

TEST REPORT

Applicant: Shenzhen Sugr Technology Co., LTD
Address: 3002, No.36, Liuxian3rdRoad, BaoanDistrict, Shenzhen, China
Equipment Type: HiDock E102
Model Name: E102
Brand Name: HiDock
FCC ID: 2AXGWE102
Test Standard: 47 CFR Part 15 Subpart C
(refer to section 3.1)
Sample Arrival Date: Feb. 20, 2024
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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
<u>Rev. 01</u>	<u>Apr. 03, 2024</u>	<u>Initial Issue</u>

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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	Shenzhen Sugr Technology Co., LTD
Address	3002, No.36, Liuxian3rdRoad, BaoanDistrict, Shenzhen, China

2.2 Manufacturer Information

Manufacturer	Jing Technology Co., Ltd.
Address	Room 3002, No.36, Liuxian 3rd Road, No.72, Xingdong Community, Xin'an Street, Bao'an District, Shenzhen, China

2.3 General Description for Equipment under Test (EUT)

EUT Name	HiDock E102
Model Name Under Test	E102
Series Model Name	N/A
Description of Model name differentiation	N/A
Hardware Version	V1.2
Software Version	V2.3.1_1FA1B648
Dimensions (Approx.)	N/A
Weight (Approx.)	N/A

2.4 Technical Information

Network and Wireless connectivity	2.4G ISM Band
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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 2400 MHz to 2483.5 MHz.
Number of Channel	79 (at intervals of 1 MHz)
Tested Channel	0 (2402 MHz), 39 (2441 MHz), 78 (2480 MHz)
Antenna Type	Ceramic Antenna
Antenna Gain	1.75 dBi
Antenna Impedance	50Ω
Antenna System (MIMO Smart Antenna)	N/A

Channel List:

Channel number	Freq. (MHz)	Channel number	Freq. (MHz)	Channel number	Freq. (MHz)	Channel number	Freq. (MHz)
0	2402	21	2423	42	2444	63	2465
1	2403	22	2424	43	2445	64	2466
2	2404	23	2425	44	2446	65	2467
3	2405	24	2426	45	2447	66	2468
4	2406	25	2427	46	2448	67	2469
5	2407	26	2428	47	2449	68	2470
6	2408	27	2429	48	2450	69	2471
7	2409	28	2430	49	2451	70	2472
8	2410	29	2431	50	2452	71	2473
9	2411	30	2432	51	2453	72	2474
10	2412	31	2433	52	2454	73	2475
11	2413	32	2434	53	2455	74	2476
12	2414	33	2435	54	2456	75	2477
13	2415	34	2436	55	2457	76	2478
14	2416	35	2437	56	2458	77	2479
15	2417	36	2438	57	2459	78	2480
16	2418	37	2439	58	2460	-	-
17	2419	38	2440	59	2461	-	-
18	2420	39	2441	60	2462	-	-
19	2421	40	2442	61	2463	-	-
20	2422	41	2443	62	2464	-	-

Note: The modulation is GFSK with FHSS, there are total 79 channels (frequency range is 2402-2480MHz, channel step is 1MHz, totally 79 channels), when this part works, it will choose 79 channels, each channel band width is 1MHz, if one channel is chosen, adjacent two channels cannot be chosen to make sure step of working channels is more than 1MHz. in this report, the equipment select the lowest, middle and highest channel from 79 channels, Which are 2402 MHz, 2441 MHz and 2480 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 Test Verdict

No.	Description	FCC Part No.	Channel	Test Result	Verdict	Remark
1	Antenna Requirement	15.203	N/A	--	Pass	Note
2	Number of Hopping Frequencies	15.247(a)	Hopping Mode	ANNEX A.1	Pass	--
3	Peak Output Power	15.247(b)	Low/Middle/High	ANNEX A.2	Pass	--
4	Occupied Bandwidth	15.247(a)	Low/Middle/High	ANNEX A.3	Pass	--
5	Carrier Frequency Separation	15.247(a)	Hopping Mode	ANNEX A.4	Pass	--
6	Time of Occupancy (Dwell time)	15.247(a)	Hopping Mode	ANNEX A.5	Pass	--
7	Conducted Spurious Emission & Authorized-band band-edge	15.247(d)	Hopping Mode; Low/Middle/High	ANNEX A.6	Pass	--
8	Conducted Emission	15.207	Low/Middle/High	ANNEX A.7	Pass	--
9	Radiated Spurious Emission	15.209 15.247(d)	Low/Middle/High	ANNEX A.8	Pass	--
10	Band Edge(Restricted-band band-edge)	15.209 15.247(d)	Low/High	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	41% to 65%	
Atmospheric Pressure	100 kPa to 102 kPa	
Temperature	NT (Normal Temperature)	+16.2°C to +26.7°C
Working Voltage of the EUT	NV (Normal Voltage)	3.7 V

4.2 Test Equipment List

Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due
Spectrum Analyzer	KEYSIGHT	N9020A	MY46471071	2023.07.25	2024.07.24
Spectrum Analyzer	KEYSIGHT	N9020A	MY52510065	2023.09.05	2024.09.04
Test Antenna-Horn	SCHWARZBECK	BBHA 9120D	01631	2022.02.23	2025.02.22
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
Amplifier	COM-MV	LSCX_LNA1-12G-01	180602	2023.09.05	2024.09.04
Amplifier	COM-MV	XKu_LNA7-18G-01	180601	2023.09.05	2024.09.04
EMI Receiver	ROHDE&SCHWARZ	ESRP	101036	2023.09.05	2024.09.04
Test Antenna-Bi-Log	SCHWARZBECK	VULB 9168	9168-01162	2023.08.04	2024.08.03
Test Antenna-Loop	SCHWARZBECK	FMZB 1519	1519-037	2021.04.16	2024.04.15
Amplifier	COM-MV	ZT30-1000M	B2018054558	2023.12.05	2024.12.04
Anechoic Chamber	EMC Electronic Co., Ltd	20.10*11.60*7.35m	130	2021.08.15	2024.08.14
EMI Receiver	KEYSIGHT	N9010B	MY57110309	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	V22.930	N/A	The section 4.5.2&4.5.3&4.5.4&4.5.5

4.4 Measurement Uncertainty

The following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2.

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of $k=2$.

Parameters	Uncertainty
Occupied Channel Bandwidth	2.8%
RF output power, conducted	1.28 dB
Power Spectral Density, conducted	1.30 dB
Unwanted Emissions, conducted	1.84 dB
All emissions, radiated	5.36 dB
Temperature	0.8°C
Humidity	4%

4.5 Description of Test Setup

4.5.1 For Antenna Port Test

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

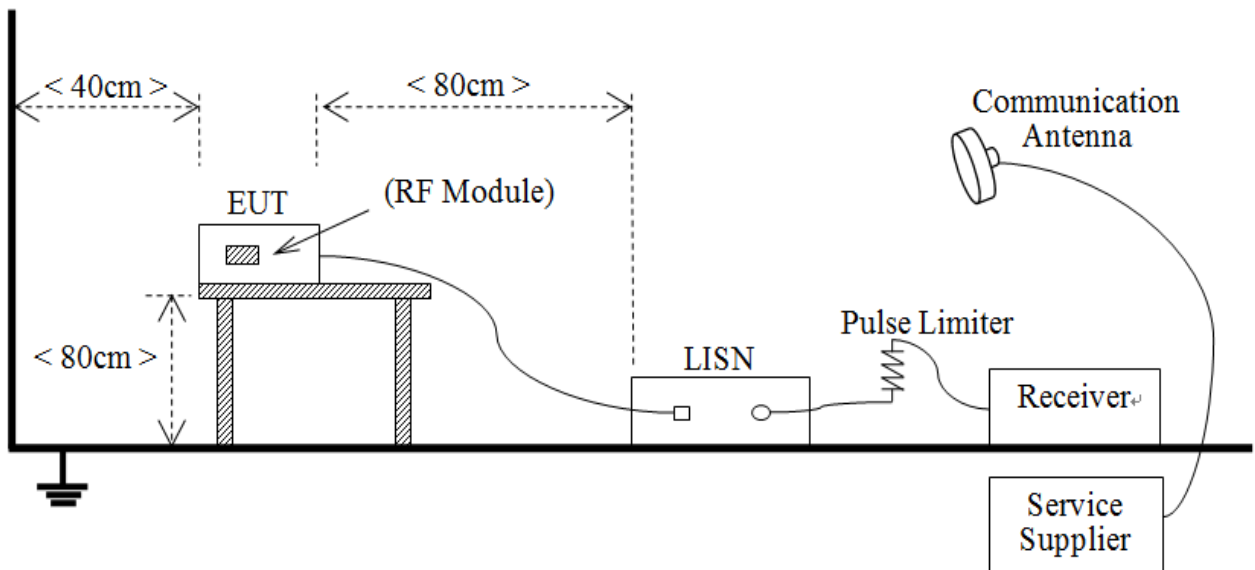
For example: the measurement value is 10 dBm and the cable 0.5dBm used, then the final result of EUT:

Conducted value (dBm) = 10 dBm + 0.5 dB = 10.5 dBm



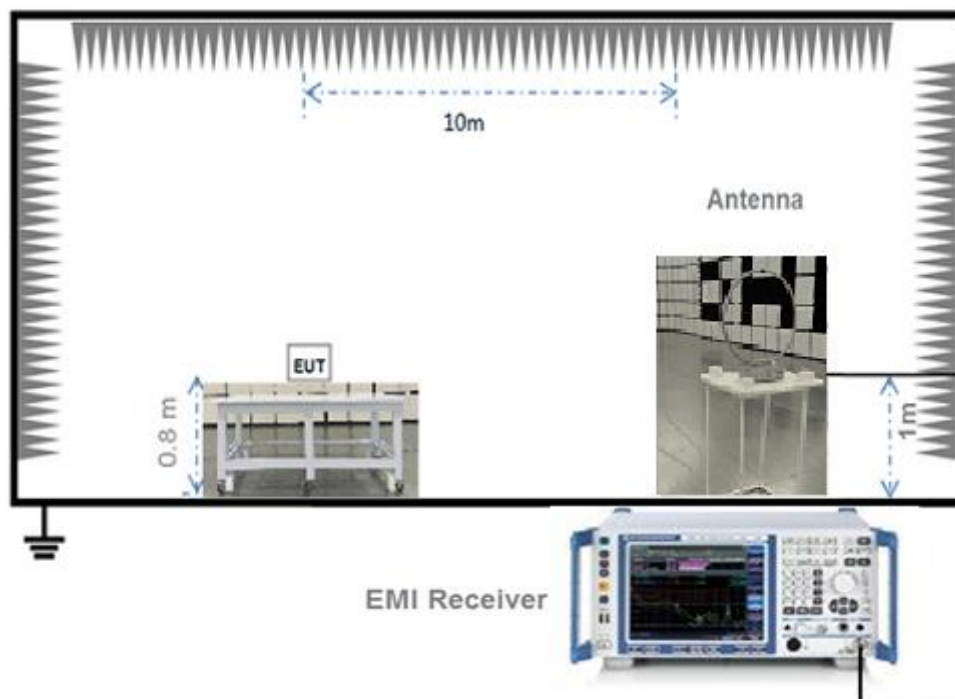
(Diagram 1)

