TEST REPORT

Applicant:	Analogue Enterprises Ltd.
Address:	Flat J, 2/F, Po Ming Building, 2-6 Foo Ming Street, Causeway Bay, Hong Kong China
Equipment Type:	Analogue Duo
Model Name:	DUO
Brand Name:	Analogue
FCC ID:	2AZVE-ADUO-C
Test Standard:	47 CFR Part 15 Subpart C (refer to section 3.1)
Sample Arrival Date:	Aug. 15, 2023
Test Date:	Aug. 18, 2023 - Sep. 12, 2023
Date of Issue:	Oct. 12, 2023

ISSUED BY:

Shenzhen BALUN Technology Co., Ltd.

Tested by: Julie Zhu **Checked by:** Ye Hongji **Approved by:** Liao Jianming (Technical Director)

Revision History

Version	Issue Date	Revisions
Rev. 01	Oct. 07, 2023	Initial Issue
Rev. 02	Oct. 12, 2023	Updated the Conducted Emissions to AC Power Line Conducted Emissions.

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1 GENERAL INFORMATION

1.1 Test Laboratory

Name	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1/F, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
Phone Number	+86 755 6685 0100

1.2 Test Location

Name	Shenzhen BALUN Technology Co., Ltd.
Location	☑ Block B, 1/F, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
	☐ 1/F, Building B, Ganghongji High-tech Intelligent Industrial Park, No. 1008, Songbai Road, Yangguang Community, Xili Sub-district, Nanshan District, Shenzhen, Guangdong Province, P. R. China
Accreditation Certificate	The laboratory is a testing organization accredited by FCC as a accredited testing laboratory. The designation number is CN1196.

2 PRODUCT INFORMATION

2.1 Applicant Information

Applicant	Analogue Enterprises Ltd.
Address	Flat J, 2/F, Po Ming Building, 2-6 Foo Ming Street, Causeway Bay, Hong Kong China

2.2 Manufacturer Information

Manufacturer	Analogue Enterprises Ltd.
Address	Flat J, 2/F, Po Ming Building, 2-6 Foo Ming Street, Causeway Bay, Hong Kong China

2.3 General Description for Equipment under Test (EUT)

EUT Name	Analogue Duo
Model Name Under Test	DUO
Series Model Name	N/A
Description of Model name differentiation	N/A
Hardware Version	4
Software Version	1.1
Dimensions (Approx.)	N/A
Weight (Approx.)	N/A

2.4 Technical Information

Network and Wireless connectivity	Bluetooth (BR) 2.4G ISM Band

The requirement for the following technical information of the EUT was tested in this report:

Modulation Technology	FHSS
Modulation Type	GFSK
Product Type	☒ Mobile ☐ Portable ☐ Fix Location
Transfer Rate	1 Mbps
Frequency Range	The frequency range used is 2406 MHz – 2476 MHz; The frequency block is 2400 MHz to 2483.5 MHz.
Number of Channel	16
Tested Channel	Low (2406 MHz), Middle (2441 MHz), High (2476 MHz)
Antenna Type	PCB Antenna
Antenna Gain	3.31 dBi
Adaptive or non-adaptive	Non-Adaptive
The Max RF Output power	-19.00 dBm

All Channel List:

Channel	Frequency	Channel	Frequency
6 (Low)	**2406**	**41 (Middle)**	**2441**
11	2411	47	2447
14	2414	51	2451
17	2417	55	2455
24	2424	59	2459
29	2429	67	2467
33	2433	73	2473
36	2436	**76 (High)**	**2476**
Note: The modulation is GFSK with FHSS, when this part works, it will choose 16 channels, in this report, the equipment select the lowest, middle and highest channel, Which are 2406 MHz, 2441 MHz and 2476 MHz. The more information please refer to the manufacturer's instructions.			

3 SUMMARY OF TEST RESULTS

3.1 Test Standards

No.	Identity	Document Title
1	47 CFR Part 15, Subpart C	Intentional radiators of radio frequency equipment
2	ANSI C63.10-2013	American National Standard for Testing Unlicensed Wireless Devices
3	KDB 558074 D01 15.247 Meas Guidance v05r02	Guidance for compliance measurements on digital transmission system, frequency hopping spread spectrum system, and hybrid system devices operating under section 15.247 of the FCC rules

3.2 Verdict

No.	Description	FCC Part No.	Test Result	Verdict
1	Antenna Requirement	15.203	--	Pass[note]
2	Number of Hopping Frequency	15.247(a)	ANNEX A.1	Pass
3	Peak Output Power	15.247(b)	ANNEX A.2	Pass
4	Occupied Bandwidth	15.247(a)	ANNEX A.3	Pass
5	Hopping Frequency Separation	15.247(a)	ANNEX A.4	Pass
6	Time of Occupancy (Dwell time)	15.247(a)	ANNEX A.5	Pass
7	Conducted Spurious Emission& Authorized-band band-edge	15.247(d)	ANNEX A.6	Pass
8	AC Power Line Conducted Emissions	15.207	ANNEX A.7	Pass
9	Radiated Spurious Emission	15.209 15.247(d)	ANNEX A.8	Pass
10	Band Edge (Restricted-band band-edge)	15.209 15.247(d)	ANNEX A.9	Pass
Note: The EUT has a permanently and irreplaceable attached antenna, which complies with the requirement FCC 15.203.				

4 GENERAL TEST CONFIGURATIONS

4.1 Test Environments

During the measurement, the normal environmental conditions were within the listed ranges:

Relative Humidity	53% to 75%	
Atmospheric Pressure	100 kPa to 102 kPa	
Temperature	NT (Normal Temperature)	+22.6℃ to +27.1℃
Working Voltage of the EUT	NV (Normal Voltage)	5.0 V

4.2 Test Equipment List

Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due
Spectrum Analyzer	KEYSIGHT	N9020A	MY50330200	2023.05.16	2024.05.15
Spectrum Analyzer	KEYSIGHT	N9020A	MY52510065	2022.09.06	2023.09.05
				2023.09.05	2024.09.04
Signaling Unit	ROHDE&SCHWARZ	CMW500	171150	2023.06.19	2024.06.18
Test Antenna-Horn	SCHWARZBECK	BBHA 9120D	01631	2022.02.03	2025.02.02
Test Antenna-Horn	A-INFO	LB-180400KF	J211060273	2021.07.02	2024.07.01
Anechoic Chamber	RAINFORD	9m*6m*6m	144	2022.02.19	2024.09.03
EMI Receiver	ROHDE&SCHWARZ	ESRP	101036	2022.09.09	2023.09.08
				2023.09.05	2024.09.04
Test Antenna-Loop	SCHWARZBECK	FMZB 1519	1519-037	2021.04.16	2024.04.15
Anechoic Chamber	EMC Electronic Co., Ltd	20.10*11.60 *7.35m	130	2021.08.15	2024.08.14
Test Antenna-Bi-Log	SCHWARZBECK	VULB 9163	9163-624	2021.08.20	2024.08.19
EMI Receiver	KEYSIGHT	N9038A	MY53220118	2022.09.08	2023.09.07
				2023.09.05	2024.09.04
Anechoic Chamber	RAINFORD	9m*6m*6m	101	2023.03.26	2026.03.03
EMI Receiver	KEYSIGHT	N9010B	MY57110309	2022.09.09	2023.09.08
				2023.09.05	2024.09.04
LISN	SCHWARZBECK	NSLK 8127	8127-687	2023.05.16	2024.05.15
Shielded Enclosure	YiHeng Electronic Co., Ltd	3.5m*3.1m* 2.8m	112	2022.02.19	2025.02.18

4.3 Test Software List

Description	Manufacturer	Software Version	Serial No.	Applicable test Setup
BL410R	BALUN	V2.1.1.488	N/A	The section 4.5.1
BL410E	BALUN	V19.8.28.435	N/A	The section 4.5.2&4.5.3&4.5.4&4.5.5

4.4 Description of Test Setup

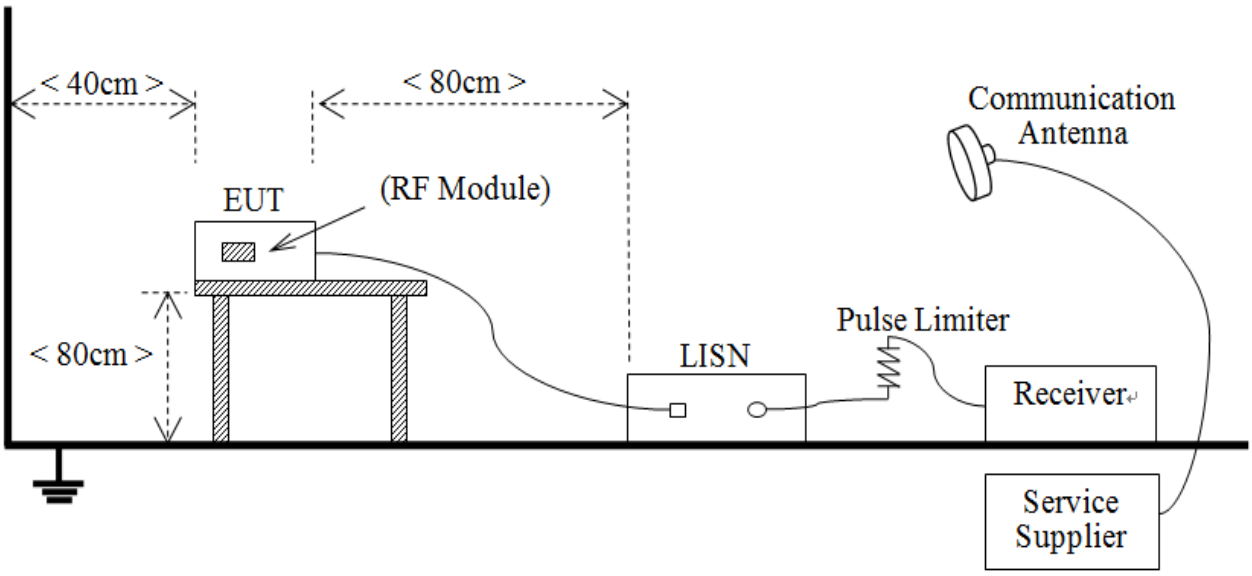
4.4.1 For Antenna Port Test

Conducted value (dBm) = Measurement value (dBm) + cable loss (dB)

For example: the measurement value is 10 dBm and the cable 0.5dBm used, then the final result of EUT:
Conducted value (dBm) = 10 dBm + 0.5 dB = 10.5 dBm

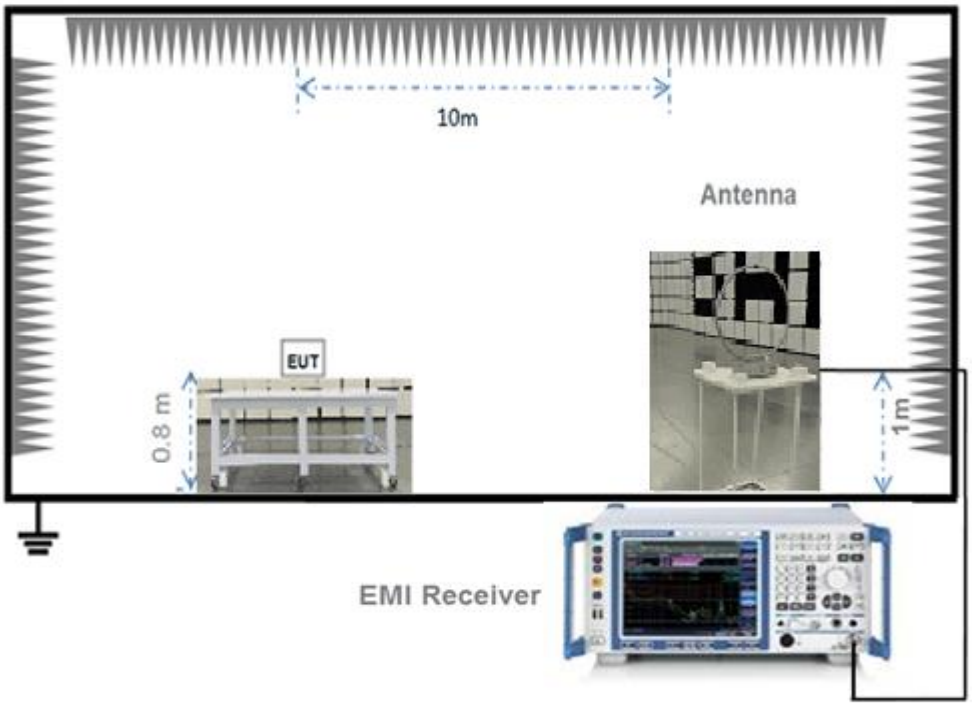
(Diagram 1)

