

Test Report

Report No. : CQASZ20231202275E
Applicant: Shenzhen Velocity Technology Innovations Co., Ltd.
Address of Applicant: Rm 209, 211, 213, 215, Bldg 424, Bagualing Industrial Zone, Yuanling Str, Futian District, ShenZhen, China
Equipment Under Test (EUT):
Product: Baby Monitor
Model No.: BBM07, BBM09, BBM10, BBM03-RX, BBM04-RX, BBM07-RX, BBM10-RX
Test Model No.: BBM07
Brand Name: bonoch
FCC ID: 2A32L-BBM07
Standards: 47 CFR Part 15, Subpart C
Date of Receipt: 2023-12-11
Date of Test: 2023-12-11 to 2024-01-09
Date of Issue: 2024-01-17
Test Result : PASS*

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

Tested By: Lewis Zhou
(Lewis Zhou)

Reviewed By: Timo Lei
(Timo Lei)

Approved By: Jack Ai
(Jack Ai)



1 Version

Revision History Of Report

Report No.	Version	Description	Issue Date
CQASZ20231202275E	Rev.01	Initial report	2024-01-17

2 Test Summary

Test Item	Test Requirement	Test method	Result
Antenna Requirement	47 CFR Part 15.203	/	PASS
AC Power Line Conducted Emission	47 CFR Part 15, Subpart C Section 15.207	ANSI C63.10-2013	PASS
Conducted Peak Output Power	47 CFR Part 15.247	ANSI C63.10-2013	PASS
20dB Occupied Bandwidth	47 CFR Part 15.247	ANSI C63.10-2013	PASS
Carrier Frequencies Separation	47 CFR Part 15.247	ANSI C63.10-2013	PASS
Hopping Channel Number	47 CFR Part 15.247	ANSI C63.10-2013	PASS
Dwell Time	47 CFR Part 15.247	ANSI C63.10-2013	PASS
Pseudorandom Frequency Hopping Sequence	47 CFR Part 15.247	ANSI C63.10-2013	PASS
Band-edge for RF Conducted Emissions	47 CFR Part 15.247	ANSI C63.10-2013	PASS
RF Conducted Spurious Emissions	47 CFR Part 15.247	ANSI C63.10-2013	PASS
Radiated Spurious emissions	47 CFR Part 15.209	ANSI C63.10-2013	PASS
Restricted bands around fundamental frequency (Radiated Emission)	47 CFR Part 15.205/15.209	ANSI C63.10-2013	PASS

Remark:

The tested sample(s) and the sample information are provided by the client.

Tx: In this whole report Tx (or tx) means Transmitter.

Rx: In this whole report Rx (or rx) means Receiver.

RF: In this whole report RF means Radiated Frequency.

CH: In this whole report CH means channel.

Volt: In this whole report Volt means Voltage.

Temp: In this whole report Temp means Temperature.

Humid: In this whole report Humid means humidity.

Press: In this whole report Press means Pressure.

N/A: In this whole report not application

3 Contents

	Page
1 VERSION	2
2 TEST SUMMARY	3
3 CONTENTS	4
4 GENERAL INFORMATION	5
4.1 CLIENT INFORMATION	5
4.2 GENERAL DESCRIPTION OF EUT	5
4.3 ADDITIONAL INSTRUCTIONS	7
4.4 TEST ENVIRONMENT	8
4.5 DESCRIPTION OF SUPPORT UNITS	8
4.6 STATEMENT OF THE MEASUREMENT UNCERTAINTY	9
4.7 TEST LOCATION	10
4.8 TEST FACILITY	10
4.9 ABNORMALITIES FROM STANDARD CONDITIONS	10
4.10 OTHER INFORMATION REQUESTED BY THE CUSTOMER	10
4.11 EQUIPMENT LIST	11
5 TEST RESULTS AND MEASUREMENT DATA	12
5.1 ANTENNA REQUIREMENT	12
5.2 CONDUCTED EMISSIONS	13
5.3 CONDUCTED PEAK OUTPUT POWER	17
5.4 20dB OCCUPIED BANDWIDTH	21
5.5 CARRIER FREQUENCIES SEPARATION	24
5.6 HOPPING CHANNEL NUMBER	27
5.7 DWELL TIME	29
5.8 BAND-EDGE FOR RF CONDUCTED EMISSIONS	32
5.9 SPURIOUS RF CONDUCTED EMISSIONS	36
5.10 OTHER REQUIREMENTS FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM	42
5.11 RADIATED SPURIOUS EMISSION & RESTRICTED BANDS	44
5.11.1 Radiated Emission below 1GHz	47
5.11.2 Transmitter Emission above 1GHz	49
6 PHOTOGRAPHS - EUT TEST SETUP	50
6.1 RADIATED EMISSION	50
6.2 CONDUCTED EMISSION	51
7 PHOTOGRAPHS - EUT CONSTRUCTIONAL DETAILS	52

4 General Information

4.1 Client Information

Applicant:	Shenzhen Velocity Technology Innovations Co, .Ltd.
Address of Applicant:	Rm 209, 211, 213, 215, Bldg 424, Bagualing Industrial Zone, Yuanling Str, Futian District, ShenZhen, China
Manufacturer:	Shenzhen Velocity Technology Innovations Co, .Ltd.
Address of Manufacturer:	Rm 209, 211, 213, 215, Bldg 424, Bagualing Industrial Zone, Yuanling Str, Futian District, ShenZhen, China
Factory:	Huizhou Tongyinhai Precision Electronics Co., Ltd.
Address of Factory:	27 Xingwang Street, Gaobao Road, Lilin Town, Huicheng District, Huizhou City, Guangdong Province

4.2 General Description of EUT

Product Name:	Baby Monitor
Model No.:	BBM07, BBM09, BBM10, BBM03-RX, BBM04-RX, BBM07-RX, BBM10-RX
Test Model No.:	BBM07
Trade Mark:	bonoch
Software Version:	V2.3
Hardware Version:	V4.3
Operation Frequency:	2410MHz to 2477MHz
Modulation Technique:	Frequency Hopping Spread Spectrum(FHSS)
Modulation Type:	GFSK
Number of Channel:	20
Hopping Channel Type:	Adaptive Frequency Hopping systems
Product Type:	<input type="checkbox"/> Mobile <input checked="" type="checkbox"/> Portable
Test Software of EUT:	EUT systems
Antenna Type:	External antenna
Antenna Gain:	1.2dBi
Power Supply:	Li-ion battery DC 3.7V 10000mAh, Charge by DC 5V for adapter
Simultaneous Transmission	<input type="checkbox"/> Simultaneous TX is supported and evaluated in this report. <input checked="" type="checkbox"/> Simultaneous TX is not supported.

Operation Frequency each of channel					
Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2410	8	2434.5	15	2459
2	2413.5	9	2438	16	2462.5
3	2417	10	2441.5	17	2466
4	2420.5	11	2445	18	2469.5
5	2424	12	2448.5	19	2473
6	2427.5	13	2452	20	2477
7	2431	14	2455.5		

Note:

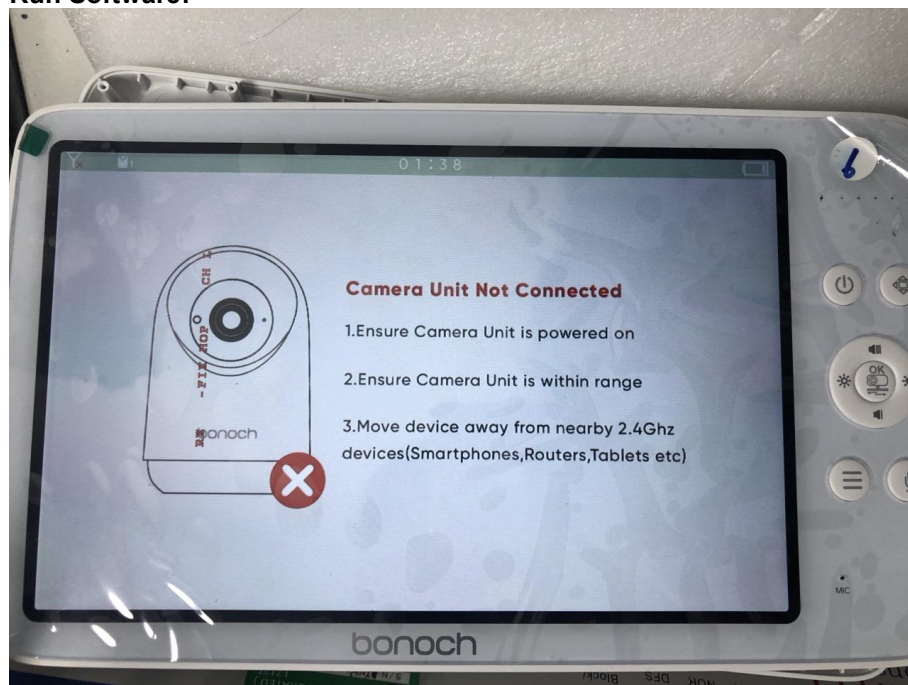
In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

Channel	Frequency
The Lowest channel	2410MHz
The Middle channel	2441.5MHz
The Highest channel	2477MHz

4.3 Additional Instructions

EUT Test Software Settings:		
Mode:	<input checked="" type="checkbox"/> Special software is used. <input type="checkbox"/> Through engineering command into the engineering mode. engineering command: *##3646633#**	
EUT Power level:	(Power level is built-in set parameters and cannot be changed and selected)	
Use test software to set the lowest frequency, the middle frequency and the highest frequency keep transmitting of the EUT.		
Mode	Channel	Frequency(MHz)
GFSK	CH1	2410
	CH10	2441.5
	CH20	2477

Run Software:



4.4 Test Environment

Operating Environment:	
Temperature:	25 °C
Humidity:	54% RH
Atmospheric Pressure:	1009mbar
Test Mode:	Use test software to set the lowest frequency, the middle frequency and the highest frequency keep transmitting of the EUT.

4.5 Description of Support Units

The EUT has been tested with associated equipment below.

Description	Manufacturer	Model No.	Remark	Supplied
/	/	/	/	/

4.6 Statement of the measurement uncertainty

The data and results referenced in this document are true and accurate.

The reader is cautioned that there may be errors within the calibration limits of the equipment and facilities.

The measurement uncertainty was calculated for all measurements listed in this test report acc. to CISPR 16 - 4 „Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC Measurements“ and is documented in the **Shenzhen Huaxia Testing Technology Co., Ltd.** quality system acc. to DIN EN ISO/IEC 17025.

Furthermore, component and process variability of devices similar to that tested may result in additional deviation. The manufacturer has the sole responsibility of continued compliance of the device.

Hereafter the best measurement capability for CQA laboratory is reported:

No.	Item	Uncertainty
1	Radiated Emission (Below 1GHz)	5.12dB
2	Radiated Emission (Above 1GHz)	4.60dB
3	Conducted Disturbance (0.15~30MHz)	3.34dB
4	Radio Frequency	3×10^{-8}
5	Duty cycle	0.6 %
6	Occupied Bandwidth	1.1%
7	RF conducted power	0.86dB
8	RF power density	0.74
9	Conducted Spurious emissions	0.86dB
10	Temperature test	0.8℃
11	Humidity test	2.0%
12	Supply voltages	0.5 %
13	Frequency Error	5.5 Hz

4.7 Test Location

All tests were performed at:

Shenzhen Huaxia Testing Technology Co., Ltd.

1F., Block A of Tongsheng Technology Building, Huahui Road, Dalang Street, Longhua District, Shenzhen, China

4.8 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

IC Registration No.: 22984-1

The 3m Semi-anechoic chamber of Shenzhen Huaxia Testing Technology Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing

The test facility is recognized, certified, or accredited by the following organizations:

• **CNAS (No. CNAS L5785)**

CNAS has accredited Shenzhen Huaxia Testing Technology Co., Ltd. Shenzhen Branch EMC Lab to ISO/IEC 17025:2005 General Requirements for the Competence of Testing and Calibration Laboratories (CNAS-CL01 Accreditation Criteria for the Competence of Testing and Calibration Laboratories) for the competence in the field of testing.

• **A2LA (Certificate No. 4742.01)**

Shenzhen Huaxia Testing Technology Co., Ltd., Shenzhen EMC Laboratory is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 4742.01.

• **FCC Registration No.: 522263**

Shenzhen Huaxia Testing Technology Co., Ltd., Shenzhen EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in our files. Registration No.:522263

4.9 Abnormalities from Standard Conditions

None.

4.10 Other Information Requested by the Customer

None.

