

FCC PART 15C TEST REPORT FOR CERTIFICATION

On Behalf of

APTIVPORT SERVICES, S.A.

Display Head Unit

DHU 1.0

FCC ID: LTQDHU1

APTIV

Prepared for : APTIVPORT SERVICES, S.A.
Rua Max Grundig, N° 1 4705-820 Braga Portugal

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Date of Test : Oct.26~Nov.11, 2022
Date of Report : Feb.20, 2023

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Appendix A. Photograph of Test

Appendix B. Photo of the EUT

TEST REPORT

Applicant : APTIVPORT SERVICES, S.A.
Manufacturer : APTIV Services Deutschland GmbH
Product : Display Head Unit
FCC ID : LTQDHU1
(A) Model No. : DHU 1.0
(B) Brand : APTIV
(C) Test Voltage : DC 12V

Tested for comply with:
FCC CFR47 Part 15 Subpart C

Test procedure used:
ANSI C63.10: 2020

The device described above is tested by Audix Technology (Shenzhen) Co., Ltd. to confirm comply with all the FCC Part 15 Subpart C requirements. The test results are contained in this test report and Audix Technology (Shenzhen) Co., Ltd. is assumed full responsibility for the accuracy and completeness of these tests. Also, this report shows that the Equipment Under Test (EUT) is to be technically compliant with the FCC requirements. This report contains data that are not covered by the NVLAP accreditation.

This Report is made under FCC Part 2.1074. No modifications were required during testing to bring this product into compliance.

This report applies to single evaluation of one sample of above mentioned product and shall not be reproduced in part without written approval of Audix Technology (Shenzhen) Co., Ltd.

The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government.

Date of Test : Oct.26~Nov.11, 2022 Report of date: Feb.20, 2023

Prepared by : Mia Zhao Reviewed by : Sunny Lu
Mia Zhao / Assistant Sunny Lu / Manager



Approved & Authorized Signer: David Jin
David Jin / Deputy General Manager

1. SUMMARY OF STANDARDS AND RESULTS

1.1. Description of Standards and Results

The EUT has been tested according to the applicable standards as referenced below.

EMISSION		
Description of Test Item	Standard	Results
Power Line Conducted Emission Test	FCC Part 15: 15.207 ANSI C63.10: 2020	N/A
Radiated Emission Test	FCC Part 15 15.209 FCC Part 15 15.205 FCC Part 15 15.247(d) ANSI C63.10: 2020	PASS
Conducted Spurious Emissions	FCC Part 15: 15.247(d) ANSI C63.10 2020	PASS
Carrier Frequency Separation Test	FCC Part 15: 15.247(a)(1) ANSI C63.10: 2020	PASS
20dB & 99% Bandwidth Test	FCC Part 15: 15.215 ANSI C63.10: 2020	PASS
Number Of Hopping Frequency Test	FCC Part 15: 15.247(a)(1)(iii) ANSI C63.10: 2020	PASS
Dwell Time Test	FCC Part 15: 15.247(a)(1)(iii) ANSI C63.10: 2020	PASS
Maximum Peak Output Power Test	FCC Part 15 15.247(b)(1) ANSI C63.10: 2020	PASS
Band Edge Compliance Test	FCC Part 15 15.247(d) ANSI C63.10: 2020	PASS
Antenna requirement	FCC Part 15: 15.203	PASS
N/A is an abbreviation for Not Applicable.		
Note: Measurement uncertainty affection to the result is considered, the EUT is technically compliant with standard requirements.		

2. GENERAL INFORMATION

2.1. Description of Equipment Under Test

Applicant	APTIVPORT SERVICES, S.A.
Applicant Address	Rua Max Grundig, N° 1 4705-820 Braga Portugal
Manufacturer	APTIV Services Deutschland GmbH
Manufacturer Address	Am Technologiepark 1 42119 Wuppertal Germany
Product	Display Head Unit
Model No.	DHU 1.0
FCC ID	LTQDHU1
Sample Type	Prototype production
Date of Receipt	Oct.14, 2022
Date of Test	Oct.26~Nov.11, 2022
Remark: This report only for BDR+EDR.	

2.2. Feature of Equipment Under Test

Product Feature & Specification		
Product	Display Head Unit	
Model No.	DHU 1.0	
Radio	IEEE802.11 a/b/g/n/ac/ax	
Power Source	☒ Commercial Power	AC 100 ~ 240V, 50-60Hz, 1.1A
	☒ External Power Source	DC 12V
	☐ Lithium battery	DC V, mAh
	☐ UM battery	DC V
Bluetooth		
Radio	BDR +EDR; BLE	
Frequency Range	2402-2480MHz	
Type of Modulation	GFSK, $\pi/4$ DQPSK, 8DPSK	
Data Rate	1Mbps, 2Mbps, 3Mbps	
Quantity of Channels	79/40	
Channel Separation	1MHz/2MHz	
2.4GHz Wi-Fi		
Support Modes	802.11b/g/n20/n40/ax20/ax40	
Frequency Range	2412-2462MHz	
Type of Modulation	802.11b(DSSS): CCK, QPSK, BPSK; 802.11g/n(OFDM): 64QAM,16QAM, QPSK, BPSK 802.11ax(OFDM): 64QAM,16QAM, QPSK, BPSK, 1024QAM	
Data Rate	802.11b: 1/2/5.5/11 Mbps; 802.11g: 6/9/12/18/24/36/48/54 Mbps; 802.11n: up to 300Mbps 802.11ax: up to 574Mbps	
Channel Separation	5MHz	
5GHz Wi-Fi		
Support Modes	802.11a/n20/n40/ac20/ac40/ac80 /ax20/ax40/ax80	
Frequency Range	5180-5240MHz, 5745-5825MHz	
Type of Modulation	802.11a/n (OFDM): QPSK, BPSK, 16QAM, 64QAM 802.11ac (OFDM): QPSK, BPSK, 16QAM, 64QAM,256QAM 802.11ax (OFDM): QPSK, BPSK, 16QAM, 64QAM,256QAM 1024QAM	
Data Rate	802.11a: 6/9/12/18/24/36/48/54 Mbps; 802.11n: up to 300Mbps; 802.11ac: up to 867Mbps; 802.11ax: up to 1201Mbps	
Channel Separation	5MHz	

Antenna System	
Type of Antenna	Internal Cable Assembly Metal Antenna
Antenna Number	2 (ANT 1 and ANT 2)
Operation Modes	SISO and MIMO mode supported
Antenna Peak Gain	Bluetooth Peak Gain: 1.6dBi WiFi 2.4GHz (2400-2483.5MHz) Peak Gain: ant1: 2.4dBi ; ant2: 1.4dB WiFi 5GHz Band1: ant1: 1.8dBi ; ant2: 2.6dBi WiFi 5GHz Band4: ant1: 2.1dBi ; ant2: 2.2dBi

2.3. Tested Supporting System Details

No.	Description	ACS No.	Manufacturer	Model	Serial Number
1.	Notebook	N/A	ACER	ZOW	N/A
Power Cord(3C): Unshielded, Detachable, 1.8m Power Adapter: Manufacturer: Lite-On, M/N: PA-1900-32 Data Cable: Shielded, Undetectable, 4.0m(Bond one ferrite core)					

2.4. Block Diagram of connection between EUT and simulators



(EUT: Display Head Unit)

2.5. Test information

A special software (Termite RS232 terminal, termite-3.4) was used to control EUT work in continuous TX mode

Tested mode, Packet Type, peak output power information			
Mode	Packet Type	Output power(dBm) P max	Output Power(dBm) P low
GFSK	DH1	1.190	2.861
	DH3		
	DH5		
$\pi/4$ DQPSK	2-DH1	0.956	2.053
	2-DH3		
	2-DH5		
8DPSK	3-DH1	0.235	1.719
	3-DH3		
	3-DH5		

$\pi/4$ DQPSK mode has been verified to have the lowest power, so the final test were performed with GFSK and 8DPSK mode, the worse-case packet type were:

GFSK Mode: DH5

8DPSK Mode: 3DH5

Item		Modulation	Data Rate	Test Channel
Radiated Test Case	Radiated Band Edge	GFSK	1Mbps	00/78
		8-DPSK	3Mbps	00/78
	Radiated Spurious Emission	GFSK	1Mbps	00/39/78
		8-DPSK	3Mbps	00/39/78
Conducted Test Case	20dB Bandwidth	GFSK	1Mbps	00/39/78
		8-DPSK	3Mbps	00/39/78
	Carrier Frequency Separation	GFSK	1Mbps	39
		8-DPSK	3Mbps	39
	Time of Occupancy	GFSK	1Mbps	39
		8-DPSK	3Mbps	39
	Number of Hopping Channels	GFSK	1Mbps	39
		8-DPSK	3Mbps	39
	Maximum Peak Output Power	GFSK	1Mbps	00/39/78
		8-DPSK	3Mbps	00/39/78
	Band Edges	GFSK	1Mbps	00/78
		8-DPSK	3Mbps	00/78
	Spurious Emission	GFSK	1Mbps	00/39/78
		8-DPSK	3Mbps	00/39/78

2.6. Test Facility

Site Description

Name of Firm

: Audix Technology (Shenzhen) Co., Ltd.
No. 6, Kefeng Road, Science & Technology Park,
Nanshan District , Shenzhen, Guangdong, China

EMC Lab.

: Certificated by ISED, Canada
Company Number: 5183A
CAB identifier: CN0034
Valid Date: Mar.31, 2023

: Certificated by FCC, USA
Designation No.: CN5022
Valid Date: Mar.31, 2023

: Accredited by NVLAP, USA
NVLAP Code: 200372-0
Valid Date: Mar.31, 2023

2.7. Measurement Uncertainty (95% confidence levels, k=2)

Test Item	Uncertainty
Uncertainty for Radiation Emission test in 3m chamber	$\pm 3.4\text{dB}(30\sim 200\text{MHz}, \text{Polarization: H})$
	$\pm 3.6\text{dB}(30\sim 200\text{MHz}, \text{Polarization: V})$
	$\pm 3.0\text{dB}(200\text{M}\sim 1\text{GHz}, \text{Polarization: H})$
	$\pm 3.2\text{dB}(200\text{M}\sim 1\text{GHz}, \text{Polarization: V})$
Uncertainty for Radiation Emission test in 3m chamber(1GHz-25GHz)	$\pm 4.6\text{dB}(1\sim 6\text{GHz}, \text{Distance: 3m})$
	$\pm 4.8\text{dB}(6\sim 25\text{GHz}, \text{Distance: 3m})$
Uncertainty for Radiated Spurious Emission test in RF chamber	$\pm 3.7\text{dB}(30\text{MHz}\sim 1000\text{MHz})$
	$\pm 3.3\text{dB}(1\sim 26.5\text{GHz})$
Uncertainty for Conduction Spurious emission test	$\pm 2.0\text{dB}$
Uncertainty for Output power test	$\pm 0.8\text{dB}$
Uncertainty for Bandwidth test	$\pm 83\text{kHz}$
Uncertainty for DC power test	$\pm 1\%$
Uncertainty for test site temperature and humidity	$\pm 0.6^{\circ}\text{C}$
	$\pm 3\%$

3. POWER LINE CONDUCTED EMISSION TEST

According to Paragraph (c) of FCC Part 15 section 15.207, Tests to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines.

4. RADIATED EMISSION TEST

4.1. Test Equipments

Frequency range: 30~1000MHz

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	3#Chamber(NSA)	AUDIX	N/A	N/A	Aug.11,22	5 Year
2.	3#Chamber(SE)	AUDIX	N/A	N/A	Sep.16,22	5 Year
3.	Signal Analyzer	Rohde & Schwarz	FSV30	104050	Apr.06,22	1 Year
4.	Tri-log-Broadband Antenna	SCHWARZBECK	VULB 9168	710	Dec.13,21	1 Year
5.	NSA Cable	HUBER+SUHNER	CFD400NL-LW	No.3	Oct.09,22	1 Year
6.	Coaxial Switch	Anritsu	MP59B	6201397223	Apr.06,22	1 Year
7.	EMI Test Receiver	Rohde & Schwarz	ESR7	101547	Apr.06,22	1 Year
8.	Amplifier	HP	8447D	2944A11159	Apr.06,22	1 Year
9.	Test Software	AUDIX	e3	6.100913a	N/A	N/A

Note: N/A means Not applicable.

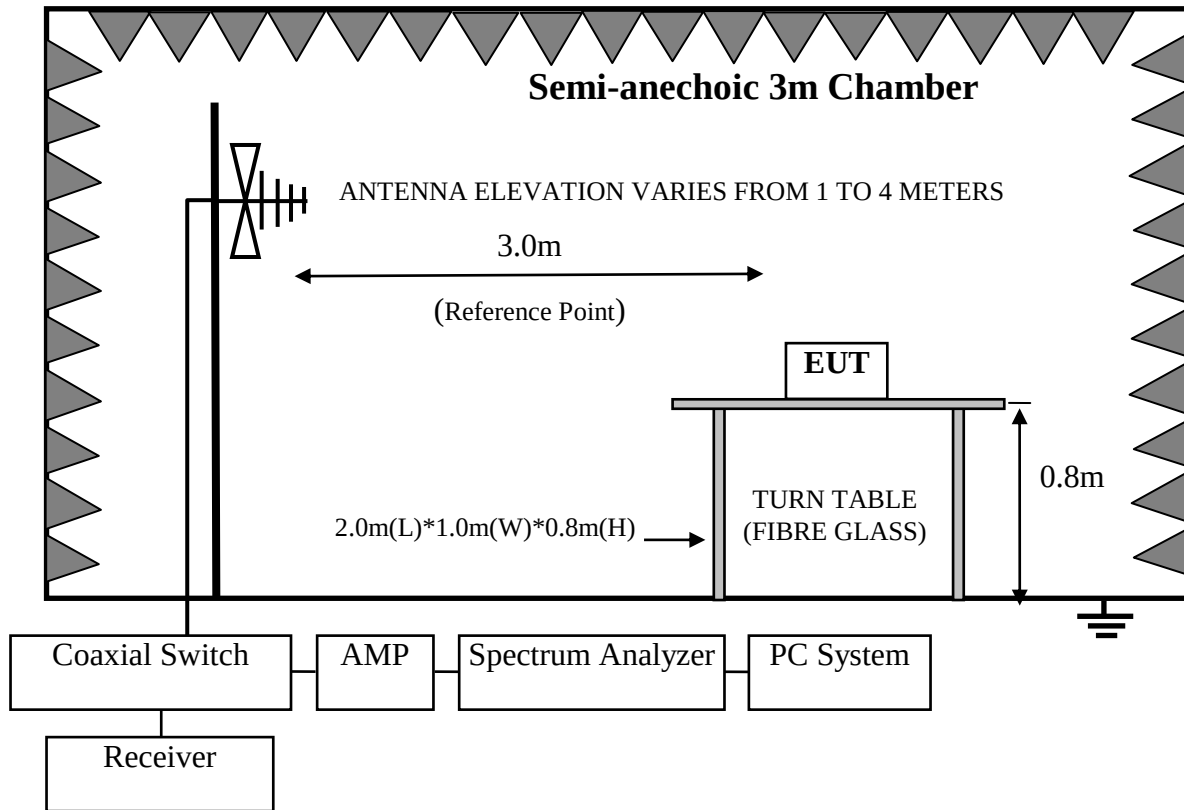
Frequency range: above 1000MHz

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	3#Chamber(Svswr)	AUDIX	N/A	N/A	Aug.09,22	5 Year
2.	3#Chamber(SE)	AUDIX	N/A	N/A	Sep.16,22	5 Year
3.	Signal Analyzer	Rohde & Schwarz	FSV30	104050	Apr.06,22	1 Year
4.	Amplifier	Agilent	83017A	MY53270084	Oct.09,22	1 Year
5.	RF Cable	EMCI	EMC104-SM-SM-15000	190407	Jul.01,22	1 Year
6.	Test Software	AUDIX	e3	6.100913a	N/A	N/A
7.	Horn Antenna	ETC	MCTD 1209	DRH15F03006	Aug.12,22	1 Year

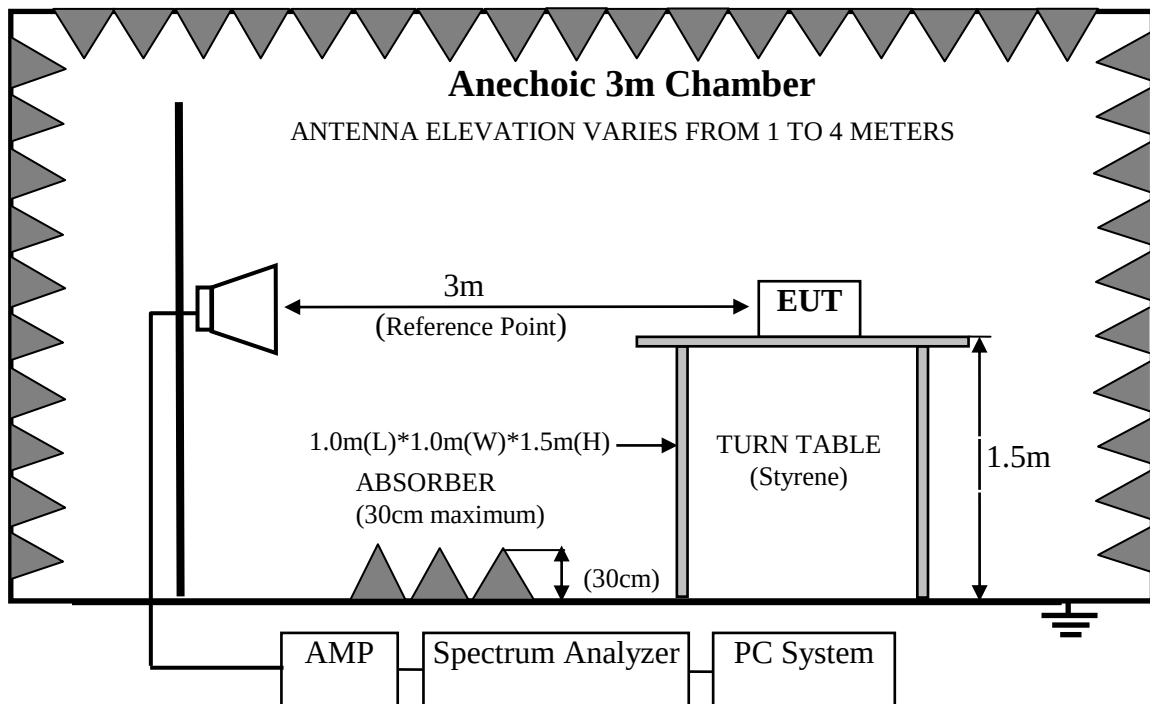
Note: N/A means Not applicable.

