FCC Part 15.247

TEST REPORT

For

Main Technology Co.,Ltd.

5F.,No.132,Wugong 1st Rd., Wugu Dist.,New Taipei City 24887 , Taiwan R.O.C.

FCC ID: 2A625-BMST1040Y

Report Type:	**Product Type:**
Original Report	MYSHOW-T MULTIMEDIA COMPUTER

Report Producer : Nana Hsu

Report Number : RLK220518001RF01

Report Date : 2022-07-15

Reviewed By: David Hsu David.Hsu

Prepared By: Bay Area Compliance Laboratories Corp.
(Linkou Laboratory)
No. 6, Wende 2Rd., Guishan Dist., Taoyuan City 33382,
Taiwan (R.O.C.)
Tel: +886 (3)3961072; Fax: +886 (3) 3961027
www.bacl.com.tw

Revision History

Revision	No.	Report Number	Issue Date	Description	Author/ Revised by
0.0	RLK220518001	RLK220518001RF01	2022-07-15	Original Report	Nana Hsu

TABLE OF CONTENTS

1. General Information

1.1. Product Description for Equipment under Test (EUT)

Applicant	Main Technology Co.,Ltd.
	5F.,No.132,Wugong 1st Rd., Wugu Dist.,New Taipei City 24887 , Taiwan R.O.C.
Manufacturer	Main Technology Co.,Ltd.
	5F.,No.132,Wugong 1st Rd., Wugu Dist.,New Taipei City 24887 , Taiwan R.O.C.
Brand(Trade) Name	MyShow
Product (Equipment)	MYSHOW-T MULTIMEDIA COMPUTER
Main Model Name	BMST1040Y
Series Model Name	BMST1040R 、 BMST1040B 、 BMST1040W 、 BMST1040G 、 BMST1040P、BMST1040O
Model Discrepancy	The major electrical and mechanical constructions of series models are identical to the basic model, except different appearance color. The model, BMST1040Y is the testing sample, and the final test data are shown on this test report.
Frequency Range	2402 ~ 2480 MHz
Transmit Power	BR(GFSK) Mode: 4.20 dBm (0.003W)
Modulation Technique	BR Mode: GFSK
Power Operation (Voltage Range)	☒ AC 120V/60Hz ☒ Adapter Brand name: K.D. Intellingent Power Model: PDN-60E-120400 I/P:100-240V 1.4A 50-60Hz O/P:12.0V ⎓ 4.0A ☐ By AC Power Cord ☐ PoE
	☐ DC Type ☐ Battery ☐ DC Power Supply ☐ External from USB Cable ☐ External DC Adapter
	☐ Host System
Received Date	Jun. 08, 2022
Date of Test	Jun. 15, 2022 ~ Jul 11, 2022

**All measurement and test data in this report was gathered from production sample serial number: RLK220518001-01 (Assigned by BACL, Linkou Laboratory).*

1.2. Objective

This report is prepared on behalf of *Main Technology Co.,Ltd.* in accordance with Part 2, Subpart J, Part 15, Subparts A and C of the Federal Communication Commission's rules.
The tests were performed in order to determine the Bluetooth BR and EDR mode of EUT compliance with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.247 rules.

1.3. 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.
FCC 558074 D01 15.247 Meas Guidance v05r02.

1.4. Statement of Compliance

Decision Rule: No, (The test results do not include MU judgment)

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested.
The determination of the test results does not require consideration of the uncertainty of the measurement, unless the assessment is required by customer agreement, regulation or standard document specification.

1.5. Measurement Uncertainty

Parameter		Uncertainty
AC Mains		+/- 2.36 dB
RF output power, conducted		±0.74 dBm
Power Spectral Density, conducted		±1.14 dBm
Occupied Bandwidth		±0.94 MHz
Unwanted Emissions, conducted		±0.66 dBm
Emissions, radiated	30 MHz~1GHz	±1.36 dBm
	1 GHz~6 GHz	±2.3 dBm
	18GHz~26.5 GHz	±2.23 dBm
	26.5 GHz~40 GHz	±2.23 dBm
Temperature		+/- 1.71°C
Humidity		+/- 3.00 %

1.6. Environmental Conditions

Test Site	Test Data	Temperature (℃)	Relative Humidity (%)	ATM Pressure (hPa)	Test Engineer
AC Line Conducted Emissions	2022/7/11	24	58	1010	Sandy Yang
Radiation Spurious Emissions	2022/6/28	27	56	1010	Allen Cheng
Conducted Spurious Emissions	2022/6/15-2022/6/16	23.6-24.5	50-51	1010	Rory Cheng
20 dB Emission Bandwidth	2022/6/16	23.6	51	1010	Rory Cheng
Channel Separation Test	2022/6/16	23.6	51	1010	Rory Cheng
Time of Occupancy	2022/6/16	23.6	51	1010	Rory Cheng
Quantity of hopping channel	2022/6/16	23.6	51	1010	Rory Cheng
Maximum Output Power	2022/6/16	23.6	51	1010	Rory Cheng
100 kHz Bandwidth of Frequency Band Edge	2022/6/16	23.6	51	1010	Rory Cheng

1.7. Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Linkou Laboratory) to collect test data is located on

☒ No.6, Wende 2Rd., Guishan Dist., Taoyuan City 33382, Taiwan (R.O.C.).

Bay Area Compliance Laboratories Corp. (Linkou Laboratory) Lab is accredited to ISO 17025 by Taiwan Accreditation Foundation (TAF code: 3546) by Mutual Recognition Agreement (MRA). 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. The FCC Registration No.: 0027578244. Designation No.: TW1119. The Test Firm Registration No.: 311381.

2. System Test Configuration

2.1. Description of Test Configuration

For BT mode, 79 channels are provided to testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2402	40	2441
2	2403	--	--
3	2404	--	--
4	2405	77	2478
--	--	78	2479
39	2440	79	2480

For BT Modes were tested with channel 1, 40 and 79.

The system was configured for testing in engineering mode, which was provided by manufacturer.

2.2. Equipment Modifications

No modification was made to the EUT.

2.3. EUT Exercise Software

The test software was used "ADB command"

Test Frequency		2402MHz	2441MHz	2480MHz
Power Level Setting	GFSK	Default	Default	Default

2.4. Support Equipment List and Details

No.	Description	Manufacturer	Model Number
A	Monitor	DELL	P2415Q
B	SD Card	SanDisk	7204DVGDB0GG
C	USB flash	SanDisk	N/A
D	MIC 1	G&V	GV-MIO01
E	MIC 2	G&V	GV-MIO01
F	AP	D-Link	DIR-850L

2.5. External Cable List and Details

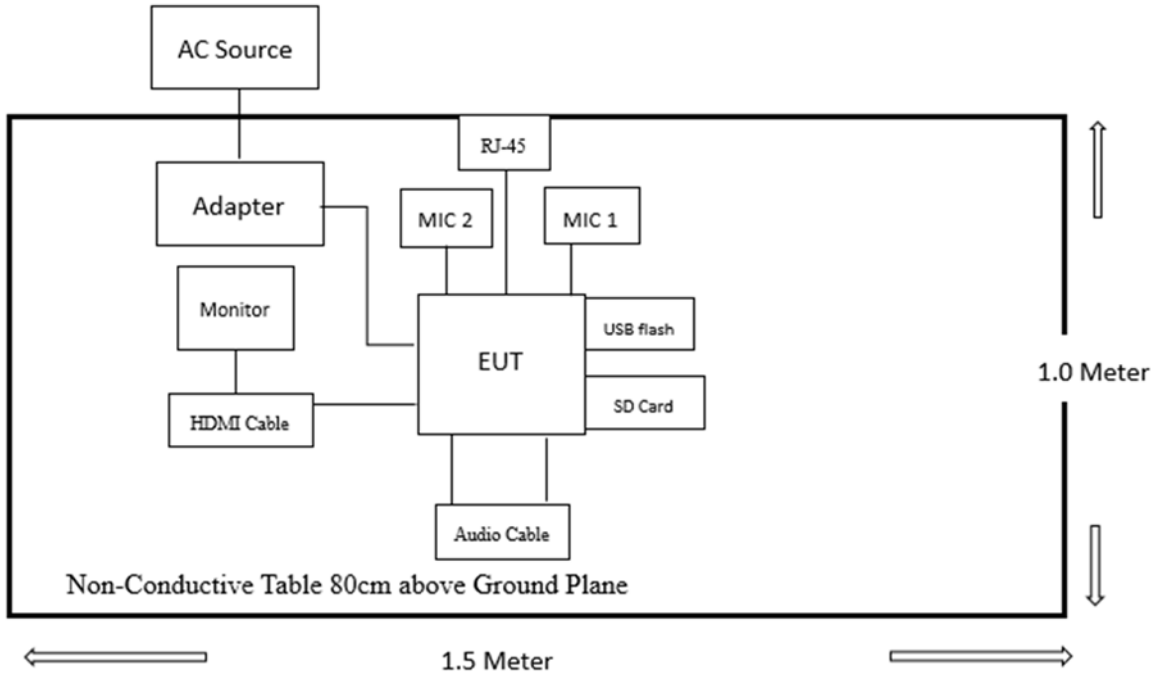
No.	Cable Description	Length (m)	From	To
1	HDMI Cable	1.06M	EUT	Monitor
2	RJ-45 Cable	2M	EUT	PC
3	Audio Cable	1.55M	EUT	EUT
4	MIC 1	5M	EUT	MIC1
5	MIC 2	5M	EUT	MIC2

2.6. Block Diagram of Test Setup

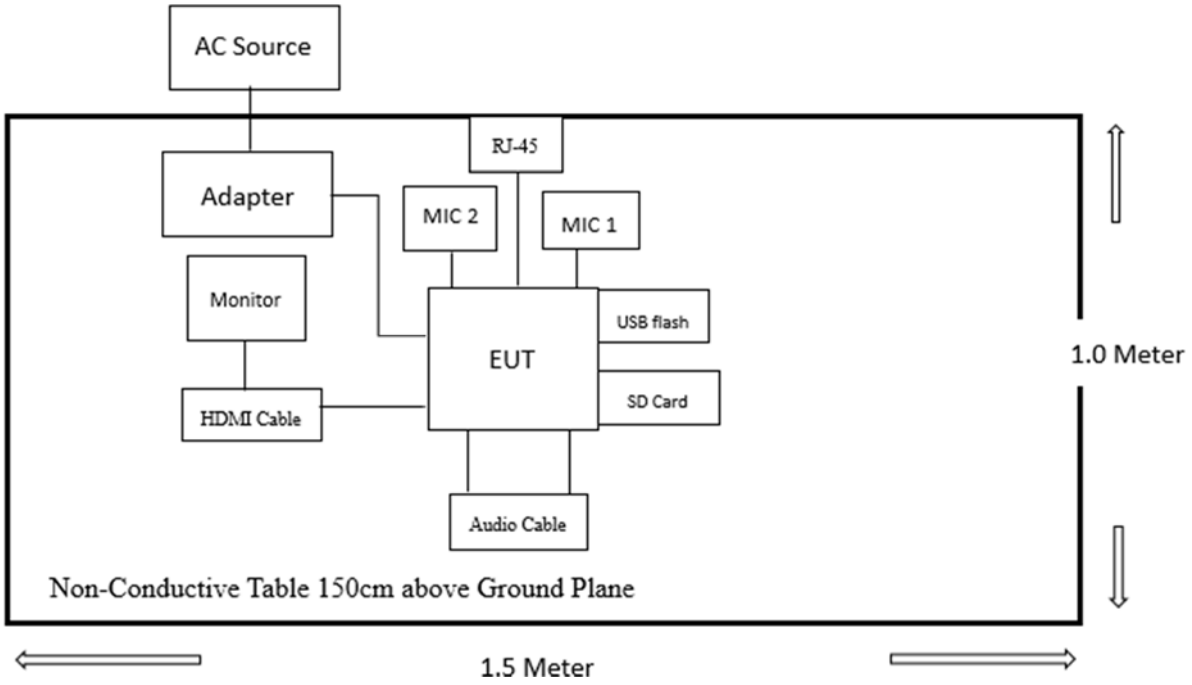
See test photographs attached in annex setup photos for the actual connections between EUT and support equipment.