4.11 Equipment List

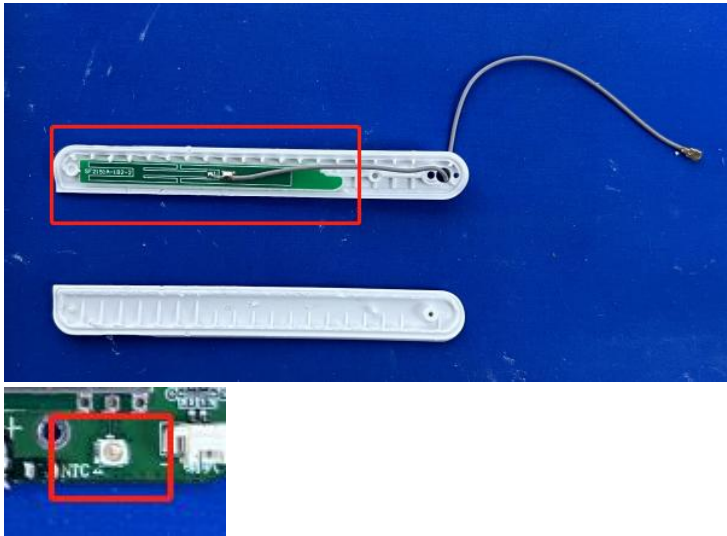
Test Equipment	Manufacturer	Model No.	Instrument No.	Calibration Date	Calibration Due Date
EMI Test Receiver	R&S	ESR7	CQA-005	2023/09/08	2024/09/07
Spectrum analyzer	R&S	FSU26	CQA-038	2023/09/08	2024/09/07
Spectrum analyzer	R&S	FSU40	CQA-075	2023/09/08	2024/09/07
Preamplifier	MITEQ	AFS4-00010300-18-10P-4	CQA-035	2023/09/08	2024/09/07
Preamplifier	MITEQ	AMF-6D-02001800-29-20P	CQA-036	2023/09/08	2024/09/07
Preamplifier	EMCI	EMC184055SE	CQA-089	2023/09/08	2024/09/07
Loop antenna	Schwarzbeck	FMZB1516	CQA-060	2021/09/16	2024/09/15
Bilog Antenna	R&S	HL562	CQA-011	2021/09/16	2024/09/15
Horn Antenna	R&S	HF906	CQA-012	2021/09/16	2024/09/15
Horn Antenna	Schwarzbeck	BBHA 9170	CQA-088	2021/09/16	2024/09/15
Coaxial Cable (Above 1GHz)	CQA	N/A	C007	2023/09/08	2024/09/07
Coaxial Cable (Below 1GHz)	CQA	N/A	C013	2023/09/08	2024/09/07
RF cable(9KHz~40GHz)	CQA	RF-01	CQA-079	2023/09/08	2024/09/07
Antenna Connector	CQA	RFC-01	CQA-080	2023/09/08	2024/09/07
Power Sensor	KEYSIGHT	U2021XA	CQA-30	2023/09/08	2024/09/07
N1918A Power Analysis Manager Power Panel	Agilent	N1918A	CQA-074	2023/09/08	2024/09/07
Power meter	R&S	NRVD	CQA-029	2023/09/08	2024/09/07
Power divider	MIDWEST	PWD-2533-02-SMA-79	CQA-067	2023/09/08	2024/09/07
EMI Test Receiver	R&S	ESR7	CQA-005	2023/09/08	2024/09/07
LISN	R&S	ENV216	CQA-003	2023/09/08	2024/09/07
Coaxial cable	CQA	N/A	CQA-C009	2023/09/08	2024/09/07
DC power	KEYSIGHT	E3631A	CQA-028	2023/09/08	2024/09/07

Note:

The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

5 Test results and Measurement Data

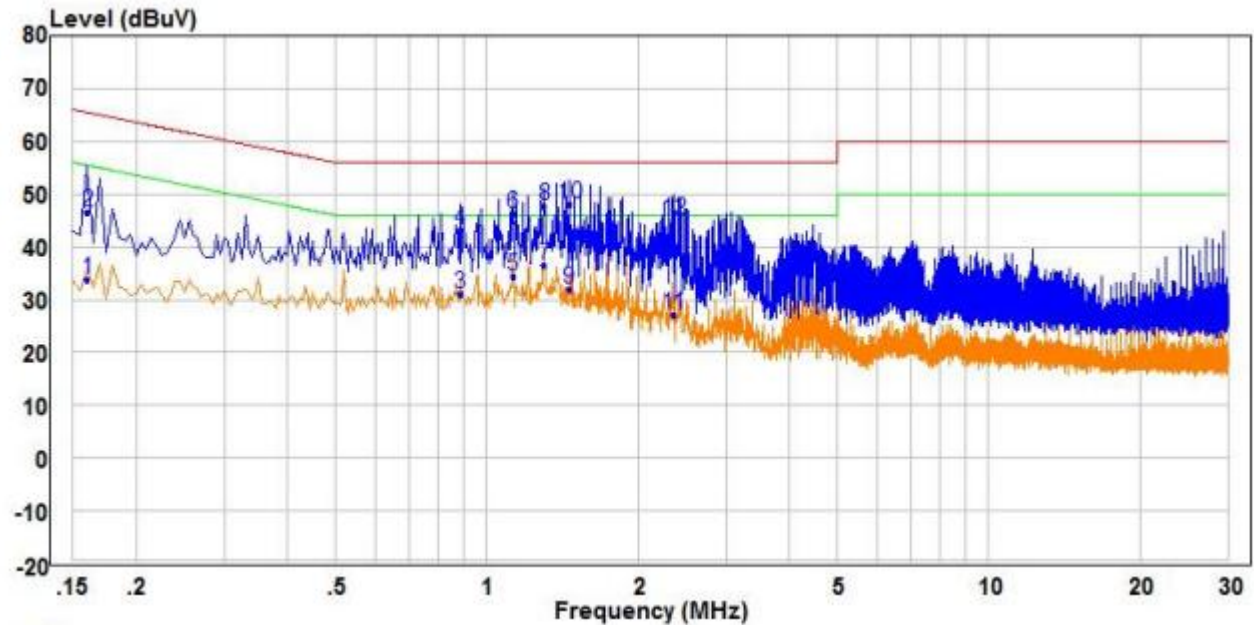
5.1 Antenna Requirement

Standard requirement:	47 CFR Part 15C Section 15.203 /247(c)
	<p>15.203 requirement: 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, 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.</p> <p>15.247(b) (4) requirement: The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.</p>
EUT Antenna:	
	<p>The antenna is External antenna.</p> <p>The connection/connection type between the antenna to the EUT's antenna port is: unique coupling.</p> <p>This is either permanently attachment or a unique coupling that satisfies the requirement.</p>

Exploratory Test Mode:	Non-hopping transmitting mode with all kind of modulation and all kind of data type at the lowest, middle, high channel.
Final Test Mode:	Through Pre-scan, find the GFSK modulation at the lowest channel is the worst case. Only the worst case is recorded in the report.
Test Voltage:	AC 120V/60Hz
Test Results:	Pass

Measurement Data

Live line:

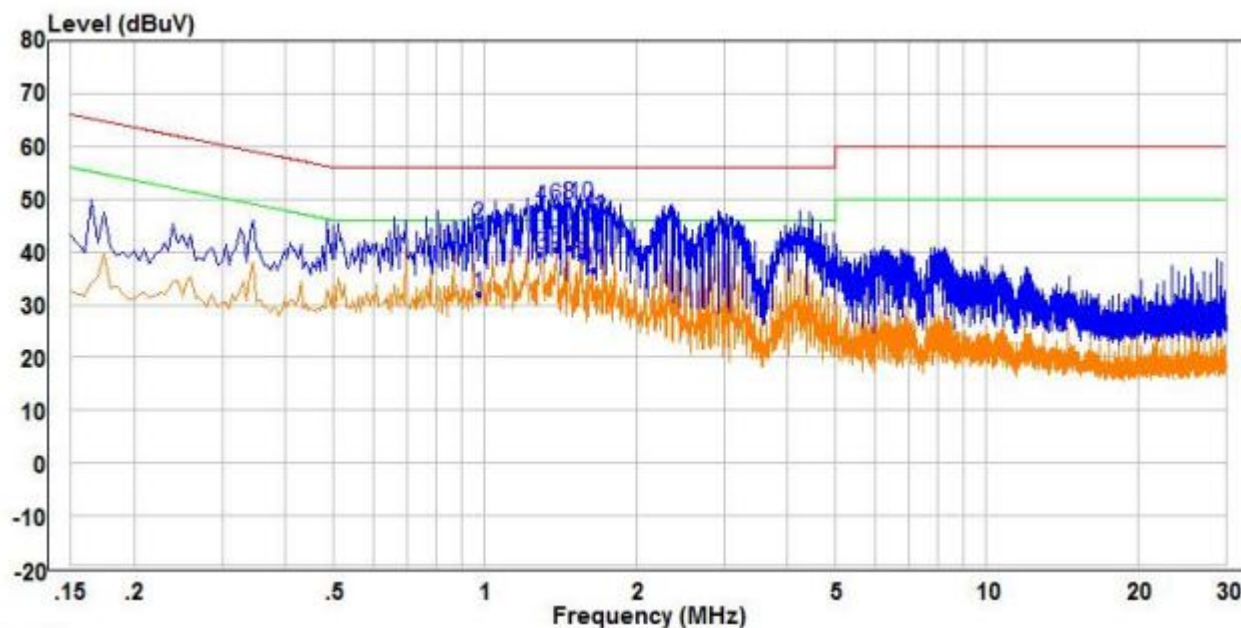


	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark	Pol/Phase
	MHz	dBuV	dB	dBuV	dBuV	dB		
1	0.160	23.31	10.49	33.80	55.46	-21.66	Average	Line
2	0.160	36.10	10.49	46.59	65.46	-18.87	QP	Line
3	0.885	20.27	10.66	30.93	46.00	-15.07	Average	Line
4	0.885	32.59	10.66	43.25	56.00	-12.75	QP	Line
5	1.130	23.95	10.53	34.48	46.00	-11.52	Average	Line
6	1.130	35.61	10.53	46.14	56.00	-9.86	QP	Line
7 AV	1.300	25.93	10.53	36.46	46.00	-9.54	Average	Line
8	1.300	37.27	10.53	47.80	56.00	-8.20	QP	Line
9	1.460	21.42	10.52	31.94	46.00	-14.06	Average	Line
10 PP	1.460	37.47	10.52	47.99	56.00	-8.01	QP	Line
11	2.355	16.54	10.56	27.10	46.00	-18.90	Average	Line
12	2.355	34.36	10.56	44.92	56.00	-11.08	QP	Line

Remark:

1. The following Quasi-Peak and Average measurements were performed on the EUT:
2. Final Test Level = Receiver Reading + LISN Factor + Cable Loss.
3. If the Peak value under Average limit, the Average value is not recorded in the report.

Neutral line:

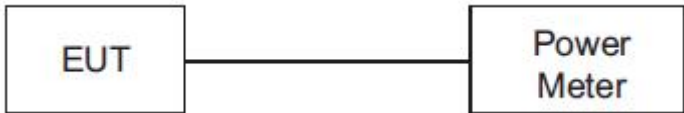
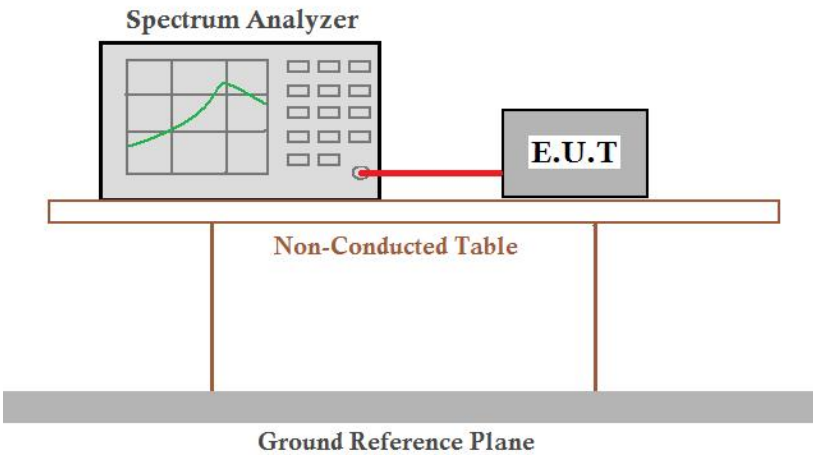


	Freq	Read	Factor	Level	Limit	Over	Remark	Pol/Phase
	MHz	dBuV	dB	dBuV	dBuV	dB		
1	0.975	21.28	10.72	32.00	46.00	-14.00	Average	Neutral
2	0.975	34.24	10.72	44.96	56.00	-11.04	QP	Neutral
3	1.295	28.87	10.71	39.58	46.00	-6.42	Average	Neutral
4	1.295	37.78	10.71	48.49	56.00	-7.51	QP	Neutral
5	1.385	29.84	10.72	40.56	46.00	-5.44	Average	Neutral
6	1.385	38.10	10.72	48.82	56.00	-7.18	QP	Neutral
7 PP	1.470	29.97	10.72	40.69	46.00	-5.31	Average	Neutral
8	1.470	38.29	10.72	49.01	56.00	-6.99	QP	Neutral
9	1.555	28.69	10.73	39.42	46.00	-6.58	Average	Neutral
10 QP	1.555	38.28	10.73	49.01	56.00	-6.99	QP	Neutral
11	1.650	25.77	10.73	36.50	46.00	-9.50	Average	Neutral
12	1.650	35.68	10.73	46.41	56.00	-9.59	QP	Neutral

Remark:

1. The following Quasi-Peak and Average measurements were performed on the EUT:
2. Final Test Level =Receiver Reading + LISN Factor + Cable Loss.
3. If the Peak value under Average limit, the Average value is not recorded in the report.

