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Report Template Version: V05
Report Template Revision Date: 2021-11-03

Test Report

Report No.:	CQASZ20250200396E-01
Applicant:	Shenzhen Thinkmak Technology Co., Ltd.
Address of Applicant:	Rm 8630, 6th Floor,No. 3012 Banxuegang Avenue,Longgang District,Shenzhen ,China

Equipment Under Test (EUT):

Product:	Speaker
Model No.:	WS-598, WS-1955, WS-1967, WS-300SL, WS-596, WS-1968, WS-X65, WS-1969,WS-1965, WS-691, WS-1966, WS-1957，AN-A7
Test Model No.:	WS-598
Brand Name:	WSTER
FCC ID:	2BN2D2537
Standards:	47 CFR Part 15, Subpart C KDB558074 D01 15.247 Meas Guidance v05r02 ANSI C63.10:2013
Date of Receipt:	2025-2-28
Date of Test:	2025-2-28 to 2025-3-17
Date of Issue:	2025-3-27
Test Result:	**PASS***

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

Tested By: lewis zhou

(Lewis Zhou)

Reviewed By: Timo Lei

(Timo Lei)

Approved By:

(Jack Ai)

SHENZHEN HUAXIA TESTING TECHNOLOGY CO., LTD. 华夏准测 APPROVED

The test report is effective only with both signature and specialized stamp, The result(s) shown in this report refer only to the sample(s) tested. Without written approval of CQA, this report can't be reproduced except in full.

1 Version

Revision History Of Report

Report No.	Version	Description	Issue Date
CQASZ20250200396E-01	Rev.01	Initial report	2025-3-27

2 Test Summary

Test Item	Test Requirement	Test method	Result
Antenna Requirement	47 CFR Part 15, Subpart C Section 15.203/15.247 (c)	ANSI C63.10 2013	PASS
AC Power Line Conducted Emission	47 CFR Part 15, Subpart C Section 15.207	ANSI C63.10 2013	PASS
Conducted Peak Output Power	47 CFR Part 15, Subpart C Section 15.247 (b)(3)	ANSI C63.10 2013	PASS
6dB Occupied Bandwidth	47 CFR Part 15, Subpart C Section 15.247 (a)(2)	ANSI C63.10 2013	PASS
Power Spectral Density	47 CFR Part 15, Subpart C Section 15.247 (e)	ANSI C63.10 2013	PASS
Band-edge for RF Conducted Emissions	47 CFR Part 15, Subpart C Section 15.247(d)	ANSI C63.10 2013	PASS
RF Conducted Spurious Emissions	47 CFR Part 15, Subpart C Section 15.247(d)	ANSI C63.10 2013	PASS
Radiated Spurious Emissions	47 CFR Part 15, Subpart C Section 15.205/15.209	ANSI C63.10 2013	PASS
Restricted bands around fundamental frequency (Radiated Emission)	47 CFR Part 15, Subpart C Section 15.205/15.209	ANSI C63.10 2013	PASS

3 Contents

Page

1 VERSION **2**

2 TEST SUMMARY **3**

3 CONTENTS **4**

4 GENERAL INFORMATION **5**

4.1 CLIENT INFORMATION 5
4.2 GENERAL DESCRIPTION OF EUT 5
4.3 ADDITIONAL INSTRUCTIONS 7
4.4 TEST ENVIRONMENT 8
4.5 DESCRIPTION OF SUPPORT UNITS 8
4.6 STATEMENT OF THE MEASUREMENT UNCERTAINTY 9
4.7 TEST LOCATION 10
4.8 TEST FACILITY 10
4.9 DEVIATION FROM STANDARDS 10
4.10 OTHER INFORMATION REQUESTED BY THE CUSTOMER 10
4.11 EQUIPMENT LIST 11

5 TEST RESULTS AND MEASUREMENT DATA **12**

5.1 ANTENNA REQUIREMENT 12
5.2 CONDUCTED EMISSIONS 13
5.3 CONDUCTED PEAK OUTPUT POWER 17
5.4 6DB OCCUPY BANDWIDTH 20
5.5 POWER SPECTRAL DENSITY 23
5.6 BAND-EDGE FOR RF CONDUCTED EMISSIONS 26
5.7 SPURIOUS RF CONDUCTED EMISSIONS 29
5.8 RADIATED SPURIOUS EMISSION & RESTRICTED BANDS 34
5.8.1 Spurious Emissions *34*

6 PHOTOGRAPHS - EUT TEST SETUP **40**

6.1 RADIATED SPURIOUS EMISSION 40
6.2 CONDUCTED EMISSIONS TEST SETUP 41

7 PHOTOGRAPHS - EUT CONSTRUCTIONAL DETAILS **42**

4 General Information

4.1 Client Information

Applicant:	Shenzhen Thinkmak Technology Co., Ltd.
Address of Applicant:	Rm 8630, 6th Floor,No. 3012 Banxuegang Avenue,Longgang District,Shenzhen ,China
Manufacturer:	Dongguan Aierpu Electronics Science&technology Co.,LTD
Address of Manufacturer:	Building 3, 20th Xiegang Xinxing Rd, Xiegang Town,Dongguan City,Guangdong Province,China
Factory:	Dongguan Aierpu Electronics Science&technology Co.,LTD
Address of Factory:	Building 3, 20th Xiegang Xinxing Rd, Xiegang Town,Dongguan City,Guangdong Province,China

4.2 General Description of EUT

Product Name:	Speaker
Model No.:	WS-598, WS-1955, WS-1967, WS-300SL, WS-596, WS-1968, WS-X65, WS-1969,WS-1965, WS-691, WS-1966, WS-1957, AN-A7
Test Model No.:	WS-598
Trade Mark:	WSTER
Software Version:	sdk_ab560x_s865_20220513
Hardware Version:	WS-598-AB5605B-T2.0
Operation Frequency:	2402MHz~2480MHz
Bluetooth Version:	V5.0
Modulation Type:	GFSK
Transfer Rate:	1Mbps, 2Mbps
Number of Channel:	40
Product Type:	☐ Mobile ☒ Portable ☐ Fix Location
Test Software of EUT:	BlueTest3
Antenna Type:	PCB antenna
Antenna Gain:	2.21dBi
EUT Power Supply:	lithium battery : 3.7V 1500mAh, Charge by DC 5V for adapter
Simultaneous Transmission	☐ Simultaneous TX is supported and evaluated in this report. ☒ Simultaneous TX is not supported.

