FCC Part 15C
Measurement and Test Report

For

Suzhou Hartioning Electronics Tech Co., Ltd.

FCC ID: 2ASIQ-BONELF-X

FCC Rule(s):	FCC Part 15.249
Product Description:	Wireless Headphone
Tested Model:	BonELF X
Report No.:	BSL11137502RF
Tested Date:	January 18-19, 2019
Issued Date:	January 19, 2019
Tested By:	Messi Wang/ Engineer
Reviewed By:	Steven Wen/ EMC Manager
Approved & Authorized By:	Jandy So / PSQ Manager
Prepared By:	

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TABLE OF CONTENTS

1. GENERAL INFORMATION.....3
1.1 PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT).....3
1.2 TEST STANDARDS.....4
1.3 TEST METHODOLOGY.....4
1.4 TEST FACILITY.....4
1.5 EUT SETUP AND TEST MODE.....5
1.6 MEASUREMENT UNCERTAINTY.....6
1.7 TEST EQUIPMENT LIST AND DETAILS.....7
2. SUMMARY OF TEST RESULTS.....8
3. ANTENNA REQUIREMENTS.....9
3.1 STANDARD APPLICABLE.....9
3.2 TEST RESULT.....9
4. RADIATED EMISSIONS.....10
4.1 STANDARD APPLICABLE.....10
4.2 TEST PROCEDURE.....10
4.3 CORRECTED AMPLITUDE & MARGIN CALCULATION.....12
4.4 ENVIRONMENTAL CONDITIONS.....12
4.5 SUMMARY OF TEST RESULTS/PLOTS.....12
5. OUT OF BAND EMISSIONS.....17
5.1 STANDARD APPLICABLE.....17
5.2 TEST PROCEDURE.....17
5.3 ENVIRONMENTAL CONDITIONS.....17
5.4 SUMMARY OF TEST RESULTS/PLOTS.....17
6. EMISSION BANDWIDTH.....18
6.1 STANDARD APPLICABLE.....18
6.2 TEST PROCEDURE.....18
6.3 ENVIRONMENTAL CONDITIONS.....18
6.4 SUMMARY OF TEST RESULTS/PLOTS.....19
7. CONDUCTED EMISSIONS.....25
7.1 TEST PROCEDURE.....25
7.2 BASIC TEST SETUP BLOCK DIAGRAM.....25
7.3 ENVIRONMENTAL CONDITIONS.....25
7.4 TEST RECEIVER SETUP.....26
7.5 SUMMARY OF TEST RESULTS/PLOTS.....26
7.6 CONDUCTED EMISSIONS TEST DATA.....26

1. GENERAL INFORMATION

1.1 Product Description for Equipment Under Test (EUT)

Client Information

Applicant:	Suzhou Hartioning Electronics Tech Co., Ltd.
Address of applicant:	Rm. 627, Building 99, No. 999 Xinghu Street, Industrial Park, Suzhou, China
Manufacturer:	Suzhou Hartioning Electronics Tech Co., Ltd.
Address of manufacturer:	Rm. 627, Building 99, No. 999 Xinghu Street, Industrial Park, Suzhou, China

General Description of EUT	
Product Name:	Wireless Headphone
Trade Name:	AMA Audio
Model No.:	BonELF X
Adding Model(s):	N/A
Rated Voltage:	DC 5V from adapter or 3.7V from battery
Power Adapter Model:	N/A
Note: The test data is gathered from a production sample, provided by the manufacturer.	

Technical Characteristics of EUT	
Frequency Range:	2402-2480MHz
Max. Field Strength:	92.41dBuV/m@1.5m
Data Rate:	1Mbps, 2Mbps, 3Mbps
Modulation:	GFSK, Pi/4 QDPSK, 8DPSK
Quantity of Channels:	79
Channel Separation:	1MHz
Antenna Type:	Ceramic antenna
Antenna Gain:	0.6dBi
Lowest Internal Frequency of EUT:	26MHz

1.2 Test Standards

The following report is prepared on behalf of the Suzhou Hartioning Electronics Tech Co., Ltd. in accordance with FCC Part 15, Subpart B, Subpart C, and section 15.107, 15.203, 15.205, 15.207, 15.209 and 15.249 of the Federal Communication Commissions rules.

The objective is to determine compliance with FCC Part 15, Subpart C, and section 15.107,15.203, 15.205, 15.207, 15.209 and 15.249 of the Federal Communication Commissions rules.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product, which results in lowering the emission, should be checked to ensure compliance has been maintained.

1.3 Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard for Testing Unlicensed Wireless Devices, and ANSI C63.4-2014, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.

1.4 Test Facility

BSL Testing Co.,LTD.
NO. 24, ZH Park, Nantou, Shenzhen, 518000 China
Designation Number : CN1217
Test Firm Registration Number: 866035
Tel: 86- 755-26508703
Fax: 86- 755-26508703

1.5 EUT Setup and Test Mode

The EUT was operated in the engineering mode to fix the Tx frequency that was for the purpose of the measurements. All testing shall be performed under maximum output power condition, and to measure its highest possible emissions level, more detailed description as follows:

Test Mode List		
Test Mode	Description	Remark
TM1	Low Channel	2402MHz
TM2	Middle Channel	2441MHz
TM3	High Channel	2480MHz
TM4	Hopping	2402-2480MHz

Modulation Configure			
Modulation	Packet	Packet Type	Packet Size
GFSK	DH1	4	27
	DH3	11	183
	DH5	15	339
Pi/4 DQPSK	2DH1	20	54
	2DH3	26	367
	2DH5	30	679
8DPSK	3DH1	24	83
	3DH3	27	552
	3DH5	31	1021
Normal mode: the Bluetooth has been tested on the modulation of GFSK, (Pi/4)DQPSK and 8DPSK, compliance test and record the worst case.			

Special Cable List and Details			
Cable Description	Length (m)	Shielded/Unshielded	With / Without Ferrite
USB Line	1.5m	Unshielded	Without Ferrite

Auxiliary Equipment List and Details			
Description	Manufacturer	Model	Serial Number
Notebook	Lenovo	E23	EB12648265
USB	ESR	S01	19682904994

1.6 Measurement Uncertainty

Measurement uncertainty		
Parameter	Conditions	Uncertainty
RF Output Power	Conducted	±0.42dB
Occupied Bandwidth	Conducted	±1.5%
Conducted Spurious Emission	Conducted	±2.17dB
Conducted Emissions	Conducted	±2.88dB
Transmitter Spurious Emissions	Radiated	±5.1dB

1.7 Test Equipment List and Details

Dscription	Manufacturer	Model	Serial No.	Cal Date	Due. Date
Communication Tester	Rohde & Schwarz	CMW500	100358	2018-11-08	2019-11-07
Spectrum Analyzer	R&S	FSP40	100550	2018-10-08	2019-10-07
Test Receiver	R&S	ESCI7	US47140102	2018-10-08	2019-10-07
Signal Generator	HP	83630B	3844A01028	2018-10-08	2019-10-07
Test Receiver	R&S	ESPI-3	100180	2018-10-08	2019-10-07
Amplifier	Agilent	8449B	4035A00116	2018-10-08	2019-10-07
Amplifier	HP	8447E	2945A02770	2018-10-08	2019-10-07
Signal Generator	IFR	2023A	202307/242	2018-10-08	2019-10-07
Broadband Antenna	SCHAFFNER	2774	2774	2018-10-21	2019-10-20
Biconical and log periodic antennas	ELECTRO-METRICS	EM-6917B-1	171	2018-10-21	2019-10-20
Horn Antenna	R&S	HF906	100253	2018-10-21	2019-10-20
Horn Antenna	EM	EM-6961	6462	2018-10-21	2019-10-20
LISN	R&S	ESH3-Z5	100196	2018-10-08	2019-10-07
LISN	COM-POWER	LI-115	02027	2018-10-08	2019-10-07
3m Semi-Anechoic Chamber	Chengyu Electron	9 (L)*6 (W)* 6 (H)	BSL086	2018-10-08	2019-10-07
Horn Antenna	Schwarzbeck	BBHA9170	00814	2018-10-21	2019-10-20
Loop Antenna	Schwarz beck	FMZB 1519B	9773	2018-10-21	2019-10-20

2. SUMMARY OF TEST RESULTS

FCC Rules	Description of Test Item	Result
§ 15.203	Antenna Requirement	PASS
§15.205	Restricted Band of Operation	PASS
§ 15.207(a)	Conducted Emission	PASS
§ 15.209(a)(f)	Radiated Spurious Emissions	PASS
§15.249(a)	Field Strength of Emissions	PASS
§15.249(d)	Out of Band Emission	PASS
§15.215 (c)	Emission Bandwidth	PASS

Note: PASS: applicable, N/A: not applicable.

