TEST REPORT

Applicant Name :	Shenzhen Jiayz photo industrial., Ltd
Address :	A16 Building, Intelligent Terminal Industrial Park of Silicon Valley Power, Guanlan, Longhua District, Shenzhen, China
Report Number :	SZNS220516-20482E-RF-00
FCC ID:	2ARN3-053103TX

Test Standard (s)

FCC PART 15.247

Sample Description

Product Type:	Plug-on Transmitter
Model No.:	Vlink2 TX-XLR
Multiple Model(s) No.:	N/A
Trade Mark:	N/A
Date Received:	2022/05/16
Report Date:	2022/06/17

Test Result:	Pass*

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

Prepared and Checked By:

Black Ding

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 "★ ".
Shenzhen Accurate Technology Co., Ltd. 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 an asterisk '*'. Customer model name, addresses, names, trademarks etc. are not considered data.
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GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Frequency Range	FHSS: 2406~2474MHz
Maximum conducted Peak output power	FHSS: 1.79dBm
Modulation Technique	FHSS: GFSK
Antenna Specification*	1.91dBi(provided by the applicant)
Voltage Range	DC 3.7V from battery or DC 3.0V from adapter (2*AA battery) or DC 5V from Type-C port
Sample serial number	SZNS220516-20482E-RF-S1
Sample/EUT Status	Good condition

Objective

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

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, 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 Shenzhen Accurate Technology Co., Ltd. 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 Frequency		$0.082*10^{-7}$
RF output power, conducted		0.73dB
Unwanted Emission, conducted		1.6dB
AC Power Lines Conducted Emissions		2.72dB
Emissions, Radiated	9kHz - 30MHz	2.66dB
	30MHz - 1GHz	4.28dB
	1GHz - 18GHz	4.98dB
	18GHz - 26.5GHz	5.06dB
	26.5GHz - 40GHz	4.72dB
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 an engineering mode, which provided by manufacturer.

FHSS channel list:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2406	10	2442
2	2410	11	2446
3	2414	12	2450
4	2418	13	2454
5	2422	14	2458
6	2426	15	2462
7	2430	16	2466
8	2434	17	2470
9	2438	18	2474

Channel 1, 9, 18 was tested.

EUT Exercise Software

EUT was configured to testing mode by manufacture, the device was tested with the Power level is default*.The 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

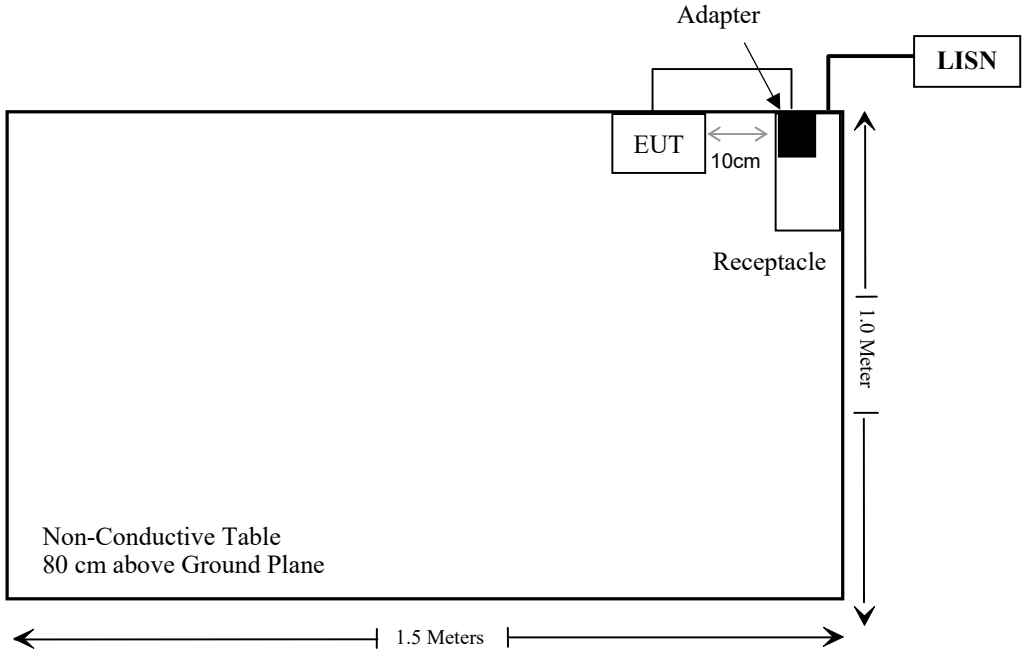
Manufacturer	Description	Model	Serial Number
Epik	Adapter	Ek2015	Unknown

External I/O Cable

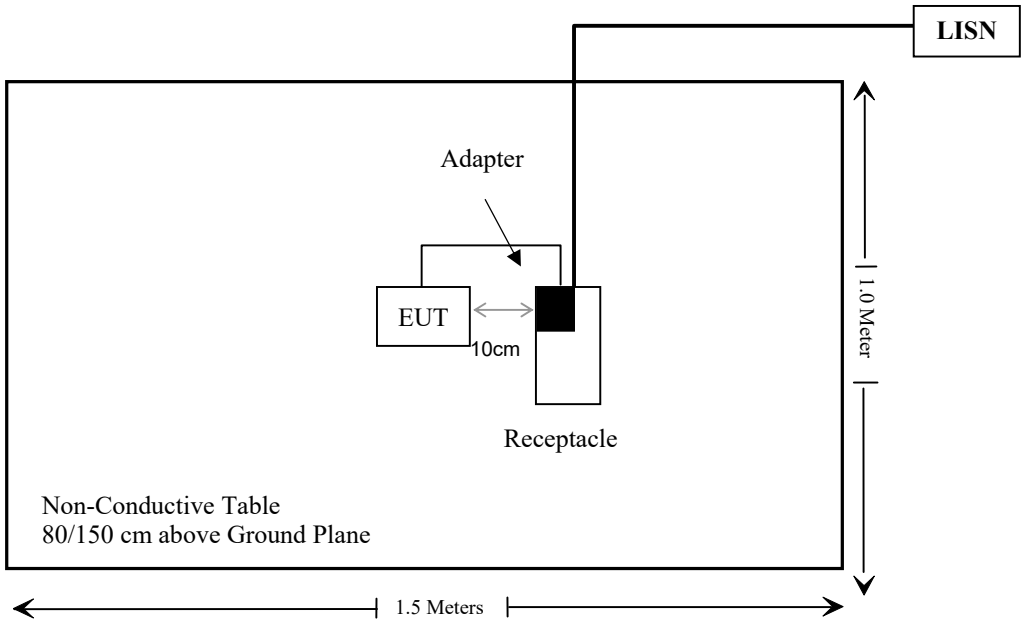
Cable Description	Length (m)	From Port	To
Unshielding Detachabel USB Cable	1.0	Adapter	EUT

Block Diagram of Test Setup

For conducted emission:



For radiated emission:



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.247 (i),§1.1307 (b) (3) &§2.1093	RF Exposure	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 & 99% Occupied Bandwidth	Compliant
§15.247(a)(1)	Channel Separation Test	Compliant
§15.247(a)(1)(iii)	Time of Occupancy (Dwell Time)	Compliant
§15.247(a)(1)(iii)	Quantity of hopping channel Test	Compliant
§15.247(b)(1)	Peak Output Power Measurement	Compliant
§15.247(d)	Band edges	Compliant

Note: EUT have two antennas, the two antenna have same RF circuit, only one of the two antennas will active to transmit when use, pre-scan the two antennas, the antenna 1 was the worst case, so all RF conducted measurement was made on antenna 1.

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Conducted Emissions 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
Unknown	RF Coaxial Cable	No.17	N0350	2021/12/14	2022/12/13
Conducted Emission Test Software: e3 19821b (V9)					
Radiated Emissions 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
Schwarzbeck	HORN ANTENNA	BBHA9170	9170-359	2020/01/05	2023/01/04
Radiated Emission Test Software: e3 19821b (V9)					
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
Wainwright	High Pass Filter	WHKX3.6/18 G-10SS	5	2021/12/14	2022/12/13
RF Conducted Test					
Rohde&Schwarz	Spectrum Analyzer	FSV-40	101948	2021/12/13	2022/12/12
WEINSCHEL	10dB Attenuator	5324	AU 3842	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), §1.1307 (b) (3) &§2.1093 – RF EXPOSURE

Applicable Standard

According to FCC §2.1093 and §1.1307(b) (3), systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

According to KDB 447498 D04 Interim General RF Exposure Guidance

SAR-Based Exemption:

SAR-based thresholds are derived based on frequency, power, and separation distance of the RF source. The formula defines the thresholds in general for either available maximum timeaveraged power or maximum time-averaged ERP, whichever is greater.

Per § 1.1307(b)(3)(i)(B), for single RF sources (i.e., any single fixed RF source, mobile device, or portable device, as defined in paragraph (b)(2) of this section): A single RF source is exempt if:

the available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold P_{th} (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive). P_{th} is given by:

$$P_{th}\ (\text{mW}) = \begin{cases} ERP_{20\ cm}(d/20\ \text{cm})^{x} & d \le 20\ \text{cm} \\ ERP_{20\ cm} & 20\ \text{cm} < d \le 40\ \text{cm} \end{cases}$$

Where

$$x = -\log_{10}\left(\frac{60}{ERP_{20\ cm}\sqrt{f}}\right) \text{ and } f \text{ is in GHz;}$$

and

$$ERP_{20\ cm}\ (\text{mW}) = \begin{cases} 2040f & 0.3\ \text{GHz} \le f < 1.5\ \text{GHz} \\ 3060 & 1.5\ \text{GHz} \le f \le 6\ \text{GHz} \end{cases}$$

d = the separation distance (cm);

For worst case:

exemption limit:

For f=2.48GHz, d=0.5cm, the P_{th}=2.72mW

The higher of the conducted or effective radiated power (e.r.p.) source-based, time-averaged output power:

The antenna gain is 1.91dBi(-0.24dBd), 0dBd=2.15dBi.

The maximum tune-up conducted power is 2dBm(1.58mW), which less than 2.72 mW@2480MHz exemption limit

So the stand-alone SAR evaluation can be exempted.

