TEST REPORT

Applicant Name :	Astera LED-Technology GmbH
Address :	Stahlgruberring 36, Munich, 81829 Germany
Report Number :	RA221213-61319E-RF-00C
FCC ID:	X55FP3-BTB

Test Standard (s)

FCC PART 15.247

Sample Description

Product Type:	Hyperion Tube BTB
Model No.:	FP3-BTB
Multiple Model(s) No.:	N/A
Trade Mark:	ASTERA
Date Received:	2022/12/13
Report Date:	2023/03/20

Test Result:	Pass*

* In the configuration tested, the EUT complied with the standards above.

Prepared and Checked By:

Andy Yu
EMC Engineer

Approved By:

Candy Li
EMC Engineer

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	RA221213-61319E-RF-00C	Original Report	2023/03/20

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Frequency Range	917.0~922.2MHz
Transmit Power	9.26dBm
Modulation Technique	GFSK
Antenna Specification	2.0dBi (It is provided by the applicant)
Voltage Range	DC14.4V from battery or DC 24 V from adapter
Sample serial number	1VCK-1 for Conducted and Radiated Emissions 1VCL-2 for RF Conducted Test (Assigned by ATC)
Sample/EUT Status	Good condition

Objective

This report is in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commission's rules.

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.247 rules.

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.

All emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Shenzhen). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.
Each test item follows test standards and with no deviation.

Measurement Uncertainty

Parameter		Uncertainty
Occupied Channel Bandwidth		5%
RF output power, conducted		0.73dB
Unwanted Emission, conducted		1.6dB
AC Line Conducted emission		2.72dB
Emissions, Radiated	30MHz - 1GHz	4.28dB
	1GHz - 18GHz	4.98dB
	18GHz - 26.5GHz	5.06dB
Temperature		1℃
Humidity		6%
Supply voltages		0.4%

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

Test Facility

The test site used by Shenzhen Accurate Technology Co., Ltd. to collect test data is located on the 1/F., Building A, Changyuan New Material Port, Science & Industry Park, Nanshan District, Shenzhen, Guangdong, P.R. China.

The test site has been approved by the FCC under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No.: 708358, the FCC Designation No.: CN1189. Accredited by American Association for Laboratory Accreditation (A2LA) The Certificate Number is 429 7.01.

Listed by Innovation, Science and Economic Development Canada (ISEDC), the Registration Number is 5077A.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in engineering mode.

Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	**917.00**	27	919.70
1	917.10	28	919.80
2	917.20	29	919.90
3	917.30	30	920.00
4	917.40	31	920.10
5	917.50	32	920.20
6	917.60	33	920.30
7	917.70	34	920.40
8	917.80	35	920.50
9	917.90	36	920.60
10	918.00	37	920.70
11	918.10	38	920.80
12	918.20	39	920.90
13	918.30	40	921.00
14	918.40	41	921.10
15	918.50	42	921.20
16	918.60	43	921.30
17	918.70	44	921.40
18	918.80	45	921.50
19	918.90	46	921.60
20	919.00	47	921.70
21	919.10	48	921.80
22	919.20	49	921.90
23	919.30	50	922.00
24	919.40	51	922.10
25	919.50	**52**	**922.20**
26	**919.60**	/	/

EUT was test on channel 0, 26, 52.

EUT Exercise Software

“AsteraApp_9.96”* software was used for the test and the power level is default*. The software and power level was provided by the applicant.

Special Accessories

No special accessory.

Equipment Modifications

No modification was made to the EUT tested.

Support Equipment List and Details

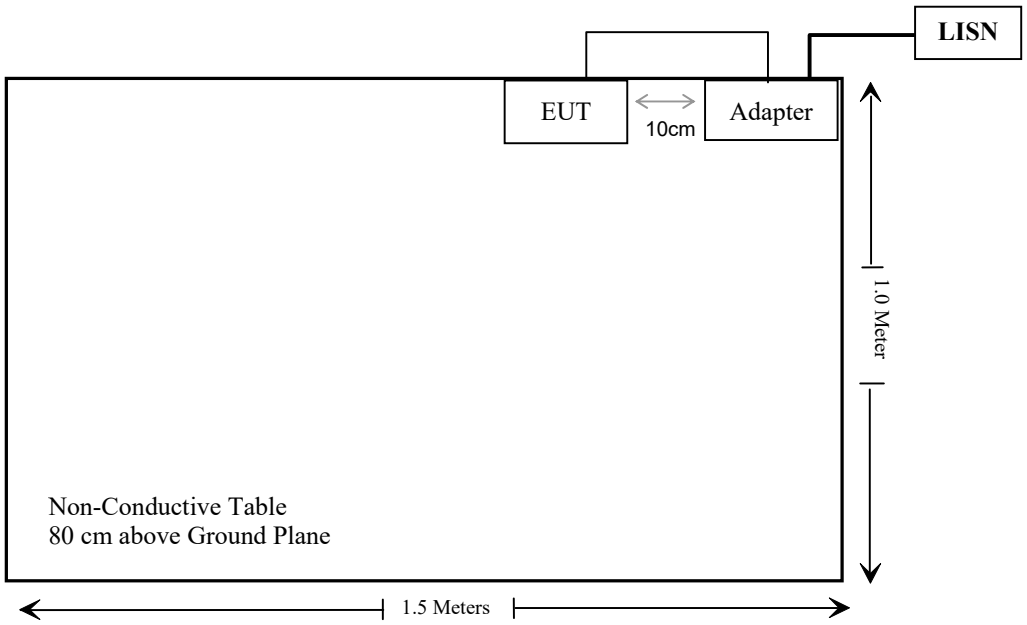
Manufacturer	Description	Model	Serial Number
Powertron	Adapter	PA1090-240T1A400	Unknown

External I/O Cable

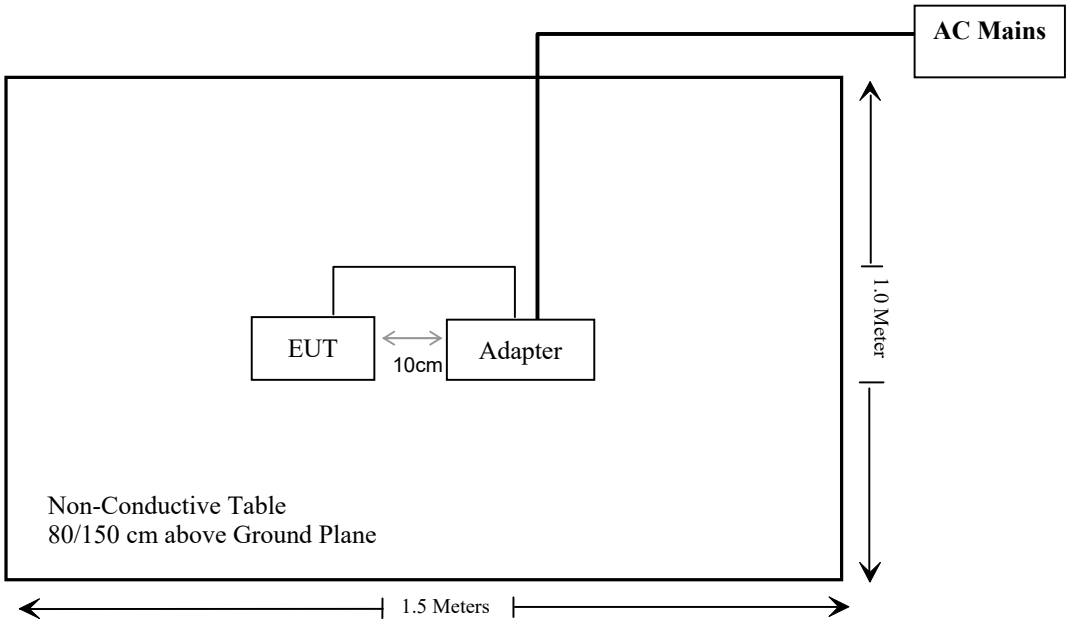
Cable Description	Length (m)	From Port	To
Un-shielding Detachable AC Cable	1.5	Adapter	LISN/AC Mains
Un-shielding Un-Detachable DC Cable	1.2	EUT	Adapter

Block Diagram of Test Setup

For conducted emission



For radiate emission



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.247 (i) & §1.1307 (b) (3) & §2.1091	MPE-Based Exemption	Compliant
§15.203	Antenna Requirement	Compliant
§15.207(a)	AC Line Conducted Emissions	Compliant
§15.205, §15.209 & §15.247(d)	Radiated Emissions	Compliant
§15.247(a)(1)	20 dB Emission Bandwidth	Compliant
§15.247(a)(1)(i)	Channel Separation Test	Compliant
§15.247(a)(1)(i)	Time of Occupancy (Dwell Time)	Compliant
§15.247(a)(1)(i)	Quantity of hopping channel Test	Compliant
§15.247(b)(2)	Peak Output Power Measurement	Compliant
§15.247(d)	Band edges	Compliant