4.5.2 For AC Power Supply Port Test



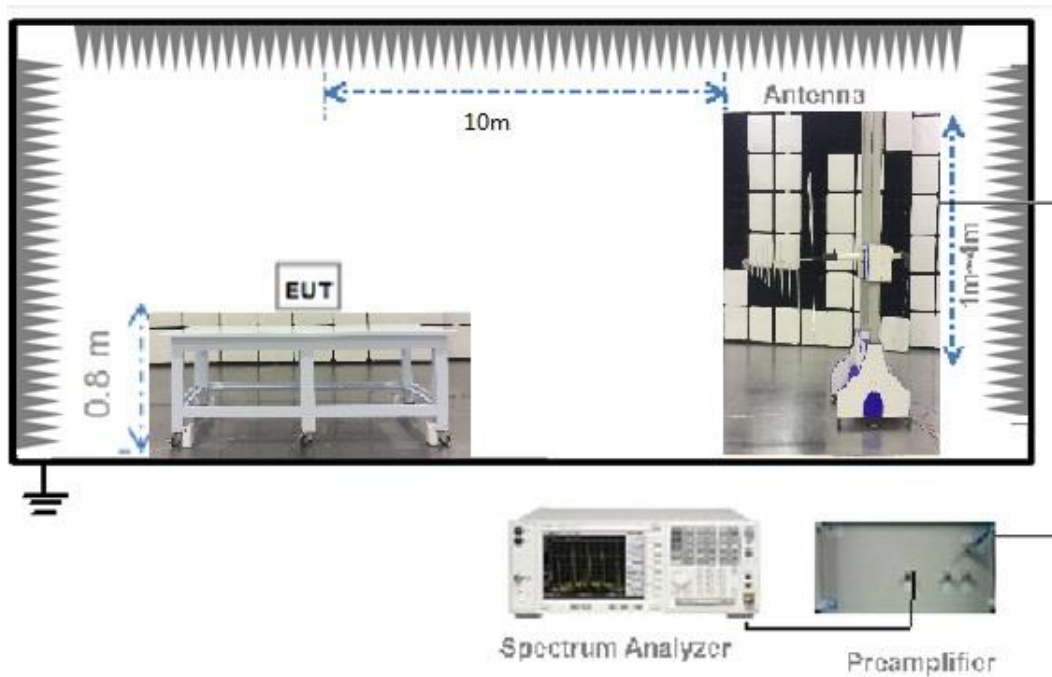
(Diagram 2)

4.5.3 For Radiated Test (Below 30 MHz)



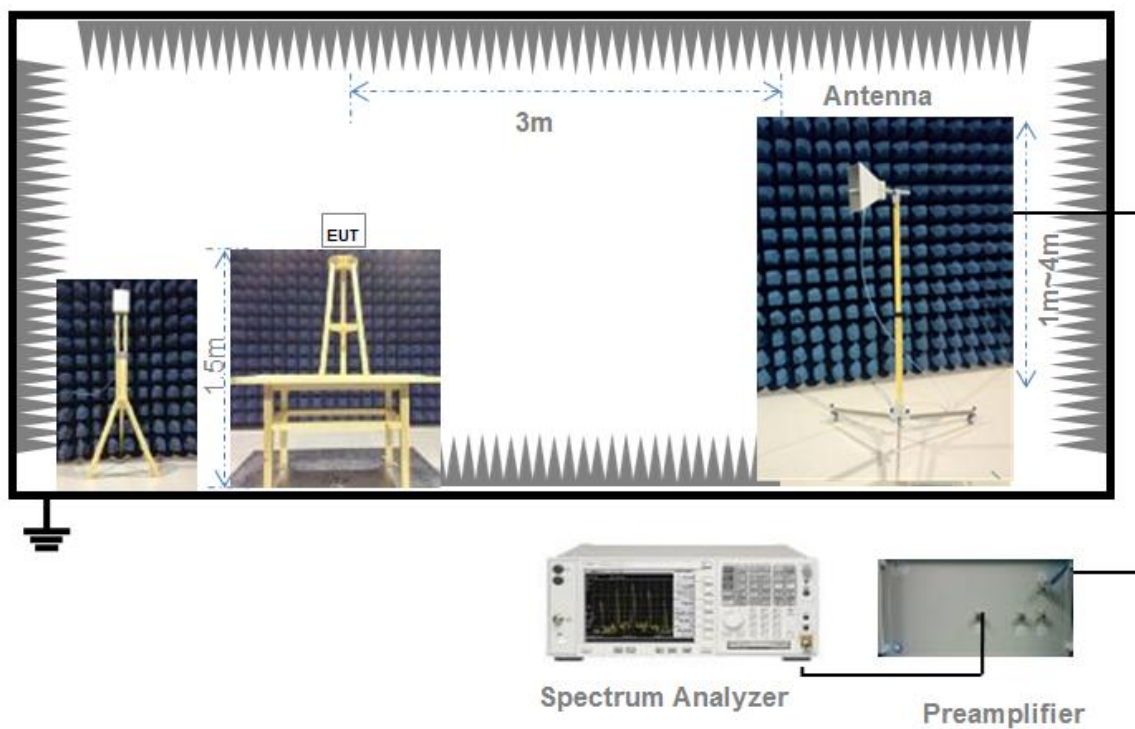
(Diagram 3)

4.5.4 For Radiated Test (30 MHz-1 GHz)



(Diagram 4)

4.5.5 For Radiated Test (Above 1 GHz)



(Diagram 5)

4.6 Measurement Results Explanation Example

4.6.1 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.

4.5.1 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) = $20 * \log (\text{Duty cycle})$.

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) = $20 * \log ((2.9 * 3) / 100) = -21.21 \text{ dB}$

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)
= $45.61 + (-21.21) = 24.4 \text{ (dBuV/m)}$

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.	An embedded-in antenna design is used.

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 Frequencies

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 4.5.1 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 = To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.

VBW $\geq$ 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 band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

5.3.2 Test Setup

See section 4.5.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.3.3 Test Procedure

The 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 $\geq$ 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 4.5.1 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 5 times the 20 dB bandwidth, centered on a hopping channel

RBW = in the range of 1% to 5% of the OBW

VBW $\geq$ 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.

5.5.1 Test Setup

See section 4.5.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.5.2 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) $\geq 1\%$ of the span

Video (or Average) Bandwidth (VBW) $\geq$ 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.

5.5.3 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 4.5.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.6.3 Test Procedure

The average time of occupancy on any channel within the Period can be calculated with formulas:

$$\{\text{Total of Dwell}\} = \{\text{Pulse Time}\} * \{\text{Number of Hopping Frequency in Period}\}$$

$$\{\text{Period}\} = 0.4\text{s} * \{\text{Number of Hopping Frequency}\}$$

The middle 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 4.5.1 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 = 300 kHz

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 Conducted Emission

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 50 μ H/50 Ω line impedance stabilization network (LISN).

Frequency range (MHz)	Conducted Limit (dB μ V)	
	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 4.5.2 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 4.5.3 to 4.5.5 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 $f \geq 1$ GHz, 100 kHz for $f < 1$ GHz

VBW $\geq$ 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 4.5.3 to 4.5.5 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 $f \geq 1$ GHz, 100 kHz for $f < 1$ GHz

VBW $\geq$ 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

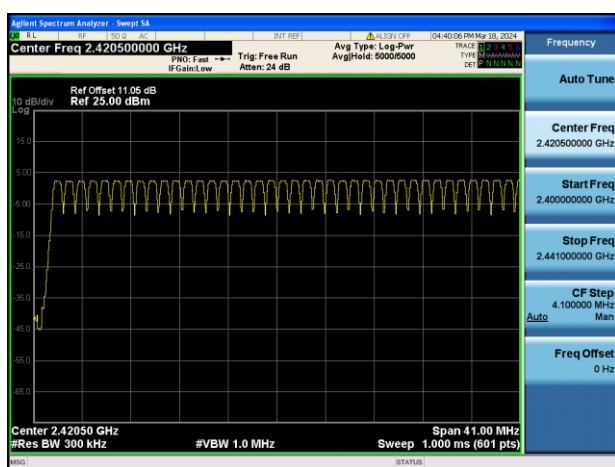
A.1 Number of Hopping Frequency

Test Data

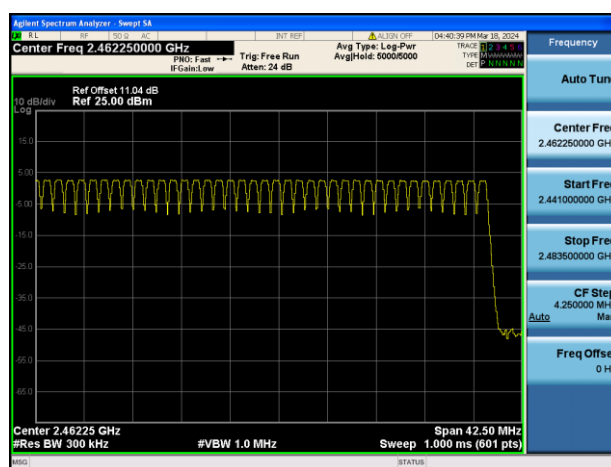
Test Mode	Frequency Block (MHz)	Measured Channel Numbers	Min. Limit	Verdict
GFSK	2400 - 2483.5	79	15	Pass

Test Plots

GFSK 2.4 GHz ~ 2.4415 GHz



GFSK 2.4415 GHz ~ 2.4835 GHz



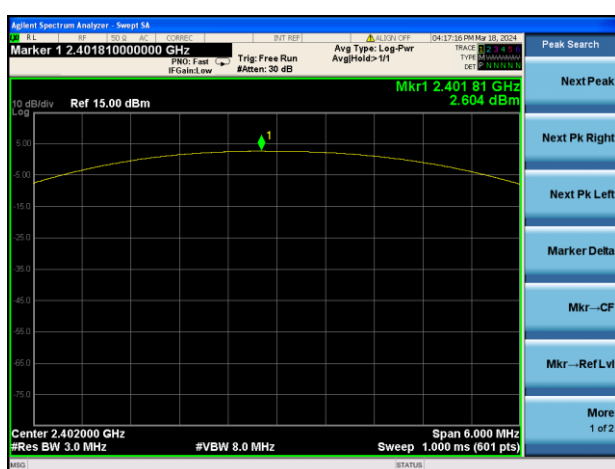
A.2 Peak Output Power

Peak Power Test Data

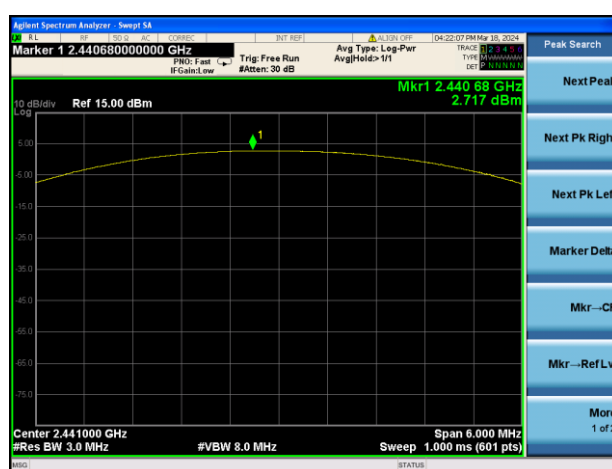
Channel	Measured Output Peak Power		Limit		Verdict
	GFSK		dBm	mW	
	dBm	mW			
Low	2.60	1.82	21	125	Pass
Middle	2.72	1.87			Pass
High	2.64	1.84			Pass