FCC §15.203 – ANTENNA REQUIREMENT

Applicable Standard

According to FCC § 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 use of a standard antenna jack or electrical connector is prohibited.

Antenna Connector Construction

The EUT has two internal antenna arrangement which was permanently attached, and the maximum antenna gain is 1.91dBi, fulfill the requirement of this section. Please refer to the EUT photos.

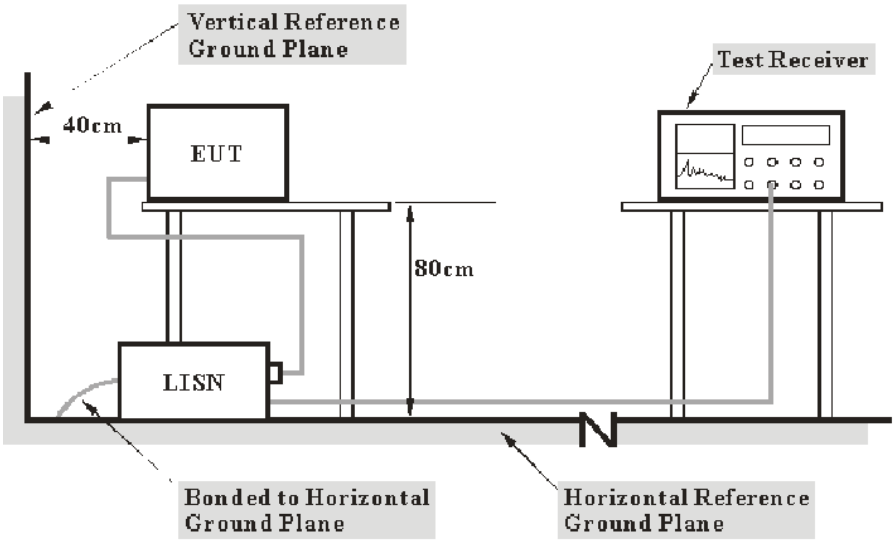
Result: Compliance.

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.

Transd Factor & Margin Calculation

The Transd factor is calculated by adding LISN VDF (Voltage Division Factor), 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, a over limit of -7 dB means the emission is 7 dB below the limit. The equation for margin calculation is as follows:

Over Limit = level – Limit
Level= reading level+ Factor

Test Data

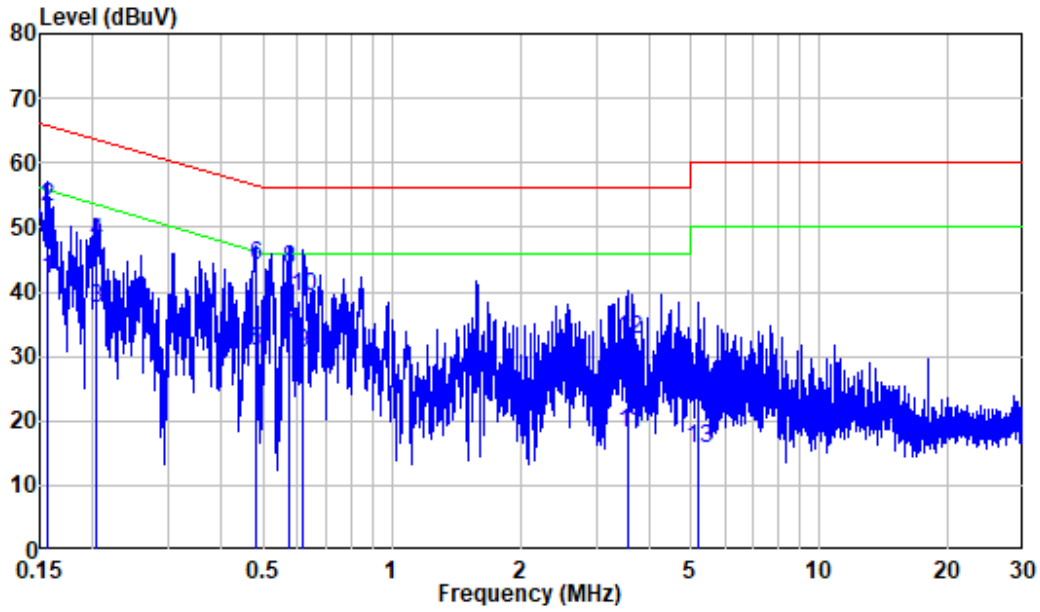
Environmental Conditions

Temperature:	23 ℃
Relative Humidity:	58 %
ATM Pressure:	101.0 kPa

The testing was performed by Jaon Liu on 2022-06-13.

EUT operation mode: Charging&Transmitting (the worst case for low channel, antenna 1)

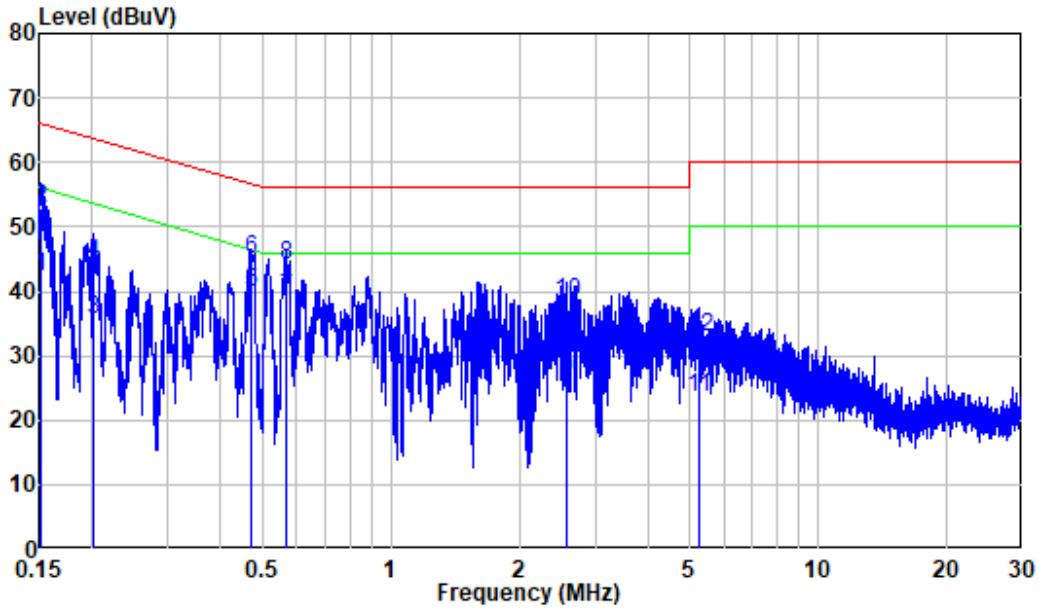
AC 120V/60 Hz, Line



Site : Shielding Room
Condition: Line
Mode : GFSK
Model : Vlink2 TX-XLR
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.156	9.80	32.21	42.01	55.68	-13.67	Average
2	0.156	9.80	43.21	53.01	65.68	-12.67	QP
3	0.203	9.80	27.58	37.38	53.48	-16.10	Average
4	0.203	9.80	37.95	47.75	63.48	-15.73	QP
5	0.479	9.80	20.86	30.66	46.36	-15.70	Average
6	0.479	9.80	34.33	44.13	56.36	-12.23	QP
7	0.576	9.81	23.78	33.59	46.00	-12.41	Average
8	0.576	9.81	33.65	43.46	56.00	-12.54	QP
9	0.619	9.81	20.72	30.53	46.00	-15.47	Average
10	0.619	9.81	29.31	39.12	56.00	-16.88	QP
11	3.584	9.84	8.31	18.15	46.00	-27.85	Average
12	3.584	9.84	22.79	32.63	56.00	-23.37	QP
13	5.218	9.85	5.83	15.68	50.00	-34.32	Average
14	5.218	9.85	14.34	24.19	60.00	-35.81	QP

AC 120V/60 Hz, Neutral



Site : Shielding Room
Condition: Neutral
Mode : GFSK
Model : Vlink2 TX-XLR
Power : AC 120V 60Hz

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dBuV	dBuV	dBuV	dB	
1	0.152	9.80	32.57	42.37	55.88	-13.51	Average
2	0.152	9.80	42.88	52.68	65.88	-13.20	QP
3	0.200	9.80	25.75	35.55	53.60	-18.05	Average
4	0.200	9.80	34.44	44.24	63.60	-19.36	QP
5	0.470	9.80	30.05	39.85	46.51	-6.66	Average
6	0.470	9.80	35.24	45.04	56.51	-11.47	QP
7	0.569	9.81	29.22	39.03	46.00	-6.97	Average
8	0.569	9.81	34.41	44.22	56.00	-11.78	QP
9	2.581	9.83	16.52	26.35	46.00	-19.65	Average
10	2.581	9.83	28.43	38.26	56.00	-17.74	QP
11	5.246	9.90	13.79	23.69	50.00	-26.31	Average
12	5.246	9.90	22.89	32.79	60.00	-27.21	QP

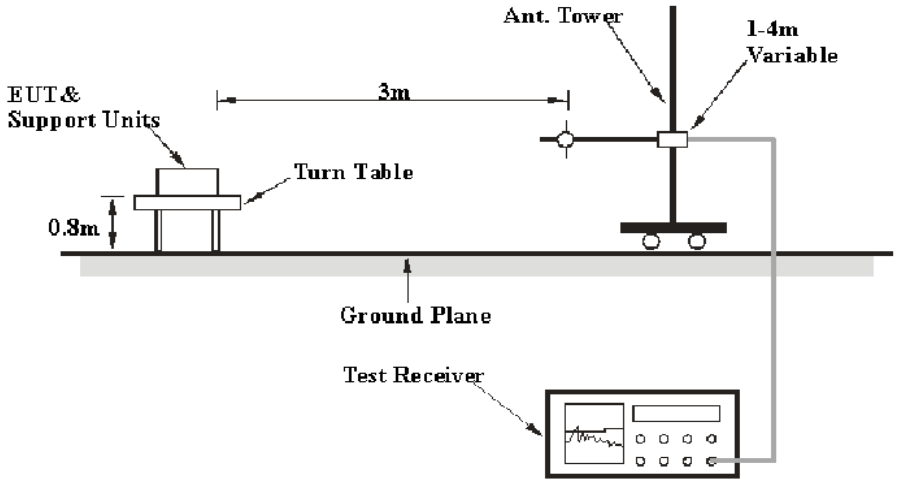
FCC §15.205, §15.209 & §15.247(d) – RADIATED EMISSIONS