Radiation:

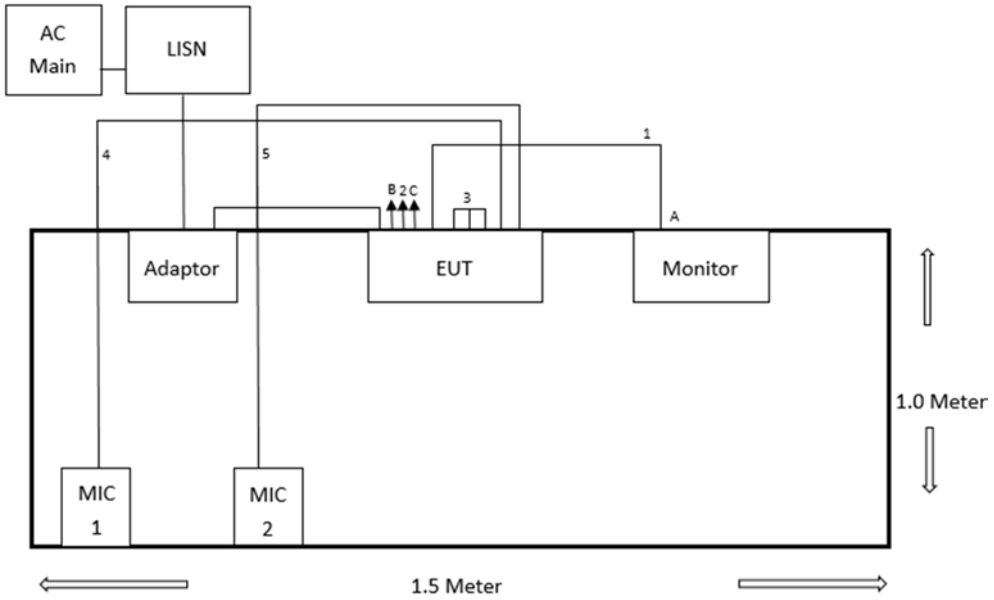
Below 1GHz:



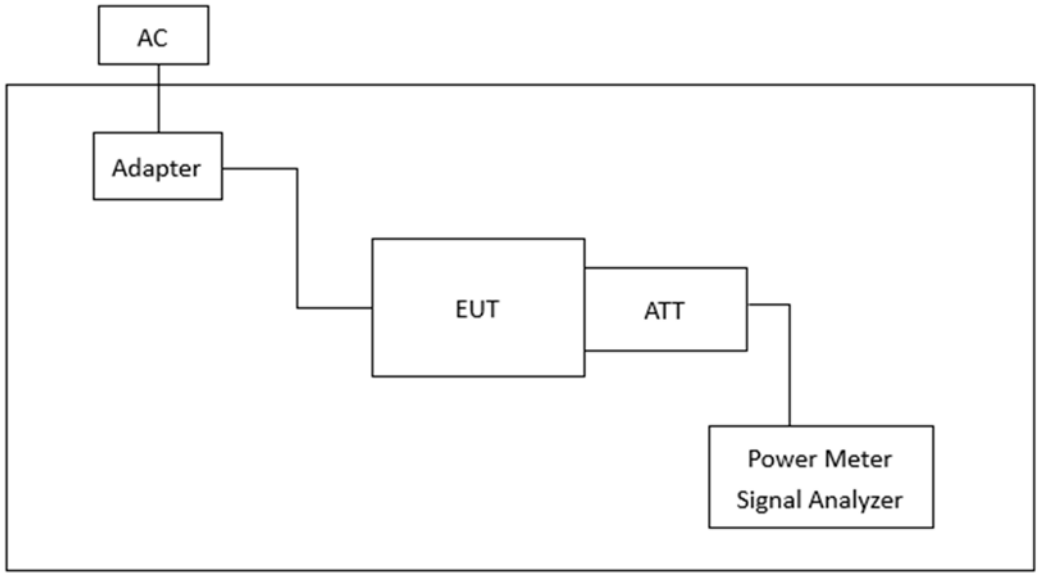
Above 1GHz:



Conduction:



Conducted:



3. Summary of Test Results

FCC Rules	Description of Test	Results
§15.247(i), §1.1307(b)(3)(i)	RF Exposure	Compliance
§15.203	Antenna Requirement	Compliance
§15.207(a)	AC Line Conducted Emissions	Compliance
§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliance
§15.247(a)(1)	20 dB Emission Bandwidth	Compliance
§15.247 (a)(1)	Channel Separation Test	Compliance
§15.247(a)(1)(iii)	Time of Occupancy (Dwell Time)	Compliance
§15.247(a)(1)(iii)	Quantity of hopping channel Test	Compliance
§15.247(b)(1)	Maximum Peak Output Power	Compliance
§15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliance

4. Test Equipment List and Details

Description	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due Date
AC Line Conduction Room (CON-A)					
Coaxial Cable 5C-2V (1.5M)	PX	P5C-2P-1.5M	PTP246-01	2021/11/5	2022/11/4
Coaxial Cable 5C-2V (3M)	HER YING	RG-10-3M	LKTE059	2021/11/5	2022/11/4
Pulse Limiter	SCHWARZBECK	VTSD 9561-F	00432	2021/9/1	2022/8/31
ESR EMI Test Receiver	Rohde & Schwarz	ESR3	102430	2022/04/28	2023/04/27
Line Impedance Stabilization Network	COM-POWER	LI-550C	20140014	2020/9/11	2022/9/10
Line Impedance Stabilization Network	COM-POWER	LI-550C	20140015	2020/9/11	2022/9/10
RF Cable	EMCI	EMCCFD300-BM-BM-8000	180526	2021/8/17	2022/8/16
Two-Line V-Network	Rohde & Schwarz	ENV216	100037	2021/9/10	2022/9/9
Radiated Room					
Bilog Antenna & 6 dB Attenuator	SUNOL SCIENCES & EMCI	JB3 & N-6-06	A111513 & AT-N0668	2022/4/11	2023/4/10
Horn Antenna	ETS-Lindgren	3115	109141	2021/7/12	2022/7/11
Horn Antenna	ETS-Lindgren	3160-09	123852	2021/7/13	2022/7/12
Horn Antenna	ETS-Lindgren	3160-10	123855	2021/7/13	2022/7/12
Spectrum Analyzer	Rohde & Schwarz	FSV40	101940	2021/12/15	2022/12/14
ESR EMI Test Receiver	Rohde & Schwarz	ESR3	102448	2021/9/28	2022/9/27
Preamplifier	A.H. Systems	PAM-1840VH	174	2022/3/23	2023/3/22
Preamplifier with 1W input limiter	A.H. Systems	PAM-0118P	470	2022/3/23	2023/3/22
Microflex Cable (1m)	MTJ	00000-MT26A-100	H0919	2021/8/7	2022/8/6

Microflex Cable (2m)	EMCI	EMC106-SM-SM-2000	180515	2021/8/7	2022/8/6
Microflex Cable (8m)	UTIFLEX	UFA210A-1-3149-300300	MFR 64639 232490-001	2021/8/7	2022/8/6
Band Reject Filter	Xi'an Xingbo	XBLBQ-DZA81	190329-1-08	2022/4/14	2023/4/13
Band Reject Filter	Xi'an Xingbo	XBLBQ-DZA62	190329-1-01	2022/4/14	2023/4/13
Temperature and Humidity Recorder	N/A	HTC-1	N/A	2021/11/5	2022/11/4
Conducted Room					
Signal and Spectrum Analyzer (with B21)	Rohde & Schwarz	FSV40	1321.3008K40-101938-Gt	2021/12/7	2022/12/6
Coaxial Cable	HER YING	RG-10-3M	LKTE059	2021/11/05	2022/11/04
Attenuator	HAEFELY TEST AG	PAT50A & PAT1000	187177 & 187176	2021/10/20	2022/10/19
Power Sensor	AGILENT	E9301A	MY41498915	2022/03/29	2023/03/28

***Statement of Traceability:** BACL Corp. attests that all of the calibrations on the equipment items listed above were traceable to the SI System of Units via the R.O.C. Center for Measurement Standards of the Electronics Testing Center, Taiwan (ETC) or to another internationally recognized National Metrology Institute (NMI), and were compliant with the current Taiwan Accreditation Foundation (TAF) requirements

5. FCC §15.247(i), §1.1307(b)(3)(i) - RF Exposure

5.1. Applicable Standard

According to subpart 15.247(i) and subpart §1.1307(b)(3)(i), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

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:

(A) The available maximum time-averaged power is no more than 1 mW, regardless of separation distance. This exemption may not be used in conjunction with other exemption criteria other than those in paragraph (b)(3)(ii)(A) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(ii)(A);
(B) Or the available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold *Pth* (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). *Pth* 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

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

(C) Or using Table 1 and the minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, R must be at least $\lambda/2\pi$, where λ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP if the physical dimensions of the radiating structure(s) do not exceed the electrical length of $\lambda/4$ or if the antenna gain is less than that of a half-wave dipole (1.64 linear value).

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

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

The sequence to apply for single portable RF sources includes the following steps:

1) determination of 1 mW blanket exemption under § 1.1307(b)(3)(i)(A)

2) determination of exemption under the MPE-based § 1.1307(b)(3)(i)(C) if 1) is not met

3) determination of exemption under the SAR-based § 1.1307(b)(3)(i)(B) if both 1) and 2) are not met

5.2. RF Exposure Evaluation Result

The EUT can be used in the WIFI and Bluetooth modes, selecting the worst mode for evaluation.

Wi-Fi and Bluetooth cannot transmit simultaneously.

Project info

Band	Freq (MHz)	Tune-up (dBm)	Ant Gain (dBi)	Distances (mm)	Duty (%)	Tune-up (mW)	ERP (dBm)	ERP (mW)
Bluetooth	2402	4.5	2	200	100%	2.82	4.35	2.72

§ 1.1307(b)(3)(i)(A) method is not applicable.

§ 1.1307(b)(3)(i)(C)

Band	Freq (MHz)	λ/2π (mm)	Distances applies	ERP Limit (mW)	Ratio	Result
Bluetooth	2402	19.88	apply	768.00	< 0.01	exempt

The minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates

ERP (watts) is no more than the calculated value prescribed for that frequency

R must be at least $\lambda/2\pi$

λ is the free-space operating wavelength in meters

Result: The EUT meets exemption requirement

6. FCC §15.203 – Antenna Requirements

6.1. Applicable Standard

According to § 15.203,

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited.

And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna does not exceed 6dBi.

6.2. Antenna Information

Manufacturer	Model	Type	Antenna Gain
SHENZHEN FEISHENG	L250MM	FPC Antenna	2.0 dBi

Result: Compliance

7. FCC §15.207(a) – AC Line Conducted Emissions

7.1. Applicable Standard

According to §15.207

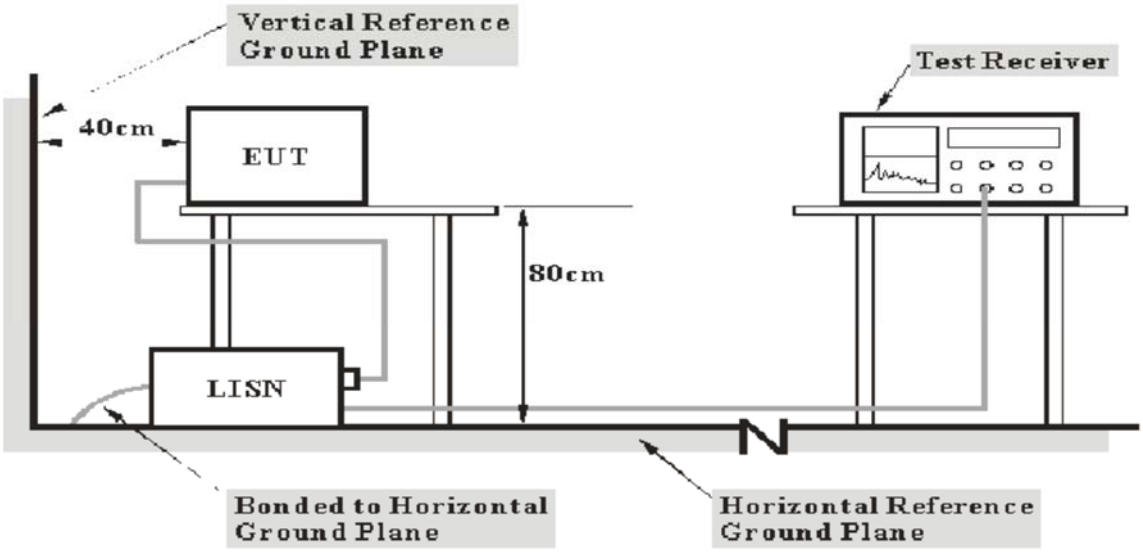
For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequencies ranges.

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15-0.5	66 to 56 Note 1	56 to 46 Note 2
0.5-5	56	46
5-30	60	50

Note 1: Decreases with the logarithm of the frequency.

Note 2: A linear average detector is required

7.2. 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 setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 limits.

