



TESTING LABORATORY
CERTIFICATE #4820.01



FCC PART 15.247

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-00AA1	
Report Date: 2021-09-01	
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FINAL

GENERAL INFORMATION**Product Description for Equipment under Test (EUT)**

EUT Name:	cotx x3 hotspot
EUT Model:	X3S
Operation Frequency:	2412-2462 MHz(802.11b/g/n ht20), 2422-2452 MHz(802.11n ht40) 2402-2480 MHz(BLE) 923.3-927.5 MHz
Maximum Peak Output Power (Conducted):	14.52 dBm(802.11b/g/n) 1.88 dBm(BLE) 26.06 dBm(Lora-DTS)
Modulation Type:	DSSS, OFDM(802.11b/g/n) GFSK(BLE) Lora(Lora-DTS)
Antenna Gain▲:	3.5 dBi
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 report is prepared on behalf of **Beijing COTX Networks Technologies Co., Ltd.** in accordance with Part 2, Subpart J, Part 15, Subparts A and C of the Federal Communications Commission's rules.

The tests were performed in order to determine the compliance of the EUT with FCC Rules Part 15-Subpart C, section 15.203, 15.205, 15.207, 15.209 and 15.247 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 increased 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 558074 D01 DTS Meas Guidance v05r02.

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

FCC Rules	Description of Test	Result
FCC§15.247 (i) & §1.1310 & §2.1091	Maximum Permissible Exposure (MPE)	Compliance
§15.203	Antenna Requirement	Compliance
§15.207 (a)	AC Line Conducted Emissions	Compliance
§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliance
§15.247 (a)(2)	6 dB Bandwidth	Compliance
§15.247(b)(3)	Maximum Conducted Output Power	Compliance
§15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliance
§15.247(e)	Power Spectral Density	Compliance

Note:

The changes were not affect the antenna port conducted and radiation emission above 1GHz test results of 802.11b/g/n. The test results of 802.11b/g/n please refer to the report of X3, FCC ID: 2A2A2X3. Report number: SZGMA210604-21533E-00A.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in Engineering Mode, which was provided by the manufacturer.

For Bluetooth LE mode, 40 channels are provided for testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2402	20	2442
1	2404	...	...
...	...	...	...
...	...	...	...
..	...	38	2478
19	2440	39	2480

EUT was tested with channel 0, 19 and 39.

For Lora-DTS mode, 8 channels are provided for testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	923.3	5	925.7
2	923.9	6	926.3
3	924.5	7	926.9
4	925.1	8	927.5

EUT was tested with channel 1, 4 and 8.

Equipment Modifications

No modification was made to the EUT.

EUT Exercise Software

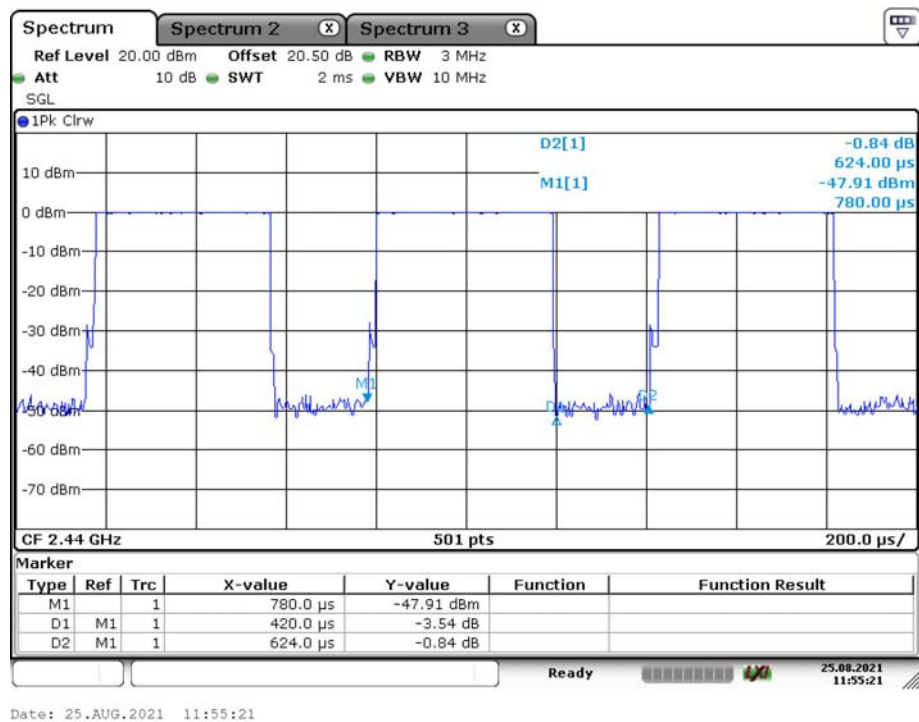
The 'PUTTY' was used during test, which was provided by manufacturer. The maximum power level was configured by the software as below table▲:

Mode	Channel	Frequency (MHz)	Power level Setting
BLE	Low	2402	Default
	Middle	2440	Default
	High	2480	Default
Lora-DTS	Low	923.3	26
	Middle	925.1	26
	High	927.5	26

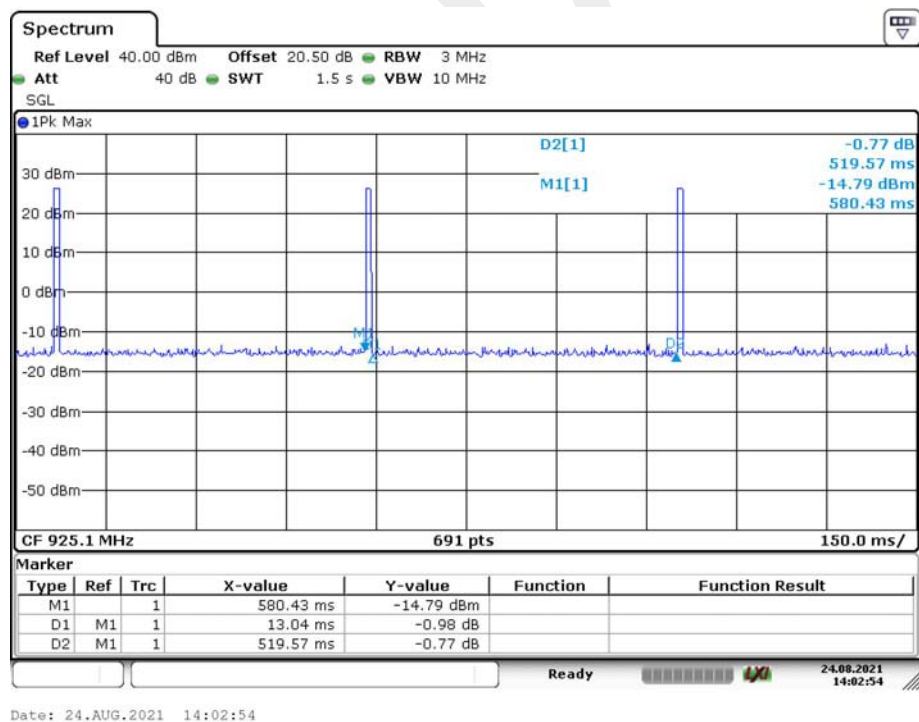
The maximum duty cycle as following table:

Test mode	T _{on} (ms)	T _{on+off} (ms)	Duty Cycle (%)
BLE	0.420	0.624	67.31
Lora-DTS	13.04	519.57	2.51

BLE



Lora-DTS

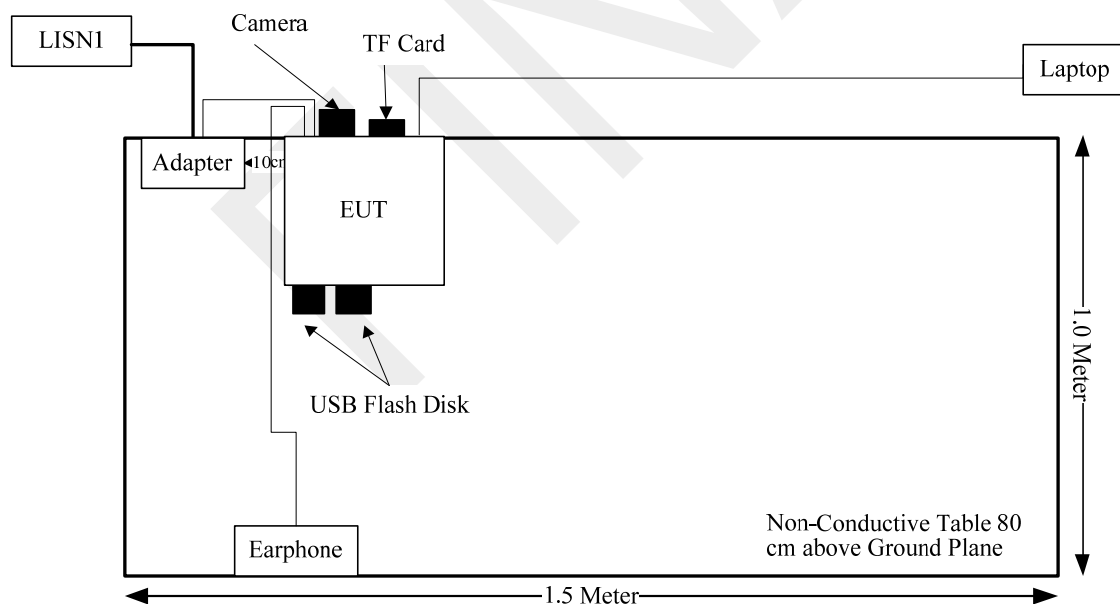


Local Support Equipment List and Details

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 §15.247 (i) & §1.1310 & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 15.247(i) 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 §15.203 - ANTENNA REQUIREMENT

Applicable Standard

According to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine compliance with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

- a. Antenna must be permanently attached to the unit.
- b. Antenna must use a unique type of connector to attach to the EUT.
- c. Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

Antenna Connector Construction

The EUT has one antenna arrangement for Wi-Fi/BLE and one antenna arrangement for Lora, use a unique type of connector to attach to the EUT. fulfill the requirement of this section. Please refer to the EUT photos.