4.4.2 For AC Power Supply Port Test



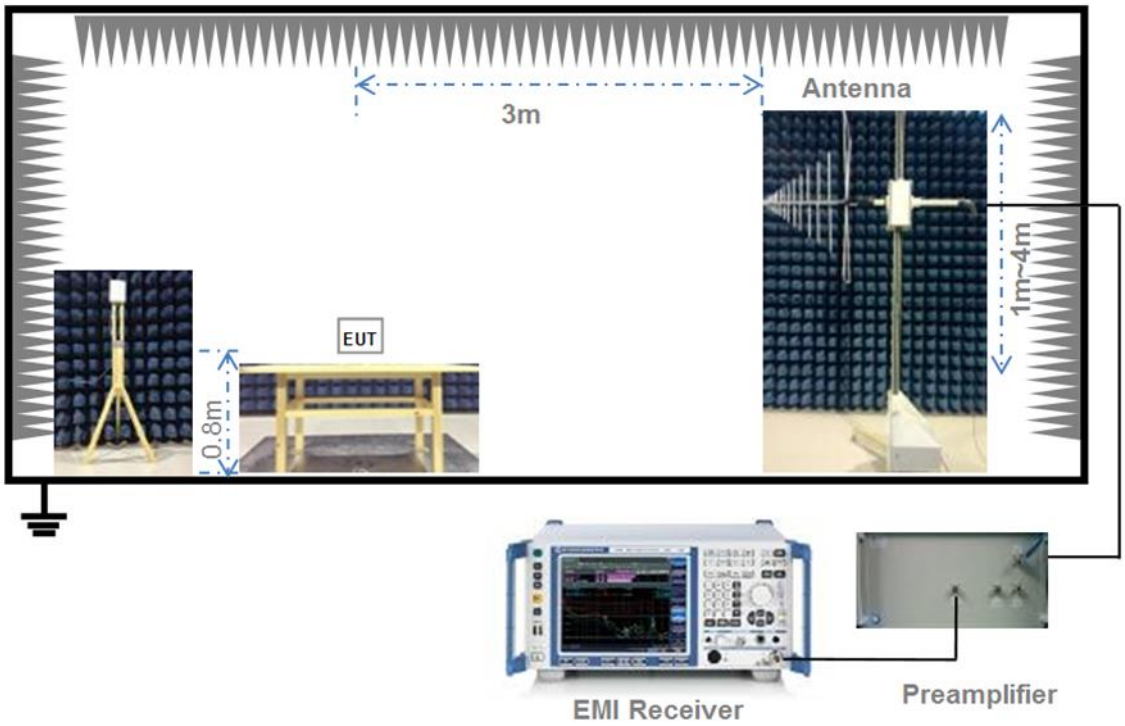
(Diagram 2)

4.4.3 For Radiated Test (Below 30 MHz)



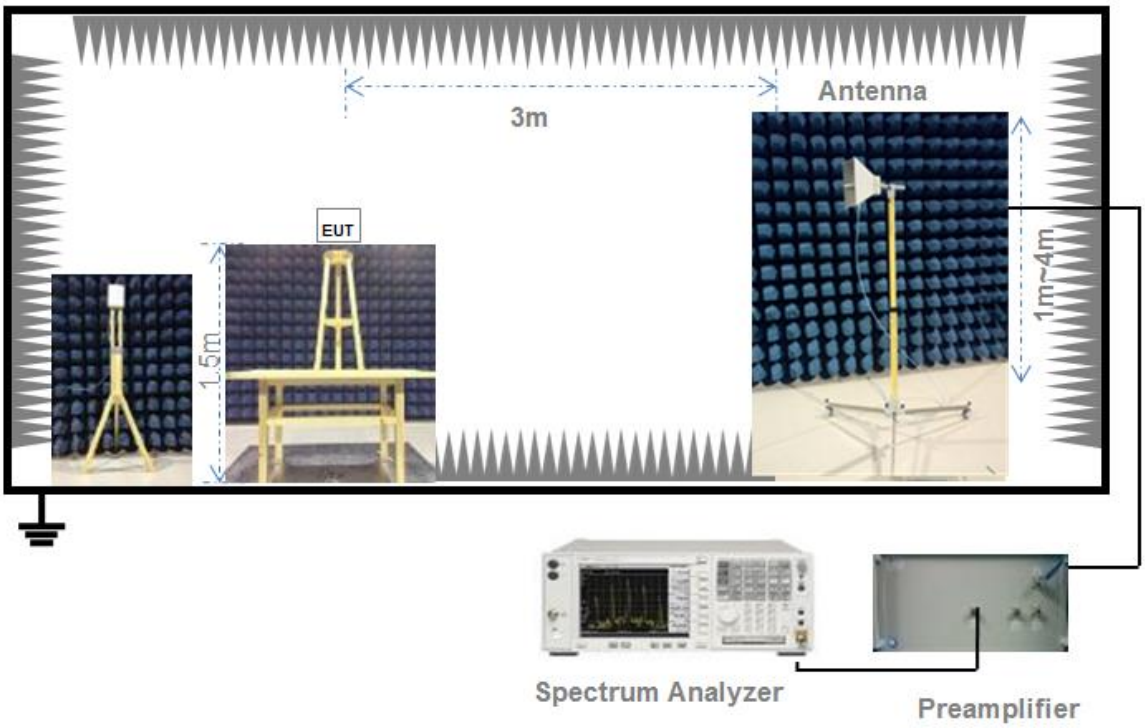
(Diagram 3)

4.4.4 For Radiated Test (30 MHz-1 GHz)



(Diagram 4)

4.4.5 For Radiated Test (Above 1 GHz)



(Diagram 5)

4.5 Measurement Results Explanation Example

4.5.1 For conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.
The spectrum analyzer offset is derived from RF cable loss and attenuator factor.
Offset = RF cable loss + attenuator factor.

4.5.2 For radiated band edges and spurious emission test:

Per part 15.35(c), the EUT Bluetooth average emission level could be determined by the peak emission level applying duty cycle correction factor, to represent averaging over the whole pulse train.
The average level is derived from the peak level corrected with “Duty cycle correction factor”.
Average Emission Level (dBuV/m) = Peak Emission Level (dBuV/m) + Duty cycle correction factor (dB)
Duty cycle correction factor (dB) = 20 * log (Duty cycle).
Duty cycle = on time / 100 milliseconds
On time = dwell time * hopping number in 100 ms
For example: bluetooth with dwell time 2.9 ms and 3 hops in 100 ms, then
Duty cycle correction factor (dB) = 20 * log ((2.9 * 3) / 100) = -21.21 dB
Following shows an average computation example with duty cycle correction factor = -21.21 dB, and the peak emission level is 45.61 dBuV/m.
Example:
Average Emission Level (dBuV/m) = Peak Emission Level (dBuV/m) + duty cycle correction factor (dB)
= 45.61 + (-21.21) = 24.4 (dBuV/m)

5 TEST ITEMS

5.1 Antenna Requirements

5.1.1 Relevant Standards

FCC §15.203 & 15.247(b)

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of § 15.211, § 15.213, § 15.217, § 15.219, or § 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with § 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

If directional gain of transmitting antennas is greater than 6 dBi, the power shall be reduced by the same level in dB comparing to gain minus 6 dBi. For the fixed point-to-point operation, the power shall be reduced by one dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi. 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 FCC rule.

5.1.2 Antenna Anti-Replacement Construction

The Antenna Anti-Replacement as following method:

Protected Method	Description
The antenna is embedded in the product.	The antenna is welded on the mainboard, can’t be replaced by the consumer

Reference Documents	Item
Photo	Please refer to the EUT Photo documents.

5.1.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.

5.2 Number of Hopping Frequency

5.2.1 Limit

FCC §15.247(a) (1) (iii)

Frequency hopping systems operating in the 2400 MHz to 2483.5 MHz bands shall use at least 15 hopping frequencies.

5.2.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.2.3 Test Procedure

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = the frequency band of operation

RBW ≥ 1% of the span

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize

5.2.4 Test Result

Please refer to ANNEX A.1.

5.3 Peak Output Power

5.3.1 Test Limit

FCC § 15.247(b)

For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

5.3.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.3.3 Test Procedure

The Bluetooth Module operates at hopping-off test mode. The lowest, middle and highest channels are selected to perform testing to verify the conducted RF output peak power of the Module.

Use the following spectrum analyzer settings:

Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel

RBW > the 20 dB bandwidth of the emission being measured

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize.

5.3.4 Test Result

Please refer to ANNEX A.2.

5.4 Occupied Bandwidth

5.4.1 Limit

FCC §15.247(a)

Measurement of the 20dB bandwidth of the modulated signal.

5.4.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.4.3 Test Procedure

Use the following spectrum analyzer settings:

Span = approximately 2 to 3 times the 20 dB bandwidth, centered on a hopping channel

RBW ≥ 1% of the 20 dB bandwidth

VBW ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

The EUT should be transmitting at its maximum data rate, Allow the trace to stabilize.

5.4.4 Test Result

Please refer to ANNEX A.3.

5.5 Carrier Frequency Separation

5.5.1 Limit

FCC §15.247(a)

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 shall have hopping channel carrier frequencies separated by a minimum of 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.

5.5.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.5.3 Test Procedure

The EUT must have its hopping function enabled. Use the following spectrum analyzer settings:

Span = wide enough to capture the peaks of two adjacent channels

Resolution (or IF) Bandwidth (RBW) ≥ 1% of the span

Video (or Average) Bandwidth (VBW) ≥ RBW

Sweep = auto

Detector function = peak

Trace = max hold

Allow the trace to stabilize. Use the marker-delta function to determine the separation between the peaks of the adjacent channels.

5.5.4 Test Result

Please refer to ANNEX A.4.

5.6 Time of Occupancy (Dwell time)

5.6.1 Limit

FCC §15.247(a)

Frequency hopping systems in the 2400 MHz - 2483.5 MHz band shall use at least 15 non-overlapping 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.

5.6.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.6.3 Test Procedure

The lowest, middle and highest channels are selected to perform testing to record the dwell time of each occupation measured in this channel, which is called Pulse Time here.

5.6.4 Test Result

Please refer to ANNEX A.5

5.7 Conducted Spurious Emission & Authorized-band band-edge

5.7.1 Limit

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.

5.7.2 Test Setup

See section 4.4.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.7.3 Test Procedure

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.
RBW = 100 kHz
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold
Allow the trace to stabilize

5.7.4 Test Result

Please refer to ANNEX A.6.

5.8 AC Power Line Conducted Emissions

5.8.1 Limit

FCC §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 within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50μH/50Ω line impedance stabilization network (LISN).

Frequency range (MHz)	Conducted Limit (dBμV)	
	Quai-peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5	56	46
0.50 - 30	60	50

5.8.2 Test Setup

See section 4.4.2 for test setup description for the AC power supply port. The photo of test setup please refer to ANNEX B.

5.8.3 Test Procedure

The maximum conducted interference is searched using Peak (PK), if the emission levels more than the AV and QP limits, and that have narrow margins from the AV and QP limits will be re-measured with AV and QP detectors. Tests for both L phase and N phase lines of the power mains connected to the EUT are performed. Refer to recorded points and plots below.

5.8.4 Test Result

Please refer to ANNEX A.7.

5.9 Radiated Spurious Emission

5.9.1 Limit

FCC §15.209&15.247(d)

Radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

According to FCC section 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 (μV/m)	Measurement Distance (m)
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

Note:

1. Field Strength (dBμV/m) = 20*log[Field Strength (μV/m)].
2. In the emission tables above, the tighter limit applies at the band edges.
3. For Above 1000 MHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20dB above the maximum permitted average limit.
4. For above 1000 MHz, limit field strength of harmonics: 54dBuV/m@3m (AV) and 74dBuV/m@3m (PK).

