TEST REPORT

Applicant Name :	Astera LED-Technology GmbH
Address :	Stahlgruberring 36, Munich,81829 Germany
Report Number :	SZ4210812-52663E-RF-00C
FCC ID:	X55AX9

Test Standard (s)

FCC PART 15.247

Sample Description

Product Type:	PowerPAR
Model No.:	AX9
Multiple Model(s) No.:	N/A
Trade Mark:	ASTERA
Date Received:	2021/08/12
Date of Test:	2022/01/12~2022/02/25
Report Date:	2022/02/25

Test Result:	Pass*

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

Prepared and Checked By:

Ting Lü
EMC Engineer

Approved By:

Robert Li
EMC Engineer

Note: This report may contain data that are not covered by the A2LA accreditation and are marked with an asterisk "★ ".
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Frequency Range	917~922.2MHz
Maximum conducted Peak output power	9.28dBm
Modulation Technique	GFSK
Antenna Specification	2.0dBi
Voltage Range	DC 18V from battery or AC 100-240V
Sample serial number	SZ4210812-52663E-RF-S2(for conduct test) SZ4210812-52663E-RF-S1(for CE&RE) (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 by manufacturer.

53 channels are provided to testing:

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

Channel 0, Channel 26 and Channel 52 were selected for testing.

EUT Exercise Software

“AsteraApp_9.96”* software was used to test.

The device was tested with the Power level is default*., which provided by manufacturer.

Equipment Modifications

No modifications were made to the unit tested.

Special Accessories

No special accessory.

Support Equipment List and Details

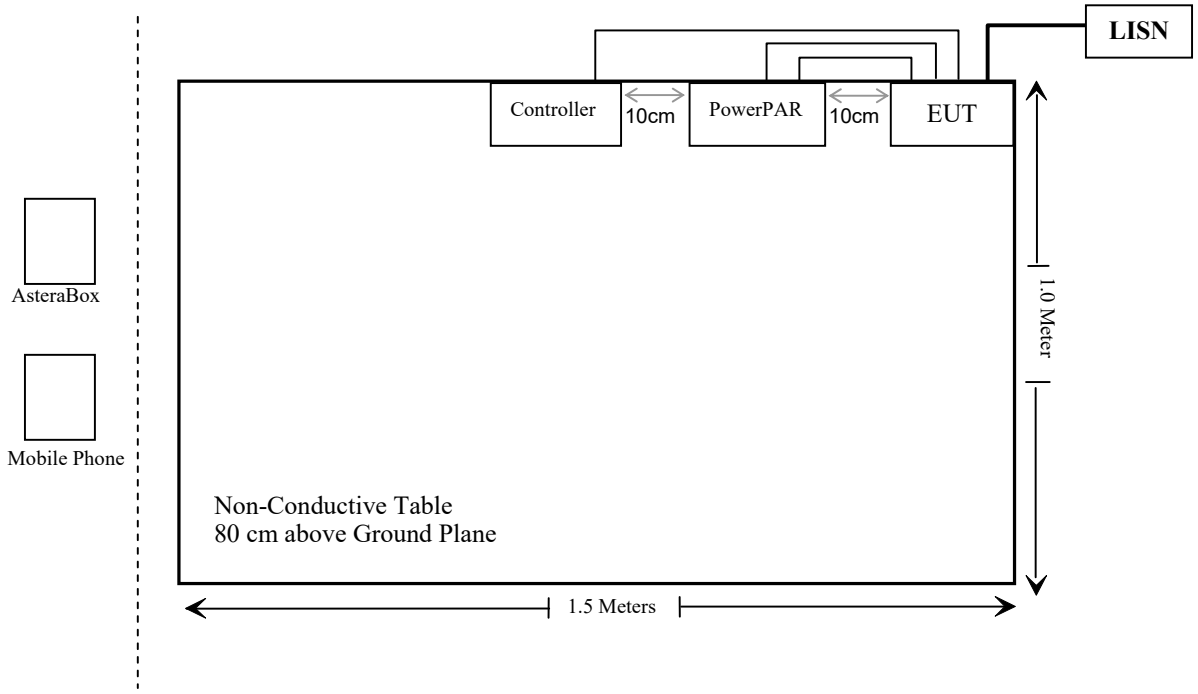
Manufacturer	Description	Model	Serial Number
ASTERA	AsteraBox	ART7-U	025-0918819
Nubia	Mobile Phone	NX549J	F4efaa79
Astera LED-Technology GmbH	PowerPAR	AX9	Unknown
Astera LED-Technology GmbH	Controller	DMX-100	Unknown

Support Cable Descriptions

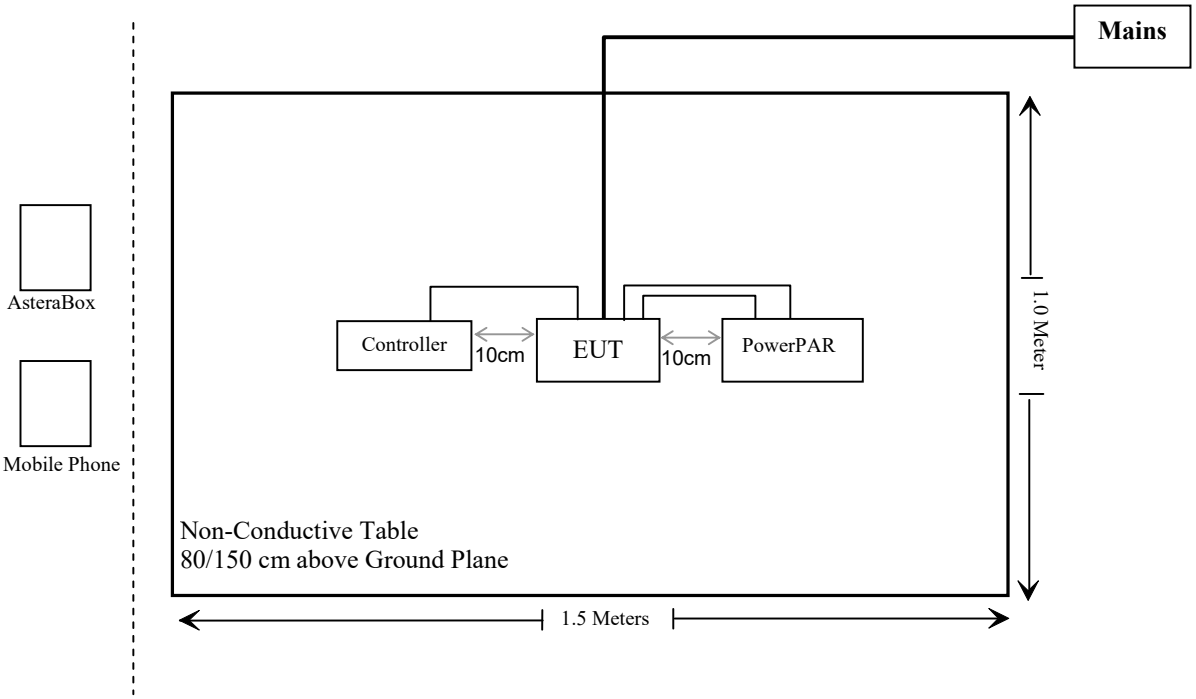
Cable Description	Length (m)	From/Port	To
Un-shielding Detachable AC Cable	1.0	EUT	LISN
Un-Shielding Detachable AC Cable	0.6	EUT	PowerPAR
Un-Dhielding Detachable DMX Cable	0.6	EUT	PowerPAR
Un-Dhielding Detachable DMX Cable	0.6	EUT	Controller