Radios	Antenna Type	input impedance (Ohm)	Antenna Gain /Frequency Range
Wi-Fi/BLE	Dipole	50	3.5 dBi/2.4~2.5GHz 2.3 dBi/5.725~5.85 GHz
Lora	Dipole	50	3.5 dBi/902~928 MHz

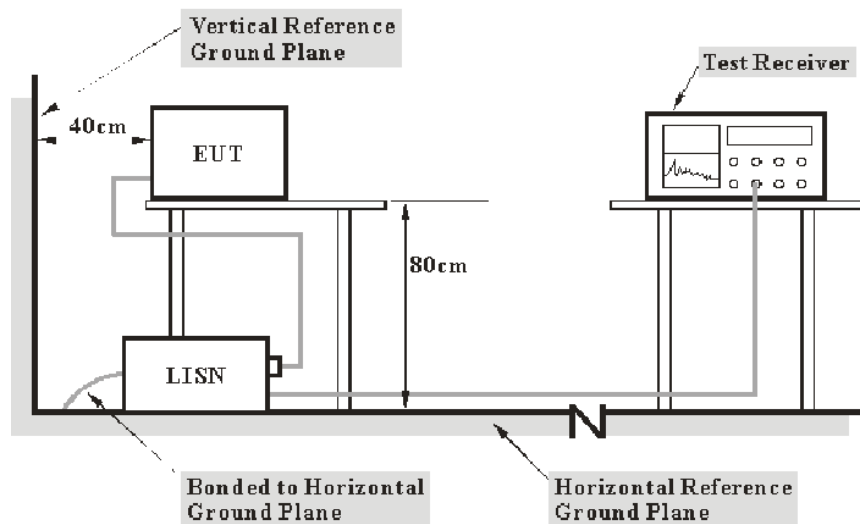
Result: Compliance.

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:

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

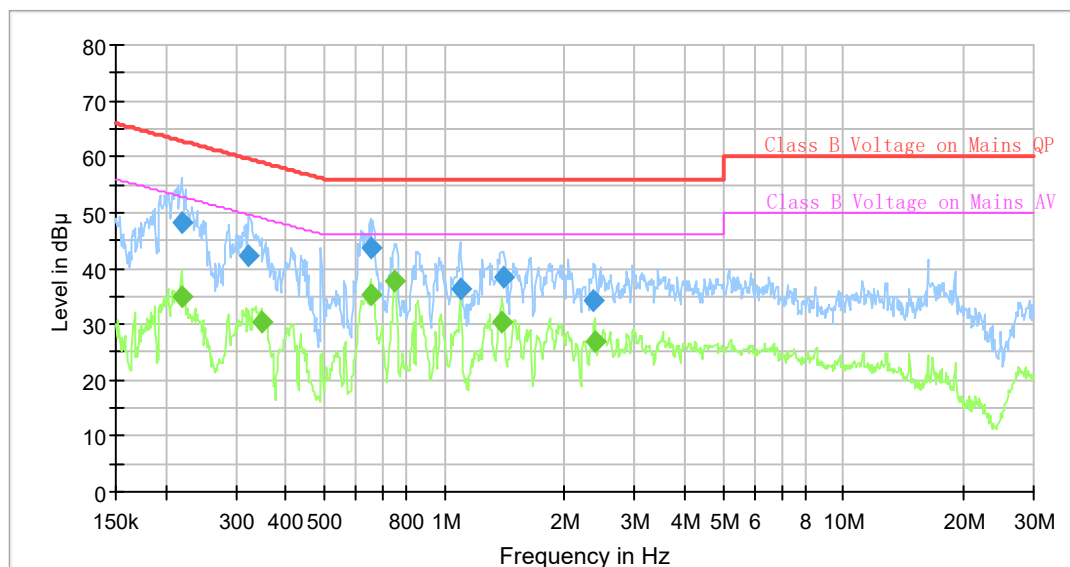
Test Equipment List and Details

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

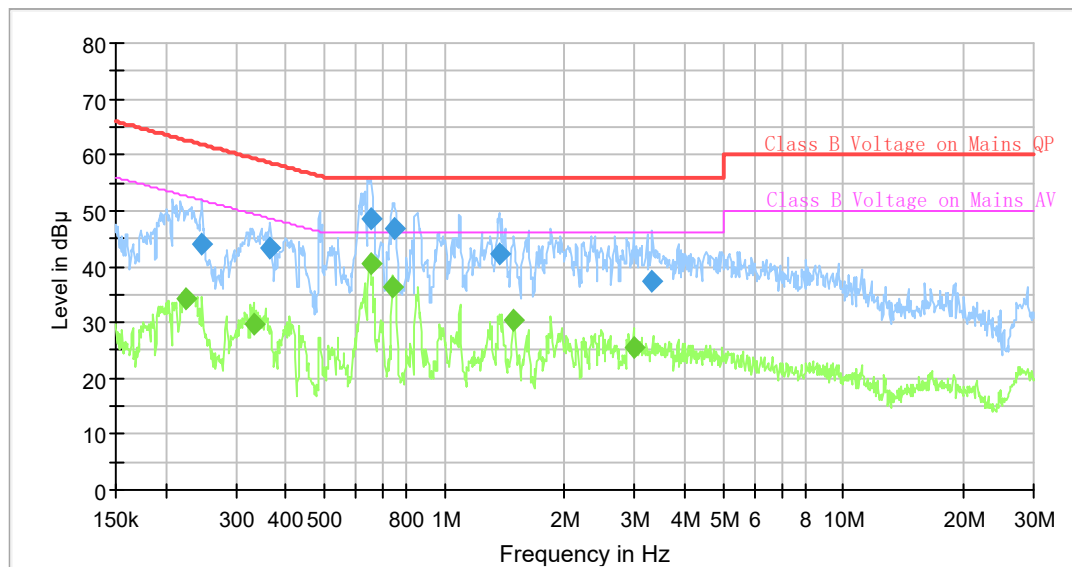
*** Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Dongguan) attests that all calibrations have been performed, traceable to National Primary Standards and International System of Units (SI).

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(BLE high channel was the worst)**AC120 V, 60 Hz, Line:****Final Result**

Frequency (MHz)	QuasiPeak (dB μV)	Average (dB μV)	Limit (dB μV)	Margin (dB)	Bandwidth (kHz)	Line	Corr. (dB)
0.219135	---	35.04	52.85	17.81	9.000	L1	9.6
0.219135	48.17	---	62.85	14.68	9.000	L1	9.6
0.323344	42.17	---	59.62	17.45	9.000	L1	9.6
0.348462	---	30.36	49.00	18.64	9.000	L1	9.6
0.653250	43.80	---	56.00	12.20	9.000	L1	9.6
0.653250	---	35.31	46.00	10.69	9.000	L1	9.6
0.751154	---	37.62	46.00	8.38	9.000	L1	9.7
1.097362	36.39	---	56.00	19.61	9.000	L1	9.7
1.394186	---	30.47	46.00	15.53	9.000	L1	9.7
1.401157	38.28	---	56.00	17.72	9.000	L1	9.7
2.365502	34.40	---	56.00	21.60	9.000	L1	9.7
2.377330	---	26.86	46.00	19.14	9.000	L1	9.7

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

Frequency (MHz)	QuasiPeak (dB μV)	Average (dB μV)	Limit (dB μV)	Margin (dB)	Bandwidth (kHz)	Line	Corr. (dB)
0.224669	---	34.21	52.64	18.43	9.000	N	9.6
0.247000	44.11	---	61.86	17.75	9.000	N	9.6
0.333166	---	29.86	49.37	19.51	9.000	N	9.6
0.366283	43.40	---	58.58	15.18	9.000	N	9.6
0.653250	---	40.63	46.00	5.37	9.000	N	9.6
0.653250	48.65	---	56.00	7.35	9.000	N	9.6
0.743699	---	36.22	46.00	9.78	9.000	N	9.6
0.747417	46.86	---	56.00	9.14	9.000	N	9.6
1.373481	42.32	---	56.00	13.68	9.000	N	9.6
1.495016	---	30.31	46.00	15.69	9.000	N	9.6
2.975516	---	25.50	46.00	20.50	9.000	N	9.6
3.320593	37.44	---	56.00	18.56	9.000	N	9.6

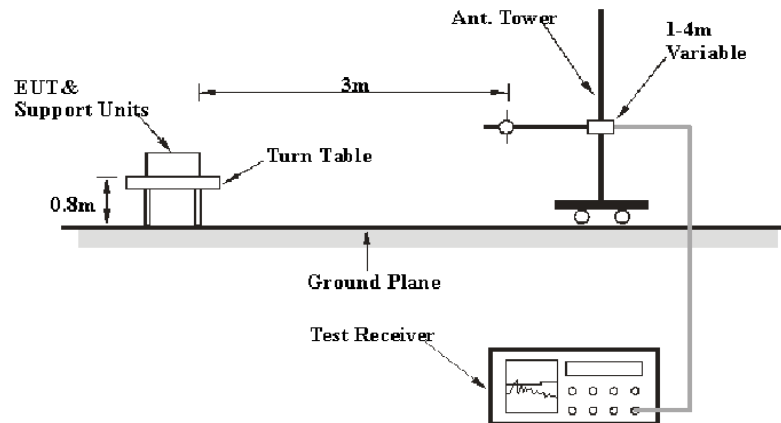
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

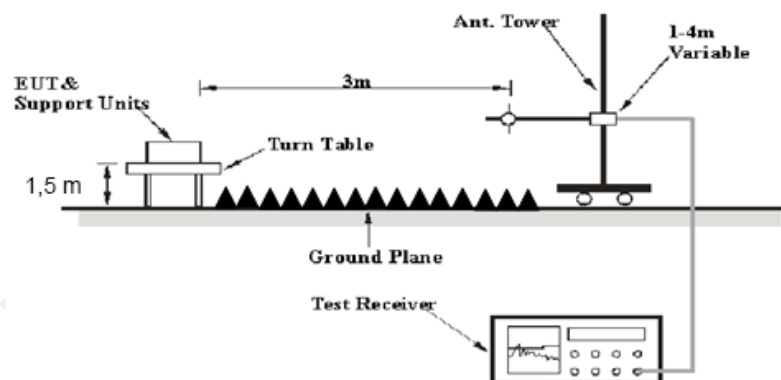
FCC §15.247 (d); §15.209; §15.205;

EUT Setup

Below 1GHz:



Above 1GHz:



The radiated emission below 1GHz tests were performed in the 10 meters chamber, above 1GHz tests were performed in the 3 meters chamber test site A, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209, and FCC 15.247 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 25 GHz.