5.9.2 Test Setup

See section 4.4.3 to 4.4.5 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.9.3 Test Procedure

The measurement frequency range is from 9 kHz to the 10th harmonic of the fundamental frequency. The Turn Table is actuated to turn from 0° to 360°, and both horizontal and vertical polarizations of the Test Antenna are used to find the maximum radiated power. Mid channels on all channel bandwidth verified. Only the worst RB size/offset presented.

The power of the EUT transmitting frequency should be ignored.

All Spurious Emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured
RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold
For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported, Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

5.9.4 Test Result

Please refer to ANNEX A.8.

5.10 Band Edge (Restricted-band band-edge)

5.10.1 Limit

FCC §15.209&15.247(d)

Radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

5.10.2 Test Setup

See section 4.4.3 to 4.4.5 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.10.3 Test Procedure

The measurement frequency range is from 9 kHz to the 10th harmonic of the fundamental frequency. The Turn Table is actuated to turn from 0° to 360°, and both horizontal and vertical polarizations of the Test Antenna are used to find the maximum radiated power. Mid channels on all channel bandwidth verified. Only the worst RB size/offset presented.

The power of the EUT transmitting frequency should be ignored.

All Spurious Emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured
RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold

For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported, Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

5.10.4 Test Result

Please refer to ANNEX A.9.

ANNEX A TEST RESULT

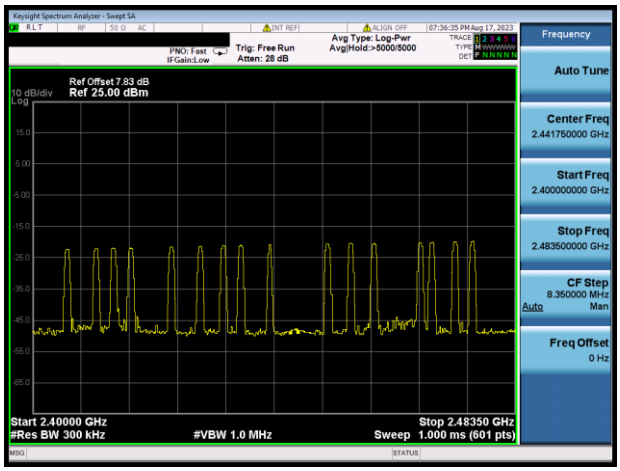
A.1 Number of Hopping Frequency

Test Data

Test Mode	Frequency Block (MHz)	Measured Channel Numbers	Min. Limit	Verdict
GFSK	2400 - 2483.5	16	15	Pass

Test plots

GFSK 2.4 GHz ~ 2.4835 GHz



A.2 Peak Output Power

Peak Power Test Data

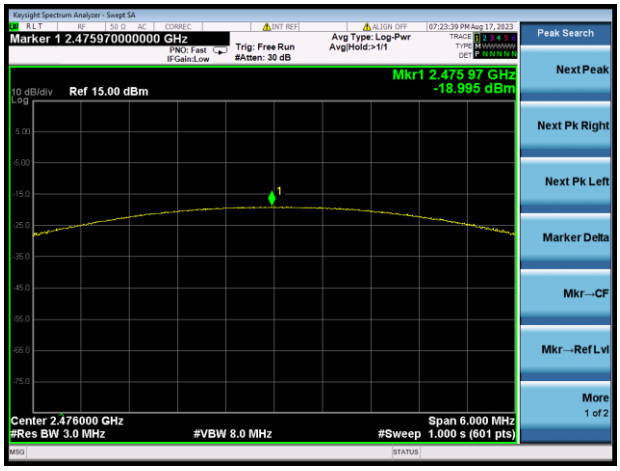
Channel	Measured Output Peak Power		Limit		Verdict
	dBm	mW	dBm	mW	
Low	-20.88	0.01	30	1000	Pass
Middle	-19.60	0.01			Pass
High	-19.00	0.01			Pass

Test plots

GFSK LOW CHANNEL

GFSK MIDDLE CHANNEL

GFSK HIGH CHANNEL



A.3 Occupied Bandwidth

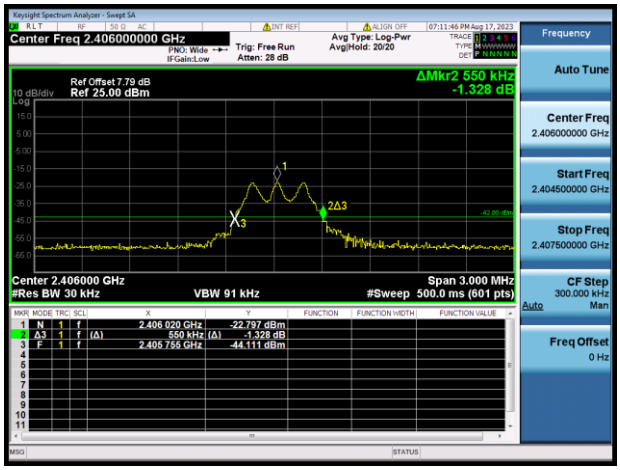
Test Data

Test Mode	GFSK	
Channel	20 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low Channel	0.550000	0.501390
Middle Channel	0.550000	0.506180
High Channel	0.550000	0.501080

Test plots

20 dB Bandwidth

GFSK LOW CHANNEL

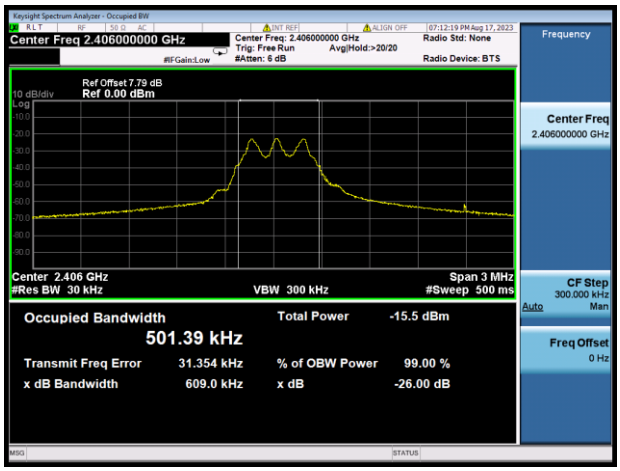


GFSK MIDDLE CHANNEL

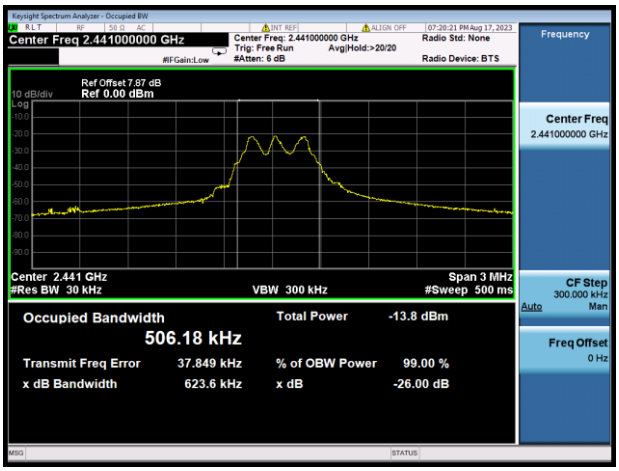
GFSK HIGH CHANNEL

99% Bandwidth

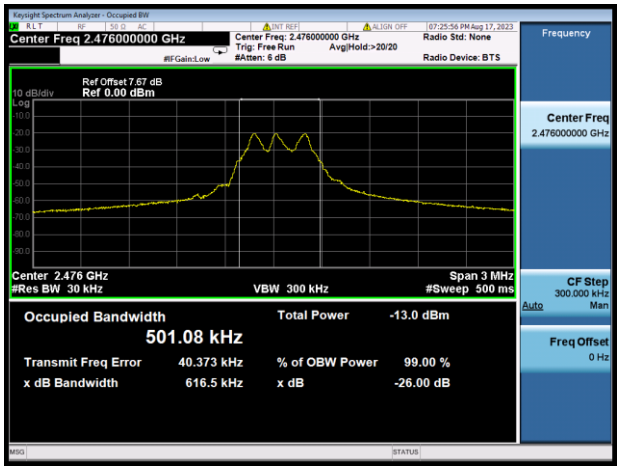
GFSK LOW CHANNEL



GFSK MIDDLE CHANNEL



GFSK HIGH CHANNEL



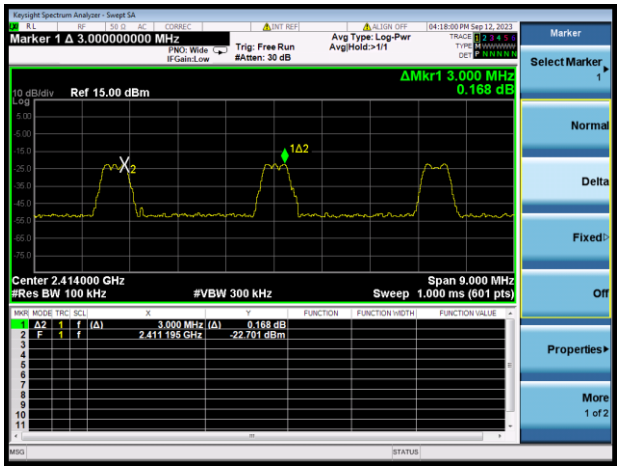
A.4 Hopping Frequency Separation

Test Data

Mode	Frequency separation (MHz)	2/3 of the 20 dB Bandwidth (MHz)	Verdict
GFSK	3.000	0.367	Pass

Test Plots

GFSK



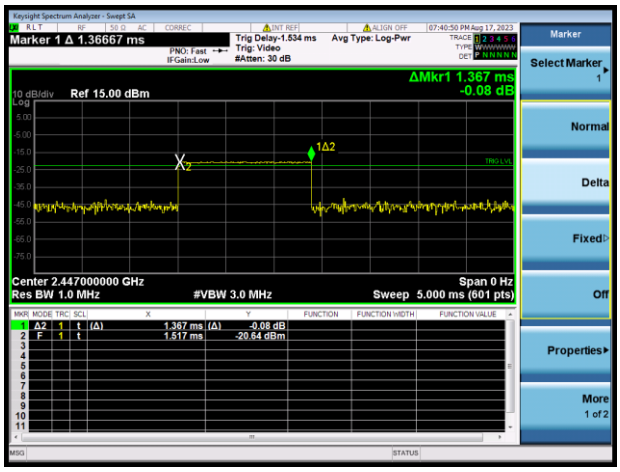
A.5 Time of Occupancy (Dwell time)

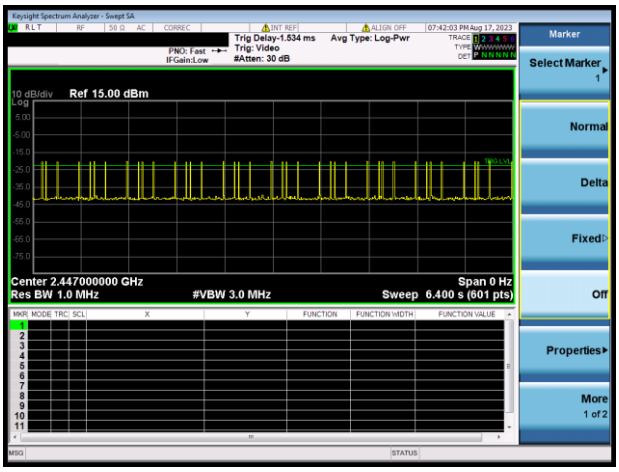
Test Data

GFSK			
Pulse Width (ms)	Total of Dwell (ms)	Limit (sec)	Verdict
1.367	53.313	0.4	Pass

Test Plots

Pulse Width	Total of Dwell





A.6 Conducted Spurious Emissions & Authorized-band band-edge

Test Data

GFSK Mode:

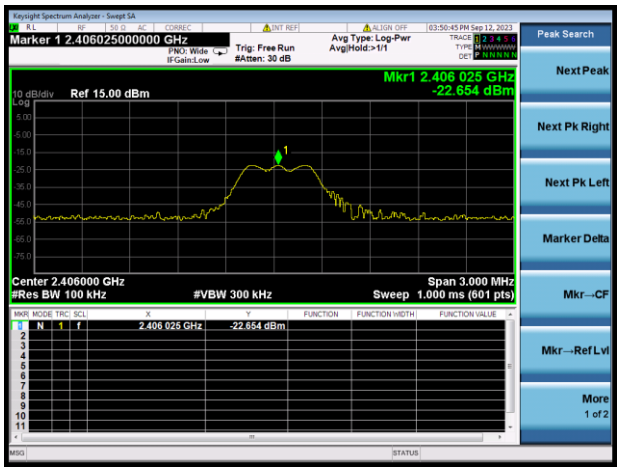
GFSK				
Channel	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
		Carrier Level	Calculated 20 dBc Limit	
Low	-47.78	-22.65	-42.65	Pass
Middle	-47.35	-21.42	-41.42	Pass
High	-46.96	-20.03	-40.03	Pass