7.3. EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150kHz to 30MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations

Frequency Range	IF B/W
150kHz – 30MHz	9kHz

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

7.5. Corrected Factor & Margin Calculation

The factor is calculated by adding LISN/ISN VDF (Voltage Division Factor), Cable Loss and Transient Limiter Attenuation. The basic equation is as follows:

Factor = LISN VDF + Cable Loss + Transient Limiter Attenuation

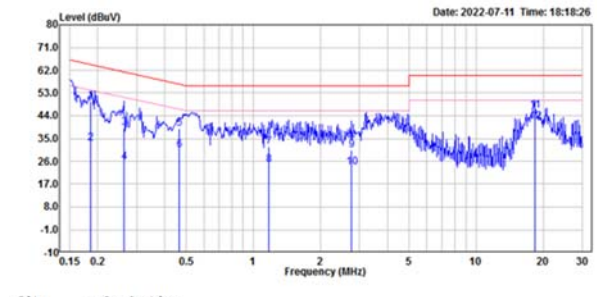
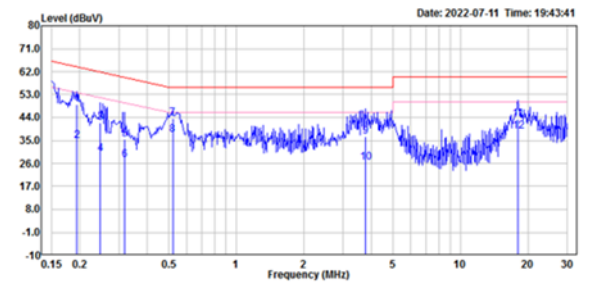
The “Over Limit” column of the following data tables indicates the degree of compliance with the applicable limit. For example, an over limit of -7 dB means the emission is 7 dB below the limit. The equation for Over Limit calculation is as follows:

Over Limit = Level – Limit Line

7.6. Test Results

Test Mode: Transmitting

Main: AC120 V, 60 Hz, Line

Line	Neutral
	

	Freq	Read Level	Level	Factor	Limit Line	Over Limit	Remark
	MHz	dBuV	dBuV	dB	dBuV	dB	
1	0.186	29.84	49.65	19.81	64.21	-14.56	QP
2	0.186	13.46	33.27	19.81	54.21	-20.94	Average
3	0.264	19.47	39.29	19.82	61.30	-22.01	QP
4	0.264	5.68	25.50	19.82	51.30	-25.80	Average
5	0.465	19.07	38.90	19.83	56.60	-17.70	QP
6	0.465	10.71	30.54	19.83	46.60	-16.06	Average
7	1.172	12.02	31.90	19.88	56.00	-24.10	QP
8	1.172	4.67	24.55	19.88	46.00	-21.45	Average
9	2.748	10.34	30.32	19.98	56.00	-25.68	QP
10	2.748	3.55	23.53	19.98	46.00	-22.47	Average
11 *	18.306	25.66	45.98	20.32	60.00	-14.02	QP
12 *	18.306	21.45	41.77	20.32	50.00	-8.23	Average

	Freq	Read Level	Level	Factor	Limit Line	Over Limit	Remark
	MHz	dBuV	dBuV	dB	dBuV	dB	
1	0.195	29.23	49.05	19.82	63.82	-14.77	QP
2	0.195	14.90	34.72	19.82	53.82	-19.10	Average
3	0.248	22.05	41.88	19.83	61.83	-19.95	QP
4	0.248	9.76	29.59	19.83	51.83	-22.24	Average
5	0.317	15.81	35.63	19.82	59.78	-24.15	QP
6	0.317	7.52	27.34	19.82	49.78	-22.44	Average
7 *	0.520	23.74	43.58	19.84	56.00	-12.42	QP
8 *	0.520	17.23	37.07	19.84	46.00	-8.93	Average
9	3.780	16.38	36.40	20.02	56.00	-19.60	QP
10	3.780	6.44	26.46	20.02	46.00	-19.54	Average
11	18.016	23.06	43.48	20.42	60.00	-16.52	QP
12	18.016	18.23	38.65	20.42	50.00	-11.35	Average

Note:

Level = Read Level + Factor

Over Limit = Level – Limit Line

Factor = (LISN, ISN, PLC or current probe) Factor + Cable Loss + Attenuator

8. FCC §15.209, §15.205 , §15.247(d) – Spurious Emissions

8.1. Applicable Standard

As per FCC §15.35(d): Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1MHz.

As Per FCC §15.205(a) except as show in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 – 0.110	16.42 – 16.423	608 – 614	4. 5 – 5. 15
0.495 – 0.505	16.69475 – 16.69525	960 – 1240	5. 35 – 5. 46
2.1735 – 2.1905	16.80425 – 16.80475	1300 – 1427	7.25 – 7.75
4.125 – 4.128	25.5 – 25.67	1435 – 1626.5	8.025 – 8.5
4.17725 – 4.17775	37.5 – 38.25	1645.5 – 1646.5	9.0 – 9.2
4.20725 – 4.20775	73 – 74.6	1660 – 1710	9.3 – 9.5
6.215 – 6.218	74.8 – 75.2	1718.8 – 1722.2	10.6 – 12.7
6.26775 – 6.26825	108 – 121.94	2200 – 2300	13.25 – 13.4
6.31175 – 6.31225	123 – 138	2310 – 2390	14.47 – 14.5
8.291 – 8.294	149.9 – 150.05	2483.5 – 2500	15.35 – 16.2
8.362 – 8.366	156.52475 – 156.52525	2690 – 2900	17.7 – 21.4
8.37625 – 8.38675	156.7 – 156.9	3260 – 3267	22.01 – 23.12
8.41425 – 8.41475	162.0125 –167.17	3.332 – 3.339	23.6 – 24.0
12.29 – 12.293	167.72 – 173.2	3 3458 – 3 358	31.2 – 31.8
12.51975 – 12.52025	240 – 285	3.600 – 4.400	36.43 – 36.5
12.57675 – 12.57725	322 – 335.4		Above 38.6
13.36 – 13.41	399.9 – 410		

As per FCC §15.209(a): Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (micro volts/meter)	Measurement Distance (meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

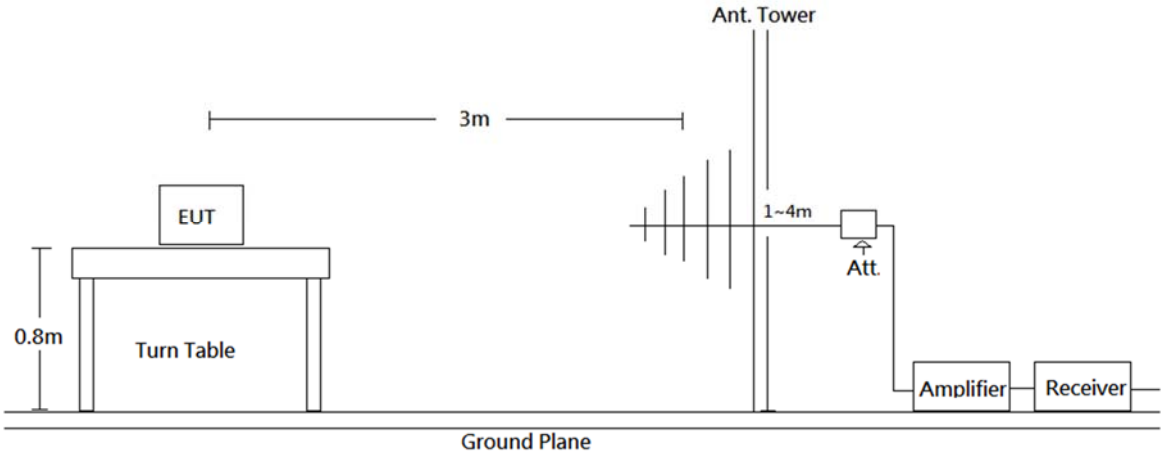
** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

As per FCC §15.247 (d) 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

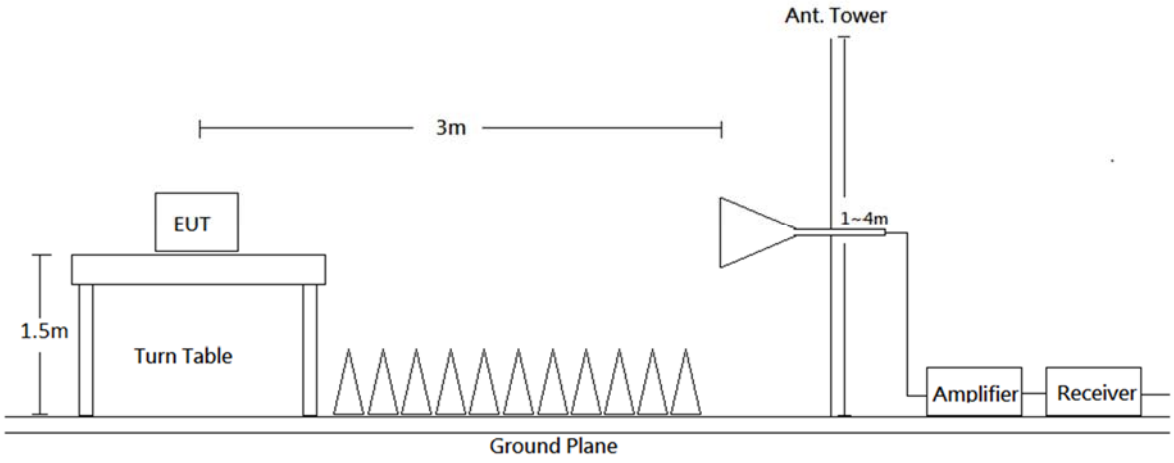
the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, 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).

8.2. EUT Setup

Below 1 GHz:



Above 1 GHz:



Radiated emission tests were performed in the 3 meters chamber test site, using the setup accordance with the ANSI C63.10-2013. The specification used was the FCC Part 15.209 and FCC 15.247 Limits.

8.3. EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 30 MHz to 26.5 GHz. During the radiated emission test, the EMI test receiver was set with the following configurations measurement method 6.3 in ANSI C63.10.

Frequency Range	RBW	VBW	Measurement method
30-1000 MHz	120 kHz	/	QP
Above 1 GHz	1 MHz	3 MHz	PK
	1 MHz	10 Hz	Ave

8.4. Test Procedure

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

All data was recorded in the Quasi-peak detector mode from 30 MHz to 1 GHz and PK and average detector modes for frequencies above 1 GHz.

8.5. Corrected Factor & Margin Calculation

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

Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain

The “Margin” column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7 dB means the emission is 7 dB below the limit. The equation for margin calculation is as follows:

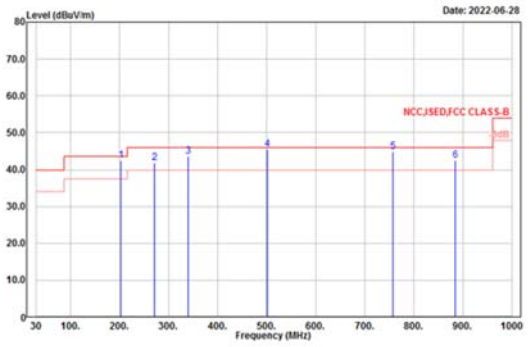
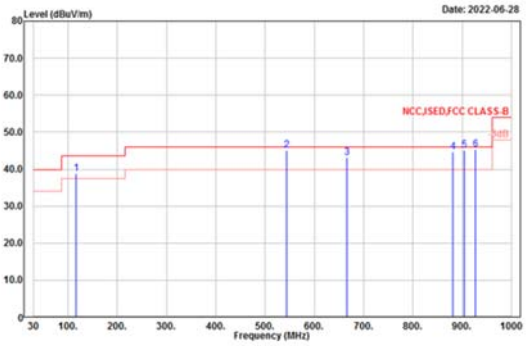
Margin = Result – Limit

8.6. Test Results

Test Mode: Transmitting (Pre-scan with three orthogonal axis, and worse case as Y axis.)

(worst case is BR (GFSK) mode Low channel)

30MHz-1GHz:

Horizontal	Vertical
	

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
1	203.630	42.41	43.50	-1.09	62.85	-20.44	Peak
2	271.530	41.93	46.00	-4.07	61.72	-19.79	Peak
3	339.430	43.56	46.00	-2.44	62.45	-18.89	Peak
4	500.450	45.44	46.00	-0.56	60.90	-15.46	QP
5	756.530	44.81	46.00	-1.19	56.29	-11.48	Peak
6	884.570	42.53	46.00	-3.47	52.33	-9.80	Peak

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
1	117.300	38.86	43.50	-4.64	57.86	-19.00	Peak
2	544.100	45.05	46.00	-0.95	59.64	-14.59	Peak
3	666.320	43.25	46.00	-2.75	55.92	-12.67	Peak
4	880.690	44.56	46.00	-1.44	54.41	-9.85	Peak
5	903.970	45.06	46.00	-0.94	54.64	-9.58	Peak
6	926.280	45.36	46.00	-0.64	54.66	-9.30	Peak

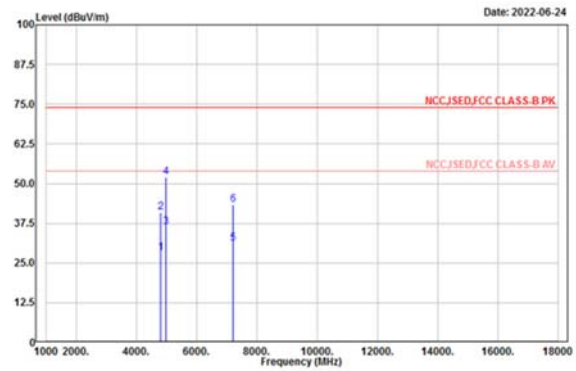
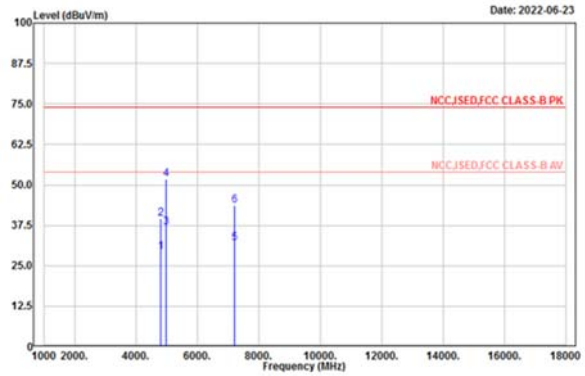
Level (Result) = Reading + Factor.