Applicable Standard

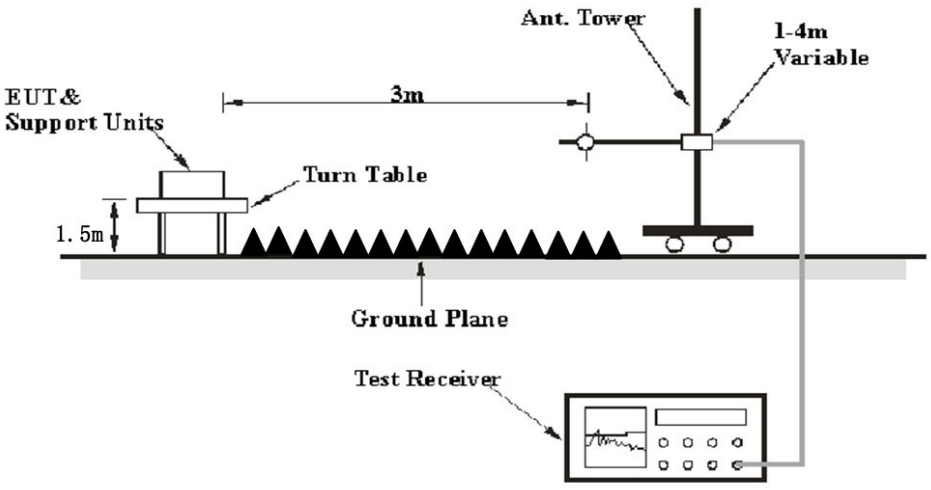
FCC §15.205; §15.209; §15.247(d)

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

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

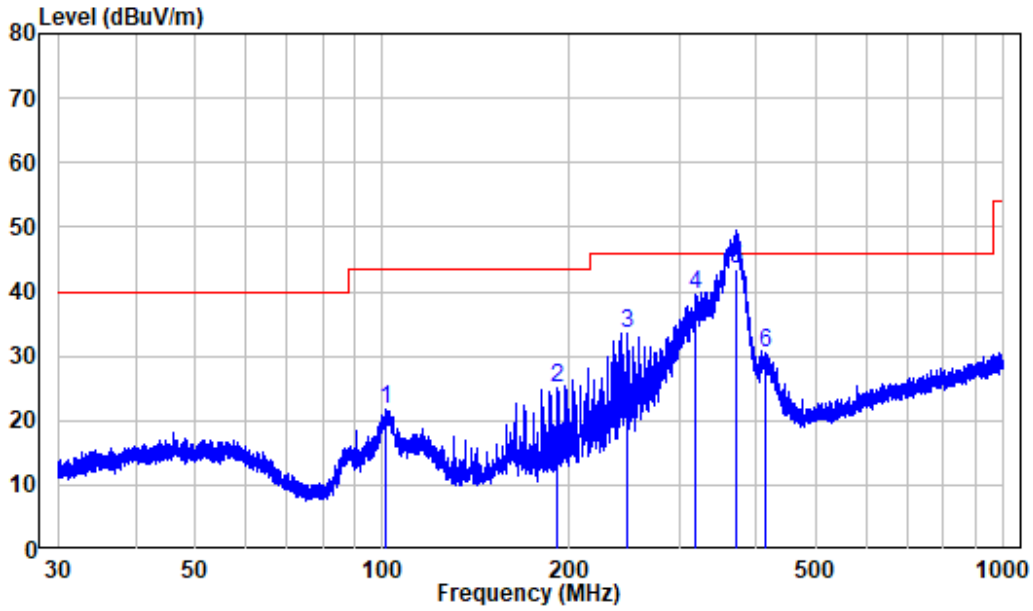
Temperature:	25.8~29 ℃
Relative Humidity:	51~60 %
ATM Pressure:	101.2 kPa

The testing was performed by Level on 2022-06-06 for below 1GHz,by Amy Cao and Level from 2022-05-30 to 2022-06-06 for above 1GHz

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

30MHz-1GHz: *(worst case for low channel, antenna 1)*

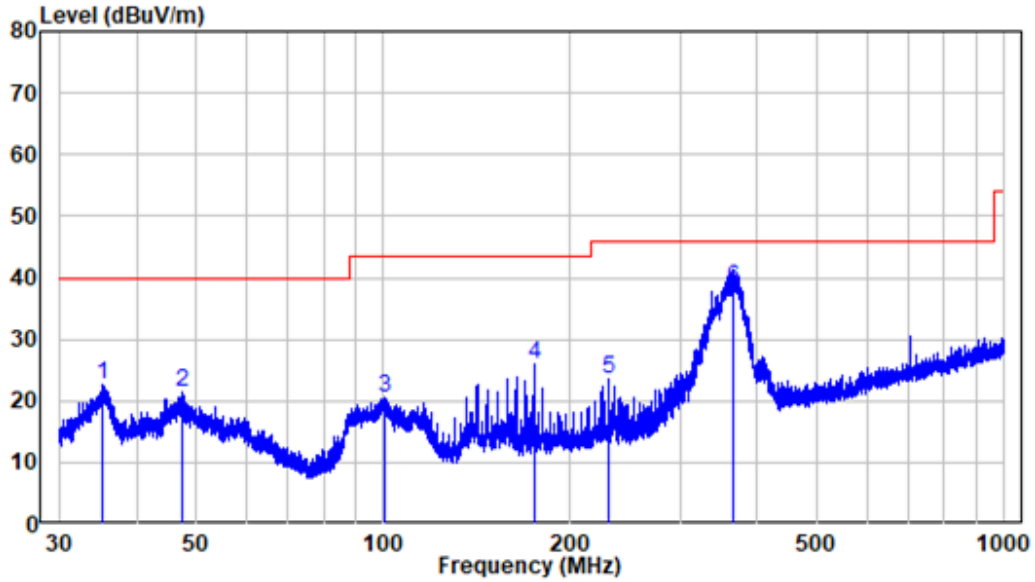
Horizontal:



Site : chamber
Condition: 3m HORIZONTAL
Job No. : SZNS220516-20482E-RF

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	101.289	-11.65	33.49	21.84	43.50	-21.66	Peak
2	191.577	-11.31	36.29	24.98	43.50	-18.52	Peak
3	247.031	-10.65	44.27	33.62	46.00	-12.38	Peak
4	319.657	-8.47	48.11	39.64	46.00	-6.36	Peak
5	371.842	-7.30	50.68	43.38	46.00	-2.62	QP
6	413.814	-6.25	36.69	30.44	46.00	-15.56	Peak

Vertical



Site : chamber
Condition: 3m VERTICAL
Job No. : SZNS220516-20482E-RF

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	35.189	-11.47	34.01	22.54	40.00	-17.46	Peak
2	47.513	-10.00	31.40	21.40	40.00	-18.60	Peak
3	100.405	-11.75	32.26	20.51	43.50	-22.99	Peak
4	174.654	-13.14	39.12	25.98	43.50	-17.52	Peak
5	230.401	-11.09	34.60	23.51	46.00	-22.49	Peak
6	366.020	-7.50	45.77	38.27	46.00	-7.73	QP

Antenna 1:

Above 1GHz:

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (2406 MHz)									
2310	67.6	PK	216	2.3	H	-7.24	60.36	74	-13.64
2310	53.77	AV	216	2.3	H	-7.24	46.53	54	-7.47
2390	67.8	PK	159	1	H	-7.22	60.58	74	-13.42
2390	53.36	AV	159	1	H	-7.22	46.14	54	-7.86
2310	67.12	PK	281	2.4	V	-7.24	59.88	74	-14.12
2310	52.78	AV	281	2.4	V	-7.24	45.54	54	-8.46
2390	68.23	PK	7	2.4	V	-7.22	61.01	74	-12.99
2390	53.96	AV	7	2.4	V	-7.22	46.74	54	-7.26
4812	52.54	PK	323	1.4	H	-3.52	49.02	74	-24.98
4812	52.72	PK	317	2.4	V	-3.52	49.2	74	-24.8
Middle Channel(2438MHz)									
4876	53.36	PK	8	2.3	H	-3.4	49.96	74	-24.04
4876	54.36	PK	248	2.3	V	-3.4	50.96	74	-23.04
High Channel(2474 MHz)									
2483.5	68.83	PK	240	1.2	H	-7.2	61.63	74	-12.37
2483.5	55.13	AV	240	1.2	H	-7.2	47.93	54	-6.07
2500	68.88	PK	140	1.1	H	-7.18	61.7	74	-12.3
2500	54.04	AV	140	1.1	H	-7.18	46.86	54	-7.14
2483.5	69.05	PK	252	1.7	V	-7.2	61.85	74	-12.15
2483.5	54.94	AV	252	1.7	V	-7.2	47.74	54	-6.26
2500	68.41	PK	165	1.9	V	-7.18	61.23	74	-12.77
2500	54.05	AV	165	1.9	V	-7.18	46.87	54	-7.13
4948	53.99	PK	134	2.4	H	-3.05	50.94	74	-23.06
4948	53.57	PK	48	1.8	V	-3.05	50.52	74	-23.48