Hopping Mode:

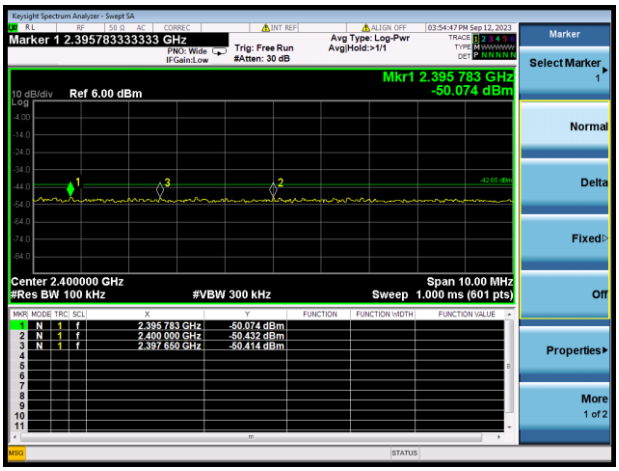
GFSK				
Channel	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
		Carrier Level	Calculated 20 dBc Limit	
GFSK	-44.64	-20.45	-40.45	Pass

Test Plots

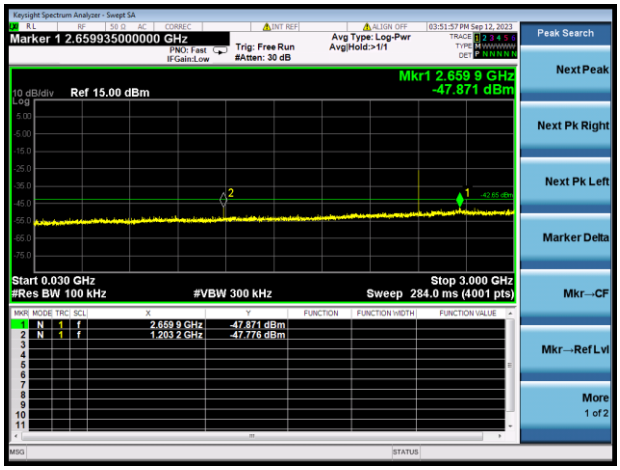
GFSK LOW CHANNEL, CARRIER LEVEL



GFSK LOW CHANNEL, BAND EDGE

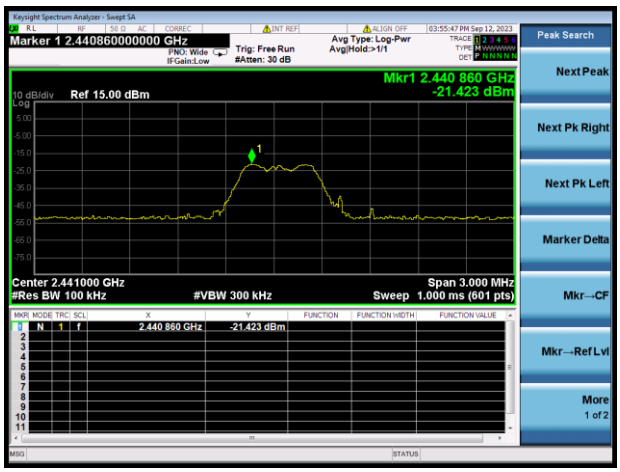


GFSK LOW CHANNEL, SPURIOUS 30 MHz ~ 3 GHz

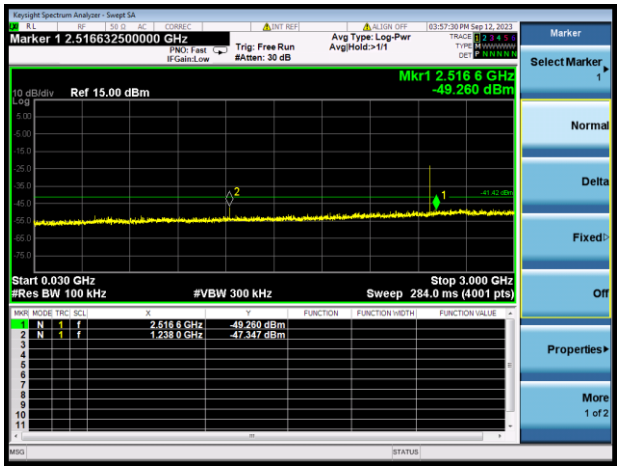


GFSK LOW CHANNEL, SPURIOUS 3 GHz ~ 25 GHz

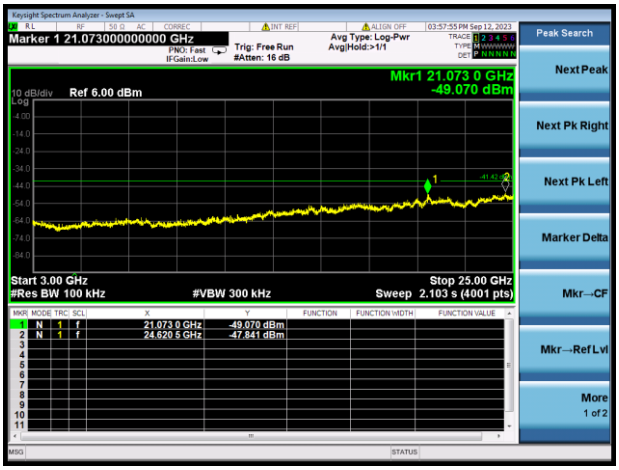
GFSK MIDDLE CHANNEL, CARRIER LEVEL



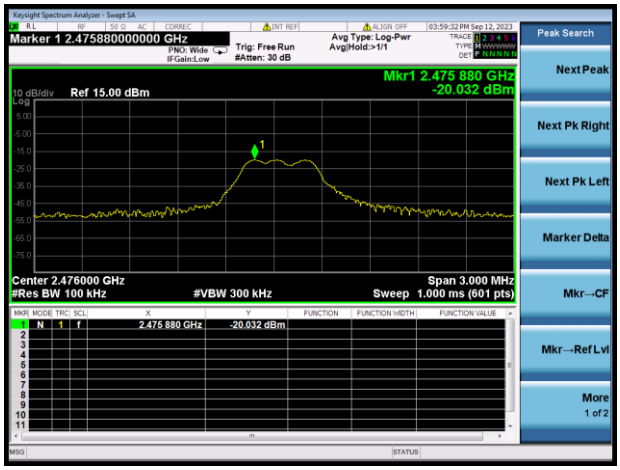
GFSK MIDDLE CHANNEL, SPURIOUS 30 MHz ~ 3 GHz



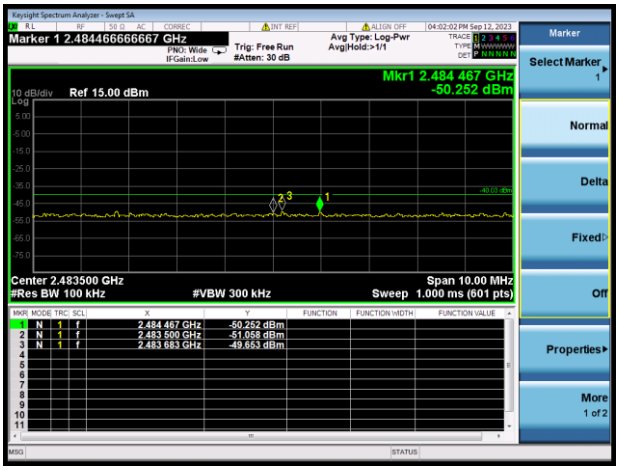
GFSK MIDDLE CHANNEL, SPURIOUS 3 GHz ~ 25 GHz



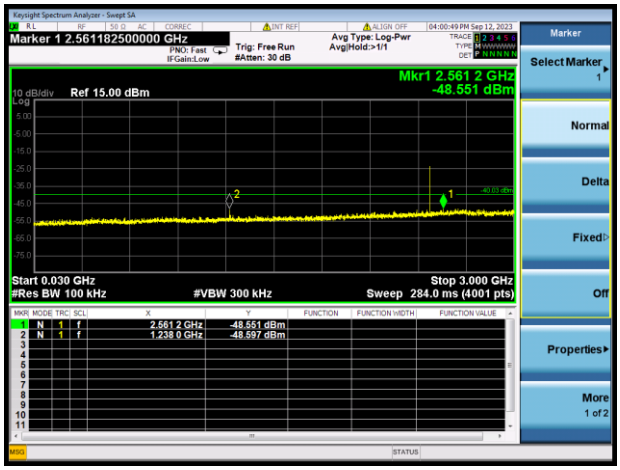
GFSK HIGH CHANNEL, CARRIER LEVEL



GFSK HIGH CHANNEL, BAND EDGE

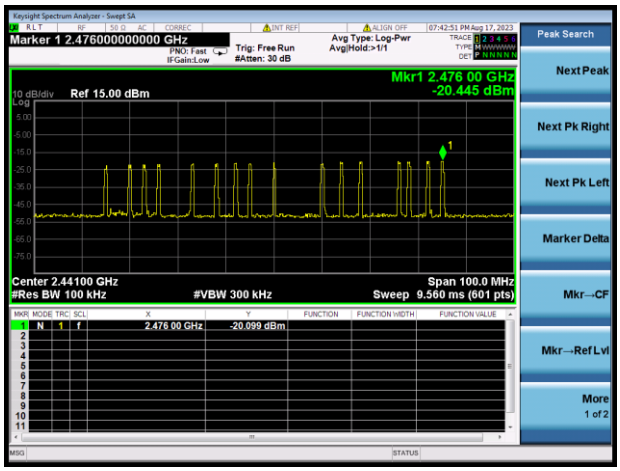


GFSK HIGH CHANNEL, SPURIOUS 30 MHz ~ 3 GHz

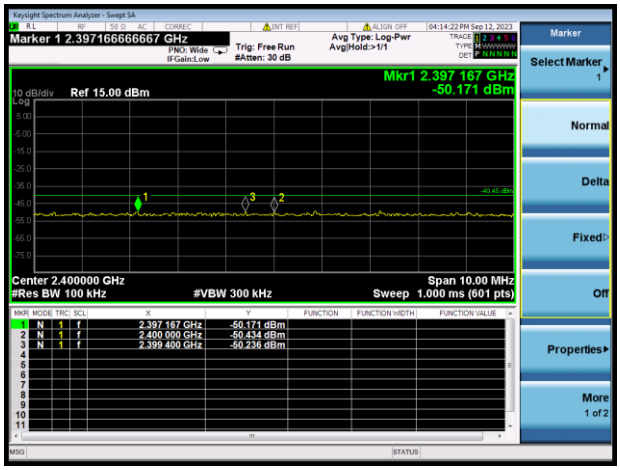


GFSK HIGH CHANNEL, SPURIOUS 3 GHz ~ 25 GHz

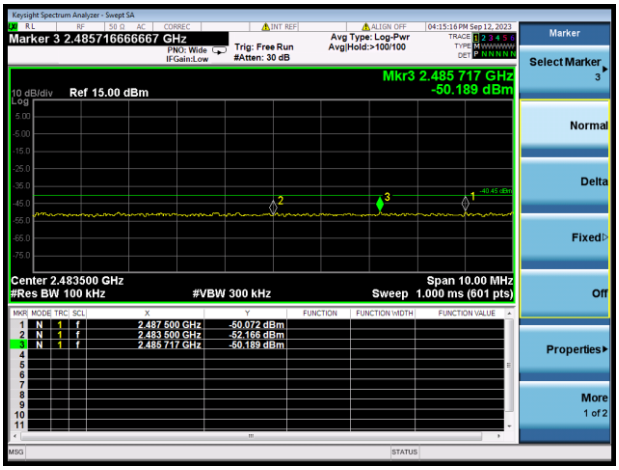
GFSK HOPPING, CARRIER LEVEL



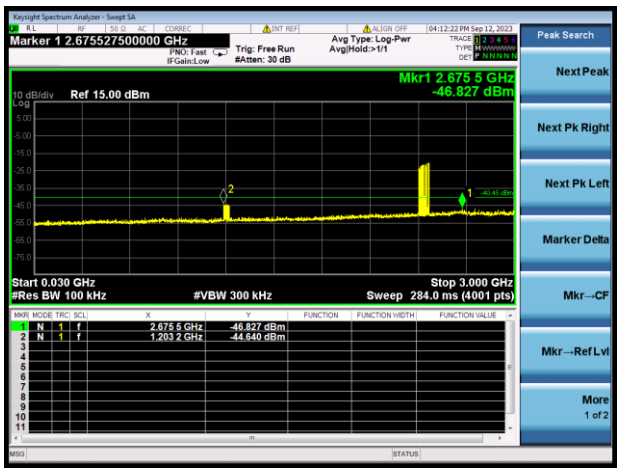
GFSK HOPPING BAND EDGE (LOW)