Over Limit (Margin) = Level – Limit Line.

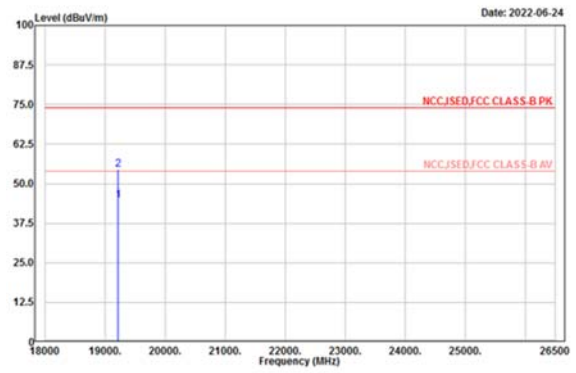
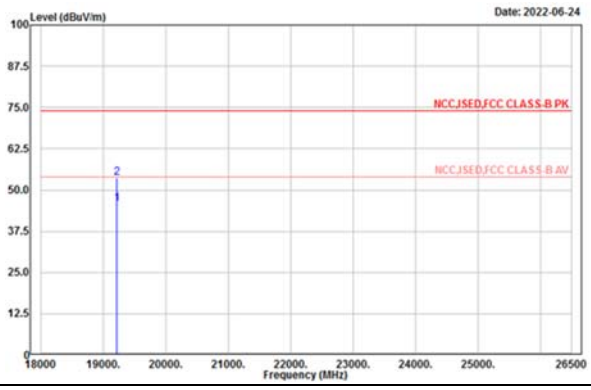
Factor = Antenna Factor + Cable Loss – Amplifier Gain.

Spurious emissions more than 20 dB below the limit were not reported.

1GHz-18GHz

Horizontal	Vertical
	

18GHz-26.5GHz

Horizontal	Vertical
	

Level (Result) = Reading + Factor.

Over Limit (Margin) = Level – Limit Line.

Factor = Antenna Factor + Cable Loss – Amplifier Gain.

Spurious emissions more than 20 dB below the limit were not reported.

Above

1GHz-18GHz

Low channel

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
1	2327.500	36.24	54.00	-17.76	46.13	-9.89	Average
2	2327.500	45.23	74.00	-28.77	55.12	-9.89	Peak
3 *	2402.000	92.31			101.97	-9.66	Average
4 *	2402.000	92.77			102.43	-9.66	Peak

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
1	4804.000	28.24	54.00	-25.76	30.94	-2.70	Average
2	4804.000	40.80	74.00	-33.20	43.50	-2.70	Peak
3	4978.000	36.36	54.00	-17.64	38.60	-2.24	Average
4	4978.000	52.02	74.00	-21.98	54.26	-2.24	Peak
5	7206.000	31.18	54.00	-22.82	27.38	3.80	Average
6	7206.000	43.31	74.00	-30.69	39.51	3.80	Peak

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
1	2386.700	37.07	54.00	-16.93	46.78	-9.71	Average
2	2386.700	46.50	74.00	-27.50	56.21	-9.71	Peak
3 *	2402.000	91.98			101.64	-9.66	Average
4 *	2402.000	92.78			102.44	-9.66	Peak

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
1	4804.000	29.29	54.00	-24.71	31.99	-2.70	Average
2	4804.000	39.66	74.00	-34.34	42.36	-2.70	Peak
3	4978.000	36.93	54.00	-17.07	39.17	-2.24	Average
4	4978.000	51.85	74.00	-22.15	54.09	-2.24	Peak
5	7206.000	32.00	54.00	-22.00	28.20	3.80	Average
6	7206.000	43.74	74.00	-30.26	39.94	3.80	Peak

Middle channel

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
1 *	2440.000	94.00			103.54	-9.54	Average
2 *	2440.000	94.40			103.94	-9.54	Peak

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
1	4882.000	28.71	54.00	-25.29	31.20	-2.49	Average
2	4882.000	40.72	74.00	-33.28	43.21	-2.49	Peak
3	4995.000	36.05	54.00	-17.95	38.23	-2.18	Average
4	4995.000	52.26	74.00	-21.74	54.44	-2.18	Peak
5	7323.000	32.30	54.00	-21.70	28.12	4.18	Average
6	7323.000	44.32	74.00	-29.68	40.14	4.18	Peak

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
1 *	2440.000	93.95			103.49	-9.54	Average
2 *	2440.000	94.38			103.92	-9.54	Peak

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
1	4882.000	30.04	54.00	-23.96	32.53	-2.49	Average
2	4882.000	40.67	74.00	-33.33	43.16	-2.49	Peak
3	4995.000	36.12	54.00	-17.88	38.30	-2.18	Average
4	4995.000	53.29	74.00	-20.71	55.47	-2.18	Peak
5	7323.000	32.60	54.00	-21.40	28.42	4.18	Average
6	7323.000	45.04	74.00	-28.96	40.86	4.18	Peak

High channel

Horizontal

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
1 *	2480.000	92.44			101.86	-9.42	Average
2 *	2480.000	92.93			102.35	-9.42	Peak
3	2489.020	36.96	54.00	-17.04	46.35	-9.39	Average
4	2489.020	46.15	74.00	-27.85	55.54	-9.39	Peak

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
1	4960.000	28.34	54.00	-25.66	30.61	-2.27	Average
2	4960.000	41.60	74.00	-32.40	43.87	-2.27	Peak
3	4978.000	37.23	54.00	-16.77	39.47	-2.24	Average
4	4978.000	53.55	74.00	-20.45	55.79	-2.24	Peak
5	7440.000	33.03	54.00	-20.97	28.56	4.47	Average
6	7440.000	44.91	74.00	-29.09	40.44	4.47	Peak

Vertical

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
1 *	2480.000	94.89			104.31	-9.42	Average
2 *	2480.000	95.35			104.77	-9.42	Peak
3	2489.080	38.38	54.00	-15.62	47.77	-9.39	Average
4	2489.080	48.64	74.00	-25.36	58.03	-9.39	Peak

	Freq	Level	Limit Line	Over Limit	Read Level	Factor	Remark
	MHz	dBuV/m	dBuV/m	dB	dBuV	dB/m	
1	4960.000	28.18	54.00	-25.82	30.45	-2.27	Average
2	4960.000	41.48	74.00	-32.52	43.75	-2.27	Peak
3	4978.000	36.09	54.00	-17.91	38.33	-2.24	Average
4	4978.000	52.61	74.00	-21.39	54.85	-2.24	Peak
5	7440.000	32.93	54.00	-21.07	28.46	4.47	Average
6	7440.000	44.84	74.00	-29.16	40.37	4.47	Peak

Level (Result) = Reading + Factor.

Over Limit (Margin) = Level – Limit Line.

Factor = Antenna Factor + Cable Loss – Amplifier Gain.

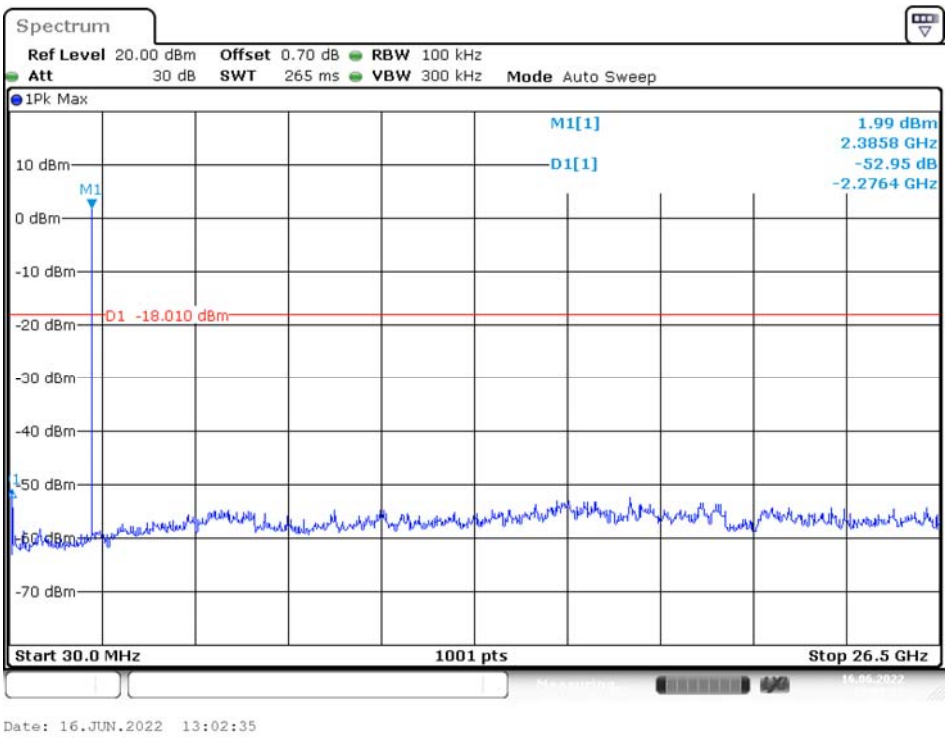
Spurious emissions more than 20 dB below the limit were not reported.

Conducted Spurious Emissions:

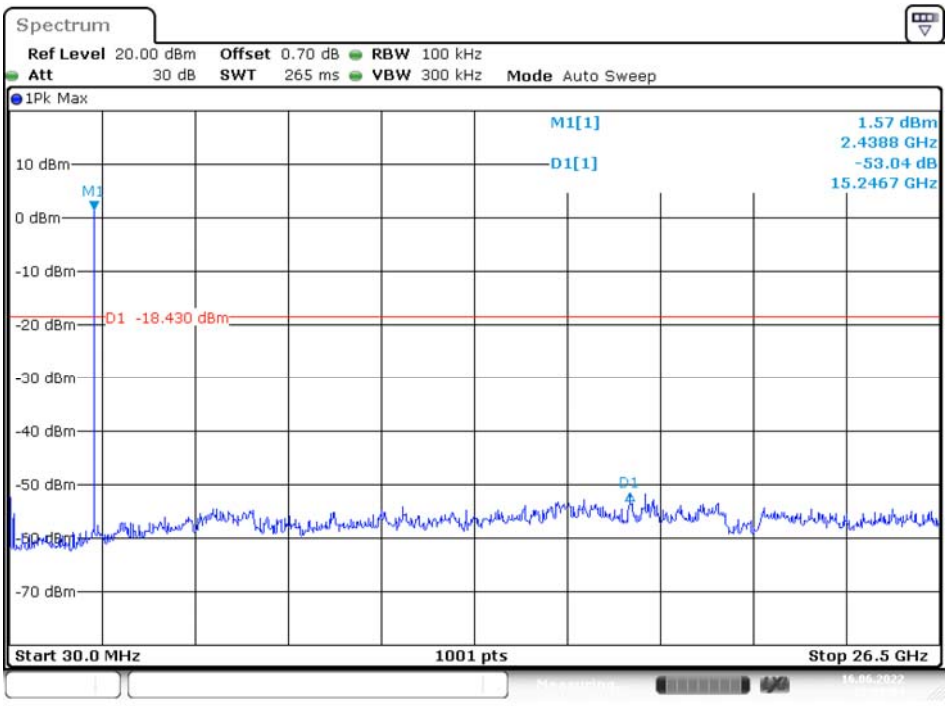
Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
BR Mode (GFSK)				
Low	2402	52.95	≥ 20	PASS
Mid	2441	53.04	≥ 20	PASS
High	2480	51.79	≥ 20	PASS

BR Mode (GFSK)

Low Channel

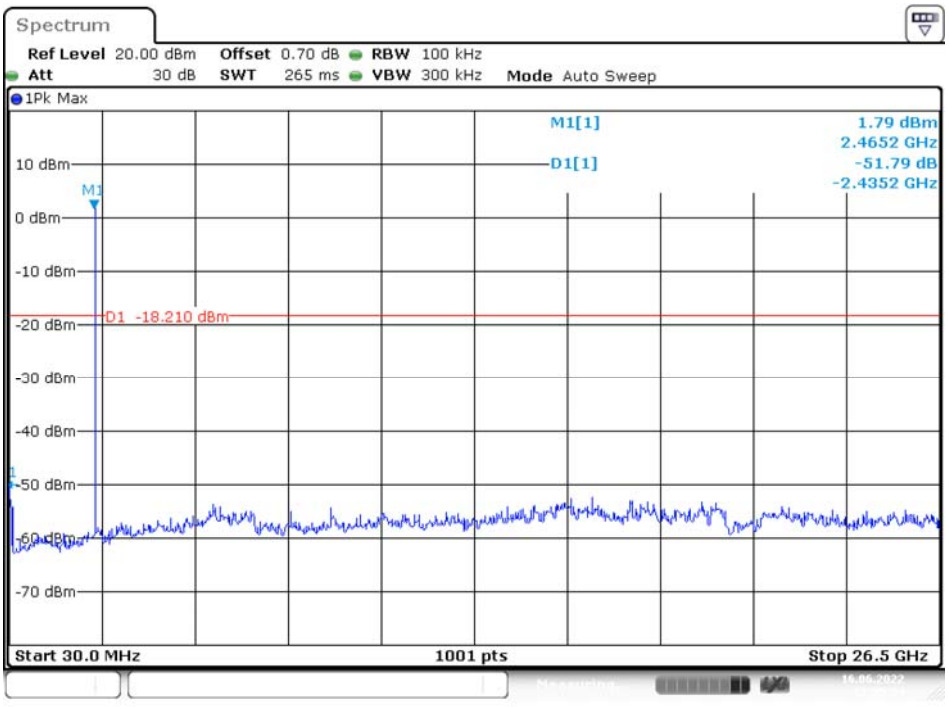


Middle Channel



Date: 16.JUN.2022 13:00:04

High Channel



Date: 16.JUN.2022 12:55:34

9. FCC §15.247(a)(1) – 20 dB Emission Bandwidth

9.1. Applicable Standard

According to FCC §15.247(a) (1) the maximum 20 dB bandwidth of the hopping channel shall be presented.