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Conducted Emissions Test					
Rohde& Schwarz	EMI Test Receiver	ESCI	100784	2022/11/25	2023/11/24
Rohde & Schwarz	L.I.S.N.	ENV216	101314	2022/11/25	2023/11/24
Anritsu Corp	50 Coaxial Switch	MP59B	6100237248	2022/12/07	2023/12/06
Unknown	RF Coaxial Cable	No.17	N0350	2022/11/25	2023/11/24
Conducted Emission Test Software: e3 19821b (V9)					
Radiated Emission Test					
Rohde& Schwarz	Test Receiver	ESR	102725	2022/11/25	2023/11/24
Rohde&Schwarz	Spectrum Analyzer	FSV40	101949	2022/11/25	2023/11/24
SONOMA INSTRUMENT	Amplifier	310 N	186131	2022/11/08	2023/11/07
A.H. Systems, inc.	Preamplifier	PAM-0118P	135	2022/11/08	2023/11/07
Schwarzbeck	Bilog Antenna	VULB9163	9163-323	2021/07/06	2024/07/05
Schwarzbeck	Horn Antenna	BBHA9120D	9120D-1067	2022/11/30	2025/11/29
Radiated Emission Test Software: e3 19821b (V9)					
Unknown	RF Coaxial Cable	No.10	N050	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.11	N1000	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.12	N040	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.13	N300	2022/11/25	2023/11/24
Unknown	RF Coaxial Cable	No.14	N800	2022/11/25	2023/11/24
Oulitong	902-928MHz Reject Filter	902-928MHz	OE01902427	2022/02/28	2023/02/27
CD	High Pass Filter	HPM-1.2/18G-60	110	2022/11/25	2023/11/24
RF Conducted Test					
Rohde & Schwarz	SPECTRUM ANALYZER	FSU26	200982	2022/07/04	2023/07/03
WEINSCHEL	10dB Attenuator	5324	AU 3842	2022/11/25	2023/11/24
Unknown	RF Cable	Unknown	1	Each time	Each time

*** Statement of Traceability:** Shenzhen Accurate Technology Co., Ltd.attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

FCC §15.247 (i) & §1.1307 (b) (3) & §2.1091- MPE-Based Exemption

Applicable Standard

According to subpart 15.247 (i) and subpart 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

According to KDB 447498 D04 Interim General RF Exposure Guidance

MPE-Based Exemption:

General frequency and separation-distance dependent MPE-based effective radiated power(ERP) thresholds are in Table B.1 [Table 1 of § 1.1307(b)(1)(i)(C)] to support an exemptionfrom further evaluation from 300 kHz through 100 GHz.

Table 1 to § 1.1307(b)(3)(i)(C) - Single RF Sources Subject to Routine Environmental Evaluation

RF Source frequency (MHz)	Threshold ERP (watts)
0.3-1.34	1,920 R^2.
1.34-30	3,450 R^2/f^2.
30-300	3.83 R^2.
300-1,500	0.0128 R^2f.
1,500-100,000	19.2R^2.

Ris the minimum separation distance in meters
f = frequency in MHz

For multiple RF sources: Multiple RF sources are exempt if:

in the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation:

$$\sum_{i=1}^{a} \frac{P_i}{P_{th,i}} + \sum_{j=1}^{b} \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^{c} \frac{Evaluated_k}{Exposure\ Limit_k} \leq 1$$

Result

Mode	Frequency (MHz)	Tune up conducted power	Antenna Gain		ERP		Evaluation Distance (m)	ERP Limit (W)
		(dBm)	(dBi)	(dBd)	(dBm)	(W)		
UHF	917.0-922.2	9.5	2.0	-0.15	9.35	0.009	0.2	0.470
BT	2402-2480	9.5	2.0	-0.15	9.35	0.009	0.2	0.768
BLE	2402-2480	7.0	2.0	-0.15	6.85	0.005	0.2	0.768
Wi-Fi	2412-2462	16.5	2.0	-0.15	16.35	0.043	0.2	0.768

Note: 1. The tune up conducted power and antenna gain was declared by the applicant.
2. The UHF can simultaneous transmit with BT or Wi-Fi, BT and Wi-Fi cannot transmit at same time

Simultaneous transmitting consideration (worst case):

The ratio=ERP_{UHF}/limit +$ERP_{Wi\text{-}Fi}$/limit=0.009/0.470+0.043/0.768=0.075＜1.0, so simultaneous exposure is compliant.

To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 20cm from nearby persons.

Result: Compliant.

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.

And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Antenna Connector Construction

The EUT has an internal antenna arrangement which was permanently attached for UHF, and the antenna gain is 2.0 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

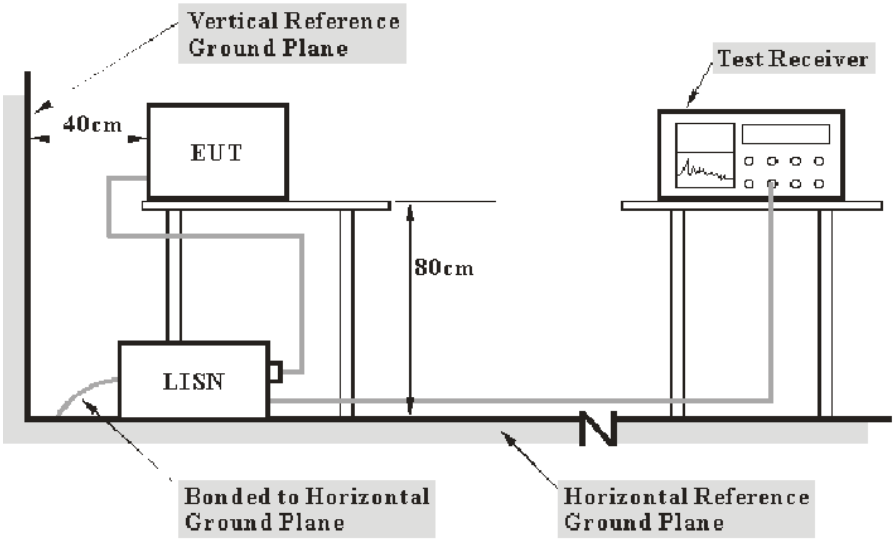
Result: Compliance.

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 measurement procedure of EUT setup is according with ANSI C63.10-2013. The related limit was specified in FCC Part 15.207.

The spacing between the peripherals was 10 cm.

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 LISN.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All final data was recorded in the Quasi-peak and average detection mode.

Corrected Factor & Margin Calculation

The Transd factor is calculated by adding LISN VDF (Voltage Division Factor) and Cable Loss. The basic equation is as follows:

Transd Factor = LISN VDF + Cable Loss

The "**Over limit**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, an Over limit of -7 dB means the emission is 7 dB below the limit. The equation for calculation is as follows:

Over Limit = Level – Limit
Level = Read Level + Factor

Test Data

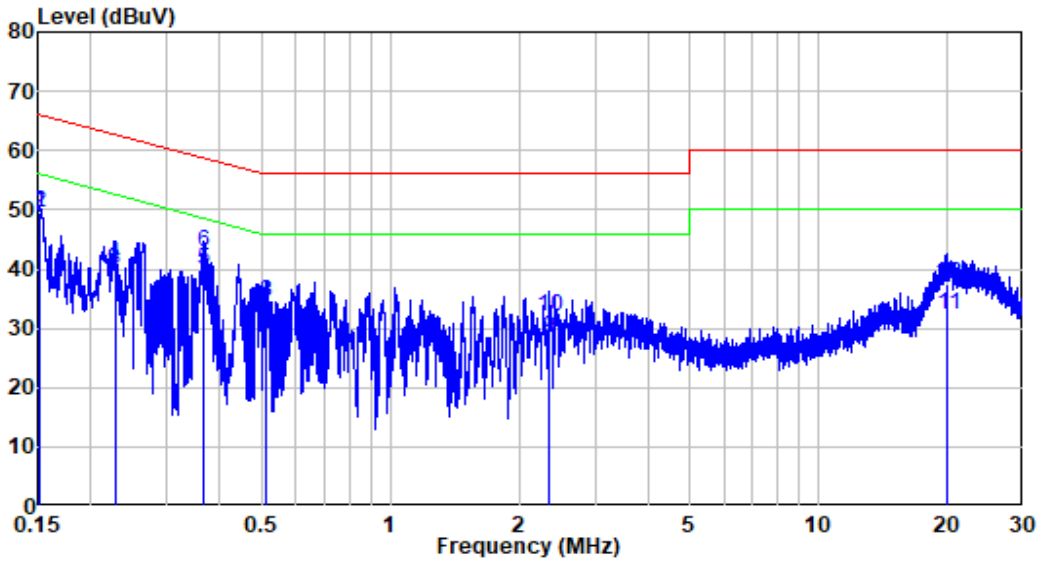
Environmental Conditions

Temperature:	23 ℃
Relative Humidity:	52 %
ATM Pressure:	101.0 kPa

The testing was performed by Lipa Wu on 2023-02-01.