3. Antenna Requirements

3.1 Standard Applicable

According to FCC Part 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.

3.2 Test Result

This product has a Ceramic antenna, fulfill the requirement of this section.

4. Radiated Emissions

4.1 Standard Applicable

According to §15.249(a), the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

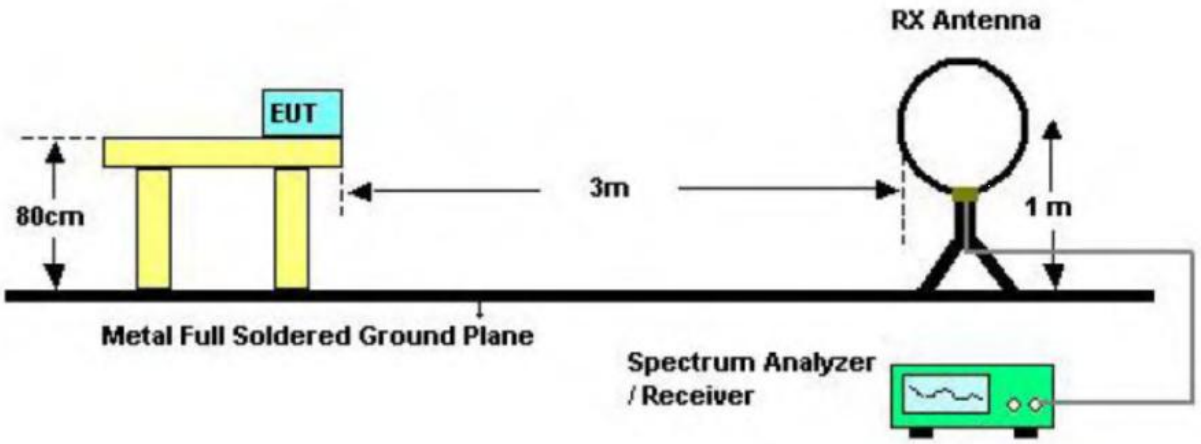
Fundamental Frequency	Field strength of fundamental (milli-volts/meter)	Field strength of Harmonics (micro-volts/meter)
902-928 MHz	50	500
2400-2483.5 MHz	50	500
5725-5875 MHz	50	500
24.0-24.25 GHz	250	2500

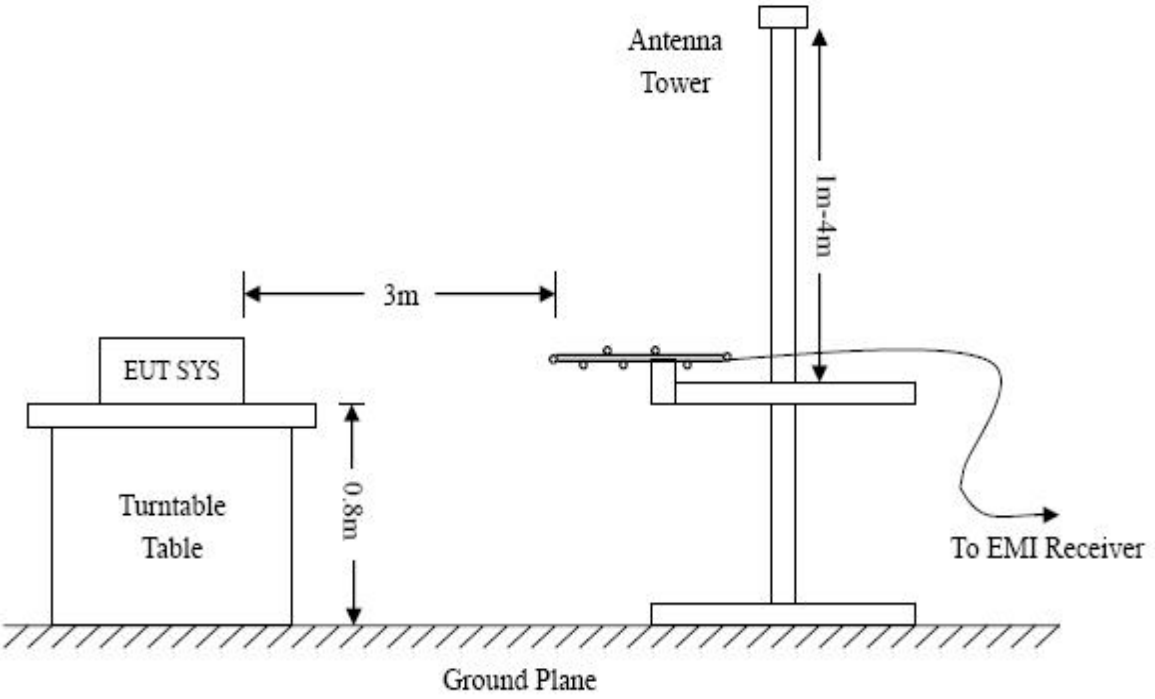
(d) Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

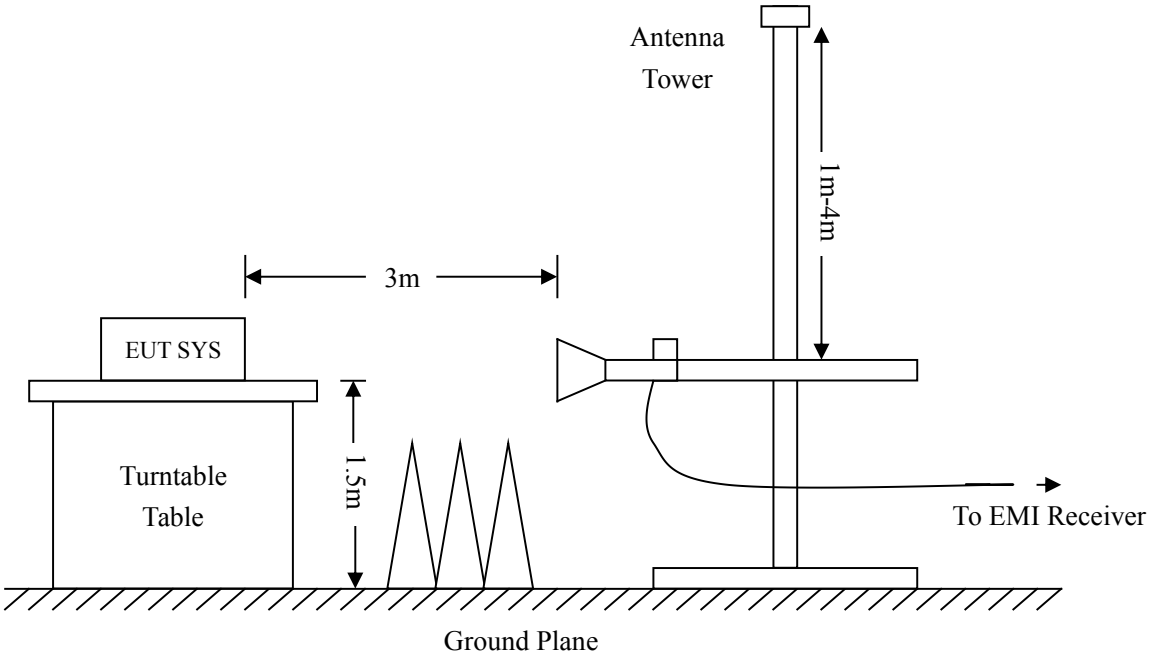
The emission limit in this paragraph is based on measurement instrumentation employing an average detector. The provisions in §15.35 for limiting peak emissions apply. Spurious Radiated Emissions measurements starting below or at the lowest crystal frequency.