9.2. Test Procedure

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

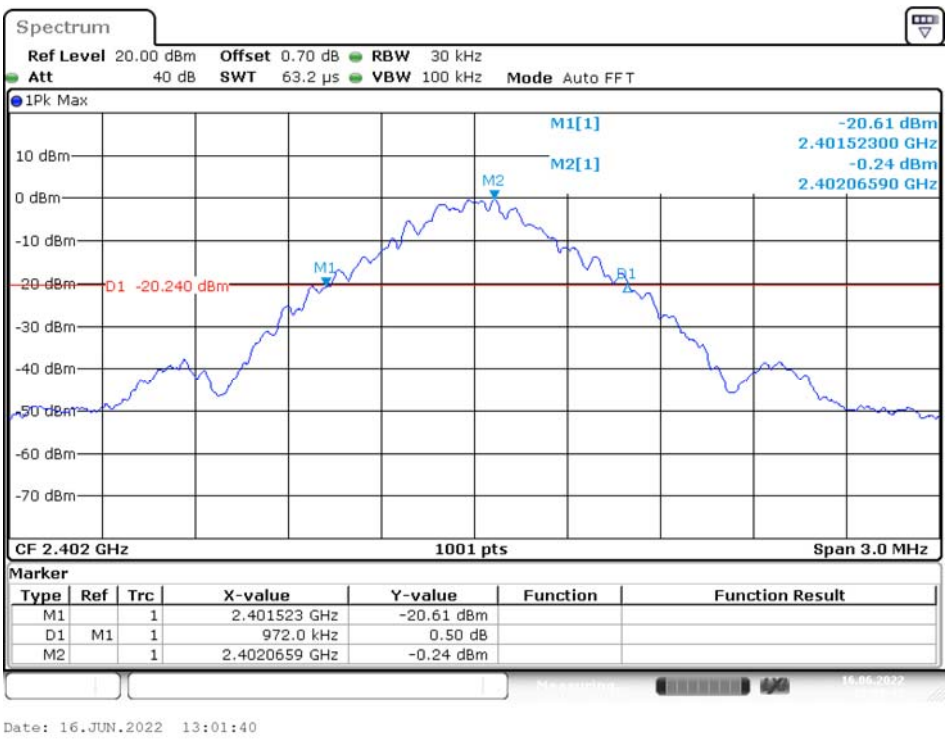
9.3. Test Results

Channel	Frequency (MHz)	20 dBc BW (MHz)
BR Mode (GFSK)		
Low	2402	0.97
Middle	2441	0.97
High	2480	0.97

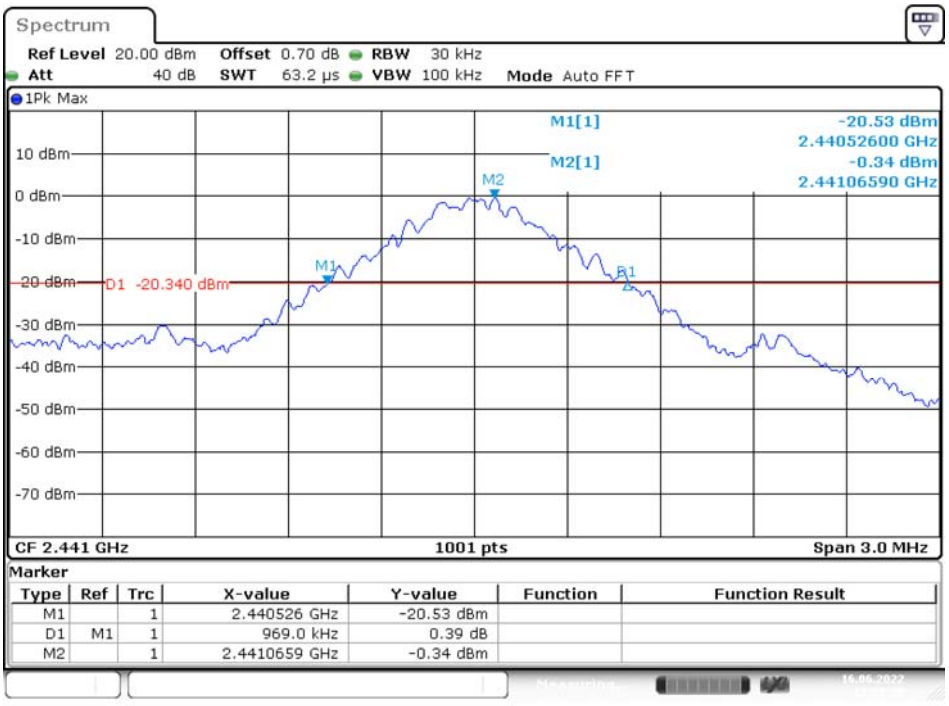
Please refer to the following plots

BR Mode (GFSK)

Low Channel

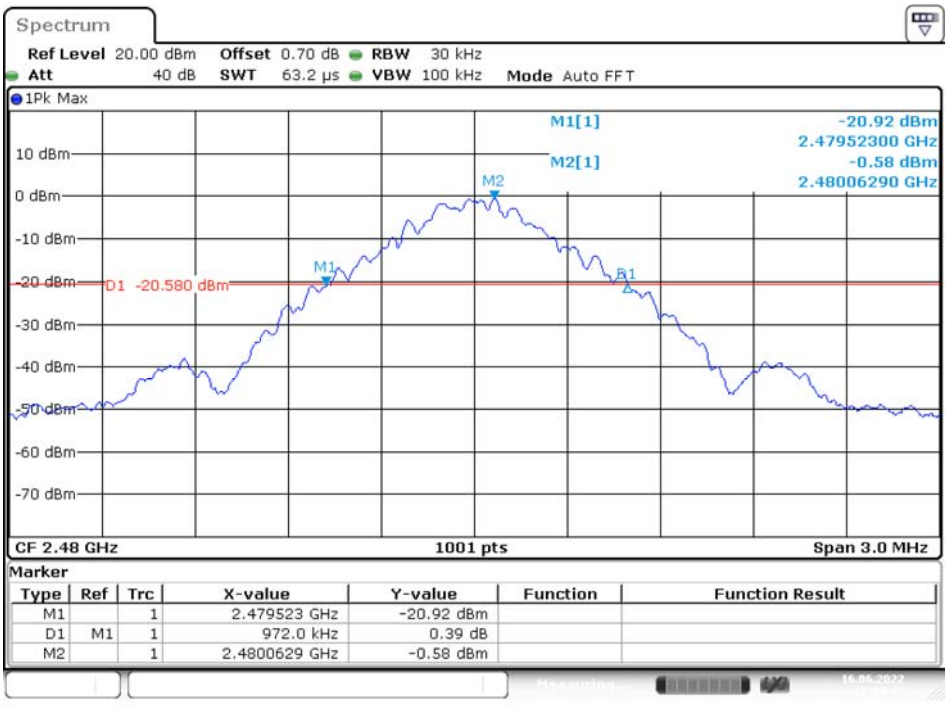


Middle Channel



Date: 16.JUN.2022 12:59:28

High Channel



Date: 16.JUN.2022 12:54:41

10. FCC §15.247(a)(1) – Channel Separation Test

10.1. Applicable Standard

According to FCC §15.247(a) (1): Frequency hopping systems shall have hopping 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.

10.2. Test Procedure

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

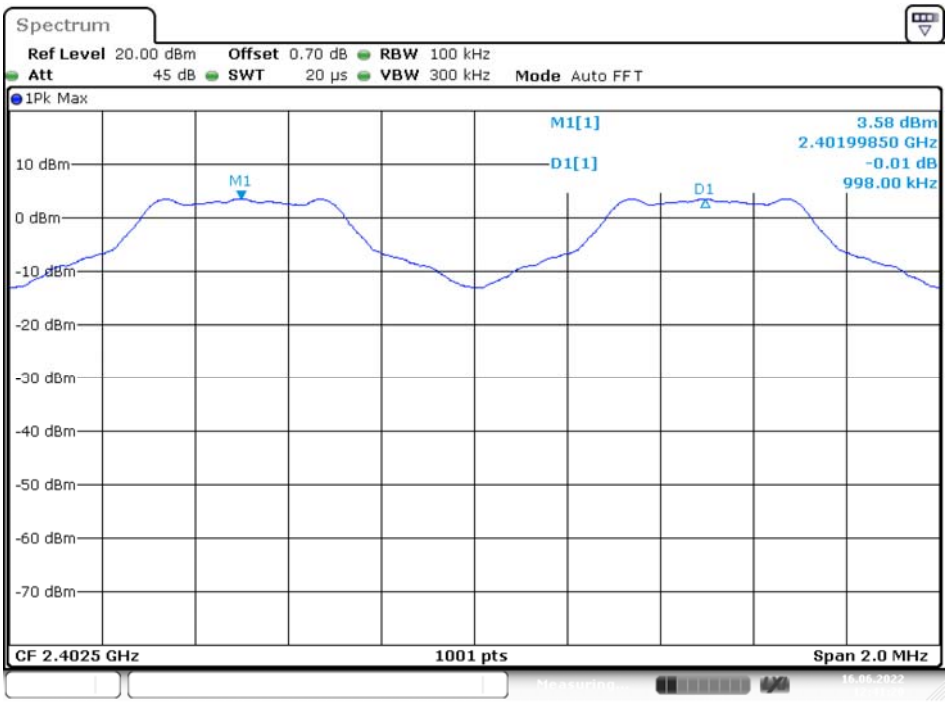
10.3. Test Results

Channel	Channel Separation (MHz)	20 dBc BW (MHz)	Two-thirds of the 20 dB bandwidth (MHz)	Channel Separation Limit	Result
BR Mode (GFSK)					
Low	0.998	0.97	0.648	>two-thirds of the 20 dB bandwidth	Compliance
Middle	0.9996	0.97	0.646	>two-thirds of the 20 dB bandwidth	Compliance
High	1.00001	0.97	0.648	>two-thirds of the 20 dB bandwidth	Compliance

Please refer to the following plots.