GFSK HOPPING BAND EDGE (HIGH)



GFSK Hopping Mode, SPURIOUS
30 MHz ~ 3 GHz



GFSK Hopping Mode, SPURIOUS
3GHz ~ 25 GHz

A.7 AC Power Line Conducted Emissions

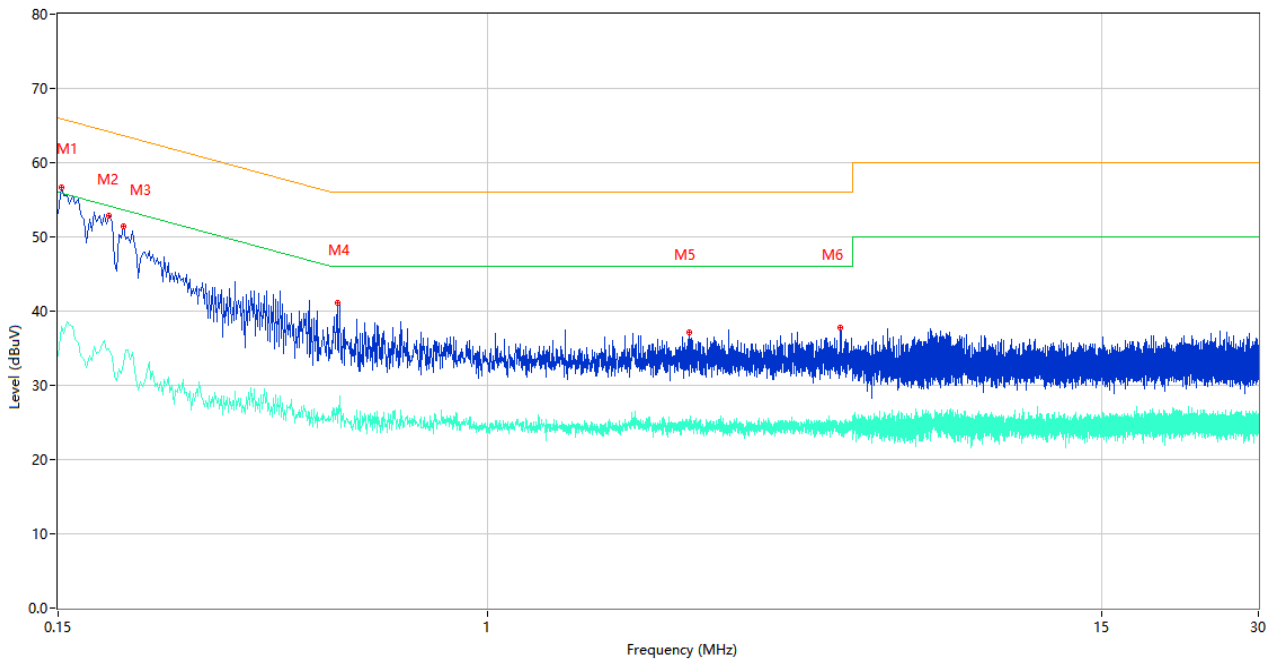
Note [1]: The EUT is working in the Normal link mode. All modes have been tested and normal link mode is worst.

Note [2]: Devices subject to Part 15 must be tested for all available U.S. voltages and frequencies (such as a nominal 120 VAC, 60 Hz and 240 VAC, 50 Hz) for which the device is capable of operation. So, The configuration 120 VAC, 60 Hz and 240 VAC, 50 Hz were tested respectively, but only the worst configuration (120 VAC, 60 Hz) shown here.

Note [3]: Results (dBuV) = Original reading level of Spectrum Analyzer (dBuV) + Factor (dB)

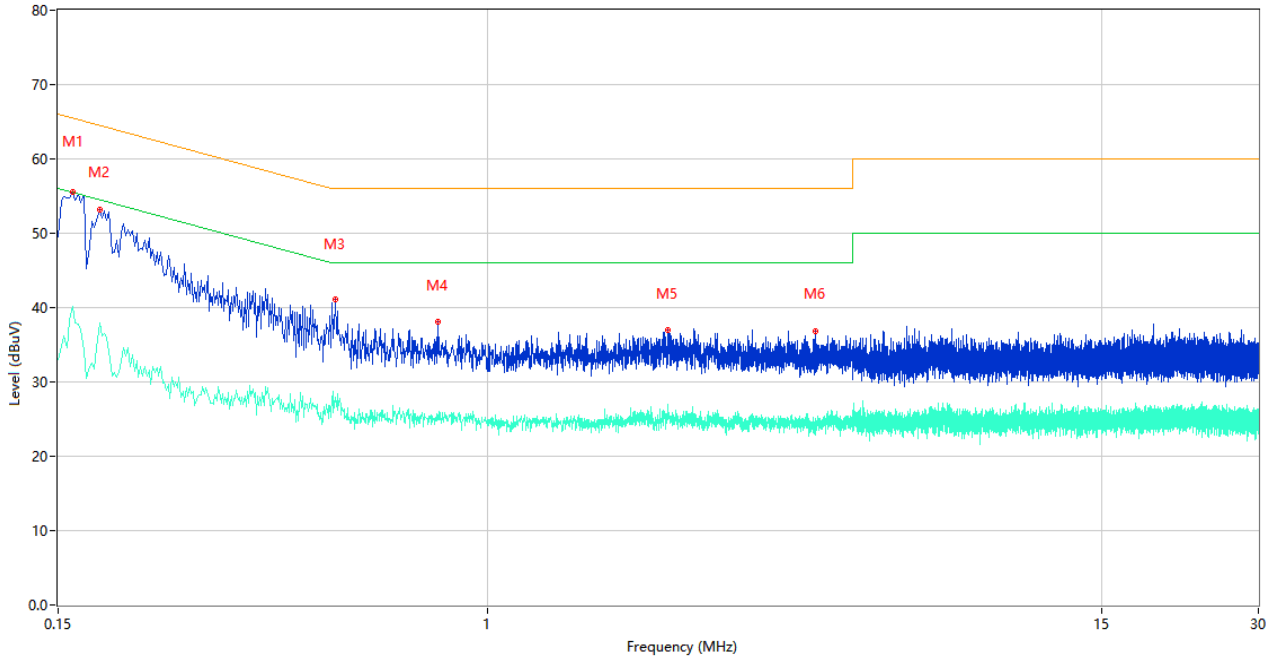
Test Data and Plots

PHASE L



No.	Frequency (MHz)	Results (dBuV)	Factor (dB)	Limit (dBuV)	Margin (dB)	Detector	Line	Verdict
1	0.152	56.62	9.78	65.89	9.27	Peak	L	Pass
1**	0.152	37.97	9.78	55.89	17.92	AV	L	Pass
2	0.188	52.79	9.78	64.12	11.33	Peak	L	Pass
2**	0.188	34.99	9.78	54.12	19.13	AV	L	Pass
3	0.200	51.38	9.77	63.61	12.23	Peak	L	Pass
3**	0.200	32.90	9.77	53.61	20.71	AV	L	Pass
4	0.516	41.06	10.00	56.00	14.94	Peak	L	Pass
4**	0.516	26.81	10.00	46.00	19.19	AV	L	Pass
5	2.434	37.22	10.22	56.00	18.78	Peak	L	Pass
5**	2.434	25.37	10.22	46.00	20.63	AV	L	Pass
6	4.730	37.70	10.12	56.00	18.30	Peak	L	Pass
6**	4.730	24.59	10.12	46.00	21.41	AV	L	Pass

PHASE N



No.	Frequency (MHz)	Results (dBuV)	Factor (dB)	Limit (dBuV)	Margin (dB)	Detector	Line	Verdict
1	0.160	55.54	9.78	65.46	9.92	Peak	N	Pass
1**	0.160	40.10	9.78	55.46	15.36	AV	N	Pass
2	0.180	53.20	9.78	64.49	11.29	Peak	N	Pass
2**	0.180	37.99	9.78	54.49	16.50	AV	N	Pass
3	0.510	41.06	9.99	56.00	14.94	Peak	N	Pass
3**	0.510	27.94	9.99	46.00	18.06	AV	N	Pass
4	0.802	38.09	10.53	56.00	17.91	Peak	N	Pass
4**	0.802	25.50	10.53	46.00	20.50	AV	N	Pass
5	2.210	36.91	10.03	56.00	19.09	Peak	N	Pass
5**	2.210	24.99	10.03	46.00	21.01	AV	N	Pass
6	4.236	36.87	9.89	56.00	19.13	Peak	N	Pass
6**	4.236	24.46	9.89	46.00	21.54	AV	N	Pass

A.8 Radiated Emission

Note [1]: The symbol of "--" in the table which means not application.

Note [2]: For the test data above 1 GHz, according the ANSI C63.10-2013, where limits are specified for both average and peak (or quasi-peak) detector functions, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.

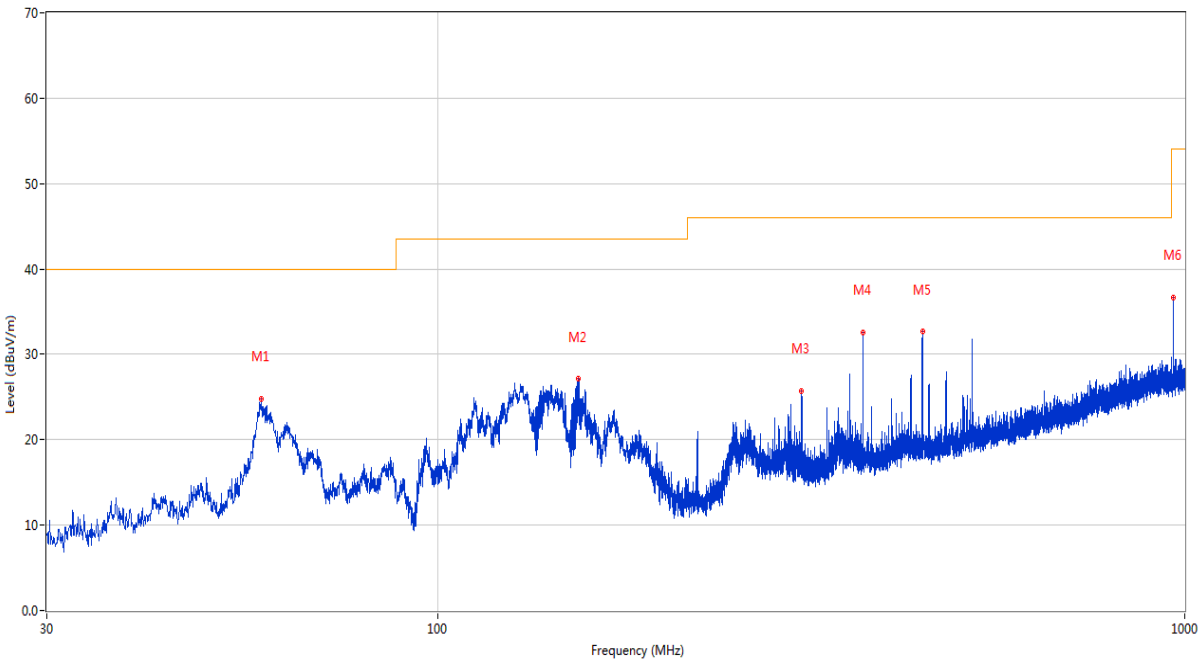
Note [3]: The EUT is working in the Normal link mode below 1 GHz. All modes have been tested and DH5-Hopping mode is the worst.