4.2. Block Diagram of Test Setup

For frequency range 30MHz-1000MHz



For frequency range above 1GHz



4.3.Radiated Emission Limits Standard:

FREQUENCY MHz	DISTANCE Meters	FIELD STRENGTHS LIMIT	
		$\mu\text{V/m}$	$\text{dB}(\mu\text{V})/\text{m}$
30 ~ 88	3	100	40.0
88 ~ 216	3	150	43.5
216 ~ 960	3	200	46.0
960 ~ 1000	3	500	54.0
Above 1000MHz	3	74.0 $\text{dB}(\mu\text{V})/\text{m}$ (Peak) 54.0 $\text{dB}(\mu\text{V})/\text{m}$ (Average)	

- Remark:
- (1) Emission Level ($\text{dB}\mu\text{V}/\text{m}$) = Reading (Receiver) ($\text{dB}\mu\text{V}$) + Antenna Factor (dB/m) + Cable Loss (dB)
Emission Level ($\text{dB}\mu\text{V}/\text{m}$) = Reading (Spectrum) ($\text{dB}\mu\text{V}$) + Antenna Factor (dB/m) – Amp Factor (dB) + Cable Loss (dB)(above 1000MHz)
 - (2) The smaller limit shall apply at the cross point between two frequency bands.
 - (3) Distance is the distance in meters between the measuring instrument, antenna and the closest point of any part of the device or system.
 - (4) The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

4.4.EUT Configuration on Test

The following equipment are installed on Radiated Emission Test to meet the commission requirements and operating regulations in a manner which tends to maximize its emission characteristics in normal application.

4.4.1. Display Head Unit (EUT)

Model Number : DHU 1.0
Serial Number : N/A

4.5.Operating Condition of EUT

- 4.5.1. Setup the EUT and simulator as shown as Section 4.2.
- 4.5.2. Turn on the power of all equipments.
- 4.5.3. Let EUT work in Tx mode.

4.6. Test Procedure

Frequency below 30MHz:

The EUT setup on the turn table which has 0.8 m height to the ground. The turn table rotated 360 degrees and antenna fixed to 1 m to find the maximum emission level. In order to find the maximum emission, all of the interface cables were manipulated according to ANSI C63.10: 2020 regulation.

EUT and its simulators are placed on a turn table, which is 0.8 meter high above ground for frequency 30MHz~1000MHz, 1.5 meter high above ground for frequency above 1GHz and put the absorbing with 2.4m(L)*2.4m(W)*0.3m(H) on the ground. The turn table can rotate 360 degrees to determine the position of the maximum emission level. Power on the EUT and let it working in test mode, then test it. EUT is set 3 meters away from the receiving antenna, which is mounted on a antenna tower. The antenna can be moved up and down between 1 meter and 4 meters to find out the maximum emission level. Broadband antenna (calibrated bilog antenna) is used as receiving antenna for frequency 30MHz~1000MHz, and the Horn antenna is used as receiving antenna for frequency above 1GHz. Both horizontal and vertical polarization of the antenna is set on Test. In order to find the maximum emission levels, all of the interface cables must be manipulated according to ANSI C63.10: 2020 on radiated emission Test

This test was performed with EUT in X, Y, Z position, and the worse case was found and reported in report.

The bandwidth of the EMI test receiver (R&S ESR7) is set at 120kHz for frequency range from 30MHz to 1000 MHz.

The bandwidth of the Spectrum's RBW is set at 1MHz and VBW is set at 3MHz for peak emissions measurement above 1GHz

This device is pulse Modulated, a duty cycle factor was used to calculated average level based measured peak level.

The frequency range from 30MHz to 10th harmonic (25GHz) are checked. and no any emissions were found from 18GHz to 25 GHz, So the radiated emissions from 18GHz to 25GHz were not record.

4.7. Radiated Emission Test Results

PASS.

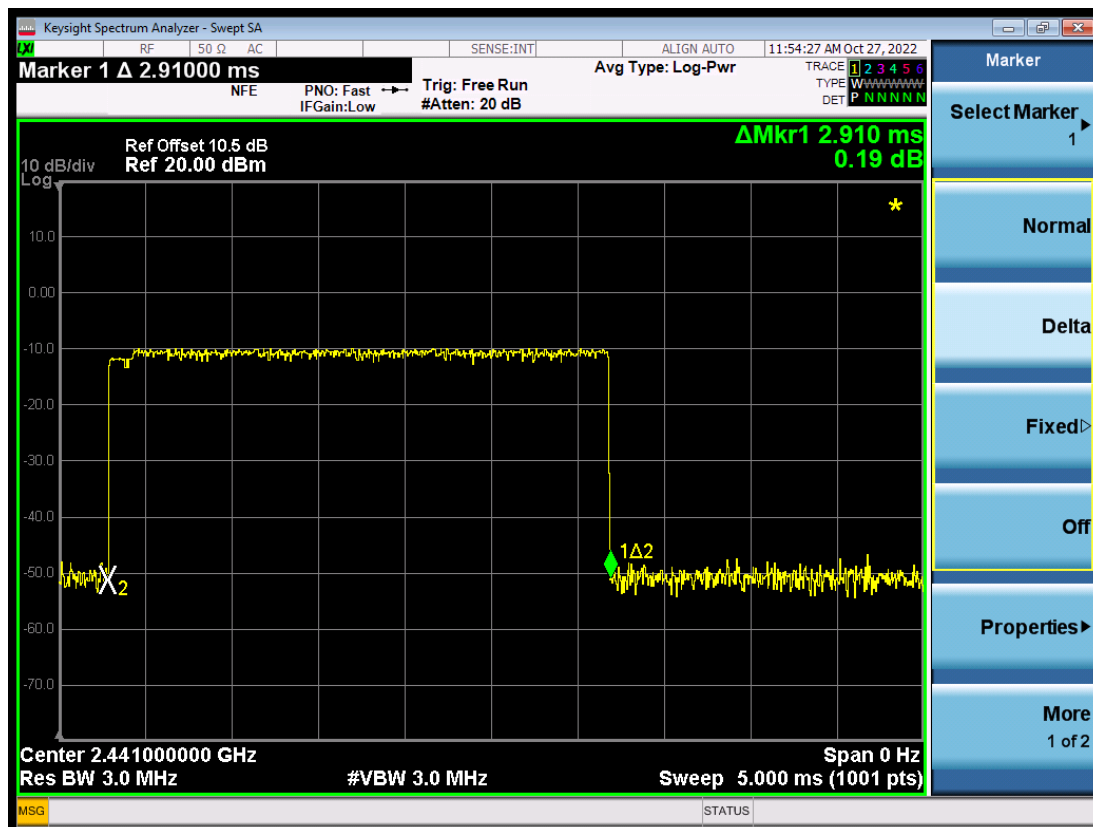
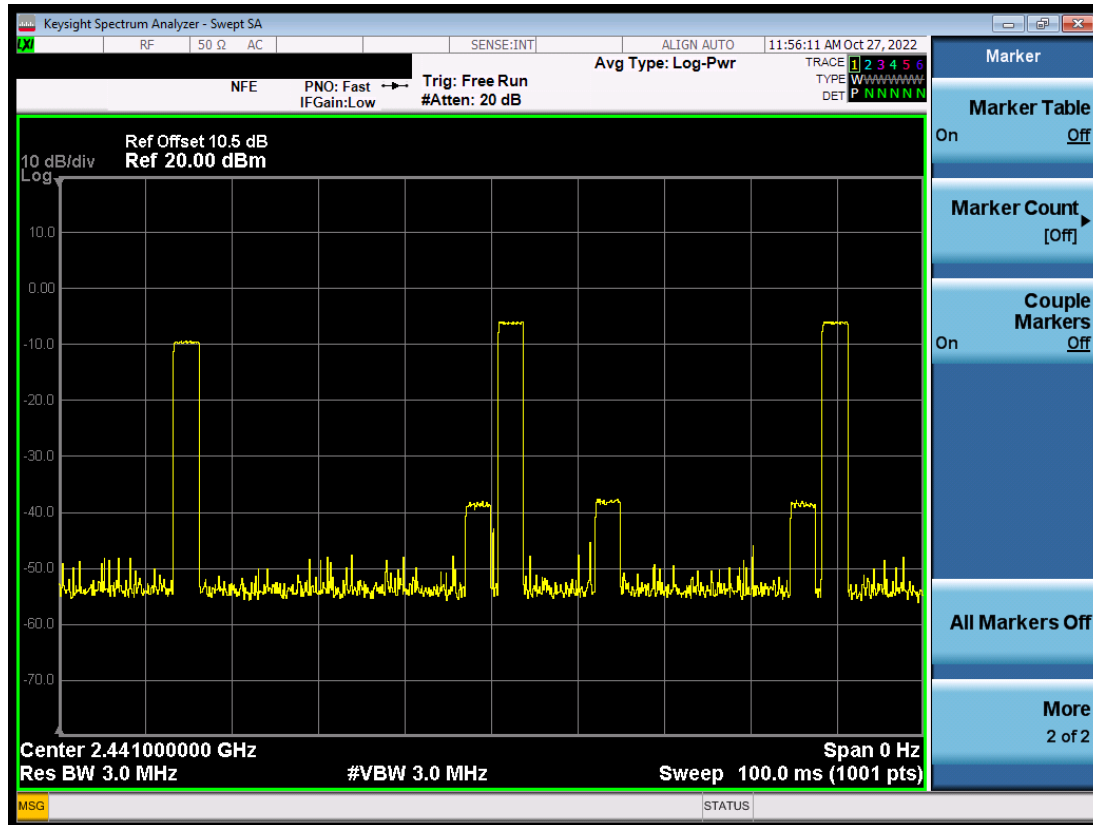
All the emissions from 30MHz to 25GHz were comply with the 15.209 Limit.

Note 1: The duty cycle factor for calculate average level is -21.18dB, and average limit is 20dB below peak limit, so if peak measured level comply with average limit, the average level was deemed to comply with average limit.

Note 2: The emissions (9kHz~30MHz) not reported for there is no emission be found.

Duty cycle factor = $20\log(\text{Dwell time}/100\text{ms}) = -21.18\text{dB}$

Dwell Time = $2.910 \times 3\text{ms}$

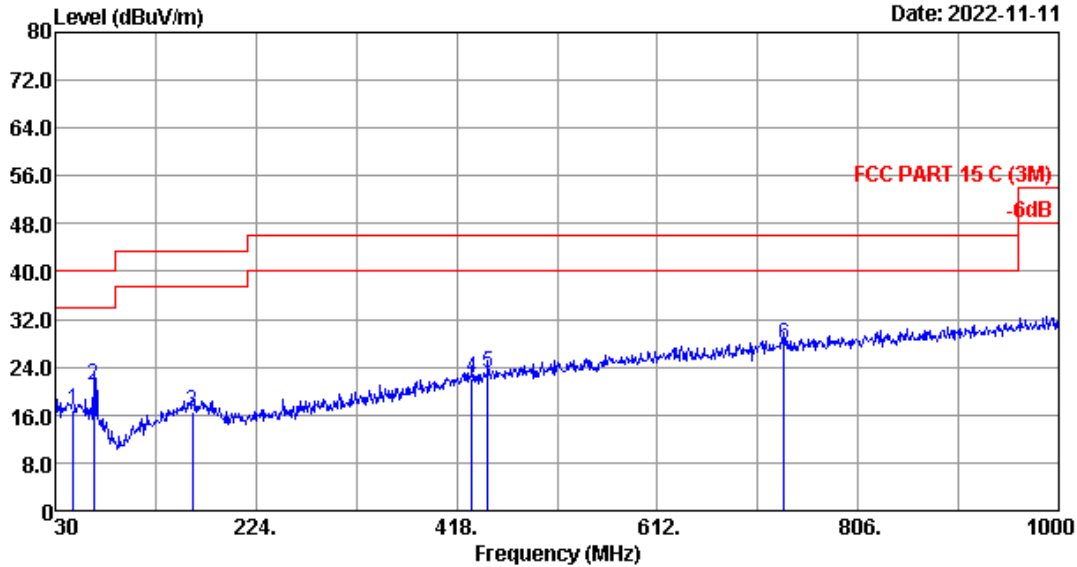


Frequency: 30MHz~1GHz

Data: 1

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Date: 2022-11-11



Site no. : 3m Chamber Data no. : 1
 Dis. / Ant. : 3m 2021 VULB9168-710 Ant. pol. : HORIZONTAL
 Limit : FCC PART 15 C (3M)
 Env. / Ins. : 23.3°C/53% Engineer : Abel
 Test Mode : BT3.0 TX

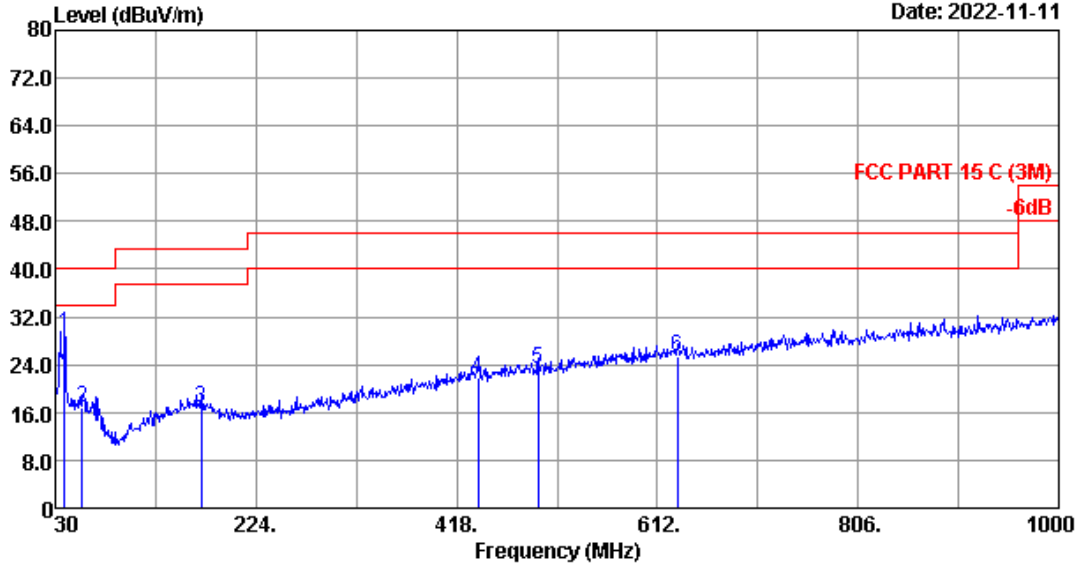
No.	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Remark
1	47.460	20.30	0.69	-4.08	16.91	40.00	23.09	QP
2	66.860	18.45	0.83	1.58	20.86	40.00	19.14	QP
3	162.890	19.51	1.28	-4.18	16.61	43.50	26.89	QP
4	432.550	23.02	2.16	-3.05	22.13	46.00	23.87	QP
5	448.070	23.45	2.21	-2.60	23.06	46.00	22.94	QP
6	734.220	27.55	2.98	-2.71	27.82	46.00	18.18	QP

Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading.
 2. The emission levels that are 20dB below the official limit are not reported.

Data: 2

File: E:\2022 Report Data\M\MOCHUANG\A1Z2209050-RF.EM6 (8)

Date: 2022-11-11



Site no. : 3m Chamber

Data no. : 2

Dis. / Ant. : 3m 2021 VULB9168-710

Ant. pol. : VERTICAL

Limit : FCC PART 15 C (3M)

Env. / Ins. : 23.3°C/53%

Engineer : Abel

Test Mode : BT3.0 TX

No.	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Remark
1	38.730	20.15	0.62	8.45	29.22	40.00	10.78	QP
2	56.190	19.82	0.75	-3.79	16.78	40.00	23.22	QP
3	170.650	19.23	1.31	-3.59	16.95	43.50	26.55	QP
4	438.370	23.18	2.18	-3.48	21.88	46.00	24.12	QP
5	496.570	23.87	2.37	-3.02	23.22	46.00	22.78	QP
6	631.400	26.19	2.73	-3.44	25.48	46.00	20.52	QP

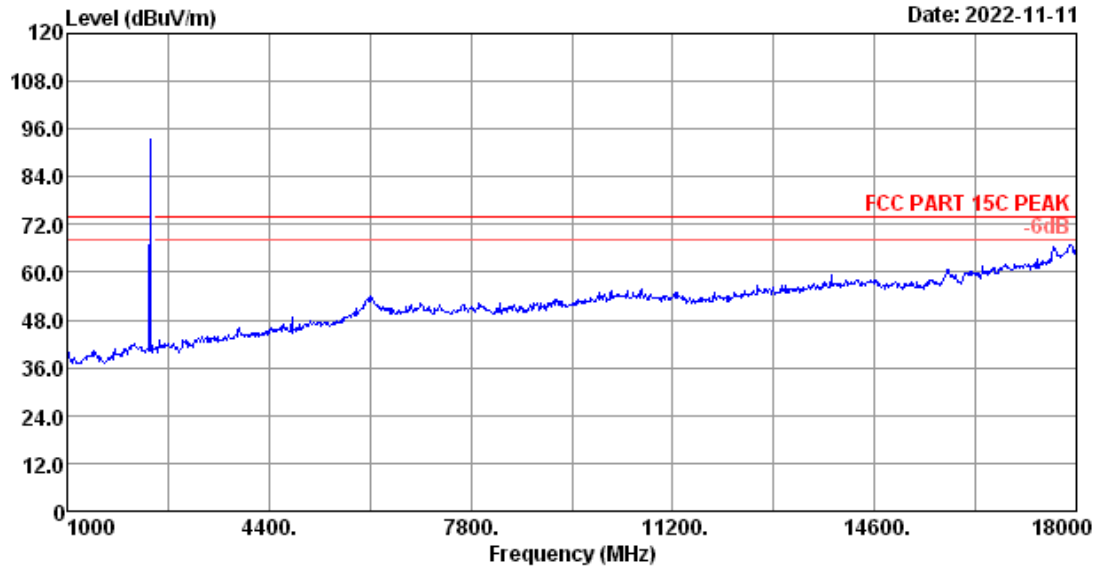
Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading.
2. The emission levels that are 20dB below the official limit are not reported.