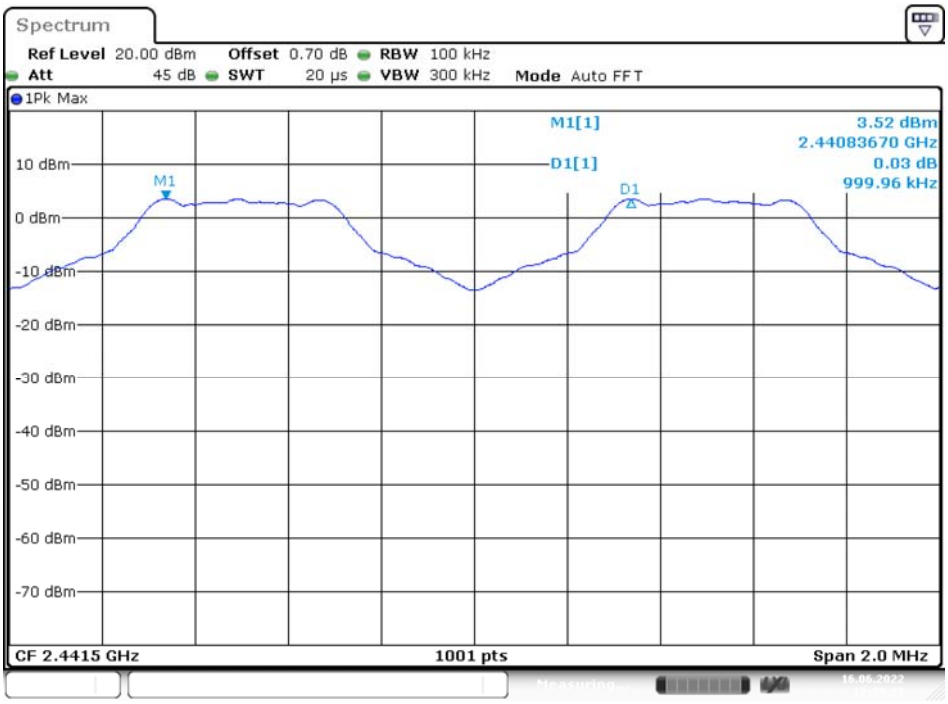
BR Mode (GFSK)

Low Channel



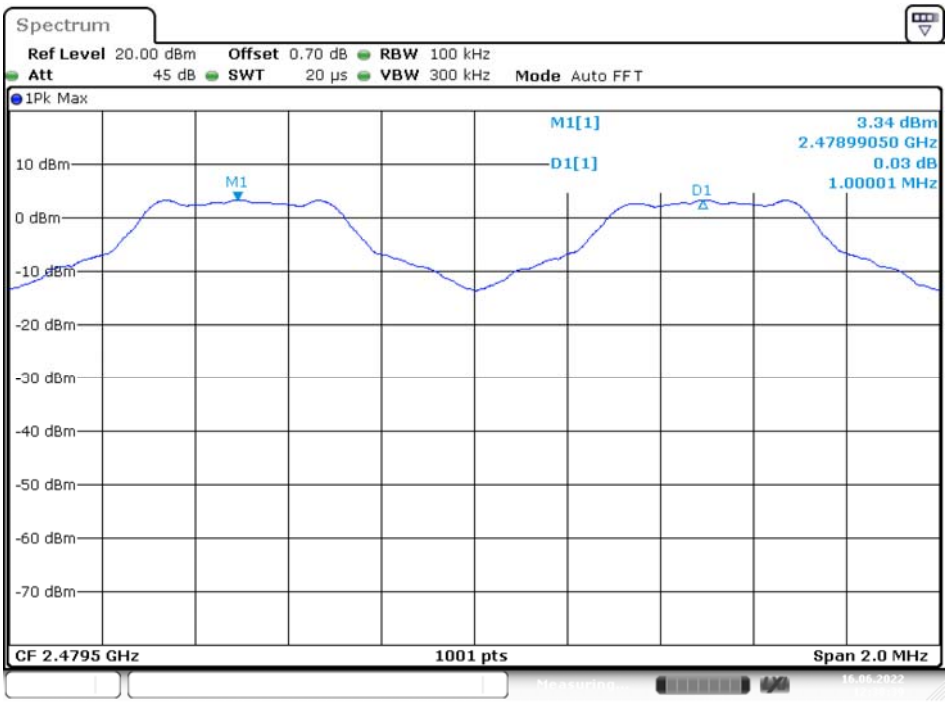
Date: 16.JUN.2022 12:41:20

Middle Channel



Date: 16.JUN.2022 12:39:23

High Channel



Date: 16.JUN.2022 12:38:39

11. FCC§15.247(a)(1)(iii) –Time of Occupancy (Dwell Time)

11.1. Applicable Standard

According to FCC §15.247(a) (1) (iii).

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.

11.2. Test Procedure

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings: Span = zero span, centered on a hopping channel RBW ≤ channel spacing and where possible RBW should be set >> 1/T, where T is the expected dwell time per channel Sweep = as necessary to capture the entire dwell time per hopping channel Detector function = peak Trace = max hold

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

Repeat the measurement using a longer sweep time to determine the number of hops over the period specified in the requirements. The sweep time shall be equal to, or less than, the period specified in the requirements.

Determine the number of hops over the sweep time and calculate the total number of hops in the period specified in the requirements, using the following equation:

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

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

11.3. Test Results

Test mode: BR mode / 2402 ~ 2480MHz (GFSK)						
Mode	**Pulse Time (ms)**	**Hopping Number**	**Period Time (s)**	**Total of Dwell (ms)**	**Limit (ms)**	**Result**
DH1	0.381	320	31.6	121.92	<400	PASS
DH3	1.638	190	31.6	311.22	<400	PASS
DH5	2.888	130	31.6	375.44	<400	PASS

Note 1: A period time = 0.4*79 = 31.6 (s), Total of Dwell=Pulse Time * Hopping Number

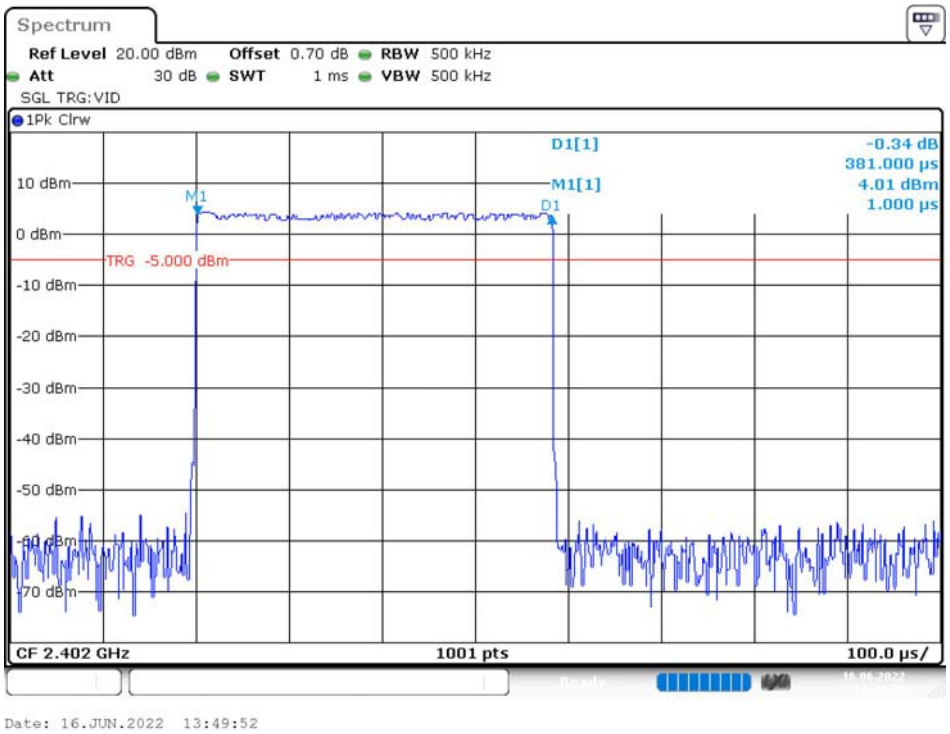
Note 2: Hopping Number = Hopping Number/10 * 10

Note 3: Hopping Number/10 = Total of highest signals in 3.16s. (Second high signals were other channel)

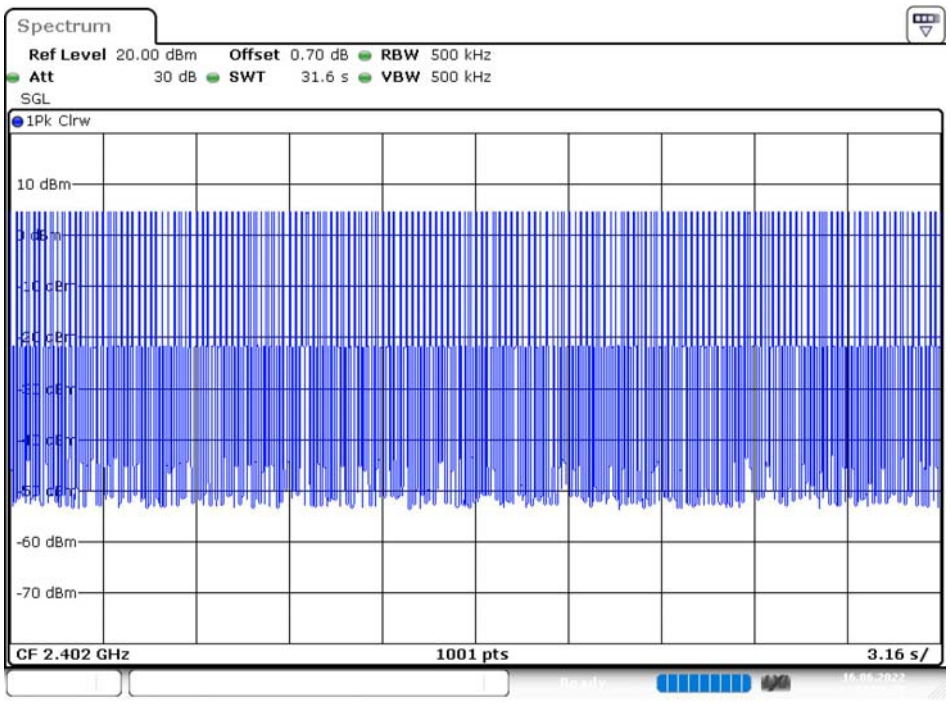
Please refer to the following plots

BR Mode (GFSK)

DH1: Pulse Width



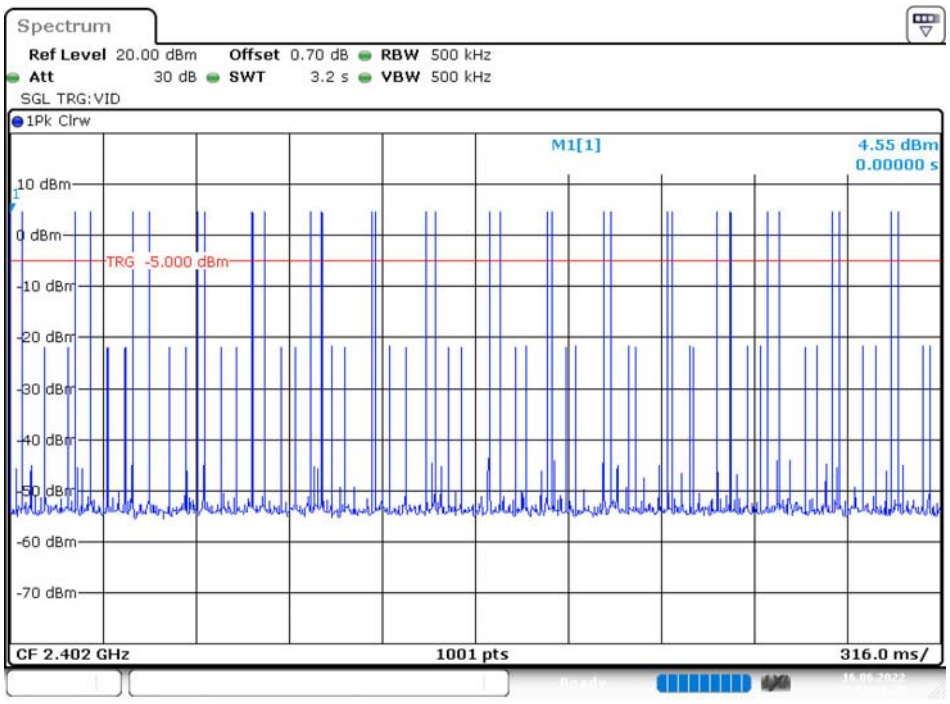
DH1: Hopping Number



Date: 16.JUN.2022 14:32:33

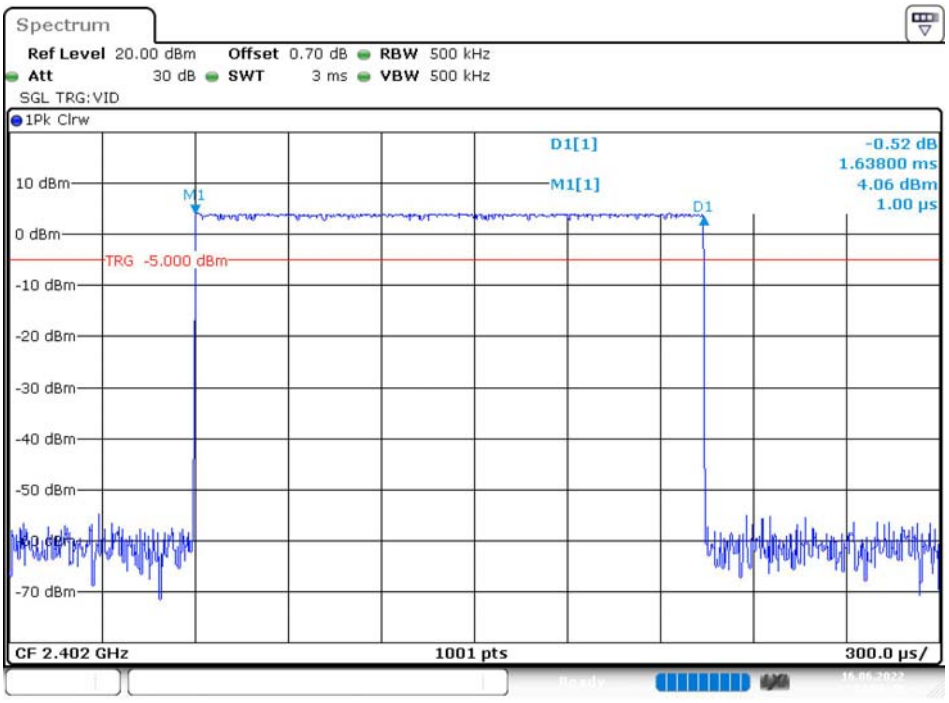
DH1: Hopping Number /10

(Hopping Number = 32 in 1/10 period of highest signals, Second High signals were other channel)



