

FCC PART 15.407

TEST REPORT

For

Beijing COTX Networks Technologies Co., Ltd.

B218, block F, Wangjing, Wanke times center, Chaoyang District, Beijing

FCC ID: 2A2A2X3S

Report Type: Original Report	Product Name: cotx x3 hotspot
Report Number: DG1210824-36075E-00BA1	
Report Date: 2021-09-01	
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Reviewed By: Assistant Manager	
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

EUT Name:	cotx x3 hotspot
EUT Model:	X3S
Operation Frequency:	5745-5825MHz(802.11a/n ht20/ac vht20) 5755-5795 MHz(802.11n ht40/ac vht40) 5775 MHz(802.11ac vht80)
Maximum Output Power (Conducted):	7.82 dBm
Antenna Gain ▲:	2.3 dBi
Modulation Type:	OFDM
Rated Input Voltage:	DC 5V from DC Port
Serial Number:	DG1210824-36075E-RF-A1-S1
EUT Received Date:	2021.08.23
EUT Received Status:	Good

Objective

This type approval report is prepared on behalf of **Beijing COTX Networks Technologies Co., Ltd.** in accordance with Part 2-Subpart J, Part 15-Subparts A, and E of the Federal Communications Commission's rules.

The tests were performed in order to determine compliance with FCC Rules Part 15, Subpart E, section 15.203, 15.205, 15.207, 15.209 and 15.407 rules.

The EUT is the updated version based on certified device, model: X3, FCC ID: 2A2A2X3. The differences between them as following:

1. Change Lora Module and increase BLE Output power by software.

The changes between the previous device and the current one are stated and guaranteed by the applicant.

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices. And KDB 789033 D02 General U-NII Test Procedures New Rules v02r01.

All emissions measurement was performed and Bay Area Compliance Laboratories Corp. (Dongguan).

Measurement Uncertainty

Parameter	Measurement Uncertainty
Occupied Channel Bandwidth	±5 %
RF output power, conducted	±0.61dB
Power Spectral Density, conducted	±0.61 dB
Unwanted Emissions, radiated	30M~200MHz: 4.55 dB, 200M~1GHz: 5.92 dB, 1G~6GHz: 4.98 dB, 6G~18GHz: 5.89 dB, 18G~26.5G: 5.47 dB, 26.5G~40G: 5.63 dB
Unwanted Emissions, conducted	±1.5 dB
Temperature	±1 °C
Humidity	±5%
DC and low frequency voltages	±0.4%
Duty Cycle	1%
AC Power Lines Conducted Emission	3.12 dB (150 kHz to 30 MHz)

Note: Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty. The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage Factor K with the 95% confidence interval.

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Dongguan) to collect test data is located on the No.12, Pulong East 1st Road, Tangxia Town, Dongguan, Guangdong, China.

The lab has been recognized as the FCC accredited lab under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No. : 897218, the FCC Designation No. : CN1220.

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: CN0022.

Declarations

BACL is not responsible for the authenticity of any test data provided by the applicant. Data included from the applicant that may affect test results are marked with a triangle symbol “▲”. Customer model name, addresses, names, trademarks etc. are not considered data.

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.

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SUMMARY OF TEST RESULTS

Rules	Description of Test	Result
FCC §15.407 (f) & §1.1310 & §2.1091	Maximum Permissible Exposure (MPE)	Compliance
FCC§15.203	Antenna Requirement	Compliance*
FCC§15.407(b)(9)& §15.207(a)	Conducted Emissions	Compliance
FCC§15.205& §15.209 &§15.407(b)	Undesirable Emission& Restricted Bands	Compliance
FCC§15.407(b)	Out Of Band Emissions	Compliance*
FCC§15.407(a) (e)	Emission Bandwidth	Compliance*
FCC§15.407(a)	Conducted Transmitter Output Power	Compliance*
FCC§15.407 (a)	Power Spectral Density	Compliance*

Note:

Compliance*: The changes were not affect the test results of the item. The test results please refer to the report of X3, FCC ID: 2A2A2X3. Report number: SZGMA210604-21533E-00B.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system support 802.11a/n ht20/n ht40/ac vht20/ac vht40/ac vht80, the ac vht20/ac vht40 were reduced since the identical parameters with 802.11n ht20 and 802.11n ht40.