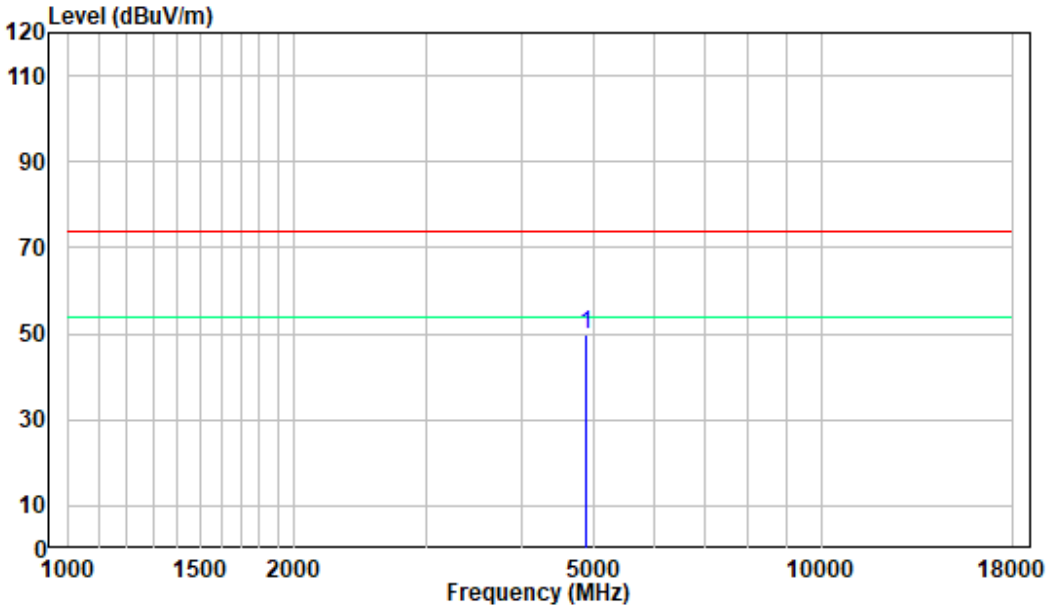
Note:
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Corrected Amplitude = Corrected Factor + Reading
Margin = Limit - Corrected. Amplitude
The other spurious emission which is in the noise floor level was not recorded.
The test result of peak was less than the limit of average,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

1-18GHz

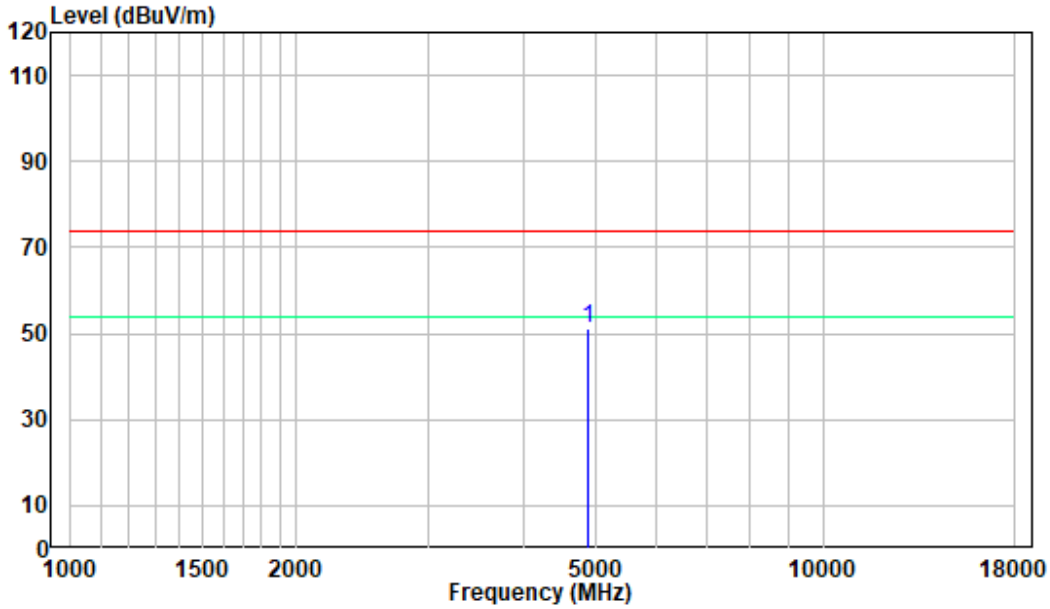
Pre-scan for Peak

Middle Channel

Horizontal:



Vertical:

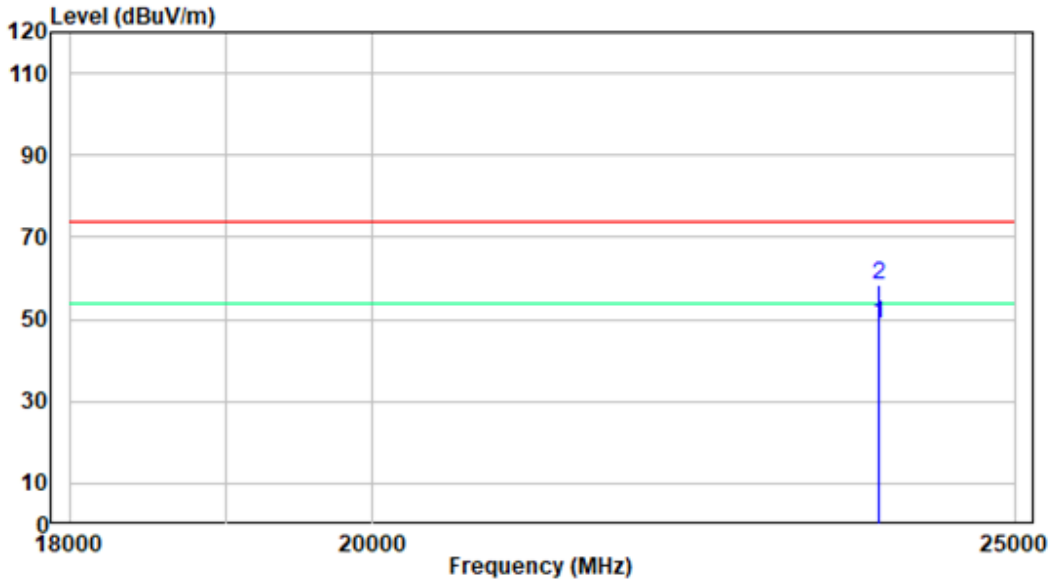


18-25GHz

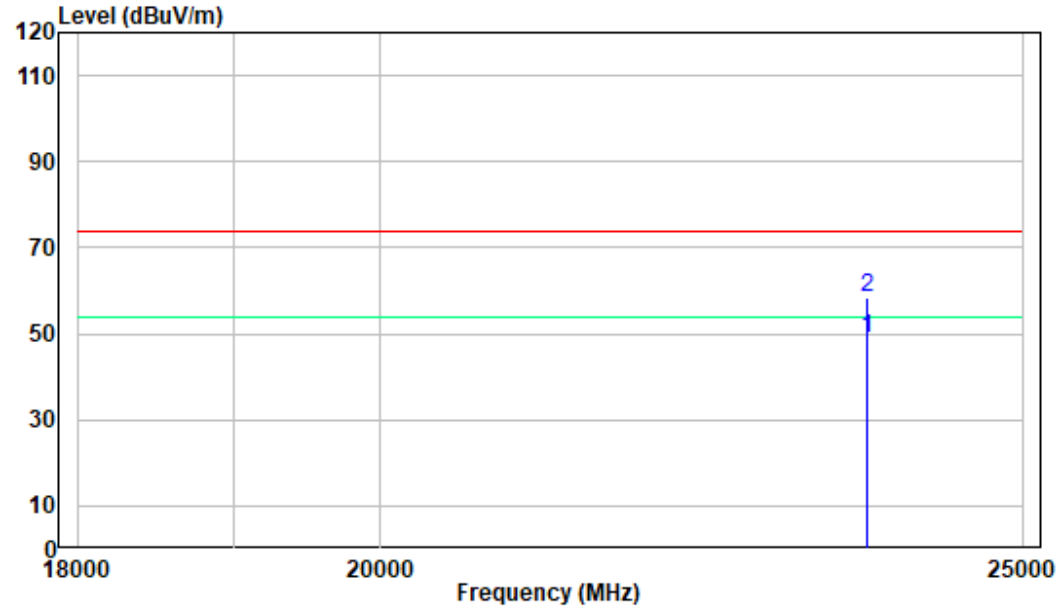
Pre-scan for Peak

Middle Channel

Horizontal:



Vertical:



Antenna 2:

Above 1GHz:

Frequency (MHz)	Receiver		Turntable Degree	Rx Antenna		Corrected Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/QP/Ave.		Height (m)	Polar (H/V)				
Low Channel (2406 MHz)									
2310	67.26	PK	354	2.5	H	-7.24	60.02	74	-13.98
2310	53.56	AV	354	2.5	H	-7.24	46.32	54	-7.68
2390	67.4	PK	204	1.9	H	-7.22	60.18	74	-13.82
2390	53.03	AV	204	1.9	H	-7.22	45.81	54	-8.19
2310	66.67	PK	208	2.2	V	-7.24	59.43	74	-14.57
2310	52.1	AV	208	2.2	V	-7.24	44.86	54	-9.14
2390	67.48	PK	280	1.4	V	-7.22	60.26	74	-13.74
2390	53.4	AV	280	1.4	V	-7.22	46.18	54	-7.82
4812	52.16	PK	138	2.2	H	-3.52	48.64	74	-25.36
4812	53.05	PK	9	2.4	V	-3.52	49.53	74	-24.47
Middle Channel(2438MHz)									
4876	52.59	PK	24	2	H	-3.4	49.19	74	-24.81
4876	53.72	PK	20	2.4	V	-3.4	50.32	74	-23.68
High Channel(2474MHz)									
2483.5	68.25	PK	27	2.3	H	-7.2	61.05	74	-12.95
2483.5	54.49	AV	27	2.3	H	-7.2	47.29	54	-6.71
2500	67.59	PK	178	1.4	H	-7.18	60.41	74	-13.59
2500	53.42	AV	178	1.4	H	-7.18	46.24	54	-7.76
2483.5	68.36	PK	21	1.4	V	-7.2	61.16	74	-12.84
2483.5	54.42	AV	21	1.4	V	-7.2	47.22	54	-6.78
2500	67.62	PK	357	2	V	-7.18	60.44	74	-13.56
2500	53.69	AV	357	2	V	-7.18	46.51	54	-7.49
4948	53.39	PK	209	2.3	H	-3.05	50.34	74	-23.66
4948	53.03	PK	145	1.2	V	-3.05	49.98	74	-24.02