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

30MHz-1000MHz:

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

1GHz- 25GHz:

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

Note: T is minimum transmission duration

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

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

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

Corrected Amplitude & Margin Calculation

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:

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

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Radiation Below 1GHz					
Sunol Sciences	Antenna	JB3	A060611-2	2020-08-25	2023-08-25
R&S	EMI Test Receiver	ESCI	100224	2020-09-12	2021-09-12
Unknown	Coaxial Cable	C-NJNJ-50	C-1000-01	2020-09-05	2021-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-0400-02	2020-09-05	2021-09-05
Unknown	Coaxial Cable	C-NJNJ-50	C-0530-01	2020-09-24	2021-09-24
Sonoma	Amplifier	310N	185914	2020-10-13	2021-10-13
Farad	Test Software	EZ-EMC	V1.1.4.2	N/A	N/A
Radiation Above 1GHz					
ETS-Lindgren	Horn Antenna	3115	000 527 35	2018-10-12	2021-10-12
Ducommun Technologies	Horn Antenna	ARH-4223-02	1007726-01 1304	2020-12-05	2023-12-04
Agilent	Spectrum Analyzer	E4440A	SG43360054	2021-07-22	2022-07-21
Unknown	Coaxial Cable	C-SJSJ-50	C-0800-01	2020-09-05	2021-09-05
Unknown	Coaxial Cable	C-2.4J2.4J-50	C-0700-02	2021-06-27	2022-06-26
Mini-Circuit	Amplifier	ZVA-213-S+	54201245	2020-09-05	2021-09-05
Quinstar	Amplifier	QLW-18405536-JO	15964001001	2021-06-27	2022-06-26
Farad	Test Software	EZ-EMC	V1.1.4.2	N/A	N/A
E-Microwave	Band-stop Filters	OBSF-2400-2483.5-S	OE01601525	2021-06-16	2022-06-15
E-Microwave	Band-stop Filters	OBSF-902-928-D	OE02012122	2021-06-16	2022-06-15
Mini Circuits	High Pass Filter	VHF-6010+	31118	2021-06-16	2022-06-15

*** 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	Radiation Above 1GHz
Temperature:	26.8°C	27.8°C
Relative Humidity:	55 %	50 %
ATM Pressure:	100.6kPa	100.6kPa
Tester:	Johnson Huang	Joker Chen
Test Date:	2021-08-30	2021-08-30

Test Result: Compliance, please Refer to the following data

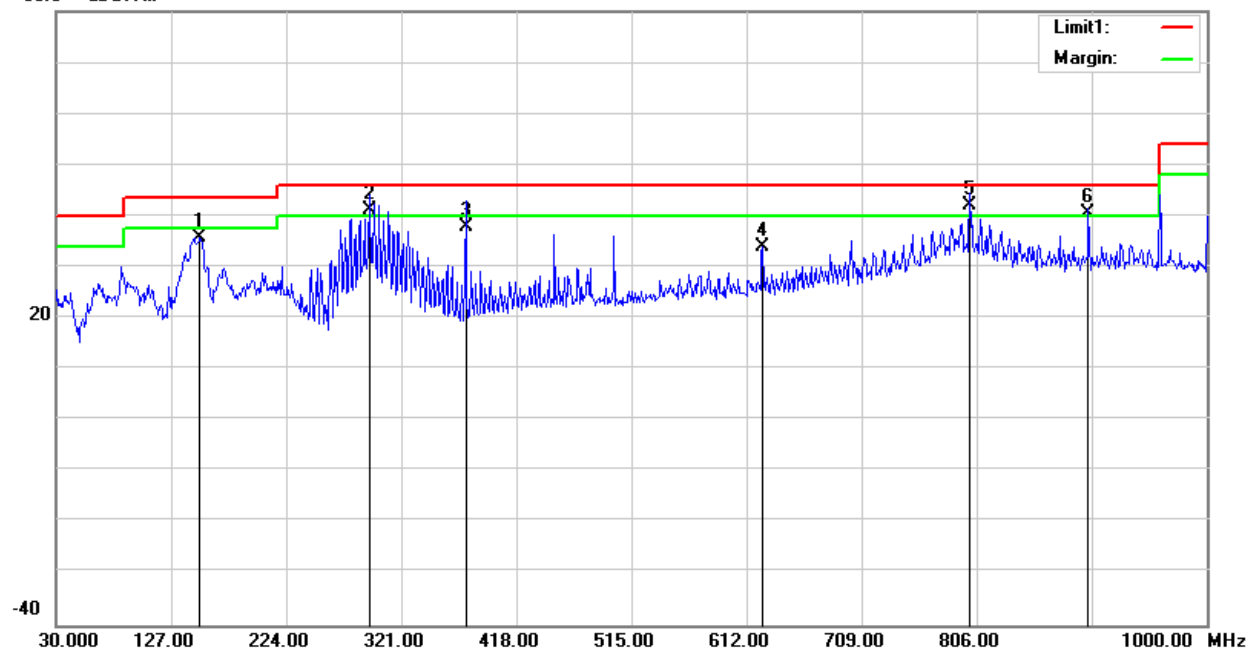
Test Mode: Transmitting

The WLAN 2.4G,5G or BLE can't transmit simultaneously, Wi-Fi/BLE can transmit simultaneously with Lora. Per pretest, no additional emission was created when simultaneous transmitting.

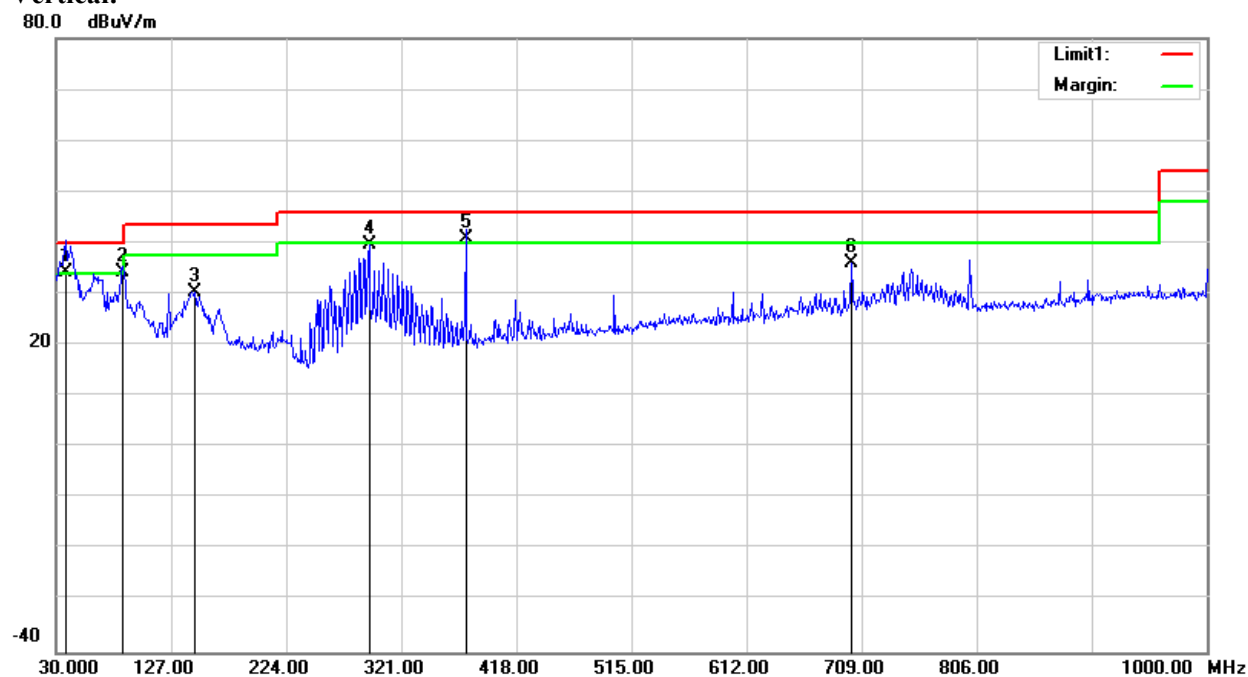
1) 30MHz-1GHz(BLE High channel was the worst)

Horizontal:

80.0 dBuV/m



Frequency (MHz)	Receiver Reading (dBuV)	Detector	Correction Factor (dB/m)	Cord. Amp. (dBuV/m)	Limit (dBuV/m)	Margin (dB)
151.2500	44.86	peak	-9.20	35.66	43.50	7.84
293.8400	48.87	QP	-7.67	41.20	46.00	4.80
375.3200	43.87	QP	-5.93	37.94	46.00	8.06
625.5800	34.70	peak	-0.82	33.88	46.00	12.12
800.1800	40.78	QP	1.14	41.92	46.00	4.08
900.0900	36.90	QP	3.55	40.45	46.00	5.55

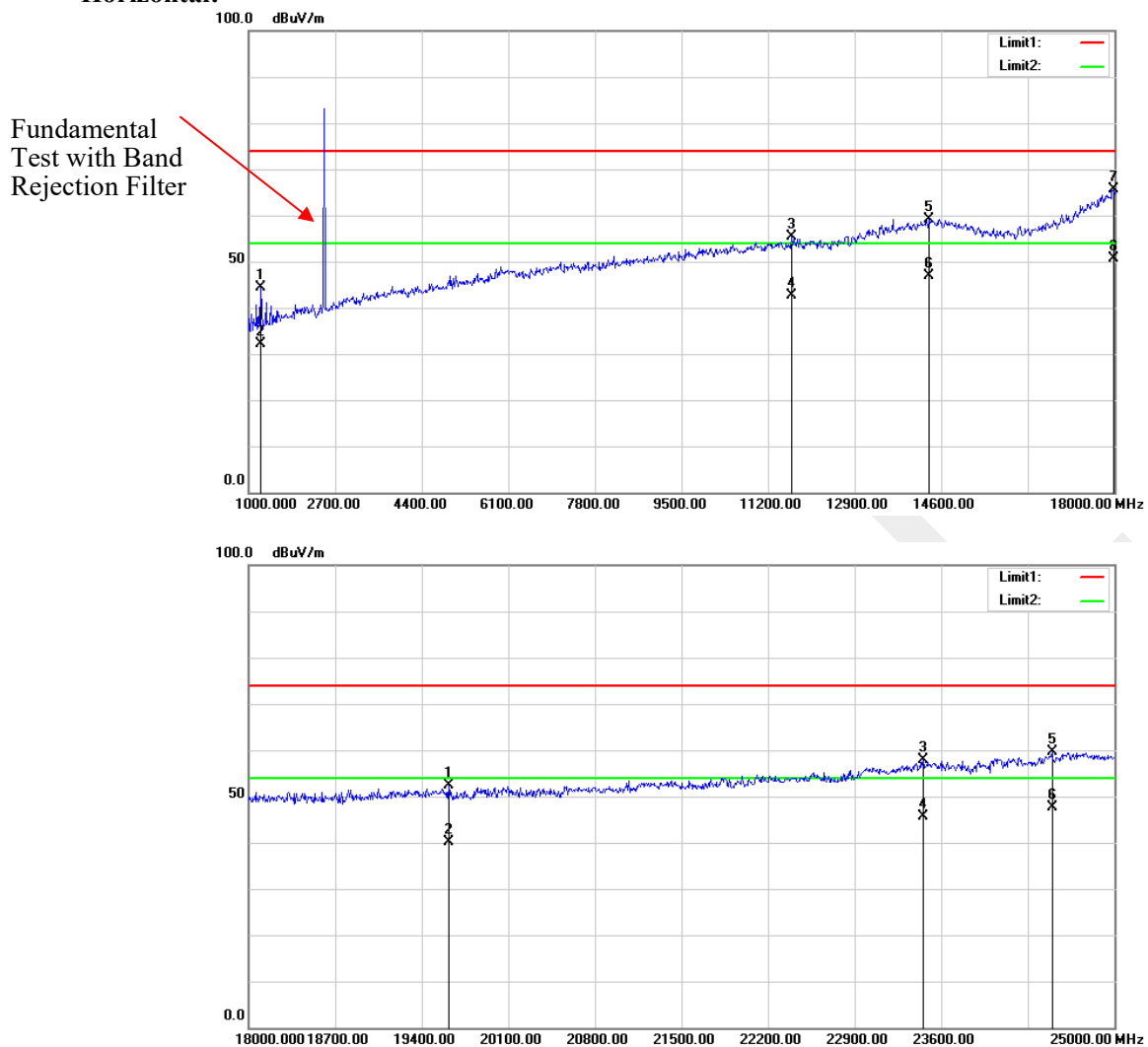
Vertical:

Frequency (MHz)	Receiver Reading (dBuV)	Detector	Correction Factor (dB/m)	Cord. Amp. (dBuV/m)	Limit (dBuV/m)	Margin (dB)
38.7300	42.70	QP	-8.50	34.20	40.00	5.80
86.2600	49.64	QP	-15.30	34.34	40.00	5.66
147.3700	39.57	peak	-9.13	30.44	43.50	13.06
293.8400	47.25	peak	-7.67	39.58	46.00	6.42
375.3200	46.73	QP	-5.93	40.80	46.00	5.20
700.2700	36.08	peak	0.10	36.18	46.00	9.82

2) 1-25GHz:
BLE Mode:

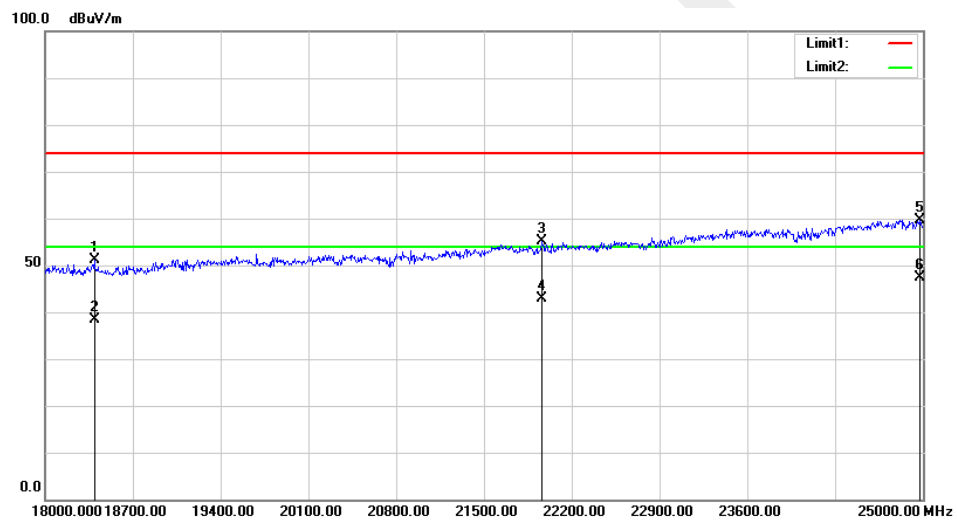
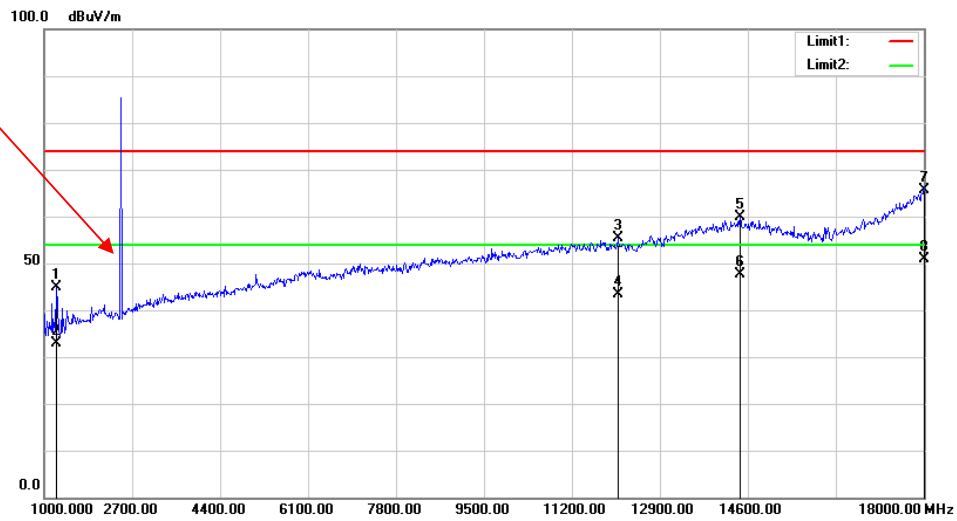
Frequency (MHz)	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	Detector (PK/QP/AV)	Polar (H/V)	Factor (dB/m)					
Low Channel: 2402 MHz									
2402.00	64.05	PK	H	28.10	3.40	0.00	95.55	N/A	N/A
2402.00	63.18	AV	H	28.10	3.40	0.00	94.68	N/A	N/A
2402.00	54.15	PK	V	28.10	3.40	0.00	85.65	N/A	N/A
2402.00	52.78	AV	V	28.10	3.40	0.00	84.28	N/A	N/A
2390.00	27.67	PK	H	28.08	3.38	0.00	59.13	74.00	14.87
2390.00	17.82	AV	H	28.08	3.38	0.00	49.28	54.00	4.72
4804.00	34.80	PK	H	32.89	5.11	27.36	45.44	74.00	28.56
4804.00	24.45	AV	H	32.89	5.11	27.36	35.09	54.00	18.91
7206.00	34.77	PK	H	35.55	5.60	27.19	48.73	74.00	25.27
7206.00	23.96	AV	H	35.55	5.60	27.19	37.92	54.00	16.08
Middle Channel: 2440 MHz									
2440.00	62.90	PK	H	28.18	3.42	0.00	94.50	N/A	N/A
2440.00	61.34	AV	H	28.18	3.42	0.00	92.94	N/A	N/A
2440.00	51.34	PK	V	28.18	3.42	0.00	82.94	N/A	N/A
2440.00	50.12	AV	V	28.18	3.42	0.00	81.72	N/A	N/A
4880.00	34.99	PK	H	33.01	5.05	27.55	45.50	74.00	28.50
4880.00	24.40	AV	H	33.01	5.05	27.55	34.91	54.00	19.09
7320.00	34.10	PK	H	35.80	5.77	27.26	48.41	74.00	25.59
7320.00	23.42	AV	H	35.80	5.77	27.26	37.73	54.00	16.27
High Channel: 2480 MHz									
2480.00	62.08	PK	H	28.26	3.38	0.00	93.72	N/A	N/A
2480.00	60.47	AV	H	28.26	3.38	0.00	92.11	N/A	N/A
2480.00	50.78	PK	V	28.26	3.38	0.00	82.42	N/A	N/A
2480.00	49.03	AV	V	28.26	3.38	0.00	80.67	N/A	N/A
2483.50	28.27	PK	H	28.27	3.38	0.00	59.92	74.00	14.08
2483.50	17.53	AV	H	28.27	3.38	0.00	49.18	54.00	4.82
4960.00	35.56	PK	H	33.14	5.15	27.37	46.48	74.00	27.52
4960.00	24.09	AV	H	33.14	5.15	27.37	35.01	54.00	18.99
7440.00	33.64	PK	H	36.07	5.95	27.22	48.44	74.00	25.56
7440.00	23.08	AV	H	36.07	5.95	27.22	37.88	54.00	16.12

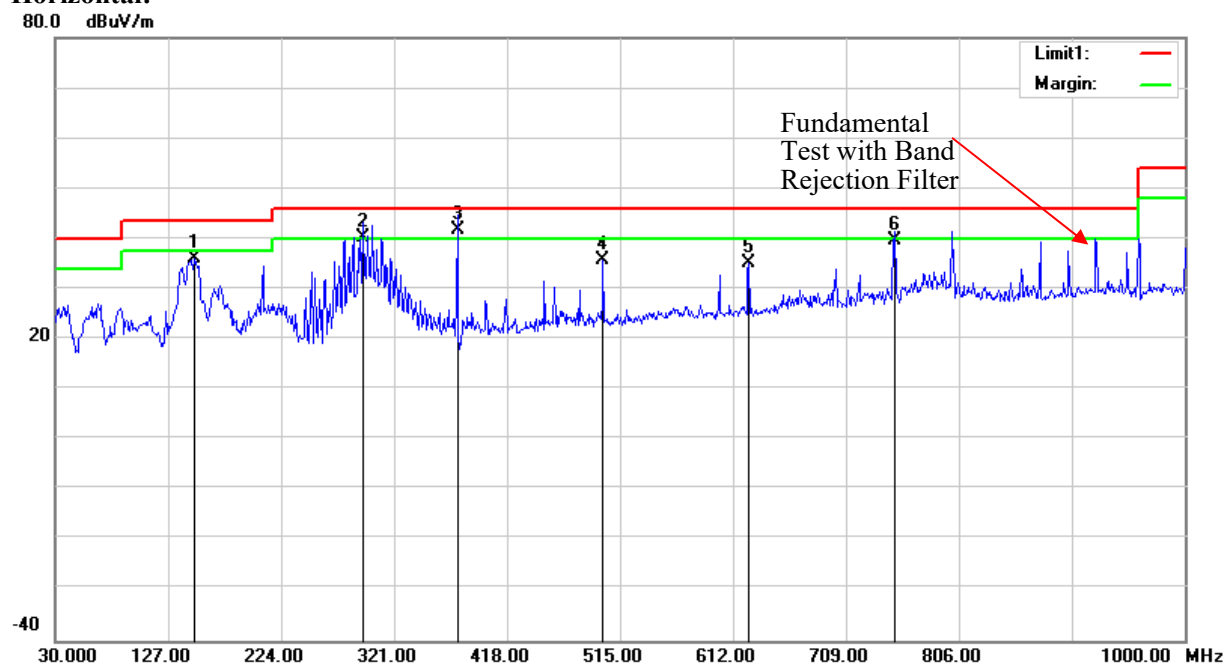
Test plots(Worst was Low channel)
Horizontal:



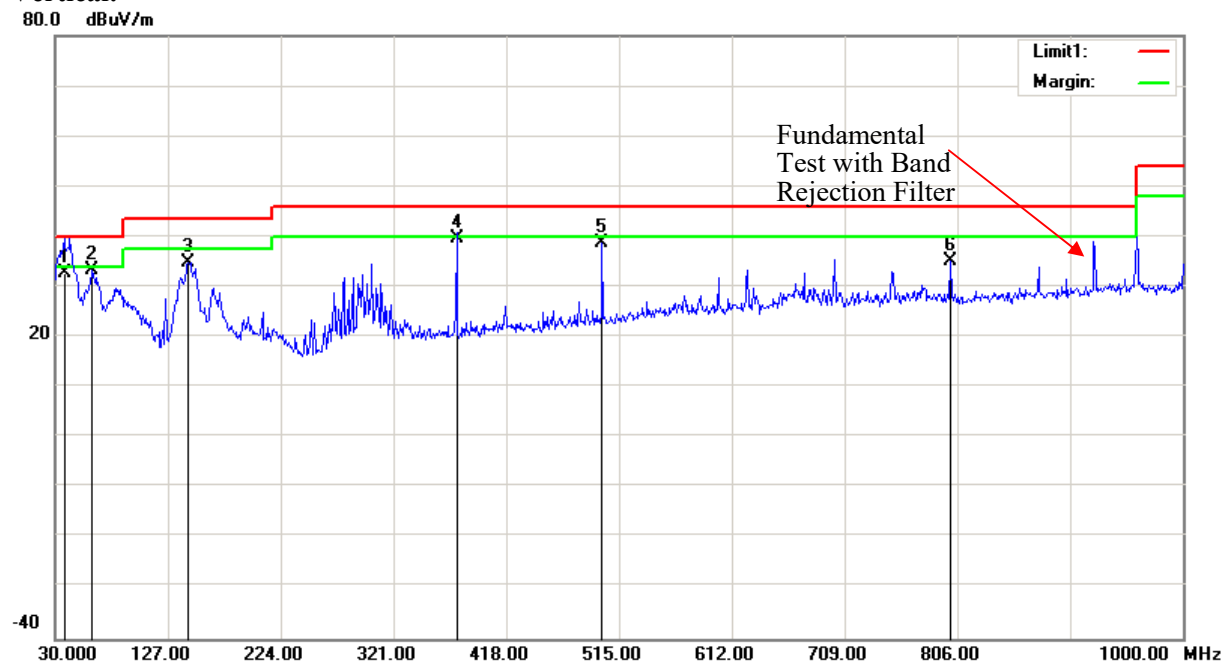
Vertical:

Fundamental
Test with Band
Rejection Filter



Lora-DTS Modes:**1) 30MHz-1GHz**(High channel was the worst)**Horizontal:**

Frequency (MHz)	Receiver Reading (dBuV)	Detector	Correction Factor (dB/m)	Cord. Amp. (dBuV/m)	Limit (dBuV/m)	Margin (dB)
149.3100	45.39	peak	-9.24	36.15	43.50	7.35
293.8400	47.93	QP	-7.67	40.26	46.00	5.74
375.3200	47.78	QP	-5.93	41.85	46.00	4.15
500.4500	39.25	peak	-3.45	35.80	46.00	10.20
625.5800	36.03	peak	-0.82	35.21	46.00	10.79
750.7100	38.83	QP	0.71	39.54	46.00	6.46

Vertical:

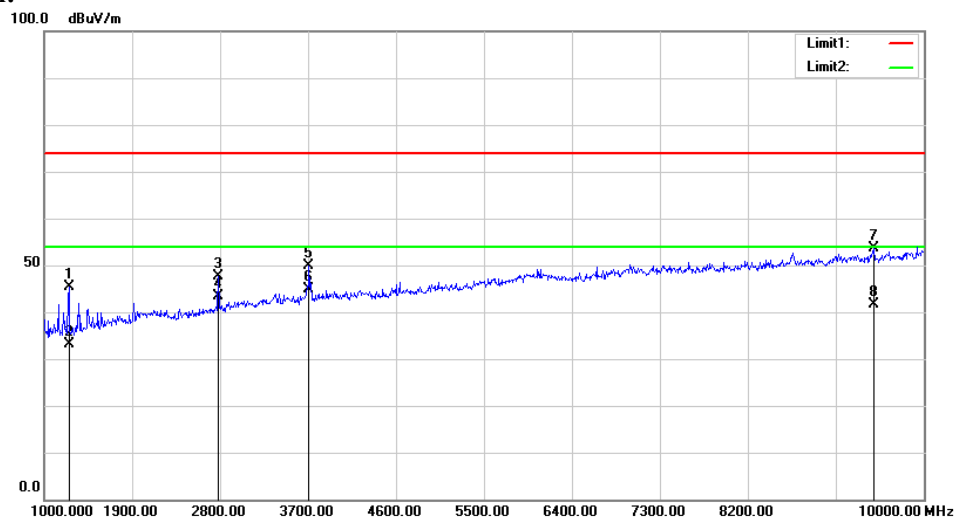
Frequency (MHz)	Receiver Reading (dBuV)	Detector	Correction Factor (dB/m)	Cord. Amp. (dBuV/m)	Limit (dBuV/m)	Margin (dB)
37.7600	40.84	QP	-8.04	32.80	40.00	7.20
62.0100	49.83	peak	-16.36	33.47	40.00	6.53
144.4600	43.78	peak	-8.92	34.86	43.50	8.64
375.3200	45.67	QP	-5.93	39.74	46.00	6.26
500.4500	42.14	peak	-3.45	38.69	46.00	7.31
800.1800	33.96	peak	1.14	35.10	46.00	10.90

2) Bandedge and 1-10GHz:

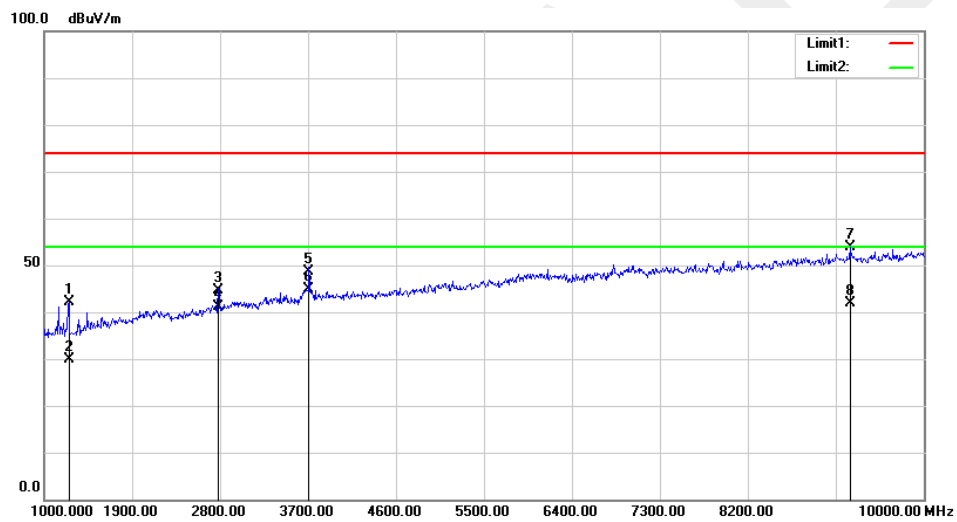
Frequency (MHz)	Receiver		Rx Antenna		Cable loss (dB)	Amplifier Gain (dB)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	Detector (PK/QP/AV)	Polar (H/V)	Factor (dB/m)					
Low Channel: 923.3 MHz									
923.30	90.25	QP	V	21.59	2.02	0.00	113.86	N/A	N/A
923.30	85.69	QP	H	21.59	2.02	0.00	109.30	N/A	N/A
902.00	8.70	QP	V	21.42	2.00	0.00	32.12	93.86	61.74
1846.60	46.23	PK	V	26.53	2.99	27.83	47.92	74.00	26.08
1846.60	42.19	AV	V	26.53	2.99	27.83	43.88	54.00	10.12
2769.90	43.09	PK	V	29.33	3.62	27.89	48.15	74.00	25.85
2769.90	38.20	AV	V	29.33	3.62	27.89	43.26	54.00	10.74
3693.20	40.23	PK	V	31.70	4.25	26.78	49.40	74.00	24.60
3693.20	36.50	AV	V	31.70	4.25	26.78	45.67	54.00	8.33
Middle Channel: 925.1 MHz									
925.10	91.47	QP	H	21.60	2.04	0.00	115.11	N/A	N/A
925.10	85.97	QP	V	21.60	2.04	0.00	109.61	N/A	N/A
1850.20	45.51	PK	V	26.55	2.98	27.83	47.21	74.00	26.79
1850.20	40.81	AV	V	26.55	2.98	27.83	42.51	54.00	11.49
2775.30	43.38	PK	V	29.35	3.62	27.89	48.46	74.00	25.54
2775.30	39.25	AV	V	29.35	3.62	27.89	44.33	54.00	9.67
3700.40	38.05	PK	V	31.72	4.26	26.79	47.24	74.00	26.76
3700.40	34.09	AV	V	31.72	4.26	26.79	43.28	54.00	10.72
High Channel: 927.5 MHz									
927.50	90.50	QP	V	21.62	2.05	0.00	114.17	N/A	N/A
927.50	84.26	QP	H	21.62	2.05	0.00	107.93	N/A	N/A
928.00	45.50	QP	V	21.62	2.05	0.00	69.17	94.17	25.00
1855.00	42.58	PK	V	26.58	2.98	27.83	44.31	74.00	29.69
1855.00	37.58	AV	V	26.58	2.98	27.83	39.31	54.00	14.69
2782.50	43.37	PK	V	29.37	3.62	27.89	48.47	74.00	25.53
2782.50	39.58	AV	V	29.37	3.62	27.89	44.68	54.00	9.32
3710.00	39.78	PK	V	31.75	4.25	26.80	48.98	74.00	25.02
3710.00	35.89	AV	V	31.75	4.25	26.80	45.09	54.00	8.91

Worst Test plots(Low channel)

Horizontal:



Vertical:



FCC §15.247(a) (2)–6 dB EMISSION BANDWIDTH

Applicable Standard

According to FCC §15.247(a) (2)

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

Test Procedure

- Set RBW = 100 kHz.
- Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
- Detector = Peak.
- Trace mode = max hold.
- Sweep = auto couple.
- Allow the trace to stabilize.
- Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.



Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESR3	102724	2021-06-21	2022-06-20
E-Microwave	Coaxial Attenuators	EMCA20-2RN-2	OE0120328	Each time	N/A
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	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:	26.9~27°C
Relative Humidity:	65~70%
ATM Pressure:	100.1~100.5 kPa
Tester:	Jack Zhou
Test Date:	2021-08-24~2021-08-26

Test Mode: Transmitting

Test Result: Compliance. Please refer to the following table and plots.