For 5725~5850MHz band, 8 channels are provided to testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
149	5745	157	5785
151	5755	159	5795
153	5765	161	5805
155	5775	165	5825

For 802.11a, 802.11n ht20, 802.11ac vht20 channel 149, 157 and 165 was tested, for 802.11n ht40, 802.11ac vht40 channel 151, 159 were tested, for 802.11ac vht80, channel 155 was tested.

Equipment Modifications

No modification was made to the EUT.

EUT Exercise Software

The software “PUTTY” was used for testing, which was provided by Manufacturer. The worst-case data rates are determined to be as follows for each mode based upon investigations by measuring the average power and PSD across all data rates, bandwidths, and modulations. The maximum power was configured as below table, that provided by the Manufacturer▲:

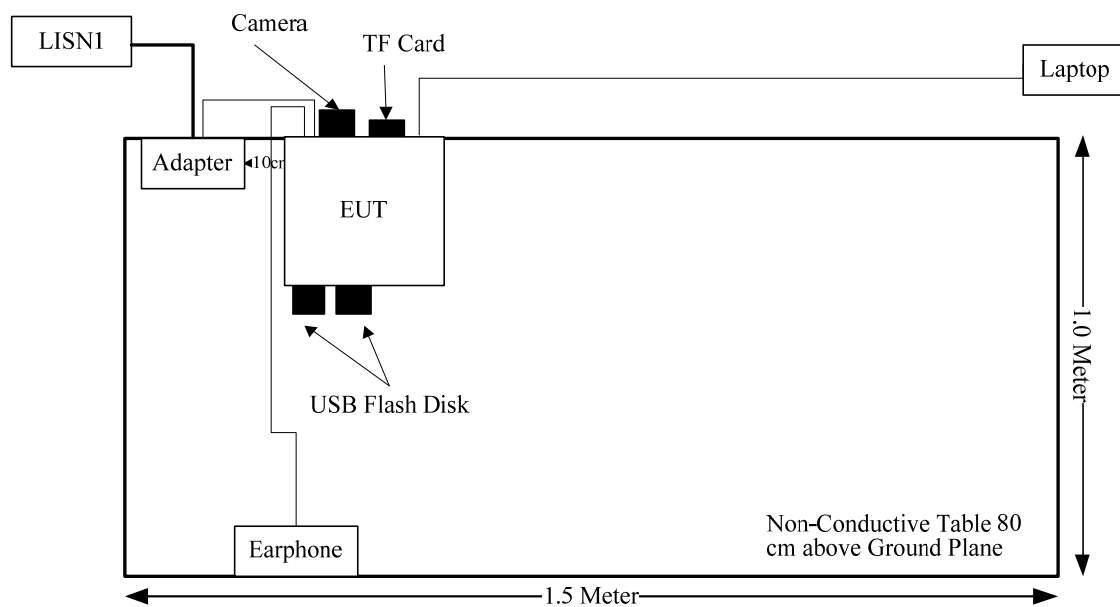
Mode	Channel	Frequency (MHz)	Data Rate (Mbps)	Power level Setting
802.11a	Low	5745	6Mbps	6
	Middle	5785	6Mbps	6
	High	5825	6Mbps	6
802.11n ht20	Low	5745	MCS0	0
	Middle	5785	MCS0	0
	High	5825	MCS0	0
802.11n ht40	Low	5755	MCS0	0
	High	5795	MCS0	0
802.11ac vht80	Middle	5775	MCS0	0

Local Support Equipment List and Details

Manufacturer	Description	Model	Serial Number
Hytera	Adapter	S010WU0500200	S010WU0500200
COTX	Camera	Un-known	SZGMA210604-21533E-RF-S2
DELL	Laptop	E6410	QDS-BRCM1017
Un-known	Earphone	Un-known	Earphone2
KINGSTON	U disk	32G	32G-1
KEYSIGHT	U disk	32G	32G-2
SANDISK	TF card	SDDR-C531	SDDR-C531-2

Support Cable List and Details

Cable Description	Shielding Type	Ferrite Core	Length (m)	From Port	To
Adapter Cable	No	No	1.5	adapter	EUT
RJ45	No	No	10	EUT	Laptop
Earphone Cable	No	No	1.2	EUT	Earphone

Block Diagram of Test Setup

FCC §15.407 (f) & §1.1310 & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 15.407(f) and subpart §1.1310, systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Limits for Maximum Permissible Exposure (MPE) (§1.1310, §2.1091)

(B) Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Averaging Time (minutes)
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f ²)	30
30–300	27.5	0.073	0.2	30
300–1500	/	/	f/1500	30
1500–100,000	/	/	1.0	30

f = frequency in MHz; * = Plane-wave equivalent power density;

According to §1.1310 and §2.1091 RF exposure is calculated.