Block Diagram of Test Setup

For conducted emission



For Spurious Emissions



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.247 (i), §2.1091	Maximum Permissible Exposure(MPE)	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 emission test					
Rohde& Schwarz	EMI Test Receiver	ESCI	100784	2021/12/13	2022/12/12
Rohde & Schwarz	L.I.S.N.	ENV216	101314	2021/12/13	2022/12/12
Anritsu Corp	50 Coaxial Switch	MP59B	6100237248	2021/12/13	2022/12/12
Conducted Emission Test Software: e3 19821b (V9)					
Radiated emission test					
Rohde& Schwarz	Test Receiver	ESR	102725	2021/12/13	2022/12/12
Rohde&Schwarz	Spectrum Analyzer	FSV40	101949	2021/12/13	2022/12/12
SONOMA INSTRUMENT	Amplifier	310 N	186131	2021/11/09	2022/11/08
A.H. Systems, inc.	Preamplifier	PAM-0118P	135	2021/11/09	2022/11/08
Quinstar	Amplifier	QLW-18405536-J0	15964001002	2021/11/11	2022/11/10
Schwarzbeck	Bilog Antenna	VULB9163	9163-323	2021/07/06	2024/07/05
Schwarzbeck	Horn Antenna	BBHA9120D	9120D-1067	2020/01/05	2023/01/04
Unknown	RF Coaxial Cable	No.10	N050	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.11	N1000	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.12	N040	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.13	N300	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.14	N800	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.15	N600	2021/12/14	2022/12/13
Unknown	RF Coaxial Cable	No.16	N650	2021/12/14	2022/12/13
CD	High Pass Filter	HPM-1.2/18G-60	110	2021/12/14	2022/12/13
Radiated Emission Test Software: e3 19821b (V9)					
RF conducted test					
Rohde & Schwarz	Spectrum Analyzer	FSV-40	101495	2021/12/13	2022/12/12
HP	6dB Attenuator	8493B 6dB Attenuator	06151	2021/12/14	2022/12/13
Unknown	RF Cable	Unknown	Unknown	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) & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

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.

Limits for General Population/Uncontrolled Exposure

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
a)

Result

Calculated Formulary:

Predication of MPE limit at a given distance

$$S = \frac{PG}{4\pi R^2}$$

S = power density (in appropriate units, e.g. mW/cm^2)
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:

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

Mode	Frequency (MHz)	Antenna Gain		Tune up conducted power		Evaluation Distance (cm)	Power Density (mW/cm^2)	MPE Limit (mW/cm^2)
		(dBi)	(numeric)	(dBm)	(mW)			
UHF	917~922.2	2.0	1.58	9.5	8.91	20	0.0028	0.61
BT	2402-2480	-1.03	0.79	8.0	6.31	20	0.0010	1
BLE	2402-2480	-1.03	0.79	9.0	7.94	20	0.0012	1
Wi-Fi	2412-2462	-1.03	0.79	17.5	56.23	20	0.0088	1

Note: 1. The tune up conducted power and antenna gain was declared by the applicant.
2. The UHF and BT/BLE/Wi-Fi can transmit at the same time, while the BT, BLE and Wi-Fi cannot transmitting simultaneously.

Simultaneous transmitting consideration:

The ratio=$MPE_{Wi\text{-}Fi}$/limit + MPE_{UHF}/limit=0.0088/1+0.0028/0.61=0.0134＜1.0

So simultaneous exposure comply with the limit.

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

Result: Compliance

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:

b. Antenna must be permanently attached to the unit.
c. Antenna must use a unique type of connector to attach to the EUT.

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 and the antenna gain is 2.0 dBi, fulfill the requirement of this section. Please refer to the EUT photos.

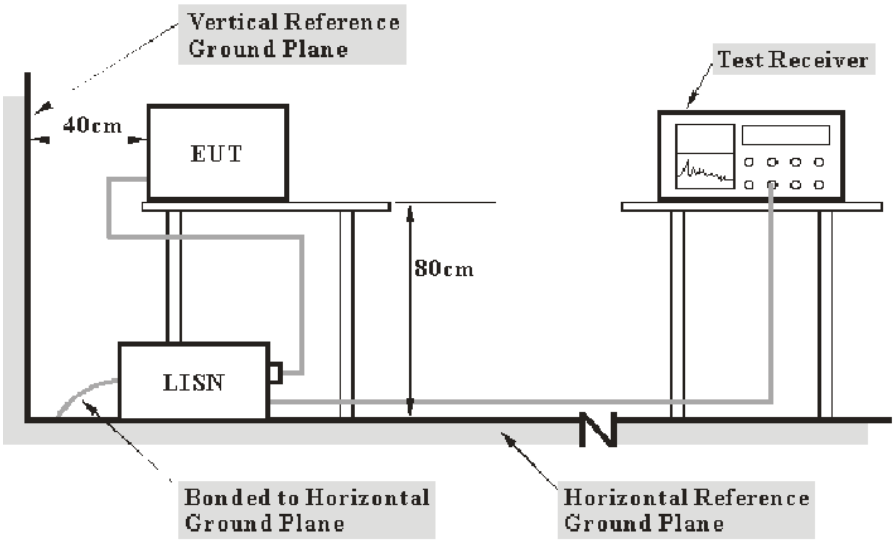
Result: Compliance.

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

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

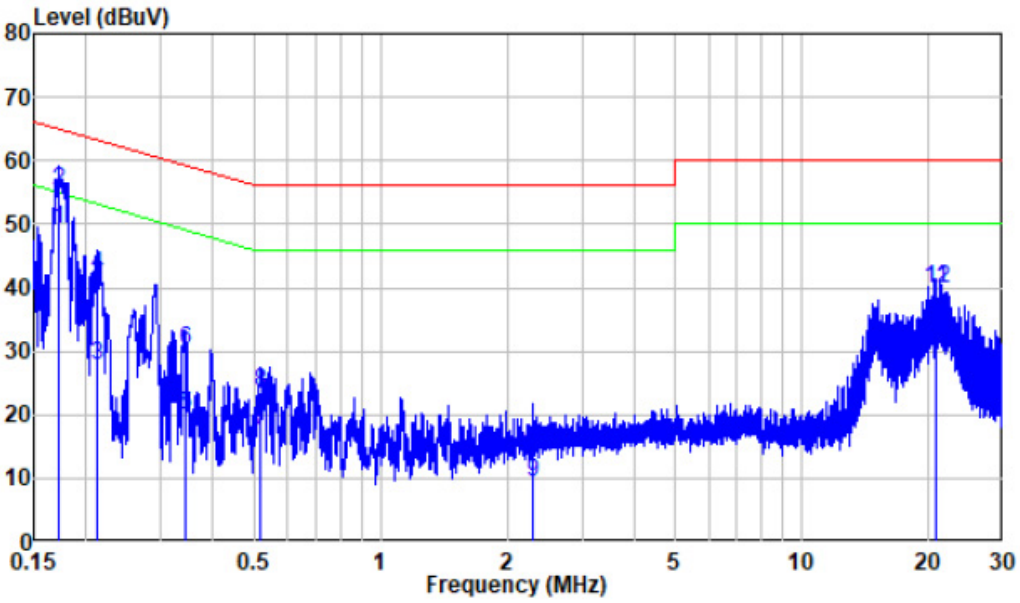
Environmental Conditions

Temperature:	22℃
Relative Humidity:	47 %
ATM Pressure:	101.0 kPa

The testing was performed by Bin Duan on 2022-01-12.