Test Plots

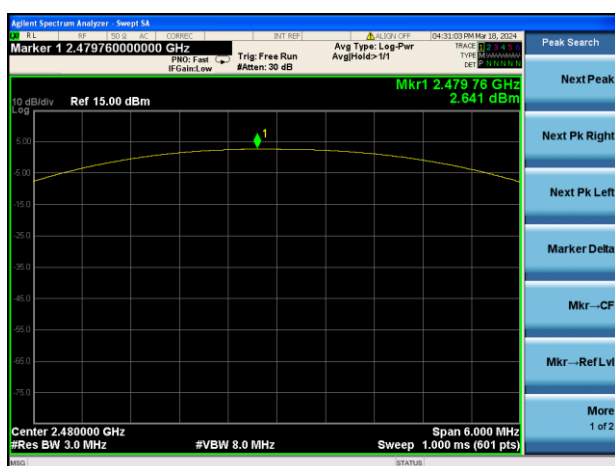
GFSK LOW CHANNEL



GFSK MIDDLE CHANNEL



GFSK HIGH CHANNEL



A.3 20 dB and 99% bandwidth

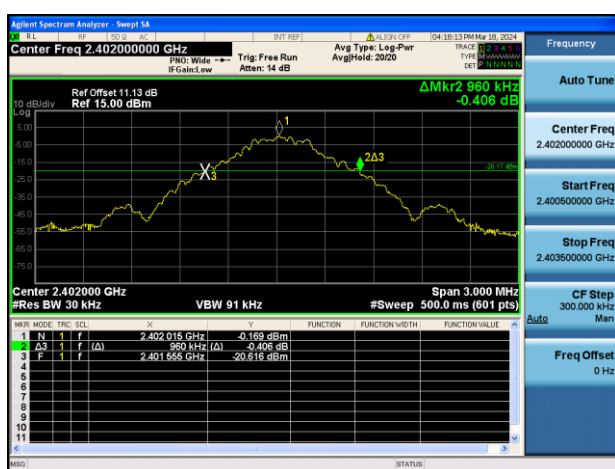
Test Data

GFSK		
Channel	20 dB Bandwidth (MHz)	99% Bandwidth (MHz)
Low	0.960000	0.863020
Middle	0.960000	0.862600
High	0.960000	0.863920

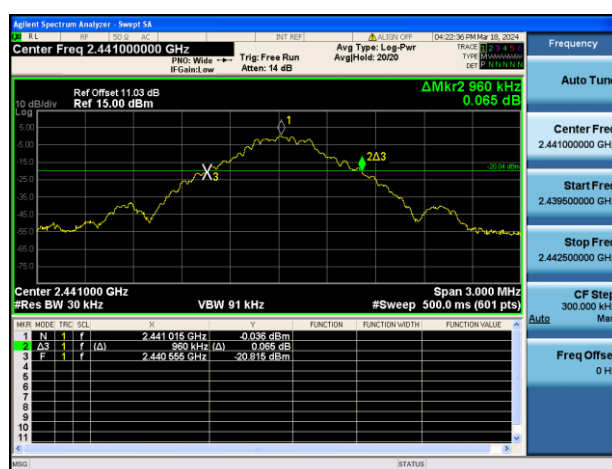
Test Plots

20 dB Bandwidth

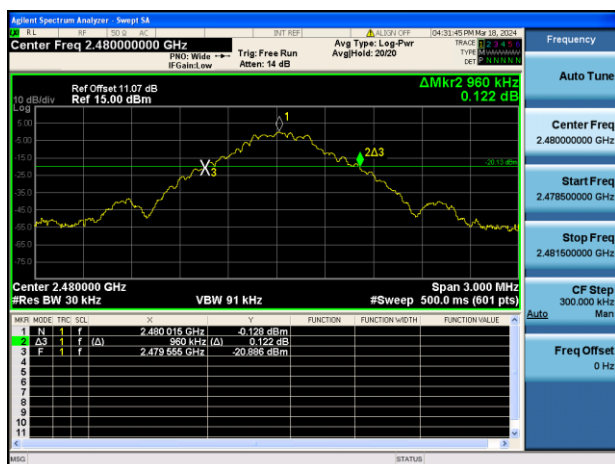
GFSK LOW CHANNEL



GFSK MIDDLE CHANNEL

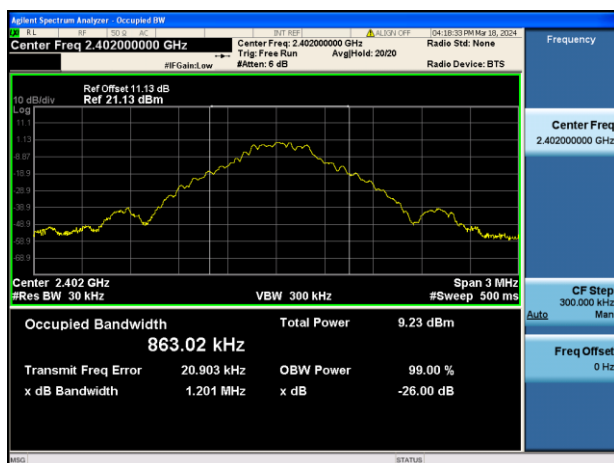


GFSK HIGH CHANNEL

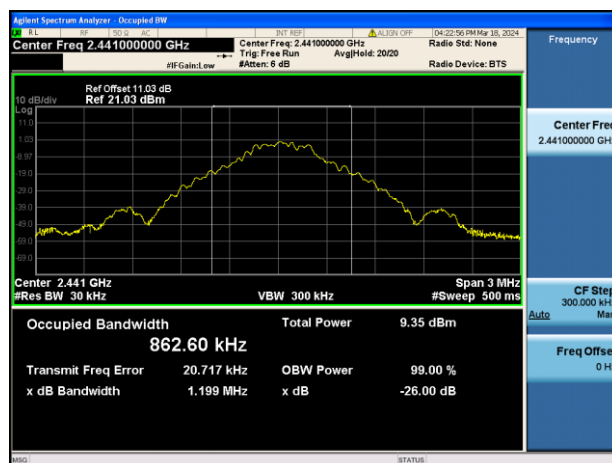


99% Bandwidth

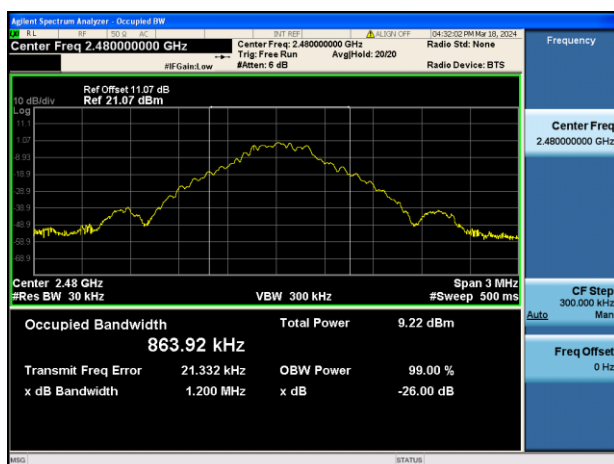
GFSK LOW CHANNEL



GFSK MIDDLE CHANNEL



GFSK HIGH CHANNEL



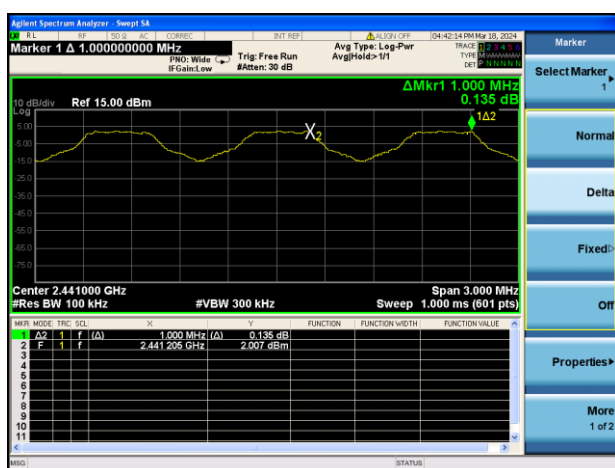
A.4 Hopping Frequency Separation

Test Data

Mode	Frequency separation (MHz)	2/3 of the 20 dB Bandwidth (MHz)	Verdict
GFSK	1.000	0.640	Pass

Test Plot

GFSK



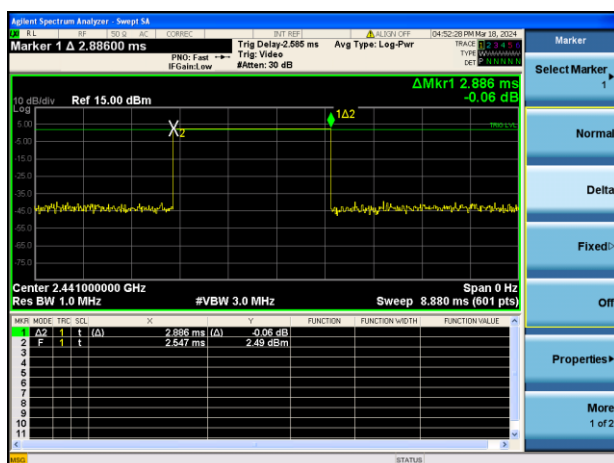
A.5 Time of Occupancy (Dwell time)

Test Data

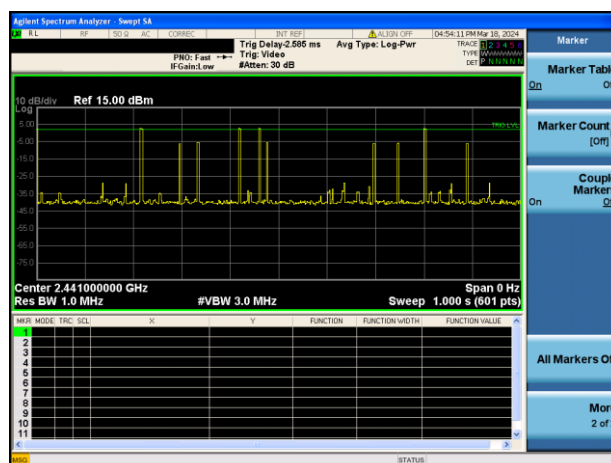
GFSK			
Pulse Width (ms)	Total of Dwell (ms)	Limit (sec)	Verdict
2.886	364.790	0.4	Pass

Test Plots

Pulse Width



Sweep time 1s



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

Test Data

GFSK				
Channel	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
		Carrier Level	Calculated 20 dBc Limit	
Low	-35.74	2.29	-17.71	Pass
Middle	-33.15	2.40	-17.60	Pass
High	-31.56	2.08	-17.92	Pass

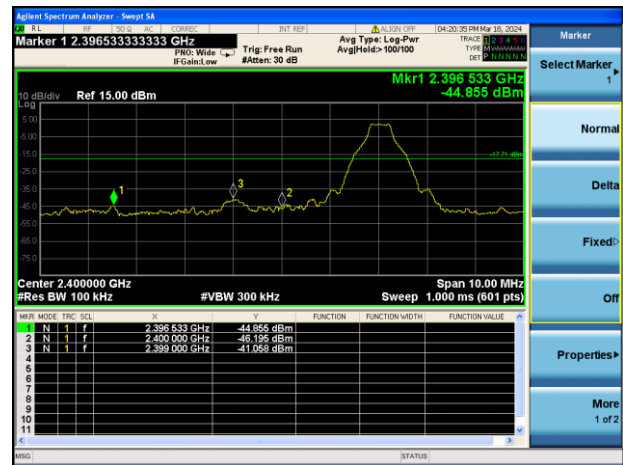
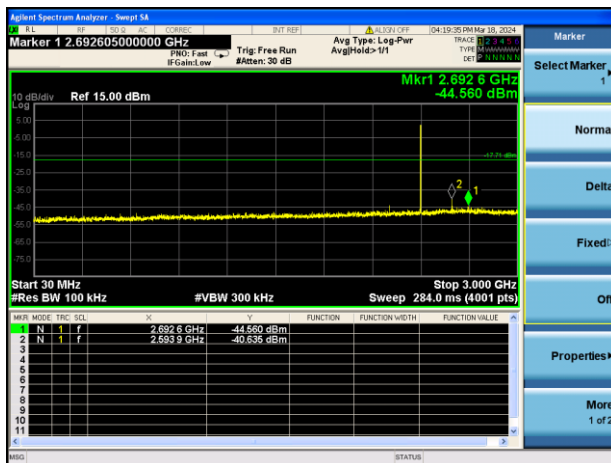
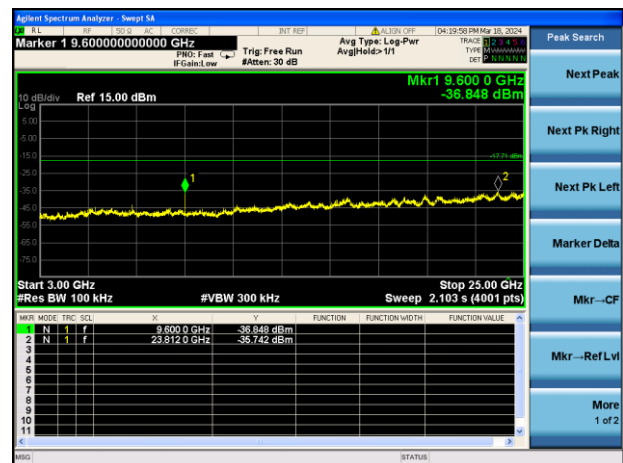
Hopping Mode				
Mode	Measured Max. Out of Band Emission (dBm)	Limit (dBm)		Verdict
		Carrier Level	Calculated 20 dBc Limit	
GFSK	-30.83	2.55	-17.45	Pass