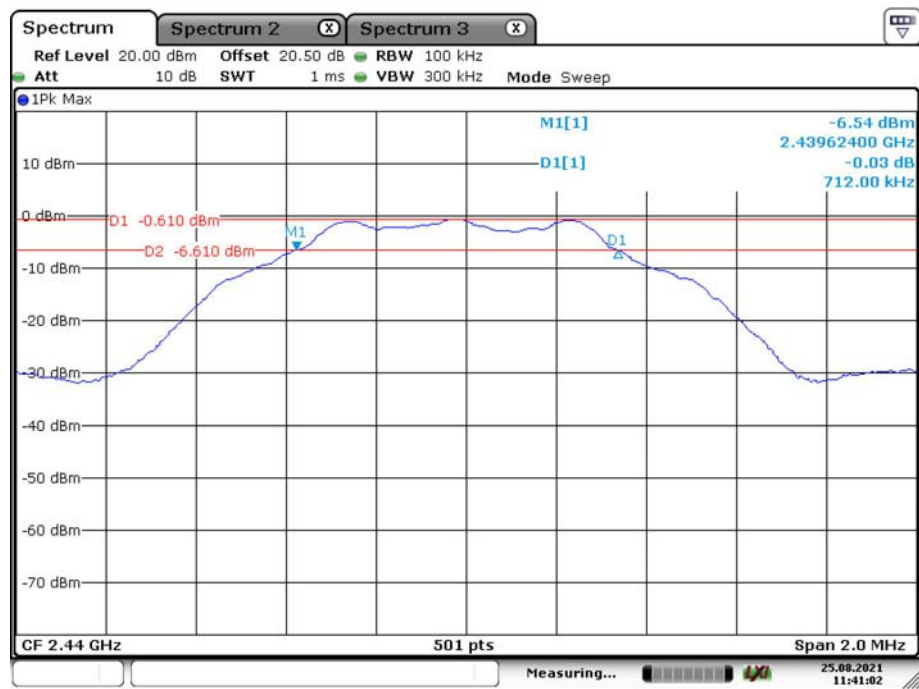
Test mode	Channel	Frequency (MHz)	6 dB Emission Bandwidth (MHz)	Limit (MHz)
BLE	Low	2402	0.720	≥ 0.5
	Middle	2440	0.712	≥ 0.5
	High	2480	0.720	≥ 0.5
Lora-DTS	Low	923.3	0.66	≥ 0.5
	Middle	925.1	0.657	≥ 0.5
	High	927.5	0.622	≥ 0.5

BLE Low Channel



Date: 25.AUG.2021 11:39:24

BLE Middle Channel



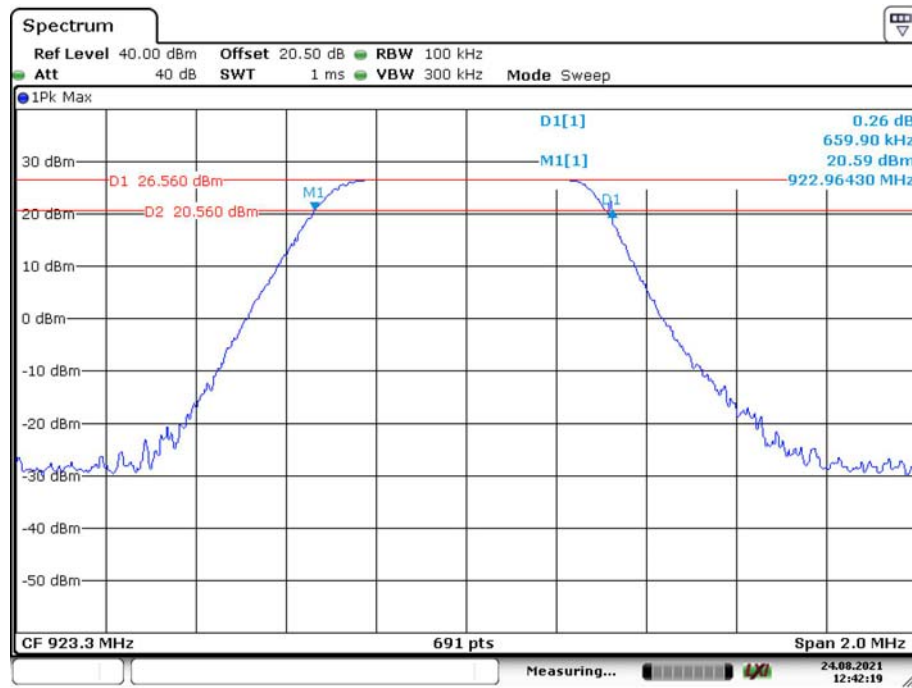
Date: 25.AUG.2021 11:41:02

BLE High Channel

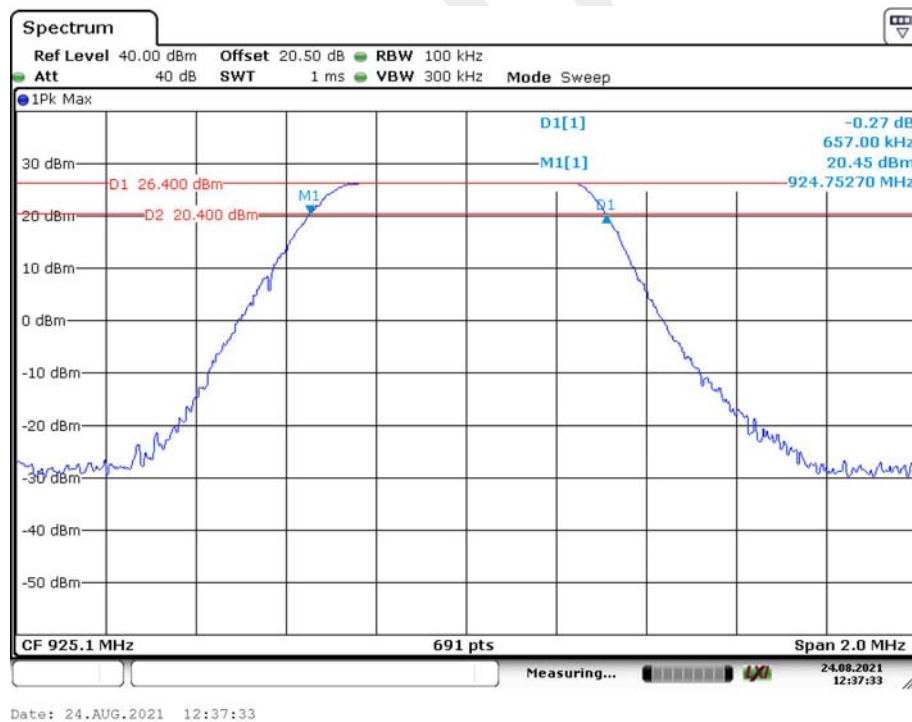


Date: 25.AUG.2021 11:48:42

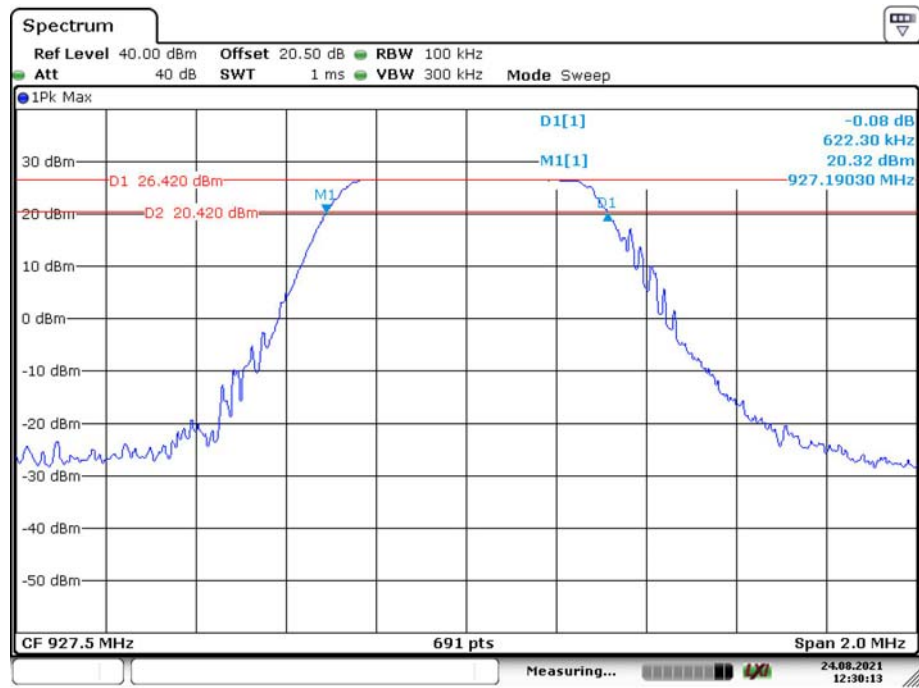
Lora-DTS Low Channel



Lora-DTS Middle Channel



Lora-DTS High Channel



Date: 24.AUG.2021 12:30:14

FCC §15.247(b) (3) - MAXIMUM PEAK CONDUCTED OUTPUT POWER

Applicable Standard

According to FCC §15.247(b) (3), for systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

Test Procedure

1. Place the EUT on a bench and set it in transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to test equipment.
3. Add a correction factor to the display.
4. Set the power meter to test average output power, record the result as average power.



Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	N/A
E-Microwave	Coaxial Attenuators	EMCA20-2RN-2	OE0120328	Each time	N/A
Agilent	USB Wideband Power Sensor	U2022XA	MY5417006	2020-09-12	2021-09-12

*** 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:	26.9~27°C
Relative Humidity:	65~70%
ATM Pressure:	100.1~100.5 kPa
Tester:	Jack Zhou
Test Date:	2021-08-24~2021-08-26

Test Mode: Transmitting

Test Result: Compliance. Please refer to the following table.

Mode	Channel	Frequency (MHz)	Maximum Peak Conducted Output Power (dBm)	Limits (dBm)
BLE	Low	2402	1.88	≤30
	Middle	2440	1.07	≤30
	High	2480	0.21	≤30
Lora-DTS	Low	923.3	25.49	≤30
	Middle	925.1	25.65	≤30
	High	927.5	26.06	≤30

FCC §15.247(d)– 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE**Applicable Standard**

According to FCC§15.247(d):In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator 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, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESR3	102724	2021-06-21	2022-06-20
E-Microwave	Coaxial Attenuators	EMCA20-2RN-2	OE0120328	Each time	N/A
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	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

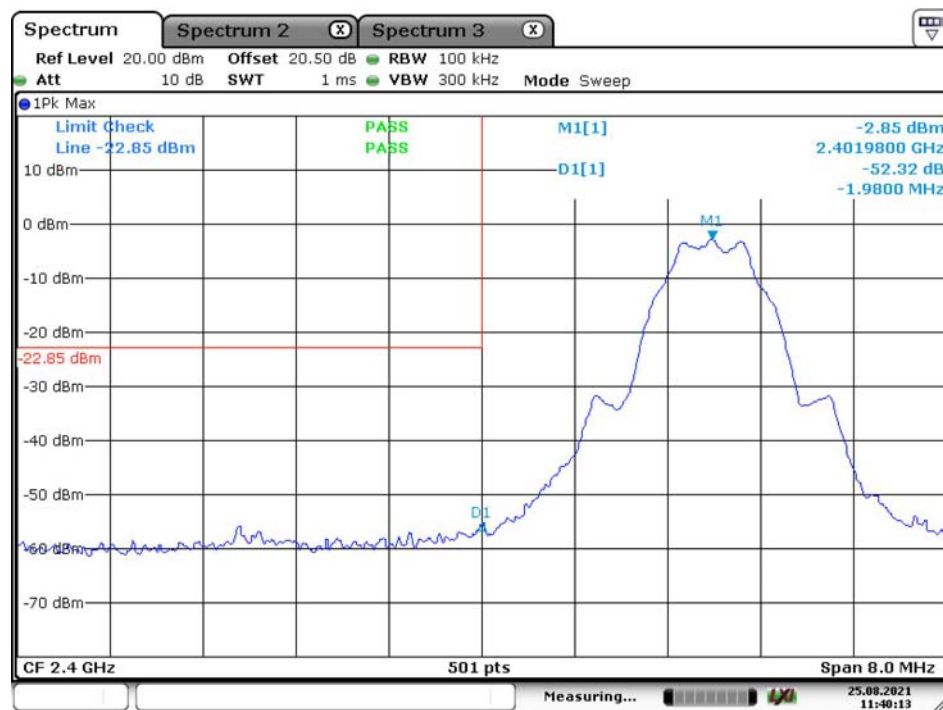
Environmental Conditions

Temperature:	26.9~27°C
Relative Humidity:	65~70%
ATM Pressure:	100.1~100.5 kPa
Tester:	Jack Zhou
Test Date:	2021-08-24~2021-08-26