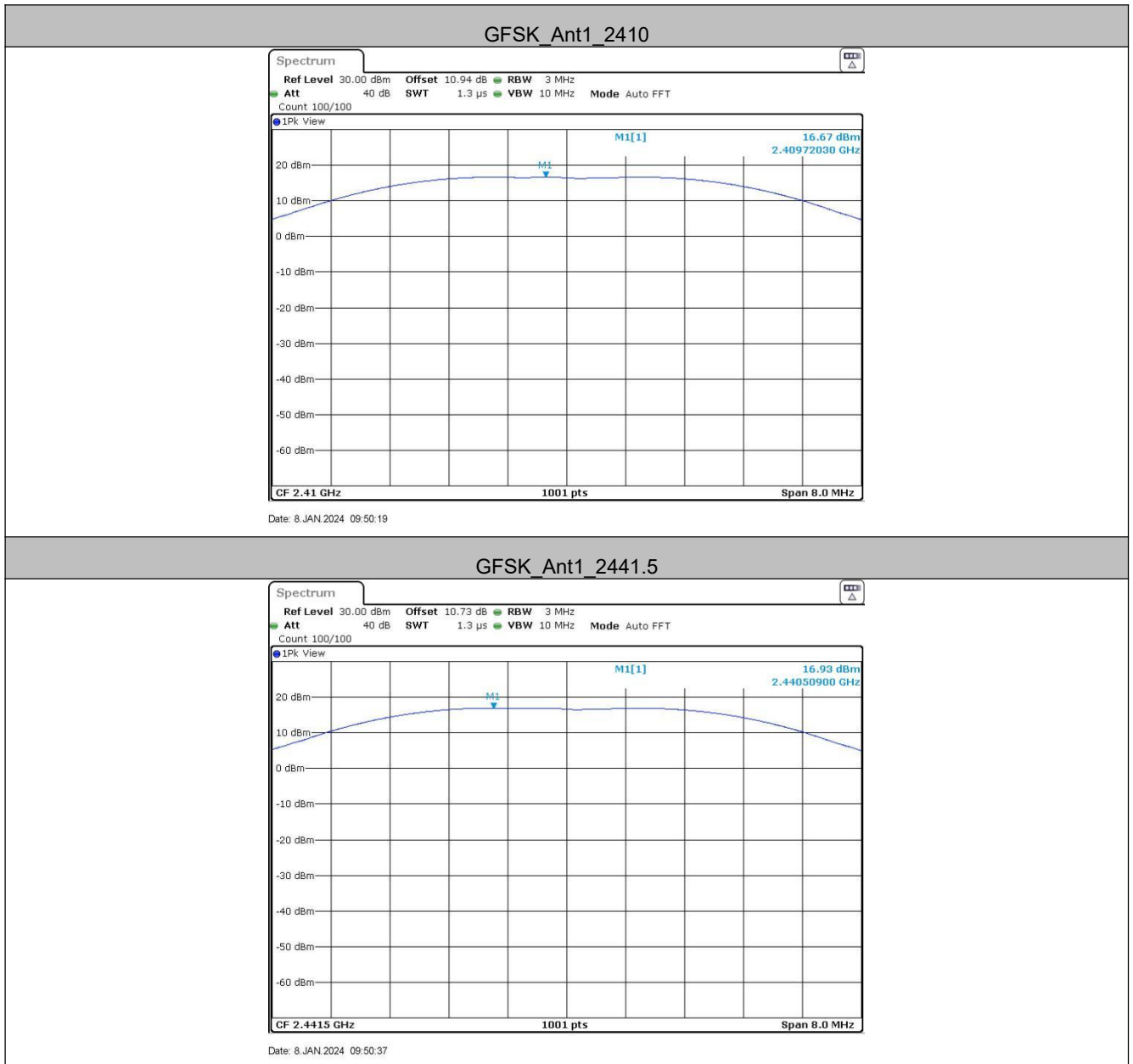
5.3 Conducted Peak Output Power

Test Requirement:	47 CFR Part 15C Section 15.247 (b)(1)
Test Method:	ANSI C63.10:2013
Test Setup:	<p>Setup for Power meter measurement method</p>  <p>Setup for Spectrum analyser measurement method</p>  <p><i>Remark: Offset=Cable loss+ attenuation factor.</i></p>
Limit:	21dBm
Exploratory Test Mode:	Non-hopping transmitting with all kind of modulation and all kind of data type
Final Test Mode:	Only the worst case is recorded in the report.
Test Results:	Pass

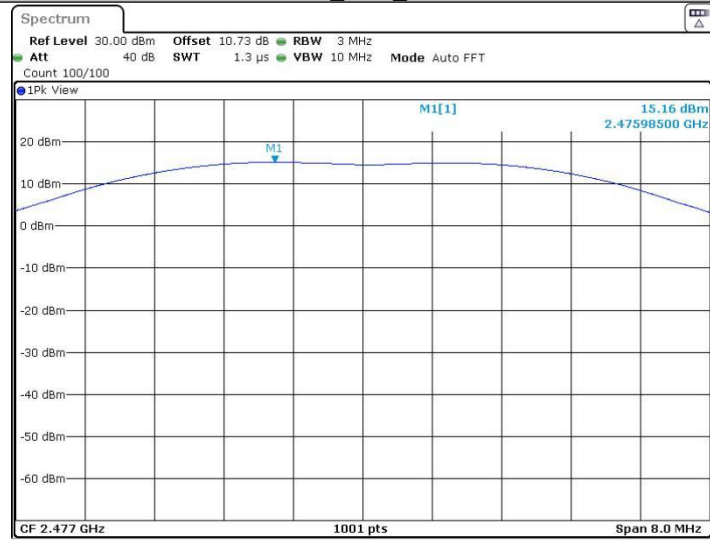
Measurement Data

GFSK mode			
Test channel	Peak Output Power (dBm)	Limit (dBm)	Result
Lowest	16.67	21.00	Pass
Middle	16.93	21.00	Pass
Highest	15.16	21.00	Pass

Test plot as follows:

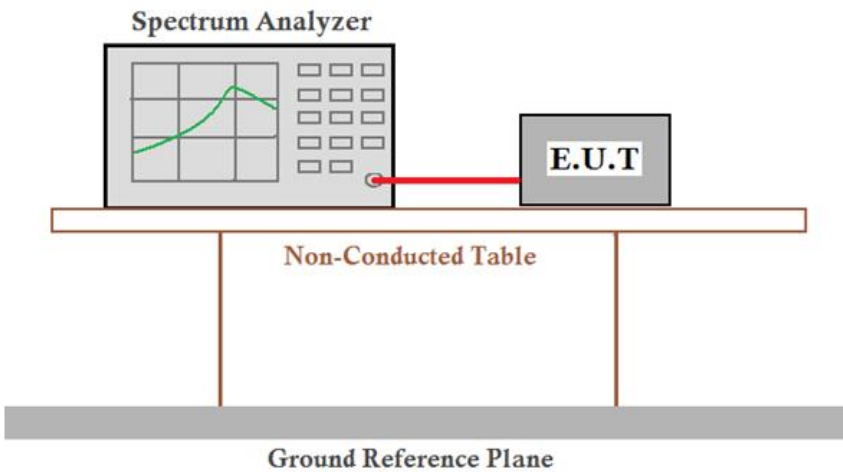


GFSK Ant1_2477



Date: 8 JAN 2024 09:50:56

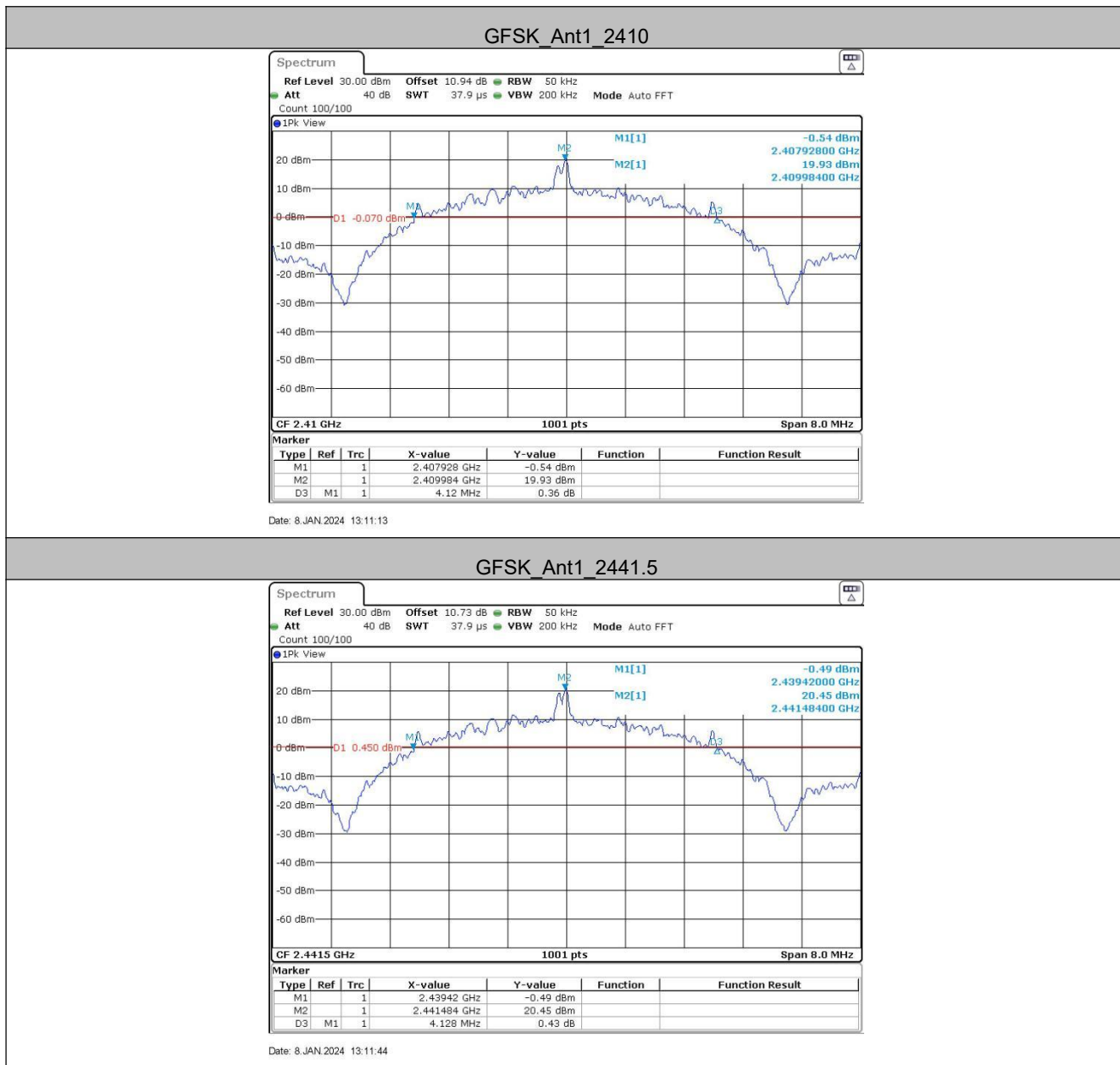
5.4 20dB Occupied Bandwidth

Test Requirement:	47 CFR Part 15C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2013
Test Setup:	 <p>Remark: Offset=Cable loss+ attenuation factor.</p>
Limit:	NA
Exploratory Test Mode:	Non-hopping transmitting with all kind of modulation and all kind of data type
Final Test Mode:	Only the worst case is recorded in the report.
Test Results:	Pass

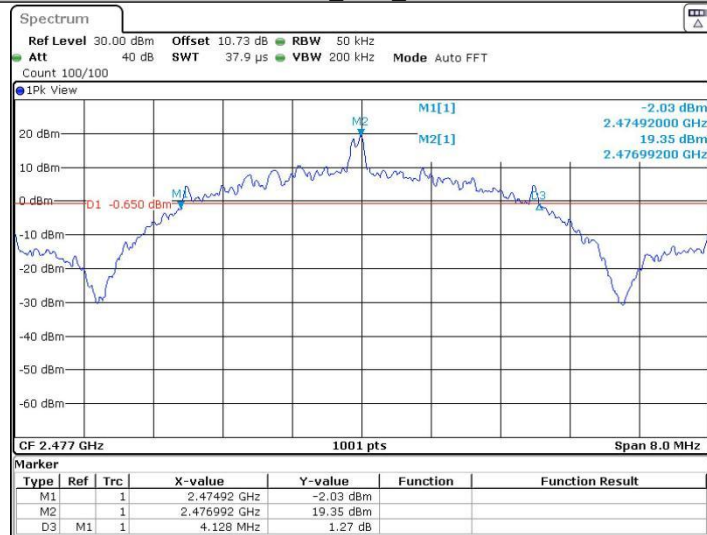
Measurement Data

Test channel	20dB Occupy Bandwidth (MHz)
	GFSK
Lowest	4.12
Middle	4.13
Highest	4.13