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

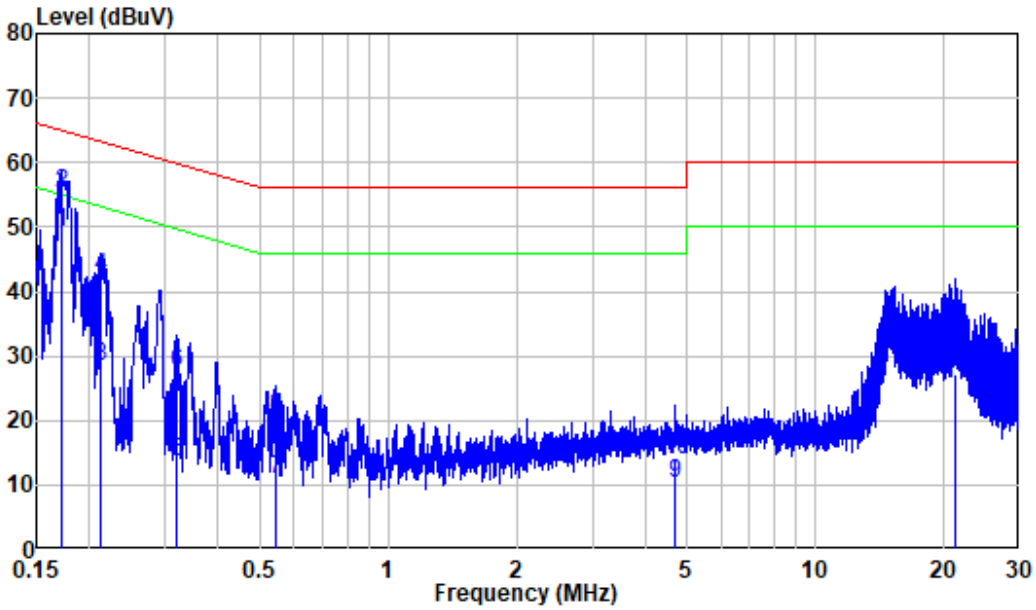
AC 120V/60 Hz, Line



Site : Shielding Room
Condition: Line
Mode : TX
Model : AX9
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.172	9.85	39.50	49.35	54.84	-5.49	Average
2	0.172	9.85	45.46	55.31	64.84	-9.53	QP
3	0.212	9.80	18.06	27.86	53.12	-25.26	Average
4	0.212	9.80	32.24	42.04	63.12	-21.08	QP
5	0.343	9.80	10.28	20.08	49.13	-29.05	Average
6	0.343	9.80	20.49	30.29	59.13	-28.84	QP
7	0.516	9.81	7.85	17.66	46.00	-28.34	Average
8	0.516	9.81	13.76	23.57	56.00	-32.43	QP
9	2.300	9.92	-0.66	9.26	46.00	-36.74	Average
10	2.300	9.92	3.81	13.73	56.00	-42.27	QP
11	20.717	10.23	29.68	39.91	50.00	-10.09	Average
12	20.717	10.23	29.68	39.91	60.00	-20.09	QP

AC 120V/60 Hz, Neutral



Site : Shielding Room
Condition: Neutral
Mode : TX
Model : AX9
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.172	9.95	39.41	49.36	54.84	-5.48	Average
2	0.172	9.95	45.41	55.36	64.84	-9.48	QP
3	0.213	9.99	18.27	28.26	53.08	-24.82	Average
4	0.213	9.99	32.24	42.23	63.08	-20.85	QP
5	0.318	9.95	3.54	13.49	49.75	-36.26	Average
6	0.318	9.95	17.42	27.37	59.75	-32.38	QP
7	0.543	9.91	0.92	10.83	46.00	-35.17	Average
8	0.543	9.91	10.70	20.61	56.00	-35.39	QP
9	4.672	10.05	0.18	10.23	46.00	-35.77	Average
10	4.672	10.05	3.72	13.77	56.00	-42.23	QP
11	21.189	10.22	15.41	25.63	50.00	-24.37	Average
12	21.189	10.22	16.96	27.18	60.00	-32.82	QP

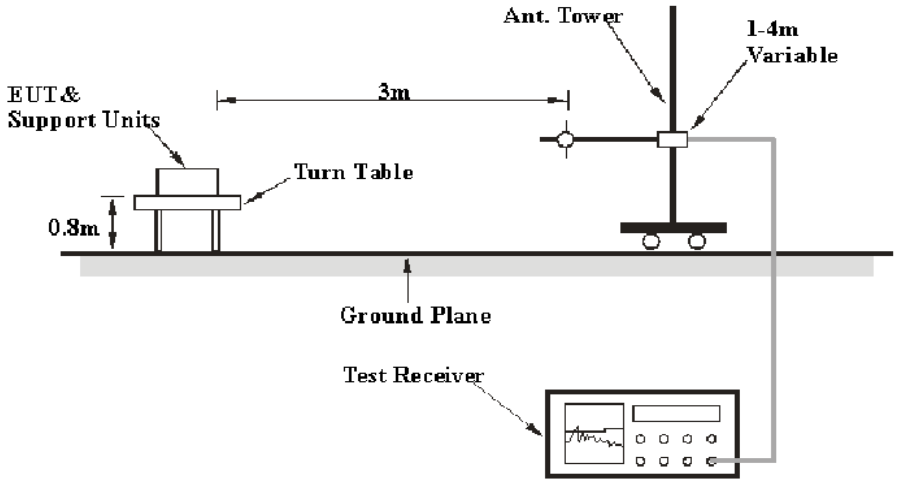
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

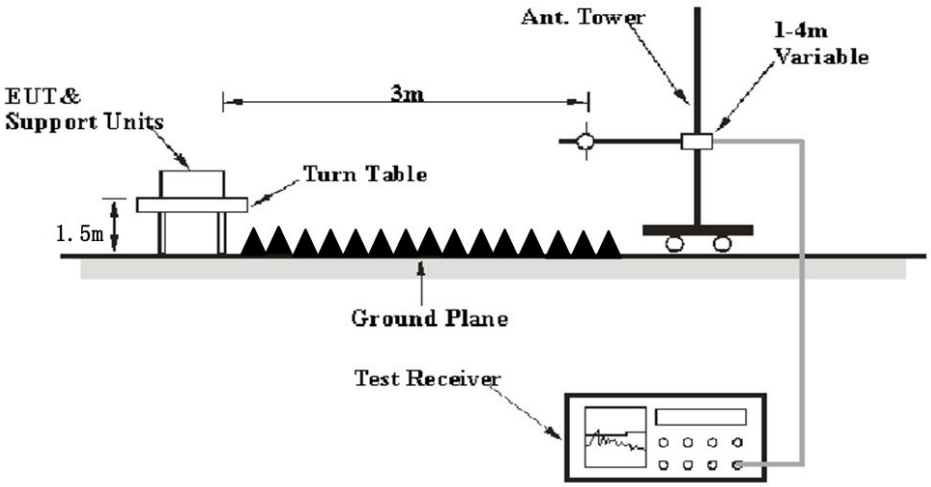
FCC §15.205; §15.209; §15.247(d)

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.

Factor & 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:	21~26.4 ℃
Relative Humidity:	53~62 %
ATM Pressure:	101 kPa

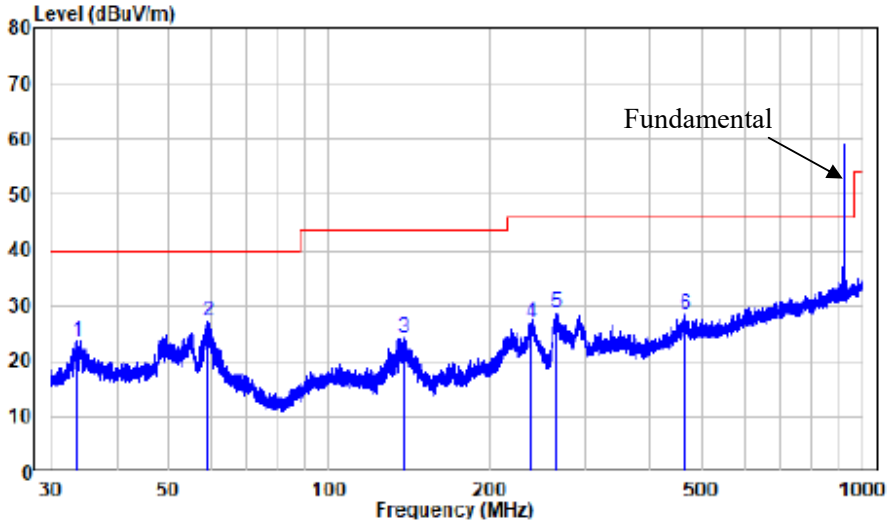
The testing was performed by Bin Deng on 2022-01-12.