EUT operation mode: Transmitting (worst case is high channel)

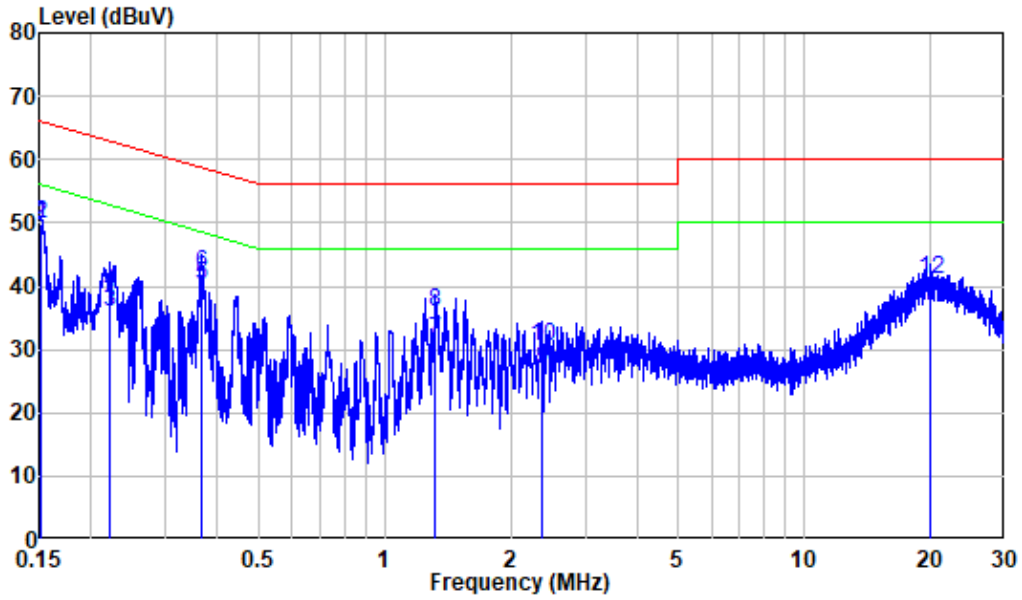
AC 120V/60 Hz, Line



Site : Shielding Room
Condition: Line
Job No. : DRA221213-61319E-RF
Mode : UHF
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.151	9.90	39.46	49.36	55.94	-6.58	Average
2	0.151	9.90	39.50	49.40	65.94	-16.54	QP
3	0.227	9.89	29.84	39.73	52.56	-12.83	Average
4	0.227	9.89	30.84	40.73	62.56	-21.83	QP
5	0.366	9.83	30.13	39.96	48.60	-8.64	Average
6	0.366	9.83	33.09	42.92	58.60	-15.68	QP
7	0.514	9.82	18.76	28.58	46.00	-17.42	Average
8	0.514	9.82	24.59	34.41	56.00	-21.59	QP
9	2.354	9.92	18.41	28.33	46.00	-17.67	Average
10	2.354	9.92	22.16	32.08	56.00	-23.92	QP
11	20.016	10.00	22.27	32.27	50.00	-17.73	Average
12	20.016	10.00	27.30	37.30	60.00	-22.70	QP

AC 120V/60 Hz, Neutral



Site : Shielding Room
Condition: Neutral
Job No. : DRA221213-61319E-RF
Mode : UHF
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.151	9.80	39.88	49.68	55.94	-6.26	Average
2	0.151	9.80	39.88	49.68	65.94	-16.26	QP
3	0.222	9.81	26.05	35.86	52.74	-16.88	Average
4	0.222	9.81	29.22	39.03	62.74	-23.71	QP
5	0.366	9.87	30.15	40.02	48.58	-8.56	Average
6	0.366	9.87	32.05	41.92	58.58	-16.66	QP
7	1.314	9.81	21.61	31.42	46.00	-14.58	Average
8	1.314	9.81	26.01	35.82	56.00	-20.18	QP
9	2.358	9.82	17.06	26.88	46.00	-19.12	Average
10	2.358	9.82	20.65	30.47	56.00	-25.53	QP
11	20.003	10.20	26.74	36.94	50.00	-13.06	Average
12	20.003	10.20	30.87	41.07	60.00	-18.93	QP

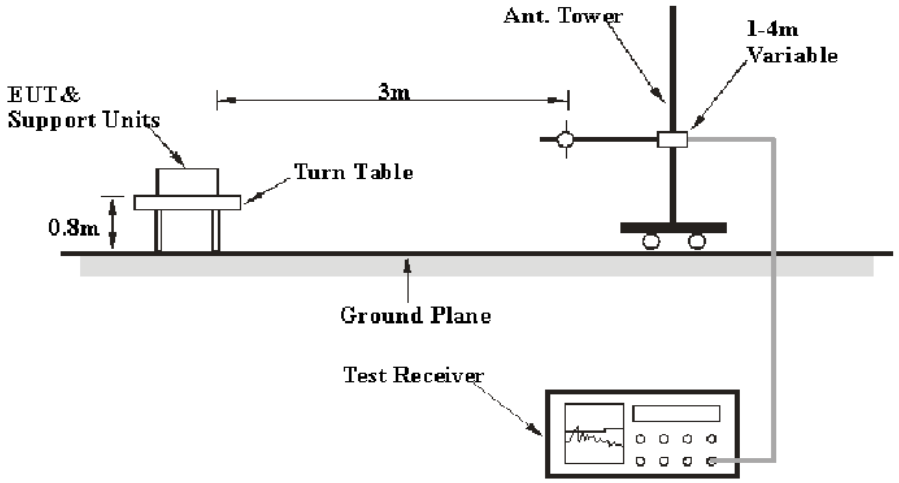
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

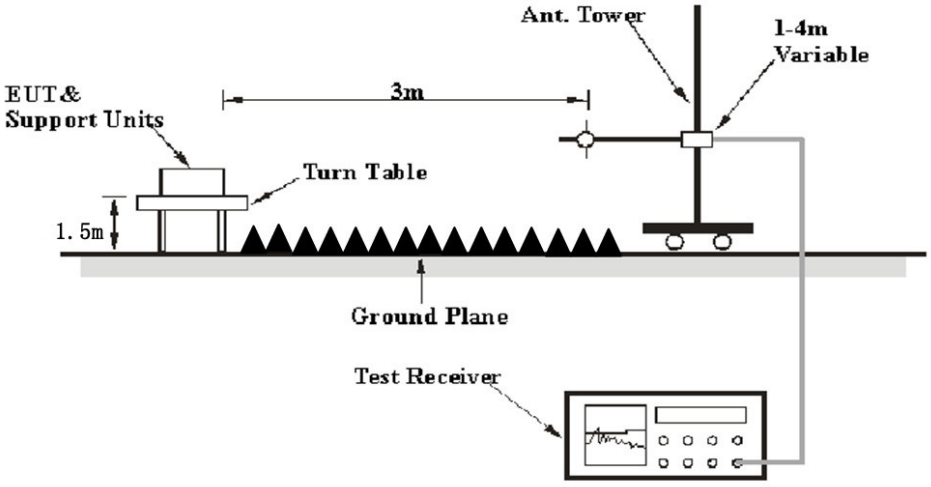
FCC §15.205; §15.209; §15.247(d)

EUT Setup

Below 1 GHz:



Above 1GHz:



The radiated emission tests were performed in the 3 meters, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC 15.209 and FCC 15.247 limits.

EMI Test Receiver & Spectrum Analyzer Setup

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

Frequency Range	RBW	Video B/W	IF B/W	Measurement
30 MHz – 1000 MHz	100 kHz	300 kHz	120 kHz	QP
Above 1 GHz	1 MHz	3 MHz	/	PK
	1 MHz	10 Hz	/	Average

Test Procedure

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

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

Corrected Amplitude & Margin Calculation

The Factor is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain. The basic equation is as follows:

Factor = Antenna Factor + Cable Loss - Amplifier Gain

The "**Over Limit/Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, an Over Limit/margin of -7dB means the emission is 7dB below the limit. The equation for calculation is as follows:

Over Limit/Margin = Level / Corrected Amplitude – Limit
Level / Corrected Amplitude = Read Level + Factor

Test Data

Environmental Conditions

Temperature:	24~25.6 ℃
Relative Humidity:	50~53 %
ATM Pressure:	101.0 kPa

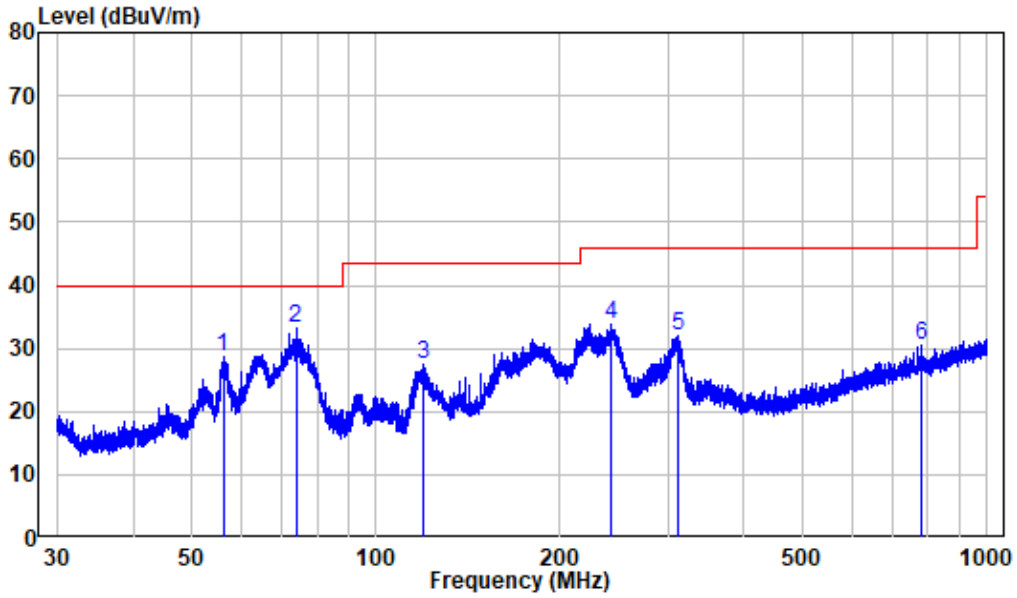
The testing was performed by Jason Liu on 2023-02-03 for below 1GHz and by Jimi Zheng on 2023-01-03 for above 1GHz.