Test plot as follows:

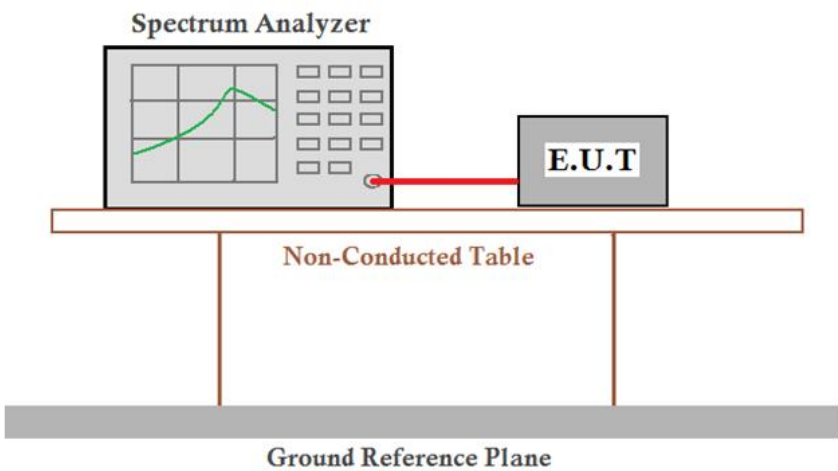


GFSK Ant1_2477



Date: 8 JAN 2024 13:12:50

5.5 Carrier Frequencies Separation

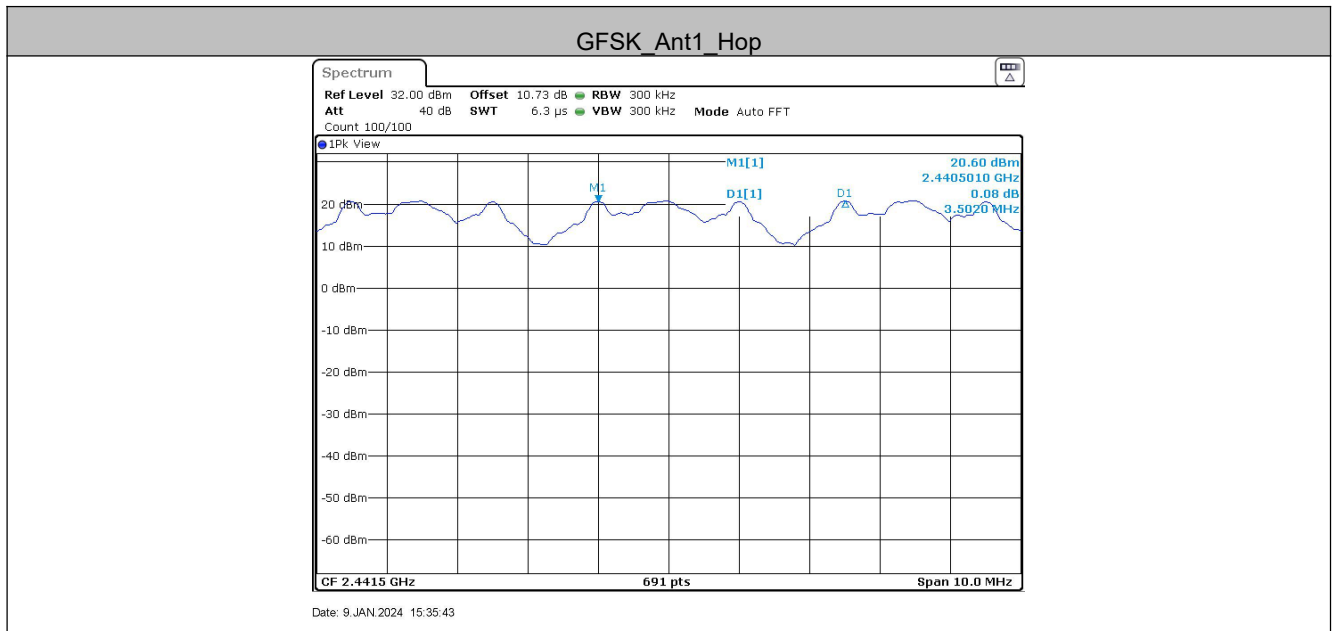
Test Requirement:	47 CFR Part 15C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2013
Test Setup:	 <p>Remark: Offset=Cable loss+ attenuation factor.</p>
Limit:	2/3 of the 20dB bandwidth
	Remark: the transmission power is less than 0.125W.
Exploratory Test Mode:	Hopping transmitting with all kind of modulation and all kind of data type
Final Test Mode:	Only the worst case is recorded in the report.
Test Results:	Pass

Measurement Data

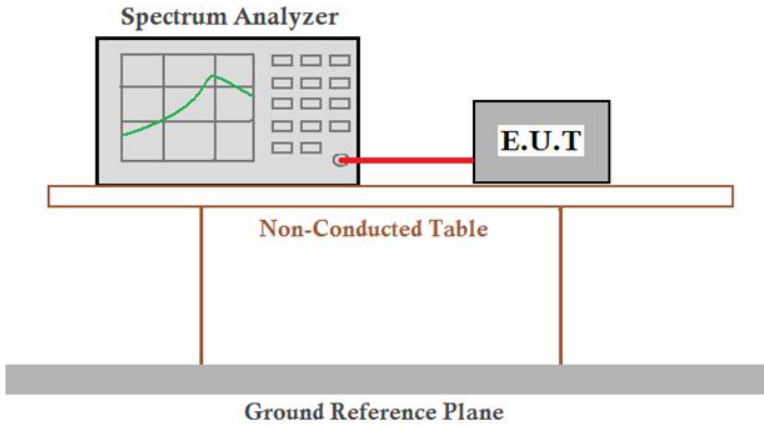
TestMode	Freq(MHz)	Result[MHz]	Limit[MHz]	Verdict
GFSK	Hop	3.5	≥2.75	PASS

Mode	20dB bandwidth (MHz) (worse case)	Limit (MHz) (Carrier Frequencies Separation)
GFSK	4.13	2.75

Test plot as follows:



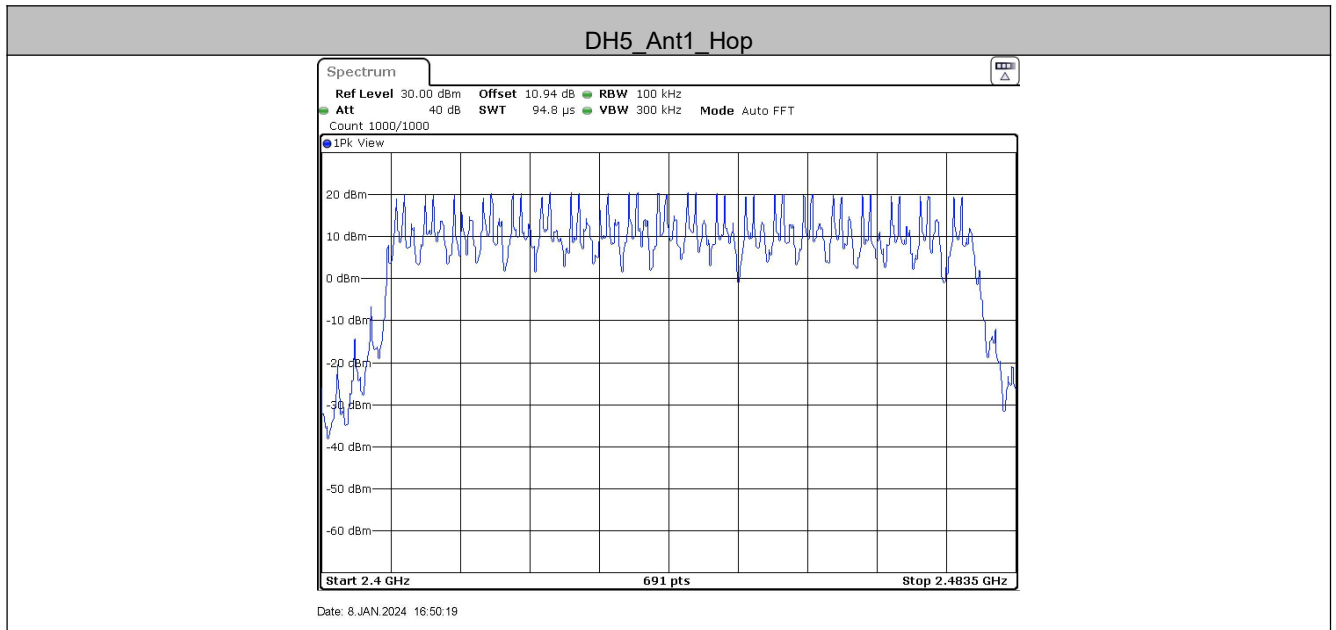
5.6 Hopping Channel Number

Test Requirement:	47 CFR Part 15C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2013
Test Setup:	 <p>Remark: $Offset = \text{Cable loss} + \text{attenuation factor}$.</p>
Limit:	At least 15 channels
Exploratory Test Mode:	hopping transmitting with all kind of modulation and all kind of data type
Final Test Mode:	Only the worst case is recorded in the report.
Test Results:	Pass

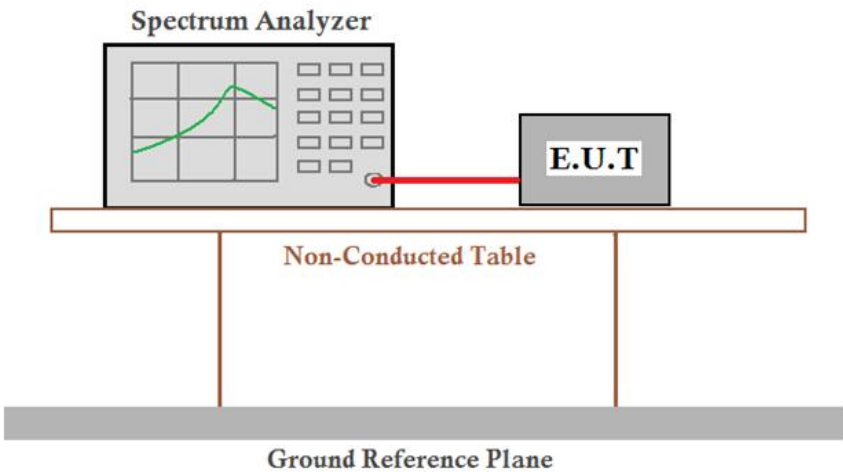
Measurement Data

Mode	Hopping channel numbers	Limit
GFSK	20	≥ 15

Test plot as follows:



5.7 Dwell Time

Test Requirement:	47 CFR Part 15C Section 15.247 (a)(1)
Test Method:	ANSI C63.10:2013
Test Setup:	 <p>Spectrum Analyzer</p> <p>E.U.T</p> <p>Non-Conducted Table</p> <p>Ground Reference Plane</p> <p><i>Remark: Offset=Cable loss+ attenuation factor.</i></p>
Test Mode:	Hopping transmitting with all kind of modulation and all kind of data type.
Limit:	0.4 Second
Test Results:	Pass