EUT operation mode: Transmitting

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

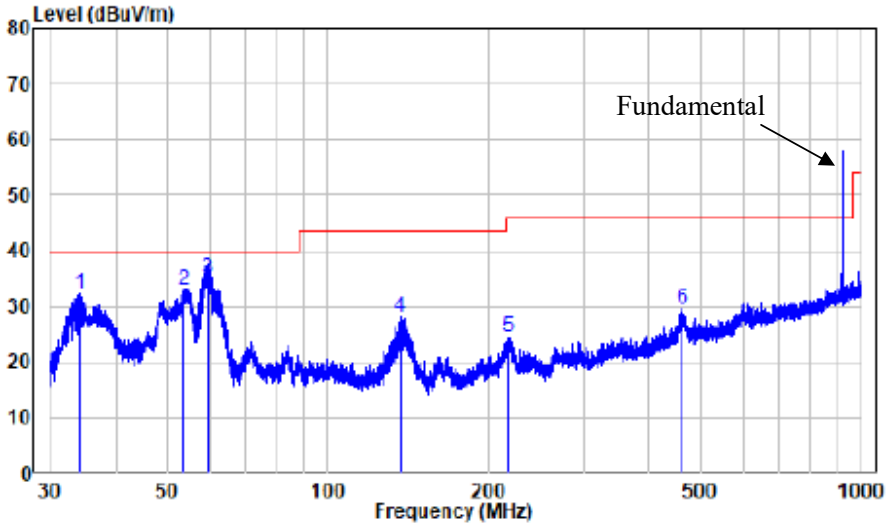
Note: when the test result of peak was less than the limit of QP more than 6dB, just peak value were recorded

Horizontal



	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	33.828	-11.88	35.30	23.42	40.00	-16.58	Peak
2	59.077	-10.29	37.37	27.08	40.00	-12.92	Peak
3	137.903	-15.35	39.56	24.21	43.50	-19.29	Peak
4	239.567	-10.92	37.91	26.99	46.00	-19.01	Peak
5	266.025	-10.41	38.98	28.57	46.00	-17.43	Peak
6	462.954	-5.45	33.94	28.49	46.00	-17.51	Peak

Vertical



	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	34.171	-11.80	43.95	32.15	40.00	-7.85	Peak
2	53.599	-10.28	43.30	33.02	40.00	-6.98	Peak
3	59.493	-10.44	45.41	34.97	40.00	-5.03	QP
4	136.520	-15.15	43.33	28.18	43.50	-15.32	Peak
5	217.926	-11.52	36.11	24.59	46.00	-21.41	Peak
6	461.536	-5.43	35.03	29.60	46.00	-16.40	Peak

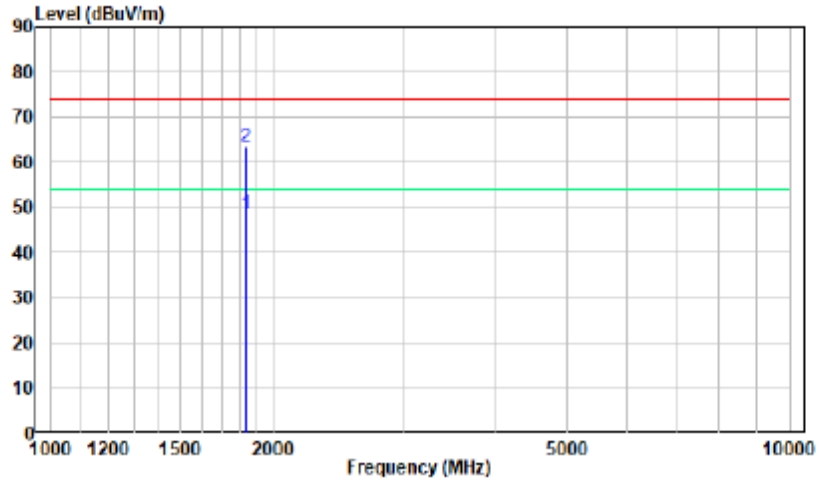
1 GHz - 10 GHz:

Frequency (MHz)	Receiver		Turntable Angle Degree	Rx Antenna		Factor (dB/m)	Absolute Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/Ave		Height (m)	Polar (H/V)				
Low Channel(917MHz)									
1834	57.35	PK	332	1	H	4.3	61.65	74	-12.35
1834	42.36	Ave.	332	1	H	4.3	46.66	54	-7.34
1834	52.08	PK	207	1.6	V	3.5	55.58	74	-18.42
1834	37.32	Ave.	207	1.6	V	3.5	40.82	54	-13.18
Middle Channel(919.6MHz)									
1839.2	59.06	PK	169	2.2	H	4.4	63.46	74	-10.54
1839.2	44.29	Ave.	169	2.2	H	4.4	48.69	54	-5.31
1839.2	53.81	PK	261	2.5	V	3.6	57.41	74	-16.59
1839.2	39.16	Ave.	261	2.5	V	3.6	42.76	54	-11.24
High Channel(922.2MHz)									
1844.4	59.21	PK	166	2.1	H	4.4	63.61	74	-10.39
1844.4	44.10	Ave.	166	2.1	H	4.4	48.50	54	-5.50
1844.4	54.56	PK	12	1.3	V	3.6	58.16	74	-15.84
1844.4	40.03	Ave.	12	1.3	V	3.6	43.63	54	-10.37

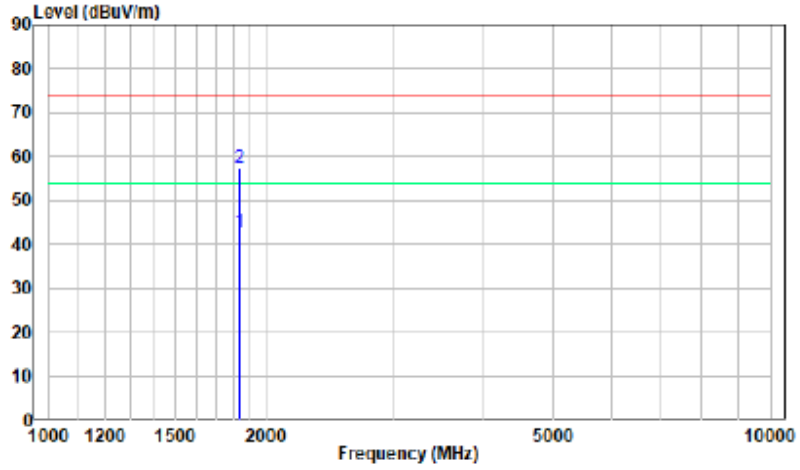
Note:
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Corrected Amplitude = Corrected Factor + Reading
Margin = Corrected. Amplitude - Limit
The other spurious emission which is 20dB to the limit was not recorded.

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

d. Set the EUT in transmitting mode, maxhold the channel.
e. Set the adjacent channel of the EUT and maxhold another trace.
f. Measure the channel separation.

Test Data

Environmental Conditions

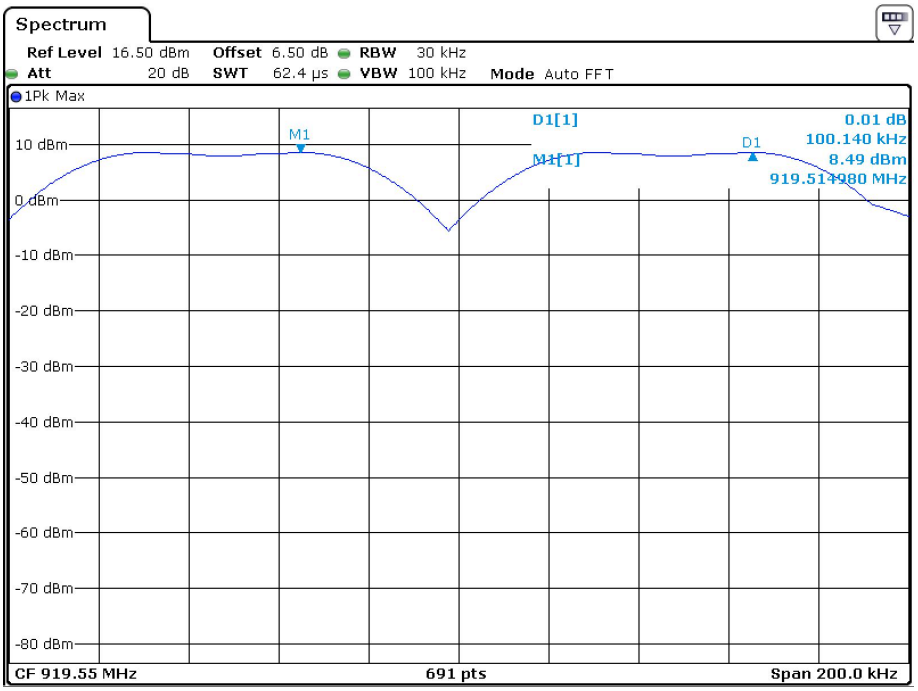
Temperature:	24 ℃
Relative Humidity:	52%
ATM Pressure:	101.0 kPa

The testing was performed by Blacker Ding on 2022-02-24.