Note:

Model No.: WS-598, WS-1955, WS-1967, WS-300SL, WS-596, WS-1968, WS-X65, WS-1969,WS-1965, WS-691, WS-1966, WS-1957, AN-A7

Only the model WS-598 was tested, Their electrical circuit design, layout, components used and internal wiring are identical. Only the model name and color is different.

Operation Frequency each of channel							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
0	2402MHz	10	2422MHz	20	2442MHz	30	2462MHz
1	2404MHz	11	2424MHz	21	2444MHz	31	2464MHz
2	2406MHz	12	2426MHz	22	2446MHz	32	2466MHz
3	2408MHz	13	2428MHz	23	2448MHz	33	2468MHz
4	2410MHz	14	2430MHz	24	2450MHz	34	2470MHz
5	2412MHz	15	2432MHz	25	2452MHz	35	2472MHz
6	2414MHz	16	2434MHz	26	2454MHz	36	2474MHz
7	2416MHz	17	2436MHz	27	2456MHz	37	2476MHz
8	2418MHz	18	2438MHz	28	2458MHz	38	2478MHz
9	2420MHz	19	2440MHz	29	2460MHz	39	2480MHz

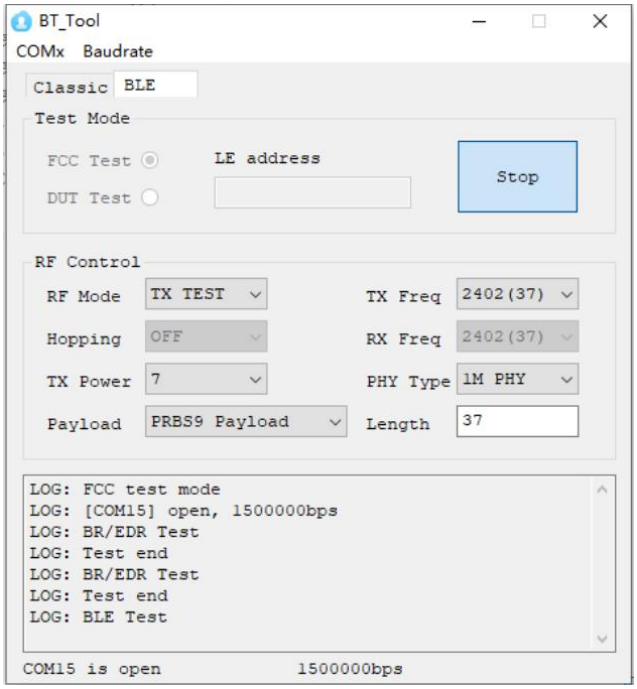
Note:
In section 15.31(m), regards to the operating frequency range over 10 MHz, the lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

Channel	Frequency
The lowest channel (CH0)	2402MHz
The middle channel (CH19)	2440MHz
The highest channel (CH39)	2480MHz

4.3 Additional Instructions

EUT Test Software Settings:		
Mode:	☒ Special software is used. ☐ Through engineering command into the engineering mode. engineering command: *#*#3646633#*#*	
EUT Power level:	Class2 (Power level is built-in set parameters and cannot be changed and selected)	
Use test software to set the lowest frequency, the middle frequency and the highest frequency keep transmitting of the EUT.		
Mode	Channel	Frequency(MHz)
GFSK	CH0	2402
	CH19	2440
	CH39	2480

Run Software:



4.4 Test Environment

Operating Environment:	
Temperature:	24.5°C
Humidity:	59% RH
Atmospheric Pressure:	1009mbar
Test Mode:	Use test software to set the lowest frequency, the middle frequency and the highest frequency keep transmitting of the EUT.

4.5 Description of Support Units

The EUT has been tested with associated equipment below.

1）Support equipment

Description	Manufacturer	Model No.	Certification	Supplied by
Adapter	MI	/	/	CQA

2) Cable

Cable No.	Description	Manufacturer	Cable Type/Length	Supplied by
/	/	/	/	/

4.6 Statement of the measurement uncertainty

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

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

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

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

Hereafter the best measurement capability for CQA laboratory is reported:

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

4.7 Test Location

All tests were performed at:

Shenzhen Huaxia Testing Technology Co., Ltd.

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

4.8 Test Facility

- **A2LA (Certificate No. 4742.01)**

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

- **FCC Registration No.: 522263**

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

4.9 Deviation from Standards

None.

4.10 Other Information Requested by the Customer

None.

4.11 Equipment List

Test Equipment	Manufacturer	Model No.	Instrument No.	Calibration Date	Calibration Due Date
EMI Test Receiver	R&S	ESR7	CQA-005	2024/9/2	2025/9/1
Spectrum analyzer	R&S	FSU26	CQA-038	2024/9/2	2025/9/1
Spectrum analyzer	R&S	FSU40	CQA-075	2024/9/2	2025/9/1
Preamplifier	MITEQ	AFS4-00010300-18-10P-4	CQA-035	2024/9/2	2025/9/1
Preamplifier	MITEQ	AMF-6D-02001800-29-20P	CQA-036	2024/9/2	2025/9/1
Preamplifier	EMCI	EMC184055SE	CQA-089	2024/9/2	2025/9/1
Loop antenna	Schwarzbeck	FMZB1516	CQA-060	2023/9/8	2026/9/7
Bilog Antenna	R&S	HL562	CQA-011	2023/11/01	2026/10/31
Horn Antenna	R&S	HF906	CQA-012	2023/11/01	2026/10/31
Horn Antenna	Schwarzbeck	BBHA 9170	CQA-088	2023/9/7	2026/9/6
Coaxial Cable (Above 1GHz)	CQA	N/A	C007	2024/9/2	2025/9/1
Coaxial Cable (Below 1GHz)	CQA	N/A	C013	2024/9/2	2025/9/1
Antenna Connector	CQA	RFC-01	CQA-080	2024/9/2	2025/9/1
RF cable(9KHz~40GHz)	CQA	RF-01	CQA-079	2024/9/2	2025/9/1
Power meter	R&S	NRVD	CQA-029	2024/9/2	2025/9/1
Power divider	MIDWEST	PWD-2533-02-SMA-79	CQA-067	2024/9/2	2025/9/1
EMI Test Receiver	R&S	ESR7	CQA-005	2024/9/2	2025/9/1
LISN	R&S	ENV216	CQA-003	2024/9/2	2025/9/1
Coaxial cable	CQA	N/A	CQA-C009	2024/9/2	2025/9/1
DC power	KEYSIGHT	E3631A	CQA-028	2024/9/2	2025/9/1