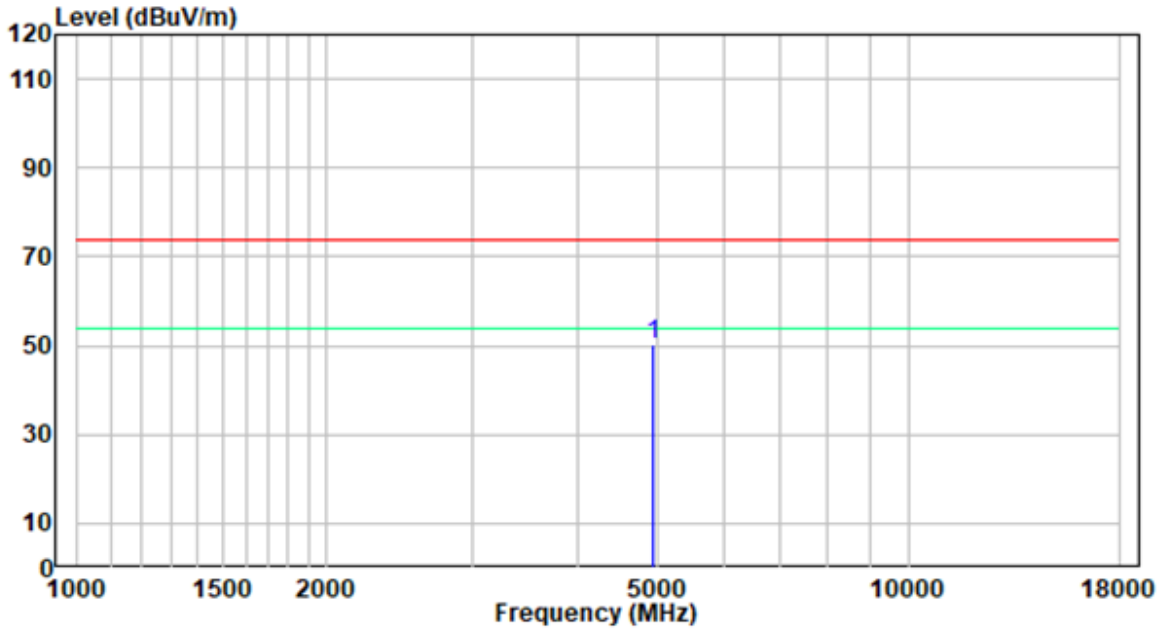
Note:
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Corrected Amplitude = Corrected Factor + Reading
Margin = Limit - Corrected. Amplitude
The other spurious emission which is in the noise floor level was not recorded.
The test result of peak was less than the limit of average,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

1-18GHz

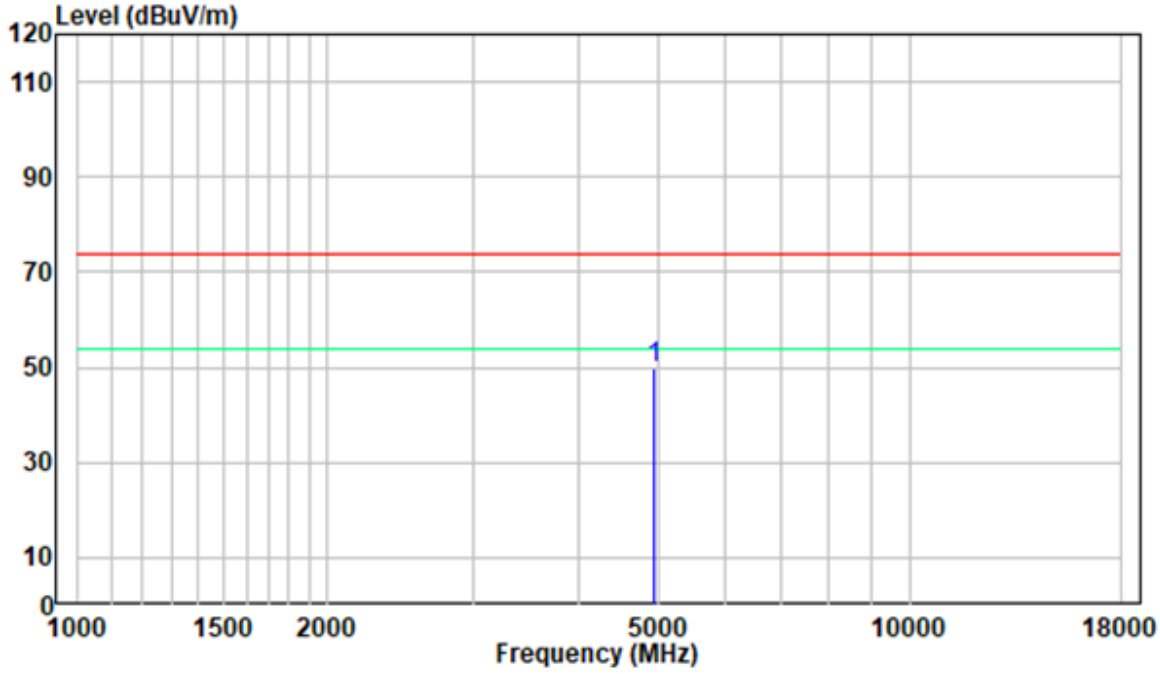
Pre-scan for Peak

High Channel

Horizontal:



Vertical:

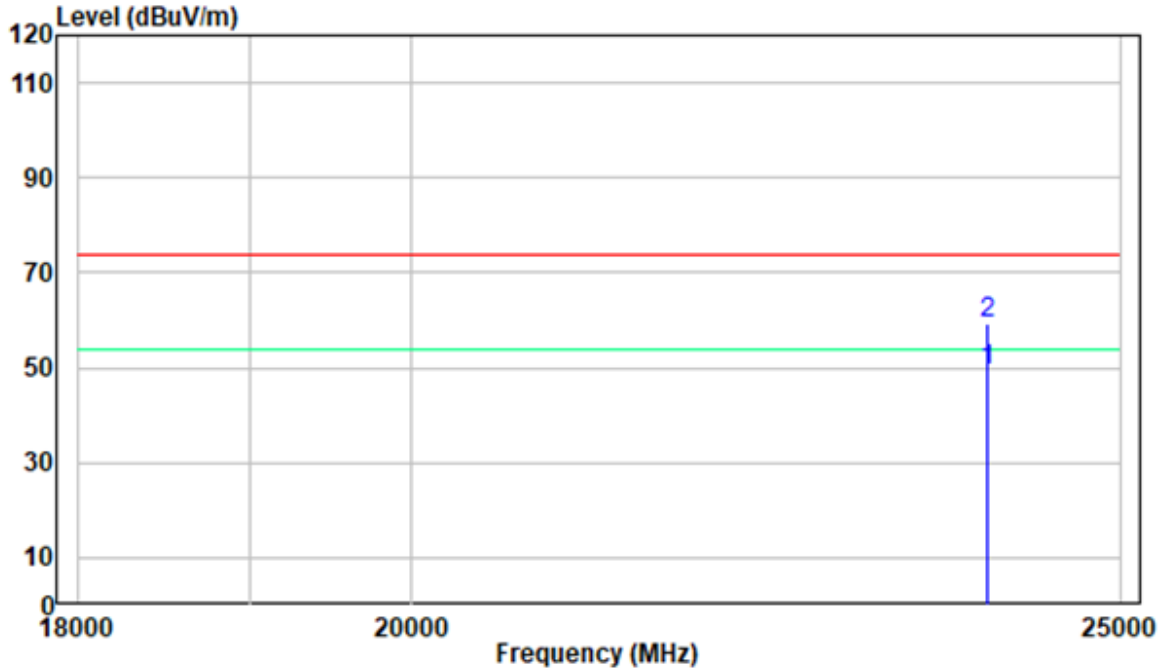


18-25GHz

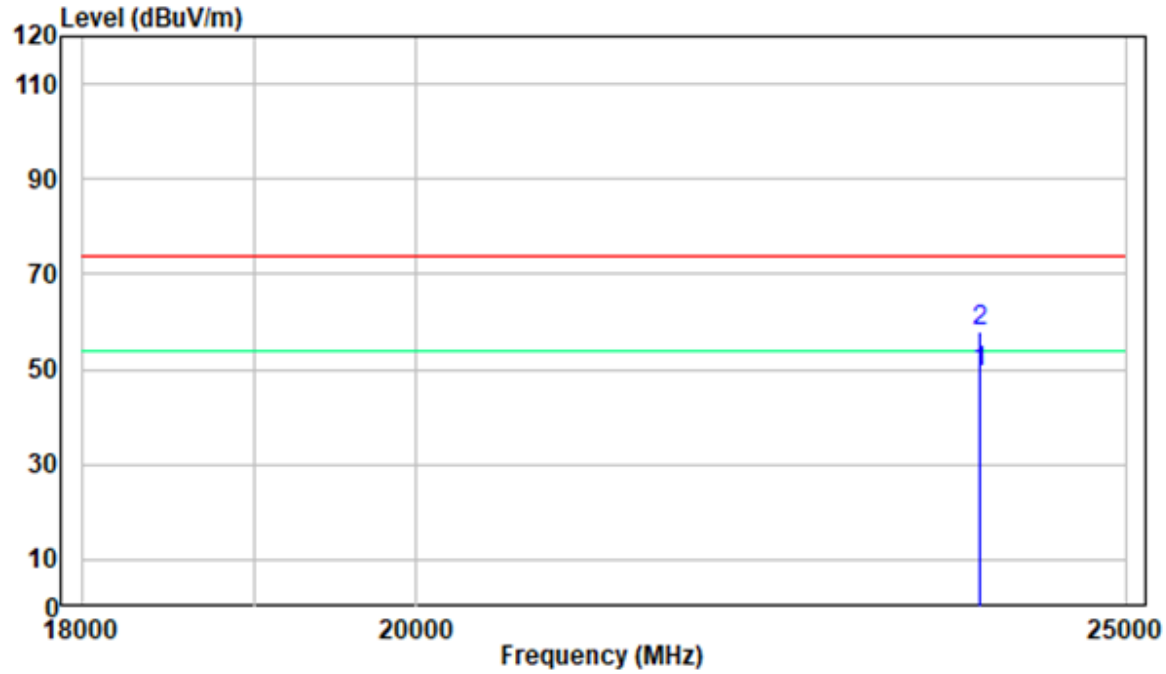
Pre-scan for Peak

High 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. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

Test Procedure

1. Set the EUT in transmitting mode, maxhold the channel.
2. Set the adjacent channel of the EUT and maxhold another trace.
3. Measure the channel separation.