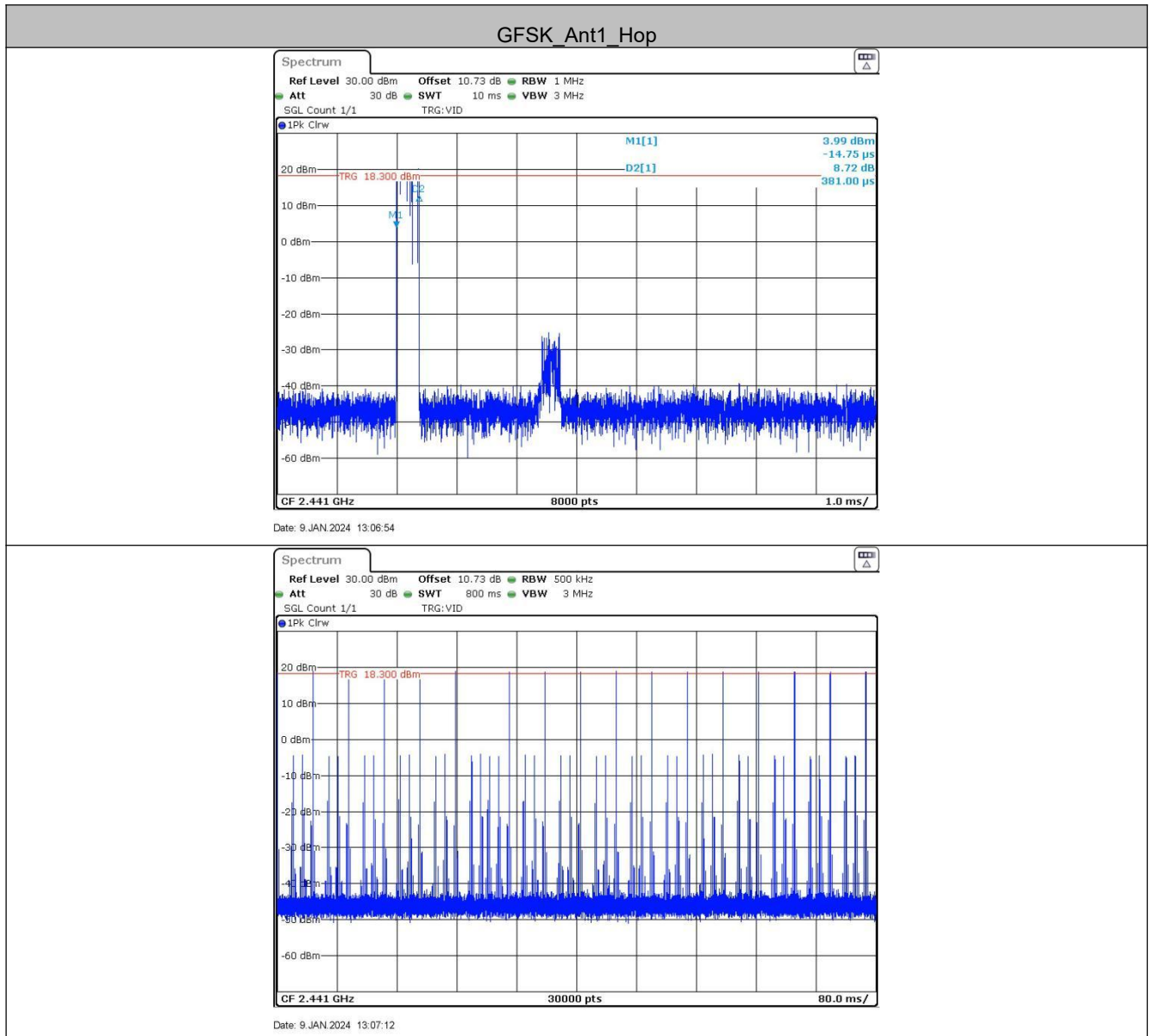
Measurement Data

TestMode	Freq(MHz)	BurstWidth [ms]	TotalHops [Num]	Result[s]	Limit[s]	Verdict
GFSK	Hop	0.381	43.037	0.016	≤0.4	PASS

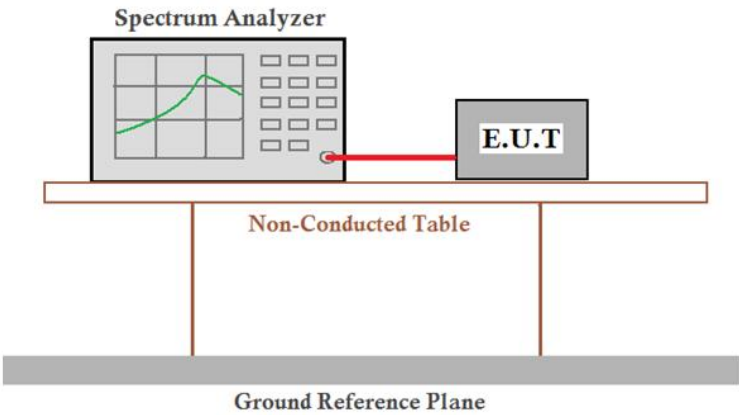
Remark:

The test period: $T = 0.4 \text{ Second/Channel} \times 20 \text{ Channel} = 8 \text{ s}$

Test plot as follows:



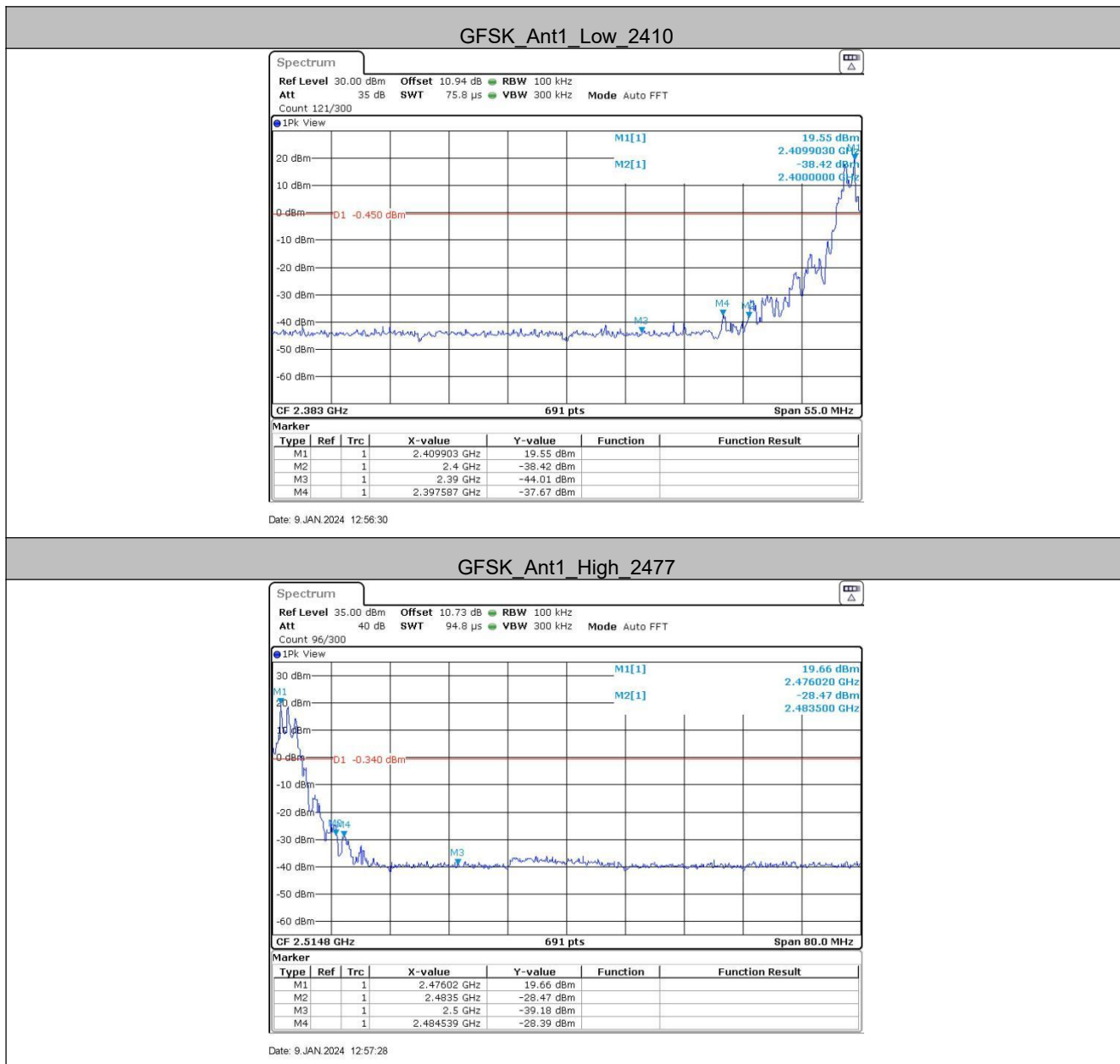
5.8 Band-edge for RF Conducted Emissions

Test Requirement:	47 CFR Part 15C Section 15.247 (d)
Test Method:	ANSI C63.10:2013
Test Setup:	 <p>Remark: $Offset = \text{cable loss} + \text{attenuation factor}$.</p>
Limit:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum 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.
Exploratory Test Mode:	Hopping and Non-hopping transmitting with all kind of modulation and all kind of data type
Final Test Mode:	Only the worst case is recorded in the report.
Test Results:	Pass

Measurement Data

TestMode	ChName	Freq(MHz)	RefLevel [dBm]	Result [dBm]	Limit [dBm]	Verdict
GFSK	Low	2402	19.55	-37.67	≤ -0.45	PASS
	High	2480	19.66	-28.39	≤ -0.34	PASS
	Low	Hop_2402	20.18	-41.48	≤ 0.18	PASS
	High	Hop_2480	19.88	-35.24	≤ -0.12	PASS

Test plot as follows:



GFSK_Ant1_Low_Hop_2410



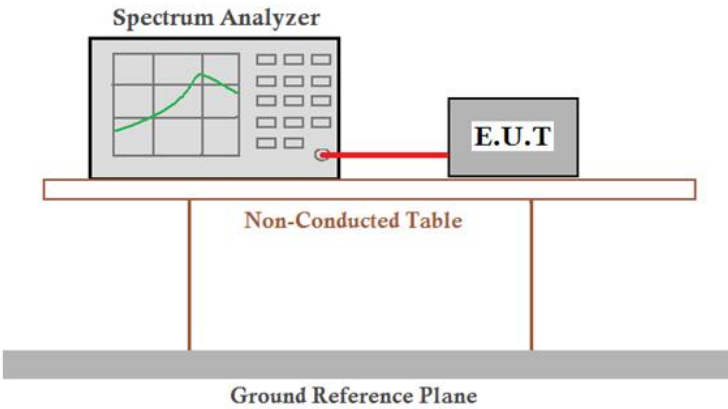
Date: 9 JAN 2024 12:58:02

GFSK_Ant1_High_Hop_2477



Date: 9 JAN 2024 13:03:40

5.9 Spurious RF Conducted Emissions

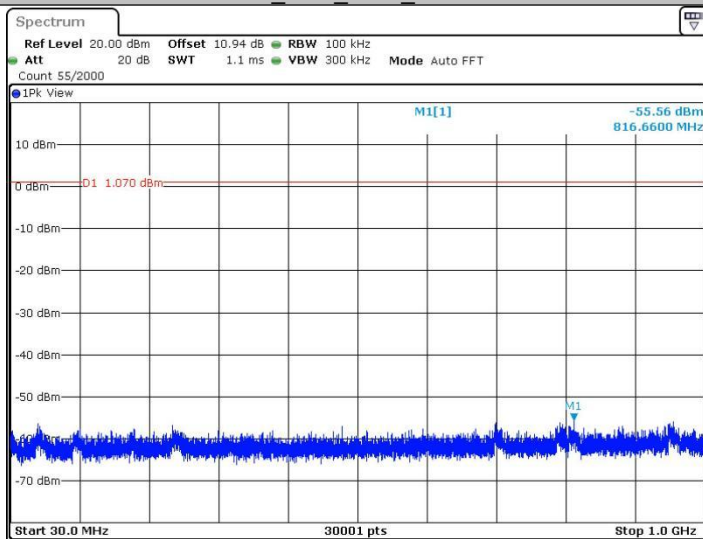
Test Requirement:	47 CFR Part 15C Section 15.247 (d)
Test Method:	ANSI C63.10:2013
Test Setup:	 <p><i>Remark: Offset=cable loss+ attenuation factor.</i></p>
Limit:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power 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.
Exploratory Test Mode:	Non-hopping transmitting with all kind of modulation and all kind of data type
Final Test Mode:	Through Pre-scan, find the GFSK of data type is the worst case.
Test Results:	Pass