Calculation formula:

Prediction of power density at the distance of the applicable MPE limit

$S = PG/4\pi R^2$ = power density (in appropriate units, e.g. mW/cm²);

P = power input to the antenna (in appropriate units, e.g., mW);

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain Factor, is normally numeric gain;

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);

For simultaneously transmit system, the calculated power density should comply with:

$$\sum_i \frac{S_i}{S_{Limit,i}} \leq 1$$

Calculated Data:

Radio	Frequency (MHz)	Antenna Gain		Conducted output power including Tune-up Tolerance		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)
		(dBi)	(numeric)	(dBm)	(mW)			
Lora-DSS	902.3-914.9	3.5	2.24	20	100.00	20.00	0.04	0.60
Lora-DTS	923.3-927.5	3.5	2.24	26.5	446.68	20.00	0.20	0.62
BLE	2402-2480	3.5	2.24	2	1.58	20.00	0.0007	1.0
WLAN 2.4G	2412-2462	3.5	2.24	15	31.62	20.00	0.01	1.0
WLAN 5.8G	5725-5850	2.3	1.70	8	6.31	20.00	0.002	1.0

The WLAN 2.4G,5G or BLE can't transmit simultaneously, Wi-Fi/BLE can transmit simultaneously with Lora:

$$\sum_i \frac{S_i}{S_{Limit,i}}$$

$$=S_{WLAN}/S_{limit-WLAN} + S_{Lora}/S_{limit-Lora}$$

$$=0.01/1+0.20/0.62$$

$$=0.33$$

$$< 1.0$$

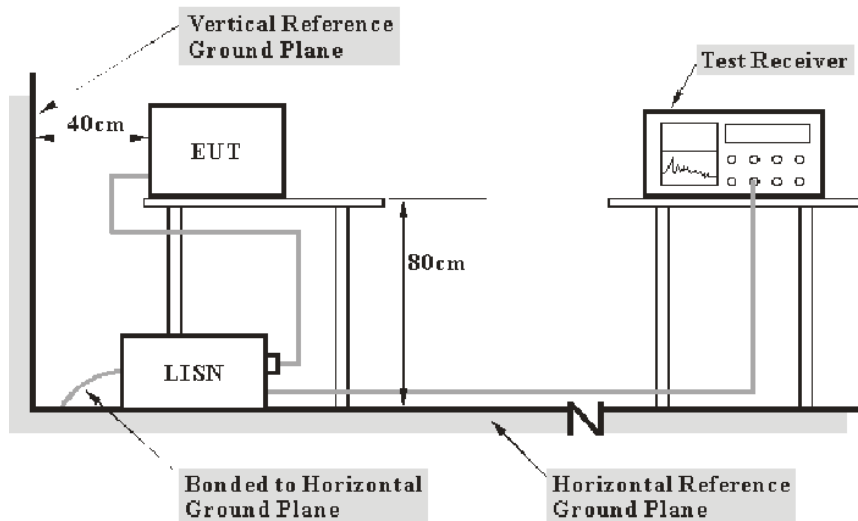
Result: The device meet FCC MPE at 20 cm distance

FCC §15.207 (a) – AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC§15.207(a).

EUT Setup



Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 limits.

The spacing between the peripherals was 10 cm.

The adapter was connected to the main LISN with a 120 V/60 Hz AC power source.

EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

Test Procedure

During the conducted emission test, the adapter was connected to the outlet of the first LISN.

The frequency and amplitude of the six highest ac power-line conducted emissions relative to the limit, measured over all the current-carrying conductors of the EUT power cords, and the operating frequency or frequency to which the EUT is tuned (if appropriate), should be reported, unless such emissions are more than 20 dB below the limit. AC power-line conducted emissions measurements are to be separately carried out only on each of the phase (“hot”) line(s) and (if used) on the neutral line(s), but not on the ground [protective earth] line(s). If less than six emission frequencies are within 20 dB of the limit, then the noise level of the measuring instrument at representative frequencies should be reported. The specific conductor of the power-line cord for each of the reported emissions should be identified. Measure the six highest emissions with respect to the limit on each current-carrying conductor of each power cord associated with the EUT (but not the power cords of associated or peripheral equipment that are part of the test configuration). Then, report the six highest emissions with respect to the limit from among all the measurements identifying the frequency and specific current-carrying conductor identified with the emission. The six highest emissions should be reported for each of the current-carrying conductors, or the six highest emissions may be reported over all the current-carrying conductors.