EUT operation mode: Transmitting

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

Test Mode	Channel	Channel Separation (kHz)	20 dBc BW (kHz)	Channel Separation Limit	Result
GFSK	Hop	100.14	59.62	≥ 20 dB bandwidth	Pass


Spectrum
Ref Level 16.50 dBm Offset 6.50 dB RBW 30 kHz
Att 20 dB SWT 62.4 µs VBW 100 kHz Mode Auto FFT
1Pk Max
D1[1] 0.01 dB
100.140 kHz
M1[1] 8.49 dBm
919.514980 MHz
M1
D1
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
CF 919.55 MHz
691 pts
Span 200.0 kHz
Date: 24.FEB.2022 10:30:52

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

g. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
h. 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.
i. Measure the frequency difference of two frequencies that were attenuated 20 dB from the reference level. Record the frequency difference as the emission bandwidth.
j. Repeat above procedures until all frequencies measured were complete.

Test Data

Environmental Conditions

Temperature:	24 ℃
Relative Humidity:	52 %
ATM Pressure:	101.0 kPa

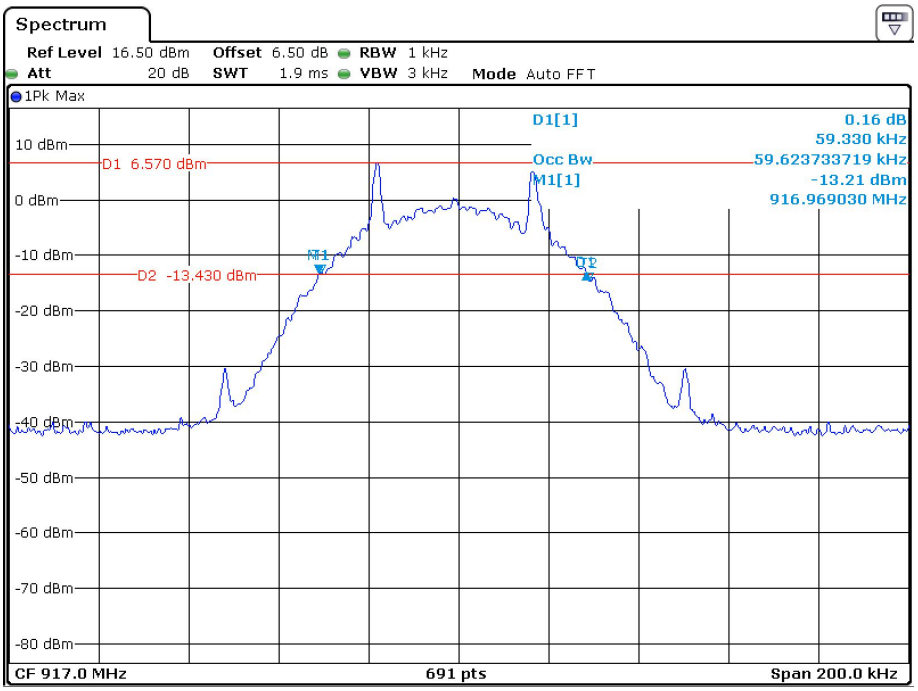
The testing was performed by Blacker Ding on 2022-02-23 and 2022-02-24.

EUT operation mode: Transmitting

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

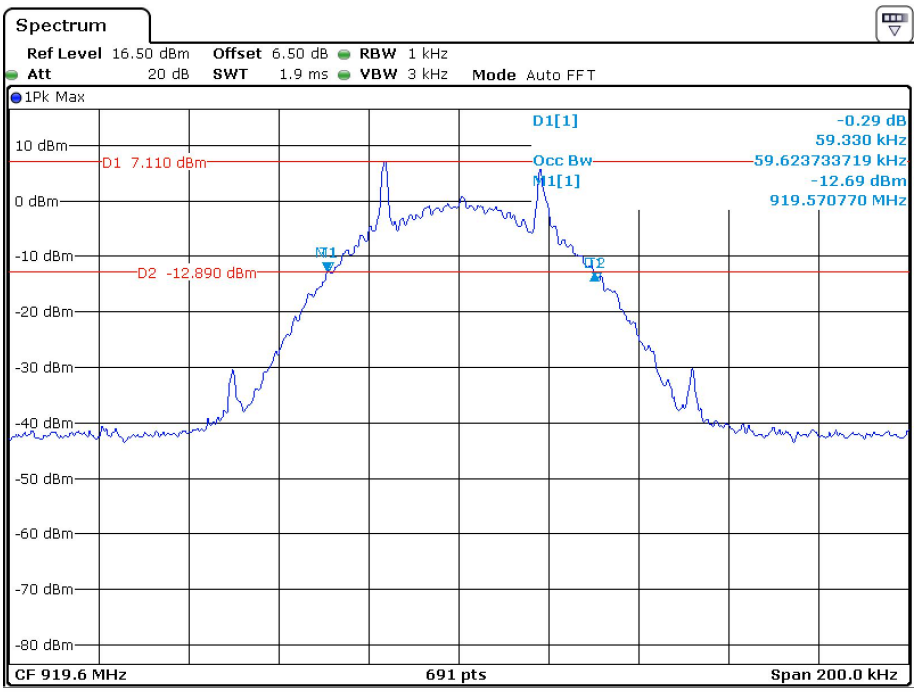
Test Mode	Channel	Frequency (MHz)	OBW (kHz)	20 dB Emission Bandwidth (kHz)	Limit (kHz)
GFSK	Low	917.0	59.62	59.33	$BW_{20dB} \leq 250$
	Middle	919.6	59.62	59.33	$BW_{20dB} \leq 250$
	High	922.2	59.62	59.62	$BW_{20dB} \leq 250$

