV )	( dB/m )	( dB )	( dB )	( cm )	( deg )	(P/A)	(H/V)
802.11g CH 01 2412MHz		2389.82	63.75	-10.25	74	60.63	32.88	7.1	36.86	111	319	P	H
		2389.95	48.24	-5.76	54	45.12	32.88	7.1	36.86	111	319	A	H
	*	2416	101.14	-	-	97.93	32.9	7.16	36.85	111	319	P	H
	*	2414	93.59	-	-	90.41	32.9	7.13	36.85	111	319	A	H
		2389.95	68.26	-5.74	74	65.14	32.88	7.1	36.86	147	188	P	V
		2389.95	52.19	-1.81	54	49.07	32.88	7.1	36.86	147	188	A	V
	*	2414	106.08	-	-	102.9	32.9	7.13	36.85	147	188	P	V
	*	2410	98.56	-	-	95.38	32.9	7.13	36.85	147	188	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	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
1		( MHz )	( dBμV/m )	( dB )	( dBμV/m )	( dBμV )	( dB/m )	( dB )	( dB )	( cm )	( deg )	(P/A)	(H/V)
802.11g CH 01 2412MHz		4830	57.14	-16.86	74	78.07	34.2	10.25	65.38	100	9	P	H
		4830	45.4	-8.6	54	66.33	34.2	10.25	65.38	100	9	A	H
		4830	54.61	-19.39	74	75.54	34.2	10.25	65.38	255	125	P	V
		4830	45.76	-8.24	54	66.69	34.2	10.25	65.38	255	125	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 (Band Edge @ 3m)

Table with 14 columns: WIFI Ant. 1, Note, Frequency (MHz), Level (dBµV/m), Over Limit (dB), Limit Line (dBµV/m), Read Level (dBµV), Antenna Factor (dB/m), Path Loss (dB), Preamp Factor (dB), Ant Pos (cm), Table Pos (deg), Peak Avg. (P/A), Pol. (H/V). Rows include test data for 802.11n HT20 CH 01 2412MHz and a Remark section.



2.4GHz 2400~2483.5MHz
WIFI 802.11n HT20 (Harmonic @ 3m)

Table with 14 columns: WIFI Ant. 1, Note, Frequency (MHz), Level (dBµV/m), Over Limit (dB), Limit Line (dBµV/m), Read Level (dBµV), Antenna Factor (dB/m), Path Loss (dB), Preamp Factor (dB), Ant Pos (cm), Table Pos (deg), Peak Avg. (P/A), Pol. (H/V). Rows include 802.11n, HT20, CH 01, 2412MHz and a Remark section.



Emission below 1GHz
2.4GHz WIFI 802.11g (LF)

Table with 14 columns: WIFI, Note, Frequency, Level, Over, Limit, Read, Antenna, Path, Preamp, Ant, Table, Peak, Pol. It contains 12 rows of test data for 2.4GHz WIFI 802.11g LF and a Remark section at the bottom.



**Note symbol**

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



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

WIFI	Note	Frequency	Level	Over	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
Ant.				Limit	Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
1		( MHz )	( dBμV/m )	( dB )	( dBμV/m )	( dBμV )	( dB/m )	( dB )	( dB )	( cm )	( deg )	( P/A )	( H/V )
802.11b		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. Path Loss(dB) = Cable loss(dB) + Filter loss(dB) + Attenuator loss(dB)
2. Level(dBμV/m) =  
Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)
3. Over Limit(dB) = Level(dBμV/m) – Limit Line(dBμV/m)

**For Peak Limit @ 2390MHz:**

1. Level(dBμV/m)  
= Antenna Factor(dB/m) + Path 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) + Path 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. Radiated Spurious Emission Plots**