Frequency: 1GHz~18GHz

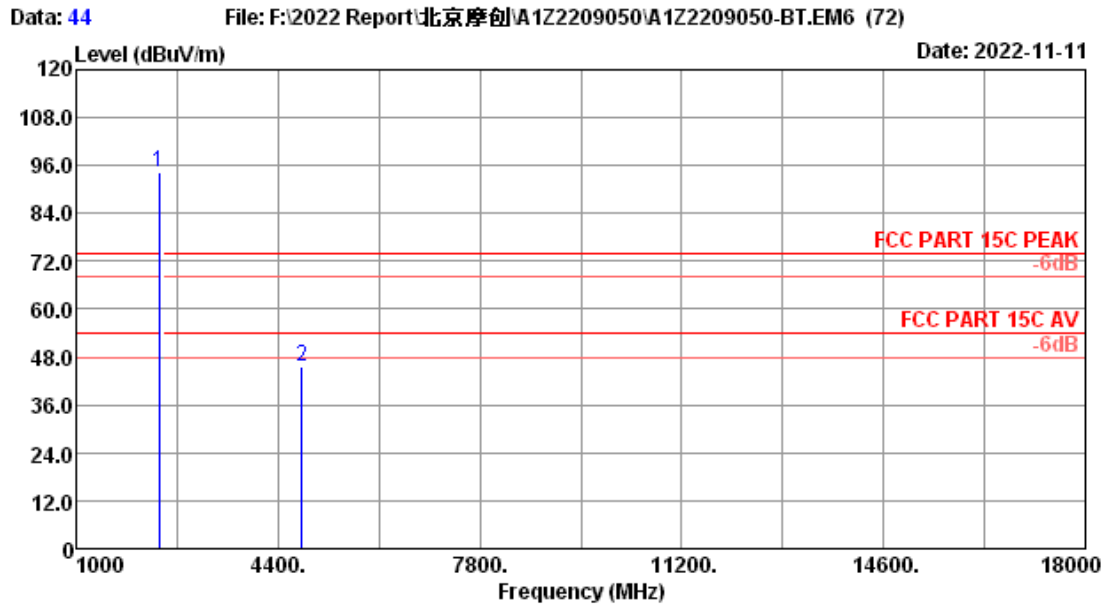
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Date: 2022-11-11



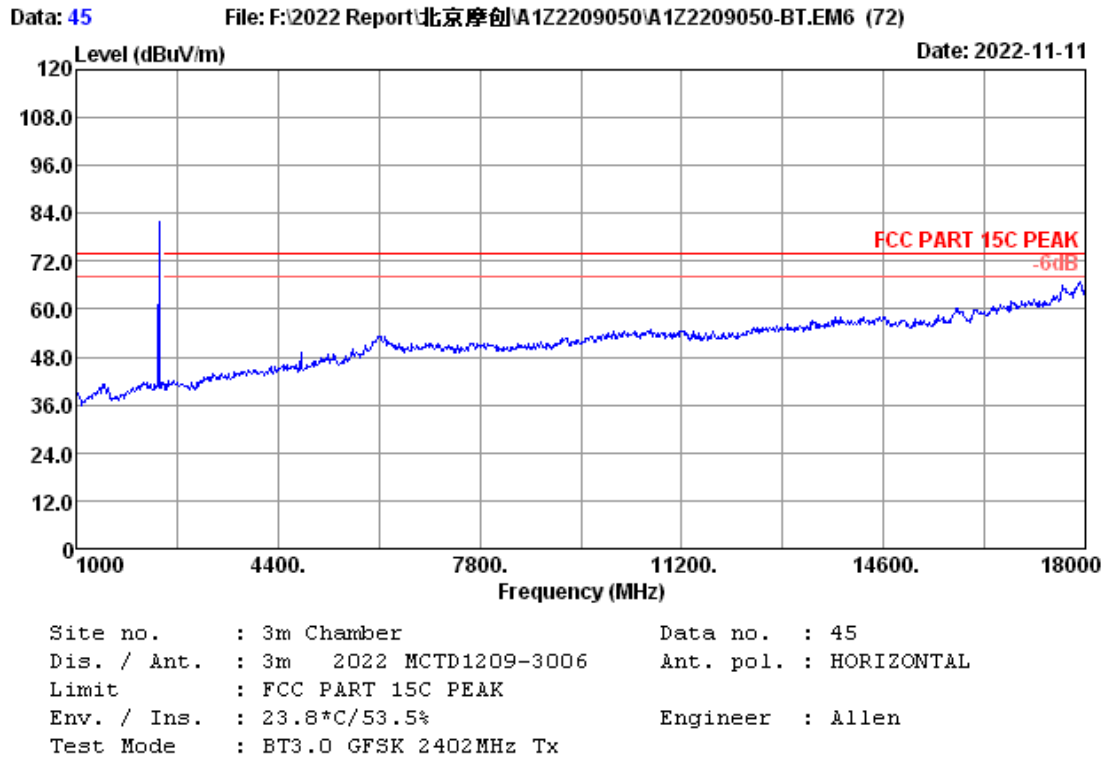
Site no.	: 3m Chamber	Data no.	: 43
Dis. / Ant.	: 3m 2022 MCTD1209-3006	Ant. pol.	: VERTICAL
Limit	: FCC PART 15C PEAK		
Env. / Ins.	: 23.8°C/53.5%	Engineer	: Allen
Test Mode	: BT3.0 GFSK 2402MHz Tx		

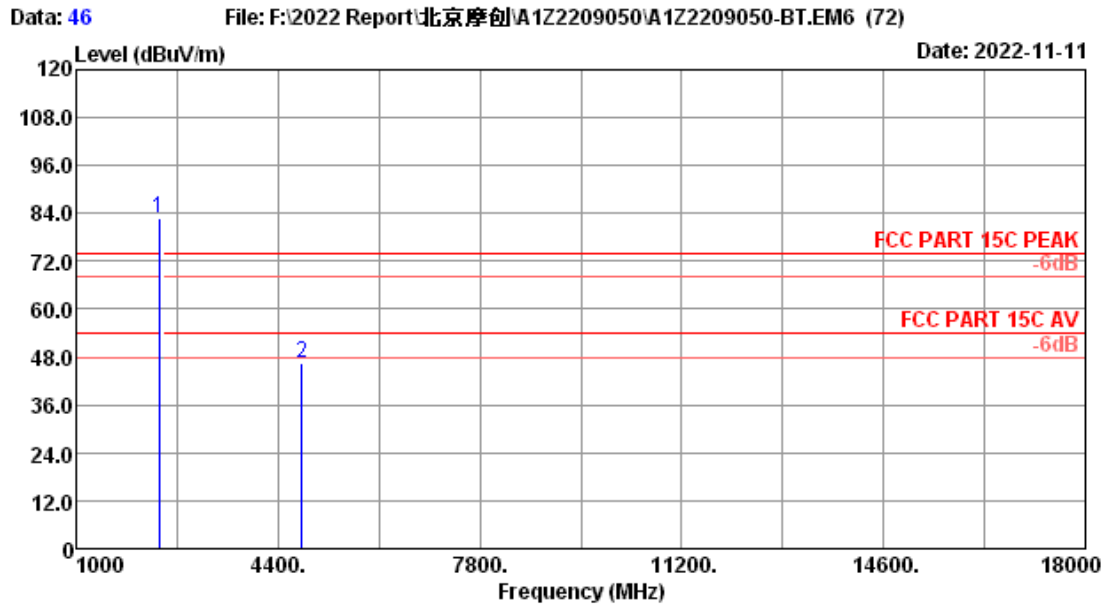


Site no. : 3m Chamber Data no. : 44
 Dis. / Ant. : 3m 2022 MCTD1209-3006 Ant. pol. : VERTICAL
 Limit : FCC PART 15C PEAK
 Env. / Ins. : 23.8°C/53.5% Engineer : Allen
 Test Mode : BT3.0 GFSK 2402MHz Tx

No.	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Amp factor (dB)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Remark
1	2402.00	27.70	2.29	98.82	34.36	94.45	-----	-----	Peak
2	4804.00	31.20	3.33	44.81	33.68	45.66	74.00	28.34	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading
 -Amp factor.
 2. The emission levels that are 20dB below the official
 limit are not reported.

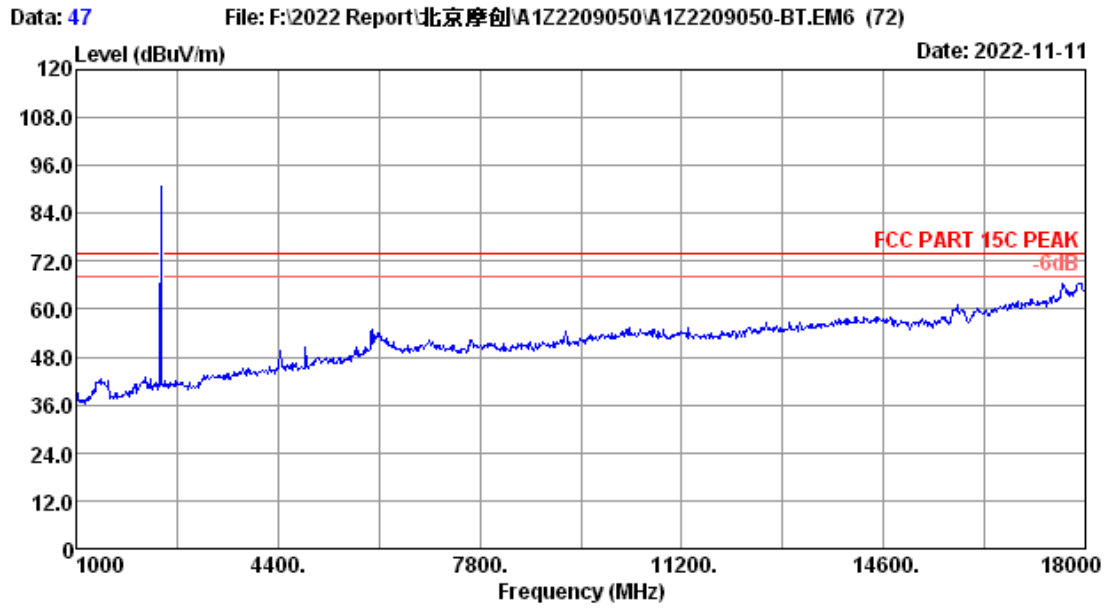




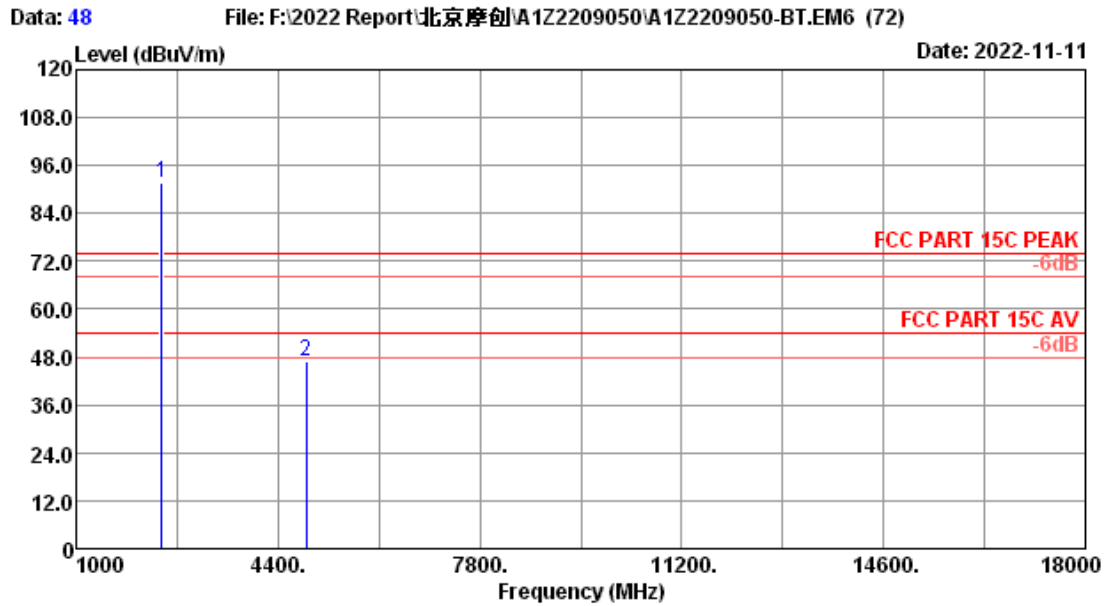
Site no. : 3m Chamber Data no. : 46
 Dis. / Ant. : 3m 2022 MCTD1209-3006 Ant. pol. : HORIZONTAL
 Limit : FCC PART 15C PEAK
 Env. / Ins. : 23.8°C/53.5% Engineer : Allen
 Test Mode : BT3.0 GFSK 2402MHz Tx

No.	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Reading (dBUV)	Amp factor (dB)	Emission Level (dBUV/m)	Limits (dBUV/m)	Margin (dB)	Remark
1	2402.00	27.70	2.29	87.12	34.36	82.75	-----	-----	Peak
2	4804.00	31.20	3.33	45.73	33.68	46.58	74.00	27.42	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading
 -Amp factor.
 2. The emission levels that are 20dB below the official
 limit are not reported.



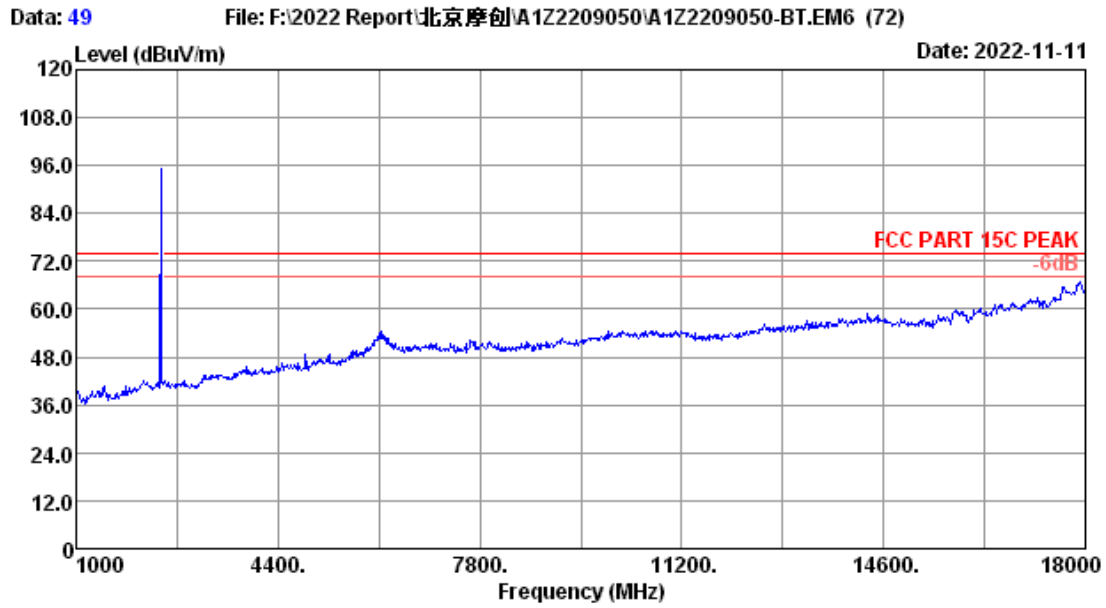
Site no.	: 3m Chamber	Data no.	: 47
Dis. / Ant.	: 3m 2022 MCTD1209-3006	Ant. pol.	: HORIZONTAL
Limit	: FCC PART 15C PEAK		
Env. / Ins.	: 23.8°C/53.5%	Engineer	: Allen
Test Mode	: BT3.0 GFSK 2441MHz Tx		



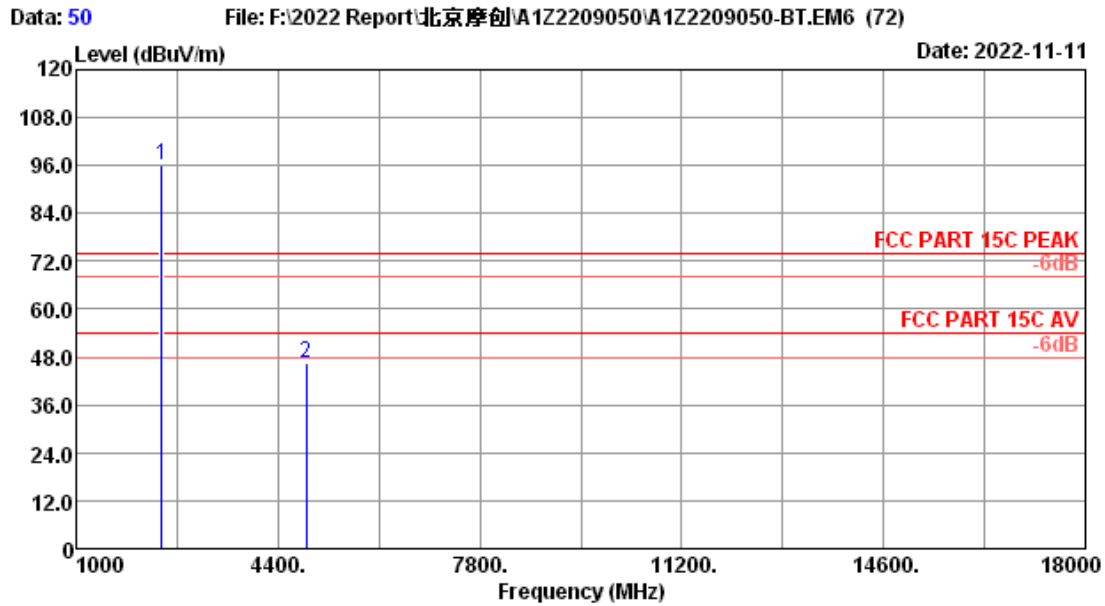
Site no. : 3m Chamber Data no. : 48
 Dis. / Ant. : 3m 2022 MCTD1209-3006 Ant. pol. : HORIZONTAL
 Limit : FCC PART 15C PEAK
 Env. / Ins. : 23.8°C/53.5% Engineer : Allen
 Test Mode : BT3.0 GFSK 2441MHz Tx

No.	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Reading (dBUV)	Amp factor (dB)	Emission Level (dBUV/m)	Limits (dBUV/m)	Margin (dB)	Remark
1	2441.00	27.80	2.32	95.85	34.35	91.62	-----	-----	Peak
2	4882.00	31.43	3.35	46.02	33.69	47.11	74.00	26.89	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading
 -Amp factor.
 2. The emission levels that are 20dB below the official
 limit are not reported.