Note [4]: Results (dBuV/m) = Original reading level of Spectrum Analyzer (dBuV/m) + Factor (dB)

The low frequency, which started from 9 kHz to 30 MHz, was pre-scanned and the result which was 20 dB lower than the limit line per 15.31(o) was not reported.

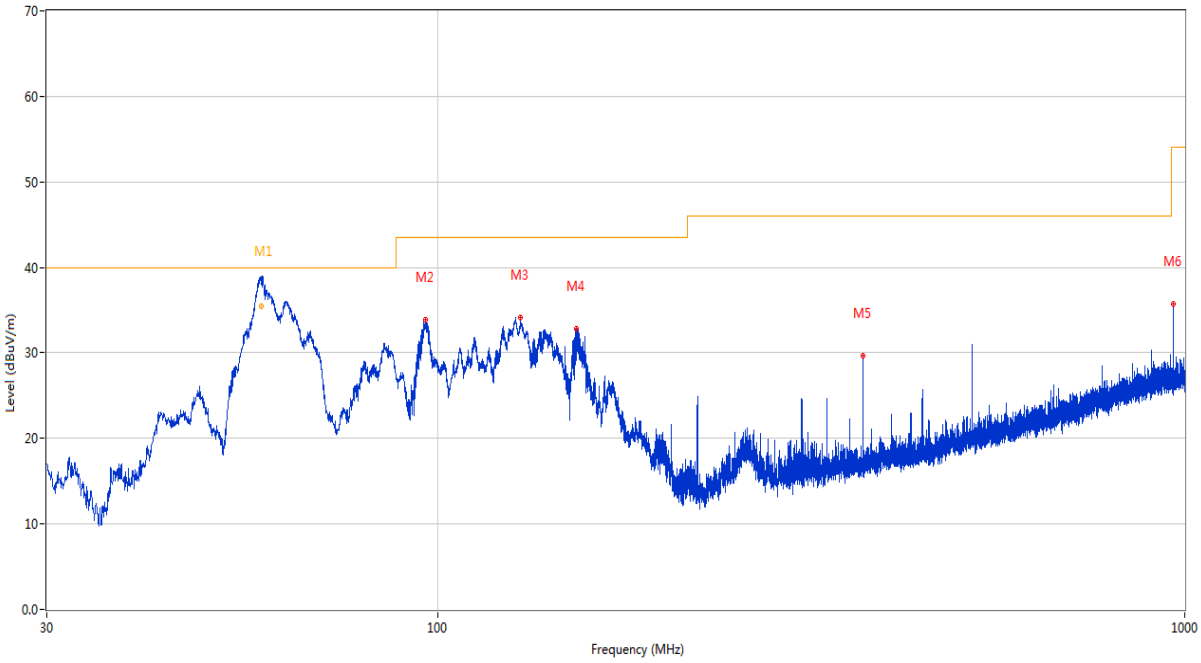
Test Data and Plots

30 MHz to 1 GHz, ANT H



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	58.081	24.77	-24.11	40.0	15.23	Peak	102.40	200	Horizontal	Pass
2	154.500	27.10	-27.41	43.5	16.40	Peak	38.70	200	Horizontal	Pass
3	307.226	25.76	-21.47	46.0	20.24	Peak	107.70	100	Horizontal	Pass
4	371.246	32.59	-19.73	46.0	13.41	Peak	209.40	100	Horizontal	Pass
5	445.500	32.63	-17.68	46.0	13.37	Peak	218.70	100	Horizontal	Pass
6	965.274	36.64	-9.43	54.0	17.36	Peak	360.00	100	Horizontal	Pass

30 MHz to 1 GHz, ANT V

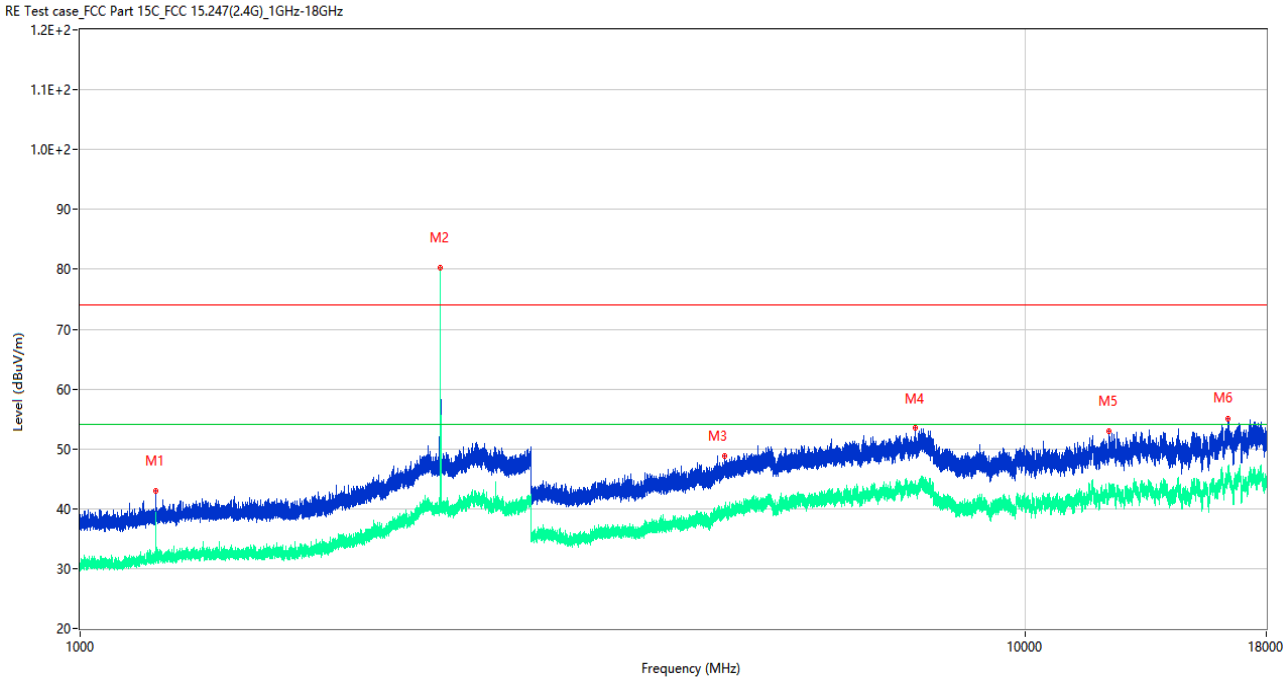


No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	58.144	38.95	-24.08	40.0	1.05	Peak	144.70	104	Vertical	N/A
1*	58.144	35.44	-24.08	40.0	4.56	QP	144.70	104	Vertical	Pass
2	96.493	33.89	-24.78	43.5	9.61	Peak	0.60	100	Vertical	Pass
3	129.037	34.20	-27.12	43.5	9.30	Peak	341.50	100	Vertical	Pass
4	153.481	32.86	-27.50	43.5	10.64	Peak	269.00	100	Vertical	Pass
5	371.246	29.70	-19.73	46.0	16.30	Peak	232.00	200	Vertical	Pass
6	965.274	35.76	-9.43	54.0	18.24	Peak	0.00	100	Vertical	Pass

Note 1: The marked spikes near 2400 MHz with circle should be ignored because they are Fundamental signal.

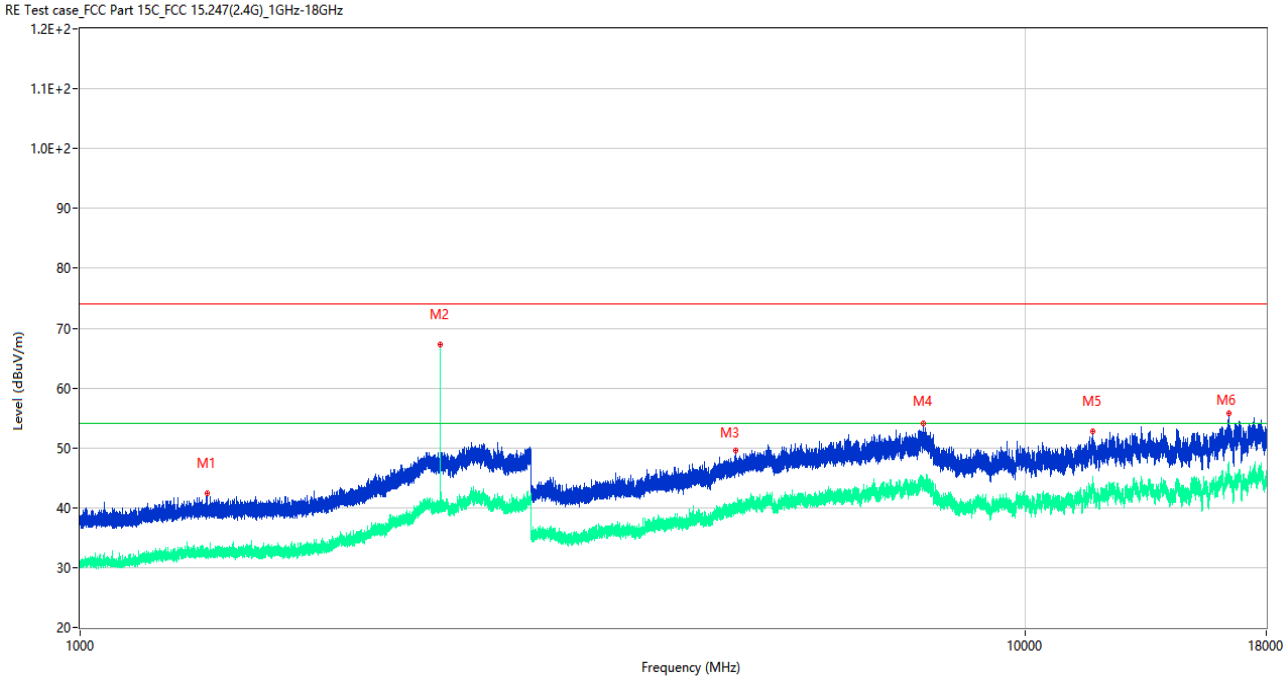
Note 2: The spurious from 18GHz-25GHz is noise only, do not show on the report.

GFSK LOW CHANNEL 1 GHz to 18 GHz, ANT H



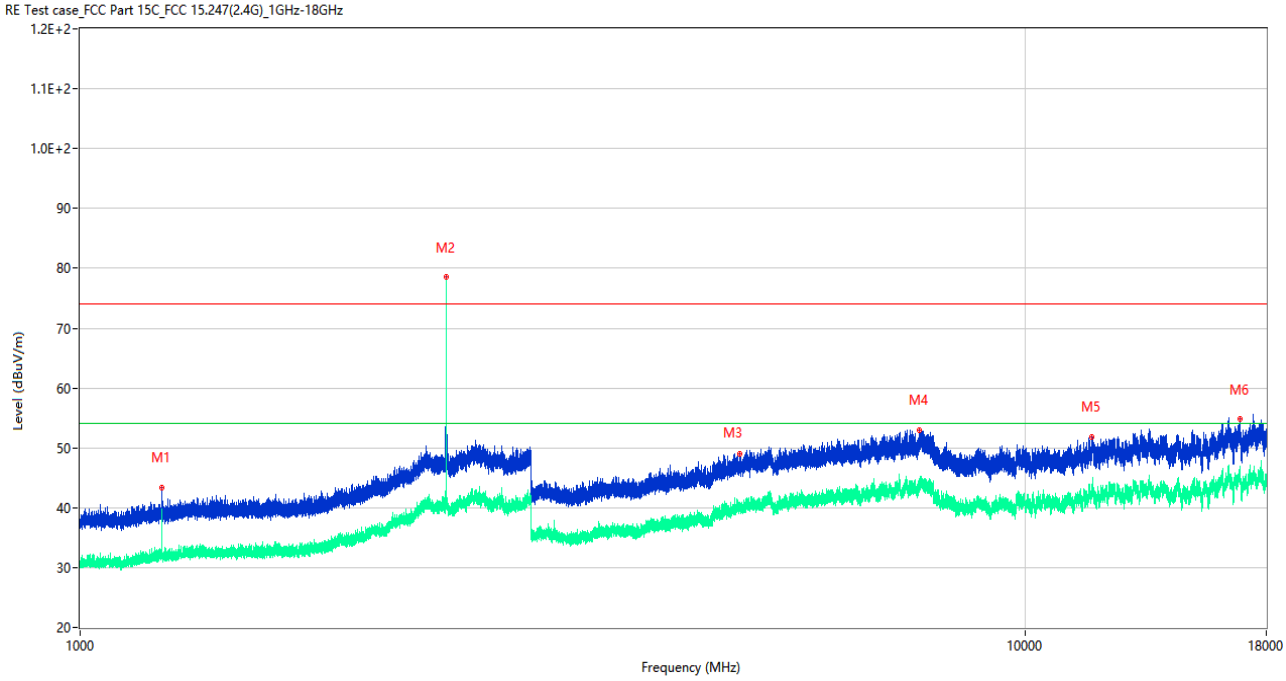
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1203.200	42.97	-17.67	74.0	31.03	Peak	35.00	100	Horizontal	Pass
1**	1203.200	38.95	-17.67	54.0	15.05	AV	35.00	100	Horizontal	Pass
2	2406.000	80.32	-10.39	74.0	-6.32	Peak	150.00	100	Horizontal	N/A
2**	2406.000	79.35	-10.39	54.0	-25.35	AV	150.00	100	Horizontal	N/A
3	4812.500	48.90	-3.01	74.0	25.10	Peak	300.00	100	Horizontal	Pass
3**	4812.500	39.31	-3.01	54.0	14.69	AV	300.00	100	Horizontal	Pass
4	7647.250	53.50	0.86	74.0	20.50	Peak	165.00	300	Horizontal	Pass
4**	7647.250	43.28	0.86	54.0	10.72	AV	165.00	300	Horizontal	Pass
5	12280.225	52.95	0.77	74.0	21.05	Peak	289.00	200	Horizontal	Pass
5**	12280.225	43.71	0.77	54.0	10.29	AV	289.00	200	Horizontal	Pass
6	16415.025	54.96	2.97	74.0	19.04	Peak	333.00	200	Horizontal	Pass
6**	16415.025	46.64	2.97	54.0	7.36	AV	333.00	200	Horizontal	Pass