4.2 Test Procedure

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.205 15.249(a) and FCC Part 15.209 Limit.
The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.
The spacing between the peripherals was 10 cm.







Frequency :9kHz-30MHz	Frequency :30MHz-1GHz	Frequency :Above 1GHz
RBW=10KHz,	RBW=120KHz,	RBW=1MHz,
VBW =30KHz	VBW=300KHz	VBW=3MHz(Peak), 10Hz(AV)
Sweep time= Auto	Sweep time= Auto	Sweep time= Auto
Trace = max hold	Trace = max hold	Trace = max hold
Detector function = peak	Detector function = peak, QP	Detector function = peak, AV

4.3 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and the Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

Corr. Ampl. = Indicated Reading + Ant. Factor + Cable Loss – Ampl. Gain

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -6dBμV means the emission is 6dBμV below the maximum limit. The equation for margin calculation is as follows:

Margin = Corr. Ampl. – FCC Part 15C Limit

4.4 Environmental Conditions

Temperature:	24 °C
Relative Humidity:	60 %
ATM Pressure:	1012 mbar

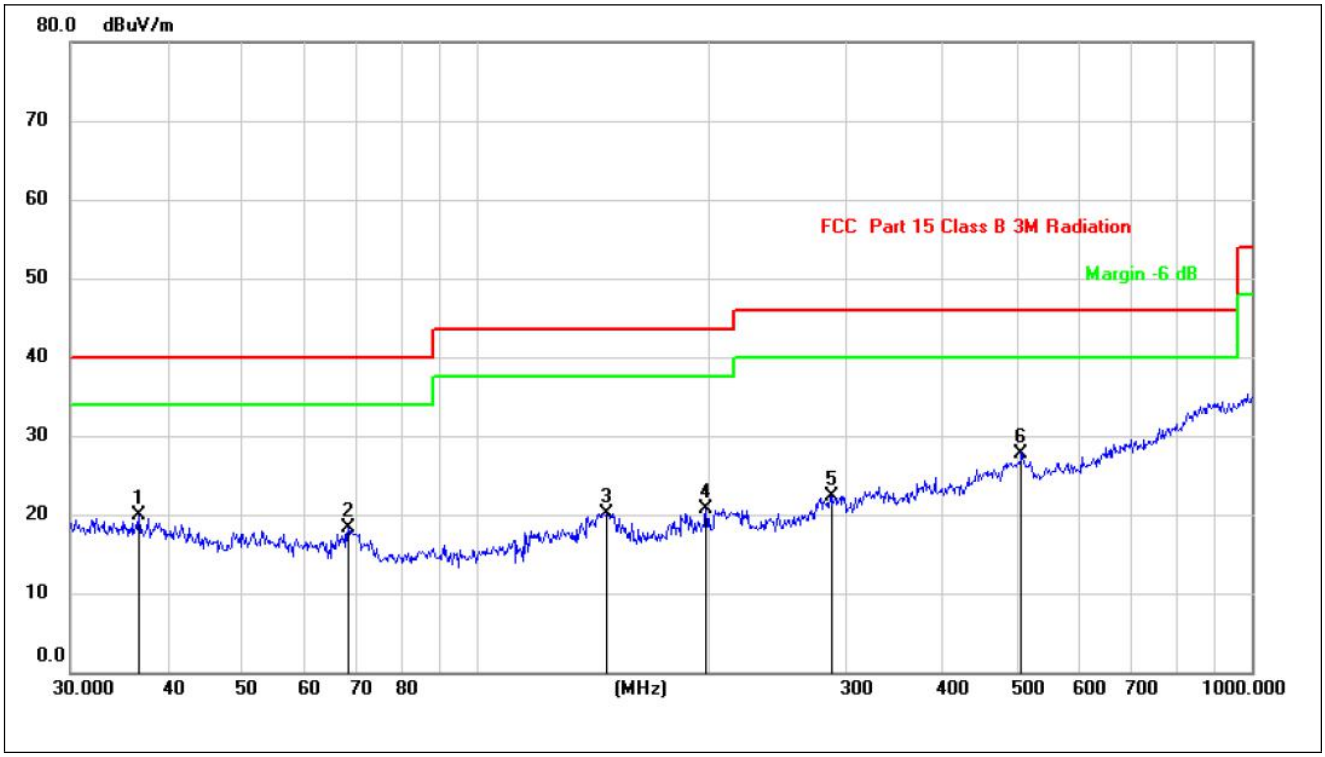
4.5 Summary of Test Results/Plots

According to the data below, the FCC Part 15.205, 15.209 and 15.249 standards, and had the worst cases.

Note:
1. Worst-case radiated emission below 1GHz is GFSK (CH High) mode.
2. Worst-case radiated emission above 1GHz is (Pi/4)DQPSK (CH Low, Middle, High) mode.

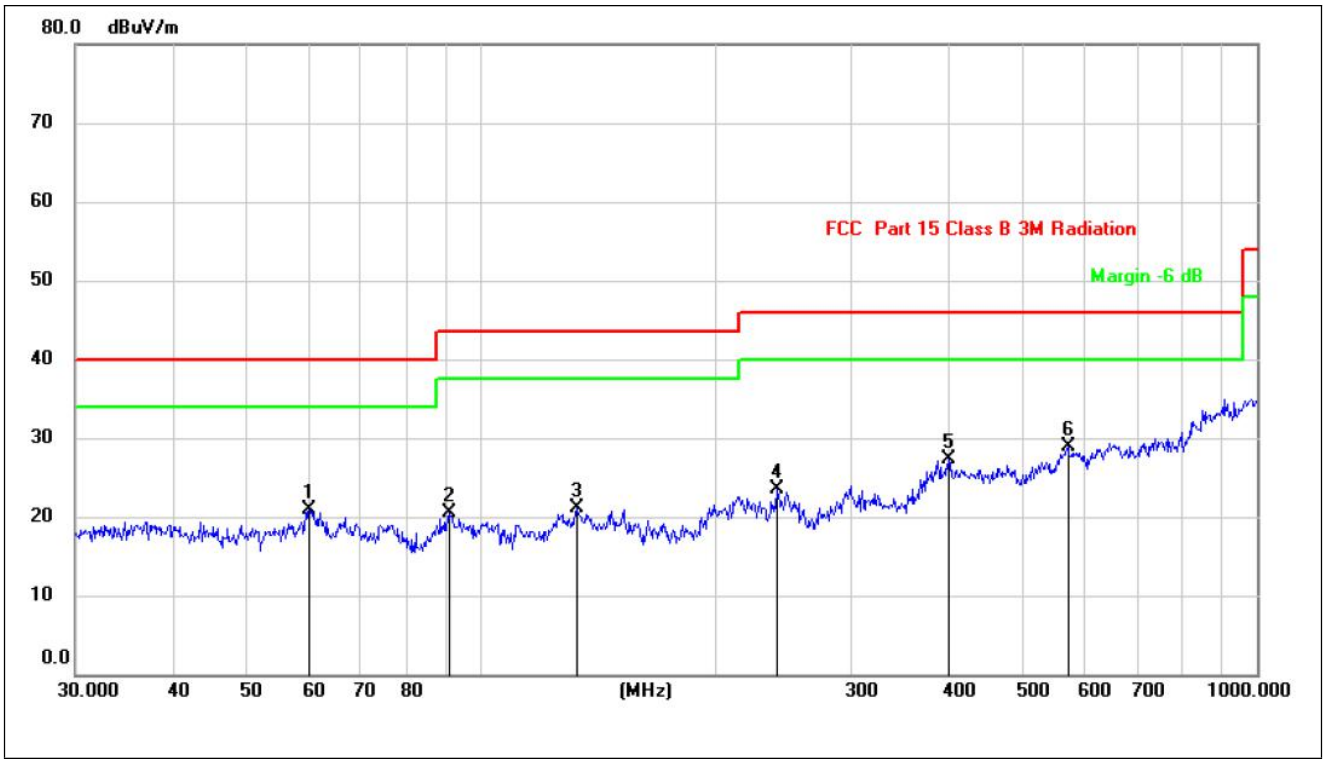
Plot of Radiated Emissions Test Data (30MHz to 1GHz): GFSK (CH High) mode:

Test Specification: Horizontal



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree
		MHz	dBuV	dBuV/m	dBuV/m	dBuV/m	dB	Detector	cm	degree
1		36.7661	15.18	4.77	19.95	40.00	-20.05	QP		
2		68.3906	17.22	1.10	18.32	40.00	-21.68	QP		
3		147.4036	17.21	2.98	20.19	43.50	-23.31	QP		
4		197.8926	17.54	3.17	20.71	43.50	-22.79	QP		
5		287.9904	15.54	6.69	22.23	46.00	-23.77	QP		
6	*	504.7062	16.86	10.94	27.80	46.00	-18.20	QP		

Test Specification: *Vertical*



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		Antenna Height	Table Degree
		MHz	dBuV	dBuV/m	dBuV/m	dBuV/m	dB	Detector	cm	degree
1		60.0690	19.17	1.66	20.83	40.00	-19.17	QP		
2		91.1745	19.47	0.95	20.42	43.50	-23.08	QP		
3		133.1511	17.59	3.48	21.07	43.50	-22.43	QP		
4		240.8303	19.27	4.19	23.46	46.00	-22.54	QP		
5		400.4318	17.68	9.61	27.29	46.00	-18.71	QP		
6	*	570.6100	17.23	11.70	28.93	46.00	-17.07	QP		

Spurious Emissions Above 1GHz :(Pi/4)DQPSK (CH Low, Middle, High) mode.

Frequency	Result	Limit	Margin	Polar	Detector
(MHz)	(dBuV/m)	(dBuV/m)	(dB)	H/V	
Low Channel-2402MHz					
2402	92.41	114	-21.59	H	PK
2402	78.52	94	-15.48	H	AV
4804	60.36	74	-13.64	H	PK
4804	49.25	54	-4.75	H	AV
7206	51.14	74	-22.86	H	PK
7206	39.25	54	-14.75	H	AV
2402	87.14	114	-26.86	V	PK
2402	78.63	94	-15.37	V	AV
4804	56.25	74	-17.75	V	PK
4804	41.24	54	-12.76	V	AV
7206	62.14	74	-11.86	V	PK
7206	38.85	54	-5.15	V	AV
Middle Channel-2441MHz					
2441	88.35	114	-25.65	H	PK
2441	79.25	94	-14.75	H	AV
4882	56.21	74	-17.79	H	PK
4882	47.45	54	-6.55	H	AV
7323	52.52	74	-21.48	H	PK
7323	45.36	54	-8.64	H	AV
2441	89.89	114	-24.11	V	PK
2441	77.41	94	-16.59	V	AV
4882	58.52	74	-15.48	V	PK
4882	42.14	54	-11.86	V	AV
7323	55.47	74	-18.53	V	PK
7323	40.63	54	-13.37	V	AV

Frequency	Result	Limit	Margin	Polar	Detector
(MHz)	(dBuV/m)	(dBuV/m)	(dB)	H/V	
Low Channel-2480MHz					
2480	88.36	114	-25.64	H	PK
2480	79.25	94	-14.75	H	AV
4960	62.14	74	-11.86	H	PK
4960	40.25	54	-13.75	H	AV
7440	51.94	74	-22.06	H	PK
7440	43.58	54	-10.42	H	AV
2480	88.63	114	-25.37	V	PK
2480	76.65	94	-17.35	V	AV
4960	52.84	74	-21.16	V	PK
4960	43.55	54	-10.45	V	AV
7440	48.96	74	-25.04	V	PK
7440	46.58	54	-7.42	V	AV

Note: Testing is carried out with frequency rang 9kHz to the tenth harmonics, which above 5th Harmonics are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.
The measurements greater than 20dB below the limit from 9kHz to 30MHz..

5. Out of Band Emissions

5.1 Standard Applicable

Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in §15.209, whichever is the lesser attenuation.

5.2 Test Procedure

As the radiation test, set the Lowest and Highest Transmitting Channel, observed the outside band of 2400MHz to 2483.5MHz, than mark the higher-level emission for comparing with the FCC rules.

5.3 Environmental Conditions

Temperature:	24 °C
Relative Humidity:	60 %
ATM Pressure:	1012 mbar

5.4 Summary of Test Results/Plots

Note: We pre-scan all mode, the worst data is DH1, 2DH1, 3DH1.

Modulation	Frequency	Measurement (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark	Result
GFSK	2390.00	49.25	74	-24.75	Peak Detector	PASS
	2400.00	51.14	74	-22.86	Peak Detector	PASS
	2483.50	50.63	74	-23.37	Peak Detector	PASS
	2488.39	48.84	74	-25.16	Peak Detector	PASS
Pi/4 DQPSK	2390.00	49.59	74	-24.41	Peak Detector	PASS
	2400.00	51.25	74	-22.75	Peak Detector	PASS
	2483.50	50.34	74	-23.66	Peak Detector	PASS
	2486.86	51.21	74	-22.79	Peak Detector	PASS
8DPSK	2390.00	50.23	74	-23.77	Peak Detector	PASS
	2400.00	49.21	74	-24.79	Peak Detector	PASS
	2483.50	52.49	74	-21.51	Peak Detector	PASS
	2496.47	50.63	74	-23.37	Peak Detector	PASS

The edge Emissions are below the FCC 15.209 Limits or complies with the 15.249 requirements.the Peak Detector is less than the limit,so the Average value is not required

6. Emission Bandwidth

6.1 Standard Applicable

According to 15.215 (c), intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

6.2 Test Procedure

According to the ANSI 63.10-2013, the emission bandwidth test method as follows.

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
Set span = 1MHz, centered on a transmitting channel
RBW ≥1% 20dB Bandwidth, VBW ≥RBW
Sweep = auto
Detector function = peak
Trace = max hold
All the trace to stabilize, use the marker-to-peak function to set the marker to the peak of the emission, use the marker-delta function to measure and record the 20dB down and 99% bandwidth of the emission.

6.3 Environmental Conditions

Temperature:	25 °C
Relative Humidity:	53%
ATM Pressure:	1018 mbar

6.4 Summary of Test Results/Plots

Worst mode: GFSK (DH1)

Channel	Frequency MHz	20dB Bandwidth kHz
Low Channel	2402	888
Middle Channel	2441	882
High Channel	2480	888

Worst mode: Pi/4 QDPSK (2DH1)

Channel	Frequency MHz	20dB Bandwidth kHz
Low Channel	2402	1128
Middle Channel	2441	1128
High Channel	2480	1128

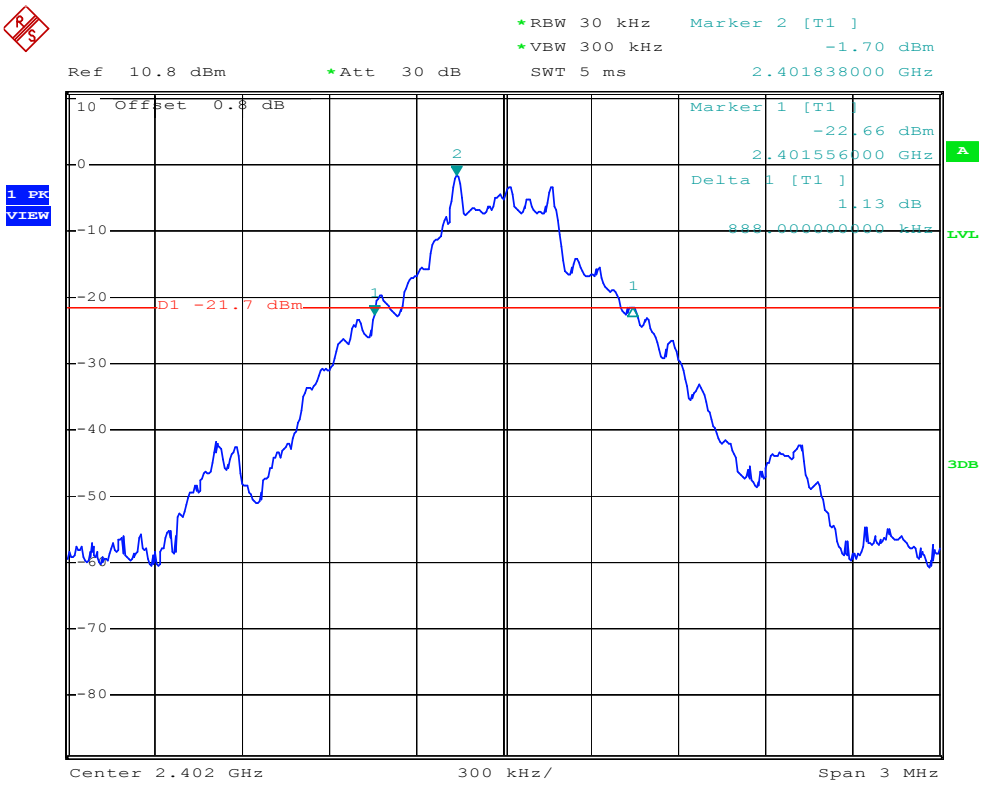
Worst mode: 8DPSK (3DH1)