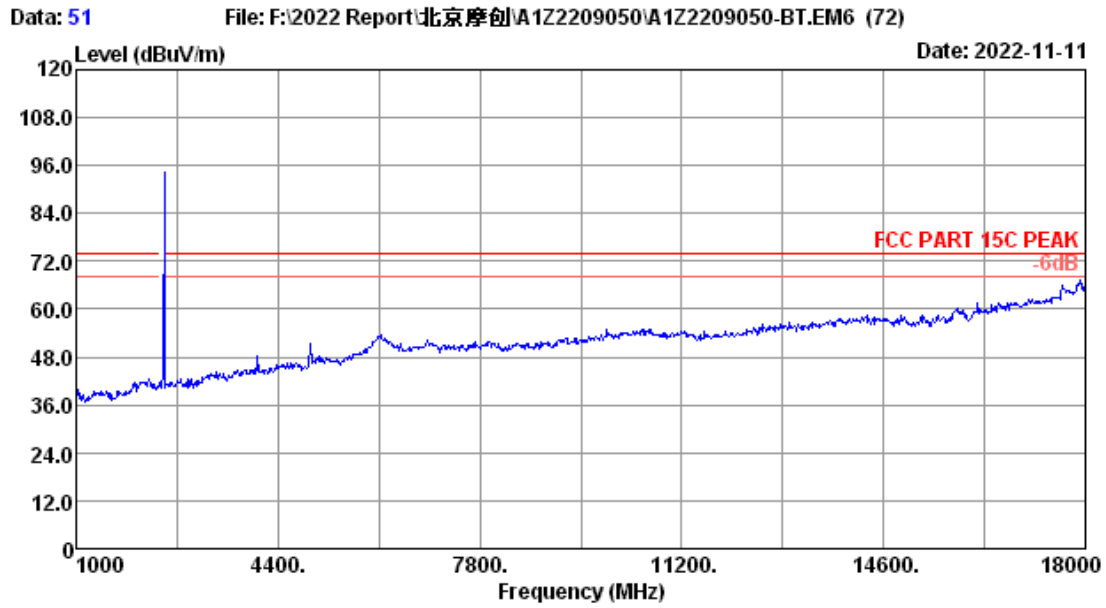
Site no.	: 3m Chamber	Data no.	: 49
Dis. / Ant.	: 3m 2022 MCTD1209-3006	Ant. pol.	: VERTICAL
Limit	: FCC PART 15C PEAK		
Env. / Ins.	: 23.8°C/53.5%	Engineer	: Allen
Test Mode	: BT3.0 GFSK 2441MHz Tx		



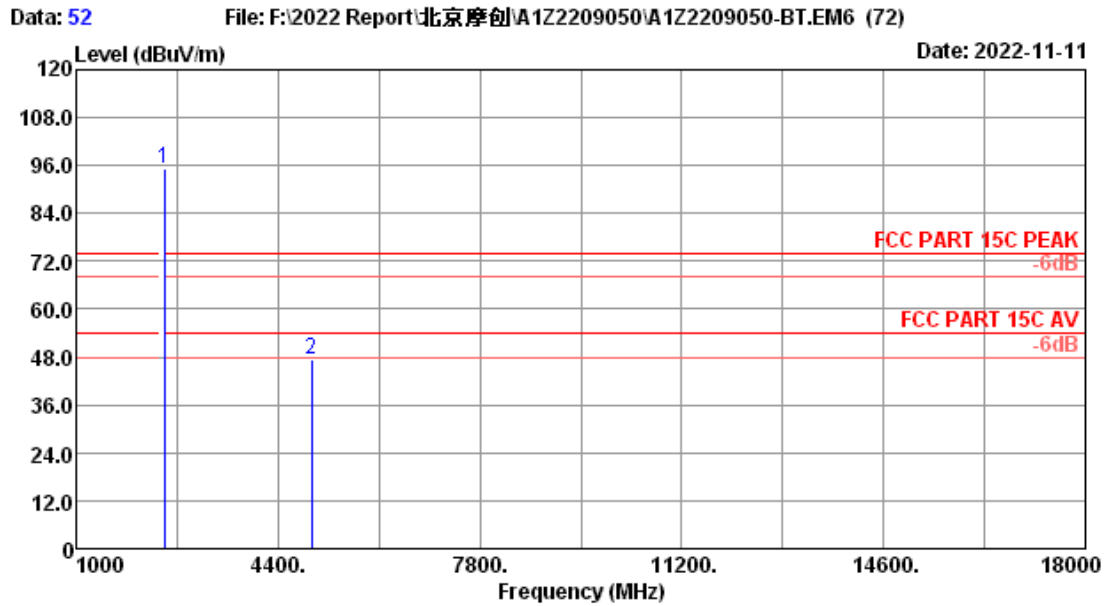
Site no. : 3m Chamber Data no. : 50
 Dis. / Ant. : 3m 2022 MCTD1209-3006 Ant. pol. : VERTICAL
 Limit : FCC PART 15C PEAK
 Env. / Ins. : 23.8°C/53.5% Engineer : Allen
 Test Mode : BT3.0 GFSK 2441MHz Tx

No.	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Reading (dBUV)	Amp factor (dB)	Emission Level (dBUV/m)	Limits (dBUV/m)	Margin (dB)	Remark
1	2441.00	27.80	2.32	100.12	34.35	95.89	-----	-----	Peak
2	4882.00	31.43	3.35	45.27	33.69	46.36	74.00	27.64	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading
 -Amp factor.
 2. The emission levels that are 20dB below the official
 limit are not reported.



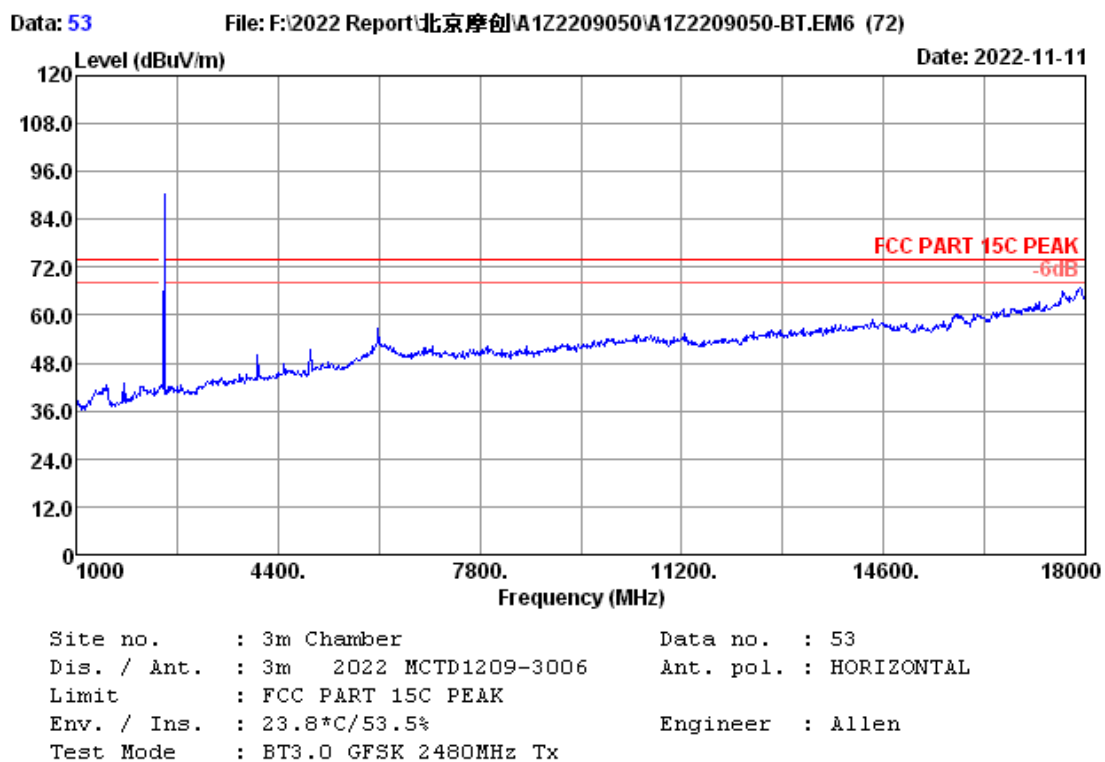
Site no.	: 3m Chamber	Data no.	: 51
Dis. / Ant.	: 3m 2022 MCTD1209-3006	Ant. pol.	: VERTICAL
Limit	: FCC PART 15C PEAK		
Env. / Ins.	: 23.8°C/53.5%	Engineer	: Allen
Test Mode	: BT3.0 GFSK 2480MHz Tx		

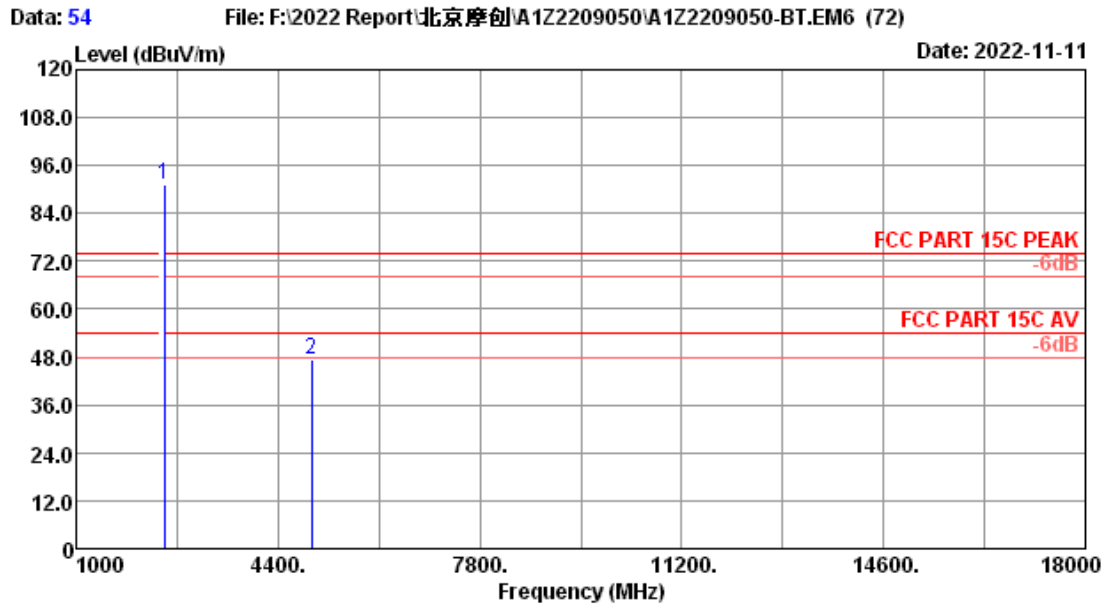


Site no. : 3m Chamber Data no. : 52
 Dis. / Ant. : 3m 2022 MCTD1209-3006 Ant. pol. : VERTICAL
 Limit : FCC PART 15C PEAK
 Env. / Ins. : 23.8°C/53.5% Engineer : Allen
 Test Mode : BT3.0 GFSK 2480MHz Tx

No.	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Amp factor (dB)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Remark
1	2480.00	27.80	2.34	99.25	34.35	95.04	-----	-----	Peak
2	4960.00	32.03	3.39	45.48	33.69	47.21	74.00	26.79	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading
 -Amp factor.
 2. The emission levels that are 20dB below the official
 limit are not reported.

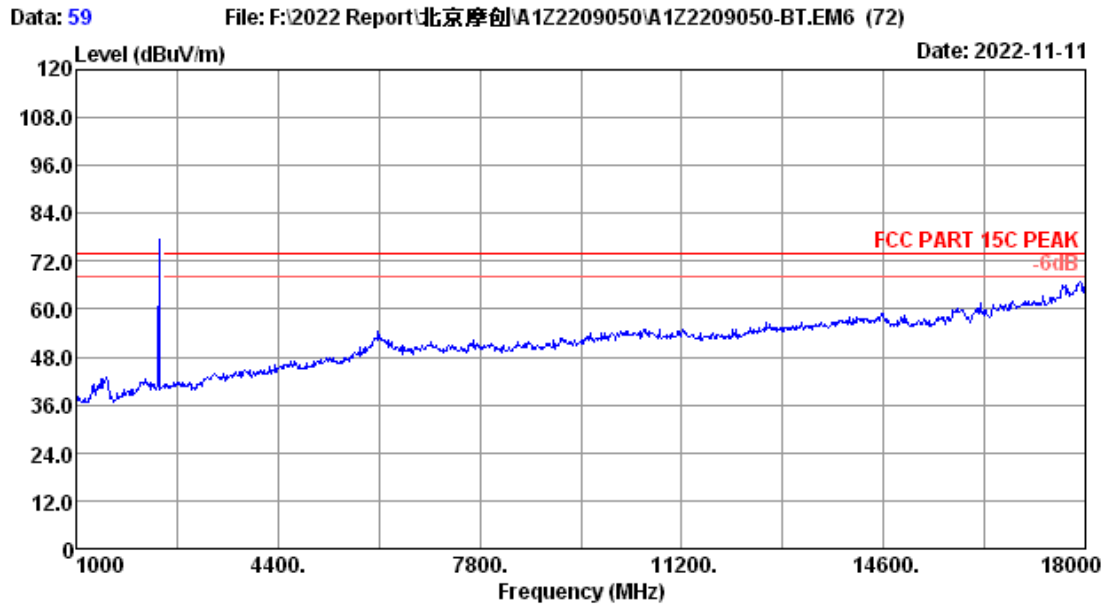




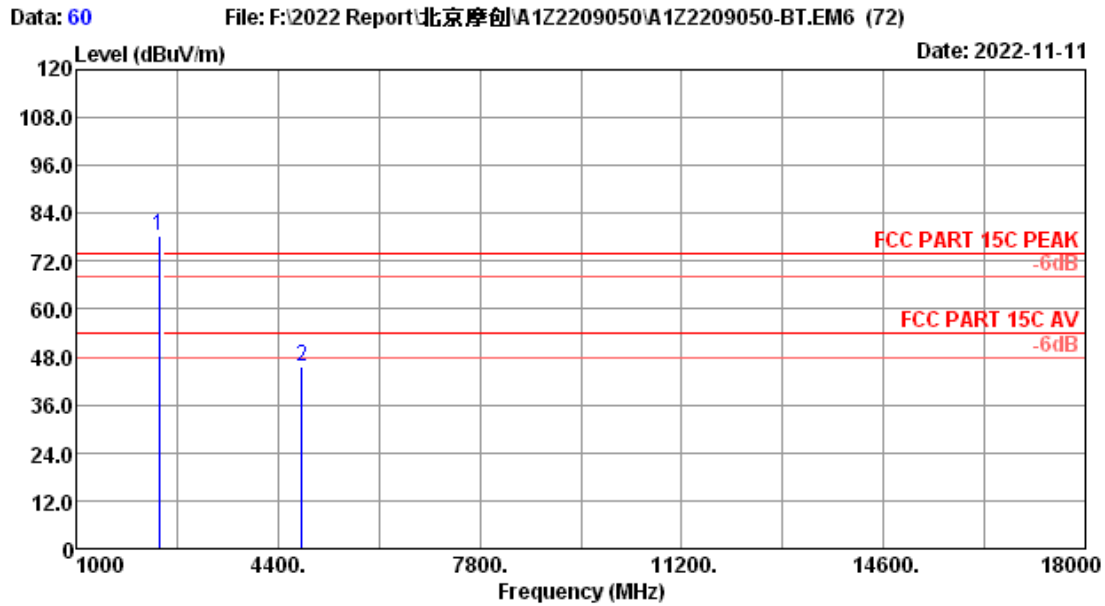
Site no. : 3m Chamber Data no. : 54
 Dis. / Ant. : 3m 2022 MCTD1209-3006 Ant. pol. : HORIZONTAL
 Limit : FCC PART 15C PEAK
 Env. / Ins. : 23.8°C/53.5% Engineer : Allen
 Test Mode : BT3.0 GFSK 2480MHz Tx

No.	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Amp factor (dB)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Remark
1	2480.00	27.80	2.34	95.59	34.35	91.38	-----	-----	Peak
2	4960.00	32.03	3.39	45.57	33.69	47.30	74.00	26.70	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading
 -Amp factor.
 2. The emission levels that are 20dB below the official
 limit are not reported.