EUT operation mode: Transmitting (Pre-scan in the X,Y and Z axes of orientation, the worst case Y-axes of orientation was recorded)

30 MHz~1 GHz: *(worst case is high channel)*

Note: when the test result of Peak was below the limit of QP more than 6dB, just the peak value was recorded.

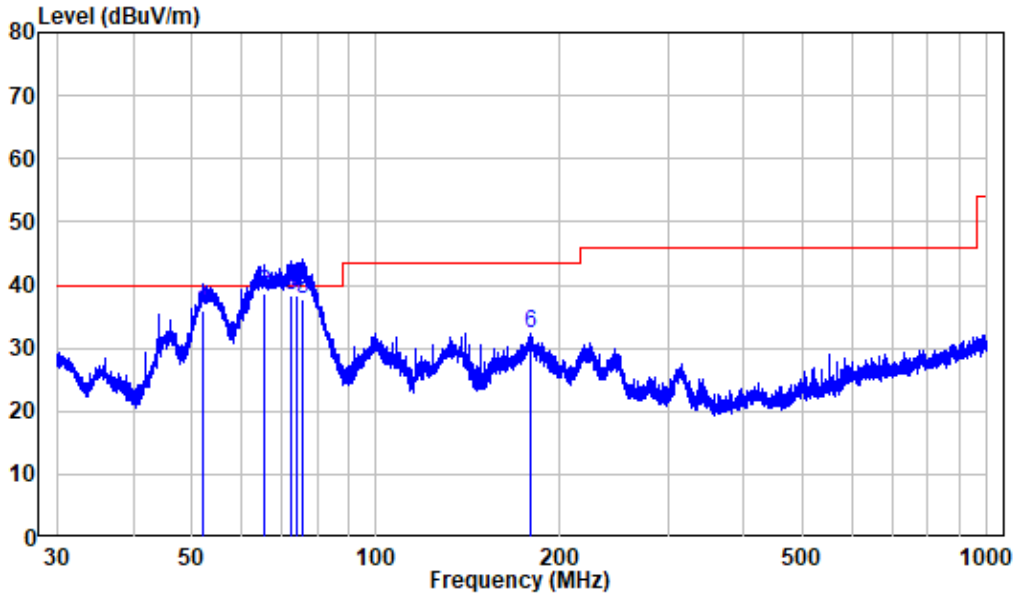
Horizontal



Site : chamber
Condition: 3m HORIZONTAL
Job No. : RA221213-61319E-RF
Test Mode: UHF

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	56.148	-10.17	38.94	28.77	40.00	-11.23	Peak
2	73.876	-16.04	49.28	33.24	40.00	-6.76	Peak
3	119.436	-13.43	40.94	27.51	43.50	-15.99	Peak
4	242.738	-10.74	44.53	33.79	46.00	-12.21	Peak
5	312.043	-8.82	40.83	32.01	46.00	-13.99	Peak
6	778.241	0.07	30.43	30.50	46.00	-15.50	Peak

Vertical



Site : chamber
Condition: 3m VERTICAL
Job No. : RA221213-61319E-RF
Test Mode: UHF

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	51.980	-9.97	45.99	36.02	40.00	-3.98	QP
2	65.515	-12.70	51.40	38.70	40.00	-1.30	QP
3	72.496	-15.72	54.19	38.47	40.00	-1.53	QP
4	74.265	-16.10	54.29	38.19	40.00	-1.81	QP
5	75.944	-16.41	54.20	37.79	40.00	-2.21	QP
6	179.229	-12.85	45.22	32.37	43.50	-11.13	Peak

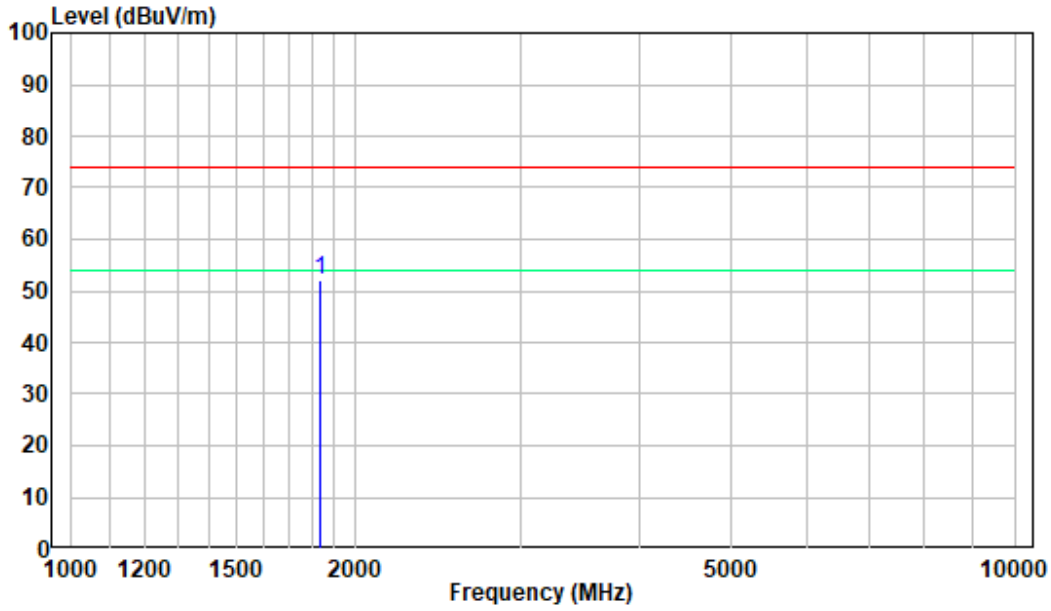
1 GHz - 10 GHz:

Frequency (MHz)	Receiver		Turn-Table	Rx Antenna		Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	Detector (PK/QP/AV)	Angle Degree	Height (m)	Polar (H / V)				
Low Channel 917MHz									
1834.00	60.06	PK	44	2.1	H	-8.50	51.56	74	-22.44
1834.00	60.11	PK	96	2.1	V	-8.50	51.61	74	-22.39
Middle Channel 919.6MHz									
1839.20	60.38	PK	136	1.2	H	-8.46	51.92	74	-22.08
1839.20	60.99	PK	75	2.2	V	-8.46	52.53	74	-21.47
High Channel 922.2MHz									
1844.40	60.00	PK	59	1.4	H	-8.41	51.59	74	-22.41
1844.40	60.58	PK	295	1.8	V	-8.41	52.17	74	-21.83

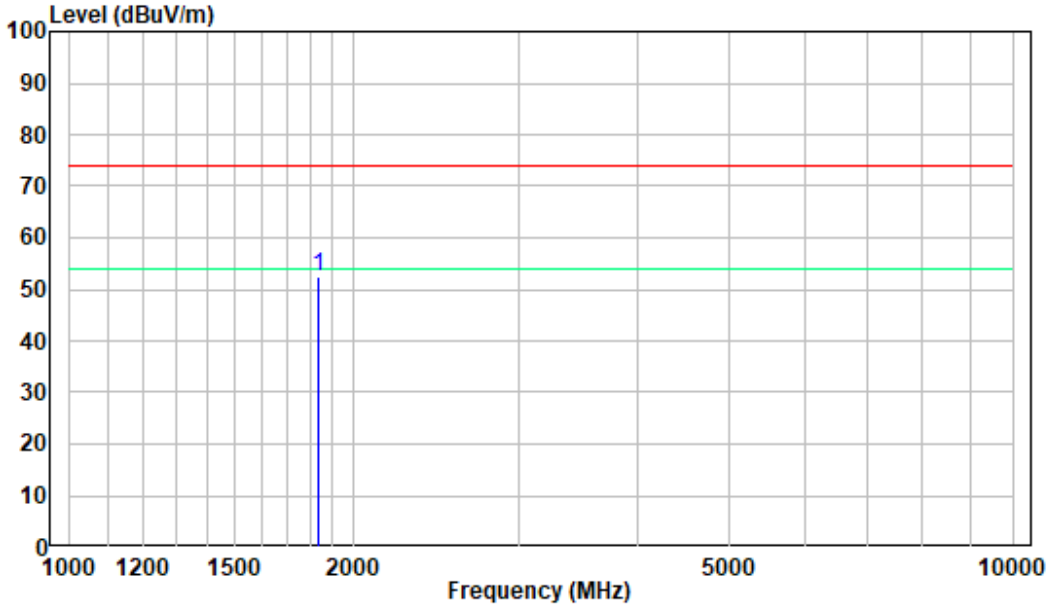
Note:
Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Corrected Amplitude = Factor + Reading
Margin = Corrected. Amplitude - Limit
The other spurious emission which is in the noise floor level was not recorded.
The test result of peak was less than the limit of average, so just peak value were recorded.