Test Data

Environmental Conditions

Temperature:	27.9 ℃
Relative Humidity:	68 %
ATM Pressure:	101.0 kPa

The testing was performed by Cat Kang on 2022-06-11.

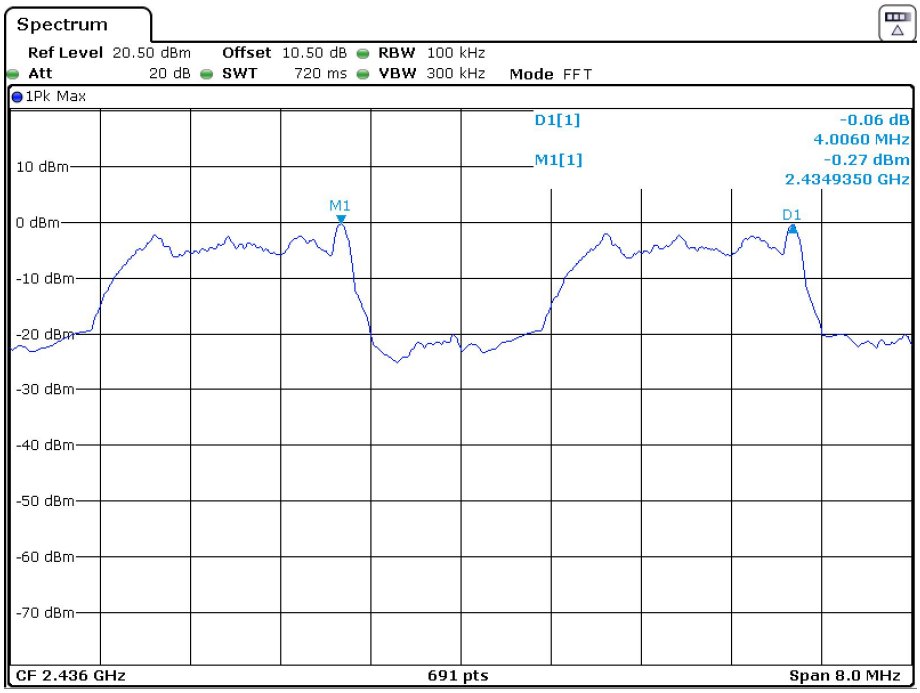
EUT operation mode: Transmitting

Test Result: Compliant.

Test Mode	Channel Separation (MHz)	20 dBc BW (MHz)	Two-thirds of the 20 dB bandwidth (MHz)	Channel Separation Limit	Result
GFSK					
Hopping	4.006	4.399	2.933	> two-thirds of the 20 dB bandwidth	Pass

Please refer to the below plots:

Hop


Spectrum
Ref Level 20.50 dBm Offset 10.50 dB RBW 100 kHz
Att 20 dB SWT 720 ms VBW 300 kHz Mode FFT
1Pk Max
D1[1] -0.06 dB
4.0060 MHz
M1[1] -0.27 dBm
2.4349350 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
D1
CF 2.436 GHz
691 pts
Span 8.0 MHz
Date: 11.JUN.2022 13:19:58

FCC §15.247(a) (1) – 20 dB EMISSION BANDWIDTH & 99% OCCUPIED BANDWIDTH

Applicable Standard

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

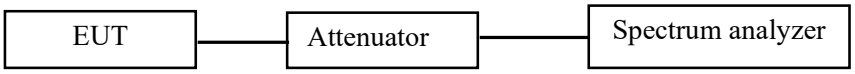
The following conditions shall be observed for measuring the occupied bandwidth and 20 dB bandwidth:
• The transmitter shall be operated at its maximum carrier power measured under normal test conditions.

• The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.

• The detector of the spectrum analyzer shall be set to “Sample”. However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or “Max Hold”) may be necessary to determine the occupied / 20 dB bandwidth if the device is not transmitting continuously.

• The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / 20 dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.

Note: It may be necessary to repeat the measurement a few times until the RBW and VBW are in compliance with the above requirement.
For the 99% emission bandwidth, the trace data points are recovered and directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached, and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the occupied bandwidth (or the 99% emission bandwidth).



Test Data

Environmental Conditions

Temperature:	26.9 ℃
Relative Humidity:	58 %
ATM Pressure:	101.0 kPa

The testing was performed by Cat Kang on 2022-05-27.

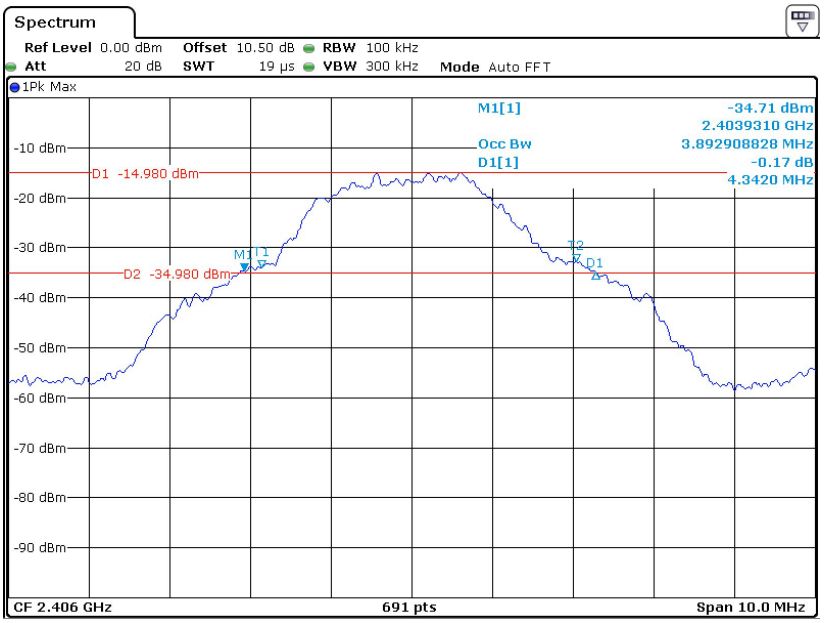
EUT operation mode: Transmitting

Test Result: Compliant.

Mode	Channel	Frequency (MHz)	20 dB Emission Bandwidth (MHz)	99% Emission Bandwidth (MHz)
GFSK	Low	2406	4.342	3.893
	Middle	2438	4.399	3.893
	High	2474	4.139	3.806

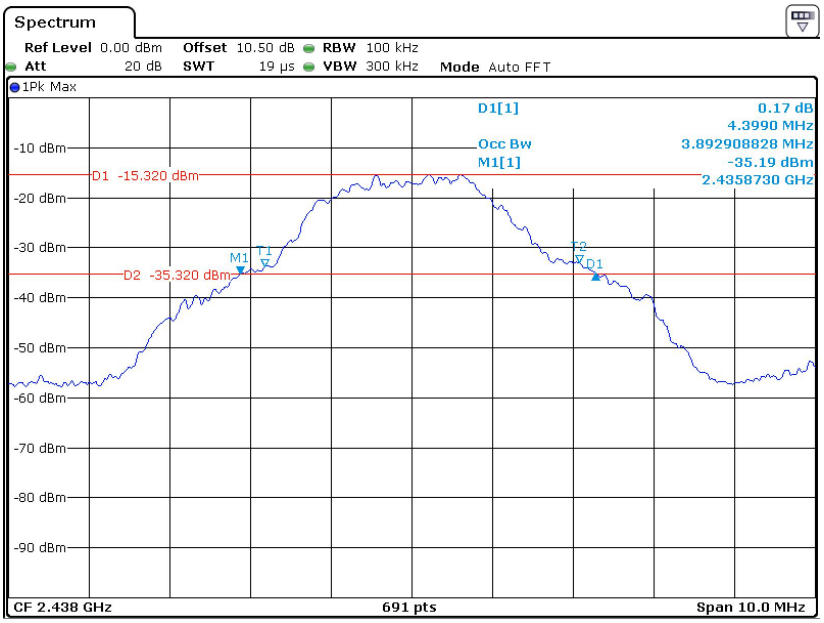
Please refer to the below plots:

Low Channel



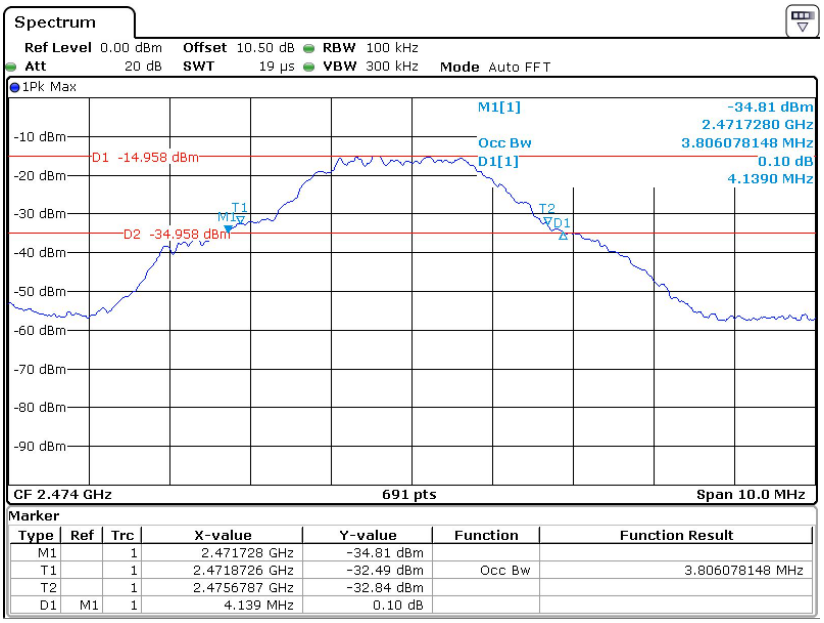
Date: 27.MAY.2022 12:03:34

Middle Channel



Date: 27.MAY.2022 12:05:39

High Channel



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

Applicable Standard

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

Test Procedure

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

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

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

Test Data

Environmental Conditions

Temperature:	27.9 ℃
Relative Humidity:	68 %
ATM Pressure:	101.0 kPa

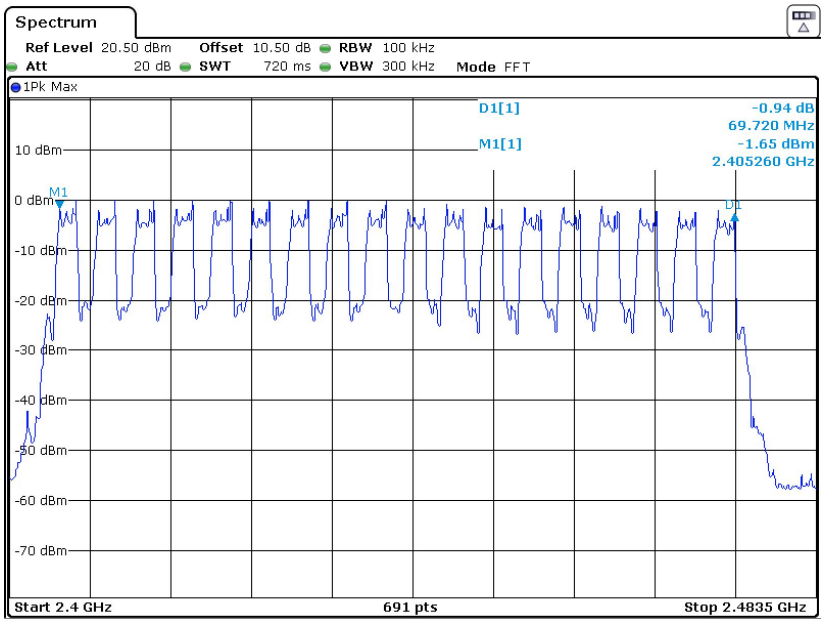
The testing was performed by Cat Kang on 2022-06-11.

EUT operation mode: Transmitting

Test Result: Compliant.

Mode	Frequency Range (MHz)	Number of Hopping Channel (CH)	Limit (CH)
GFSK	2400-2483.5	18	≥15

Hop



Date: 11.JUN.2022 13:16:30

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

Applicable Standard

Frequency hopping systems in the 2400-2483.5 MHz shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

Test Procedure

1. The EUT was worked in channel hopping.
2. Set the RBW to: 1MHz.
3. Set the VBW ≥ 3×RBW.
4. Set the span to 0Hz.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Recorded the time of single pulses

Test Data

Environmental Conditions

Temperature:	27.9 ℃
Relative Humidity:	68 %
ATM Pressure:	101.0 kPa

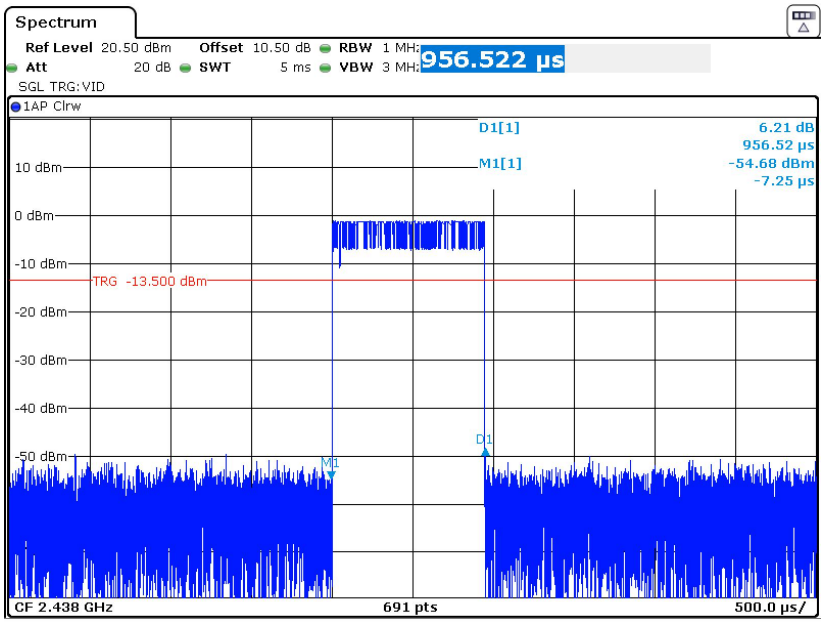
The testing was performed by Cat Kang on 2022-06-11.

EUT operation mode: Transmitting

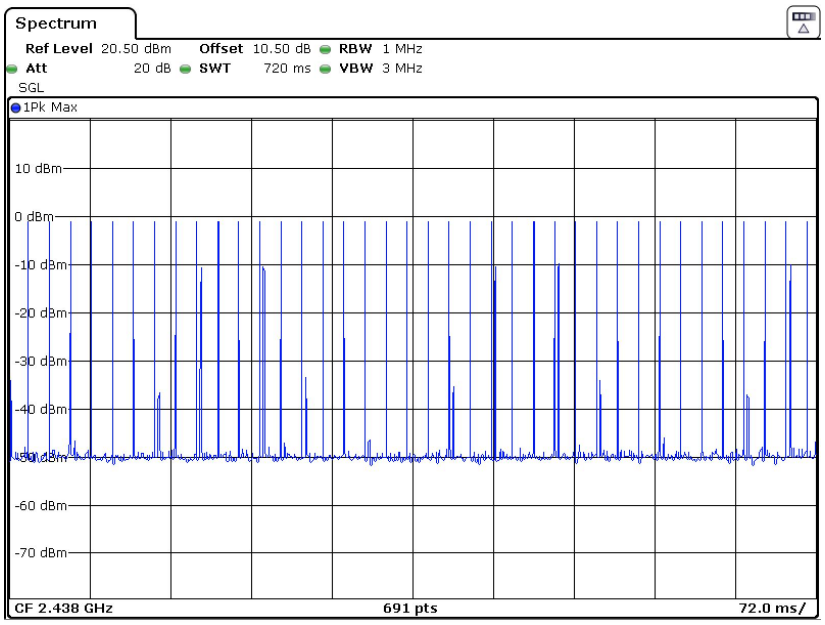
Test Result: Compliant.

Test Mode	Channel	Pulse Time [ms]	Total Hops [Num]	Period Time (s)	Result[s]	Limit[s]	Verdict
GFSK	Hop	0.957	380	7.2	0.364	<=0.4	PASS

Note: A period time=0.4*18=7.2(s), Result= Pulse Time *Total hops
Total hops=Hopping Number in 720ms*10
Hopping Number in 720ms=Total of highest signals in 720ms (Second high signals were other channel)



Date: 11.JUN.2022 13:23:29



Date: 11.JUN.2022 13:24:36

FCC §15.247(b) (1) - PEAK OUTPUT POWER MEASUREMENT

Applicable Standard

According to §15.247(b) (1), for frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. And for all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

Test Procedure

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

Test Data

Environmental Conditions

Temperature:	26.9 ℃
Relative Humidity:	58 %
ATM Pressure:	101.0 kPa

The testing was performed by Cat Kang on 2022-05-26.

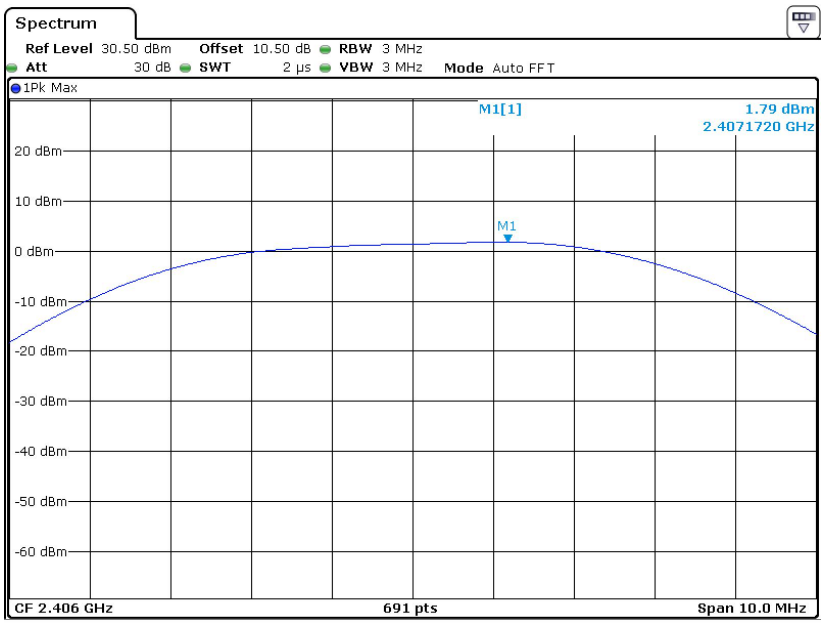
EUT operation mode: Transmitting

Test Result: Compliant.