Test software:

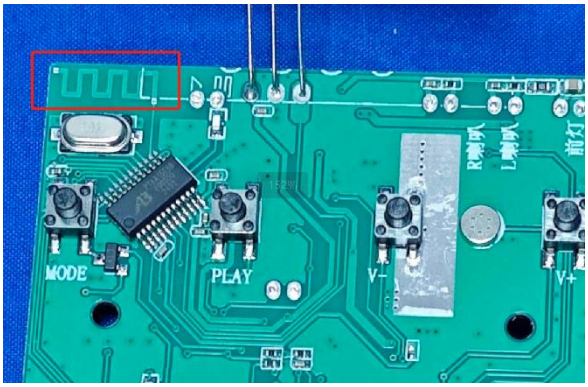
	Manufacturer	Software brand	Software version
Radiated Emissions test software	Tonscend	JS1120-3	Version:8
Conducted Emissions test software	Audix	e3	Version:9
RF Conducted test software	Audix	e3	V3.5.39

Note:

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

5 Test results and Measurement Data

5.1 Antenna Requirement

Standard requirement:	47 CFR Part 15C Section 15.203 /247(c)
15.203 requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. 15.247(b) (4) requirement: The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.	
EUT Antenna:	
The antenna is PCB antenna. The connection/connection type between the antenna to the EUT's antenna port is: permanently attachment This is either permanently attachment or a unique coupling that satisfies the requirement.	

5.2 Conducted Emissions

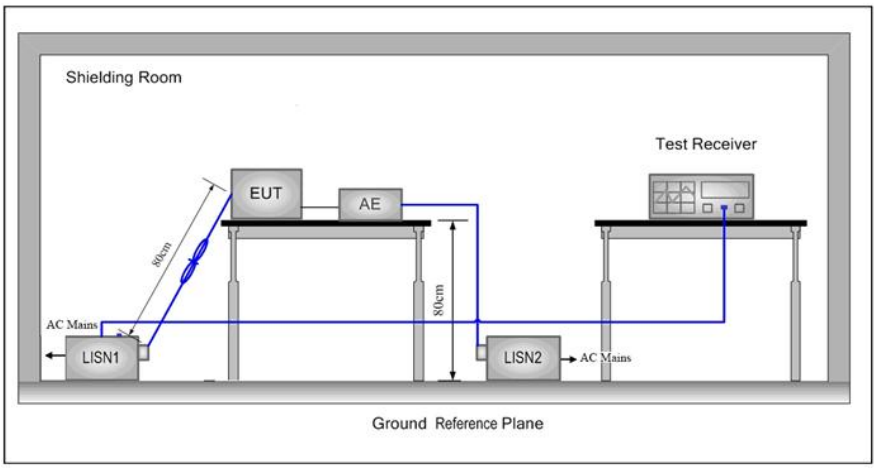
Test Requirement:	47 CFR Part 15C Section 15.207
Test Method:	ANSI C63.10: 2013
Test Frequency Range:	150kHz to 30MHz
Limit:	

Frequency range (MHz)	Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

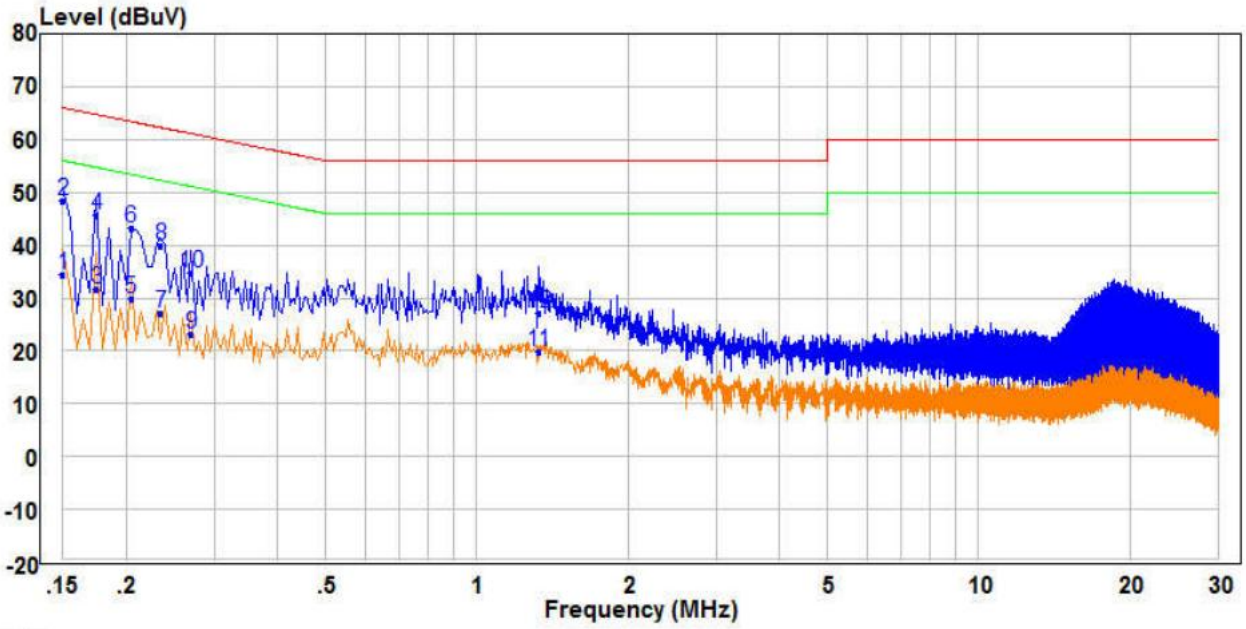
Test Procedure:

1) The mains terminal disturbance voltage test was conducted in a shielded room.
2) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a 50Ω/50μH + 5Ω linear impedance. The power cables of all other units of the EUT were connected to a second LISN 2, which was bonded to the ground reference plane in the same way as the LISN 1 for the unit being measured. A multiple socket outlet strip was used to connect multiple power cables to a single LISN provided the rating of the LISN was not exceeded.
3) The tabletop EUT was placed upon a non-metallic table 0.8m above the ground reference plane. And for floor-standing arrangement, the EUT was placed on the horizontal ground reference plane,
4) The test was performed with a vertical ground reference plane. The rear of the EUT shall be 0.4 m from the vertical ground reference plane. The vertical ground reference plane was bonded to the horizontal ground reference plane. The LISN 1 was placed 0.8 m from the boundary of the unit under test and bonded to a ground reference plane for LISNs mounted on top of the ground reference plane. This distance was between the closest points of the LISN 1 and the EUT. All other units of the EUT and associated equipment was at least 0.8 m from the LISN 2.
5) In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10: 2013 on conducted measurement.