### **Note symbol**

<b>-L</b>	<b>Low channel location</b>
<b>-R</b>	<b>High channel location</b>



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

WIFI	2.4GHz 2400~2483.5MHz Band Edge @ 3m																																																											
ANT	802.11g CH01 2412MHz																																																											
1	Horizontal	Fundamental																																																										
<b>Peak</b>	<p>Site Condition : 030405-K5 FCC PART 15C 3m 3317.5M 75957 HORIZONTAL RSM 1000.000MHz YBR 3000.000MHz SRT Auto Project : FR1N0920-01 Mode : 2 Plane : Y Full-directivity IME1 : #3 PowerSetting : 7</p> <table border="1"> <thead> <tr> <th>Over</th> <th>Limit</th> <th>ReadAntenna</th> <th>Cable Preamp</th> <th>A/Pos</th> <th>T/Pos</th> <th>Remark</th> <th>Pol/Phas</th> </tr> <tr> <th>MHz</th> <th>dBm</th> <th>dB</th> <th>dB</th> <th>dB</th> <th>dB</th> <th>cm</th> <th>deg</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>2389.82</td> <td>63.75</td> <td>-10.25</td> <td>74.00</td> <td>60.63</td> <td>32.88</td> <td>7.10</td> <td>36.86</td> <td>111</td> <td>319</td> <td>Peak</td> <td>HORIZONTAL</td> </tr> </tbody> </table>	Over	Limit	ReadAntenna	Cable Preamp	A/Pos	T/Pos	Remark	Pol/Phas	MHz	dBm	dB	dB	dB	dB	cm	deg	1	2389.82	63.75	-10.25	74.00	60.63	32.88	7.10	36.86	111	319	Peak	HORIZONTAL	<p>Site Condition : 030405-K5 FCC PART 15C 3m 3317.5M 75957 HORIZONTAL RSM 1000.000MHz YBR 3000.000MHz SRT Auto Project : FR1N0920-01 Mode : 2 Plane : Y Full-directivity IME1 : #3 PowerSetting : 7</p> <table border="1"> <thead> <tr> <th>Over</th> <th>Limit</th> <th>ReadAntenna</th> <th>Cable Preamp</th> <th>A/Pos</th> <th>T/Pos</th> <th>Remark</th> <th>Pol/Phas</th> </tr> <tr> <th>MHz</th> <th>dBm</th> <th>dB</th> <th>dB</th> <th>dB</th> <th>dB</th> <th>cm</th> <th>deg</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>2416.00</td> <td>101.14</td> <td>27.14</td> <td>74.00</td> <td>97.93</td> <td>32.90</td> <td>7.16</td> <td>36.85</td> <td>111</td> <td>319</td> <td>Peak</td> <td>HORIZONTAL</td> </tr> </tbody> </table>	Over	Limit	ReadAntenna	Cable Preamp	A/Pos	T/Pos	Remark	Pol/Phas	MHz	dBm	dB	dB	dB	dB	cm	deg	1	2416.00	101.14	27.14	74.00	97.93	32.90	7.16	36.85	111	319	Peak	HORIZONTAL