Channel	Frequency MHz	20dB Bandwidth kHz
Low Channel	2402	1158
Middle Channel	2441	1158
High Channel	2480	1158

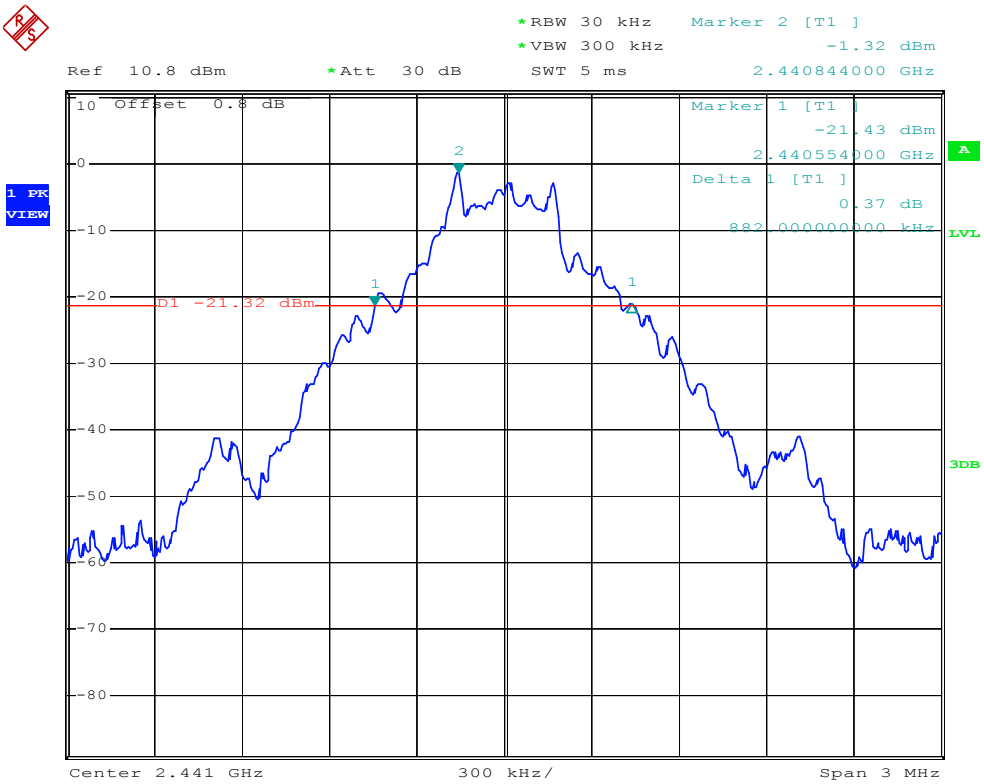
Please refer to the following test plots

Worst mode: GFSK (DH1)

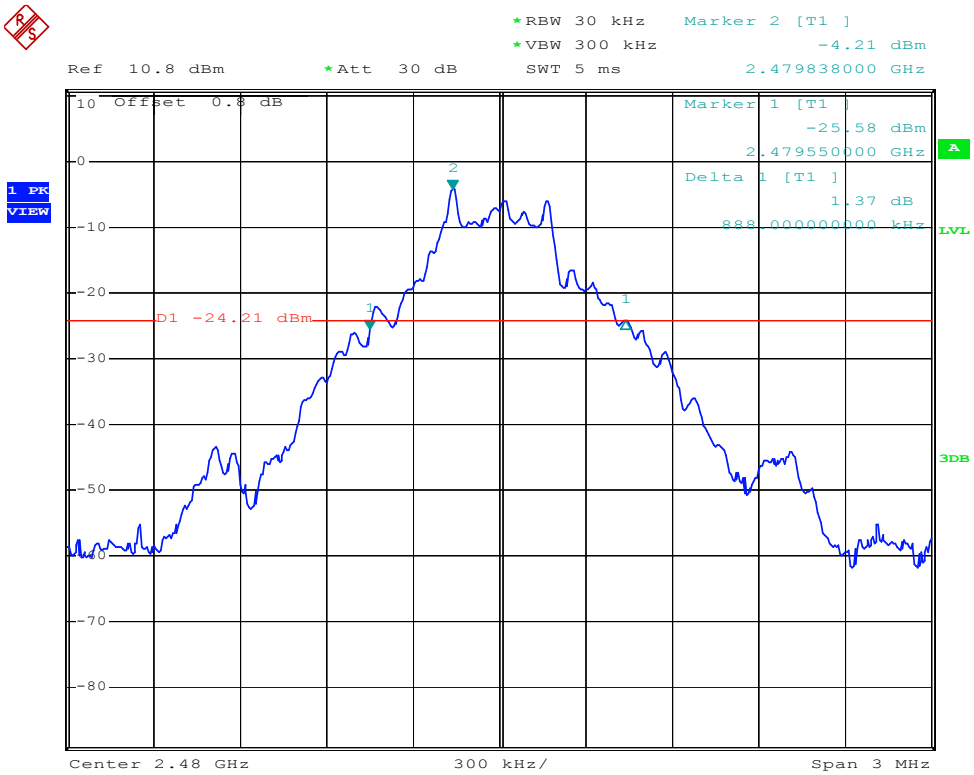
Low Channel:



Middle Channel:

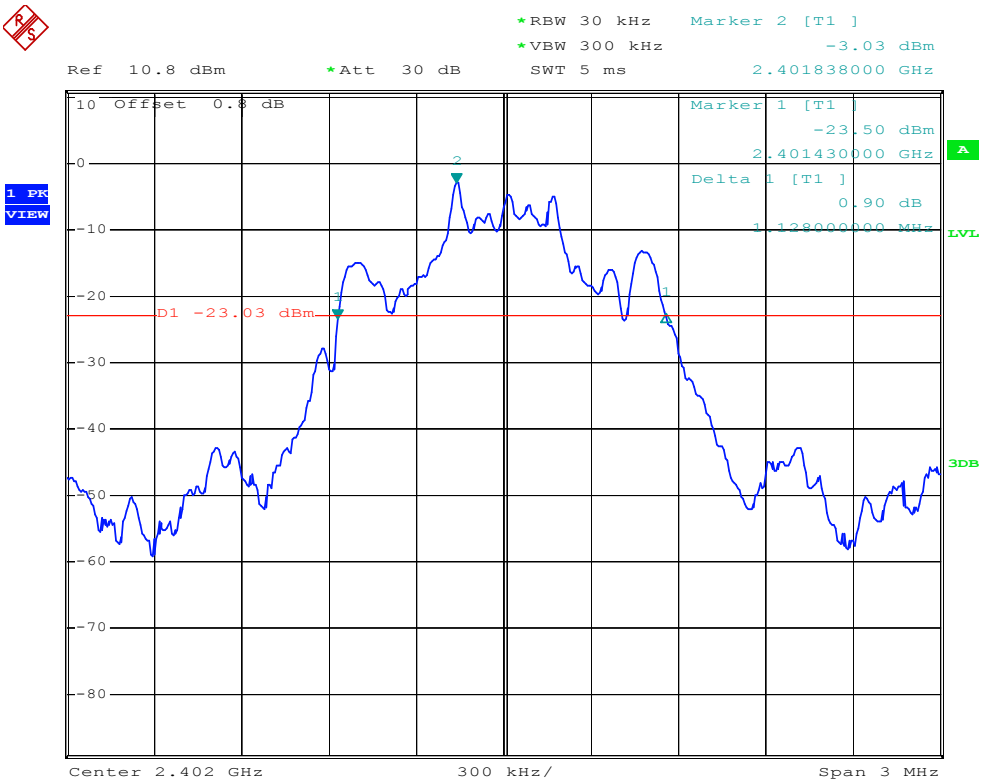


High Channel:

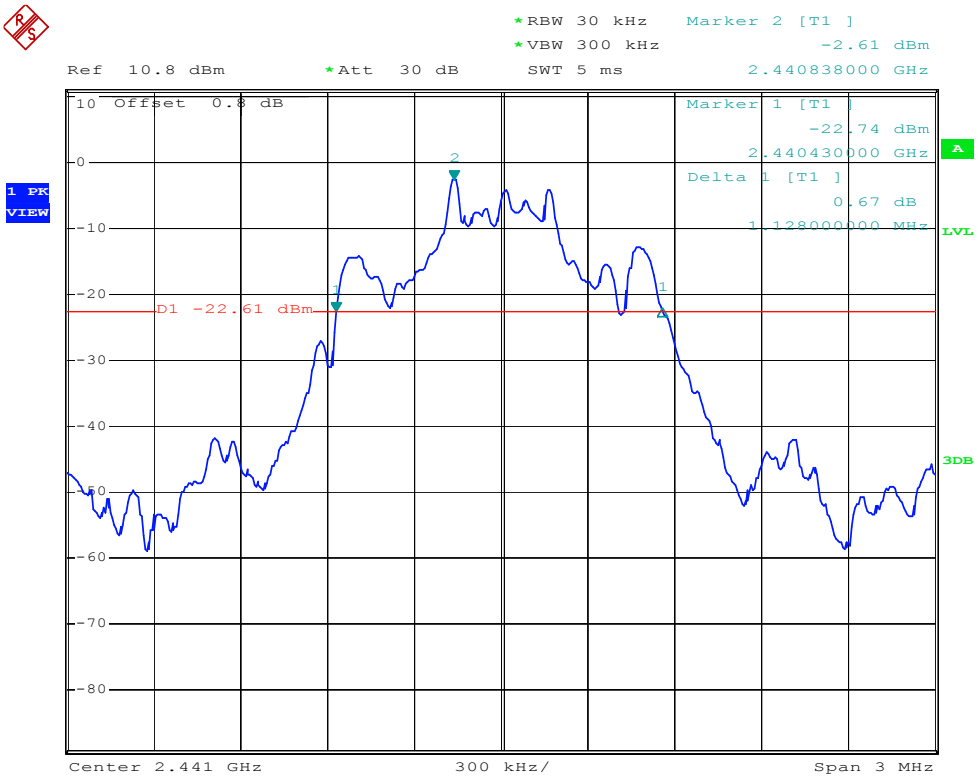


Worst mode: Pi/4 QDPSK (2DH1)

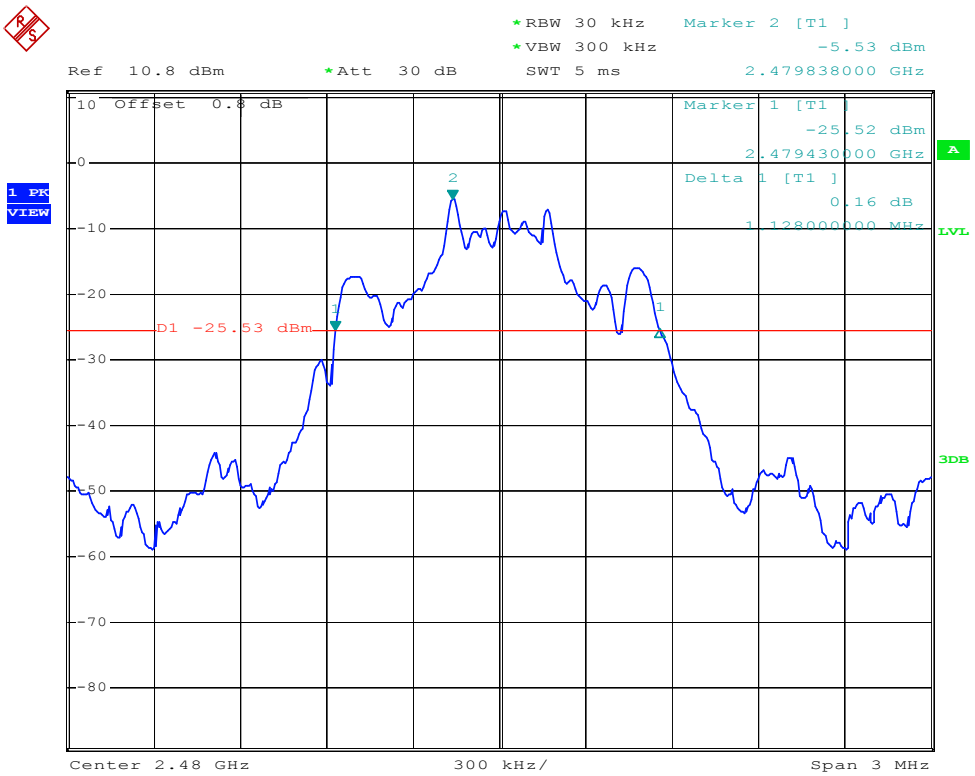
Low Channel:



Middle Channel:

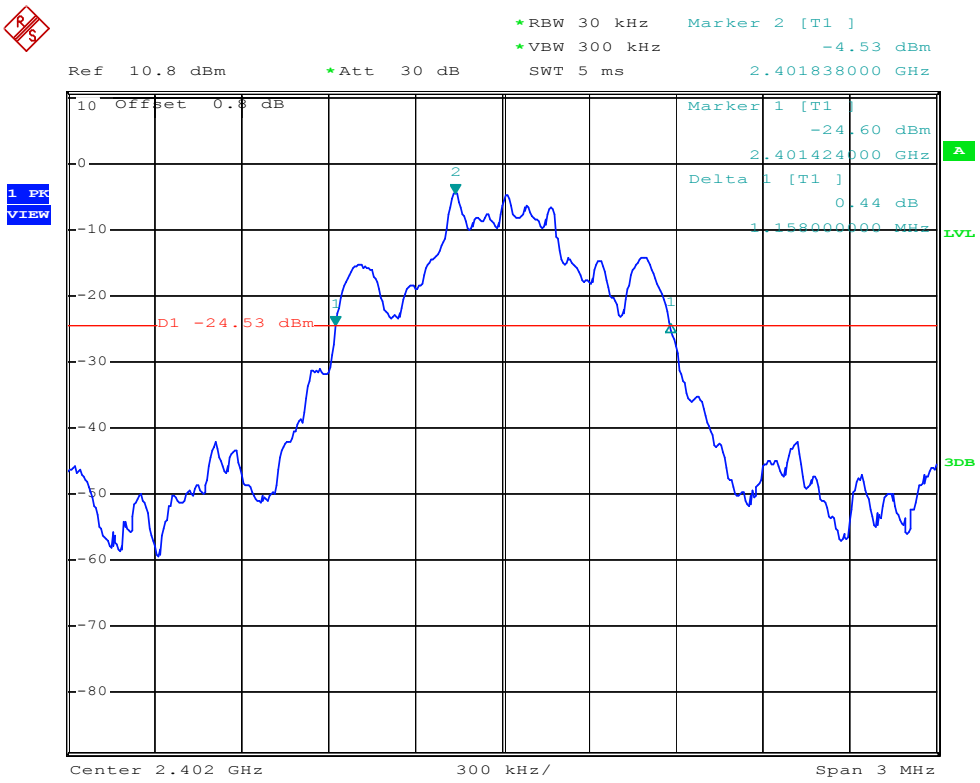


High Channel:

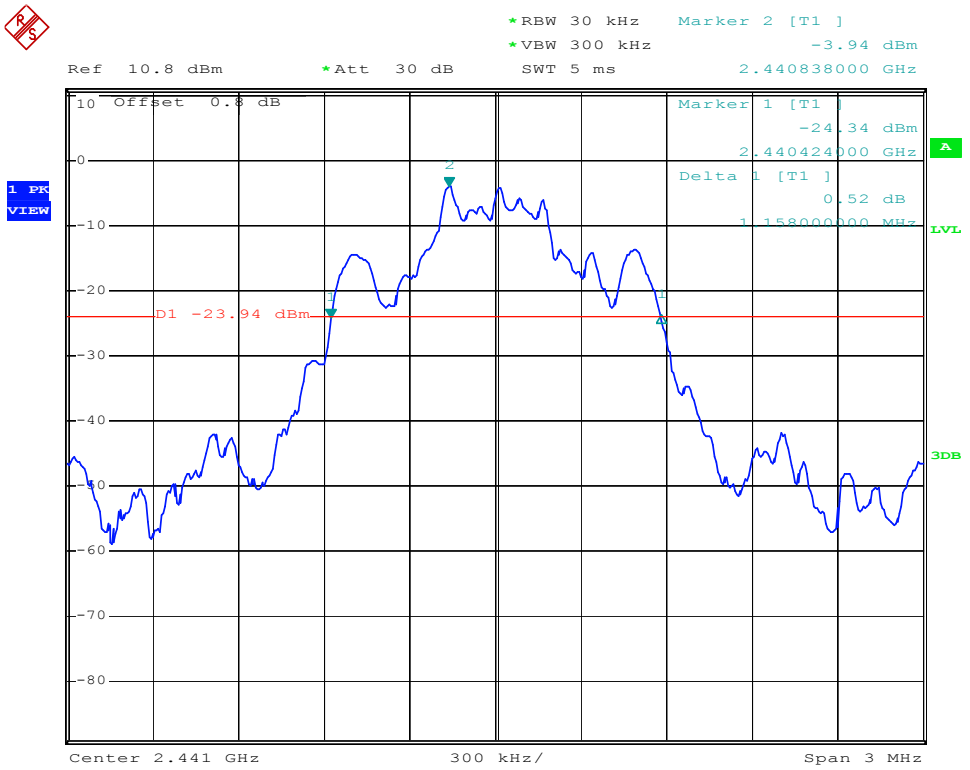


Worst mode: 8DPSK (3DH1)

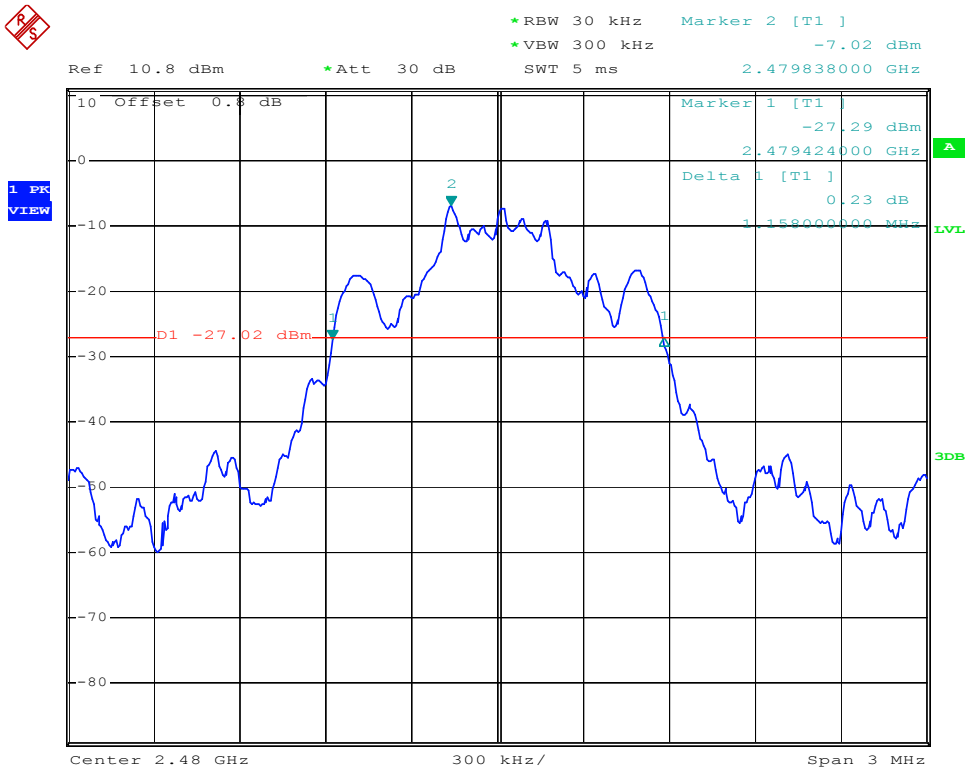
Low Channel:



Middle Channel:



High Channel:

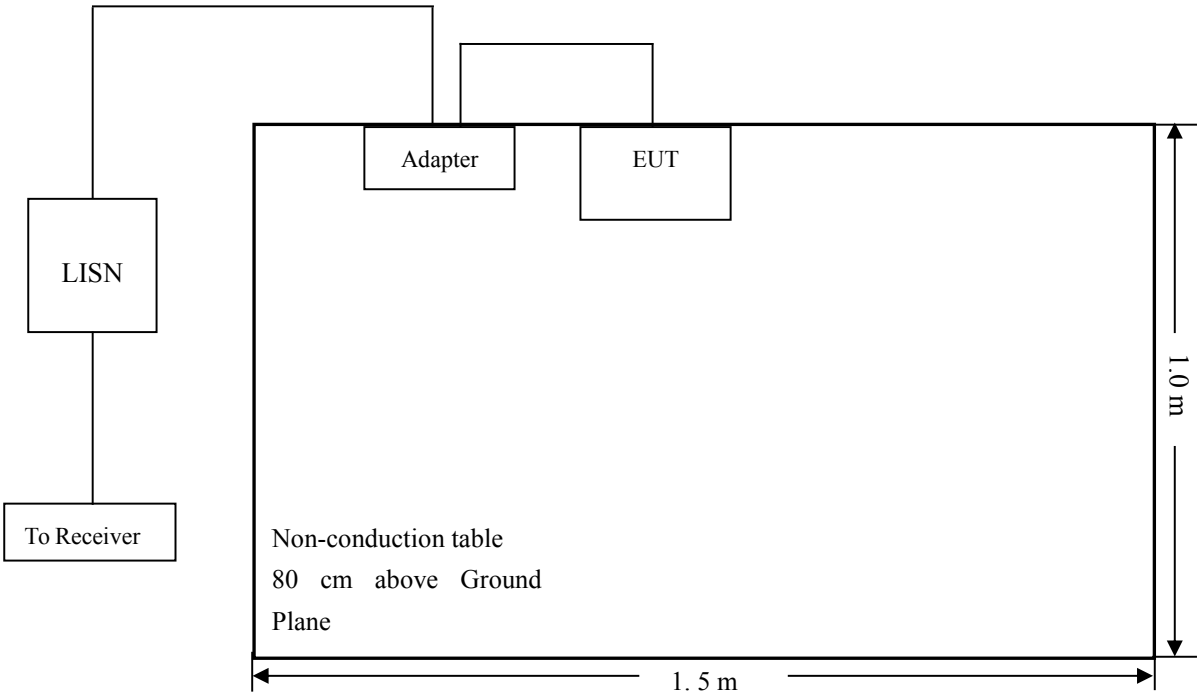


7. Conducted Emissions

7.1 Test Procedure

The setup of EUT is according with per ANSI C63.4-2014 measurement procedure. The specification used was with the FCC Part 15.207 Limit.
The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.
The spacing between the peripherals was 10 cm.