Low Channel



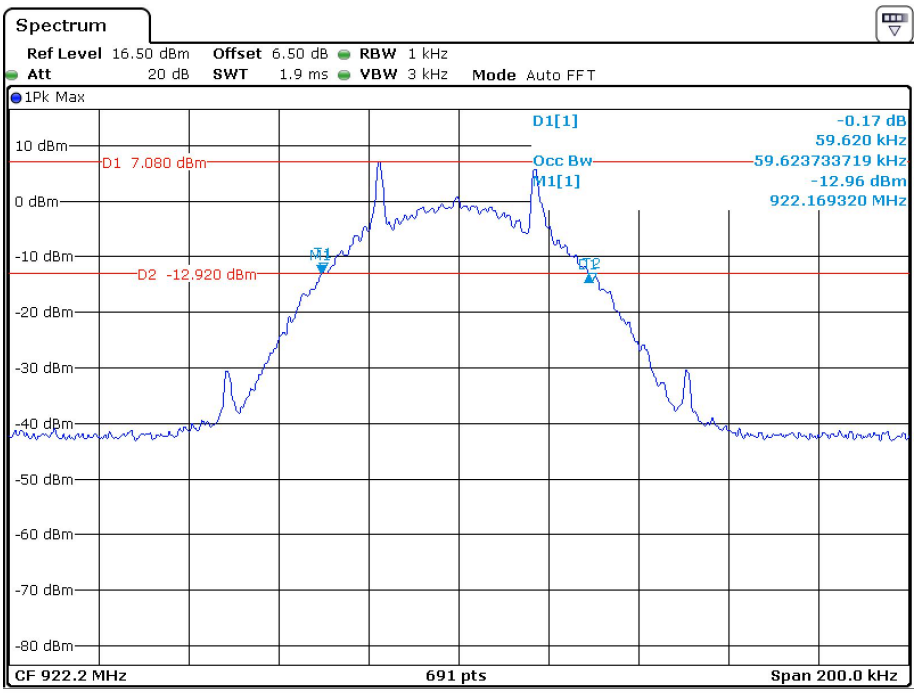
Date: 23.FEB.2022 18:16:45

Middle Channel



Date: 24.FEB.2022 09:06:06

High Channel



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

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

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

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

Test Data

Environmental Conditions

Temperature:	24 ℃
Relative Humidity:	52 %
ATM Pressure:	101.0 kPa

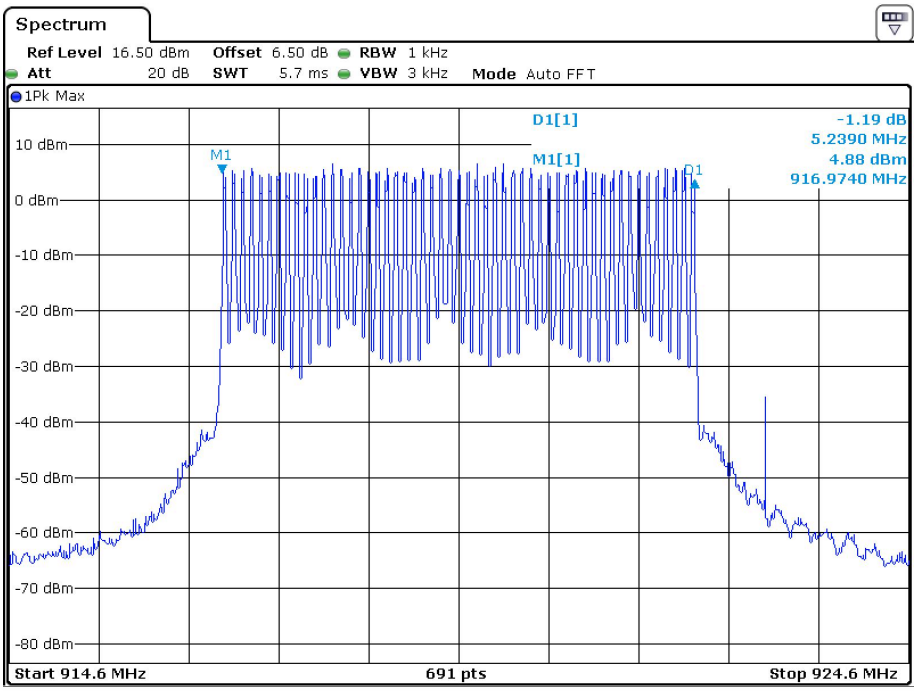
The testing was performed by Blacker Ding on 2022-02-24.

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	$N_{CH} \geq 50$

Number of Hopping Channels



Date: 24.FEB.2022 10:27:53

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

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:	24 ℃
Relative Humidity:	52 %
ATM Pressure:	101.0 kPa

The testing was performed by Blacker Ding from 2022-02-24 to 2022-02-25.

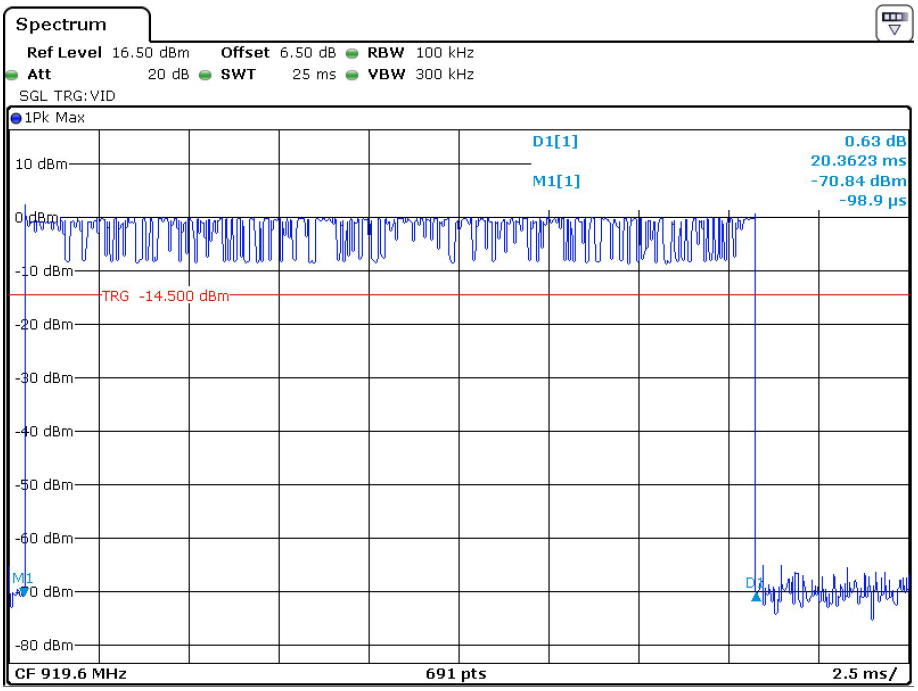
EUT operation mode: Transmitting

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	20.362	14	0.285	<=0.4	PASS

Note: 1. A period time=20(S), Result=Pulse Time*Totalhops
2. The Second high signals on plot were other channel

Pulse time



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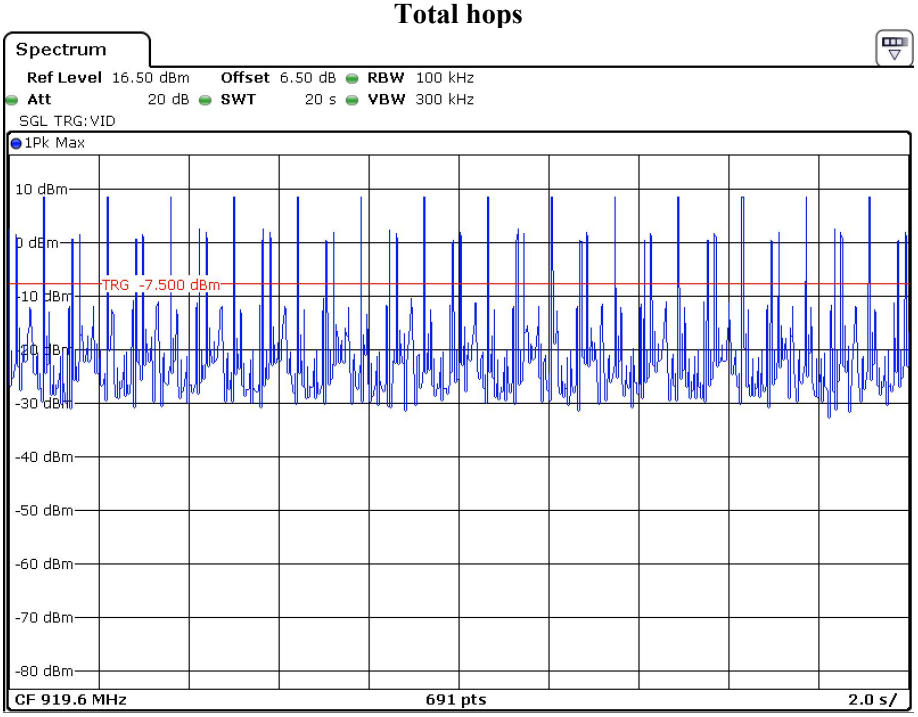
Total hops



Date: 25.FEB.2022 10:58:00

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

Applicable Standard

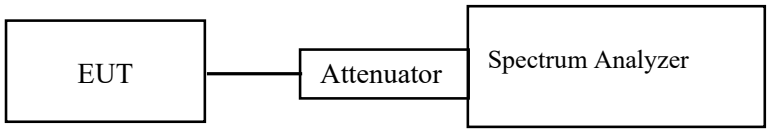
According to FCC §15.247(b) (2), For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of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

Test Procedure

n. Place the EUT on a bench and set it in transmitting mode.

o. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to one test equipment.

p. Add a correction factor to the display.