Corrected Amplitude & Margin Calculation

The basic equation is as follows:

$$V_C = V_R + A_C + VDF$$

$$C_f = A_C + VDF$$

Herein,

V_C (cord. Reading): corrected voltage amplitude

V_R : reading voltage amplitude

A_C : attenuation caused by cable loss

VDF: voltage division factor of AMN

C_f : Correction Factor

The “**Margin**” column of the following data tables indicates the degree of compliance within the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

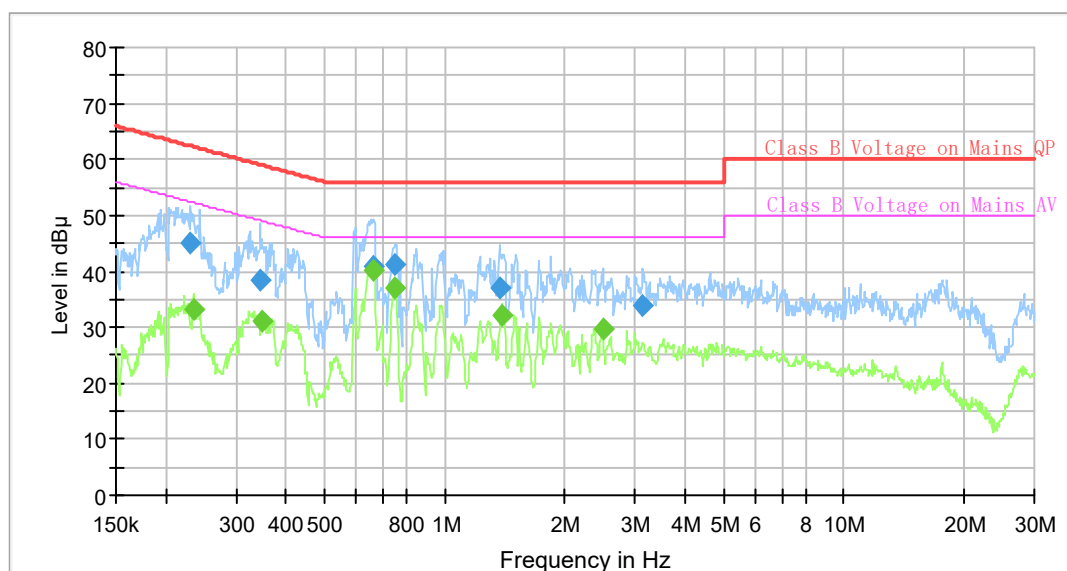
Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	LISN	ENV 216	101614	2020-09-12	2021-09-12
R&S	EMI Test Receiver	ESCI	101121	2021-07-06	2022-07-05
MICRO-COAX	Coaxial Cable	C-NJNJ-50	C-0200-01	2020-09-05	2021-09-05
R&S	Test Software	EMC32	Version 9.10.00	N/A	N/A

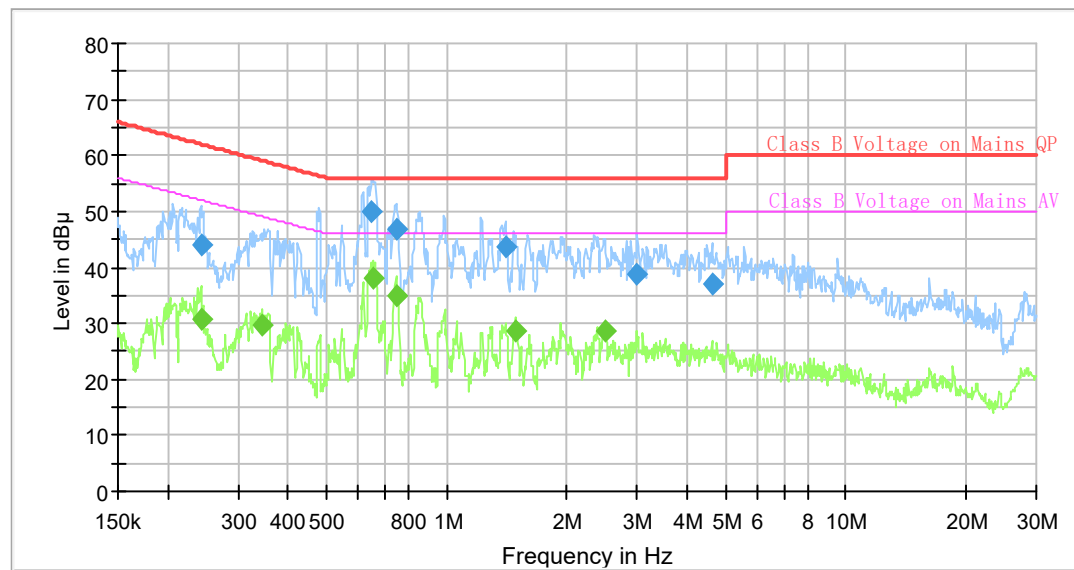
*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