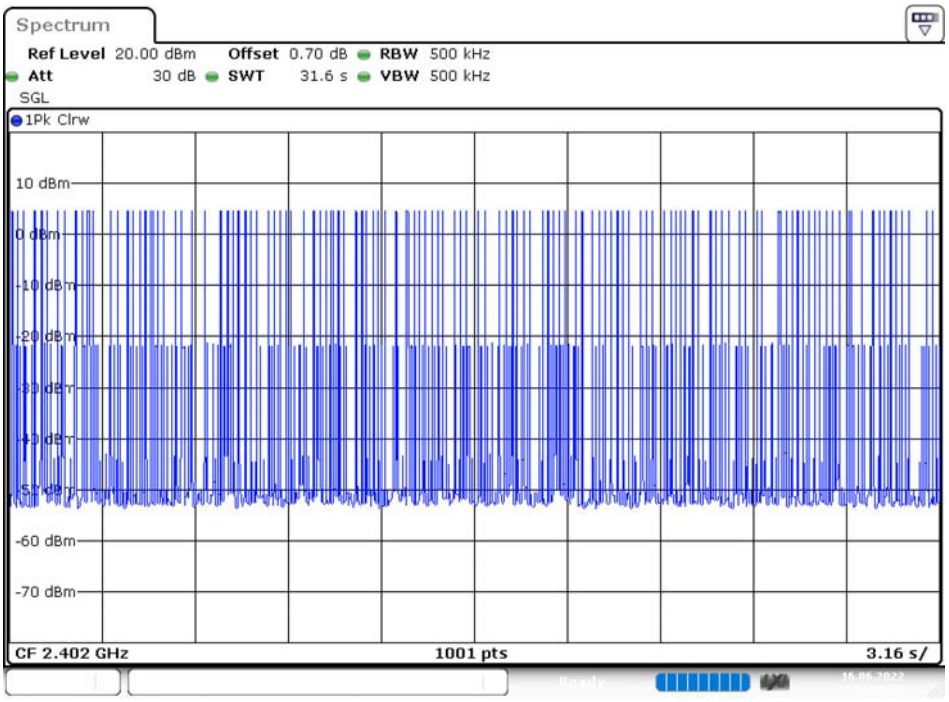
Date: 16.JUN.2022 14:43:37

DH3: Pulse Width



Date: 16.JUN.2022 14:06:42

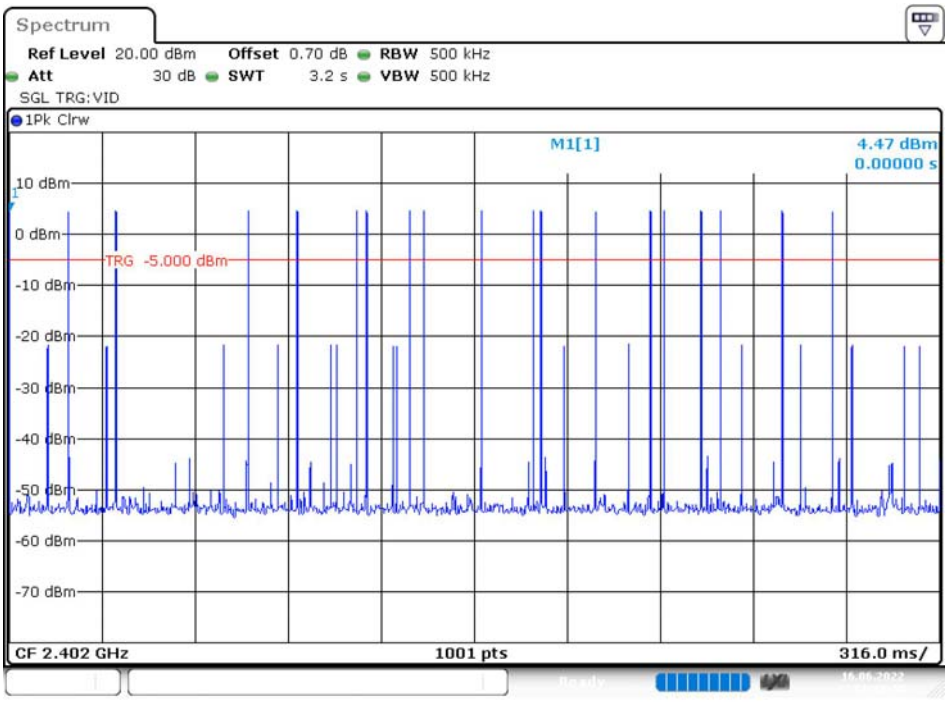
DH3: Hopping Number



Date: 16.JUN.2022 14:33:30

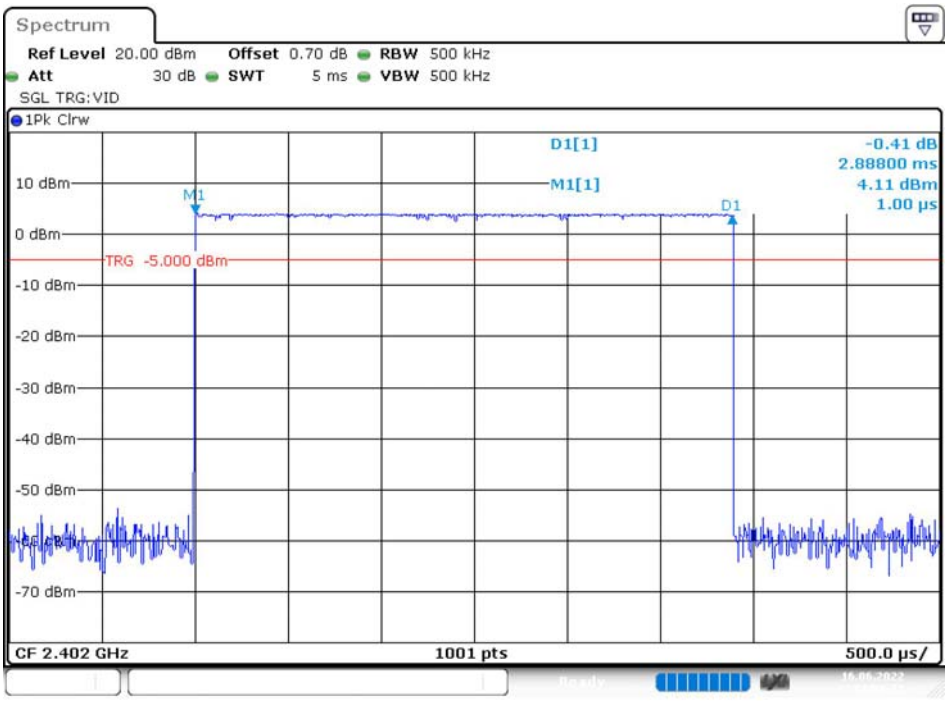
DH3: Hopping Number /10

(Hopping Number = 19 in 1/10 period of highest signals, Second High signals were other channel)



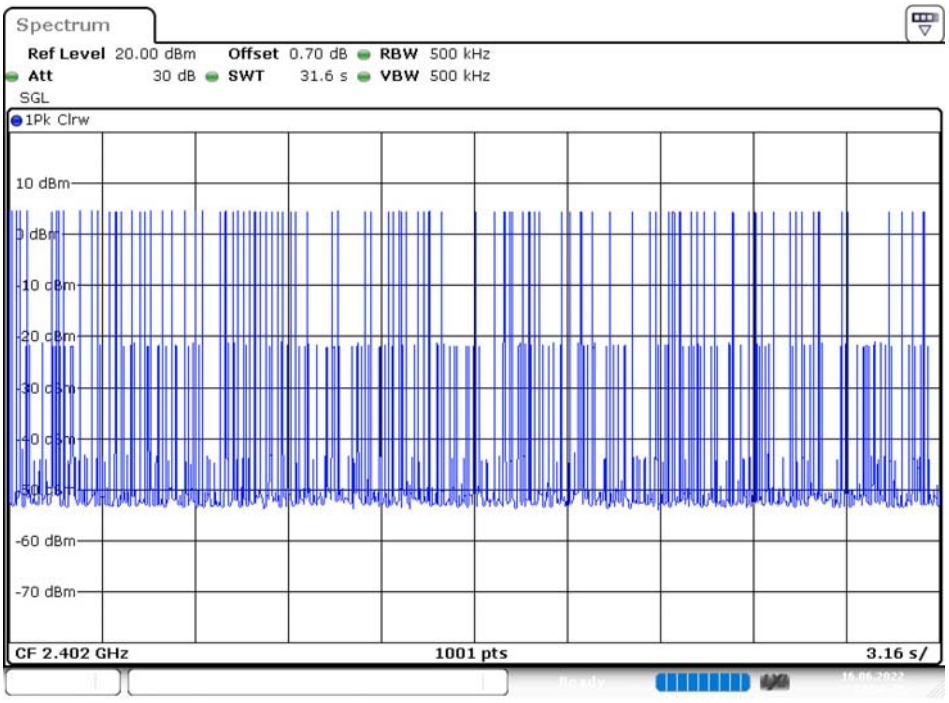
Date: 16.JUN.2022 14:42:44

DH5: Pulse Width



Date: 16.JUN.2022 14:08:12

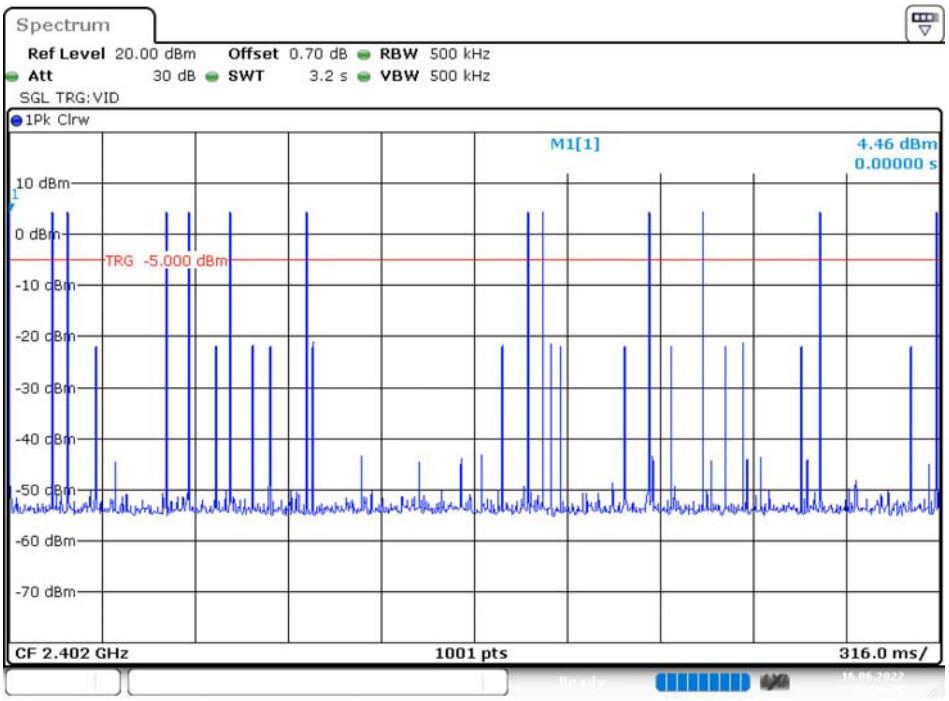
DH5: Hopping Number



Date: 16.JUN.2022 14:34:42

DH5: Hopping Number /10

(Hopping Number = 13 in 1/10 period of highest signals, Second High signals were other channel)



Date: 16.JUN.2022 14:40:38

12. FCC §15.247(a)(1)(iii) –Quantity of hopping channel Test

12.1. Applicable Standard

According to FCC §15.247(a) (1) (iii).

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.