Test Setup:	
Test Mode:	Through Pre-scan, find the transmitting mode at the lowest channel is the worst case.
Test Voltage:	AC 120V/60Hz
Test Results:	Pass

Measurement Data

Live line:



	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark	Pol/Phase
	MHz	dBuV	dB	dBuV	dBuV	dB		
1 AV	0.150	24.89	9.49	34.38	56.00	-21.62	Average	Line
2 PP	0.150	38.91	9.49	48.40	66.00	-17.60	QP	Line
3	0.175	22.08	9.49	31.57	54.72	-23.15	Average	Line
4	0.175	36.27	9.49	45.76	64.72	-18.96	QP	Line
5	0.205	20.33	9.49	29.82	53.41	-23.59	Average	Line
6	0.205	33.77	9.49	43.26	63.41	-20.15	QP	Line
7	0.235	17.74	9.49	27.23	52.27	-25.04	Average	Line
8	0.235	30.30	9.49	39.79	62.27	-22.48	QP	Line
9	0.270	13.78	9.49	23.27	51.12	-27.85	Average	Line
10	0.270	25.17	9.49	34.66	61.12	-26.46	QP	Line
11	1.325	10.20	9.53	19.73	46.00	-26.27	Average	Line
12	1.325	17.70	9.53	27.23	56.00	-28.77	QP	Line

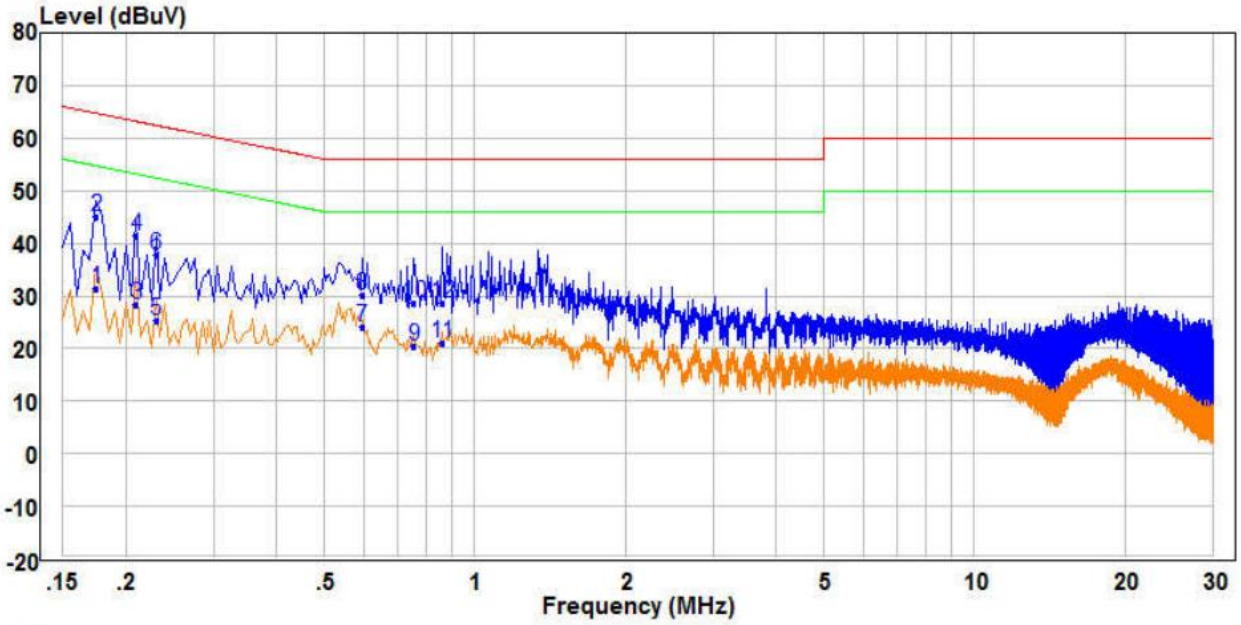
Remark:

1. The following Quasi-Peak and Average measurements were performed on the EUT:

2. Final Test Level =Receiver Reading + LISN Factor + Cable Loss.

3. If the Peak value under Average limit, the Average value is not recorded in the report.

Neutral line:

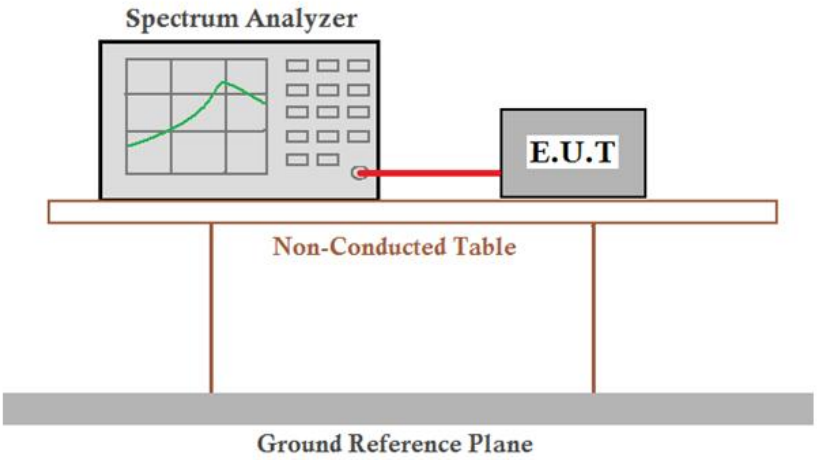


		Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark	Pol/Phase
		MHz	dBuV	dB	dBuV	dBuV	dB		
1		0.175	21.64	9.65	31.29	54.72	-23.43	Average	Neutral
2	PP	0.175	35.37	9.65	45.02	64.72	-19.70	QP	Neutral
3		0.210	18.67	9.59	28.26	53.21	-24.95	Average	Neutral
4		0.210	31.85	9.59	41.44	63.21	-21.77	QP	Neutral
5		0.230	15.80	9.56	25.36	52.45	-27.09	Average	Neutral
6		0.230	28.08	9.56	37.64	62.45	-24.81	QP	Neutral
7	AV	0.595	14.32	9.80	24.12	46.00	-21.88	Average	Neutral
8		0.595	20.22	9.80	30.02	56.00	-25.98	QP	Neutral
9		0.755	10.53	9.86	20.39	46.00	-25.61	Average	Neutral
10		0.755	18.69	9.86	28.55	56.00	-27.45	QP	Neutral
11		0.860	11.41	9.79	21.20	46.00	-24.80	Average	Neutral
12		0.860	18.95	9.79	28.74	56.00	-27.26	QP	Neutral

Remark:

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

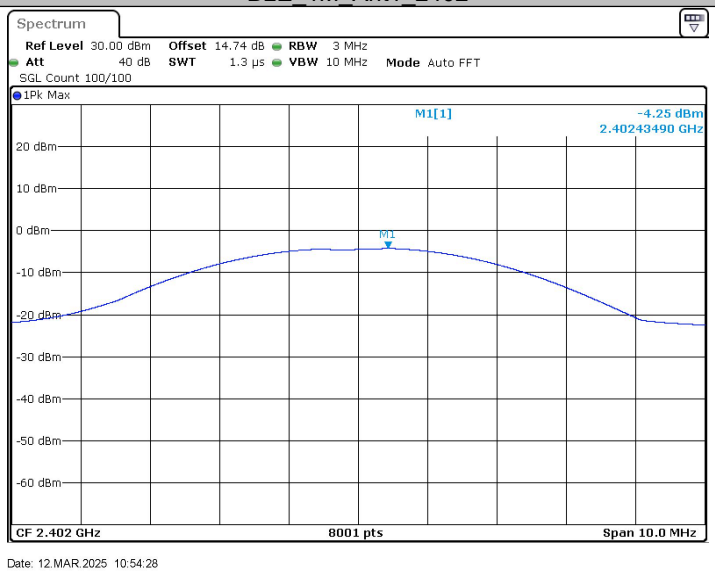
5.3 Conducted Peak Output Power

Test Requirement:	47 CFR Part 15C Section 15.247 (b)(3)
Test Method:	ANSI C63.10 2013
Test Setup:	 *Remark: Offset=Cable loss+ attenuation factor.*
Limit:	30dBm
Test Mode:	Transmitting with GFSK modulation.
Test Results:	Pass

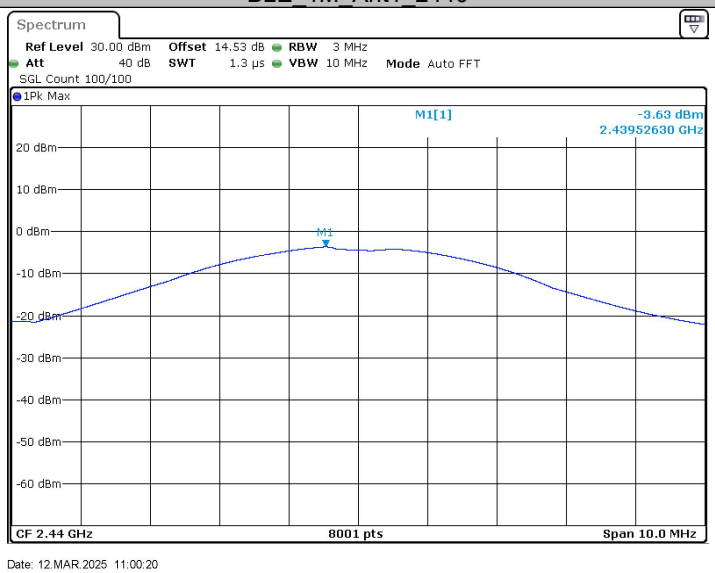
Measurement Data

TestMode	Freq(MHz)	Conducted Peak Powert[dBm]	Conducted Limit[dBm]	EIRP[dBm]	EIRP Limit[dBm]	Verdict
BLE_1M	2402	-4.25	≤30	-2.04	≤36	PASS
	2440	-3.63	≤30	-1.42	≤36	PASS
	2480	-3.13	≤30	-0.92	≤36	PASS