Test Data**Environmental Conditions**

Temperature:	26.7°C
Relative Humidity:	63%
ATM Pressure:	100.3kPa
Tester:	Walker Chen
Test Date:	2021-08-25

Test Result: Compliance**Test Mode:** Transmitting**AC120 V, 60 Hz, Line:****Final Result**

Frequency (MHz)	QuasiPeak (dB μ V)	Average (dB μ V)	Limit (dB μ V)	Margin (dB)	Bandwidth (kHz)	Line	Corr. (dB)
0.230342	45.15	---	62.44	17.29	9.000	L1	9.6
0.234983	---	33.02	52.27	19.25	9.000	L1	9.6
0.345004	38.59	---	59.08	20.49	9.000	L1	9.6
0.348462	---	31.00	49.00	18.00	9.000	L1	9.6
0.659799	---	40.11	46.00	5.89	9.000	L1	9.6
0.663098	40.98	---	56.00	15.02	9.000	L1	9.6
0.751154	41.22	---	56.00	14.78	9.000	L1	9.7
0.751154	---	36.95	46.00	9.05	9.000	L1	9.7
1.373481	36.87	---	56.00	19.13	9.000	L1	9.7
1.394186	---	32.27	46.00	13.73	9.000	L1	9.7
2.486475	---	29.74	46.00	16.26	9.000	L1	9.7
3.143322	33.77	---	56.00	22.23	9.000	L1	9.7

AC120 V, 60 Hz, Neutral:**Final Result**

Frequency (MHz)	QuasiPeak (dB μ V)	Average (dB μ V)	Limit (dB μ V)	Margin (dB)	Bandwidth (kHz)	Line	Corr. (dB)
0.242121	---	30.88	52.02	21.14	9.000	N	9.6
0.242121	43.91	---	62.02	18.11	9.000	N	9.6
0.345004	---	29.52	49.08	19.56	9.000	N	9.6
0.650000	50.08	---	56.00	5.92	9.000	N	9.6
0.653250	---	37.93	46.00	8.07	9.000	N	9.6
0.747417	46.97	---	56.00	9.03	9.000	N	9.6
0.747417	---	34.81	46.00	11.19	9.000	N	9.6
1.401157	43.66	---	56.00	12.34	9.000	N	9.6
1.480177	---	28.66	46.00	17.34	9.000	N	9.6
2.486475	---	28.59	46.00	17.41	9.000	N	9.6
3.005345	38.66	---	56.00	17.34	9.000	N	9.6
4.615042	37.05	---	56.00	18.95	9.000	N	9.6

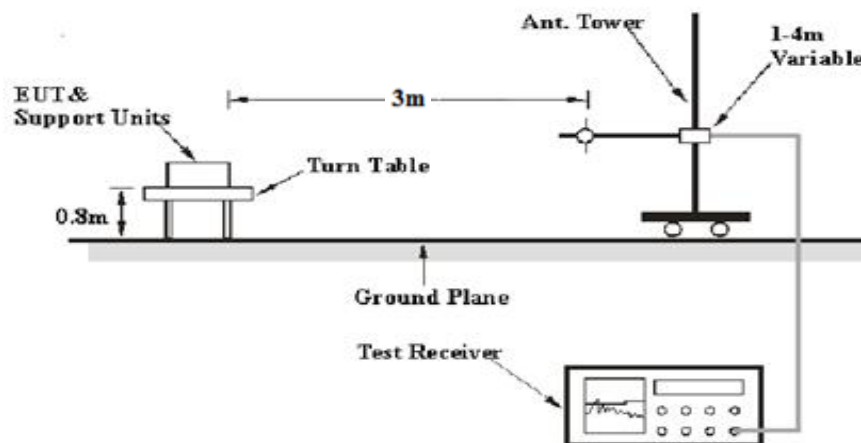
FCC §15.209, §15.205 , §15.407(b) –UNWANTED EMISSION