GFSK LOW CHANNEL 1 GHz to 18 GHz, ANT V



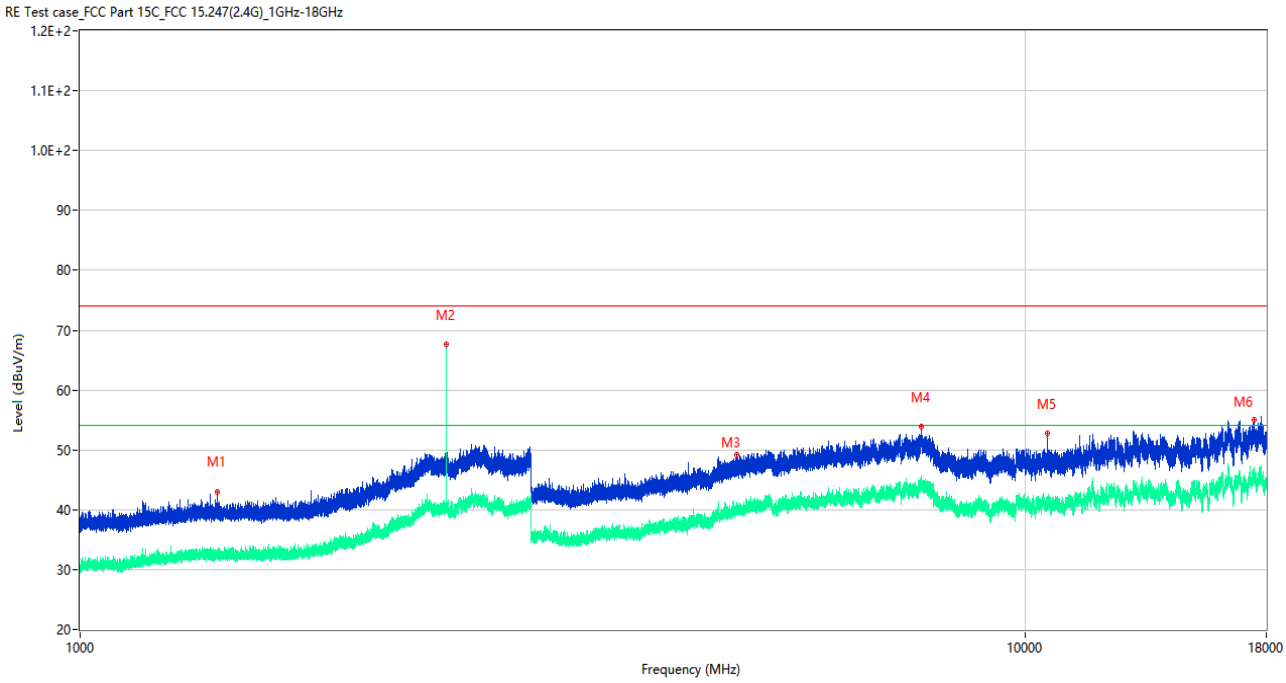
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1364.100	42.40	-17.16	74.0	31.60	Peak	167.00	100	Vertical	Pass
1**	1364.100	32.14	-17.16	54.0	21.86	AV	167.00	100	Vertical	Pass
2	2406.300	67.30	-10.43	74.0	6.70	Peak	147.00	100	Vertical	N/A
2**	2406.300	65.89	-10.43	54.0	-11.89	AV	147.00	100	Vertical	N/A
3	4940.250	49.59	-3.61	74.0	24.41	Peak	177.00	100	Vertical	Pass
3**	4940.250	40.48	-3.61	54.0	13.52	AV	177.00	100	Vertical	Pass
4	7804.750	54.05	0.90	74.0	19.95	Peak	200.00	200	Vertical	Pass
4**	7804.750	43.85	0.90	54.0	10.15	AV	200.00	200	Vertical	Pass
5	11799.287	52.84	-0.15	74.0	21.16	Peak	245.00	300	Vertical	Pass
5**	11799.287	43.83	-0.15	54.0	10.17	AV	245.00	300	Vertical	Pass
6	16429.463	55.84	2.77	74.0	18.16	Peak	134.00	100	Vertical	Pass
6**	16429.463	46.58	2.77	54.0	7.42	AV	134.00	100	Vertical	Pass

GFSK MIDDLE CHANNEL 1 GHz to 18 GHz, ANT H



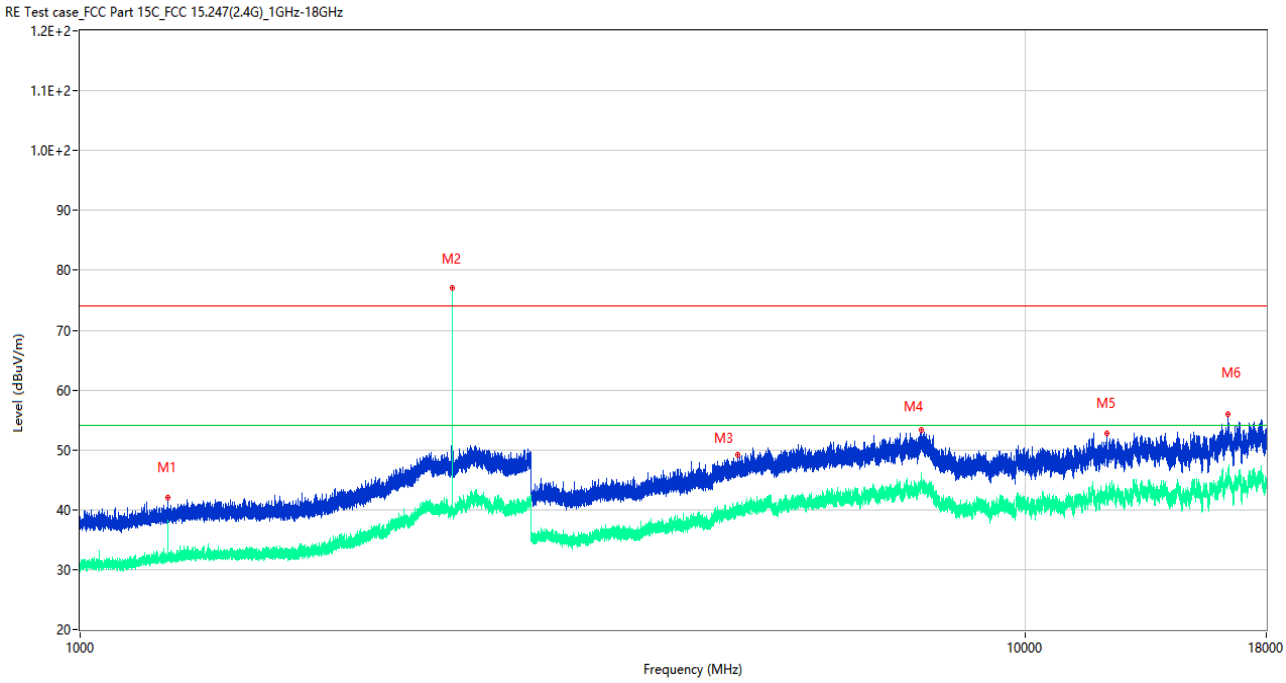
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1220.600	43.36	-17.38	74.0	30.64	Peak	33.00	200	Horizontal	Pass
1**	1220.600	38.72	-17.38	54.0	15.28	AV	33.00	200	Horizontal	Pass
2	2441.000	78.48	-9.79	74.0	-4.48	Peak	159.00	200	Horizontal	N/A
2**	2441.000	77.72	-9.79	54.0	-23.72	AV	159.00	200	Horizontal	N/A
3	4987.000	49.06	-3.07	74.0	24.94	Peak	227.00	150	Horizontal	Pass
3**	4987.000	39.94	-3.07	54.0	14.06	AV	227.00	150	Horizontal	Pass
4	7736.500	52.95	0.35	74.0	21.05	Peak	136.00	200	Horizontal	Pass
4**	7736.500	43.82	0.35	54.0	10.18	AV	136.00	200	Horizontal	Pass
5	11770.787	51.87	-0.17	74.0	22.13	Peak	360.00	300	Horizontal	Pass
5**	11770.787	42.64	-0.17	54.0	11.36	AV	360.00	300	Horizontal	Pass
6	16869.412	54.75	3.24	74.0	19.25	Peak	182.00	300	Horizontal	Pass
6**	16869.412	44.99	3.24	54.0	9.01	AV	182.00	300	Horizontal	Pass