12.2. Test Procedure

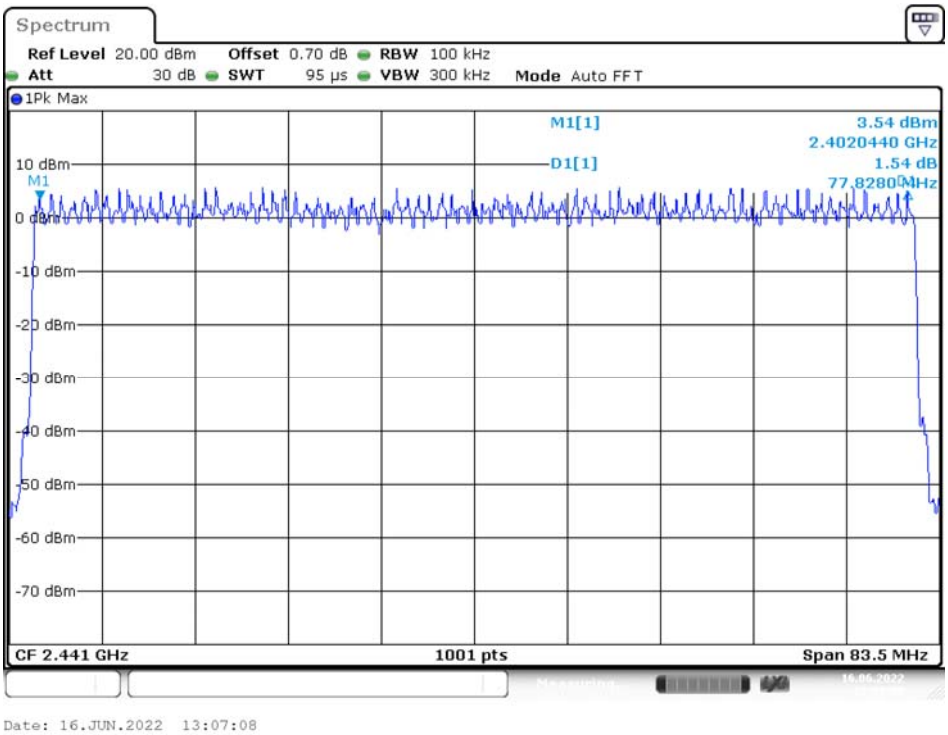
1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
2. Set the EUT in hopping mode from first channel to last.
3. By using the Max-Hold function record the Quantity of the channel.

12.3. Test Results

Mode	Frequency Range (MHz)	Number of Hopping Channel (CH)	Limit (CH)	Result
GFSK	2402-2480	79	>15	Compliance

Please refer to the following plots

BR Mode (GFSK)



13. FCC §15.247(b)(1) – Maximum Output Power

13.1. Applicable Standard

According to FCC §15.247(b) (1).

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. For all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

13.2. Test Procedure

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

2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to measuring equipment.

13.3. Test Results

Channel	Frequency (MHz)	Peak Conducted Output Power		Limit (W)	Result
		(dBm)	(W)		
BR Mode (GFSK)					
Low	2402	4.20	0.003	0.125	Compliance
Middle	2441	4.10	0.003	0.125	Compliance
High	2480	3.81	0.002	0.125	Compliance

14. FCC §15.247(d) – 100 kHz Bandwidth of Frequency Band Edge

14.1. Applicable Standard

According to FCC §15.247(d), in any 100 kHz 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 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. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emissions limits specified in §15.209(a) see §15.205(c).

14.2. Test Procedure

Span = wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products which fall outside of the authorized band of operation.

RBW = 100 kHz VBW = 300 kHz

Sweep = coupled

Detector function = peak Trace = max hold

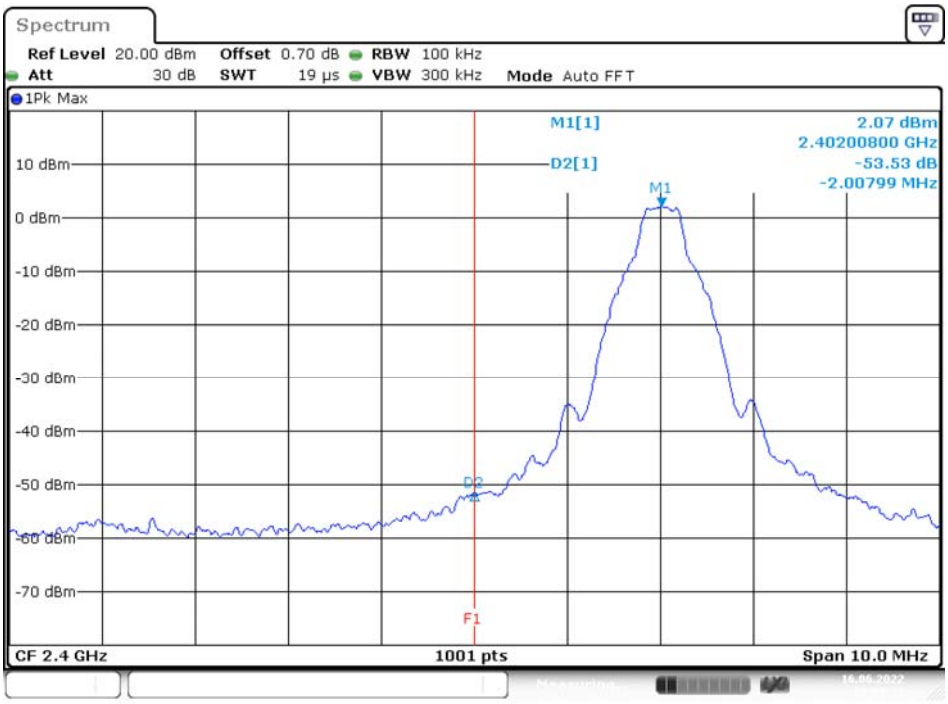
14.3. Test Results

Channel	Frequency (MHz)	Delta Peak to Band Emission (dBc)	Limit (dBc)	Result
BR Mode (GFSK)				
Low	2402-2480	53.53	≥ 20	PASS
High	2402-2480	58.24	≥ 20	PASS
BR Hopping Mode (GFSK)				
Low	2402-2480	56.27	≥ 20	PASS
High	2402-2480	55.90	≥ 20	PASS

Please refer to the following plots.

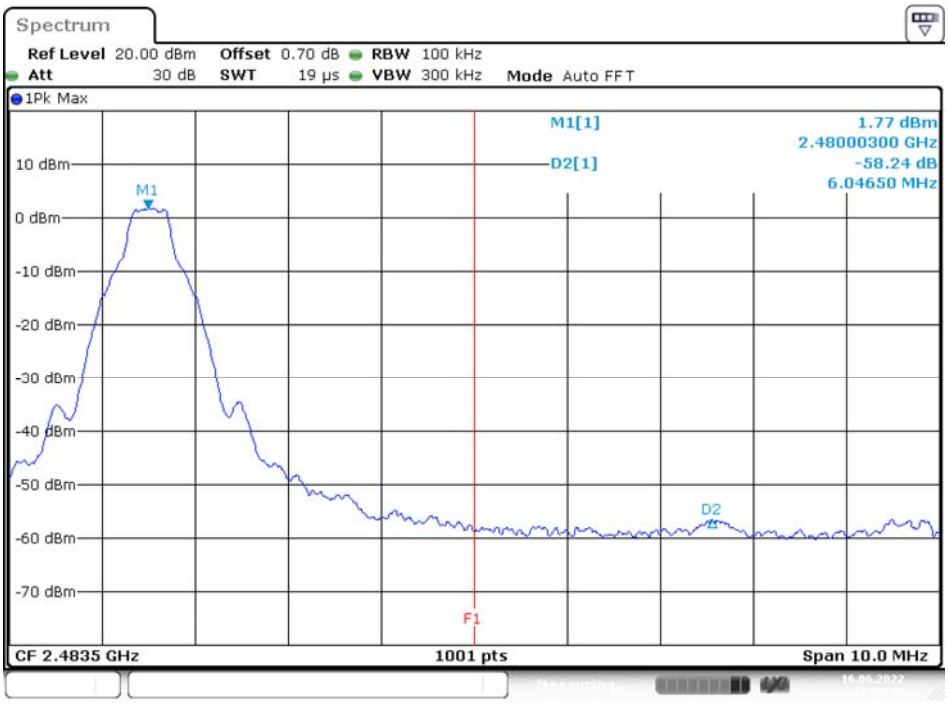
BR Mode (GFSK)

Band Edge, CH Low



Date: 16.JUN.2022 13:02:17

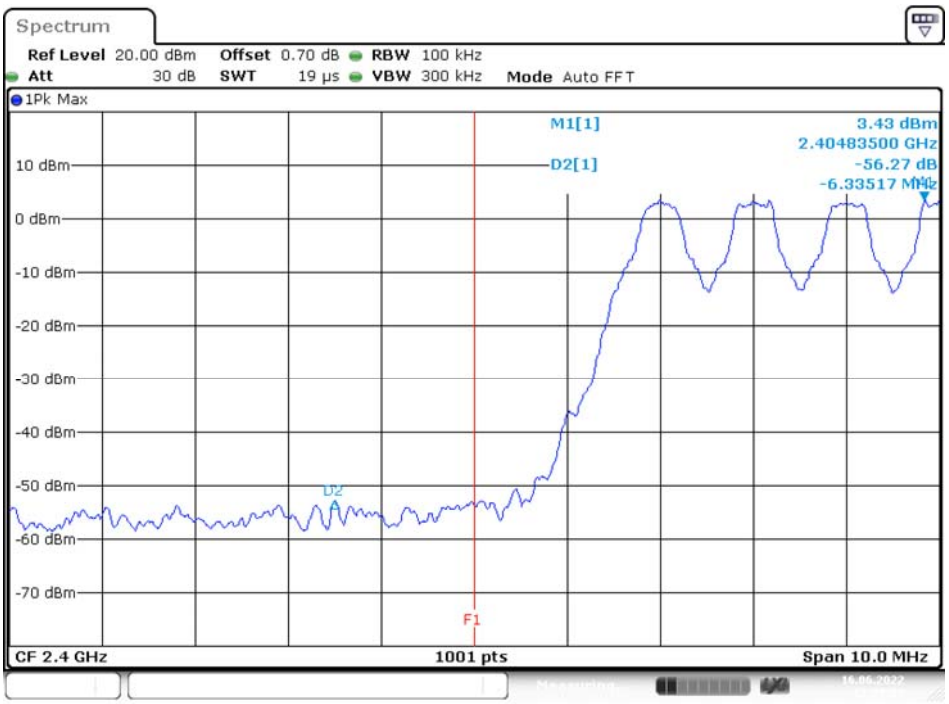
Band Edge, CH High



Date: 16.JUN.2022 12:55:17

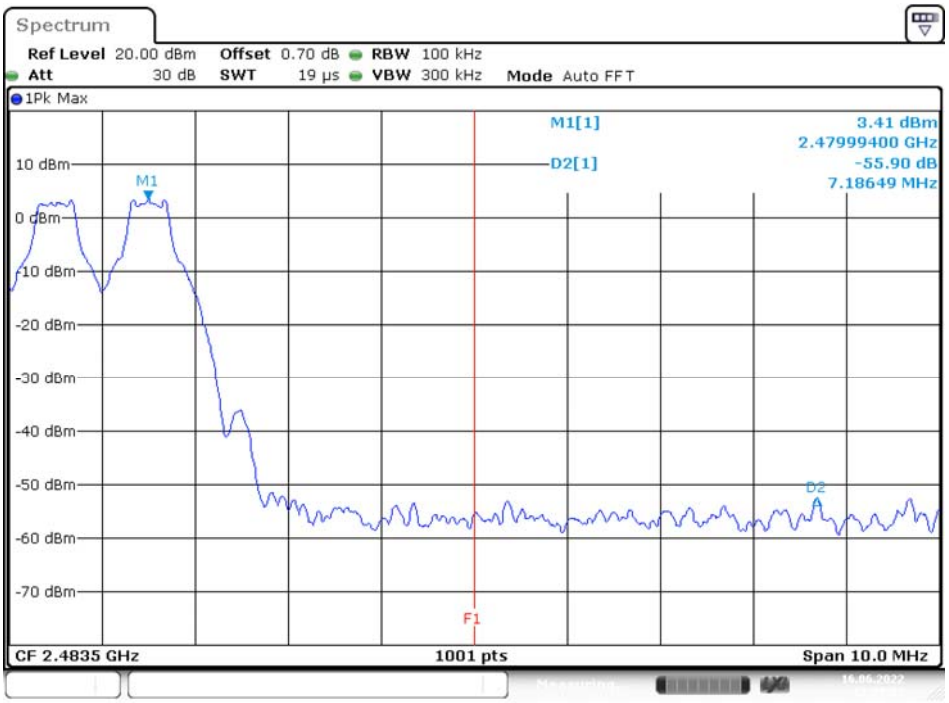
BR Hopping Mode (GFSK)

Band Edge, CH Low



Date: 16.JUN.2022 12:37:39

Band Edge, CH High



Date: 16.JUN.2022 12:37:57

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