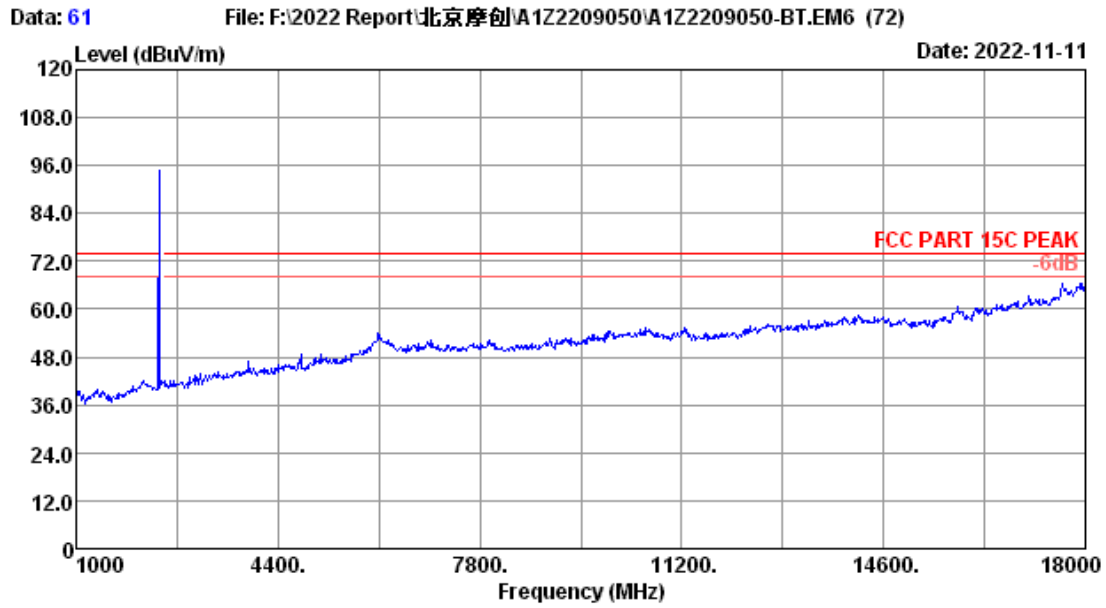
Site no.	: 3m Chamber	Data no.	: 59
Dis. / Ant.	: 3m 2022 MCTD1209-3006	Ant. pol.	: HORIZONTAL
Limit	: FCC PART 15C PEAK		
Env. / Ins.	: 23.8°C/53.5%	Engineer	: Allen
Test Mode	: BT3.0 8DPSK 2402MHz Tx		



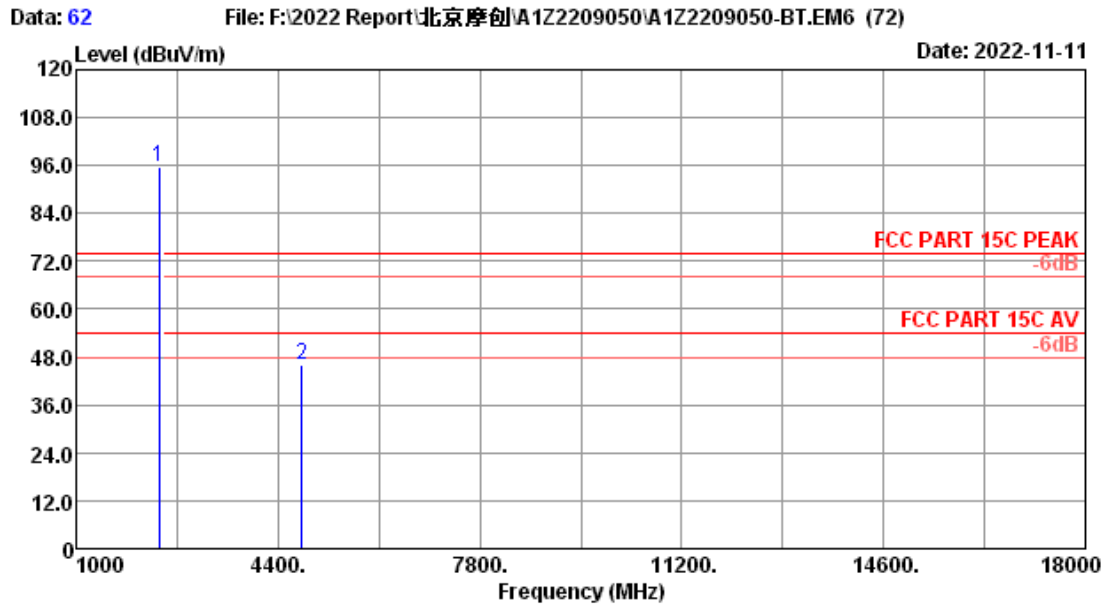
Site no. : 3m Chamber Data no. : 60
 Dis. / Ant. : 3m 2022 MCTD1209-3006 Ant. pol. : HORIZONTAL
 Limit : FCC PART 15C PEAK
 Env. / Ins. : 23.8°C/53.5% Engineer : Allen
 Test Mode : BT3.0 8DPSK 2402MHz Tx

No.	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Reading (dBUV)	Amp factor (dB)	Emission Level (dBUV/m)	Limits (dBUV/m)	Margin (dB)	Remark
1	2402.00	27.70	2.29	82.71	34.36	78.34	-----	-----	Peak
2	4804.00	31.20	3.33	44.90	33.68	45.75	74.00	28.25	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading
 -Amp factor.
 2. The emission levels that are 20dB below the official
 limit are not reported.



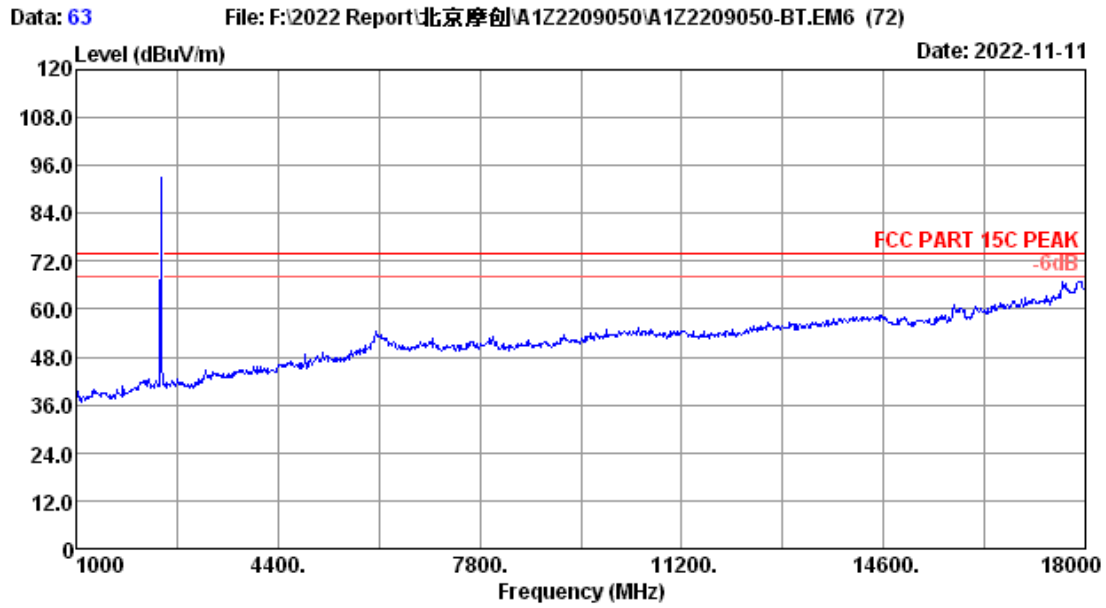
Site no.	: 3m Chamber	Data no.	: 61
Dis. / Ant.	: 3m 2022 MCTD1209-3006	Ant. pol.	: VERTICAL
Limit	: FCC PART 15C PEAK		
Env. / Ins.	: 23.8°C/53.5%	Engineer	: Allen
Test Mode	: BT3.0 8DPSK 2402MHz Tx		



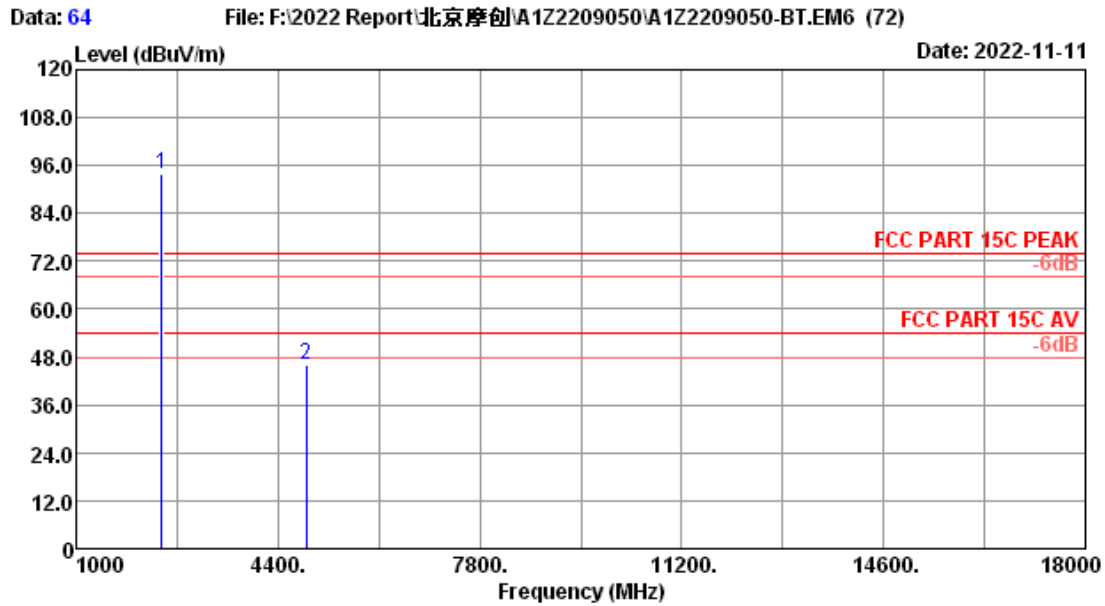
Site no. : 3m Chamber Data no. : 62
 Dis. / Ant. : 3m 2022 MCTD1209-3006 Ant. pol. : VERTICAL
 Limit : FCC PART 15C PEAK
 Env. / Ins. : 23.8°C/53.5% Engineer : Allen
 Test Mode : BT3.0 8DPSK 2402MHz Tx

No.	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Amp factor (dB)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Remark
1	2402.00	27.70	2.29	100.07	34.36	95.70	-----	-----	Peak
2	4804.00	31.20	3.33	45.25	33.68	46.10	74.00	27.90	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading
 -Amp factor.
 2. The emission levels that are 20dB below the official
 limit are not reported.



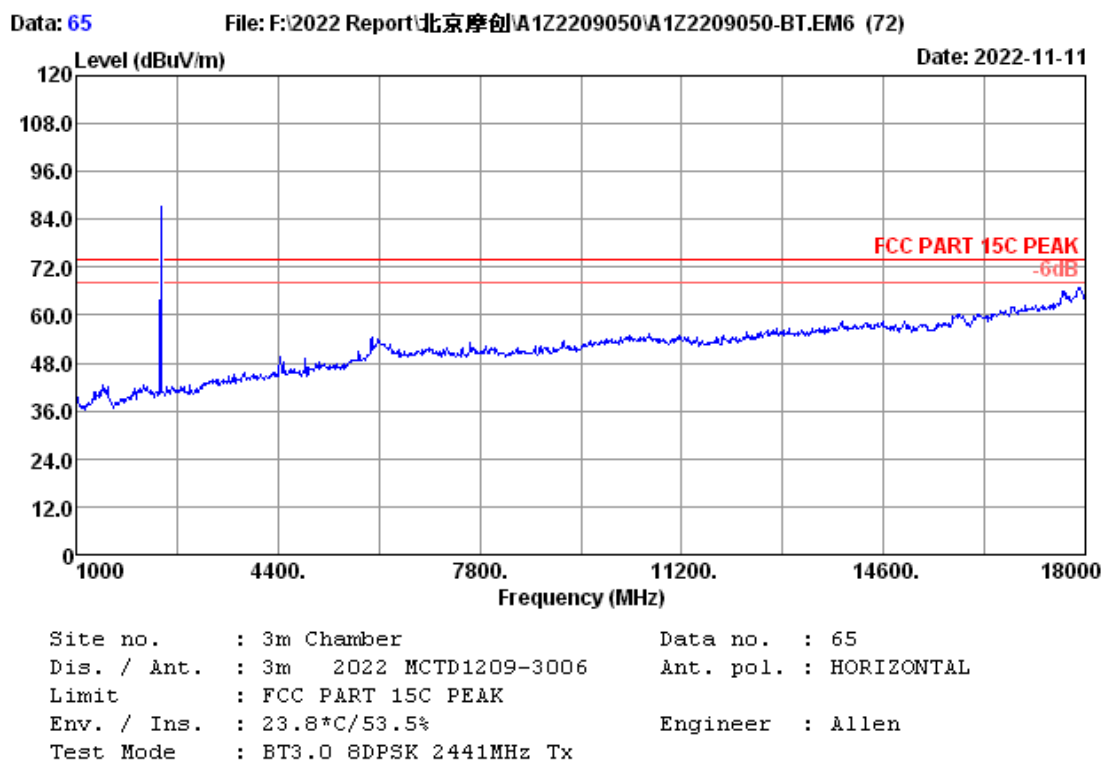
Site no.	: 3m Chamber	Data no.	: 63
Dis. / Ant.	: 3m 2022 MCTD1209-3006	Ant. pol.	: VERTICAL
Limit	: FCC PART 15C PEAK		
Env. / Ins.	: 23.8°C/53.5%	Engineer	: Allen
Test Mode	: BT3.0 8DPSK 2441MHz Tx		

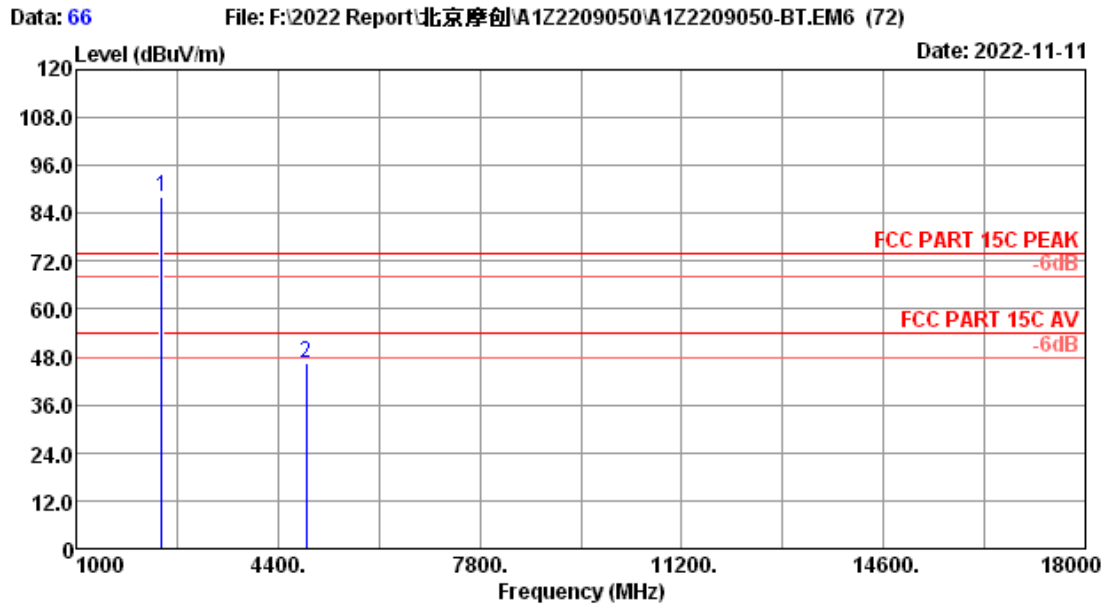


Site no. : 3m Chamber Data no. : 64
 Dis. / Ant. : 3m 2022 MCTD1209-3006 Ant. pol. : VERTICAL
 Limit : FCC PART 15C PEAK
 Env. / Ins. : 23.8°C/53.5% Engineer : Allen
 Test Mode : BT3.0 8DPSK 2441MHz Tx

No.	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Amp factor (dB)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Remark
1	2441.00	27.80	2.32	97.90	34.35	93.67	-----	-----	Peak
2	4882.00	31.43	3.35	44.95	33.69	46.04	74.00	27.96	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading
 -Amp factor.
 2. The emission levels that are 20dB below the official
 limit are not reported.

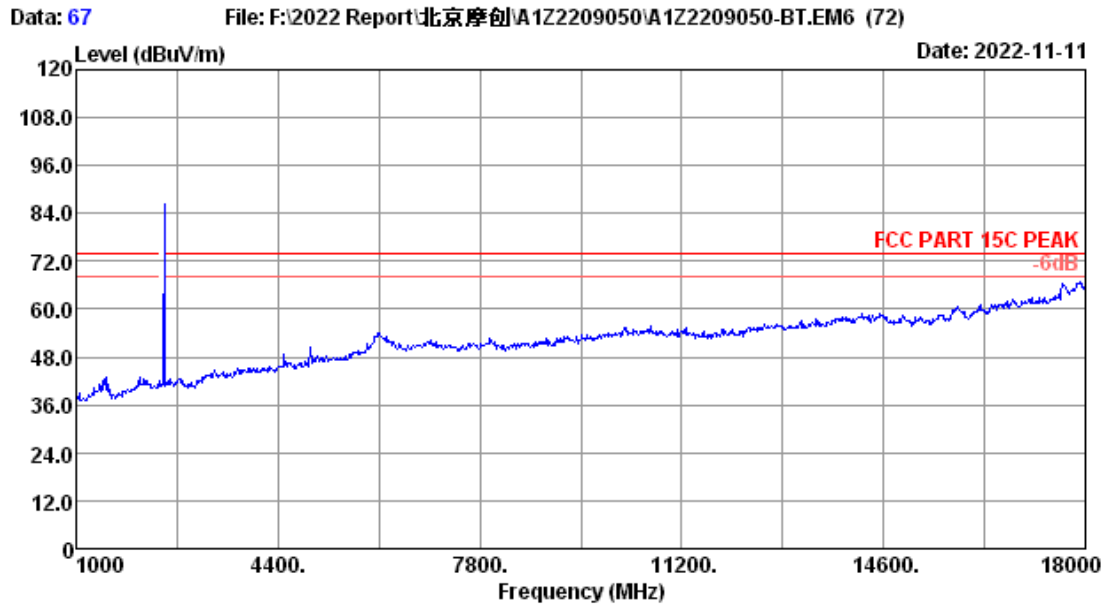




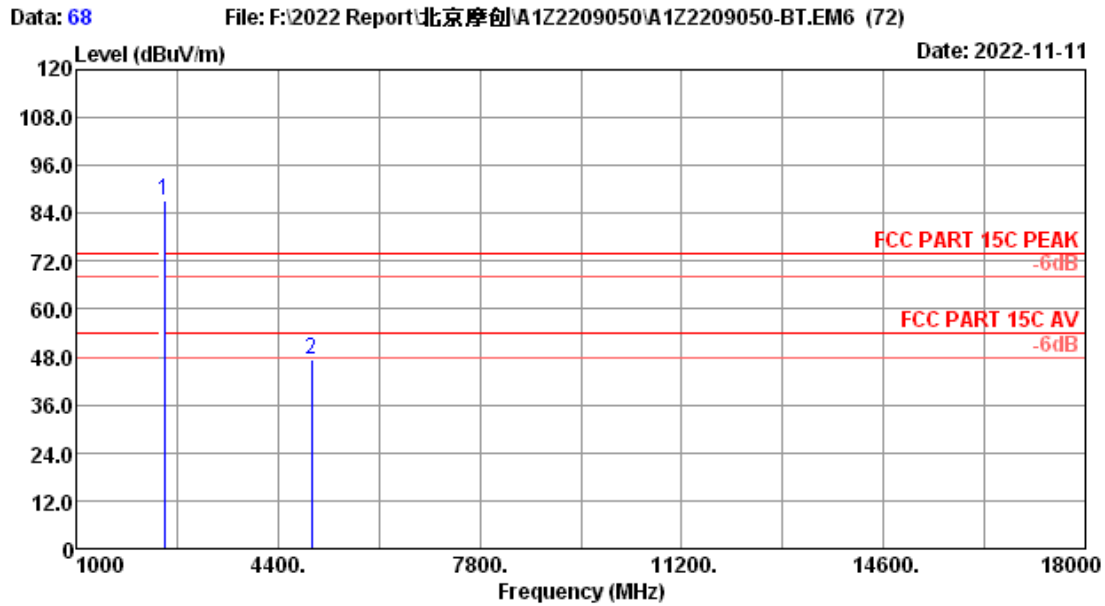
Site no. : 3m Chamber Data no. : 66
 Dis. / Ant. : 3m 2022 MCTD1209-3006 Ant. pol. : HORIZONTAL
 Limit : FCC PART 15C PEAK
 Env. / Ins. : 23.8°C/53.5% Engineer : Allen
 Test Mode : BT3.0 8DPSK 2441MHz Tx

No.	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Amp factor (dB)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Remark
1	2441.00	27.80	2.32	92.44	34.35	88.21	-----	-----	Peak
2	4882.00	31.43	3.35	45.33	33.69	46.42	74.00	27.58	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading
 -Amp factor.
 2. The emission levels that are 20dB below the official
 limit are not reported.