Test mode: Transmitting

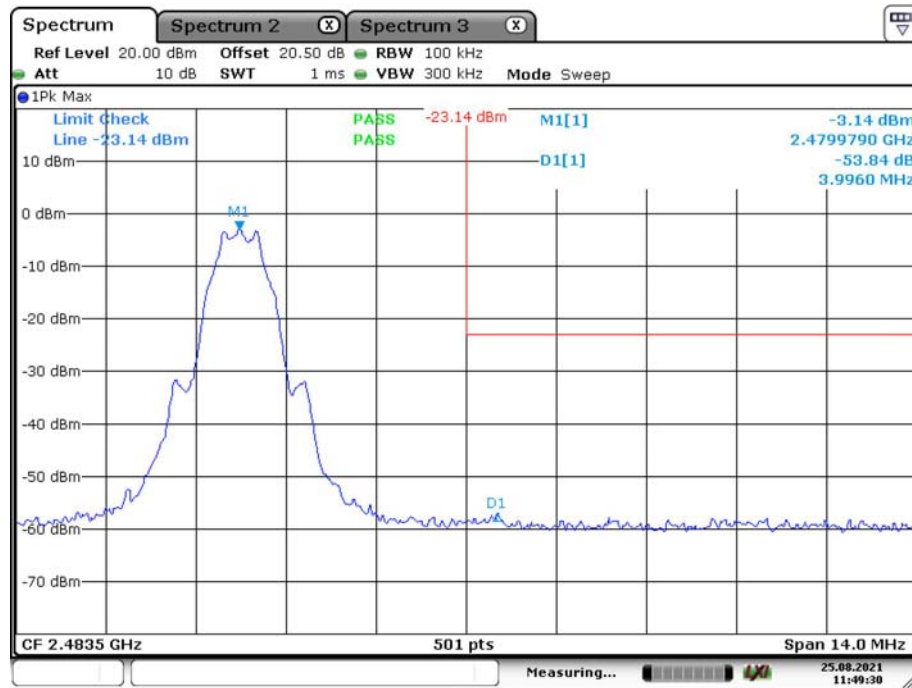
Test Result: Compliance. Please refer to following plots.

BLE Band Edge, Left Side



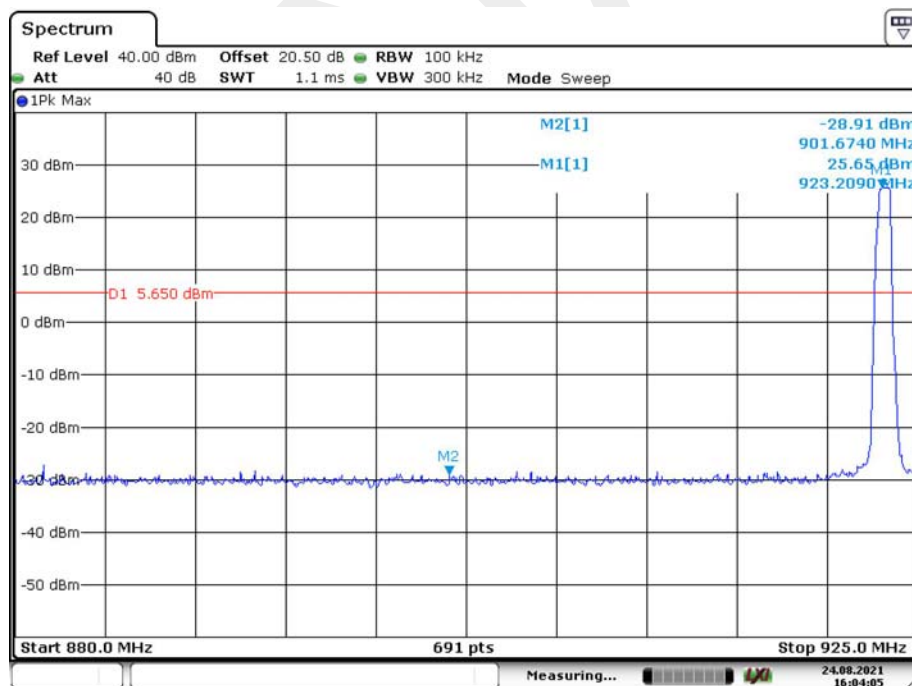
Date: 25.AUG.2021 11:40:13

BLE Band Edge, Right Side



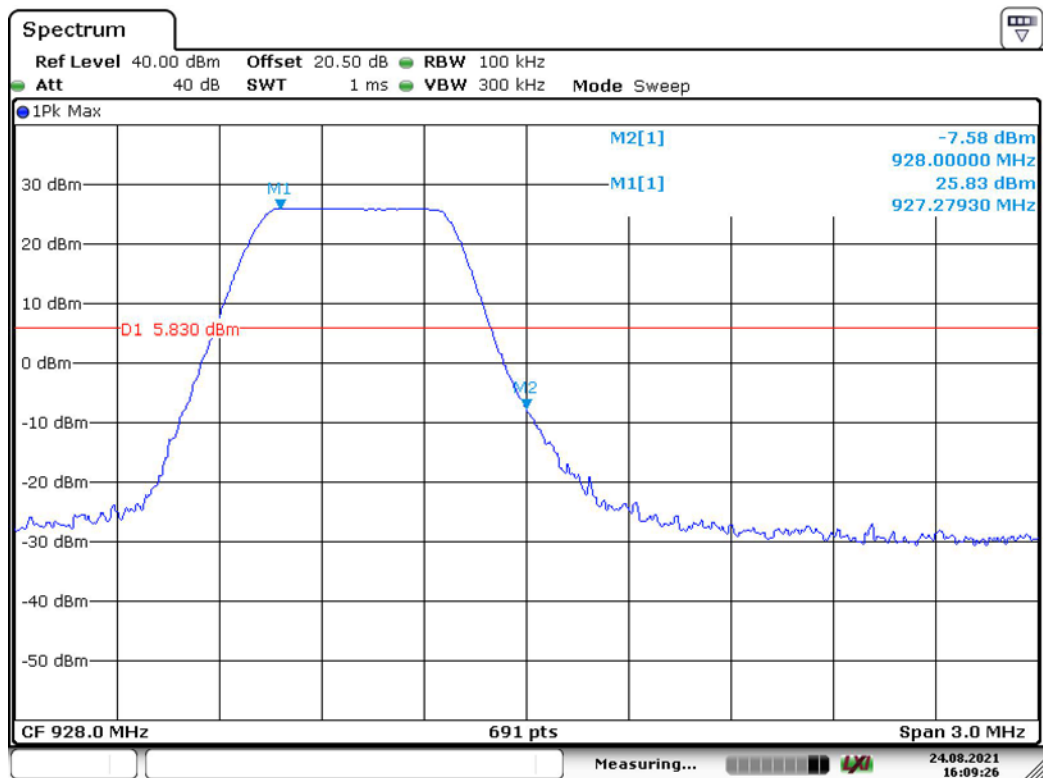
Date: 25.AUG.2021 11:49:30

Lora-DTS Band Edge, Left Side



Date: 24.AUG.2021 16:04:05

Lora-DTS Band Edge, Right Side



Date: 24.AUG.2021 16:09:27

FCC §15.247(e) - POWER SPECTRAL DENSITY**Applicable Standard**

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT was set without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
3. Set the RBW = 3 kHz, VBW = 10 kHz, Set the span to 1.5 times the DTS bandwidth.
4. Use the peak marker function to determine the maximum amplitude level.

Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
R&S	EMI Test Receiver	ESR3	102724	2021-06-21	2022-06-20
E-Microwave	Coaxial Attenuators	EMCA20-2RN-2	OE0120328	Each time	N/A
Unknown	Coaxial Cable	C-SJ00-0010	C0010/01	Each time	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**

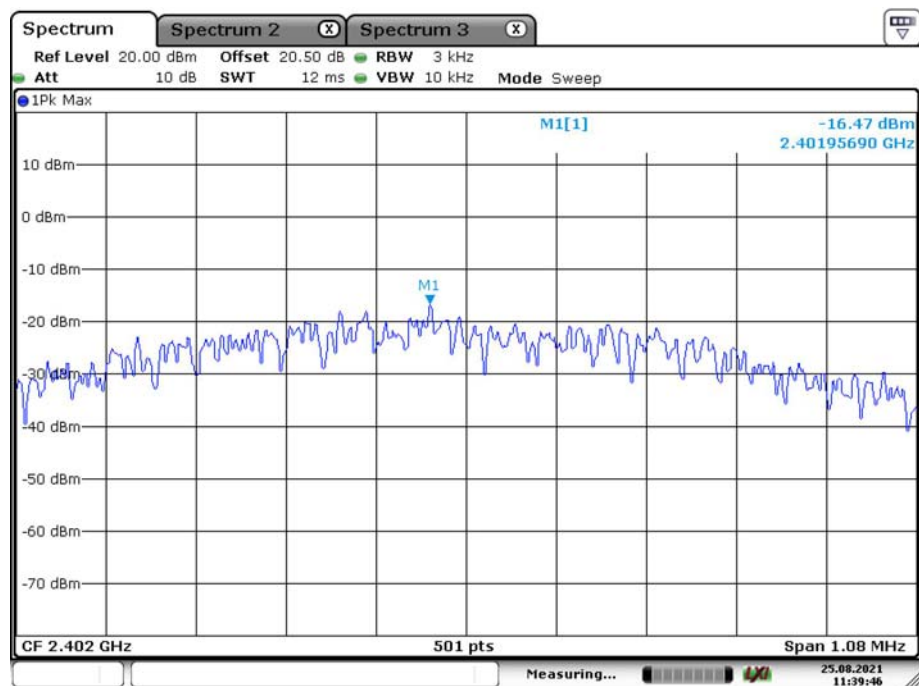
Temperature:	26.9~27°C
Relative Humidity:	65~70%
ATM Pressure:	100.1~100.5 kPa
Tester:	Jack Zhou
Test Date:	2021-08-24~2021-08-26