Test Plots

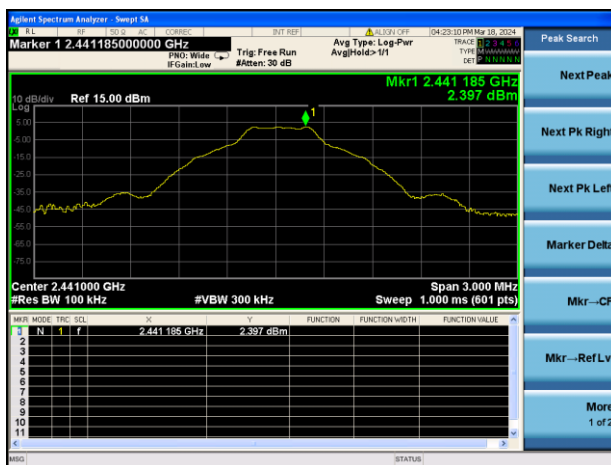
GFSK LOW CHANNEL, CARRIER LEVEL



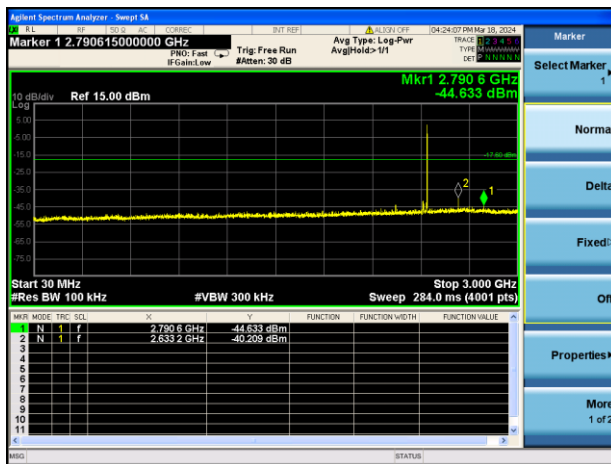
GFSK LOW CHANNEL, BAND EDGE

GFSK LOW CHANNEL, SPURIOUS
30 MHz ~ 3 GHzGFSK LOW CHANNEL, SPURIOUS
3 GHz ~ 25 GHz

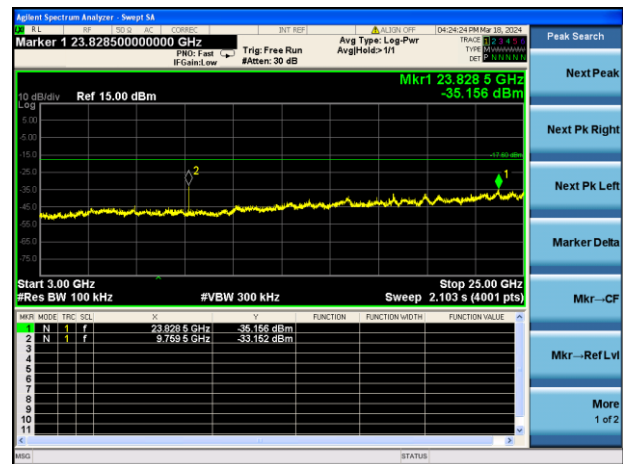
GFSK MIDDLE CHANNEL, CARRIER LEVEL



GFSK MIDDLE CHANNEL, SPURIOUS 30 MHz ~ 3 GHz



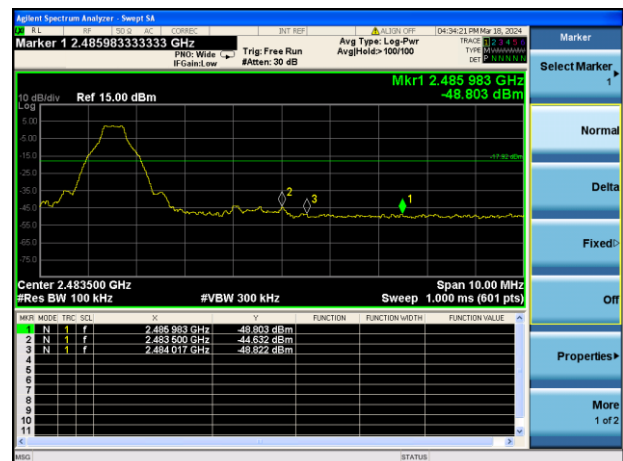
GFSK MIDDLE CHANNEL, SPURIOUS 3 GHz ~ 25 GHz



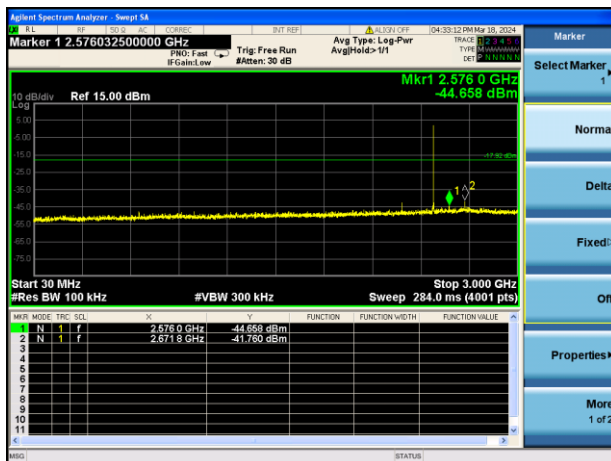
GFSK HIGH CHANNEL, CARRIER LEVEL



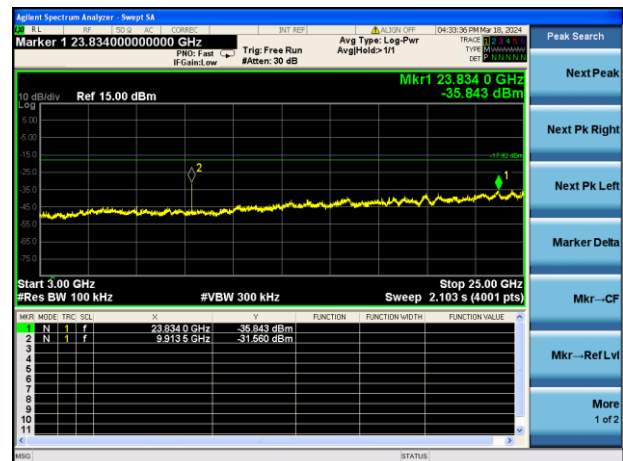
GFSK HIGH CHANNEL, BAND EDGE



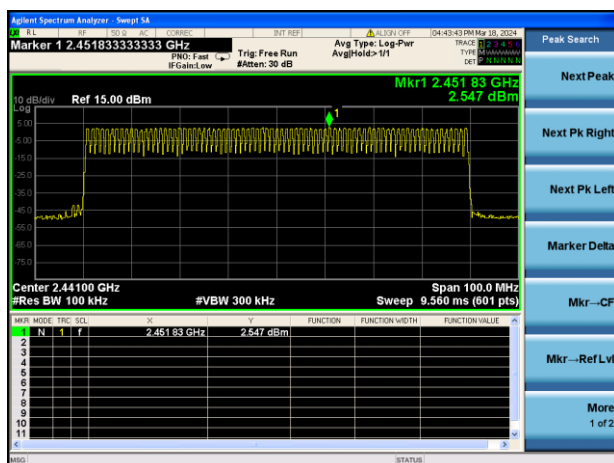
GFSK HIGH CHANNEL, SPURIOUS 30 MHz ~ 3 GHz



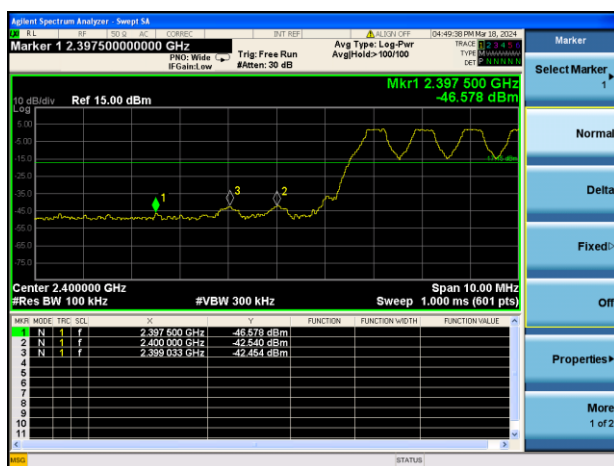
GFSK HIGH CHANNEL, SPURIOUS 3 GHz ~ 25 GHz



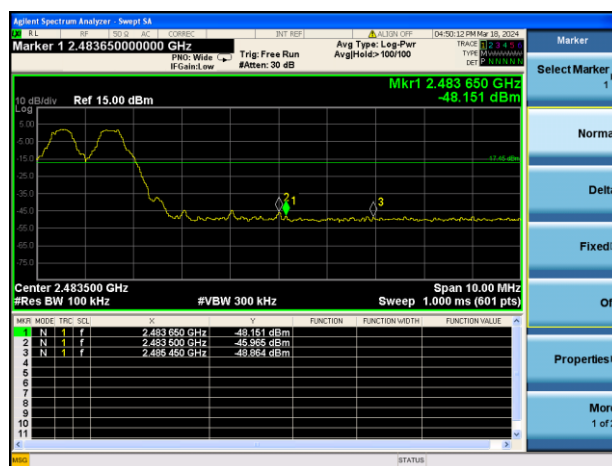
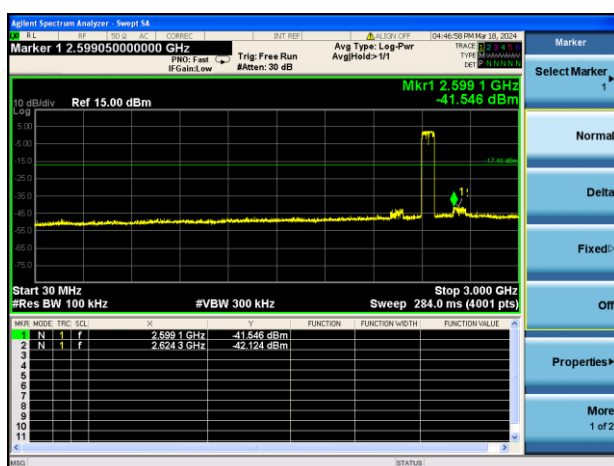
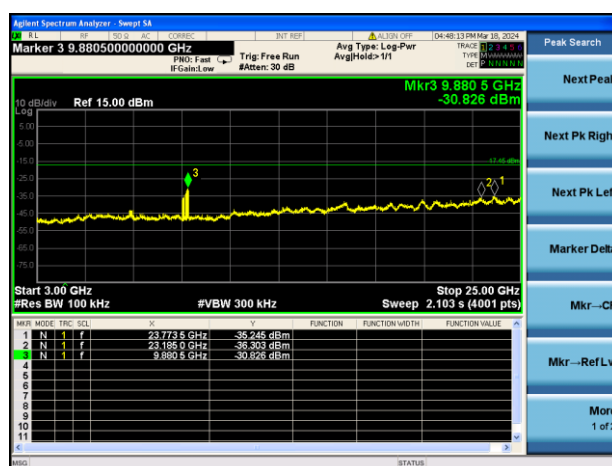
GFSK HOPPING, CARRIER LEVEL