GFSK_Ant1_2410_0~Reference



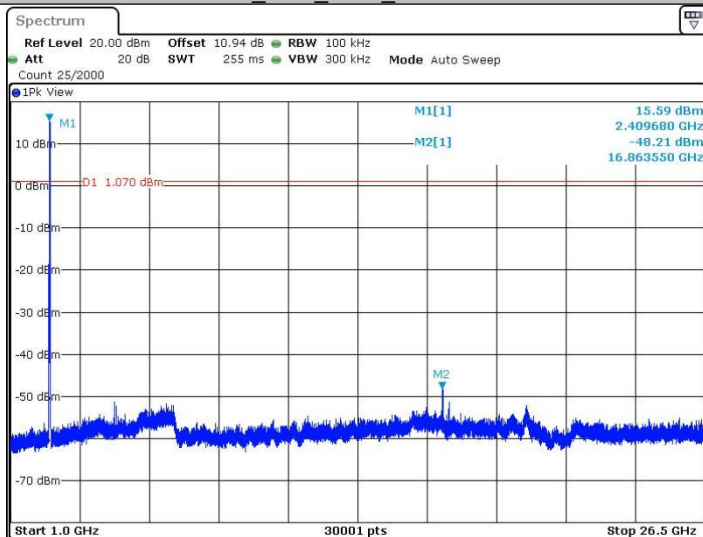
Date: 26 DEC.2023 09:55:04

GFSK_Ant1_2410_30~1000



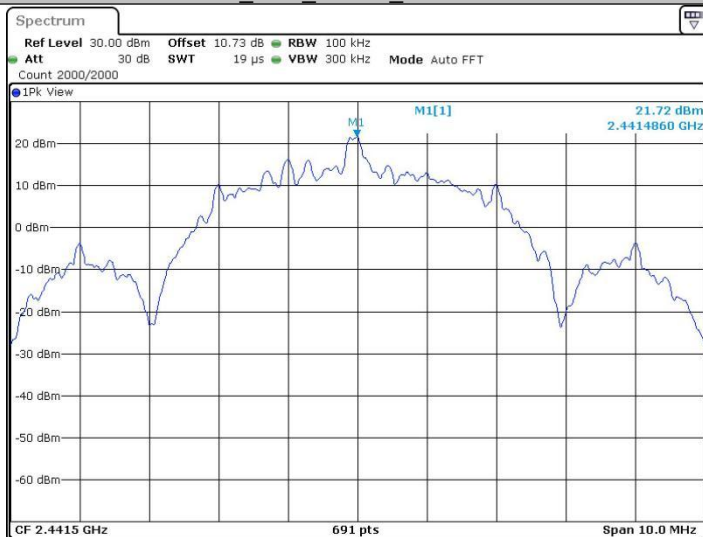
Date: 26 DEC.2023 09:55:10

GFSK_Ant1_2410_1000~26500



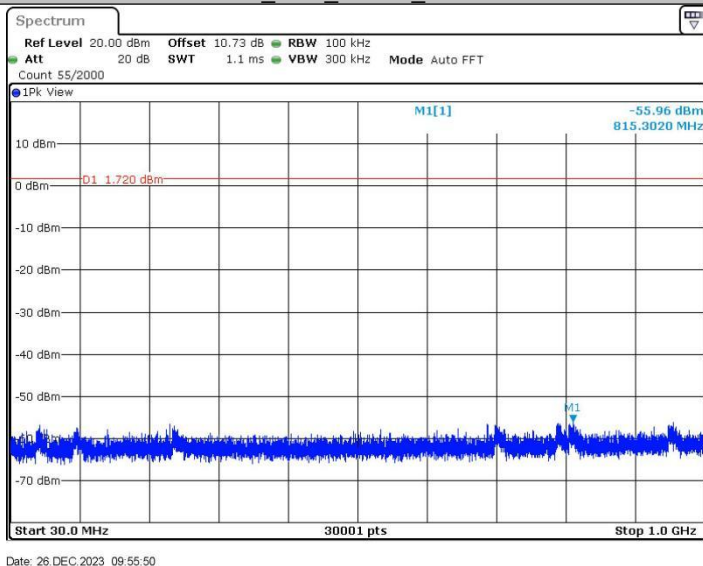
Date: 26 DEC 2023 09:55:32

GFSK_Ant1_2441.5_0~Reference

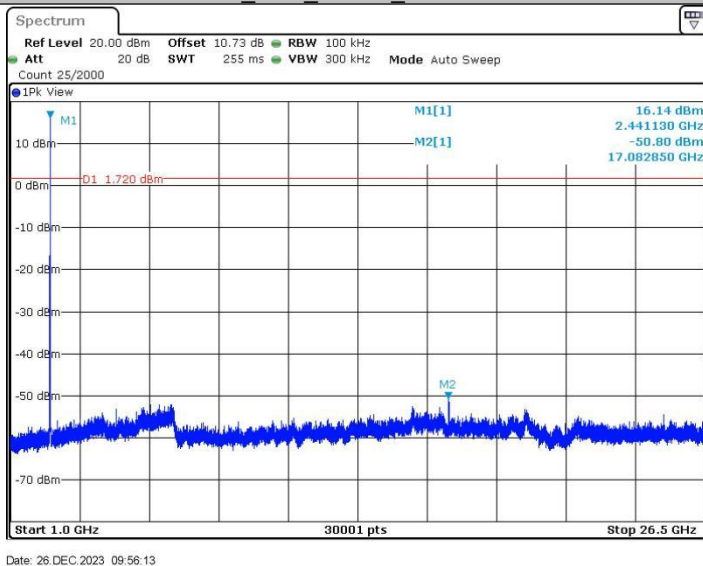


Date: 26 DEC 2023 09:55:44

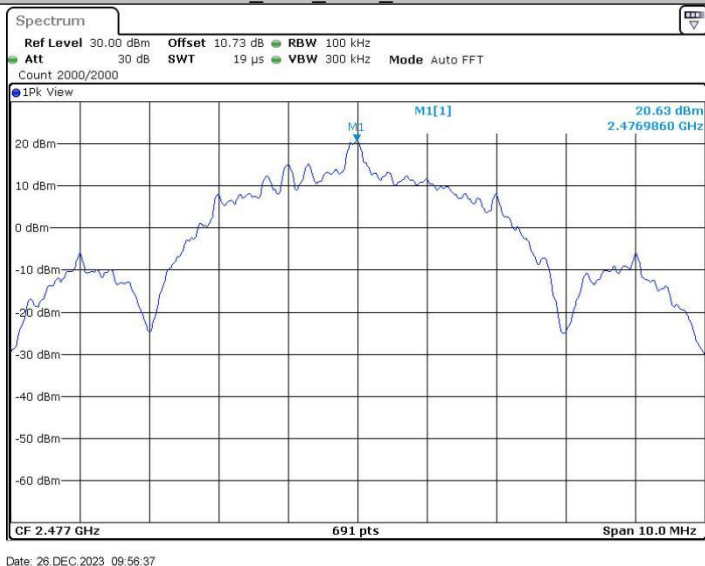
GFSK Ant1_2441.5_30~1000



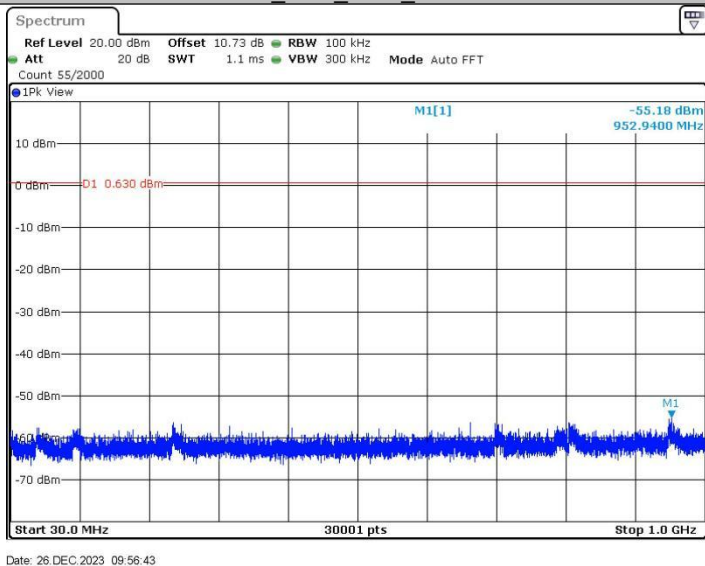
GFSK Ant1_2441.5_1000~26500

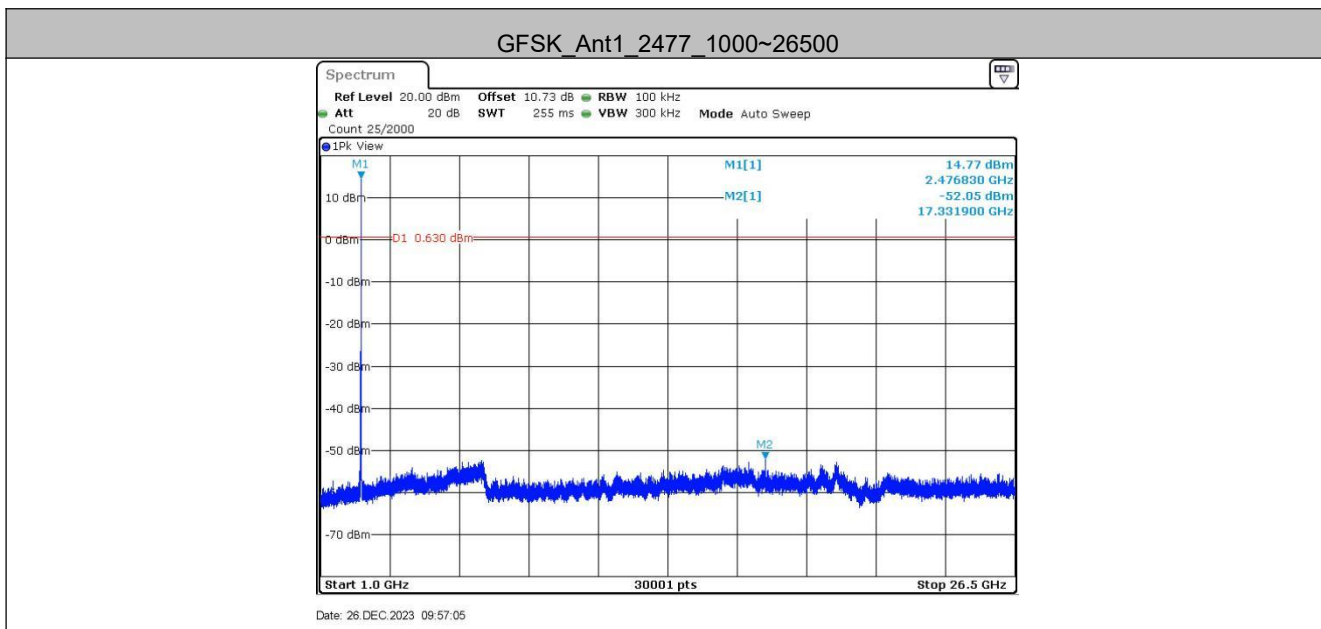


GFSK_Ant1_2477_0~Reference



GFSK_Ant1_2477_30~1000





Remark:

Pre test 9kHz to 25GHz, find the highest point when testing, so only the worst data were shown in the test report. Per FCC Part 15.33 (a) and 15.31 (o), The amplitude of spurious emissions from intentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.

5.10 Other requirements Frequency Hopping Spread Spectrum System

Test Requirement:	47 CFR Part 15C Section 15.247 (a)(1), (h) requirement:
	<p>The system shall hop to channel frequencies that are selected at the system hopping rate from a Pseudorandom 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.</p> <p>Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.</p> <p>The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.</p>
	<p>Compliance for section 15.247(a)(1)</p>
	<p>According to Bluetooth Core Specification, the pseudorandom sequence may be generated in a nine-stage shift register whose 5th and 9th stage outputs are added in a modulo-two addition stage. And the result is fed back to the input of the first stage. The sequence begins with the first ONE of 9 consecutive ONES; i.e. the shift register is initialized with nine ones.</p> <ul style="list-style-type: none"> • Number of shift register stages: 9 • Length of pseudo-random sequence: $2^9 - 1 = 511$ bits • Longest sequence of zeros: 8 (non-inverted signal) <div data-bbox="301 1373 1355 1520" data-label="Diagram"> </div> <p><i>Linear Feedback Shift Register for Generation of the PRBS sequence</i></p> <p>An example of Pseudorandom Frequency Hopping Sequence as follow:</p> <div data-bbox="276 1621 1264 1767" data-label="Diagram"> </div> <p>Each frequency used equally on the average by each transmitter.</p> <p>According to Bluetooth Core Specification, Bluetooth receivers are designed to have input and IF bandwidths that match the hopping channel bandwidths of any Bluetooth transmitters and shift frequencies in synchronization with the transmitted signals.</p>
	<p>Compliance for section 15.247(g)</p>
	<p>According to Bluetooth Core Specification, the Bluetooth system transmits the packet with the pseudorandom hopping frequency with a continuous data and the short burst transmission from the Bluetooth system is also transmitted under the frequency hopping system with the pseudorandom hopping frequency system.</p>

Compliance for section 15.247(h)

According to Bluetooth Core specification, the Bluetooth system incorporates with an adaptive system to detect other user within the spectrum band so that it individually and independently to avoid hopping on the occupied channels.

According to the Bluetooth Core specification, the Bluetooth system is designed not have the ability to coordinated with other FHSS System in an effort to avoid the simultaneous occupancy of individual hopping frequencies by multiple transmitter.

5.11 Radiated Spurious Emission & Restricted bands

Test Requirement:	47 CFR Part 15C Section 15.209 and 15.205				
Test Method:	ANSI C63.10: 2013				
Test Site:	Measurement Distance: 3m (Semi-Anechoic Chamber)				
Receiver Setup:	Frequency	Detector	RBW	VBW	Remark
	0.009MHz-0.090MHz	Peak	10kHz	30kHz	Peak
	0.009MHz-0.090MHz	Average	10kHz	30kHz	Average
	0.090MHz-0.110MHz	Quasi-peak	10kHz	30kHz	Quasi-peak
	0.110MHz-0.490MHz	Peak	10kHz	30kHz	Peak
	0.110MHz-0.490MHz	Average	10kHz	30kHz	Average
	0.490MHz -30MHz	Quasi-peak	10kHz	30kHz	Quasi-peak
	30MHz-1GHz	Peak	120 kHz	300kHz	Peak
	Above 1GHz	Peak	1MHz	3MHz	Peak
		Peak	1MHz	10Hz	Average
Limit:	Frequency	Field strength (microvolt/meter)	Limit (dBuV/m)	Remark	Measurement distance (m)
	0.009MHz-0.490MHz	2400/F(kHz)	-	-	300
	0.490MHz-1.705MHz	24000/F(kHz)	-	-	30
	1.705MHz-30MHz	30	-	-	30
	30MHz-88MHz	100	40.0	Quasi-peak	3
	88MHz-216MHz	150	43.5	Quasi-peak	3
	216MHz-960MHz	200	46.0	Quasi-peak	3
	960MHz-1GHz	500	54.0	Quasi-peak	3
	Above 1GHz	500	54.0	Average	3
Note: 15.35(b), Unless otherwise specified, the limit on peak radio frequency emissions is 20dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device.					