Applicable Standard

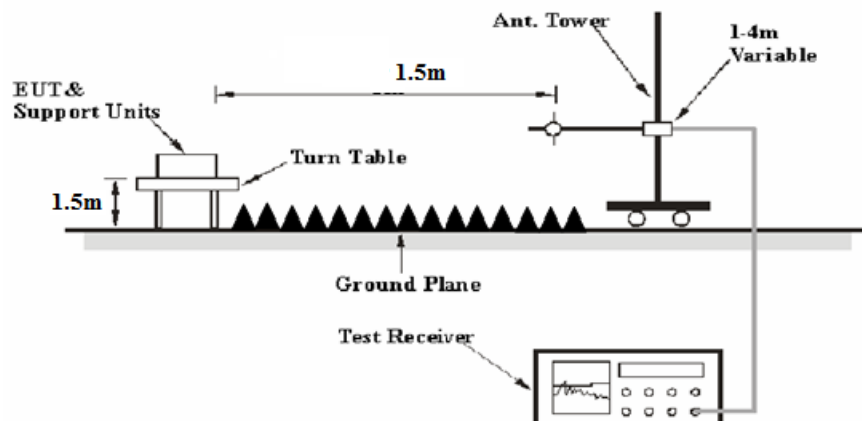
FCC §15.407(b); §15.209; §15.205;

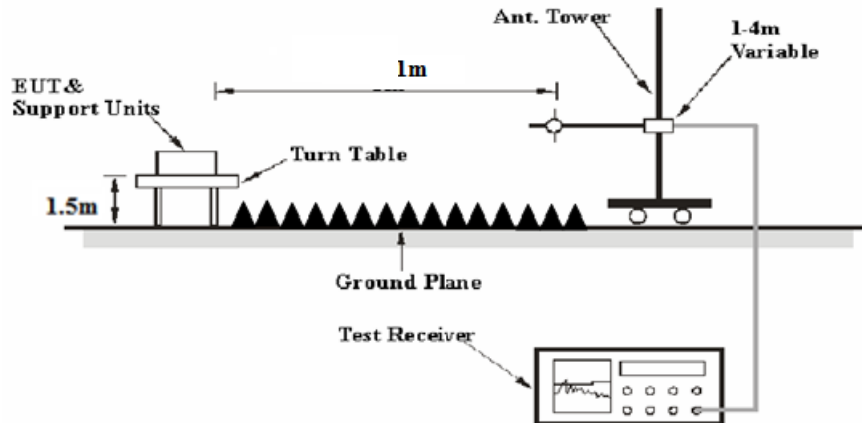
EUT Setup

Below 1 GHz:



1-26.5 GHz:



26.5-40 GHz:

The radiated emission using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, and FCC 15.407 limits.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

The spacing between the peripherals was 10 cm.

EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 40 GHz.

During the radiated emission test, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

30-1000MHz:

Measurement	RBW	Video B/W	IF B/W
QP	120 kHz	300 kHz	120kHz

1GHz- 40GHz:

Measurement	Duty cycle	RBW	Video B/W
PK	Any	1MHz	3 MHz
Ave.	>98%	1MHz	10 Hz
	<98%	1MHz	1/T

If the maximized peak measured value complies with under the QP/Average limit more than 6dB, then it is unnecessary to perform an QP/Average measurement.

Test Procedure

During the radiated emission test, the adapter was connected to the first AC floor outlet.

Data was recorded in Quasi-peak detection mode for frequency range of 30 MHz-1GHz, peak and Average detection modes for frequencies above 1GHz.

According to KDB 789033 D02 General UNII Test Procedures New Rules v02r01, emission shall be computed as: $E [dB\mu V/m] = EIRP[dBm] + 95.2$, for $d = 3$ meters.