GFSK HOPPING BAND EDGE (LOW)



GFSK HOPPING BAND EDGE (HIGH)

GFSK Hopping Mode, SPURIOUS
30 MHz ~ 3 GHzGFSK Hopping Mode, SPURIOUS
3GHz ~ 25 GHz

A.7 Conducted Emissions

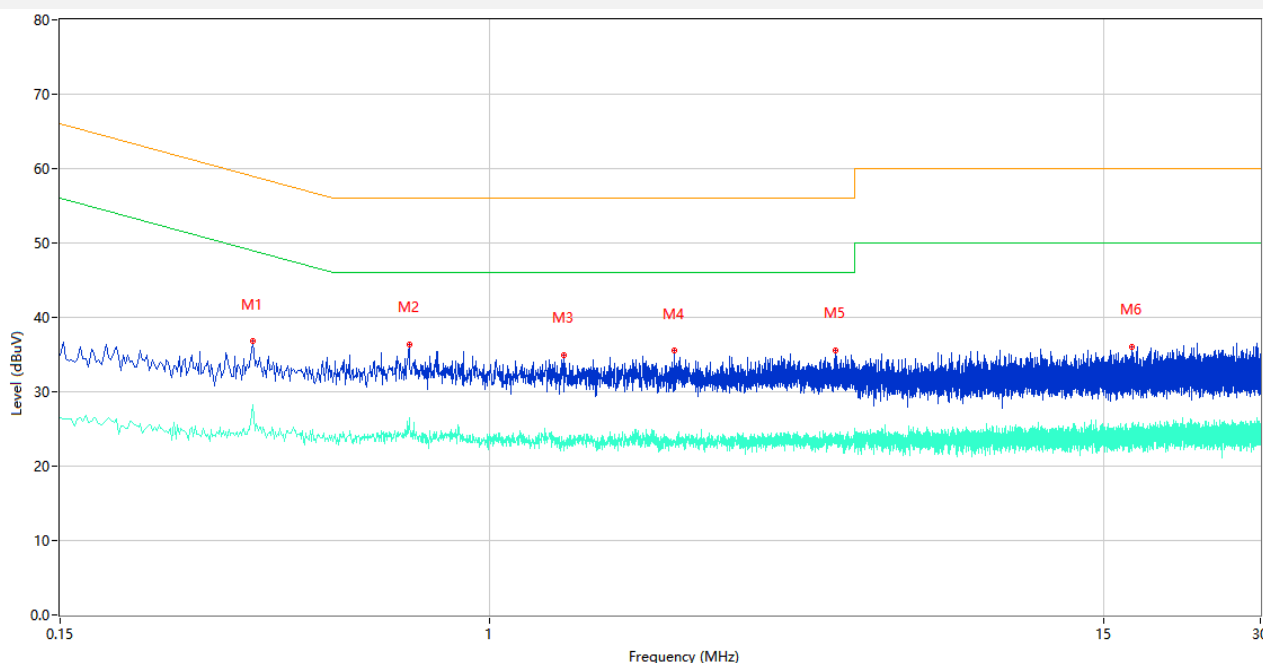
Note¹: The EUT is working in the Normal link mode. All modes have been tested and normal link mode is worst.

Note²: 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.

Note³: Results (dBuV) = Original reading level of Spectrum Analyzer (dBuV) + Factor (dB)

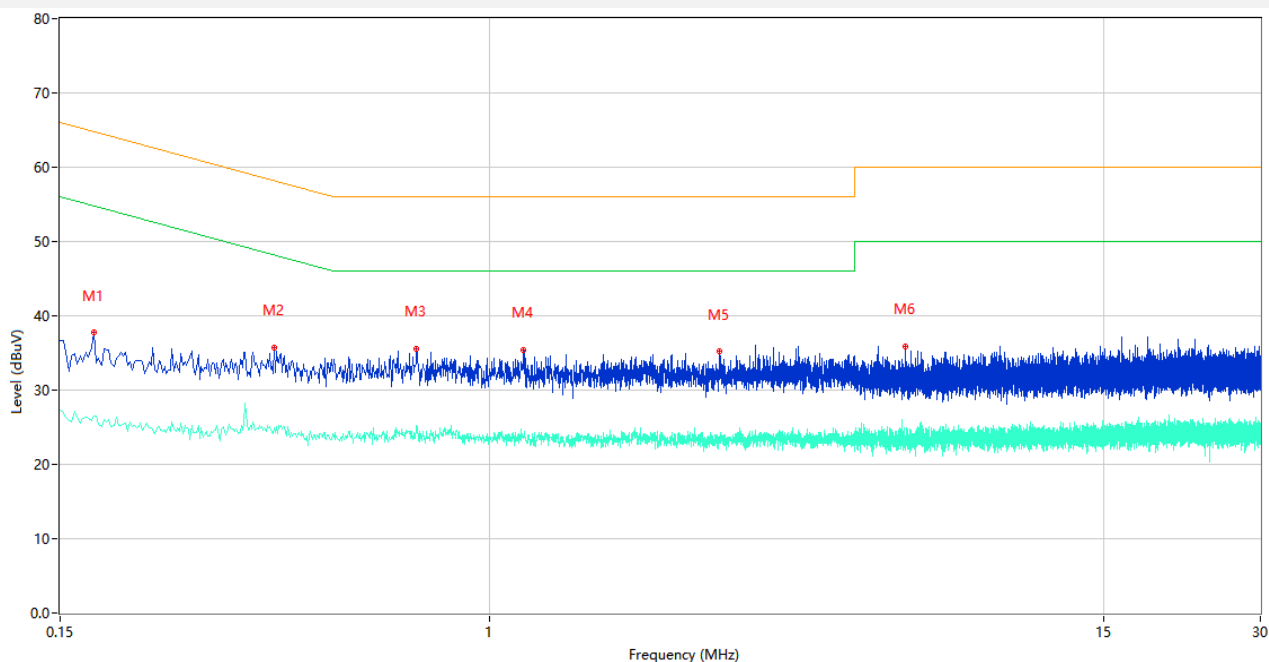
Test Data and Plots

PHASE L



No.	Frequency (MHz)	Results (dBuV)	Factor (dB)	Limit (dBuV)	Margin (dB)	Detector	Line	Verdict
1	0.352	36.76	10.75	58.92	22.16	Peak	L	Pass
1**	0.352	28.20	10.75	48.92	20.72	AV	L	Pass
2	0.700	36.42	10.65	56.00	19.58	Peak	L	Pass
2**	0.700	26.53	10.65	46.00	19.47	AV	L	Pass
3	1.388	34.96	9.79	56.00	21.04	Peak	L	Pass
3**	1.388	23.50	9.79	46.00	22.50	AV	L	Pass
4	2.256	35.52	10.13	56.00	20.48	Peak	L	Pass
4**	2.256	23.47	10.13	46.00	22.53	AV	L	Pass
5	4.596	35.59	10.57	56.00	20.41	Peak	L	Pass
5**	4.596	23.68	10.57	46.00	22.32	AV	L	Pass
6	17.050	36.04	10.72	60.00	23.96	Peak	L	Pass
6**	17.050	24.66	10.72	50.00	25.34	AV	L	Pass
6**	22.814	30.75	10.85	50.00	19.25	AV	L	Pass

PHASE N



No.	Frequency (MHz)	Results (dBuV)	Factor (dB)	Limit (dBuV)	Margin (dB)	Detector	Line	Verdict
1	0.174	37.73	9.78	64.77	27.04	Peak	N	Pass
1**	0.174	26.57	9.78	54.77	28.20	AV	N	Pass
2	0.386	35.74	10.61	58.15	22.41	Peak	N	Pass
2**	0.386	24.89	10.61	48.15	23.26	AV	N	Pass
3	0.724	35.57	10.42	56.00	20.43	Peak	N	Pass
3**	0.724	25.30	10.42	46.00	20.70	AV	N	Pass
4	1.160	35.44	10.29	56.00	20.56	Peak	N	Pass
4**	1.160	23.56	10.29	46.00	22.44	AV	N	Pass
5	2.754	35.17	10.20	56.00	20.83	Peak	N	Pass
5**	2.754	23.85	10.20	46.00	22.15	AV	N	Pass
6	6.250	35.92	9.94	60.00	24.08	Peak	N	Pass
6**	6.250	23.09	9.94	50.00	26.91	AV	N	Pass

A.8 Radiated Spurious 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.

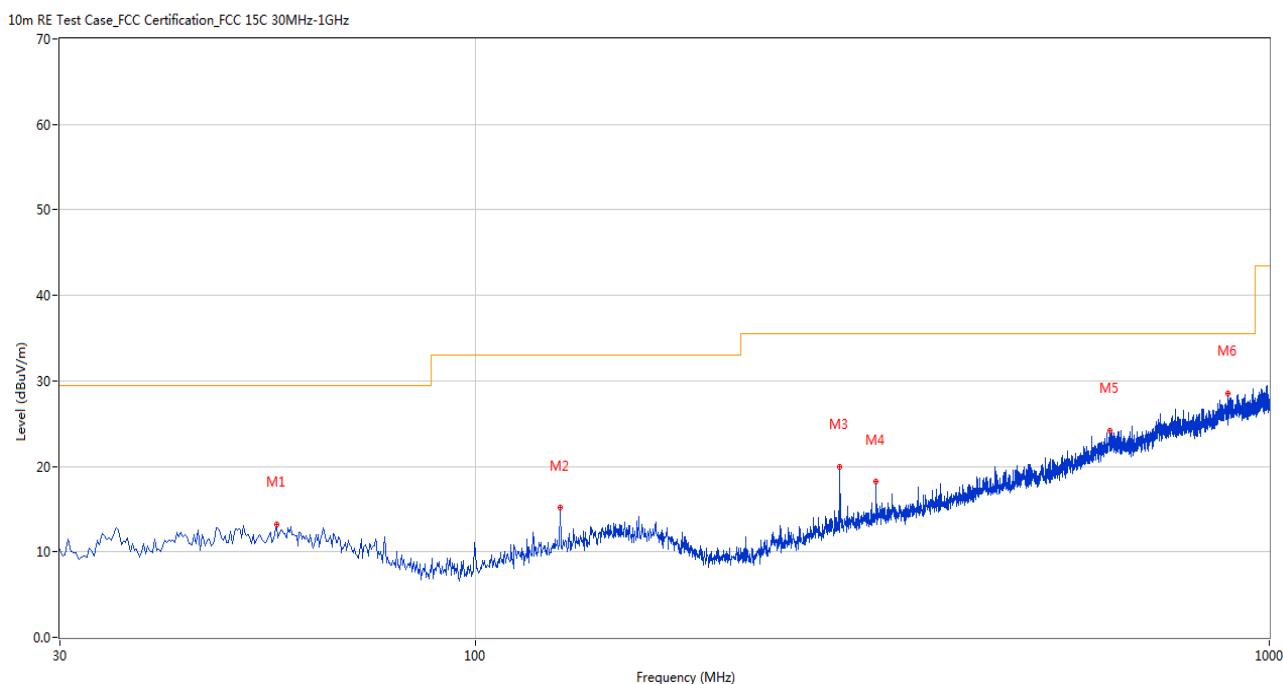
Note ³: The EUT is working in the Normal link mode below 1 GHz. All modes have been tested and DH5-Hopping mode is the worst.