Pre-scan with Middle channel

Horizontal



Vertical



FCC §15.247(a) (1)-CHANNEL SEPARATION TEST

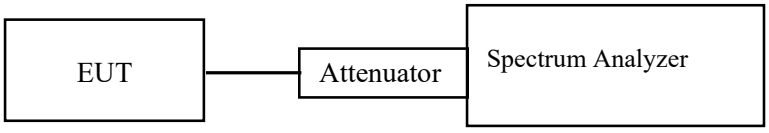
Applicable Standard

Frequency hopping systems shall have hoping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater provided the systems operate with an output power no greater than 125 mW.

Test Procedure

Test Method: ANSI C63.10-2013 Clause 7.8.2

a. Set the EUT in transmitting mode, maxhold the channel.
b. Set the adjacent channel of the EUT and maxhold another trace.
c. Measure the channel separation.



Test Data

Environmental Conditions

Temperature:	26~27.5 ℃
Relative Humidity:	50~52 %
ATM Pressure:	101.0 kPa

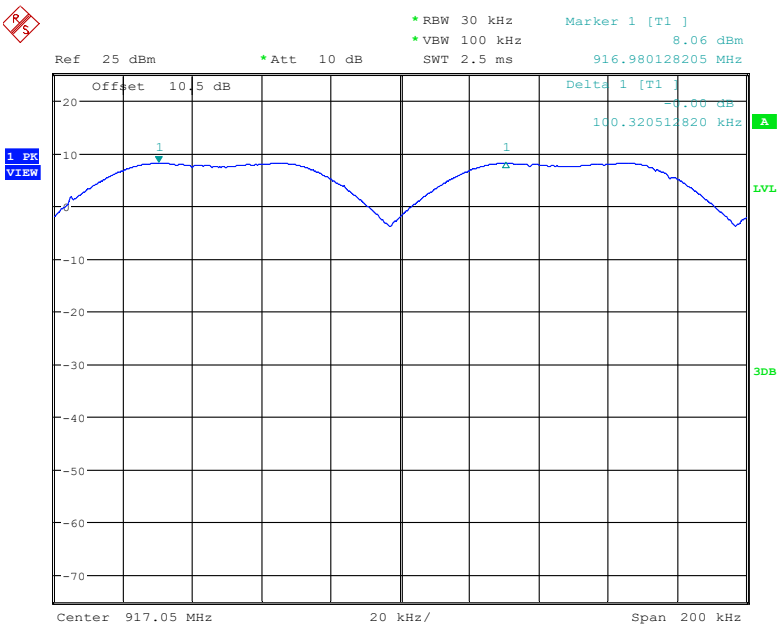
The testing was performed by Jesse on 2023-02-08 and 2023-03-17.

EUT operation mode: Transmitting

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

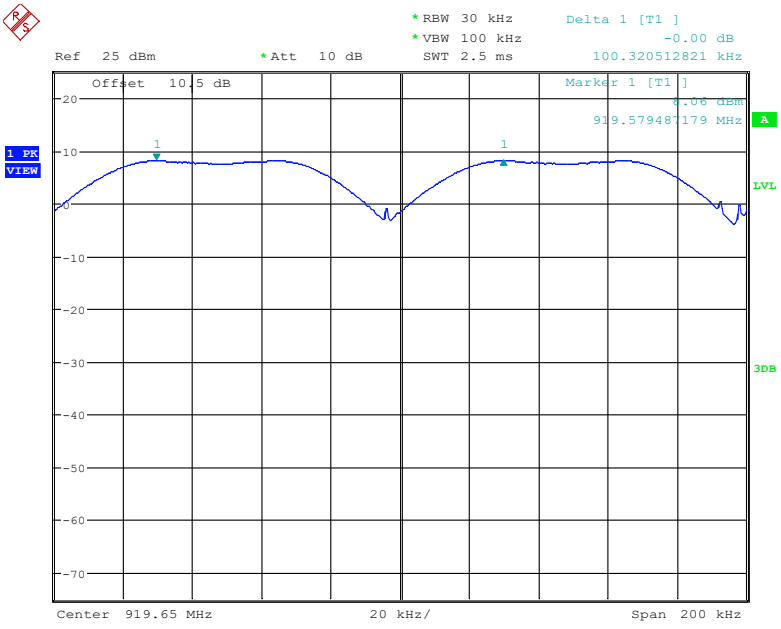
Channel	Channel Separation (MHz)	20dB Emission Bandwidth (MHz)	Limit	Result
Low	0.100	0.069	≥the 20dB bandwidth	Compliance
Middle	0.100	0.069	≥the 20dB bandwidth	Compliance
High	0.100	0.069	≥the 20dB bandwidth	Compliance

Low Channel



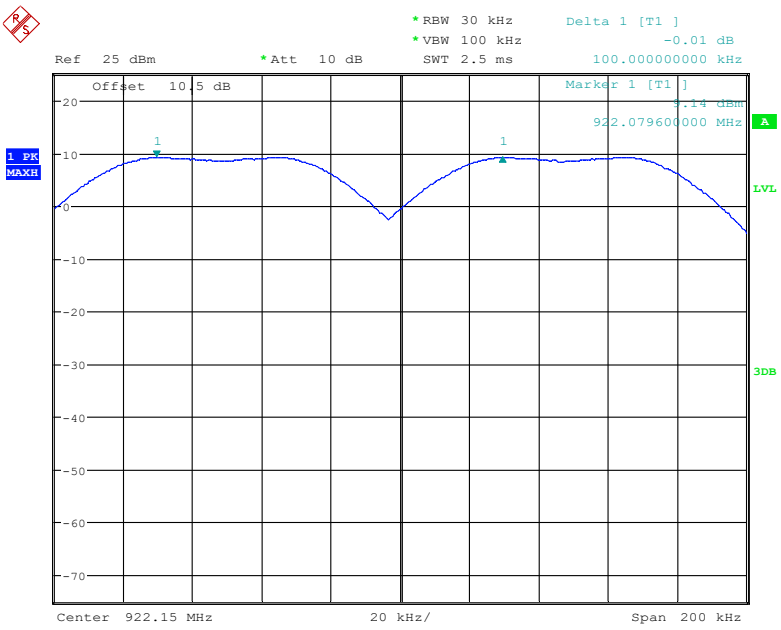
Date: 8.FEB.2023 00:46:04

Middle Channel



Date: 8.FEB.2023 00:44:16

High Channel



Date: 17.MAR.2023 16:20:00

FCC §15.247(a) (1) (i) – 20 dB EMISSION BANDWIDTH

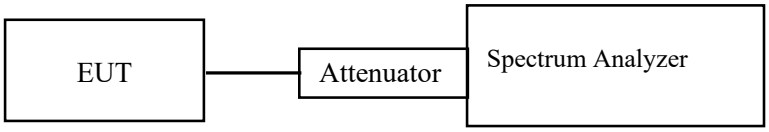
Applicable Standard

According to §15.247(a) (1) (i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

Test Procedure

Test Method: ANSI C63.10-2013 Clause 7.8.7 & Clause 6.9.2

a. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
b. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
c. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
d. Repeat above procedures until all frequencies measured were complete.



Test Data

Environmental Conditions

Temperature:	27.5 ℃
Relative Humidity:	52 %
ATM Pressure:	101.0 kPa

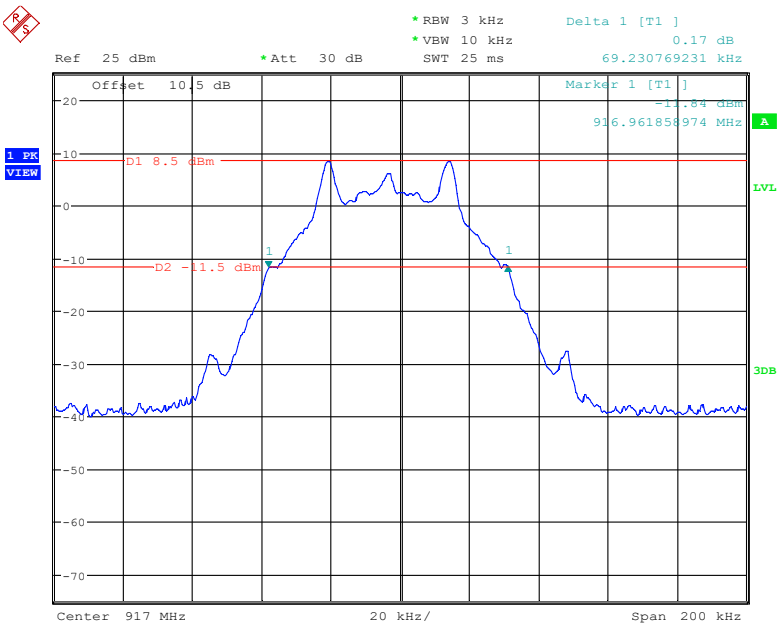
The testing was performed by Jesse on 2023-02-09.