Channel	Frequency (MHz)	Conducted Peak Output Power(dBm)		Limit (dBm)
		ANT 1	ANT 2	
Low	2406	1.79	1.73	21
Middle	2438	1.71	1.69	21
High	2474	0.72	0.71	21

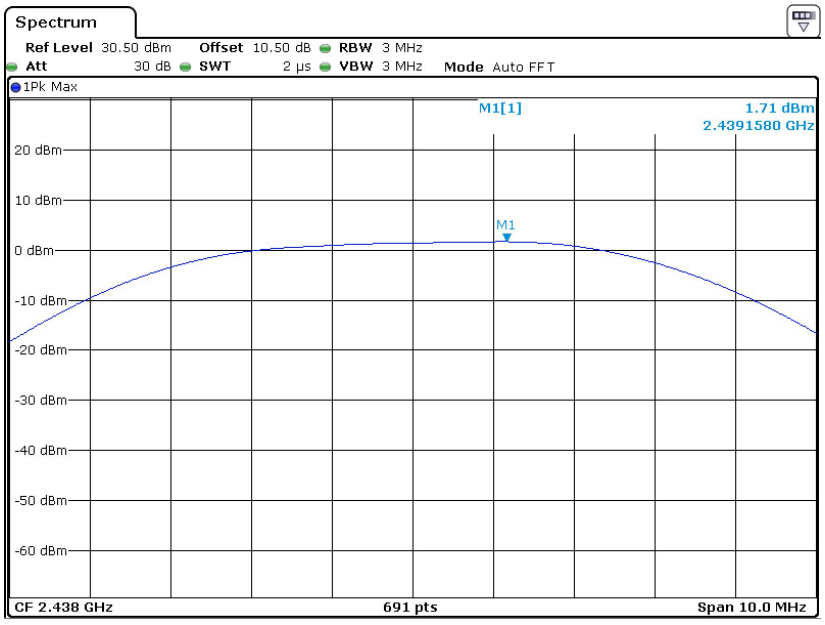
Please refer to following plots for the worst case: (antenna 1)

Low Channel



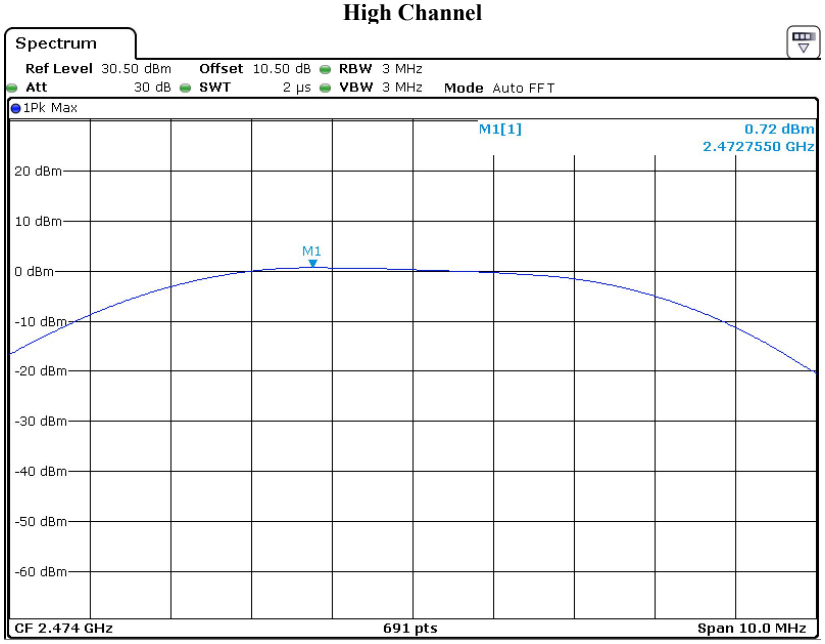
Date: 26.MAY.2022 10:48:04

Middle Channel



Date: 26.MAY.2022 10:48:37

High Channel



Date: 26.MAY.2022 10:49:23

FCC §15.247(d) - BAND EDGES TESTING

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

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Remove the antenna from the EUT and then connect to a low loss RF cable from the antenna port to a EMI test receiver, then turn on the EUT and make it operate in transmitting mode. Then set it to Low Channel and High Channel within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW of spectrum analyzer to 100 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 Data

Environmental Conditions

Temperature:	26.9 ℃
Relative Humidity:	58 %
ATM Pressure:	101.0 kPa

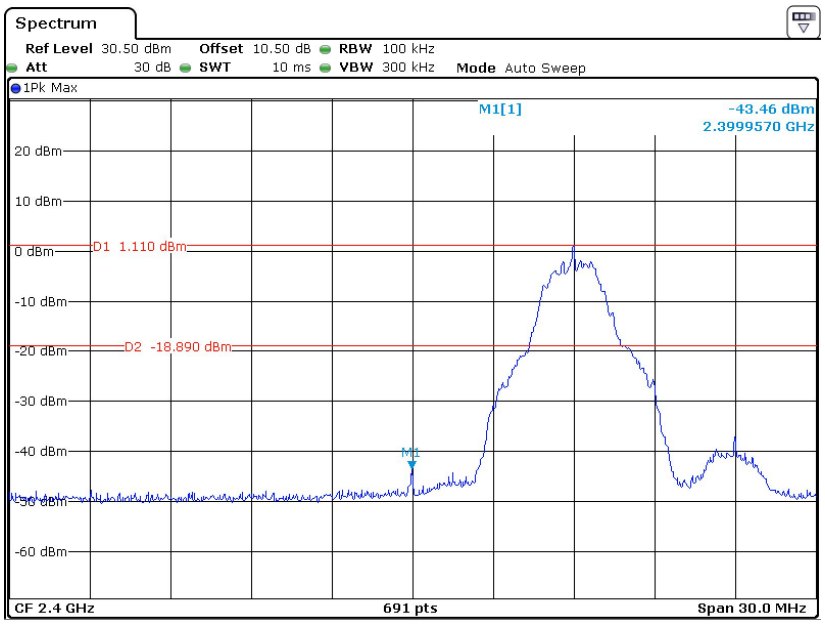
The testing was performed by Cat Kang on 2022-05-26 and 2022-06-11.

EUT operation mode: Transmitting

Test Result: Compliant.

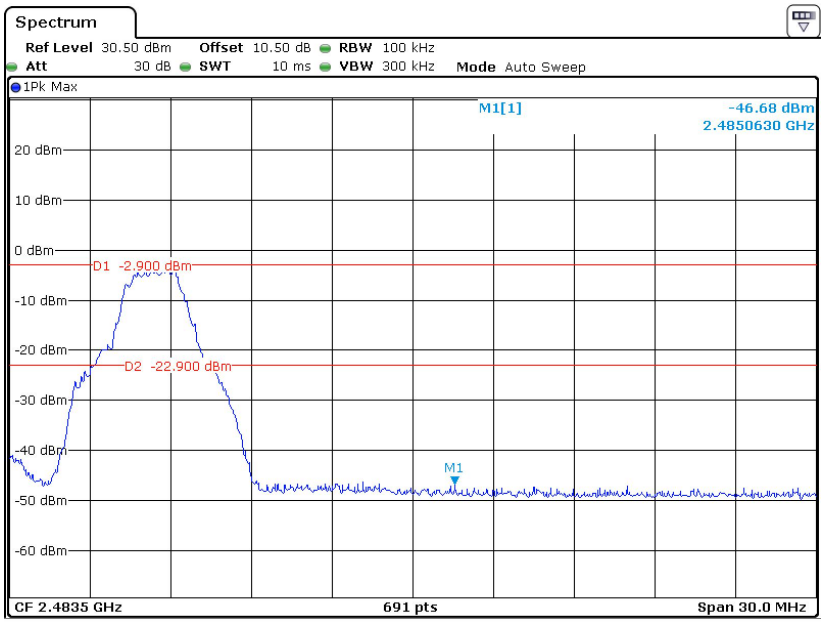
Conducted Band Edge Result:

GFSK_Low Channel



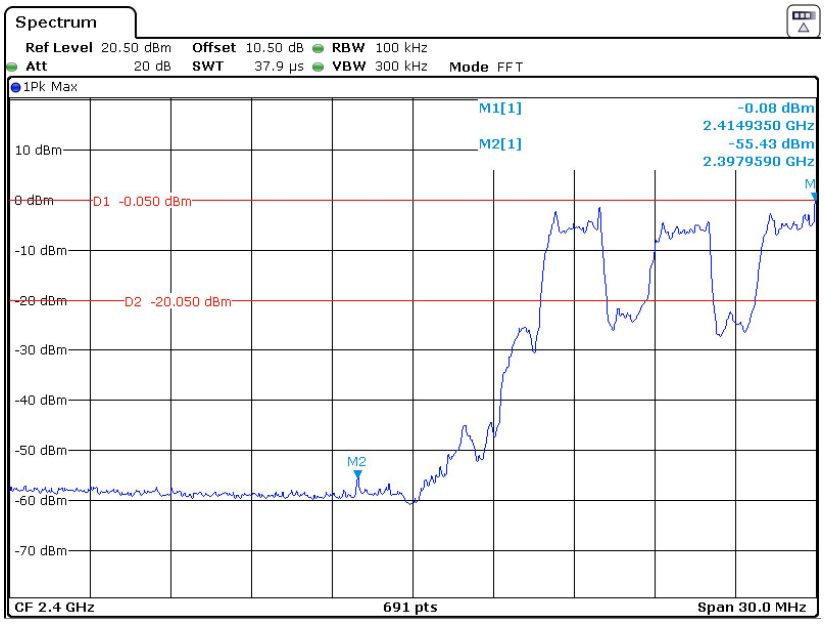
Date: 26.MAY.2022 11:12:39

GFSK_High Channel



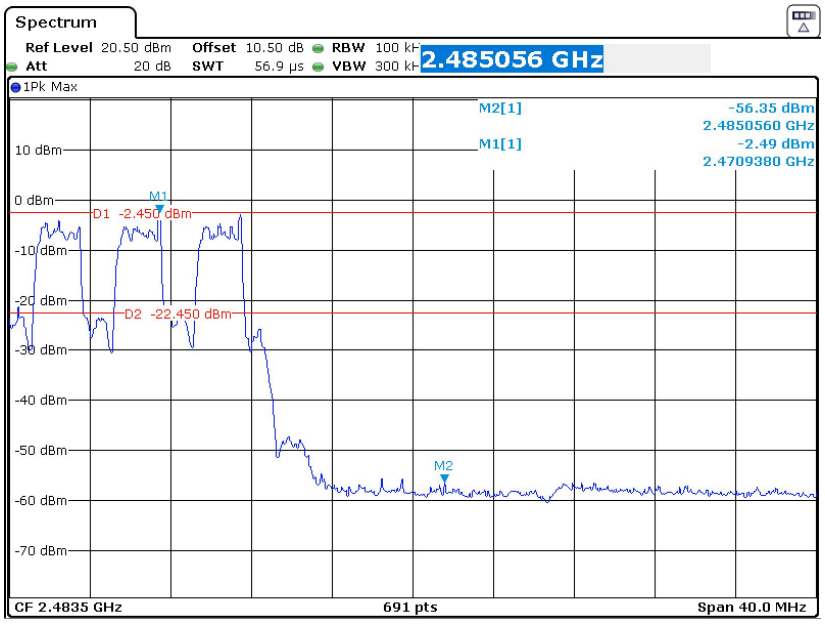
Date: 26.MAY.2022 11:06:25

GFSK_Hop_Low Channel



Date: 11.JUN.2022 13:28:04

GFSK_Hop_High Channel



Date: 11.JUN.2022 13:30:26

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