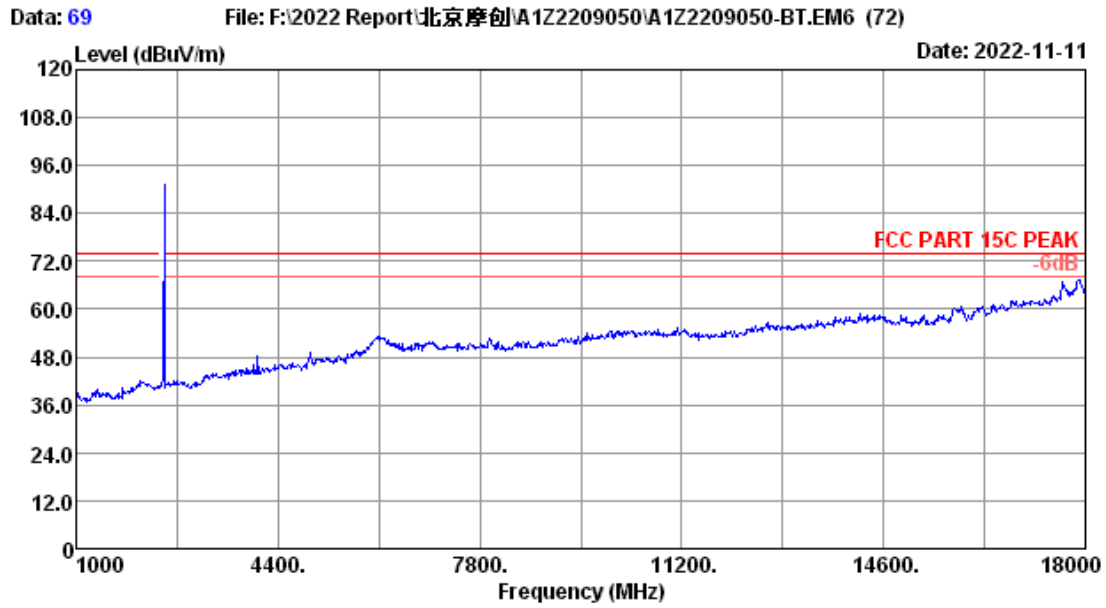
Site no.	: 3m Chamber	Data no.	: 67
Dis. / Ant.	: 3m 2022 MCTD1209-3006	Ant. pol.	: HORIZONTAL
Limit	: FCC PART 15C PEAK		
Env. / Ins.	: 23.8°C/53.5%	Engineer	: Allen
Test Mode	: BT3.0 8DPSK 2480MHz Tx		



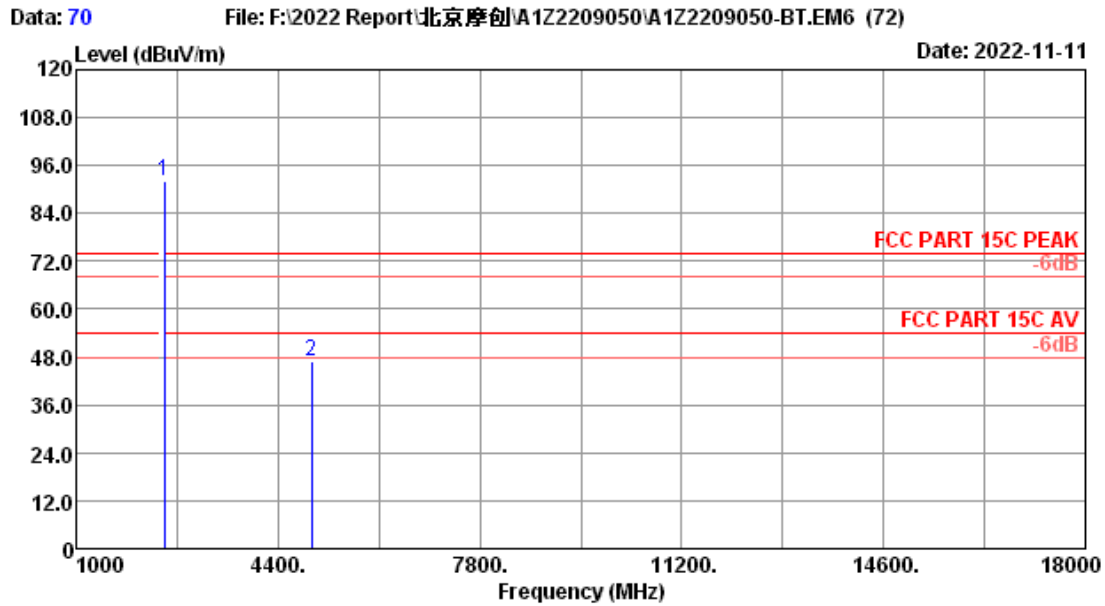
Site no. : 3m Chamber Data no. : 68
 Dis. / Ant. : 3m 2022 MCTD1209-3006 Ant. pol. : HORIZONTAL
 Limit : FCC PART 15C PEAK
 Env. / Ins. : 23.8°C/53.5% Engineer : Allen
 Test Mode : BT3.0 8DPSK 2480MHz Tx

No.	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Reading (dBUV)	Amp factor (dB)	Emission Level (dBUV/m)	Limits (dBUV/m)	Margin (dB)	Remark
1	2480.00	27.80	2.34	91.46	34.35	87.25	-----	-----	Peak
2	4960.00	32.03	3.39	45.76	33.69	47.49	74.00	26.51	Peak

Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading
 -Amp factor.
 2. The emission levels that are 20dB below the official
 limit are not reported.



Site no.	: 3m Chamber	Data no.	: 69
Dis. / Ant.	: 3m 2022 MCTD1209-3006	Ant. pol.	: VERTICAL
Limit	: FCC PART 15C PEAK		
Env. / Ins.	: 23.8°C/53.5%	Engineer	: Allen
Test Mode	: BT3.0 8DPSK 2480MHz Tx		



Site no. : 3m Chamber Data no. : 70
 Dis. / Ant. : 3m 2022 MCTD1209-3006 Ant. pol. : VERTICAL
 Limit : FCC PART 15C PEAK
 Env. / Ins. : 23.8°C/53.5% Engineer : Allen
 Test Mode : BT3.0 8DPSK 2480MHz Tx

No.	Freq. (MHz)	Ant. Factor (dB/m)	Cable Loss (dB)	Reading (dBuV)	Amp factor (dB)	Emission Level (dBuV/m)	Limits (dBuV/m)	Margin (dB)	Remark
1	2480.00	27.80	2.34	96.29	34.35	92.08	-----	-----	Peak
2	4960.00	32.03	3.39	45.37	33.69	47.10	74.00	26.90	Peak

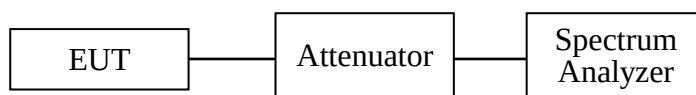
Remarks: 1. Emission Level= Antenna Factor + Cable Loss + Reading
 -Amp factor.
 2. The emission levels that are 20dB below the official
 limit are not reported.

5. CONDUCTED SPURIOUS EMISSIONS

5.1. Test Equipments

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	PXA Signal Analyzer	Agilent	N9030A	MY51380221	Apr.07,22	1 Year
2.	RF Cable	HUBER+SUHNER	SUCOFLEX-106	505238/6	Apr.07,22	1 Year

5.2. Block Diagram of Test Setup



5.3. Limit

In any 100kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30dB instead of 20dB.

5.4. Test Procedure

Use the test method described in ANSI C63.10 clause 7.8.8:

The transmitter output was connected to a spectrum analyzer, The resolution bandwidth is set to 100 kHz, The video bandwidth is set to 300 kHz and measure all the emissions With peak detector.

Note: The cable loss and attenuator loss were offset into spectrum analyzer as an amplitude offset.

5.5. Test result

PASS (The testing data was attached in the next pages.)

EUT: Display Head Unit		
M/N: DHU 1.0		
Test date: 2022-10-27	Pressure: 102.1±1.0 kpa	Humidity: 53.2±3.0%
Tested by: Xinyao	Test site: RF site	Temperature: 22.3±0.6 °C

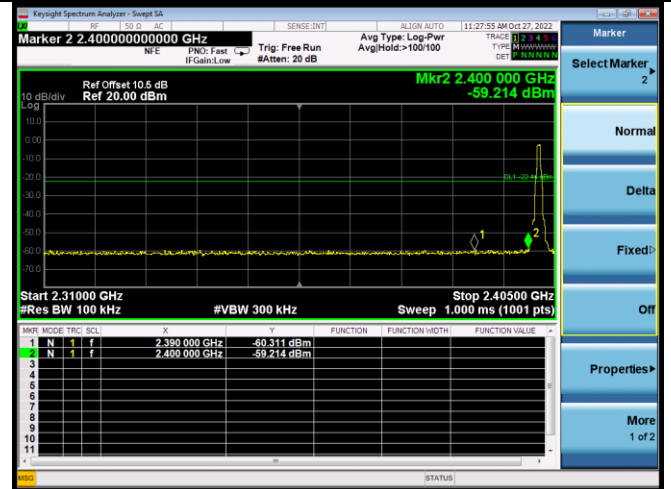
Hopping off

FSK

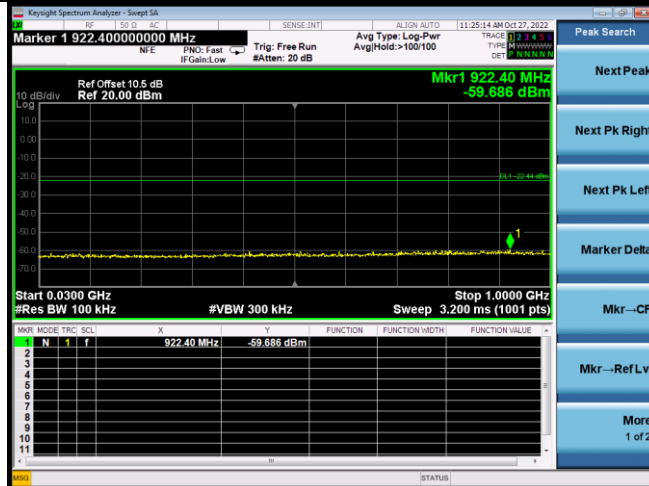
2402MHz



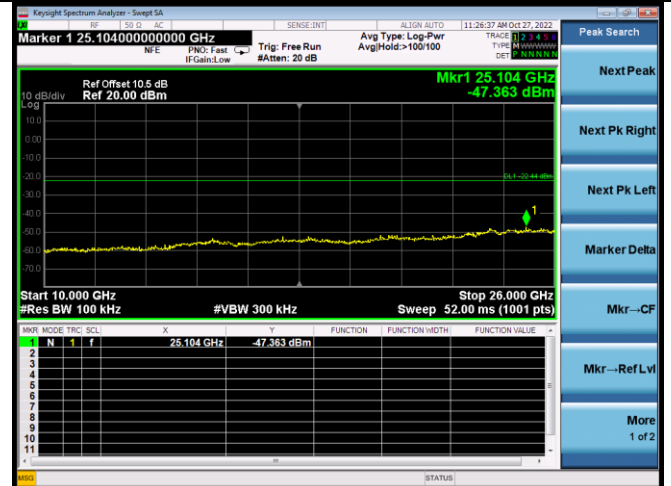
2402MHz(2.3GHz – 2.4GHz)



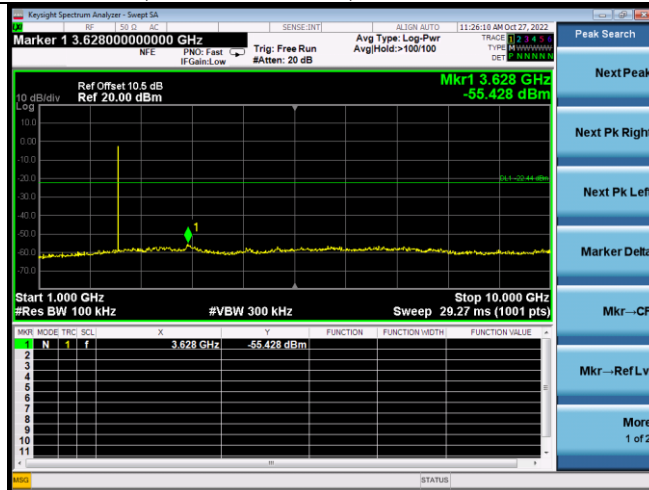
2402MHz(30MHz – 1GHz)



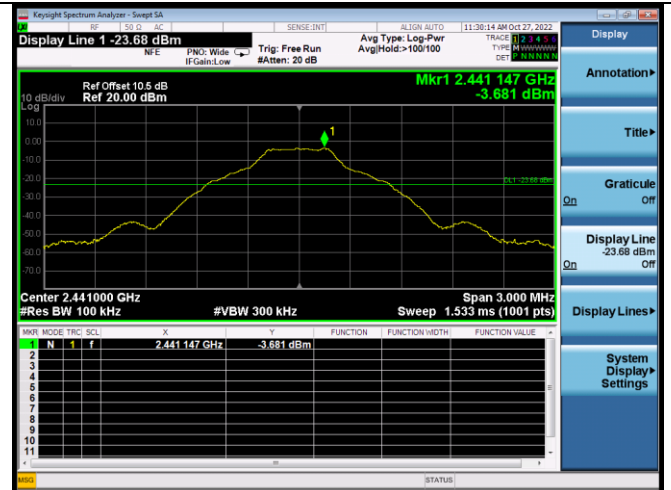
2402MHz(10GHz – 26GHz)



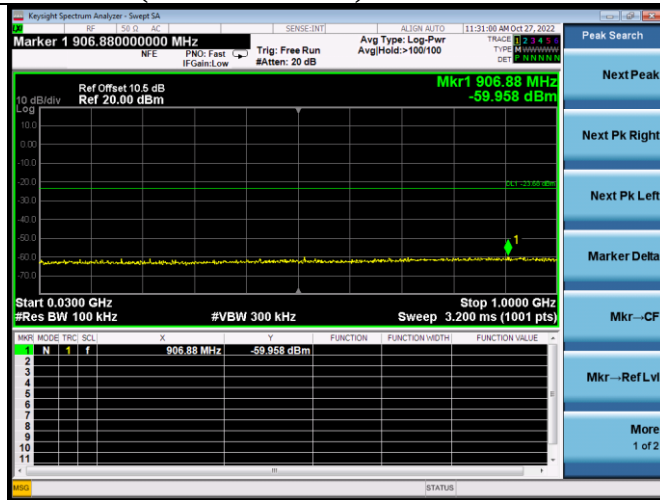
2402MHz(1GHz – 10GHz)



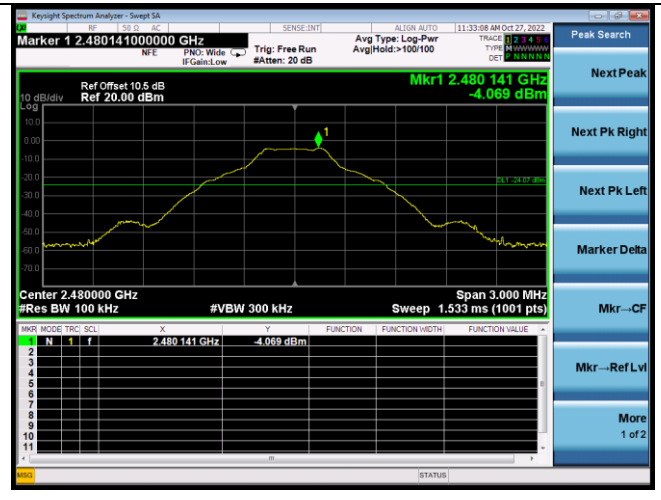
2441MHz



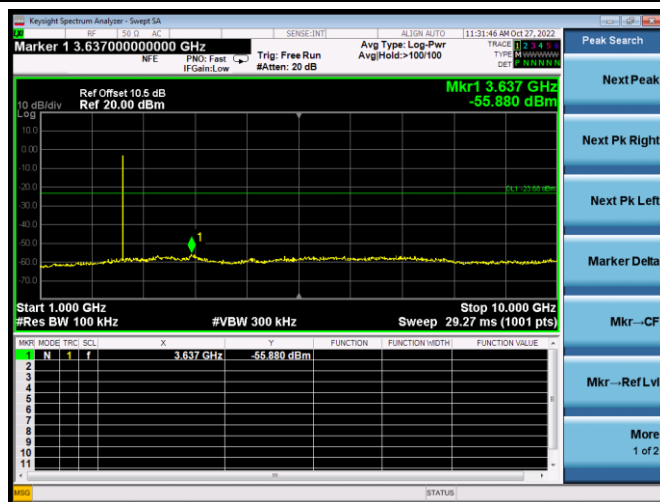
2441MHz(30MHz – 1GHz)



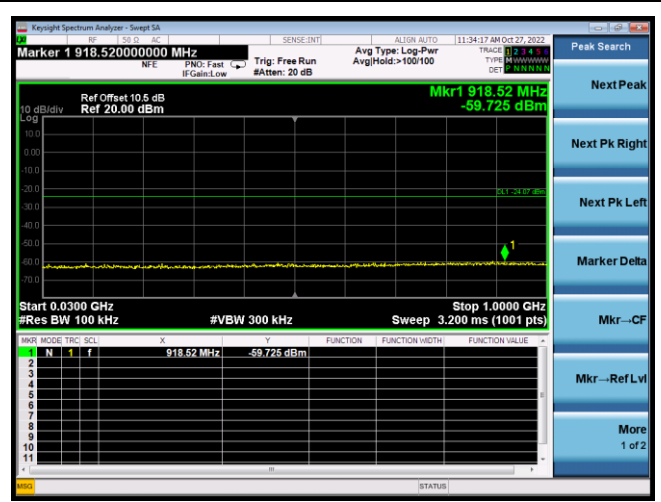
2480MHz



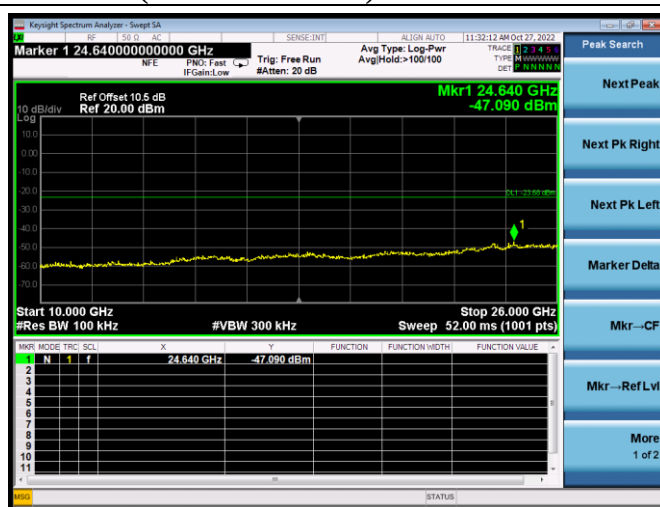
2441MHz(1GHz – 10GHz)