EUT operation mode: Transmitting

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

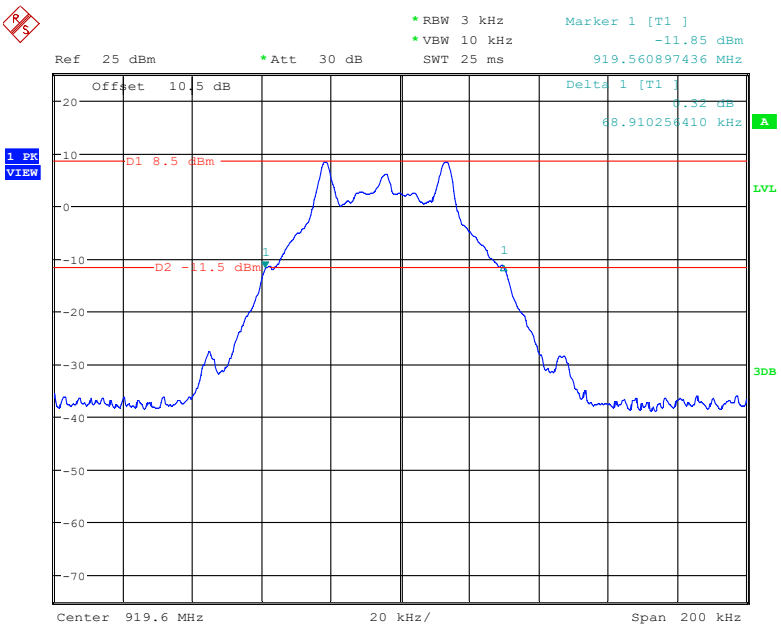
Mode	Channel	Frequency (MHz)	20 dB Emission Bandwidth (MHz)	Limit (MHz)
GFSK	Low	917.0	0.069	0.25
	Middle	919.6	0.069	0.25
	High	922.2	0.069	0.25

Low Channel



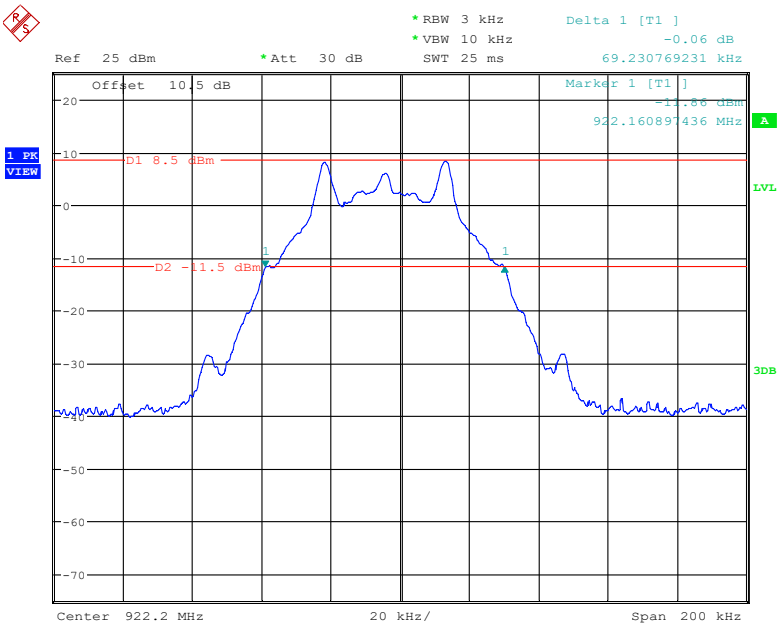
Date: 9.FEB.2023 00:00:13

Middle Channel



Date: 9.FEB.2023 00:08:53

High Channel



Date: 9.FEB.2023 00:44:35

FCC §15.247(a) (1) (i)-QUANTITY OF HOPPING CHANNEL TEST

Applicable Standard

According to §15.247(a) (1) (i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

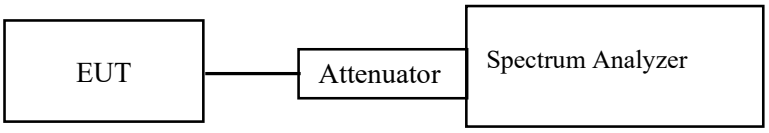
Test Procedure

Test Method: ANSI C63.10-2013 Clause 7.8.3

a. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.

b. Set the EUT in hopping mode from first channel to last.

c. By using the max-hold function record the quantity of the channel.



Test Data

Environmental Conditions

Temperature:	26 ℃
Relative Humidity:	50 %
ATM Pressure:	101.0 kPa

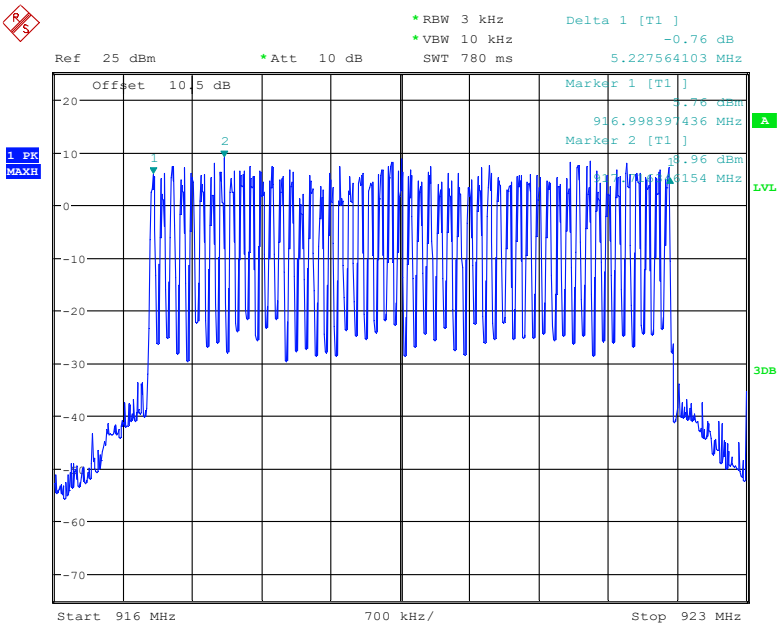
The testing was performed by Jesse on 2023-03-20.

EUT operation mode: Transmitting

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

Mode	Frequency Range (MHz)	Number of Hopping Channel (CH)	Limit (CH)
GFSK	902-928	53	≥50

Number of Hopping Channels



Date: 20.MAR.2023 10:20:11

FCC §15.247(a) (1) (i) - TIME OF OCCUPANCY (DWELL TIME)

Applicable Standard

According to §15.247(a) (1) (i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

Test Procedure

Test Method: ANSI C63.10-2013 Clause 7.8.4

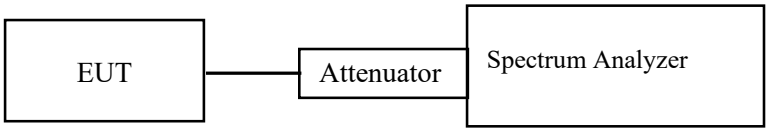
The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:
a) Span: Zero span, centered on a hopping channel.
b) RBW shall be ≤ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel.
c) Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel.
d) Detector function: Peak.
e) Trace: Max hold.

Use the marker-delta function to determine the transmit time per hop. If this value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in transmit time.

Repeat the measurement using a longer sweep time to determine the number of hops over the period specified in the requirements. The sweep time shall be equal to, or less than, the period specified in the requirements. Determine the number of hops over the sweep time and calculate the total number of hops in the period specified in the requirements, using the following equation:

(Number of hops in the period specified in the requirements) =
(number of hops on spectrum analyzer) × (period specified in the requirements / analyzer sweep time)

The average time of occupancy is calculated from the transmit time per hop multiplied by the number of hops in the period specified in the requirements. If the number of hops in a specific time varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation.



Test Data

Environmental Conditions

Temperature:	27 ℃
Relative Humidity:	52 %
ATM Pressure:	101.0 kPa

The testing was performed by Jesse on 2023-02-08.