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

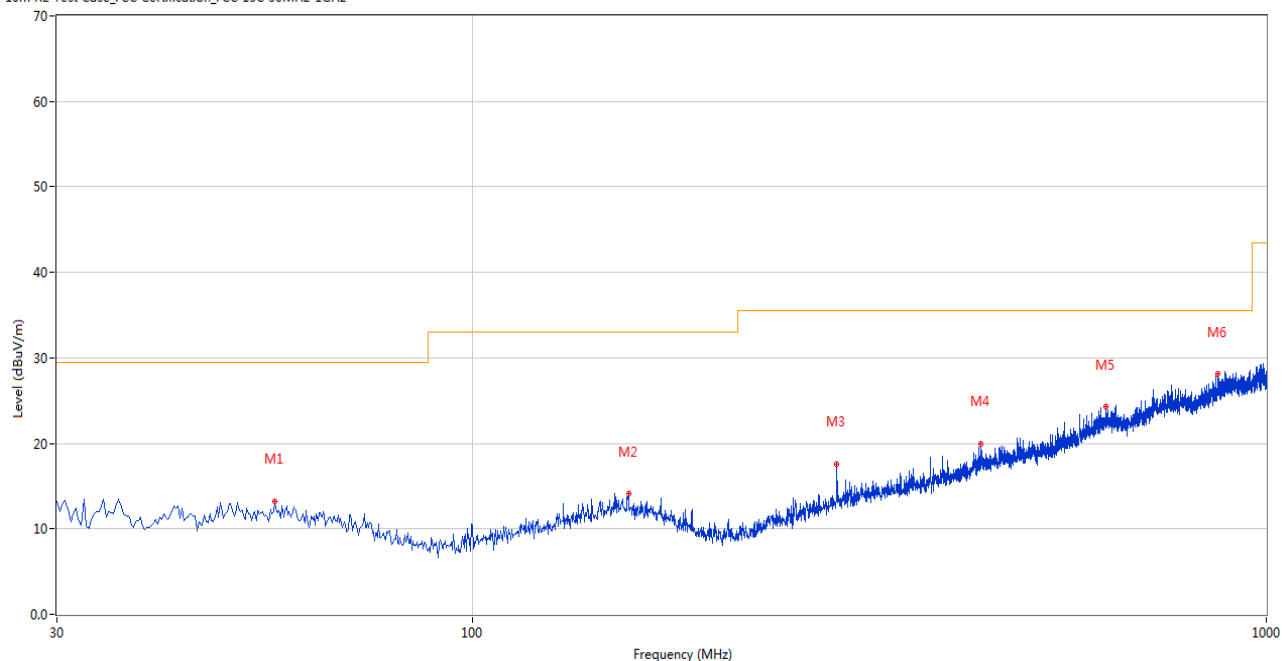
30 MHz to 1 GHz, ANT H



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	56.183	13.22	-26.19	29.5	16.28	Peak	25.00	100	Horizontal	Pass
2	127.946	15.14	-27.49	33.0	17.86	Peak	13.00	100	Horizontal	Pass
3	287.956	19.97	-25.01	35.5	15.53	Peak	353.00	200	Horizontal	Pass
4	319.958	18.17	-24.11	35.5	17.33	Peak	360.00	200	Horizontal	Pass
5	630.765	24.23	-15.89	35.5	11.27	Peak	177.00	200	Horizontal	Pass
6	886.538	28.48	-11.41	35.5	7.02	Peak	137.00	100	Horizontal	Pass

30 MHz to 1 GHz, ANT V

10m RE Test Case_FCC Certification_FCC 15C 30MHz-1GHz



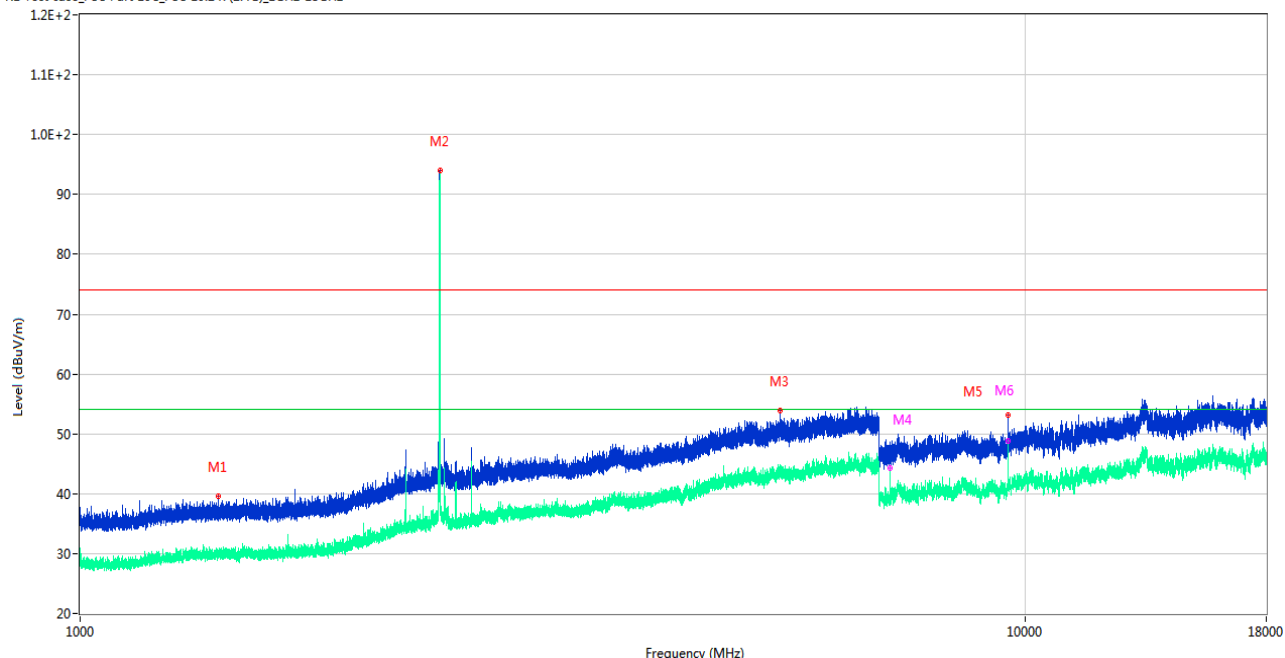
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	56.426	13.22	-26.21	29.5	16.28	Peak	146.00	100	Vertical	Pass
2	157.281	14.07	-25.85	33.0	18.93	Peak	360.00	200	Vertical	Pass
3	287.956	17.52	-25.01	35.5	17.98	Peak	44.00	100	Vertical	Pass
4	437.541	19.93	-20.89	35.5	15.57	Peak	298.00	200	Vertical	Pass
5	628.098	24.25	-15.99	35.5	11.25	Peak	270.00	100	Vertical	Pass
6	869.083	28.13	-11.32	35.5	7.37	Peak	99.00	200	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

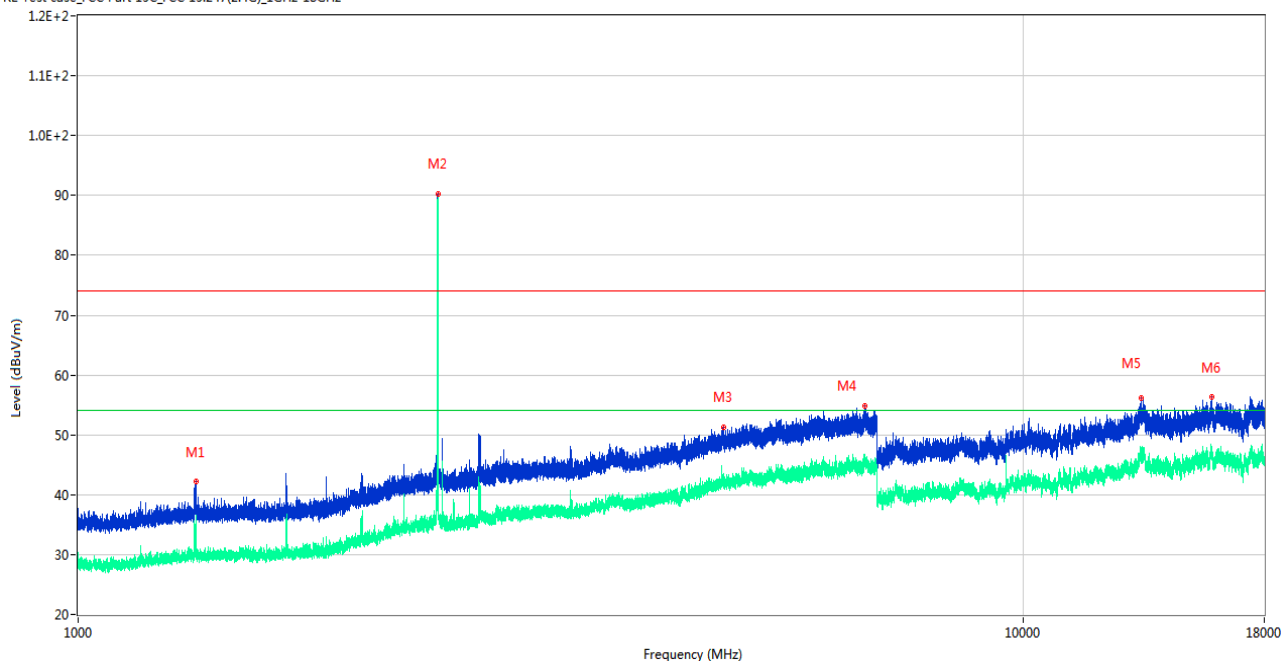
RE Test case_FCC Part 15C_FCC 15.247(2.4G)_1GHz-18GHz



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1400.600	39.57	-17.16	74.0	34.43	Peak	58.00	100	Horizontal	Pass
1**	1400.600	29.75	-17.16	54.0	24.25	AV	58.00	100	Horizontal	Pass
2	2402.200	93.99	-9.74	74.0	-19.99	Peak	227.00	200	Horizontal	N/A
2**	2402.200	93.62	-9.74	54.0	-39.62	AV	227.00	200	Horizontal	N/A
3	5506.800	53.83	-0.98	74.0	20.17	Peak	360.00	150	Horizontal	Pass
3**	5506.800	44.43	-0.98	54.0	9.57	AV	360.00	150	Horizontal	Pass
4	7200.388	48.28	-3.55	74.0	25.72	Peak	360.00	150	Horizontal	Pass
4**	7200.388	44.28	-3.55	54.0	9.72	AV	360.00	150	Horizontal	Pass
5	9602.162	53.13	0.03	74.0	20.87	Peak	0.00	150	Horizontal	Pass
5**	9602.162	47.65	0.03	54.0	6.35	AV	0.00	150	Horizontal	Pass
6	9602.450	51.25	0.03	74.0	22.75	Peak	360.00	150	Horizontal	Pass
6**	9602.450	48.82	0.03	54.0	5.18	AV	360.00	150	Horizontal	Pass