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<b>Avg.</b>	<p>Site Condition : 030405-K5 FCC PART 15C (AVG) 3m 3317.5M 75957 HORIZONTAL RSM 1000.000MHz YBR 0.010MHz SRT Auto Project : FR1N0920-01 Mode : 2 Plane : Y Full-directivity IME1 : #3 PowerSetting : 7</p> <table border="1"> <thead> <tr> <th>Over</th> <th>Limit</th> <th>ReadAntenna</th> <th>Cable Preamp</th> <th>A/Pos</th> <th>T/Pos</th> <th>Remark</th> <th>Pol/Phas</th> </tr> <tr> <th>MHz</th> <th>dBm</th> <th>dB</th> <th>dB</th> <th>dB</th> <th>dB</th> <th>cm</th> <th>deg</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>2389.95</td> <td>48.24</td> <td>-5.76</td> <td>54.00</td> <td>45.12</td> <td>32.88</td> <td>7.10</td> <td>36.86</td> <td>111</td> <td>319</td> <td>Average</td> <td>HORIZONTAL</td> </tr> </tbody> </table>	Over	Limit	ReadAntenna	Cable Preamp	A/Pos	T/Pos	Remark	Pol/Phas	MHz	dBm	dB	dB	dB	dB	cm	deg	1	2389.95	48.24	-5.76	54.00	45.12	32.88	7.10	36.86	111	319	Average	HORIZONTAL	<p>Site Condition : 030405-K5 FCC PART 15C (AVG) 3m 3317.5M 75957 HORIZONTAL RSM 1000.000MHz YBR 0.010MHz SRT Auto Project : FR1N0920-01 Mode : 2 Plane : Y Full-directivity IME1 : #3 PowerSetting : 7</p> <table border="1"> <thead> <tr> <th>Over</th> <th>Limit</th> <th>ReadAntenna</th> <th>Cable Preamp</th> <th>A/Pos</th> <th>T/Pos</th> <th>Remark</th> <th>Pol/Phas</th> </tr> <tr> <th>MHz</th> <th>dBm</th> <th>dB</th> <th>dB</th> <th>dB</th> <th>dB</th> <th>cm</th> <th>deg</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>2414.00</td> <td>93.59</td> <td>39.59</td> <td>54.00</td> <td>90.41</td> <td>32.90</td> <td>7.13</td> <td>36.85</td> <td>111</td> <td>319</td> <td>Average</td> <td>HORIZONTAL</td> </tr> </tbody> </table>	Over	Limit	ReadAntenna	Cable Preamp	A/Pos	T/Pos	Remark	Pol/Phas	MHz	dBm	dB	dB	dB	dB	cm	deg	1	2414.00	93.59	39.59	54.00	90.41	32.90	7.13	36.85	111	319	Average	HORIZONTAL
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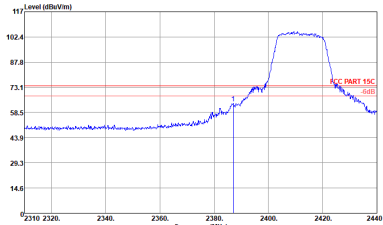
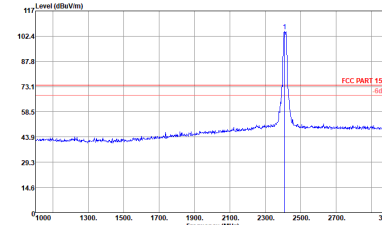
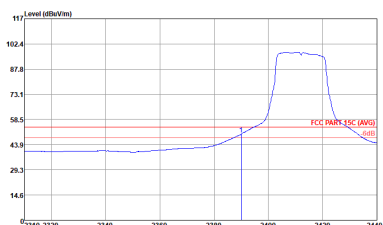
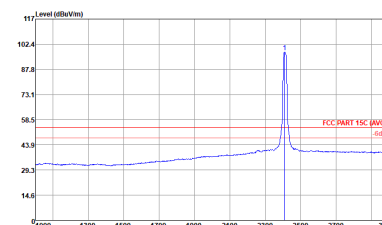
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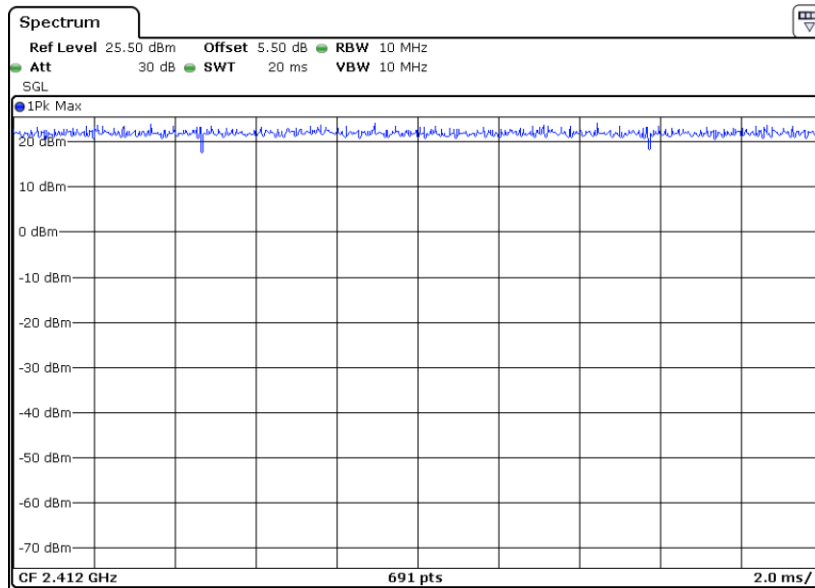
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Peak Avg.	<p>Site : 03CH00-KS            Condition : FCC PART 15C 3m 3117 SN 75957 HORIZONTAL            Project : RBM 1000 000MHz VSW 3000 000MHz SFT Auto            Mode : 2            Plane : 2            Full-directivity : Full-directivity            MEI : 63            PowerRating : 63</p> <table border="1"> <thead> <tr> <th>Over</th> <th>Limit</th> <th>ReadAntenna</th> <th>Cable</th> <th>Preamp</th> <th>A/Pos</th> <th>T/Pos</th> <th>Remark</th> <th>Poi/Phas</th> </tr> <tr> <th>Level</th> <th>Level</th> <th>Level