Test Result: Compliance. Please refer to the following table and plots

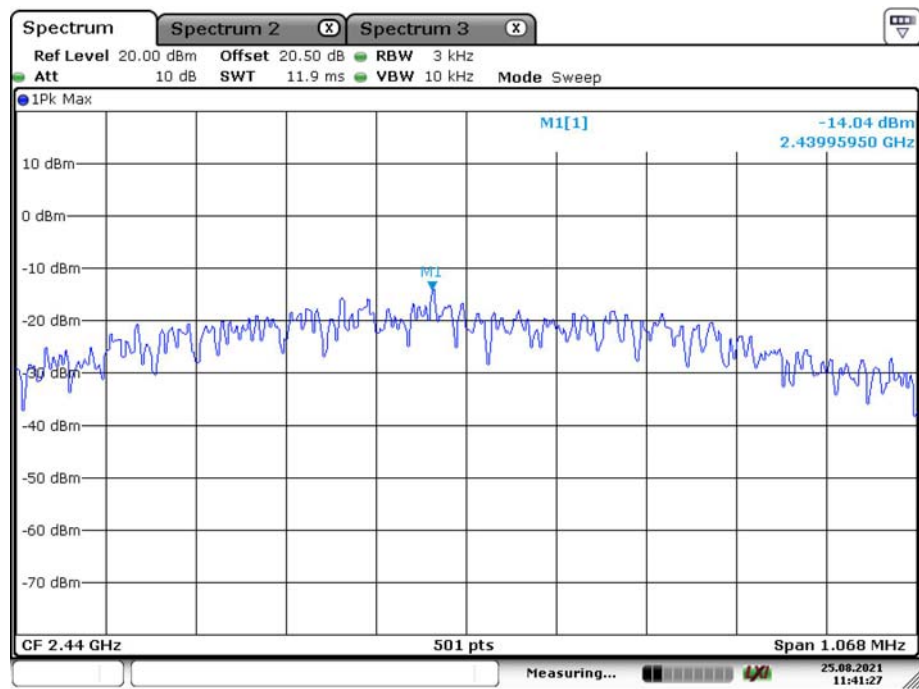
Test Mode: Transmitting

Mode	Channel	Frequency (MHz)	Power Spectral Density (dBm/3kHz)	Limits (dBm/3kHz)
BLE	Low	2402	-16.47	≤ 8.0
	Middle	2440	-14.04	≤ 8.0
	High	2480	-16.47	≤ 8.0
Lora-DTS	Low	923.3	7.78	≤ 8.0
	Middle	925.1	7.52	≤ 8.0
	High	927.5	7.86	≤ 8.0

Power Spectral Density, BLE Low Channel

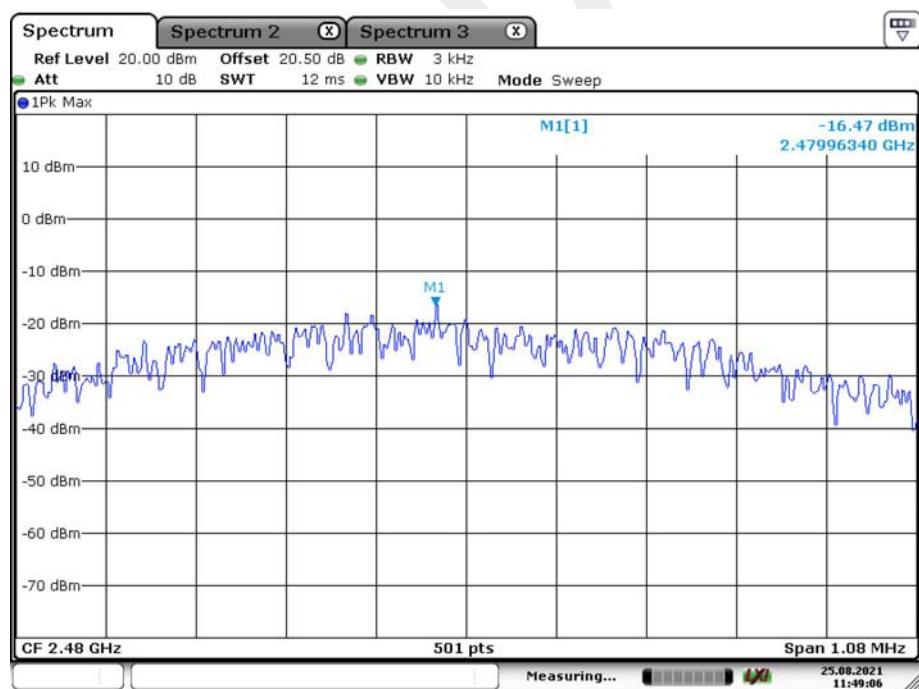


Power Spectral Density, BLE Middle Channel



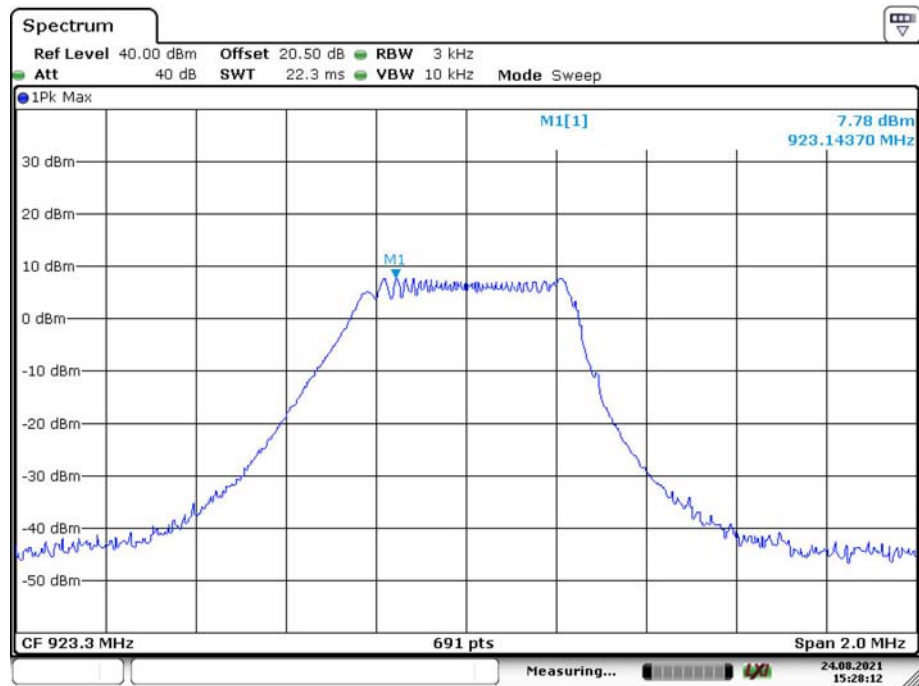
Date: 25.AUG.2021 11:41:27

Power Spectral Density, BLE High Channel



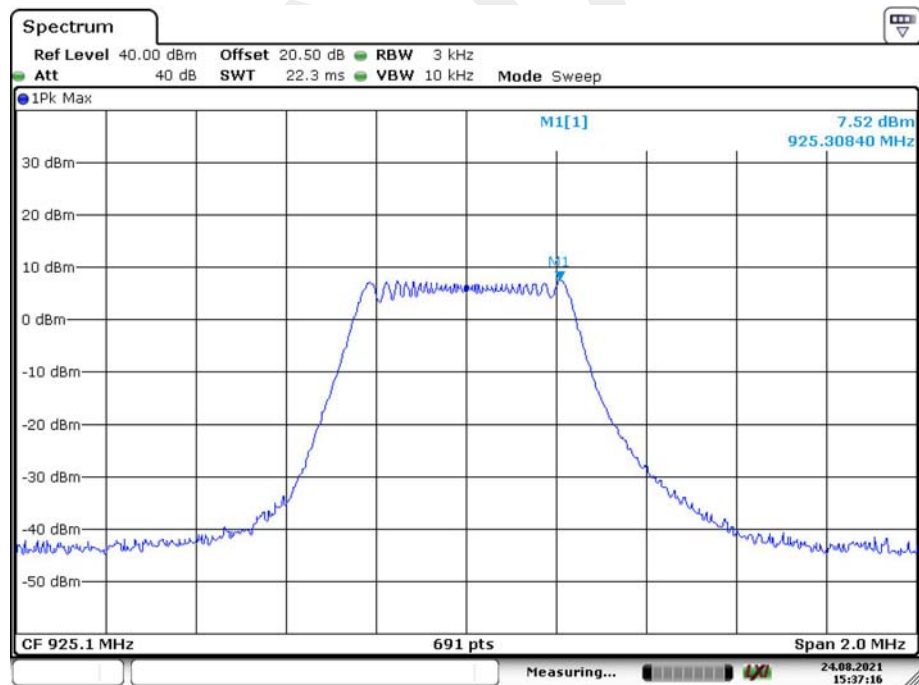
Date: 25.AUG.2021 11:49:06

Power Spectral Density, Lora-DTS Low Channel

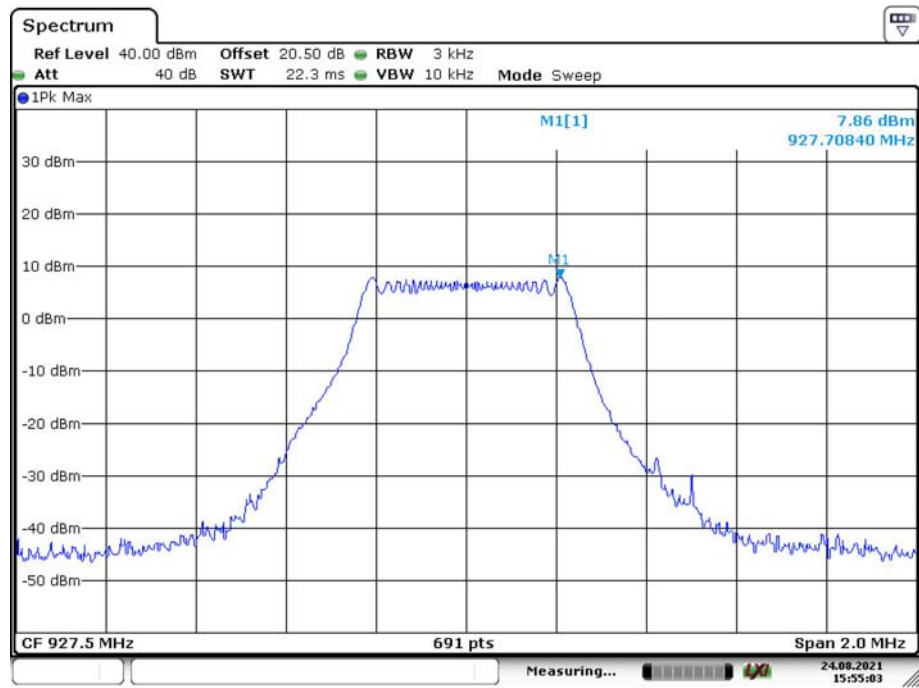


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Power Spectral Density, Lora-DTS Middle Channel



Date: 24.AUG.2021 15:37:16

Power Spectral Density, Lora-DTS High Channel

Date: 24.AUG.2021 15:55:03

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