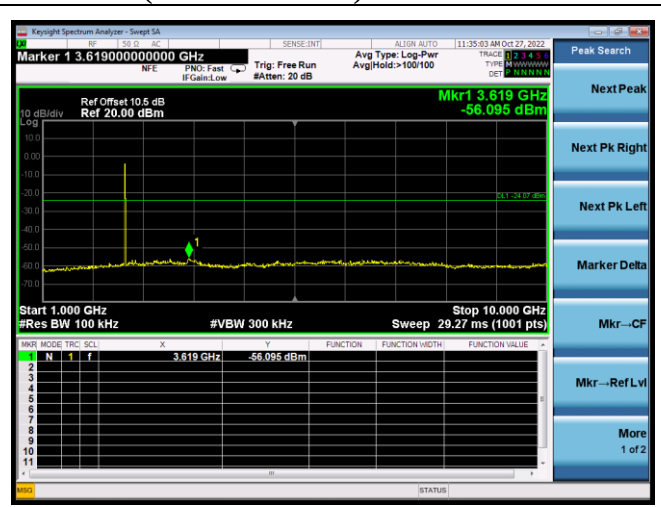
2480MHz(30MHz – 1GHz)



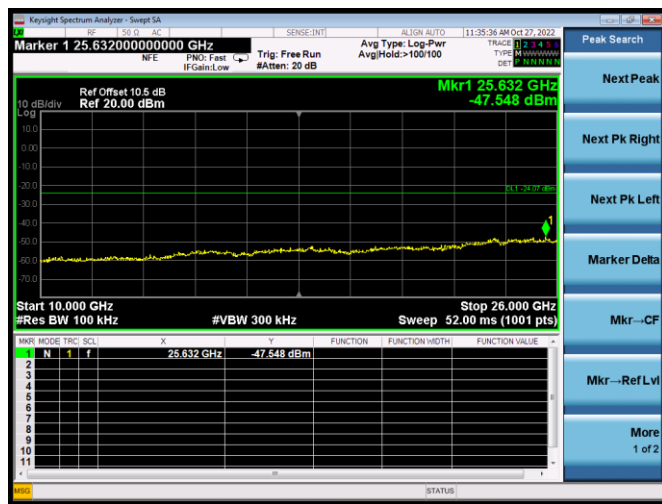
2441MHz(10GHz – 26GHz)



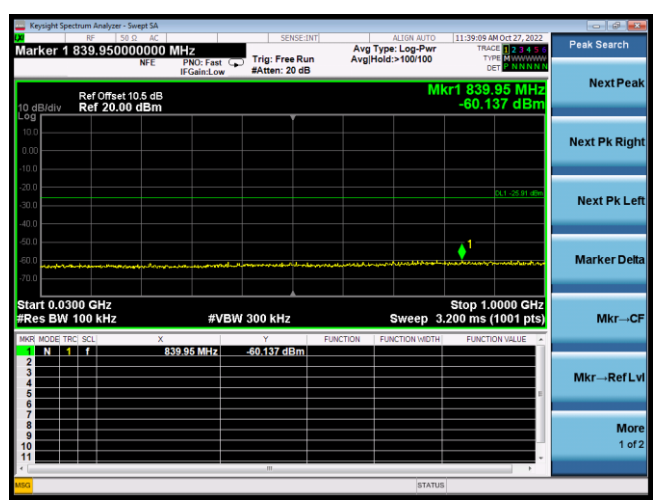
2480MHz(1GHz – 10GHz)



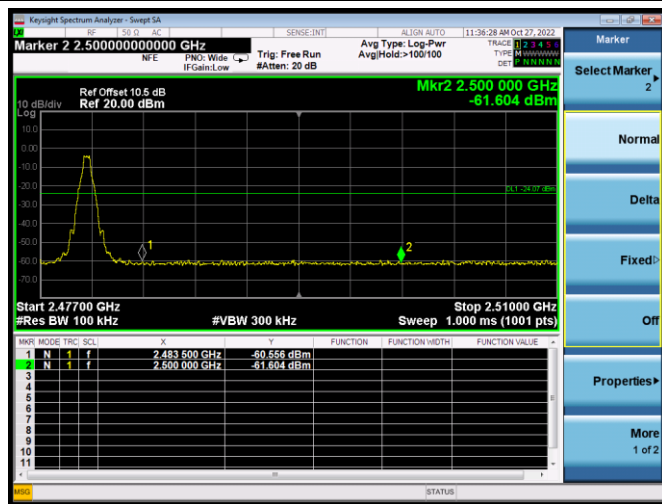
2480MHz(10GHz – 26GHz)



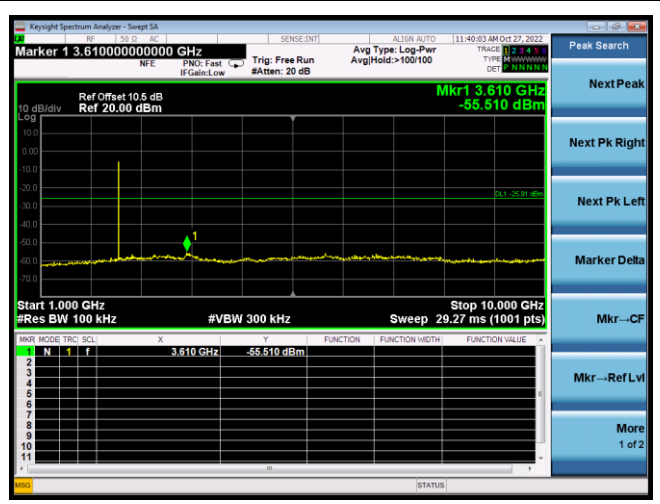
2402MHz(30MHz – 1GHz)



2480MHz(2.4GHz – 2.5GHz)

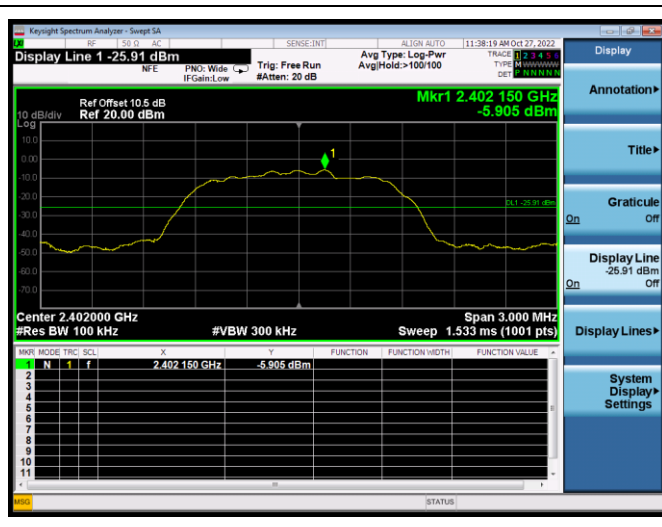


2402MHz(1GHz – 10GHz)

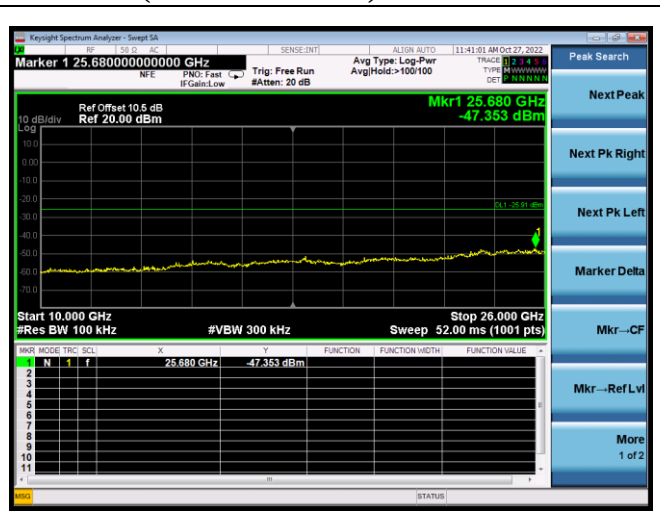


8-DPSK

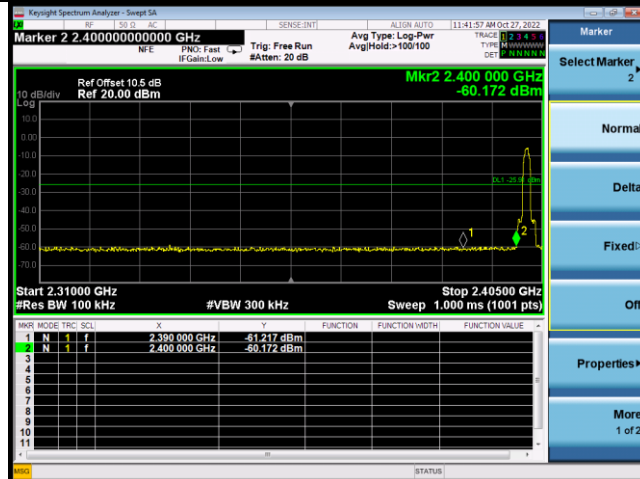
2402MHz



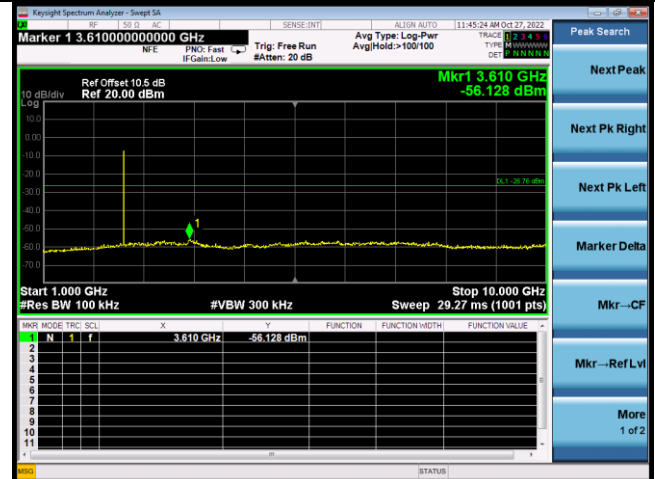
2402MHz(10GHz – 26GHz)



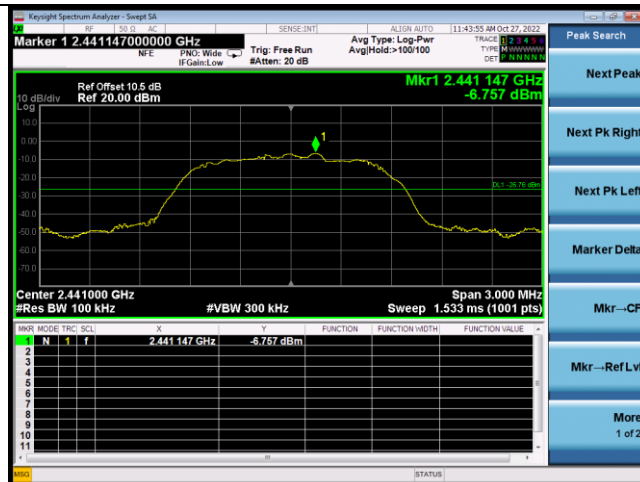
2402MHz(2.3GHz – 2.4GHz)



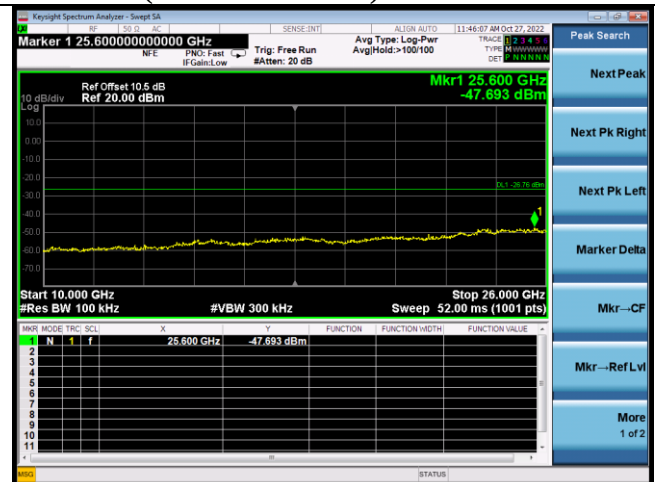
2441MHz(1GHz – 10GHz)



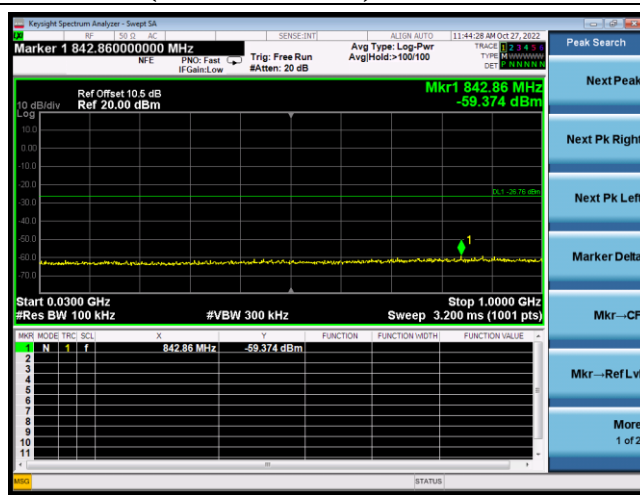
2441MHz



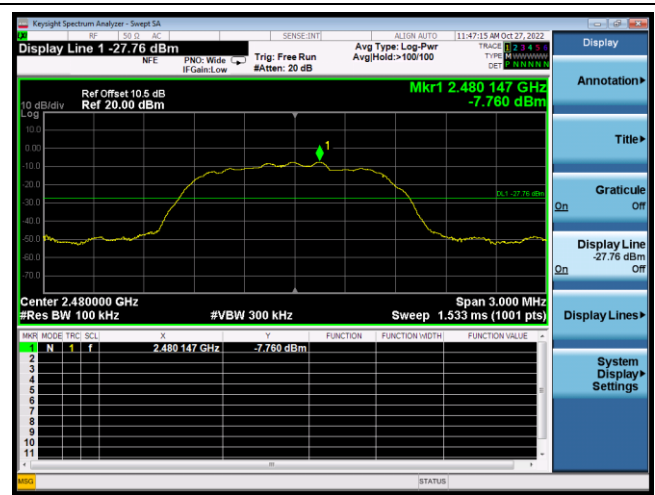
2441MHz(10GHz – 26GHz)



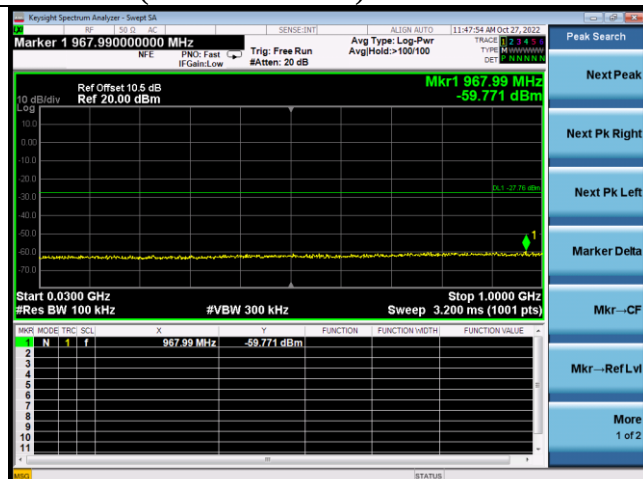
2441MHz (30MHz – 1GHz)



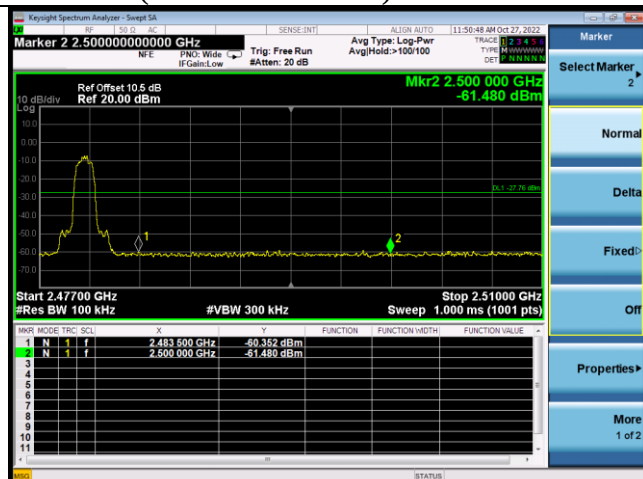
2480MHz



2480MHz(30MHz – 1GHz)

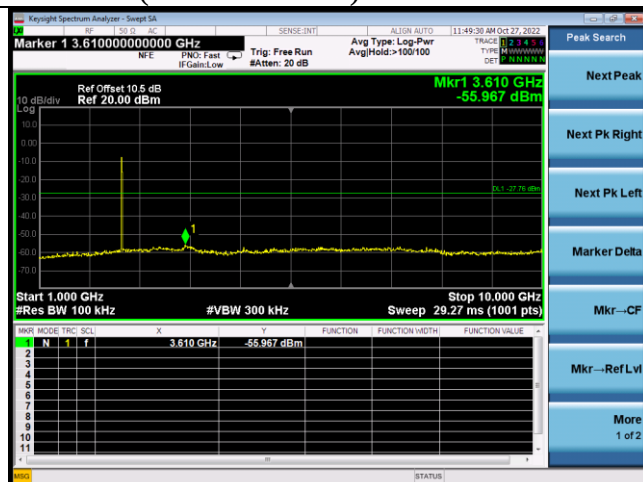


2480MHz(2.4GHz – 2.5GHz)