Test Setup:

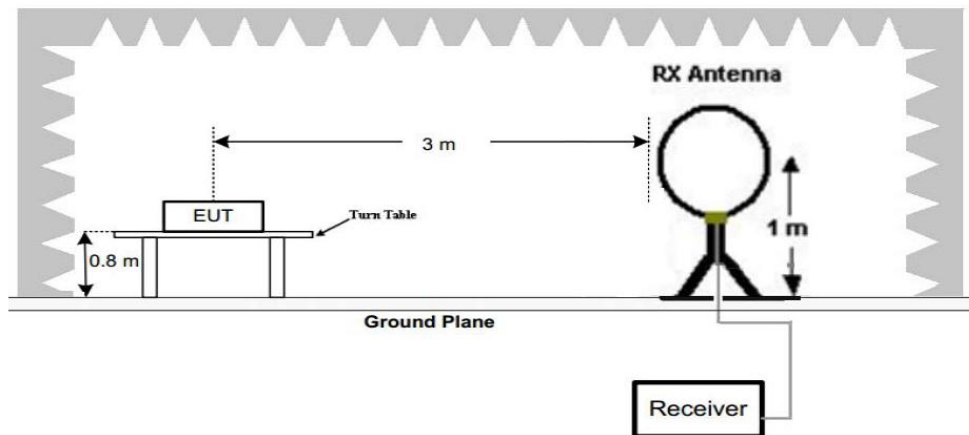


Figure 1. Below 30MHz

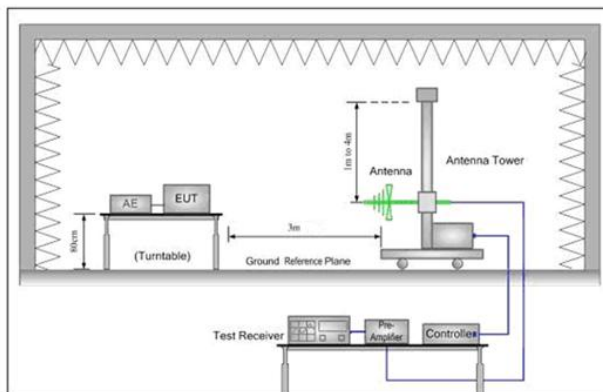


Figure 2. 30MHz to 1GHz

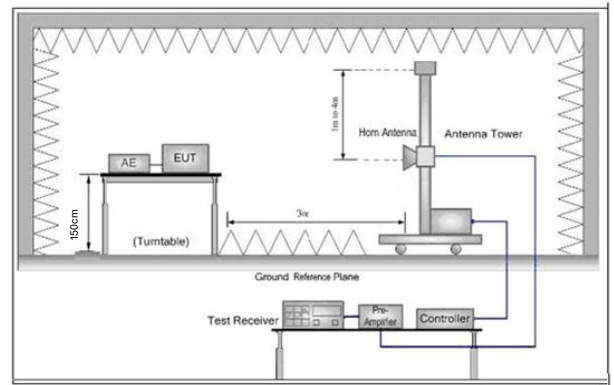


Figure 3. Above 1 GHz

Test Procedure:

- a. 1) Below 1G: The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
2) Above 1G: The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
Note: For the radiated emission test above 1GHz:
Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the measurement antenna aimed at the source of emissions at each frequency of significant emissions, with polarization oriented for maximum response. The measurement antenna may have to be higher or lower than the EUT, depending on the radiation pattern of the emission and staying aimed at the emission source for receiving the maximum signal. The final measurement antenna elevation shall be that which maximizes the emissions. The measurement antenna elevation for maximum emissions shall be restricted to a range of heights of from 1 m to 4 m above the ground or reference ground plane.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- c. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.

	<p>d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.</p> <p>e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.</p> <p>f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.</p> <p>g. Test the EUT in the lowest channel (2402MHz), the middle channel (2441MHz), the Highest channel (2480MHz)</p> <p>h. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.</p> <p>i. Repeat above procedures until all frequencies measured was complete.</p>
Exploratory Test Mode:	Non-hopping transmitting mode with all kind of modulation and all kind of data type Transmitting mode
Final Test Mode:	Only the worst case is recorded in the report.
Test Results:	Pass

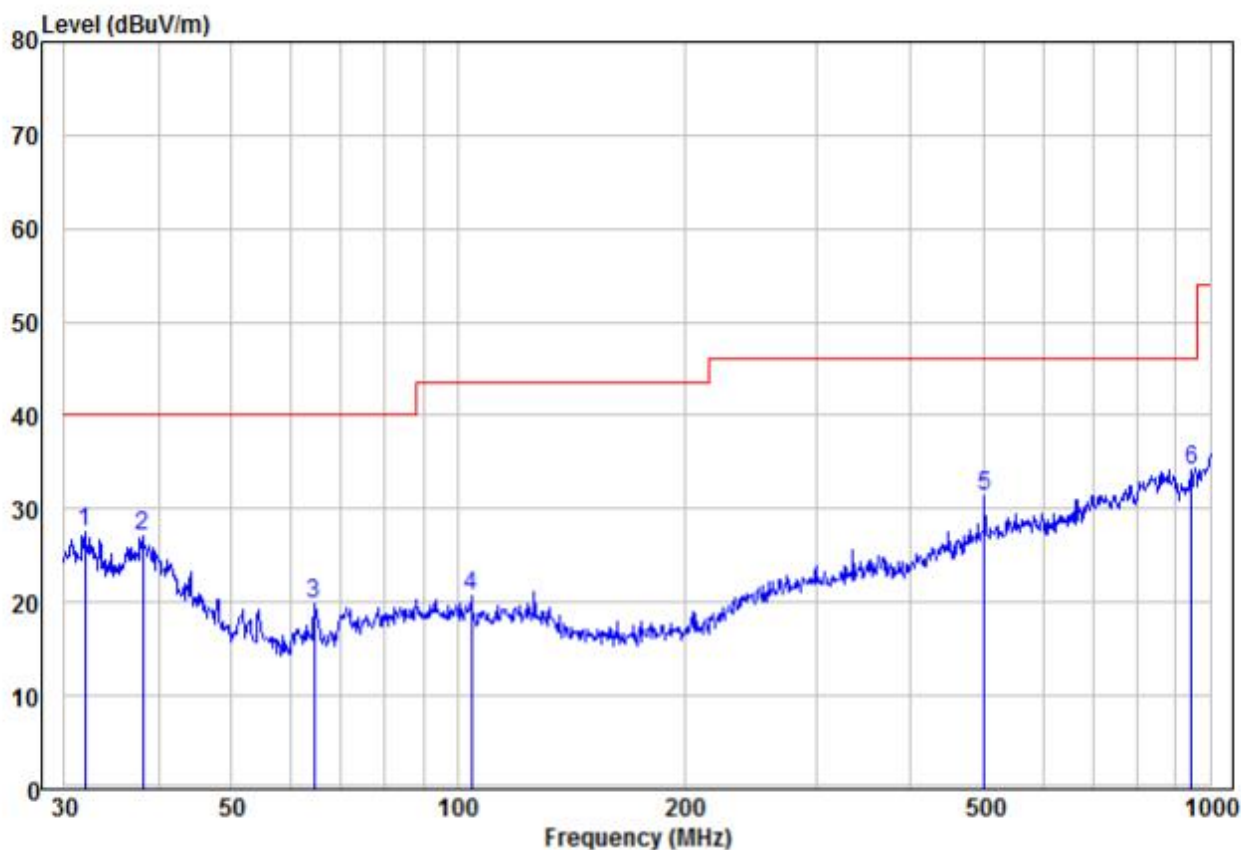
5.11.1 Radiated Emission below 1GHz

30MHz~1GHz

Test mode:

Transmitting

Vertical



	Freq	Read		Limit	Over		
	MHz	Level	Factor	Level	Line	Limit	Remark
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB	Pol/Phase
1	31.95	12.19	15.41	27.60	40.00	-12.40	Peak
2	38.08	13.69	13.49	27.18	40.00	-12.82	Peak
3	64.43	13.40	6.41	19.81	40.00	-20.19	Peak
4	104.17	10.21	10.45	20.66	43.50	-22.84	Peak
5	501.18	13.12	18.29	31.41	46.00	-14.59	Peak
6 pp	945.44	10.57	23.62	34.19	46.00	-11.81	Peak

Remark:

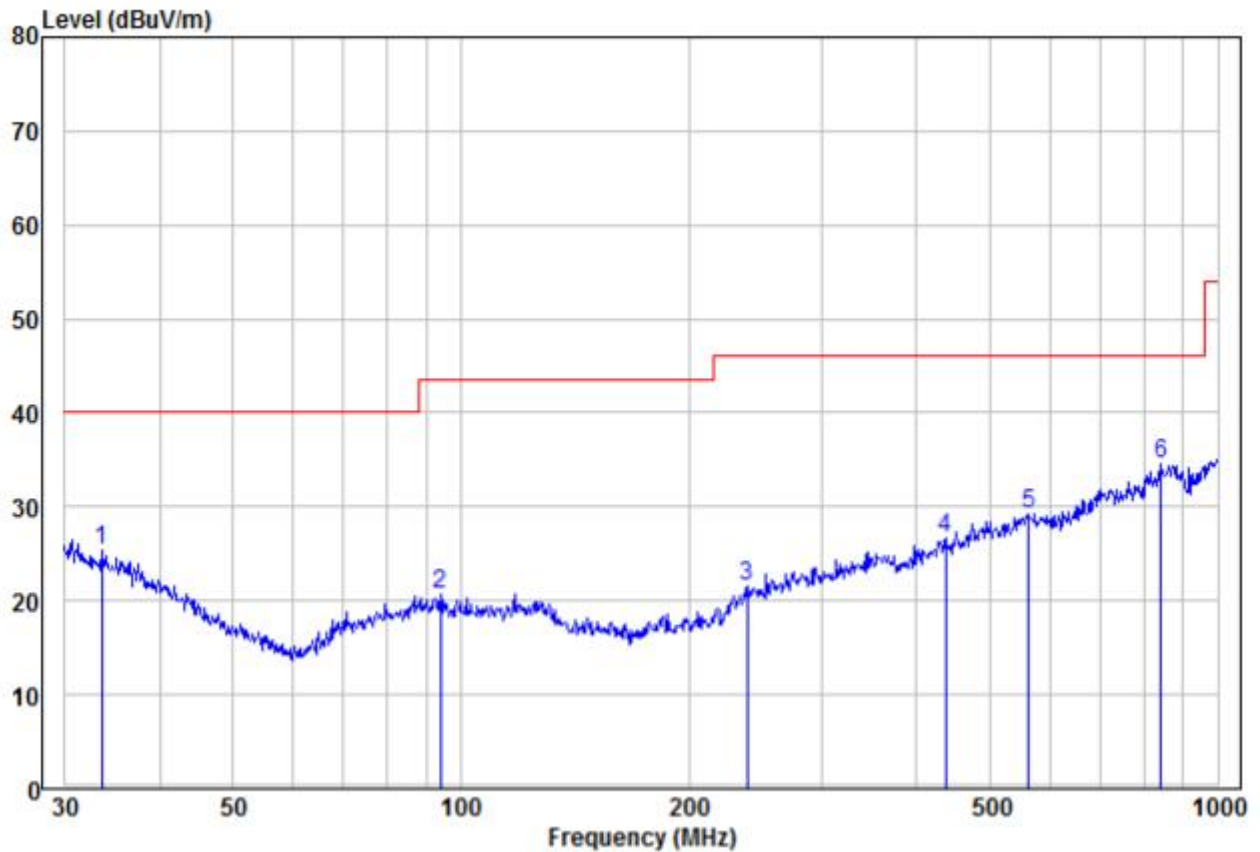
The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:

Factor= Antenna Factor + Cable Factor – Preamplifier Factor,

Level = Read Level + Factor,

Over Limit=Level-Limit Line.

Test mode:	Transmitting	Horizontal
------------	--------------	------------



	Freq	Read		Limit	Over		
	MHz	Level	Factor	Level	Line	Limit	Remark
		dBuV	dB/m	dBuV/m	dBuV/m	dB	Pol/Phase
1	33.56	10.44	14.99	25.43	40.00	-14.57	Peak
2	94.10	10.39	10.28	20.67	43.50	-22.83	Peak
3	239.15	9.99	11.46	21.45	46.00	-24.55	Peak
4	437.12	10.42	16.33	26.75	46.00	-19.25	Peak
5	562.66	10.35	18.92	29.27	46.00	-16.73	Peak
6 pp	842.13	10.47	24.10	34.57	46.00	-11.43	Peak

Remark:

The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:

Factor= Antenna Factor + Cable Factor – Preamplifier Factor,

Level = Read Level + Factor,

Over Limit=Level-Limit Line.