GFSK LOW CHANNEL 1 GHz to 18 GHz, ANT V

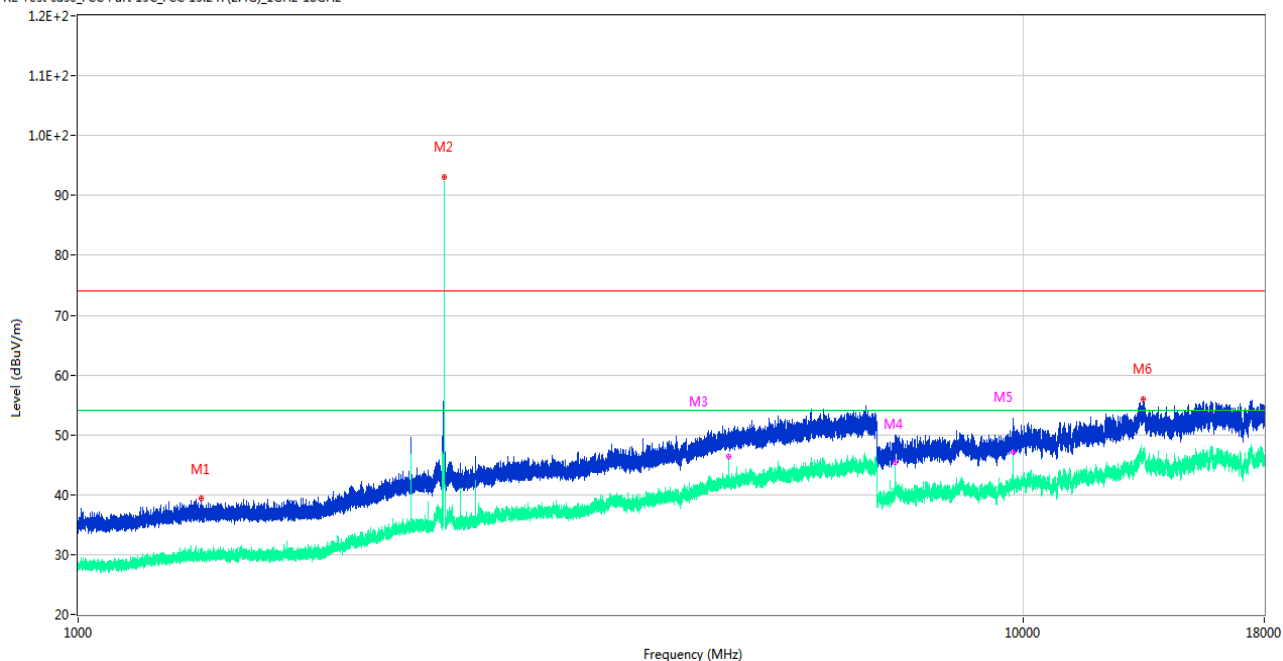
RE Test case_FCC Part 15C_FCC 15.247(2.4G)_1GHz-18GHz



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1332.400	42.20	-17.12	74.0	31.80	Peak	147.00	300	Vertical	Pass
1**	1332.400	36.61	-17.12	54.0	17.39	AV	147.00	300	Vertical	Pass
2	2401.900	90.26	-9.75	74.0	-16.26	Peak	208.00	200	Vertical	N/A
2**	2401.900	90.02	-9.75	54.0	-36.02	AV	208.00	200	Vertical	N/A
3	4823.800	51.28	-1.95	74.0	22.72	Peak	54.00	150	Vertical	Pass
3**	4823.800	41.60	-1.95	54.0	12.40	AV	54.00	150	Vertical	Pass
4	6807.200	54.87	2.09	74.0	19.13	Peak	306.00	400	Vertical	Pass
4**	6807.200	46.48	2.09	54.0	7.52	AV	306.00	400	Vertical	Pass
5	13322.250	56.06	0.91	74.0	17.94	Peak	175.00	150	Vertical	Pass
5**	13322.250	46.55	0.91	54.0	7.45	AV	175.00	150	Vertical	Pass
6	15840.151	56.33	1.44	74.0	17.67	Peak	56.00	400	Vertical	Pass
6**	15840.151	46.45	1.44	54.0	7.55	AV	56.00	400	Vertical	Pass

GFSK MIDDLE CHANNEL 1 GHz to 18 GHz, ANT H

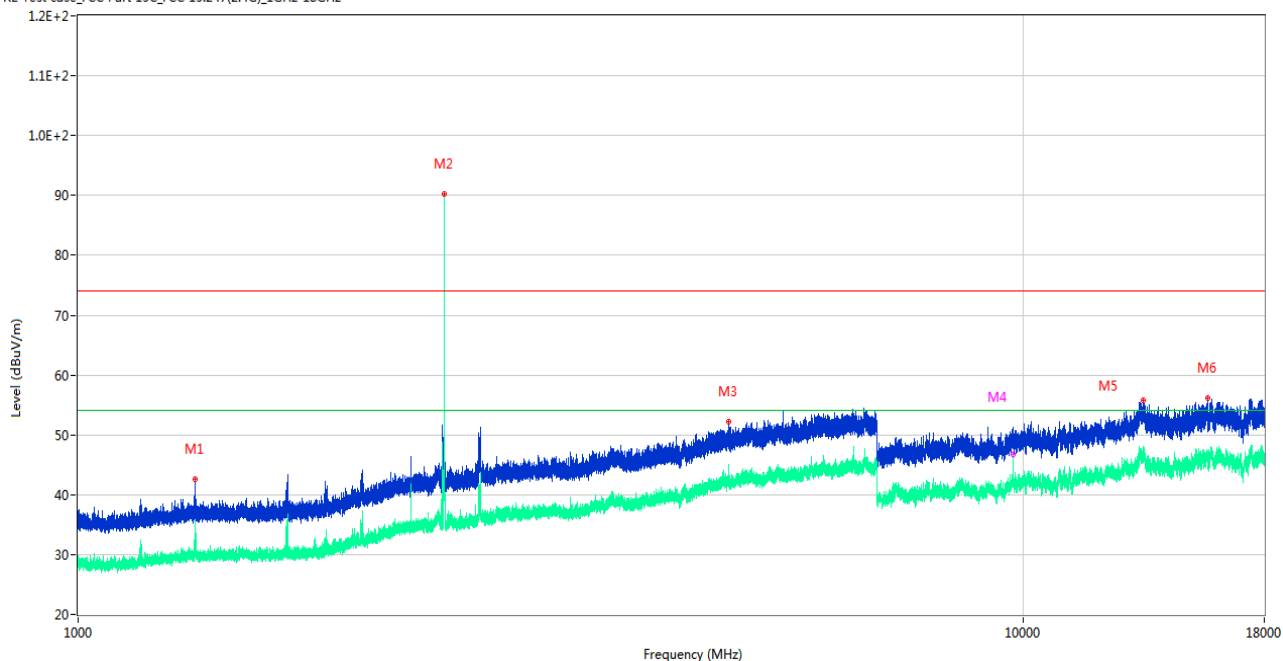
RE Test case_FCC Part 15C_FCC 15.247(2.4G)_1GHz-18GHz



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1350.100	39.36	-17.02	74.0	34.64	Peak	16.00	300	Horizontal	Pass
1**	1350.100	29.94	-17.02	54.0	24.06	AV	16.00	300	Horizontal	Pass
2	2440.900	93.07	-12.38	74.0	-19.07	Peak	89.00	200	Horizontal	N/A
2**	2440.900	92.68	-12.38	54.0	-38.68	AV	89.00	200	Horizontal	N/A
3	4879.600	49.68	-2.71	74.0	24.32	Peak	21.00	150	Horizontal	Pass
3**	4879.600	46.40	-2.71	54.0	7.60	AV	21.00	150	Horizontal	Pass
4	7317.400	49.19	-3.21	74.0	24.81	Peak	173.00	150	Horizontal	Pass
4**	7317.400	45.47	-3.21	54.0	8.53	AV	173.00	150	Horizontal	Pass
5	9758.562	51.41	-0.39	74.0	22.59	Peak	0.00	150	Horizontal	Pass
5**	9758.562	47.08	-0.39	54.0	6.92	AV	0.00	150	Horizontal	Pass
6	13388.925	56.02	0.67	74.0	17.98	Peak	100.00	200	Horizontal	Pass
6**	13388.925	45.74	0.67	54.0	8.26	AV	100.00	200	Horizontal	Pass

GFSK MIDDLE CHANNEL 1 GHz to 18 GHz, ANT V

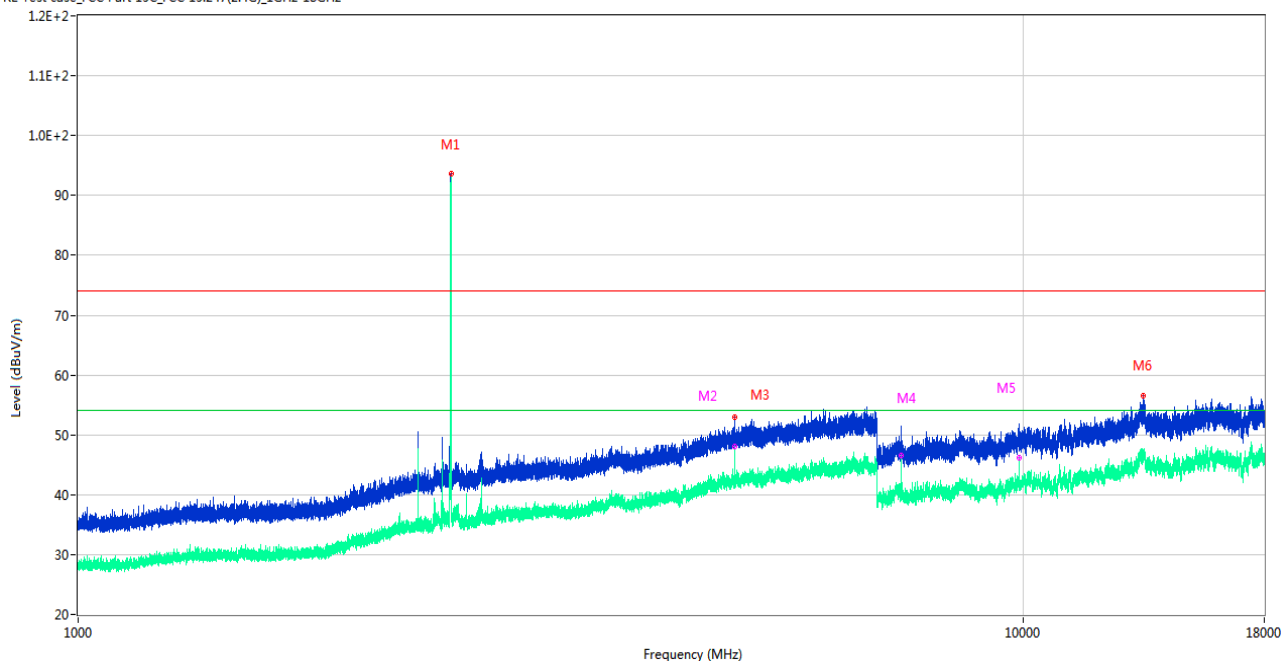
RE Test case_FCC Part 15C_FCC 15.247(2.4G)_1GHz-18GHz



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1331.200	42.67	-17.03	74.0	31.33	Peak	142.00	300	Vertical	Pass
1**	1331.200	35.63	-17.03	54.0	18.37	AV	142.00	300	Vertical	Pass
2	2440.900	90.24	-12.38	74.0	-16.24	Peak	210.00	200	Vertical	N/A
2**	2440.900	89.56	-12.38	54.0	-35.56	AV	210.00	200	Vertical	N/A
3	4878.800	52.25	-2.72	74.0	21.75	Peak	202.00	150	Vertical	Pass
3**	4878.800	43.68	-2.72	54.0	10.32	AV	202.00	150	Vertical	Pass
4	9758.276	51.18	-0.39	74.0	22.82	Peak	224.00	150	Vertical	Pass
4**	9758.276	46.73	-0.39	54.0	7.27	AV	224.00	150	Vertical	Pass
5	13410.713	55.73	0.49	74.0	18.27	Peak	25.00	150	Vertical	Pass
5**	13410.713	46.74	0.49	54.0	7.26	AV	25.00	150	Vertical	Pass
6	15667.425	56.25	1.38	74.0	17.75	Peak	298.00	300	Vertical	Pass
6**	15667.425	46.43	1.38	54.0	7.57	AV	298.00	300	Vertical	Pass