7.2 Basic Test Setup Block Diagram



7.3 Environmental Conditions

Temperature:	25 °C
Relative Humidity:	52%
ATM Pressure:	1012 mbar

7.4 Test Receiver Setup

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

Start Frequency..... 150 kHz
Stop Frequency..... 30 MHz
Sweep Speed..... Auto
IF Bandwidth..... 10 kHz
Quasi-Peak Adapter Bandwidth..... 9 kHz
Quasi-Peak Adapter Mode.....Normal

7.5 Summary of Test Results/Plots

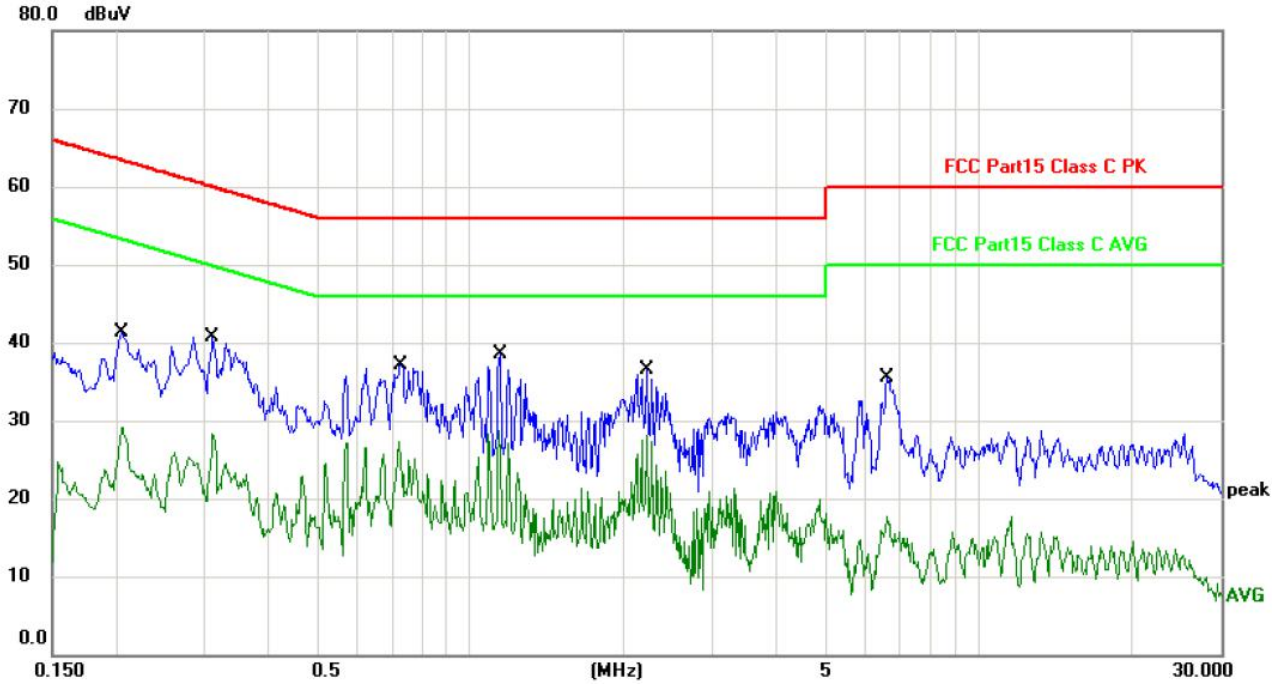
According to the data in section 7.7, the EUT complied with the FCC Part 15.207 Conducted margin for this device.

7.6 Conducted Emissions Test Data

Note: We pre-scan all mode, the worst data is GFSK (Low channel).

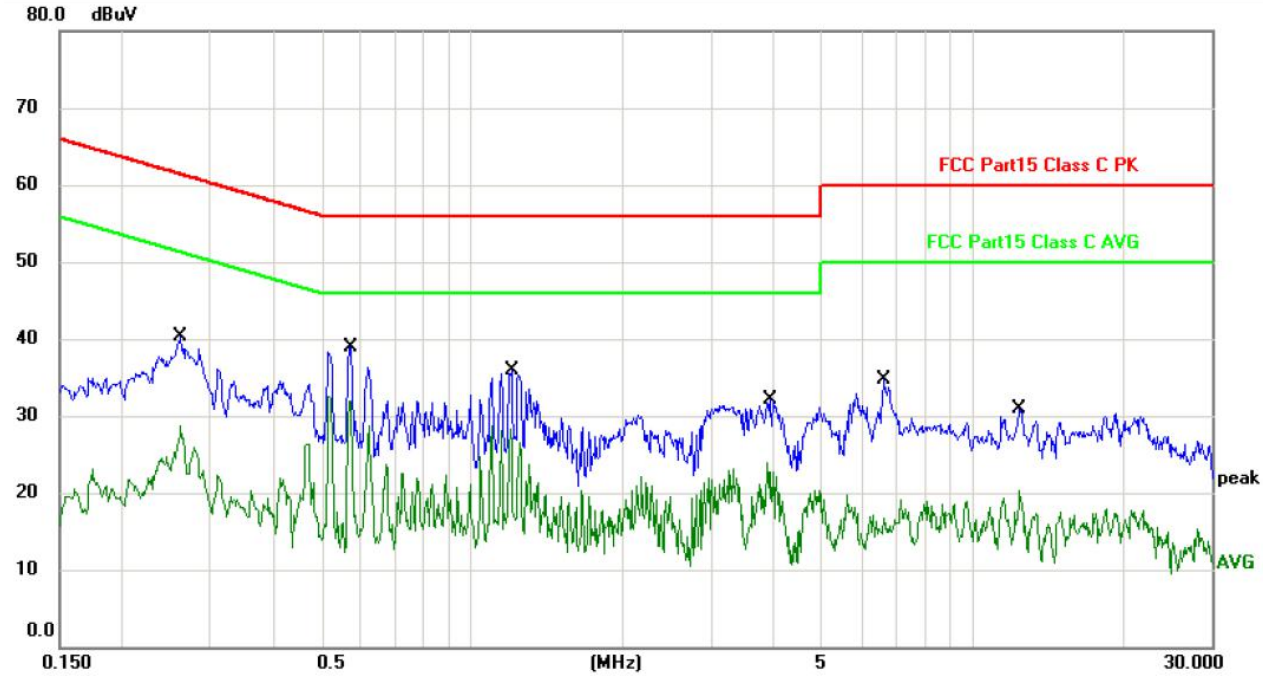
Plot of Conducted Emissions The Worst Test Data GFSK (Low channel):

Test Specification: *Neutral*



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.2060	40.79	0.60	41.39	63.36	-21.97	QP	
2		0.2060	22.93	0.60	23.53	53.36	-29.83	AVG	
3		0.3115	39.34	0.62	39.96	59.93	-19.97	QP	
4		0.3115	21.62	0.62	22.24	49.93	-27.69	AVG	
5		0.7300	36.50	0.68	37.18	56.00	-18.82	QP	
6		0.7300	22.45	0.68	23.13	46.00	-22.87	AVG	
7	*	1.1420	37.83	0.68	38.51	56.00	-17.49	QP	
8		1.1420	22.53	0.68	23.21	46.00	-22.79	AVG	
9		2.2260	35.76	0.78	36.54	56.00	-19.46	QP	
10		2.2260	16.10	0.78	16.88	46.00	-29.12	AVG	
11		6.6179	34.52	0.94	35.46	60.00	-24.54	QP	
12		6.6179	12.68	0.94	13.62	50.00	-36.38	AVG	

Test Specification: *Line*



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1		0.2620	39.74	0.49	40.23	61.36	-21.13	QP
2		0.2620	20.49	0.49	20.98	51.36	-30.38	AVG
3	*	0.5740	38.37	0.51	38.88	56.00	-17.12	QP
4		0.5740	16.47	0.51	16.98	46.00	-29.02	AVG
5		1.1980	35.26	0.65	35.91	56.00	-20.09	QP
6		1.1980	20.93	0.65	21.58	46.00	-24.42	AVG
7		3.9460	31.18	0.84	32.02	56.00	-23.98	QP
8		3.9460	19.11	0.84	19.95	46.00	-26.05	AVG
9		6.6499	33.88	0.90	34.78	60.00	-25.22	QP
10		6.6499	14.64	0.90	15.54	50.00	-34.46	AVG
11		12.4339	30.06	0.82	30.88	60.00	-29.12	QP
12		12.4339	15.91	0.82	16.73	50.00	-33.27	AVG

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