Factor</th> <th>Loss Factor</th> <th>dB</th> <th>cm</th> <th>deg</th> <th></th> <th></th> </tr> </thead> <tbody> <tr> <td>1</td> <td>4830.00</td> <td>56.61</td> <td>-8.29</td> <td>74.00</td> <td>74.54</td> <td>34.20</td> <td>10.25</td> <td>65.38</td> <td>272</td> <td>240</td> <td>Peak</td> <td>HORIZONTAL</td> </tr> <tr> <td>2</td> <td>4830.00</td> <td>44.30</td> <td>-9.70</td> <td>54.00</td> <td>65.23</td> <td>34.20</td> <td>10.25</td> <td>65.38</td> <td>272</td> <td>300</td> <td>Average</td> <td>HORIZONTAL</td> </tr> </tbody> </table>	Over	Limit	ReadAntenna	Cable	Preamp	A/Pos	T/Pos	Remark	Poi/Phas	Level	Level	Level Factor	Loss Factor	dB	cm	deg			1	4830.00	56.61	-8.29	74.00	74.54	34.20	10.25	65.38	272	240	Peak	HORIZONTAL	2	4830.00	44.30	-9.70	54.00	65.23	34.20	10.25	65.38	272	300	Average	HORIZONTAL	<p>Site : 03CH00-KS            Condition : FCC PART 15C 3m 3117 SN 75957 VERTICAL            Project : RBM 1000 000MHz VSW 3000 000MHz SFT Auto            Mode : 2            Plane : 2            Full-directivity : Full-directivity            MEI : 63            PowerRating : 63</p> <table border="1"> <thead> <tr> <th>Over</th> <th>Limit</th> <th>ReadAntenna</th> <th>Cable</th> <th>Preamp</th> <th>A/Pos</th> <th>T/Pos</th> <th>Remark</th> <th>Poi/Phas</th> </tr> <tr> <th>Level</th> <th>Level</th> <th>Level Factor</th> <th>Loss Factor</th> <th>dB</th> <th>cm</th> <th>deg</th> <th></th> <th></th> </tr> </thead> <tbody> <tr> <td>1</td> <td>4830.00</td> <td>57.17</td> <td>-16.83</td> <td>74.00</td> <td>78.10</td> <td>34.20</td> <td>10.25</td> <td>65.38</td> <td>100</td> <td>241</td> <td>Peak</td> <td>VERTICAL</td> </tr> <tr> <td>2</td> <td>4830.00</td> <td>44.64</td> <td>-9.36</td> <td>54.00</td> <td>65.07</td> <td>34.20</td> <td>10.25</td> <td>65.38</td> <td>100</td> <td>241</td> <td>Average</td> <td>VERTICAL</td> </tr> </tbody> </table>	Over	Limit	ReadAntenna	Cable	Preamp	A/Pos	T/Pos	Remark	Poi/Phas	Level	Level	Level Factor	Loss Factor	dB	cm	deg			1	4830.00	57.17	-16.83	74.00	78.10	34.20	10.25	65.38	100	241	Peak	VERTICAL	2	4830.00	44.64	-9.36	54.00	65.07	34.20	10.25	65.38	100	241	Average	VERTICAL
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## Appendix D. Duty Cycle Plots

Band	Duty Cycle(%)	T(ms)	1/T(kHz)	VBW Setting
802.11g	100	-	-	10Hz
802.11n 20M	100	-	-	10Hz

### 802.11g



### 802.11n20