5.11.2 Transmitter Emission above 1GHz

Worse case mode:		GFSK		Test channel:		Lowest	
Frequency	Meter Reading	Factor	Emission Level	Limits	Over	Detector Type	Ant. Pol.
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)		H/V
2390	53.86	-9.2	44.66	74	-29.34	Peak	H
2400	54.65	-9.39	45.26	74	-28.74	Peak	H
4822	52.02	-4.33	47.69	74	-26.31	Peak	H
7233	50.41	1.01	51.42	74	-22.58	Peak	H
2390	53.86	-9.2	44.66	74	-29.34	Peak	V
2400	55.67	-9.39	46.28	74	-27.72	Peak	V
4822	54.76	-4.33	50.43	74	-23.57	Peak	V
7233	50.27	1.01	51.28	74	-22.72	Peak	V

Worse case mode:		GFSK		Test channel:		Middle	
Frequency	Meter Reading	Factor	Emission Level	Limits	Over	Detector Type	Ant. Pol.
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)		H/V
4883	52.23	-4.11	48.12	74	-27.02	peak	H
7324.5	50.62	1.51	52.13	74	-23.54	peak	H
4883	53.48	-4.11	49.37	74	-24.19	peak	V
7324.5	48.56	1.51	50.07	74	-22.39	peak	V

Worse case mode:		GFSK		Test channel:		Highest	
Frequency	Meter Reading	Factor	Emission Level	Limits	Over	Detector Type	Ant. Pol.
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)		H/V
2483.5	55.51	-9.29	46.22	74	-27.78	Peak	H
4954	52.88	-4.04	48.84	74	-25.16	Peak	H
7431	50.42	1.57	51.99	74	-22.01	Peak	H
2483.5	55.68	-9.29	46.39	74	-27.61	Peak	V
4954	50.62	-4.04	46.58	74	-27.42	Peak	V
7431	50.94	1.57	52.51	74	-21.49	Peak	V

Remark:

- 1) The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:
Final Test Level = Receiver Reading + Antenna Factor + Cable Factor – Preamplifier Factor
- 2) Scan from 9kHz to 25GHz, the disturbance above 10GHz and below 30MHz was very low. As shown in this section, for frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. So, only the peak measurements were shown in the report.

6 Photographs - EUT Test Setup

6.1 Radiated Emission

9KHz~30MHz:



30MHz~1GHz:



Above 1GHz:



6.2 Conducted Emission



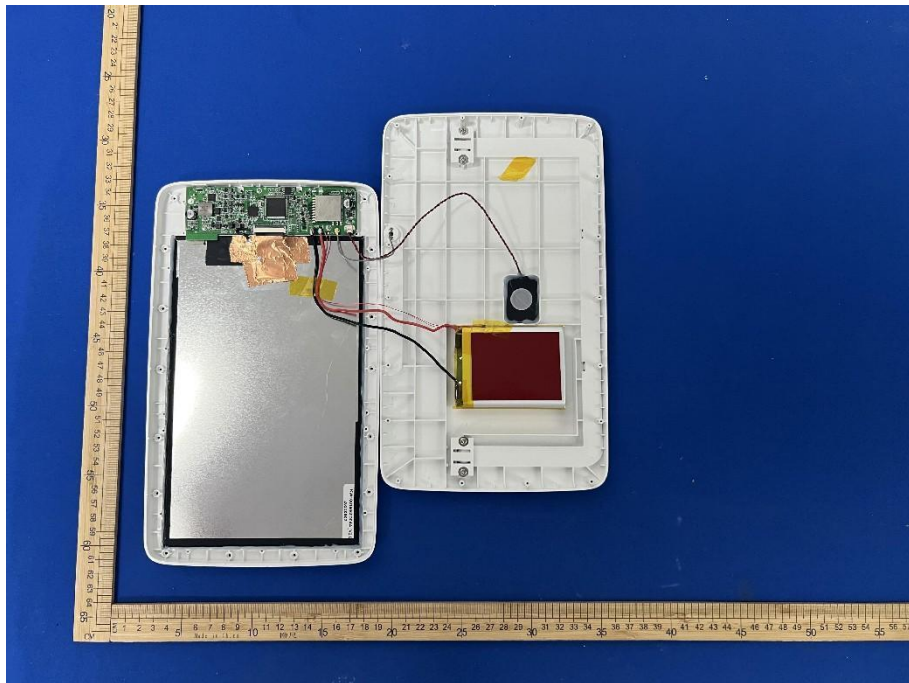
7 Photographs - EUT Constructional Details

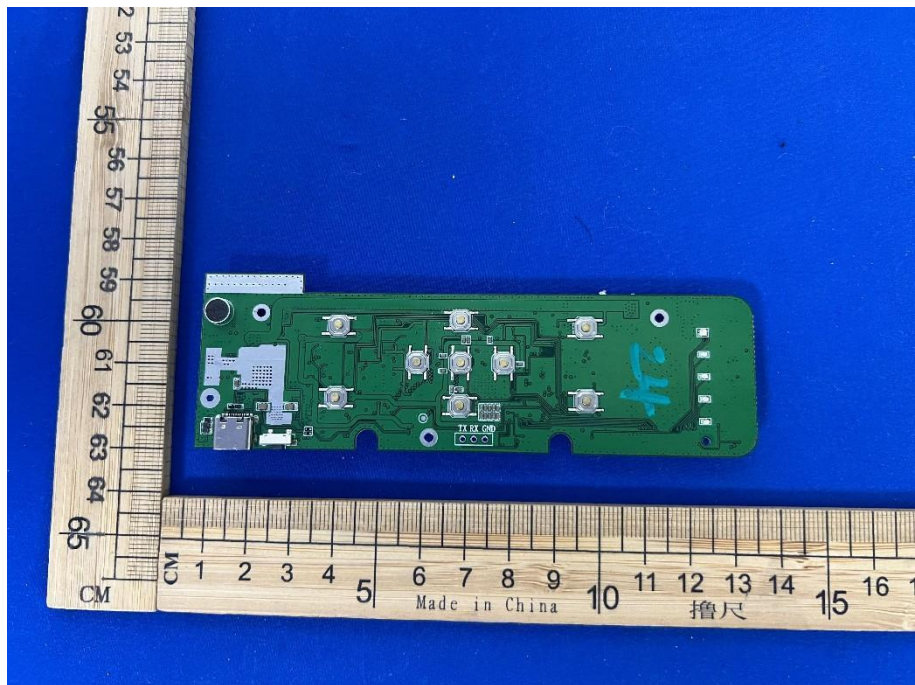
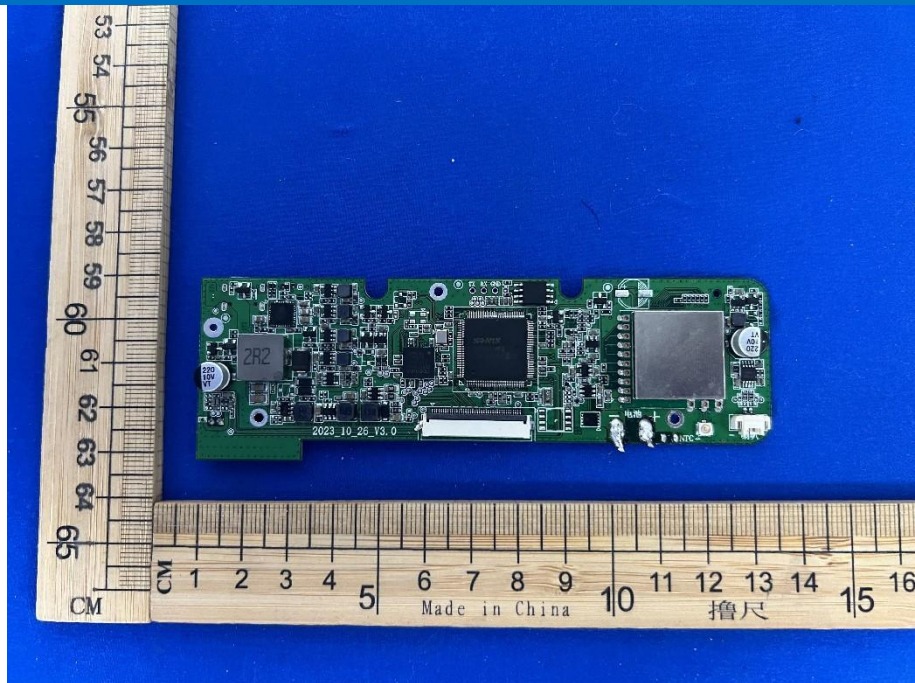


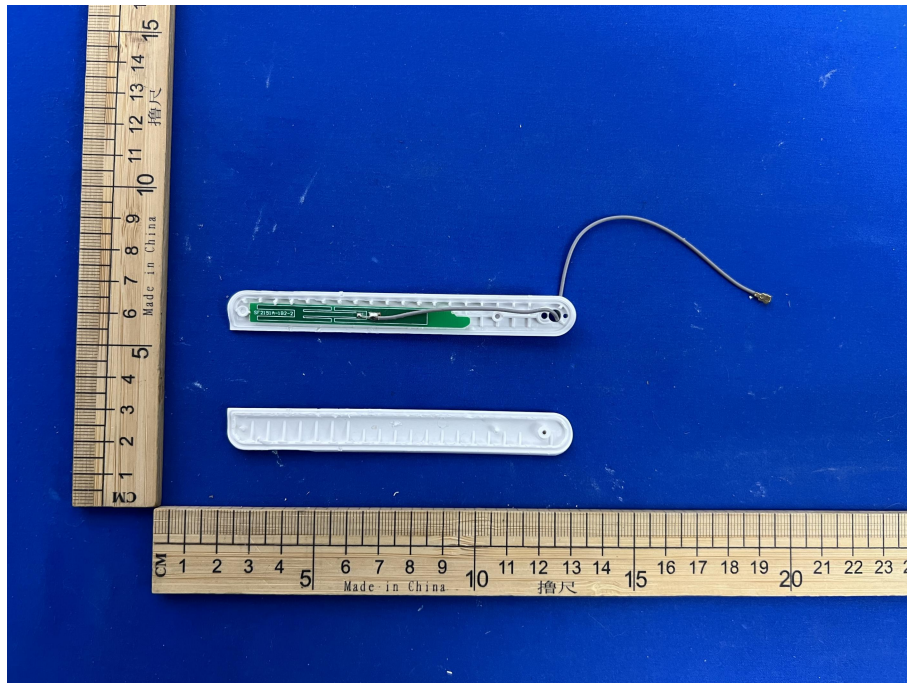
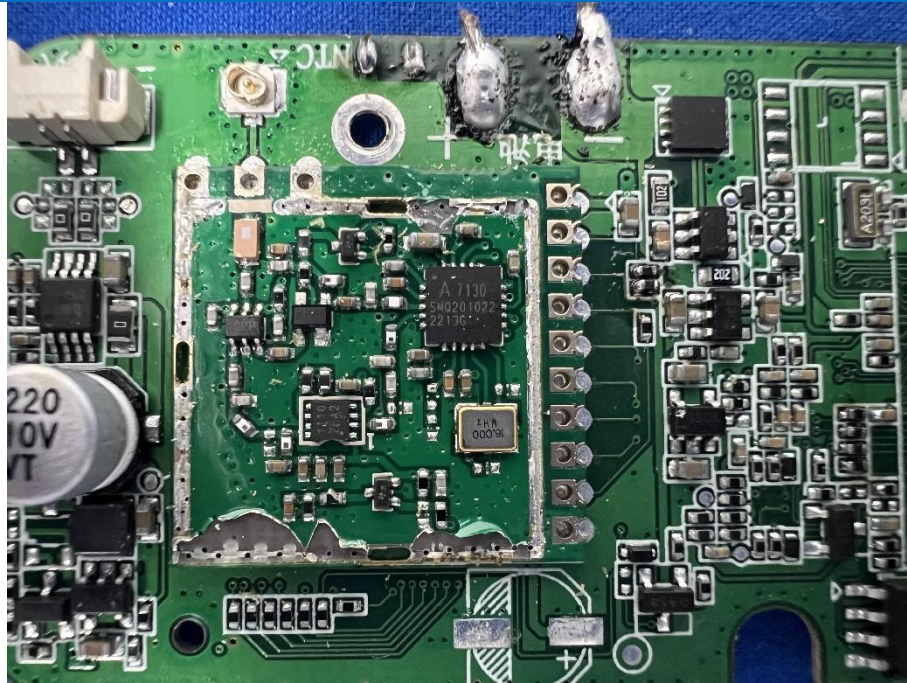












*** END OF REPORT ***