GFSK HIGH CHANNEL 1 GHz to 18 GHz, ANT H

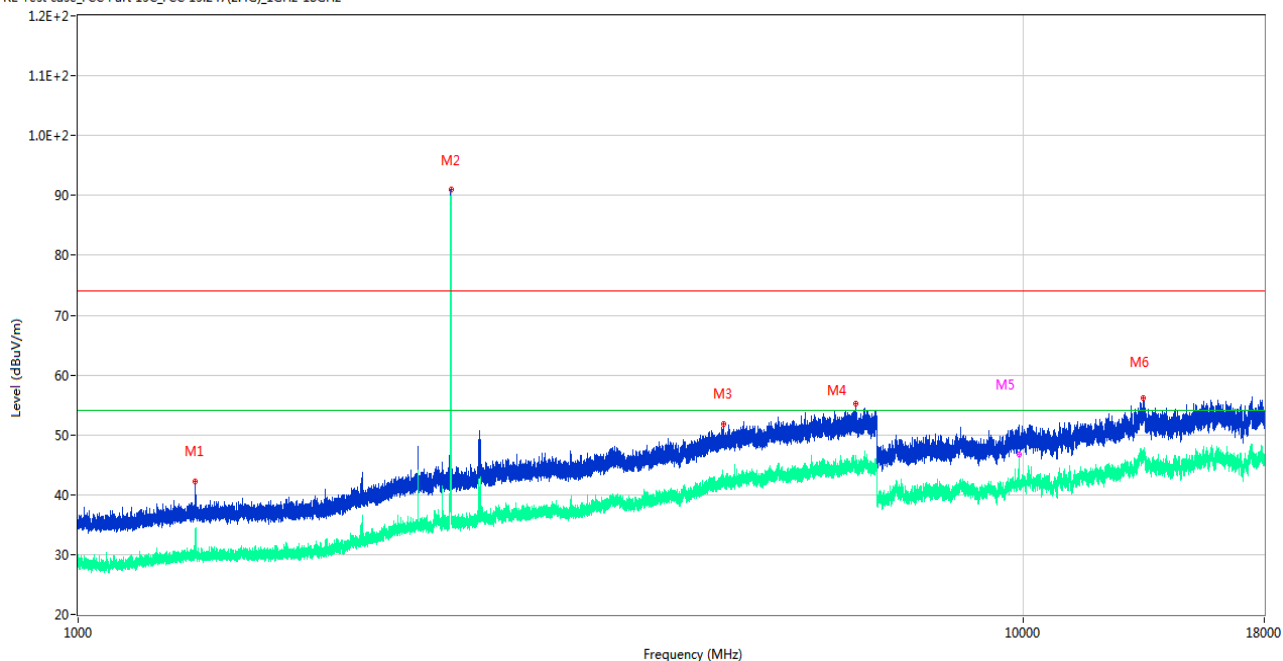
RE Test case_FCC Part 15C_FCC 15.247(2.4G)_1GHz-18GHz



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2479.900	93.60	-11.32	74.0	-19.60	Peak	79.00	150	Horizontal	N/A
1**	2479.900	92.75	-11.32	54.0	-38.75	AV	79.00	150	Horizontal	N/A
2	4957.200	52.75	-2.48	74.0	21.25	Peak	63.00	150	Horizontal	Pass
2**	4957.200	48.01	-2.48	54.0	5.99	AV	63.00	150	Horizontal	Pass
3	4957.400	52.87	-2.45	74.0	21.13	Peak	40.00	200	Horizontal	Pass
3**	4957.400	47.29	-2.45	54.0	6.71	AV	40.00	200	Horizontal	Pass
4	7434.125	50.78	-3.39	74.0	23.22	Peak	345.00	150	Horizontal	Pass
4**	7434.125	46.61	-3.39	54.0	7.39	AV	345.00	150	Horizontal	Pass
5	9914.387	50.15	-0.99	74.0	23.85	Peak	360.00	150	Horizontal	Pass
5**	9914.387	46.24	-0.99	54.0	7.76	AV	360.00	150	Horizontal	Pass
6	13394.962	56.57	0.63	74.0	17.43	Peak	104.00	400	Horizontal	Pass
6**	13394.962	46.59	0.63	54.0	7.41	AV	104.00	400	Horizontal	Pass

GFSK HIGH CHANNEL 1 GHz to 18 GHz, ANT V

RE Test case_FCC Part 15C_FCC 15.247(2.4G)_1GHz-18GHz



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1329.700	42.24	-17.02	74.0	31.76	Peak	360.00	100	Vertical	Pass
1**	1329.700	34.31	-17.02	54.0	19.69	AV	360.00	100	Vertical	Pass
2	2479.900	90.94	-11.32	74.0	-16.94	Peak	34.00	150	Vertical	N/A
2**	2479.900	90.10	-11.32	54.0	-36.10	AV	34.00	150	Vertical	N/A
3	4824.400	51.91	-2.10	74.0	22.09	Peak	44.00	200	Vertical	Pass
3**	4824.400	41.91	-2.10	54.0	12.09	AV	44.00	200	Vertical	Pass
4	6656.600	55.26	-0.11	74.0	18.74	Peak	360.00	100	Vertical	Pass
4**	6656.600	44.95	-0.11	54.0	9.05	AV	360.00	100	Vertical	Pass
5	9914.387	51.56	-0.99	74.0	22.44	Peak	51.00	150	Vertical	Pass
5**	9914.387	46.72	-0.99	54.0	7.28	AV	51.00	150	Vertical	Pass
6	13414.912	56.13	0.42	74.0	17.87	Peak	0.00	150	Vertical	Pass
6**	13414.912	46.30	0.42	54.0	7.70	AV	0.00	150	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.

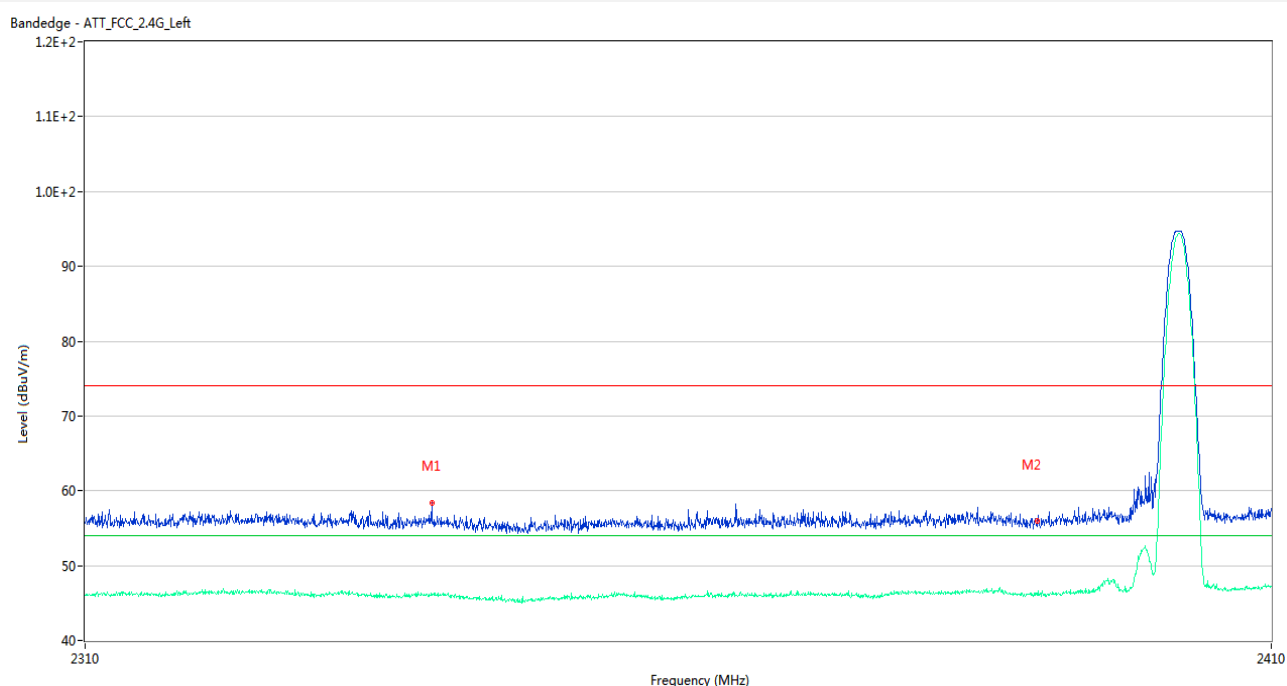
Note ²: The test data all are tested in the vertical and horizontal antenna which the trace is max hold. So these plots have shown the worst case.

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 and Plots

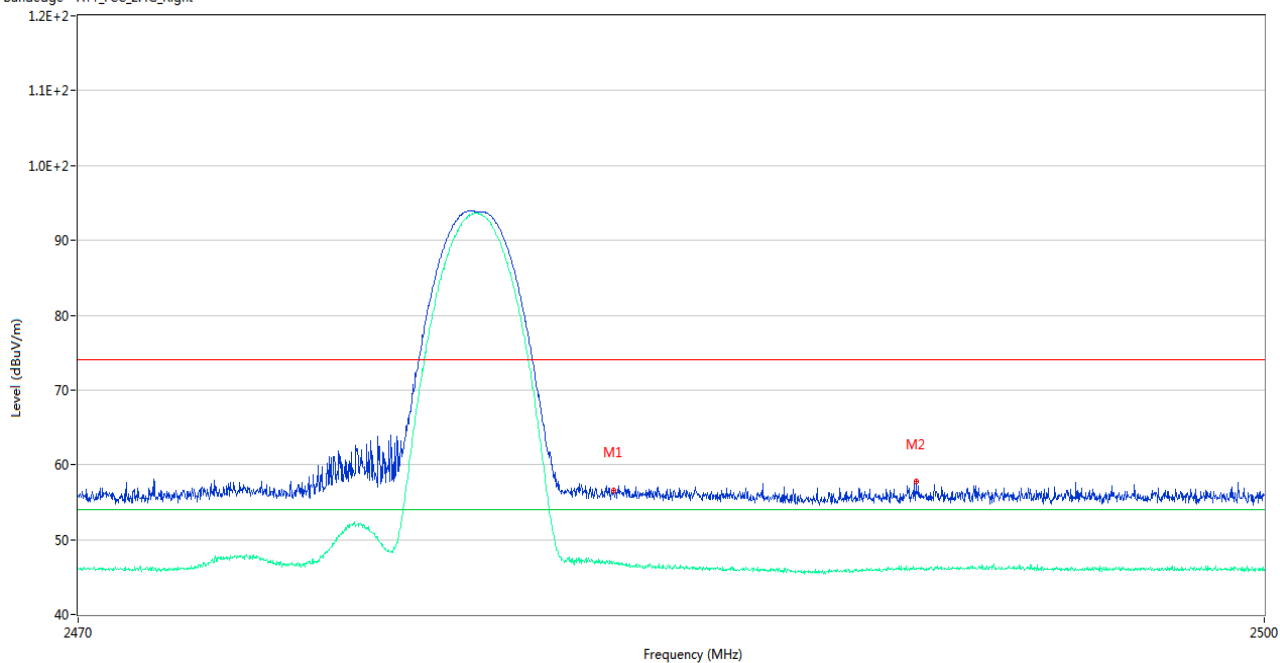
GFSK LOW CHANNEL



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2338.800	58.37	1.33	74.0	15.63	Peak	291.00	150	Horizontal	Pass
1**	2338.800	45.98	1.33	54.0	8.02	AV	291.00	150	Horizontal	Pass
2	2389.950	56.00	1.92	74.0	18.00	Peak	213.00	150	Horizontal	Pass
2**	2389.950	46.33	1.92	54.0	7.67	AV	213.00	150	Horizontal	Pass

GFSK HIGH CHANNEL

Bandedge - ATT_FCC_2.4G_Right



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2483.500	56.64	2.11	74.0	17.36	Peak	87.00	150	Horizontal	Pass
1**	2483.500	47.05	2.11	54.0	6.95	AV	87.00	150	Horizontal	Pass
2	2491.150	57.71	1.84	74.0	16.29	Peak	164.00	150	Horizontal	Pass
2**	2491.150	46.11	1.84	54.0	7.89	AV	164.00	150	Horizontal	Pass

ANNEX B TEST SETUP PHOTOS

Please refer the document “BL-SZ23C1088-AR.PDF”.

ANNEX C EUT EXTERNAL PHOTOS

Please refer the document “BL-SZ23C1088-AW.PDF”.

ANNEX D EUT INTERNAL PHOTOS

Please refer the document “BL-SZ23C1088-AI.PDF”.

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--END OF REPORT--