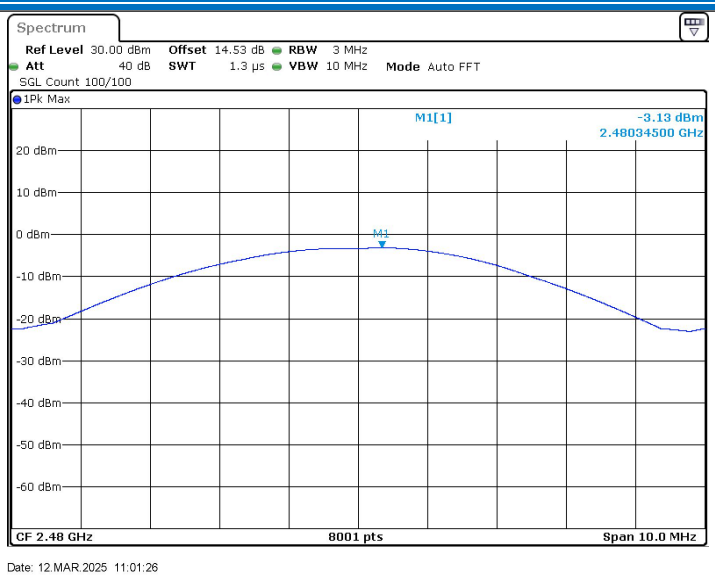
BLE_1M_Ant1_2402



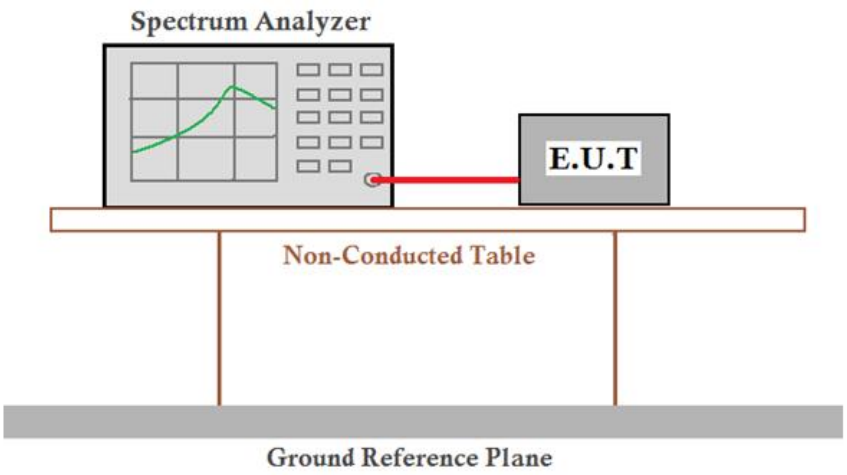
BLE_1M_Ant1_2440



BLE_1M_Ant1_2480


Spectrum
Ref Level 30.00 dBm Offset 14.53 dB RBW 3 MHz
Att 40 dB SWT 1.3 µs VBW 10 MHz Mode Auto FFT
SGL Count 100/100
1Pk Max
M1[1] -3.13 dBm
2.48034500 GHz
20 dBm
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
M1
CF 2.48 GHz
8001 pts
Span 10.0 MHz
Date: 12.MAR.2025 11:01:26

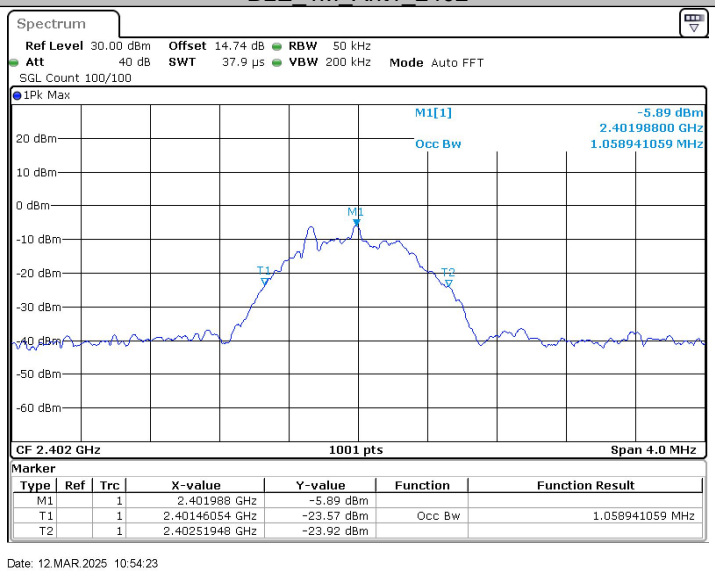
5.4 6dB Occupy Bandwidth

Test Requirement:	47 CFR Part 15C Section 15.247 (a)(2)
Test Method:	ANSI C63.10 2013
Test Setup:	 *Remark: Offset=Cable loss+ attenuation factor.*
Limit:	≥ 500 kHz
Instruments Used:	Refer to section 4.11 for details.
Test Results:	Pass

Measurement Data

TestMode	Antenna	Freq(MHz)	OCB [MHz]	FL[MHz]	FH[MHz]
BLE_1M	Ant1	2402	1.059	2401.4605	2402.5195
		2440	1.063	2439.4565	2440.5195
		2480	1.047	2479.4645	2480.5115

BLE_1M_Ant1_2402

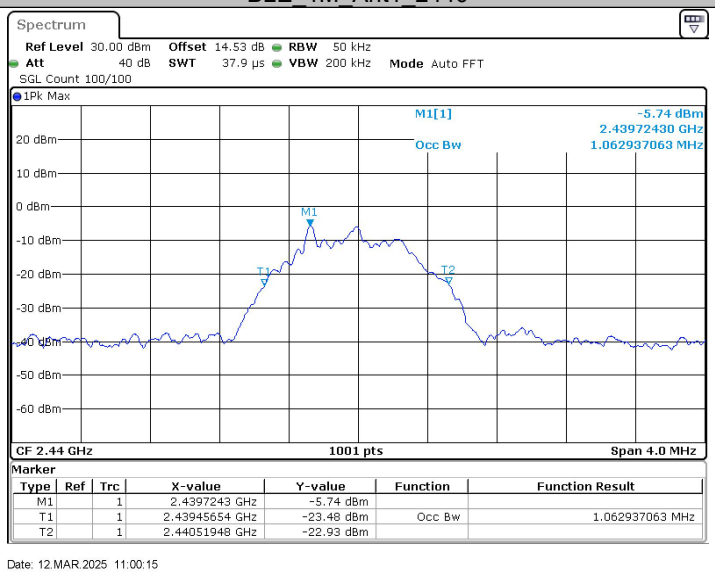


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.401988 GHz	-5.89 dBm		
T1		1	2.40146054 GHz	-23.57 dBm	Occ Bw	1.058941059 MHz
T2		1	2.40251948 GHz	-23.92 dBm		

Date: 12.MAR.2025 10:54:23

BLE_1M_Ant1_2440

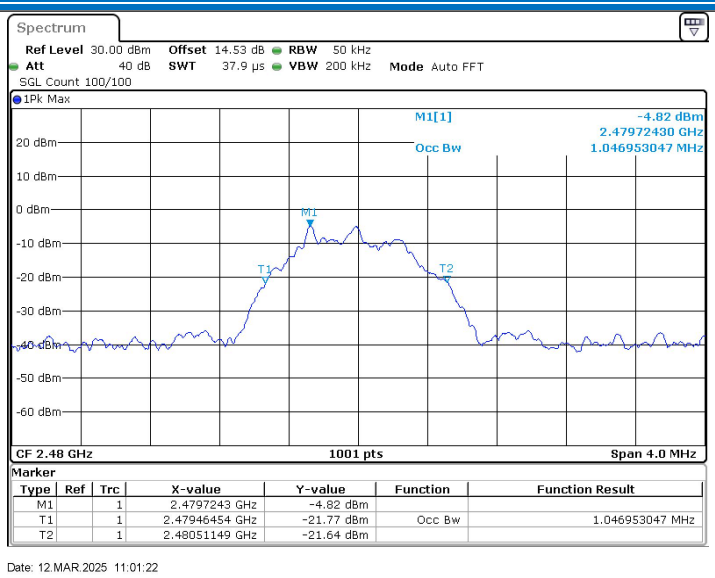


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4397243 GHz	-5.74 dBm		
T1		1	2.43945654 GHz	-23.48 dBm	Occ Bw	1.062937063 MHz
T2		1	2.44051948 GHz	-22.93 dBm		