Test Data

Environmental Conditions

Temperature:	24 ℃
Relative Humidity:	52 %
ATM Pressure:	101.0 kPa

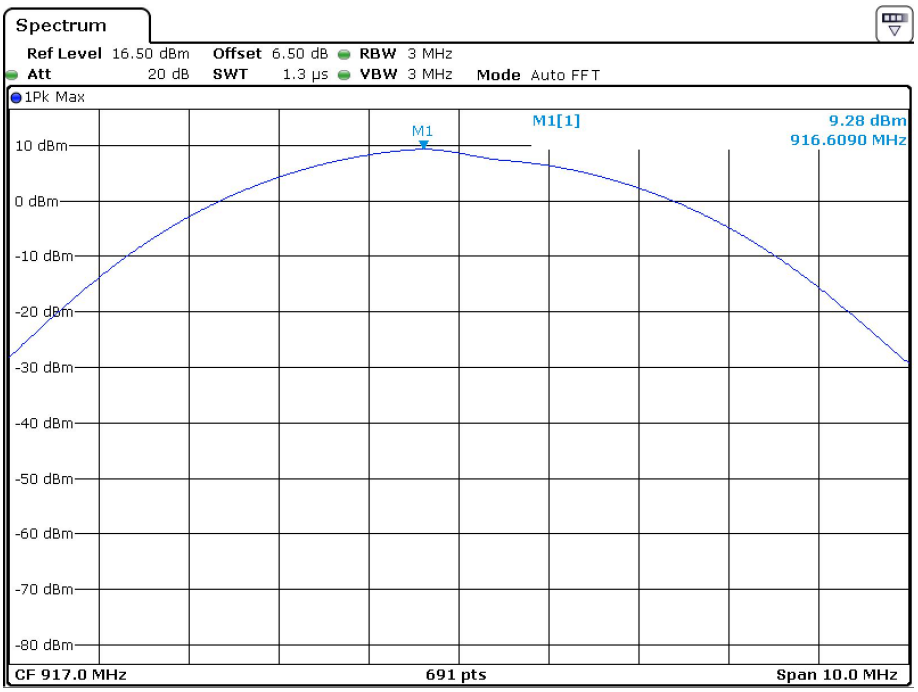
The testing was performed by Blacker Ding from 2022-02-24 to 2022-02-25.

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

EUT operation mode: Transmitting

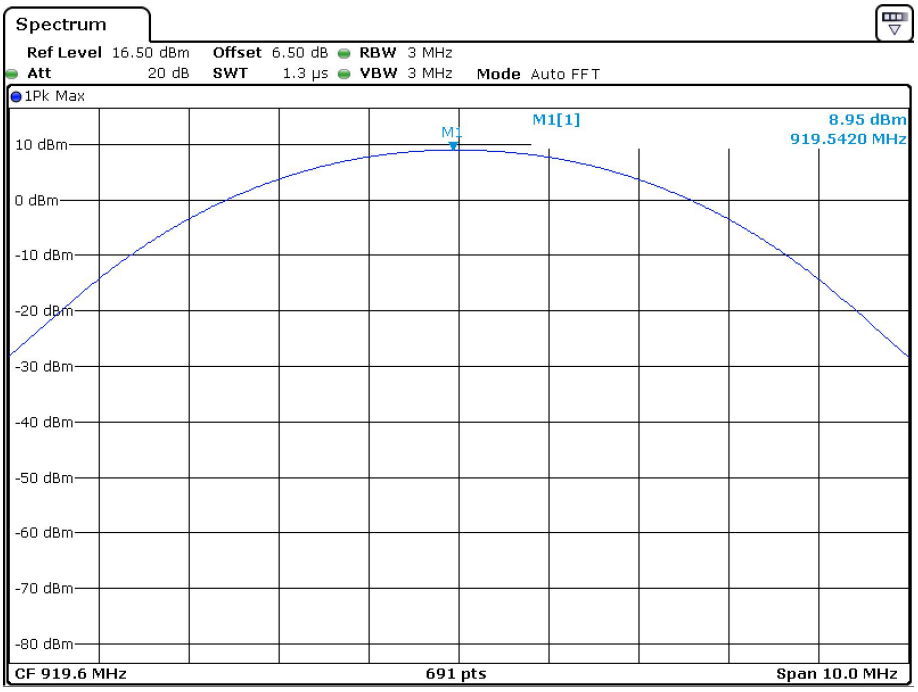
Mode	Channel	Frequency (MHz)	Peak Output Power (dBm)	Limit (dBm)
GFSK	Low	917.0	9.28	30
	Middle	919.6	8.95	30
	High	922.2	9.09	30

Low Channel



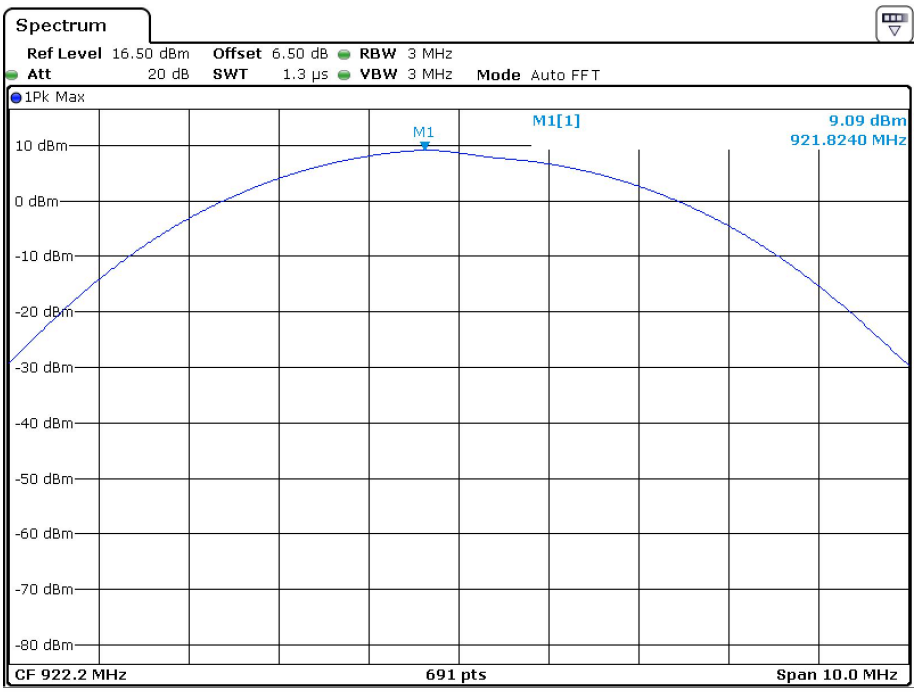
Date: 25.FEB.2022 10:41:11

Middle Channel



Date: 24.FEB.2022 09:05:12

High Channel



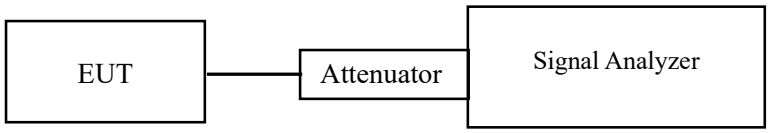
FCC §15.247(d) – 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE

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

q. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
r. 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.
s. 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.
t. 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.
u. Repeat above procedures until all measured frequencies were complete.