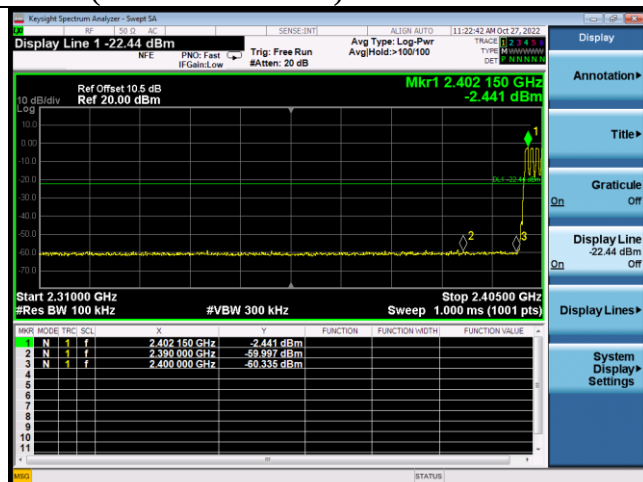


Hopping on

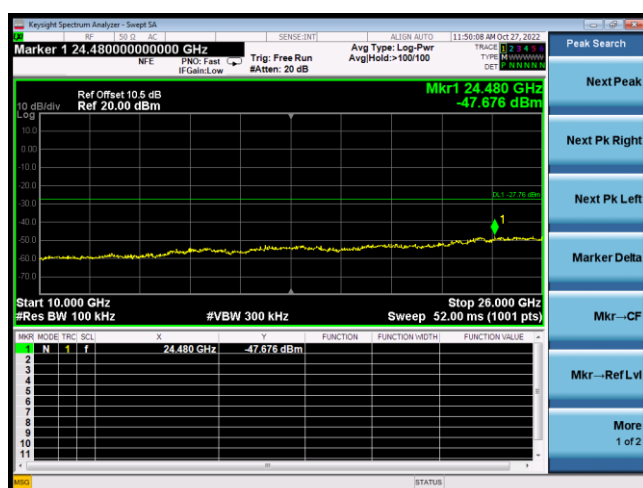
2480MHz(1GHz – 10GHz)



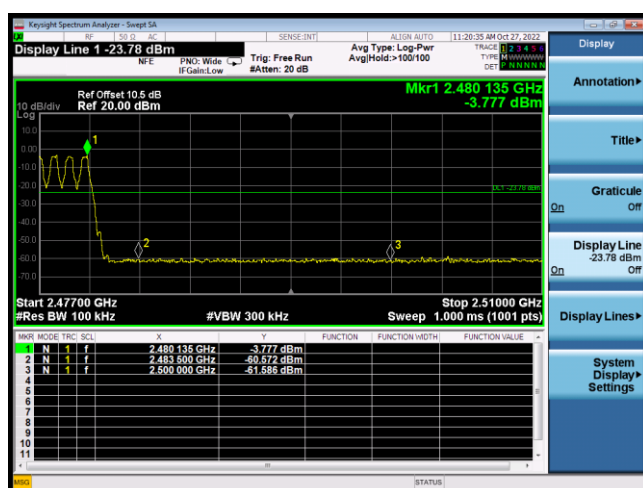
GFSK(2.3GHz – 2.4GHz)



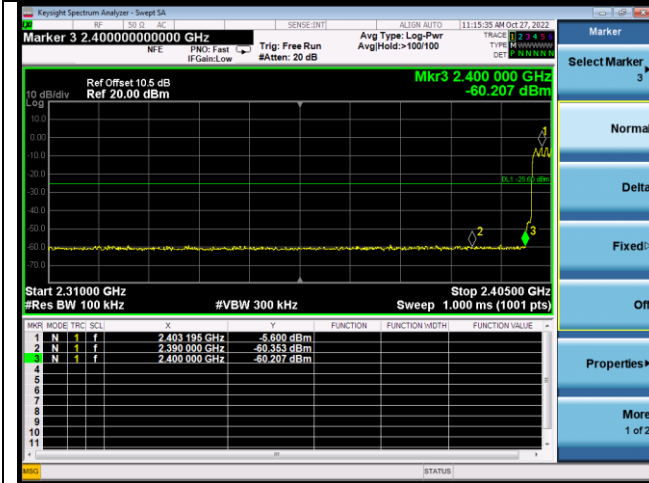
2480MHz(10GHz – 26GHz)



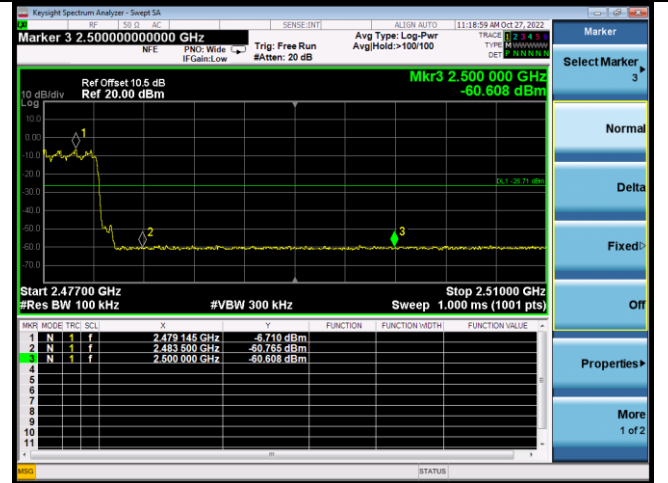
GFSK(2.4GHz – 2.5GHz)



8-DPSK(2.3GHz – 2.4GHz)



8-DPSK(2.4GHz – 2.5GHz)



6. 20 DB & 99% BANDWIDTH TEST

6.1.Test Equipments

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	PXA Signal Analyzer	Agilent	N9030A	MY51380221	Apr.07,22	1 Year
2.	RF Cable	HUBER+SUHNER	SUCOFLE X-106	505238/6	Apr.07,22	1 Year

6.2.Limit

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§ 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

6.3.Test Procedure

Use the test method descried in ANSI C63.10 clause 7.8.7:

1. Connect the antenna port of the EUT to the spectrum analyzer.
2. Let the EUT transmit at Low/ Mid/ High channel with test software.
3. Setting of SA is following as: RBW: 30kHz / VBW: 100kHz
Sweep Mode: Continuous sweep
Detect mode: Positive peak
Trace mode: Max hold.
4. Use the occupied bandwidth function of the SA measure the 20dB bandwidth directly.

6.4.Test Results

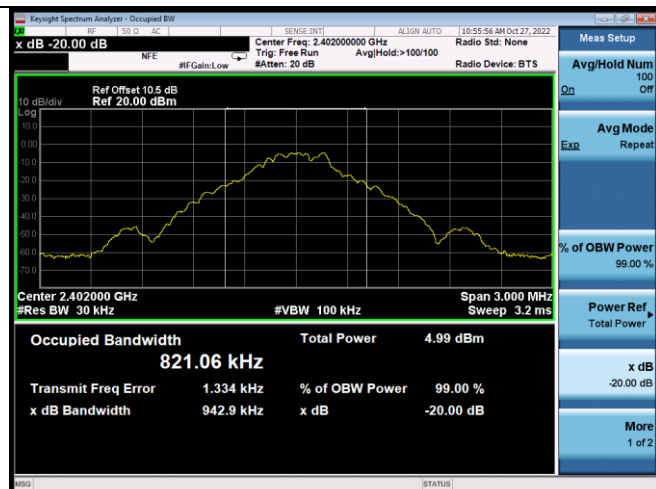
EUT: Display Head Unit		
M/N: DHU 1.0		
Test date: 2022-10-27	Pressure: 102.1 ±1.0 kpa	Humidity: 53.2 ±3.0%
Tested by: Xinyao	Test site: RF site	Temperature:22.3±0.6 °C

Test Mode	Frequency (MHz)	20dB bandwidth (KHz)	Limit (KHz)
GFSK	2402	942.9	N/A
	2441	944.3	N/A
	2480	945.3	N/A
8-DPSK	2402	1304	N/A
	2441	1303	N/A
	2480	1302	N/A
Conclusion : PASS			

Test Mode	Frequency (MHz)	99% Bandwidth (KHz)	Limit (KHz)
GFSK	2402	821.06	N/A
	2441	823.78	N/A
	2480	822.46	N/A
8-DPSK	2402	1182.0	N/A
	2441	1179.6	N/A
	2480	1179.9	N/A
Conclusion: PASS			

GFSK

2402MHz



8-DPSK

2402MHz



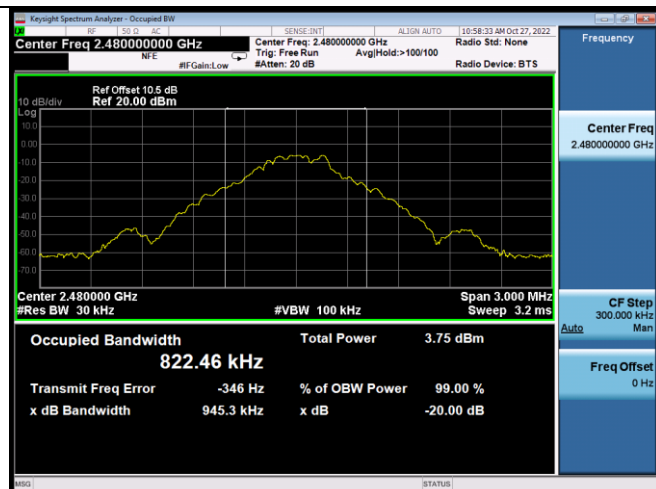
2441MHz



2441MHz



2480MHz



2480MHz



7. CARRIER FREQUENCY SEPARATION TEST

7.1. Test Equipments

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	PXA Signal Analyzer	Agilent	N9030A	MY51380221	Apr.07,22	1 Year
2.	RF Cable	HUBER+SUHNER	SUCOFLEX-106	505238/6	Apr.07,22	1 Year

7.2. Limit

Frequency hopping systems shall have hopping channel carrier frequency separated by a minimum of 25kHz or the 20dB 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.

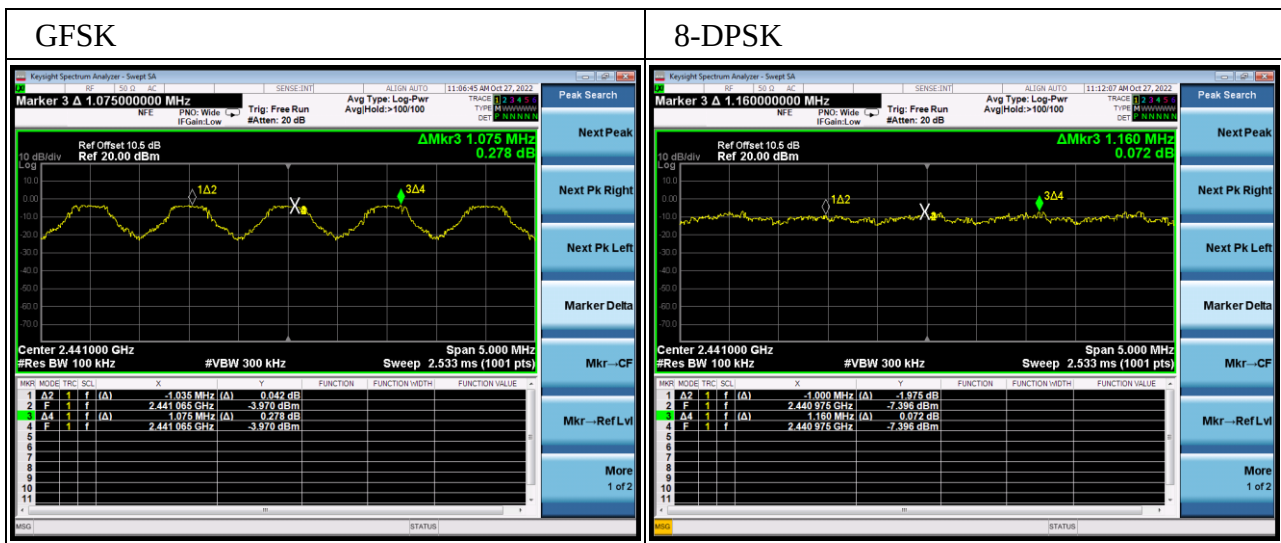
7.3. Test Procedure

Use the test method described in ANSI C63.10 clause 7.8.2:

1. Connect the antenna port of the EUT to the Spectrum analyzer.
2. Let the EUT transmit at Low/ Mid/ High channel.
3. Setting of SA is following as: RBW: 100kHz / VBW: 300kHz.Span: 5MHz
4. Use the mark Delta function of the SA measure out the channel separation.

7.4. Test Results.

EUT: Display Head Unit			
M/N: DHU 1.0			
Test date: 2022-10-27		Pressure: 102.1 ±1.0 kpa	Humidity: 53.2 ±3.0%
Tested by: Xinyao		Test site: RF site	Temperature: 22.3 ±0.6 °C
Test Mode	Channel separation	Limit(KHz)	Conclusion
GFSK	1.0MHz	630.200	PASS
8-DPSK	1.0MHz	869.333	PASS



8. NUMBER OF HOPPING FREQUENCY TEST

8.1.Test Equipments

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	PXA Signal Analyzer	Agilent	N9030A	MY51380221	Apr.07,22	1 Year
2.	RF Cable	HUBER+SUHNER	SUCOFLEX-106	505238/6	Apr.07,22	1 Year

8.2.Limit

Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels

8.3.Test Procedure

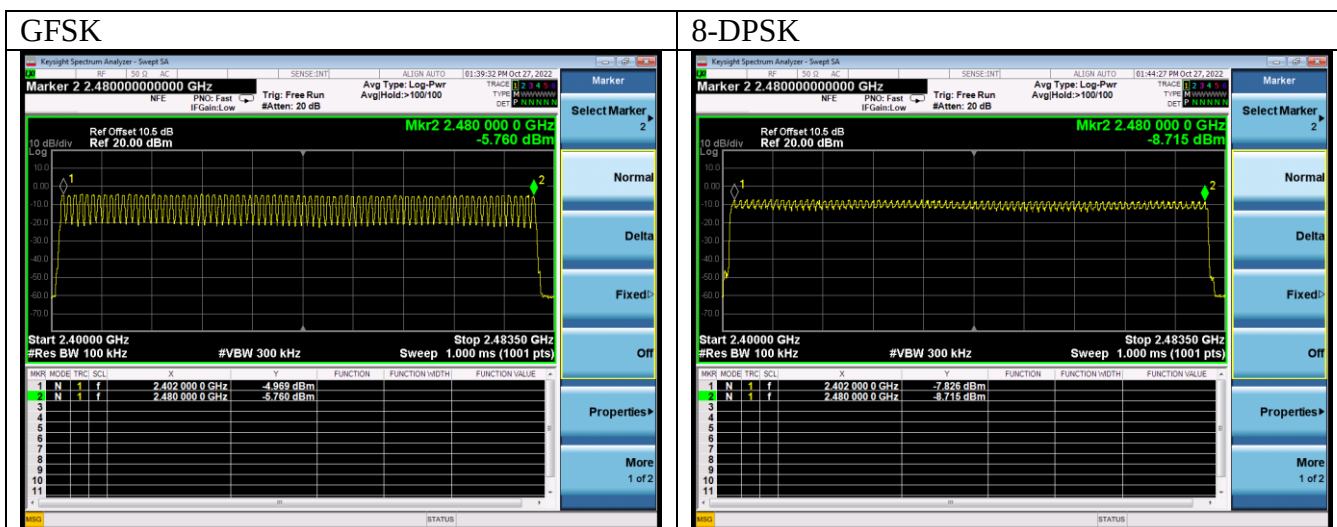
Use the test method described in ANSI C63.10 clause 7.8.3:

1. Connect the antenna of the EUT to Spectrum analyzer and let the EUT working at hopping mode.
2. Setting of SA is following as: RBW: 100kHz / VBW: 300kHz ,
Start frequency: 2390MHz
Stop frequency: 2483.5MHz
And waiting for the hopping trace until stability, count out the number of the hopping.

8.4.Test Results

EUT: Display Head Unit		
M/N: DHU 1.0		
Test date: 2022-10-27	Pressure: 102.1 ±1.0 kpa	Humidity: 53.2 ±3.0%
Tested by: Xinyao	Test site: RF site	Temperature:22.3±0.6 °C

Test Mode	Number of channel	Limit	Conclusion
GFSK	79	≥15	PASS
8-DPSK	79	≥15	PASS



9. DWELL TIME

9.1. Test Equipments

Item	Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
1.	PXA Signal Analyzer	Agilent	N9030A	MY51380221	Apr.07,22	1 Year
2.	RF Cable	HUBER+SUHNER	SUCOFLEX-106	505238/6	Apr.07,22	1 Year

9.2. Limit

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.

9.3. Test Procedure

Use the test method described in ANSI C63.10 clause 7.8.4:

1. Connect the antenna of the EUT to Spectrum analyzer and let the EUT working at hopping mode.
2. Setting of SA is following as:
RBW: 100kHz / VBW: 300kHz
Sweep Mode: Single
Detect mode: Positive peak
Trace mode: Auto
Span: 0Hz
Sweep time: 5s and big enough to measure one hopping signal
3. Use below formula calculate the Dwell time
Dwell time=Hopping number per second*0.4*channel number*Pulse bandwidth per hopping.

9.4. Test Results

EUT: Display Head Unit		
M/N: DHU 1.0		
Test date: 2022-10-27	Pressure: 102.1 ±1.0 kpa	Humidity: 53.2 ±3.0%
Tested by: Xinyao	Test site: RF site	Temperature: 22.3 ±0.6 °C

Mode		dwell time	Limit	Conclusion
GFSK	DH1	50 hops/5s*0.4s*79channels* 0.404 ms =127.664ms	≤ 400ms	PASS
	DH3	22 hops/5s*0.4s*79channels* 1.665 ms =231.502ms	≤ 400ms	PASS
	DH5	21 hops/5s*0.4s*79channels* 2.915 ms =386.879ms	≤ 400ms	PASS
8-DPSK	3-DH1	49 hops/5s*0.4s*79channels* 0.411 ms =127.278ms	≤ 400ms	PASS
	3-DH3	27 hops/5s*0.4s*79channels* 1.659 ms =283.092ms	≤ 400ms	PASS
	3-DH5	18 hops/5s*0.4s*79channels* 2.925 ms =332.748ms	≤ 400ms	PASS

Note: All the lower levels were signaled from receiver and should not be considered in here.