According to C63.10, the above 1G test result shall be extrapolated to the specified distance using an extrapolation Factor of 20dB/decade from 3m to 1.5m or 1m

Distance extrapolation Factor = $20 \log (\text{specific distance } [3m] / \text{test distance } [1.5m])$ dB = 6.02 dB
or

Distance extrapolation Factor = $20 \log (\text{specific distance } [3m] / \text{test distance } [1m])$ dB = 9.54 dB

All emissions under the average limit and under the noise floor have not recorded in the report.

Corrected Amplitude & Margin Calculation

For the range 30MHz-1GHz, the Corrected Amplitude is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading. The basic equation is as follows:

$$\text{Corrected Amplitude} = \text{Meter Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

For the range 1GHz-40GHz, Test performed at 1.5m or 1m, the Corrected Amplitude is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain from the Meter Reading and the Distance extrapolation Factor. The basic equation is as follows:

$$\begin{aligned} &\text{Corrected Amplitude} \\ &= \text{Meter Reading} + \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain} - \text{Distance extrapolation factor} \end{aligned}$$

The “**Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of 7dB means the emission is 7dB below the limit. The equation for margin calculation is as follows:

$$\text{Margin} = \text{Limit} - \text{Corrected Amplitude}$$

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiation Below 1GHz Test					
Sunol Sciences	Antenna	JB3	A060611-1	2020-11-10	2023-11-10
R&S	EMI Test Receiver	ESR3	102453	2020-09-12	2021-09-12
Unknown	Coaxial Cable	C-NJNJ-50	C-0075-01	2020-09-05	2021-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-0400-01	2020-09-05	2021-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-1400-01	2021-05-06	2022-05-06
HP	Amplifier	8447D	2727A05902	2021-09-05	2022-09-05
Farad	Test Software	EZ-EMC	V1.1.4.2	N/A	N/A

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

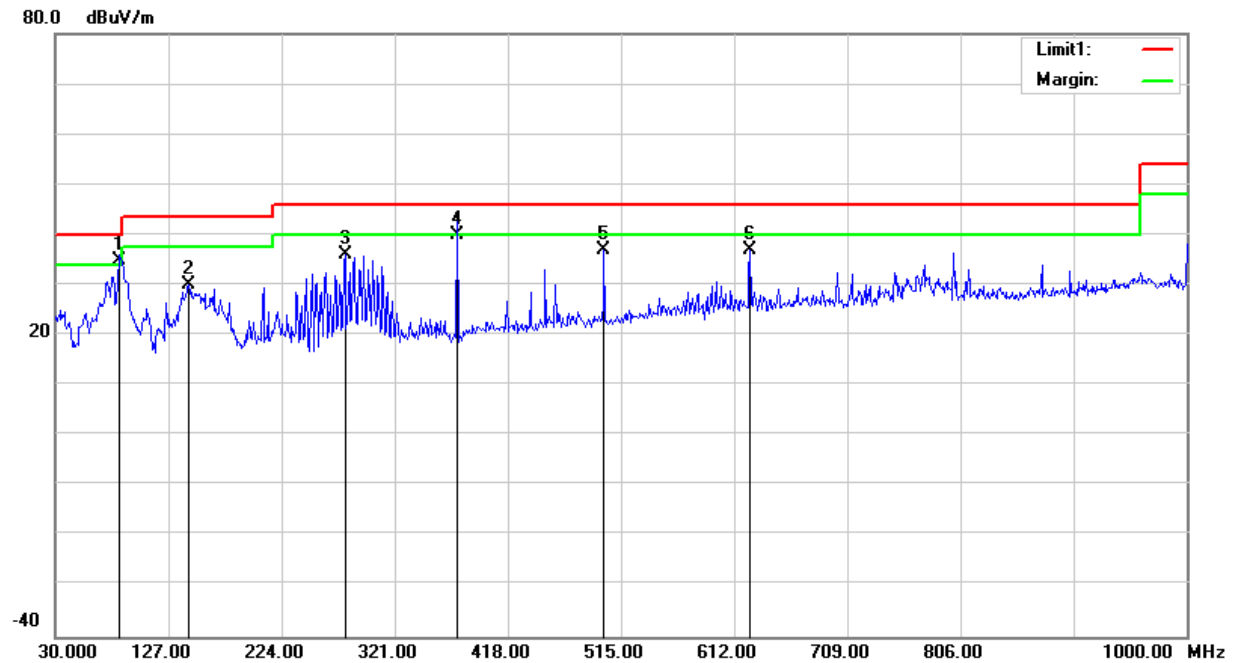
Test Data**Environmental Conditions**

Test Items	Radiation Below 1GHz
Temperature:	26.8°C
Relative Humidity:	55 %
ATM Pressure:	100.6kPa
Tester:	Johnson Huang
Test Date:	2021-08-30