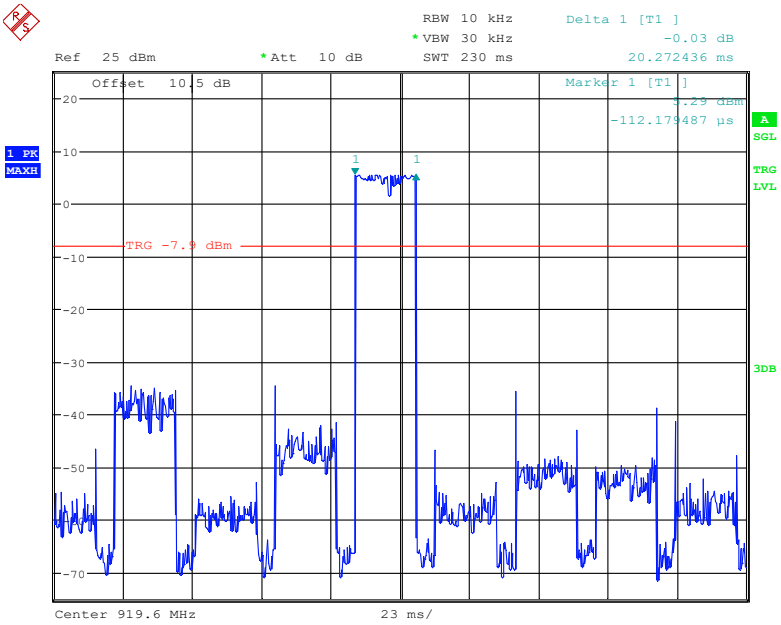
EUT operation mode: Transmitting

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

Test Mode	Channel	Pulse Time [ms]	Total Hops [Num]	Result[s]	Limit[s]	Verdict
GFSK	Hop	20.27	15	0.304	<=0.4	PASS

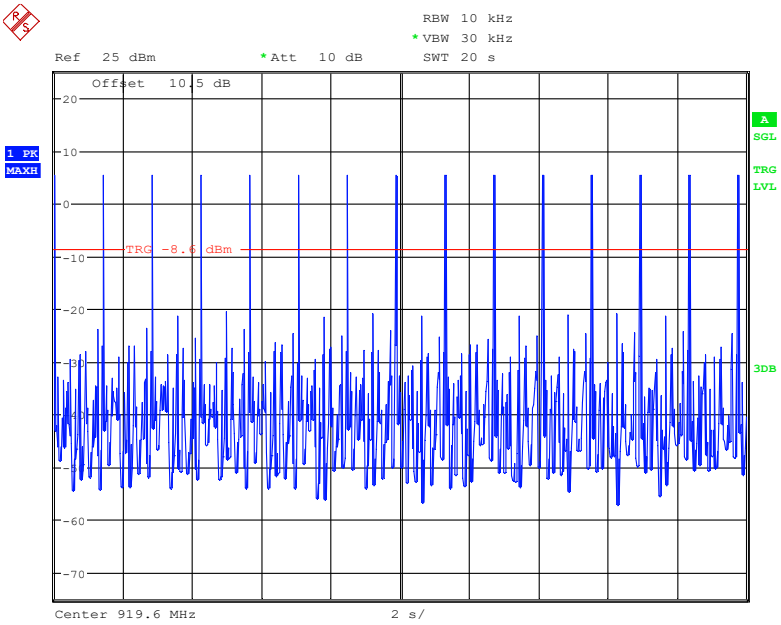
Note: A period time=20(s), Result= Pulse Time *Total hops

Pulse time



Date: 8.FEB.2023 01:03:45

Hops



Date: 8.FEB.2023 00:54:18

FCC §15.247(b) (2) - MAXIMUM CONDUCTED OUTPUT POWER

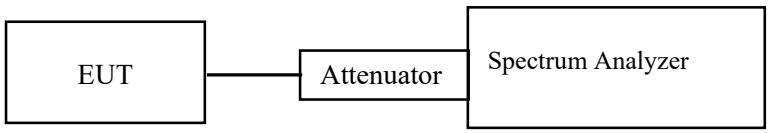
Applicable Standard

According to FCC §15.247(b) (2), For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

Test Procedure

Test Method: ANSI C63.10-2013 Clause 7.8.5

a) Place the EUT on a bench and set it in transmitting mode.
b) Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to one test equipment.
c) Add a correction factor to the display.



Test Data

Environmental Conditions

Temperature:	26~27.5 ℃
Relative Humidity:	50~52 %
ATM Pressure:	101.0 kPa

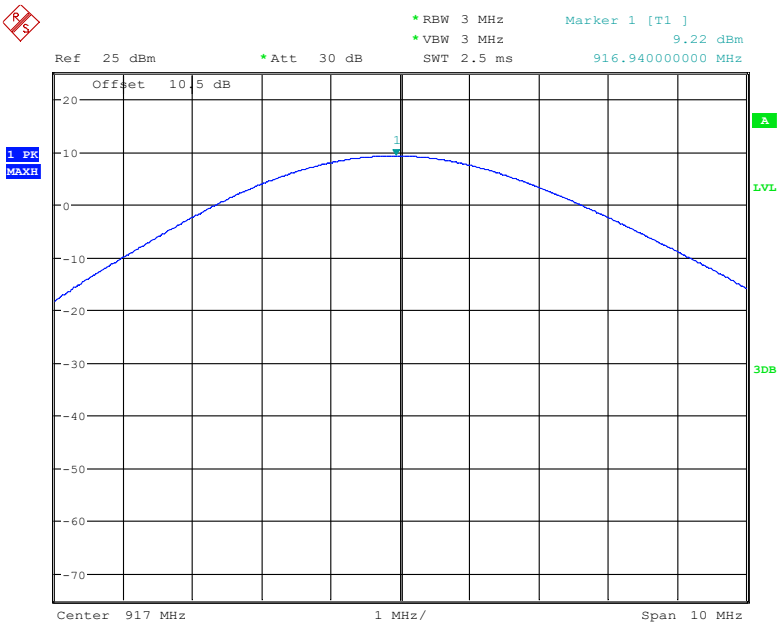
The testing was performed by Jesse from 2023-03-17 to 2023-03-20.

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

EUT operation mode: Transmitting

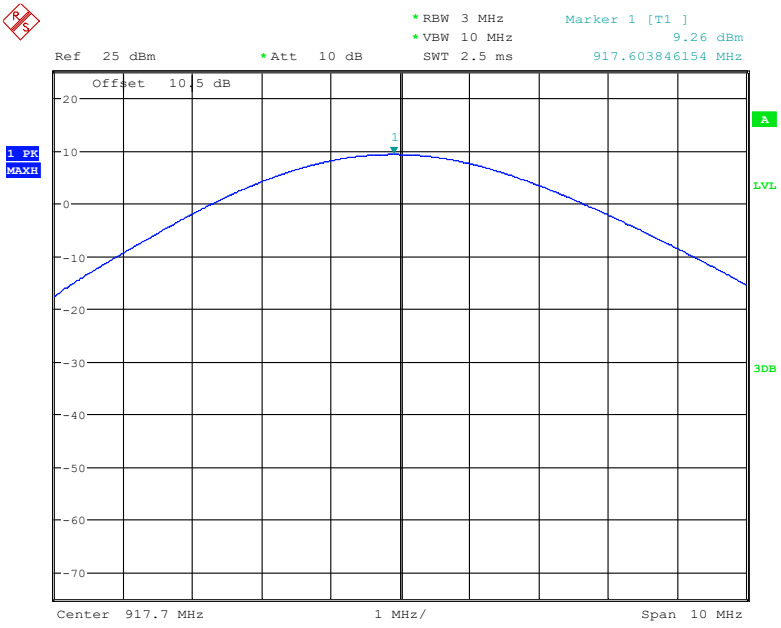
Mode	Channel	Frequency (MHz)	Peak Output Power (dBm)	Limit (dBm)
GFSK	CH 0	917.0	9.22	30
	CH 7	917.7	9.26	30
	CH 26	919.6	9.18	30
	CH 52	922.2	9.16	30