Test Data

Environmental Conditions

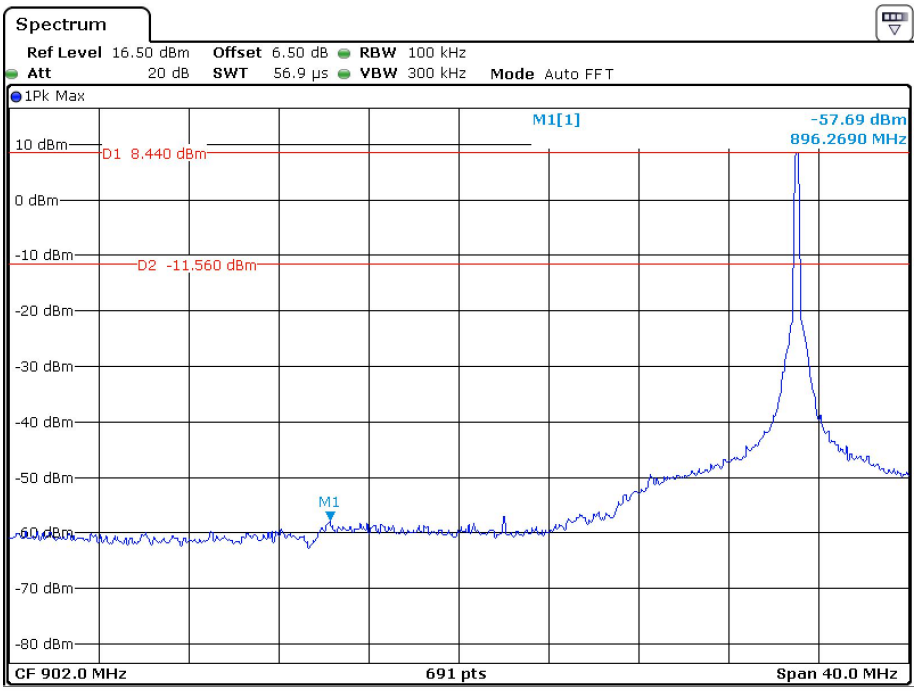
Temperature:	24 ℃
Relative Humidity:	52 %
ATM Pressure:	101.0 kPa

The testing was performed by Blacker Ding from 2022-02-23 to 2022-02-24.

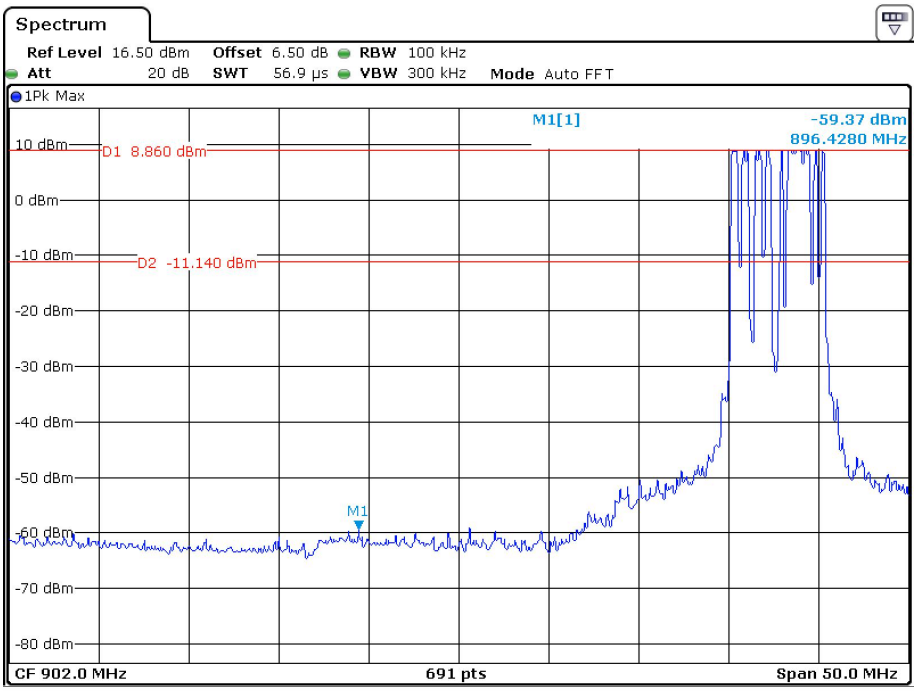
Test Result: Compliance. Please refer to following table and plots.

EUT operation mode: Transmitting

Band Edge, Left Side

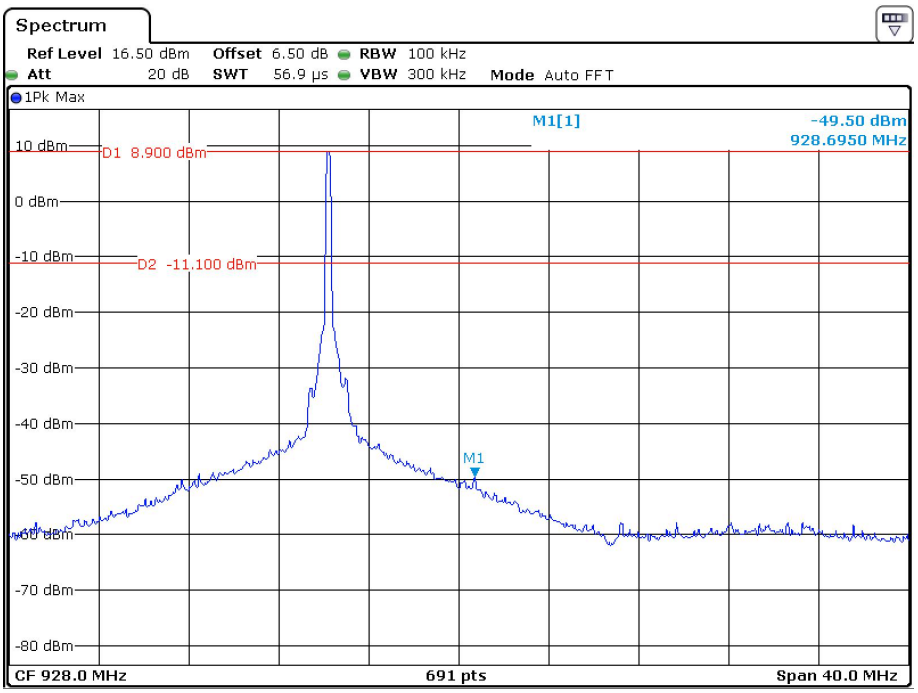


Date: 23.FEB.2022 18:18:37

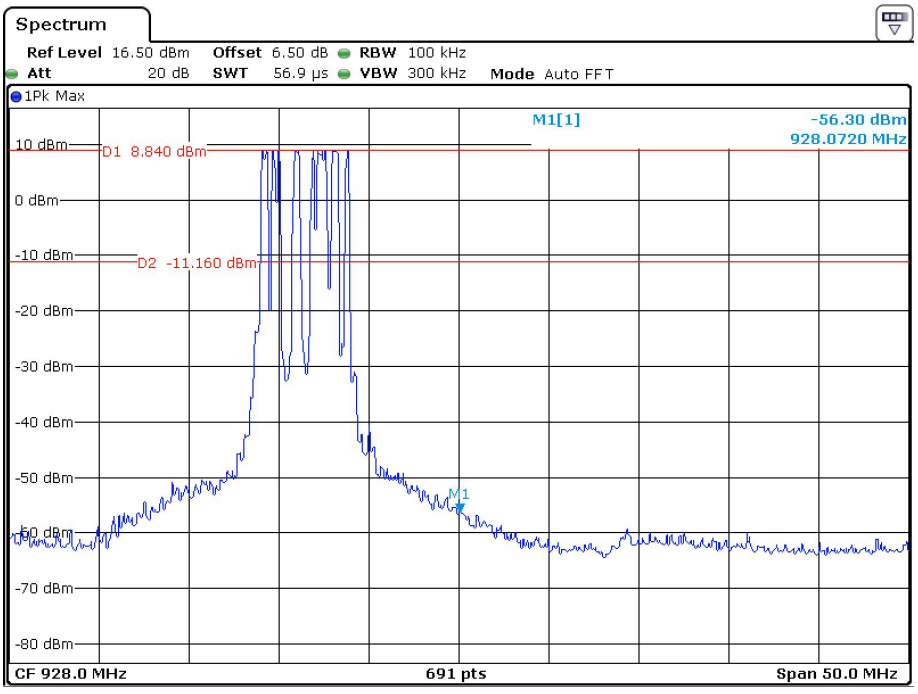


Date: 24.FEB.2022 09:19:57

Band Edge, Right Side



Date: 24.FEB.2022 09:11:42



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