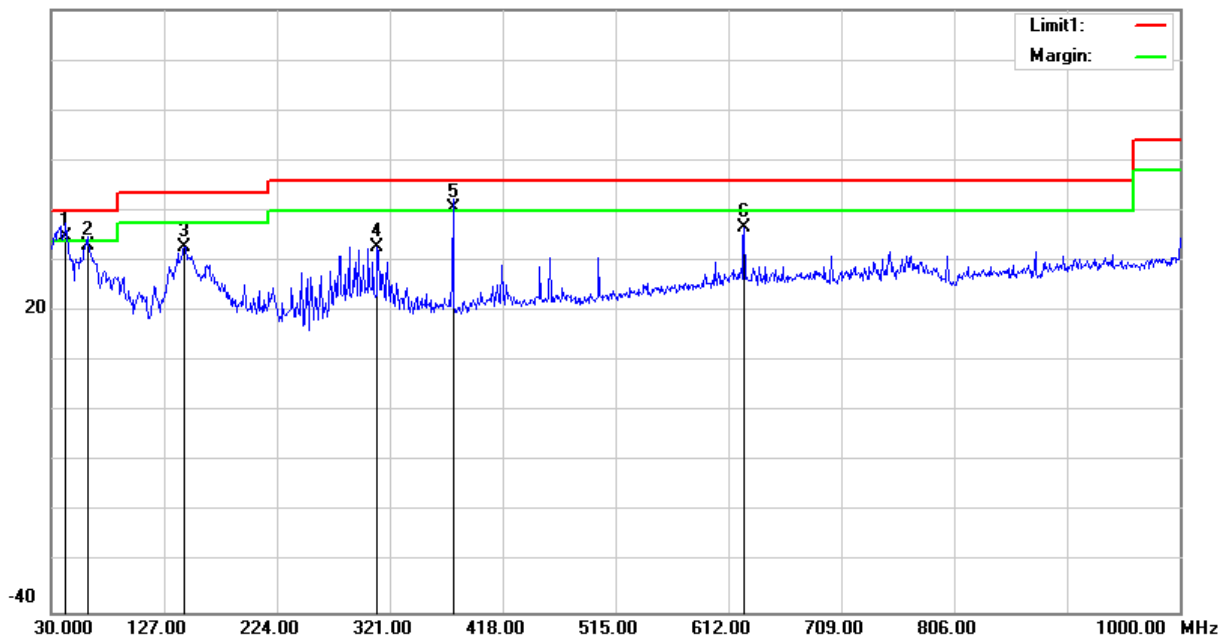
Test Mode: Transmitting

Test Result: Compliance.

Note: The changes were not affect the test results of above 1GHz test. The test results of above 1GHz test please refer to the report of X3, FCC ID: 2A2A2X3. Report number: SZGMA210604-21533E-00B.

1) Below 1GHz(802.11a 5745 MHz was the worst):**Horizontal:**

Frequency (MHz)	Receiver Reading (dBuV)	Detector	Correction Factor (dB/m)	Cord. Amp. (dBuV/m)	Limit (dBuV/m)	Margin (dB)
85.2900	50.26	QP	-15.35	34.91	40.00	5.09
144.4600	38.95	peak	-8.92	30.03	43.50	13.47
278.3200	44.55	peak	-8.63	35.92	46.00	10.08
374.3500	45.87	QP	-5.95	39.92	46.00	6.08
500.4500	40.27	peak	-3.45	36.82	46.00	9.18
625.5800	37.68	peak	-0.82	36.86	46.00	9.14

Vertical:80.0 dB μ V/m

Frequency (MHz)	Receiver Reading (dB μ V)	Detector	Correction Factor (dB/m)	Cord. Amp. (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
42.6100	45.79	QP	-10.99	34.80	40.00	5.20
61.0400	49.34	QP	-16.36	32.98	40.00	7.02
144.4600	41.67	peak	-8.92	32.75	43.50	10.75
310.3300	39.77	peak	-7.14	32.63	46.00	13.37
375.3200	46.53	QP	-5.93	40.60	46.00	5.40
625.5800	37.51	peak	-0.82	36.69	46.00	9.31

***** END OF REPORT *****