917.0MHz



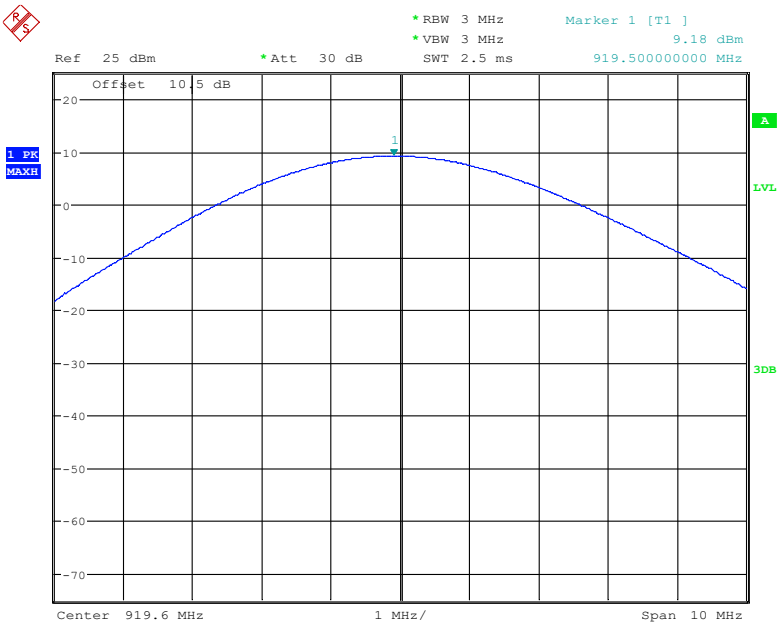
Date: 17.MAR.2023 16:35:01

917.7MHz



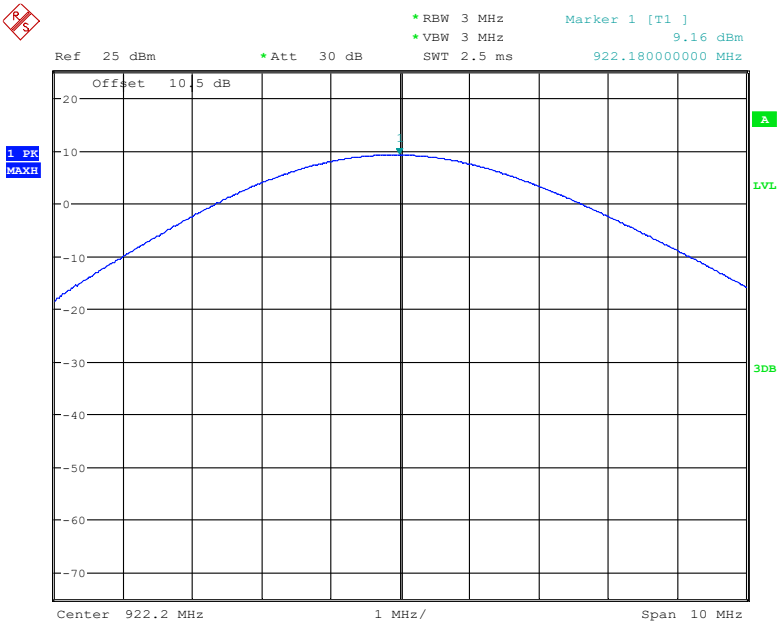
Date: 20.MAR.2023 10:22:47

919.6MHz



Date: 17.MAR.2023 16:40:27

922.2MHz



Date: 17.MAR.2023 16:46:04

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

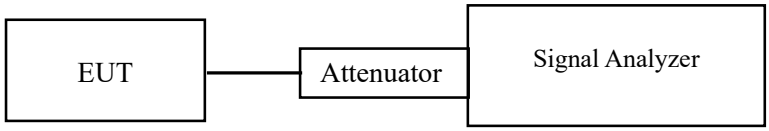
Applicable Standard

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

Test Method: ANSI C63.10-2013 Clause 7.8.6 & Clause 6.10

a. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
b. 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.
c. 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.
d. 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.
e. Repeat above procedures until all measured frequencies were complete.



Test Data

Environmental Conditions

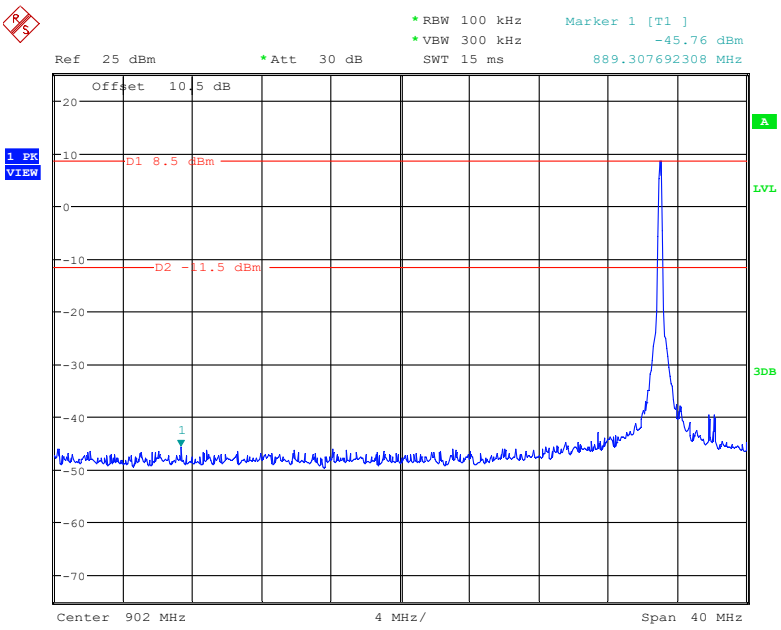
Temperature:	27~27.5 ℃
Relative Humidity:	52 %
ATM Pressure:	101.0 kPa

The testing was performed by Jesse on 2023-02-08 and 2023-02-09.

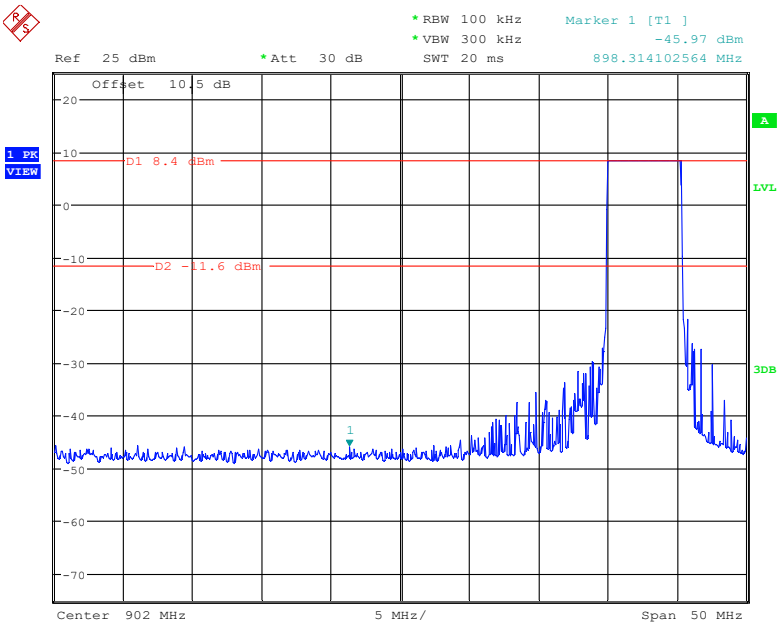
Test Result: Compliance. Please refer to following plots.

EUT operation mode: Transmitting

Band Edge, Left Side

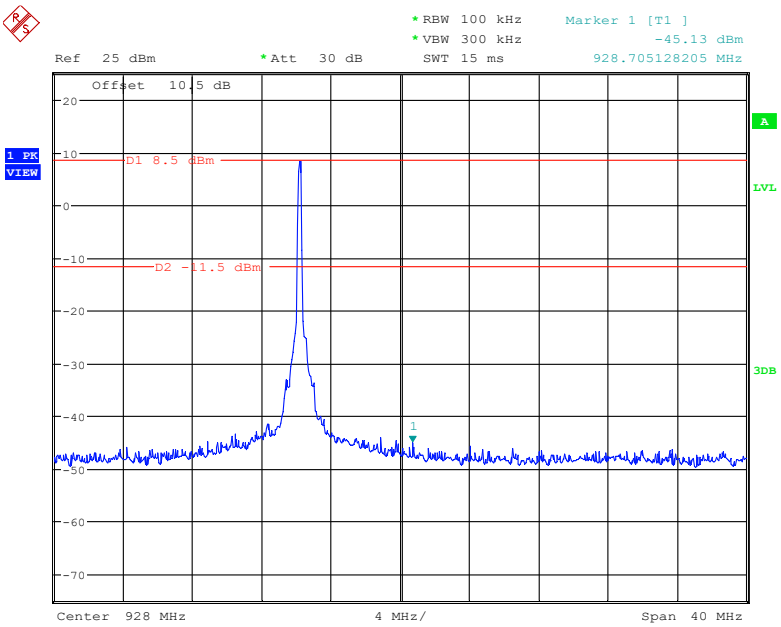


Date: 8.FEB.2023 23:46:23

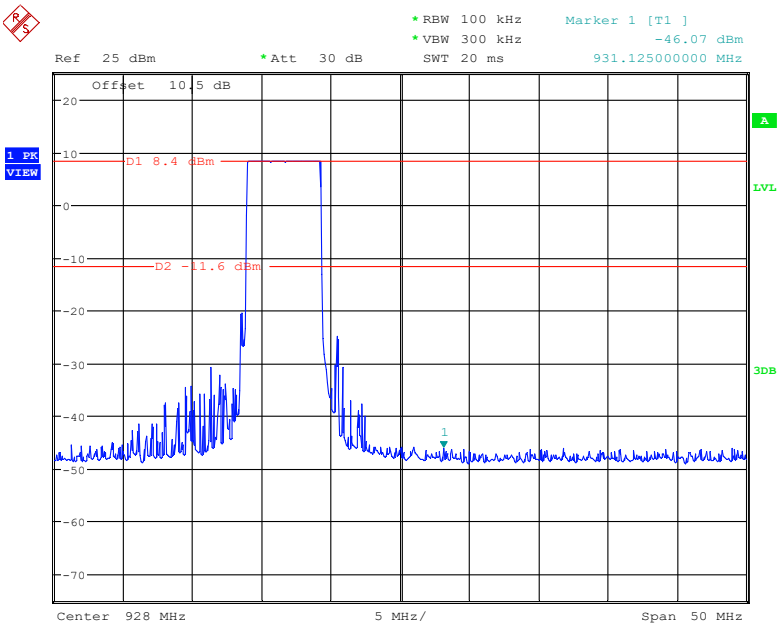


Date: 9.FEB.2023 00:50:00

Band Edge, Right Side



Date: 9.FEB.2023 00:40:37



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