GFSK MIDDLE CHANNEL 1 GHz to 18 GHz, ANT V



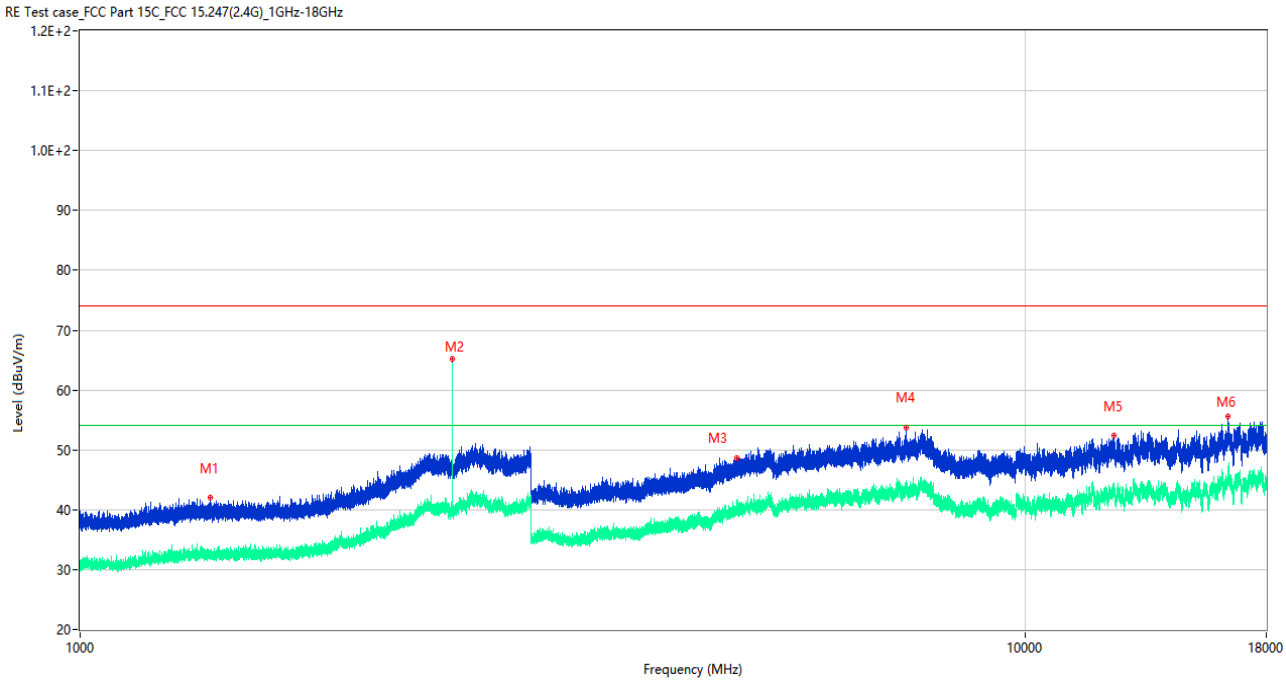
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1398.300	43.00	-17.00	74.0	31.00	Peak	111.00	200	Vertical	Pass
1**	1398.300	32.14	-17.00	54.0	21.86	AV	111.00	200	Vertical	Pass
2	2440.900	67.58	-9.79	74.0	6.42	Peak	160.00	200	Vertical	N/A
2**	2440.900	66.19	-9.79	54.0	-12.19	AV	160.00	200	Vertical	N/A
3	4950.000	49.19	-3.31	74.0	24.81	Peak	12.00	100	Vertical	Pass
3**	4950.000	41.23	-3.31	54.0	12.77	AV	12.00	100	Vertical	Pass
4	7771.750	53.88	1.36	74.0	20.12	Peak	344.00	300	Vertical	Pass
4**	7771.750	43.53	1.36	54.0	10.47	AV	344.00	300	Vertical	Pass
5	10571.175	52.73	-2.35	74.0	21.27	Peak	192.00	300	Vertical	Pass
5**	10571.175	41.41	-2.35	54.0	12.59	AV	192.00	300	Vertical	Pass
6	17458.199	54.98	5.42	74.0	19.02	Peak	123.00	200	Vertical	Pass
6**	17458.199	45.84	5.42	54.0	8.16	AV	123.00	200	Vertical	Pass

GFSK HIGH CHANNEL 1 GHz to 18 GHz, ANT H



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1237.600	42.04	-17.44	74.0	31.96	Peak	360.00	400	Horizontal	Pass
1**	1237.600	35.65	-17.44	54.0	18.35	AV	360.00	400	Horizontal	Pass
2	2476.300	77.03	-11.22	74.0	-3.03	Peak	149.00	150	Horizontal	N/A
2**	2476.300	76.67	-11.22	54.0	-22.67	AV	149.00	150	Horizontal	N/A
3	4968.750	49.25	-3.56	74.0	24.75	Peak	282.00	150	Horizontal	Pass
3**	4968.750	39.53	-3.56	54.0	14.47	AV	282.00	150	Horizontal	Pass
4	7762.250	53.39	1.73	74.0	20.61	Peak	345.00	400	Horizontal	Pass
4**	7762.250	44.14	1.73	54.0	9.86	AV	345.00	400	Horizontal	Pass
5	12202.325	52.79	0.44	74.0	21.21	Peak	185.00	100	Horizontal	Pass
5**	12202.325	42.82	0.44	54.0	11.18	AV	185.00	100	Horizontal	Pass
6	16378.537	55.93	2.35	74.0	18.07	Peak	34.00	300	Horizontal	Pass
6**	16378.537	44.89	2.35	54.0	9.11	AV	34.00	300	Horizontal	Pass

GFSK HIGH CHANNEL 1 GHz to 18 GHz, ANT V



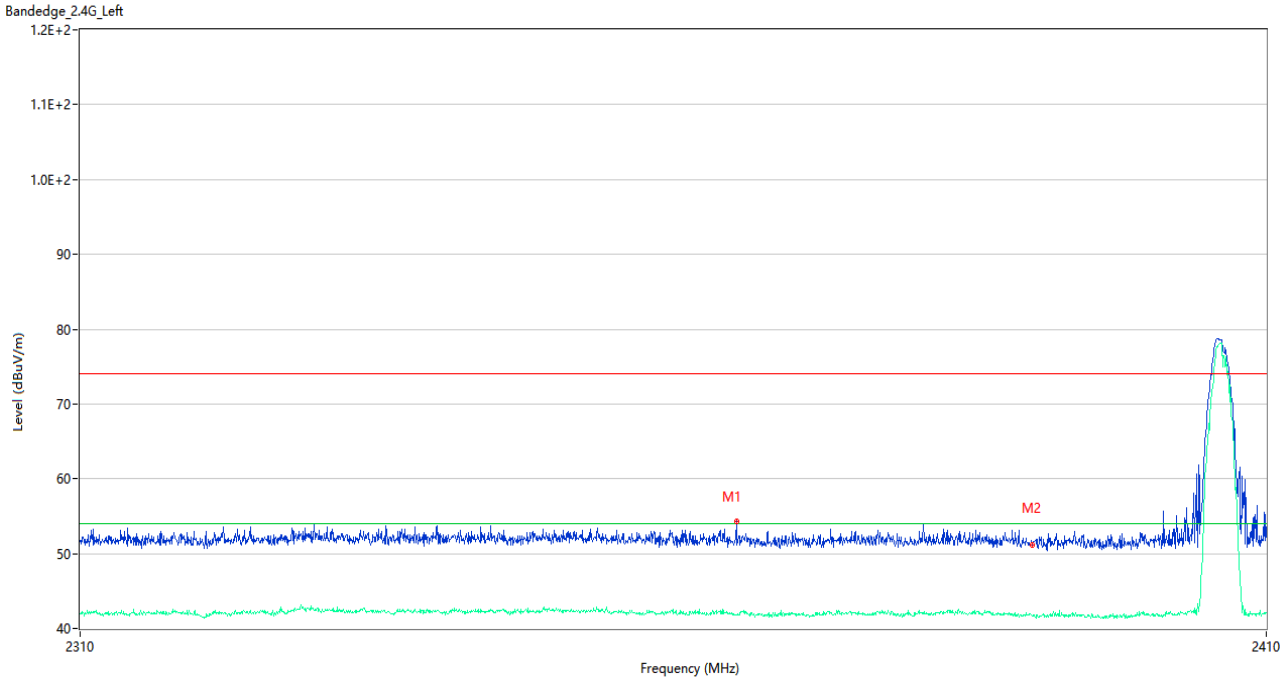
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1373.400	42.01	-16.85	74.0	31.99	Peak	360.00	300	Vertical	Pass
1**	1373.400	32.78	-16.85	54.0	21.22	AV	360.00	300	Vertical	Pass
2	2476.000	65.11	-11.25	74.0	8.89	Peak	144.00	200	Vertical	N/A
2**	2476.000	64.32	-11.25	54.0	-10.32	AV	144.00	200	Vertical	N/A
3	4950.250	48.64	-3.39	74.0	25.36	Peak	177.00	150	Vertical	Pass
3**	4950.250	39.90	-3.39	54.0	14.10	AV	177.00	150	Vertical	Pass
4	7486.000	53.75	1.41	74.0	20.25	Peak	223.00	200	Vertical	Pass
4**	7486.000	44.83	1.41	54.0	9.17	AV	223.00	200	Vertical	Pass
5	12404.675	52.31	1.10	74.0	21.69	Peak	358.00	300	Vertical	Pass
5**	12404.675	42.89	1.10	54.0	11.11	AV	358.00	300	Vertical	Pass
6	16407.937	55.57	3.06	74.0	18.43	Peak	43.00	300	Vertical	Pass
6**	16407.937	45.17	3.06	54.0	8.83	AV	43.00	300	Vertical	Pass

A.9 Band Edge (Restricted-band band-edge)

Note [1]: The lowest and highest channels are tested to verify the band edge emissions. Please refer to the following the plots for emissions values.
Note [2]: The test data all are tested in the vertical and horizontal antenna which the trace is max hold. So these plots have shown the worst case.
Note [3]: According the ANSI C63.10-2013, where limits are specified for both average and peak (or quasi-peak) detector functions, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.
Note [4]: The Level (dBuV/m) has been corrected by factor.

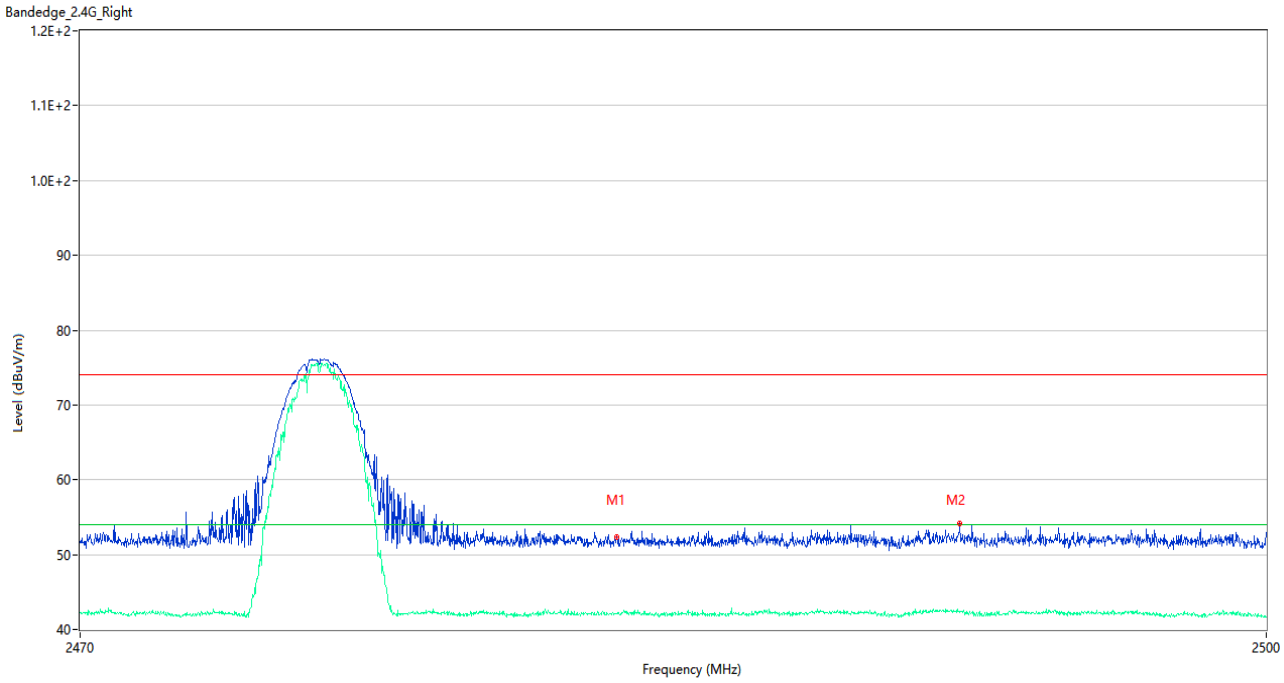
Test Data

GFSK LOW CHANNEL



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2364.800	54.38	-1.69	74.0	19.62	Peak	250.00	200	Horizontal	Pass
1**	2364.800	41.79	-1.69	54.0	12.21	AV	250.00	200	Horizontal	Pass
2	2389.950	51.19	-1.82	74.0	22.81	Peak	0.00	150	Horizontal	Pass
2**	2389.950	41.65	-1.82	54.0	12.35	AV	0.00	150	Horizontal	Pass

GFSK HIGH CHANNEL



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2483.530	52.35	-1.10	74.0	21.65	Peak	119.00	200	Horizontal	Pass
1**	2483.530	42.07	-1.10	54.0	11.93	AV	119.00	200	Horizontal	Pass
2	2492.215	54.11	-0.80	74.0	19.89	Peak	351.00	150	Horizontal	Pass
2**	2492.215	42.44	-0.80	54.0	11.56	AV	351.00	150	Horizontal	Pass

ANNEX B TEST SETUP PHOTOS

Please refer the document “BL-SZ2370995-AR.PDF”.

ANNEX C EUT EXTERNAL PHOTOS

Please refer the document “BL-SZ2370995-AW.PDF”.

ANNEX D EUT INTERNAL PHOTOS

Please refer the document “BL-SZ2370995-AI.PDF”.

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--END OF REPORT--