Date: 12.MAR.2025 11:00:15

BLE_1M_Ant1_2480

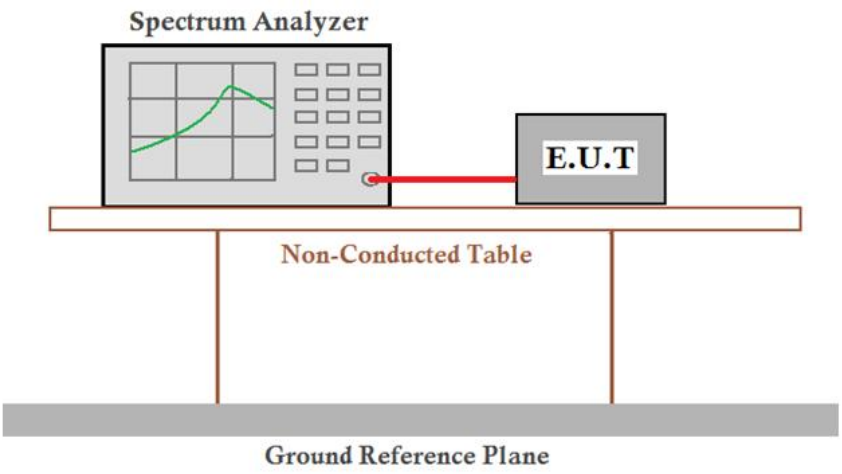


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4797243 GHz	-4.82 dBm		
T1		1	2.47946454 GHz	-21.77 dBm	Occ Bw	1.046953047 MHz
T2		1	2.48051149 GHz	-21.64 dBm		

Date: 12.MAR.2025 11:01:22

5.5 Power Spectral Density

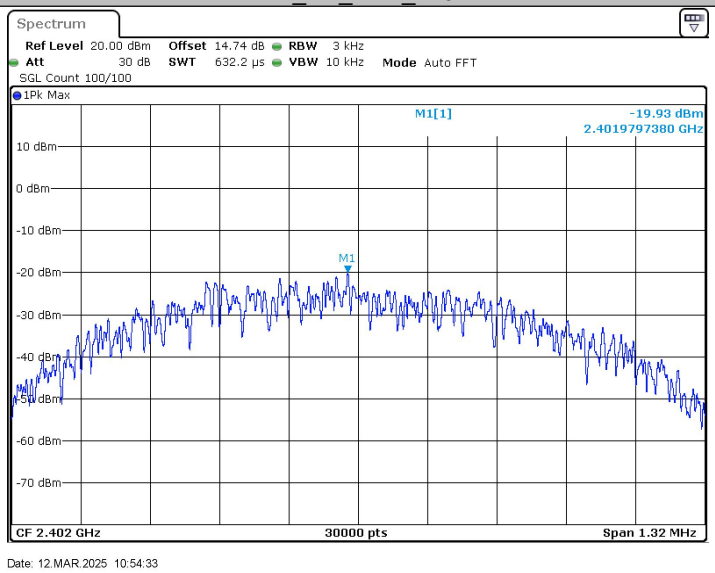
Test Requirement:	47 CFR Part 15C Section 15.247 (e)
Test Method:	ANSI C63.10 2013
Test Setup:	 *Remark: Offset=Cable loss+ attenuation factor.*
Limit:	≤8.00dBm/3kHz
Test Mode:	Transmitting with GFSK modulation.
Test Results:	Pass

Measurement Data

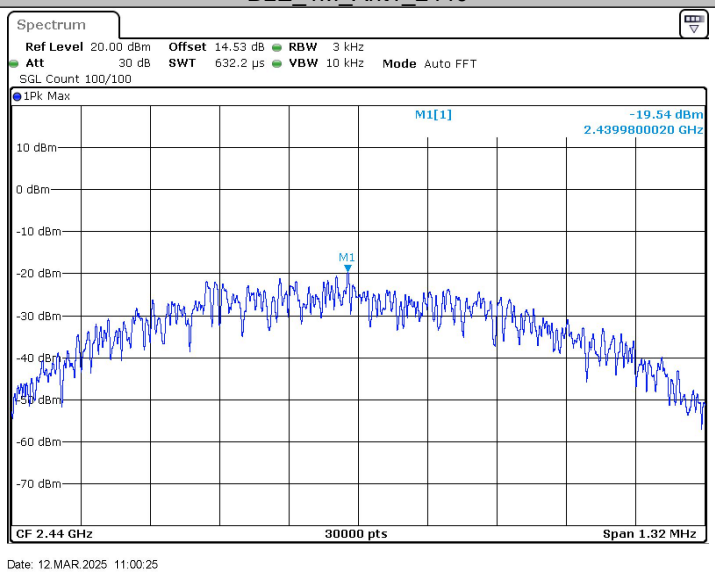
TestMode	Freq(MHz)	Result[dBm/3kHz]	Limit[dBm/3kHz]	Verdict
BLE_1M	2402	-19.93	≤8.00	PASS
	2440	-19.54	≤8.00	PASS
	2480	-19.16	≤8.00	PASS

Test plot as follows:

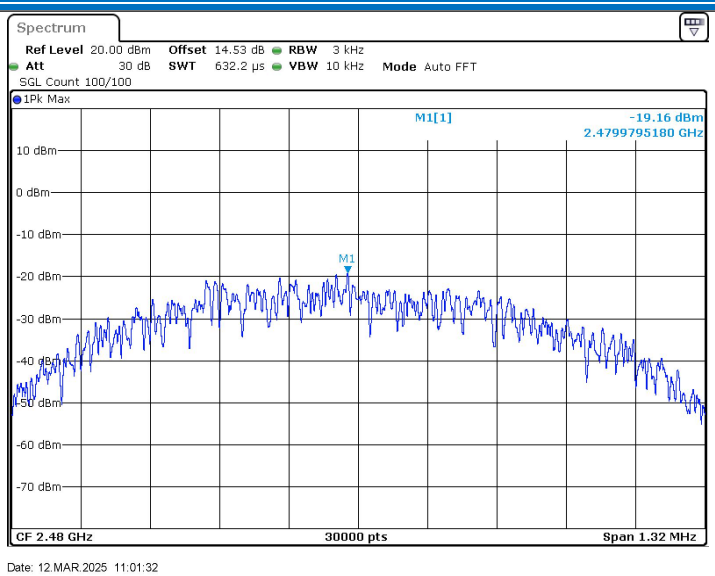
BLE_1M_Ant1_2402



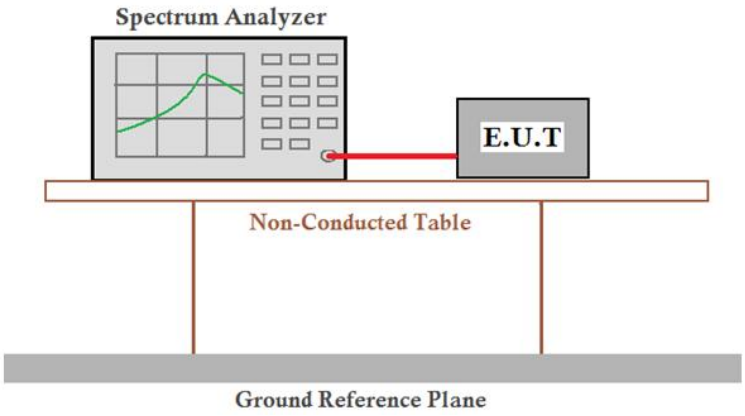
BLE_1M_Ant1_2440



BLE_1M_Ant1_2480


Spectrum
Ref Level 20.00 dBm Offset 14.53 dB RBW 3 kHz
Att 30 dB SWT 632.2 µs VBW 10 kHz Mode Auto FFT
SGL Count 100/100
1Pk Max
M1[1] -19.16 dBm
2.4799795180 GHz
M1
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.48 GHz
30000 pts
Span 1.32 MHz
Date: 12.MAR.2025 11:01:32

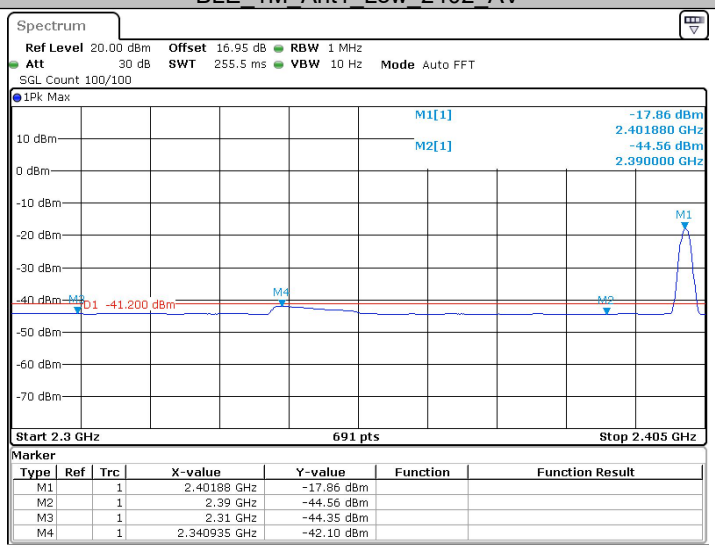
5.6 Band-edge for RF Conducted Emissions

Test Requirement:	47 CFR Part 15C Section 15.247 (d)
Test Method:	ANSI C63.10 2013
Test Setup:	 *Remark: Offset=Cable loss+ attenuation factor.*
Limit:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.
Test Mode:	Transmitting with GFSK modulation.
Test Results:	Pass

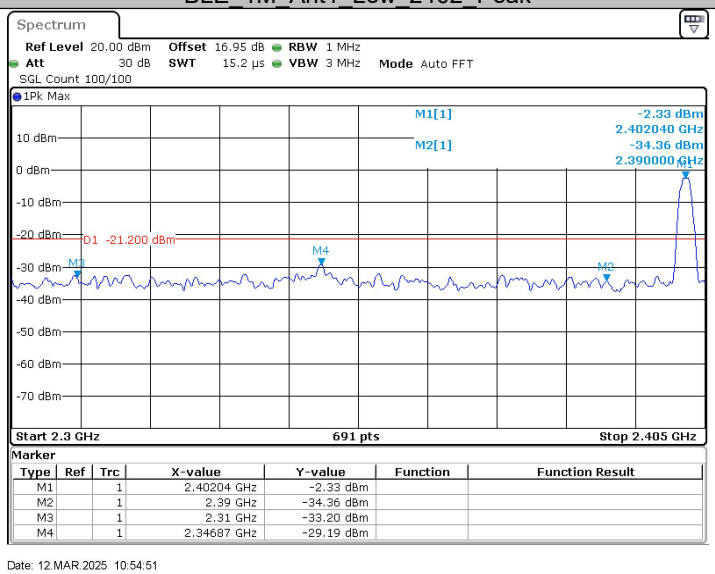
ChName	Freq(MHz)	Detector	Freq [MHz]	Result [dBm]	Limit [dBm]	Result [dBuV/m]	Limit [dBuV/m]	Verdict
Low	2402	AV	2310.000	-44.35	≤-41.20	50.85	≤54	PASS
		AV	2340.935	-42.1	≤-41.20	53.10	≤54	PASS
		AV	2390.000	-44.56	≤-41.20	50.64	≤54	PASS
		Peak	2310.000	-33.2	≤-21.20	62.00	≤74	PASS
		Peak	2346.870	-29.19	≤-21.20	66.01	≤74	PASS
		Peak	2390.000	-34.36	≤-21.20	60.84	≤74	PASS
High	2480	AV	2483.500	-44.39	≤-41.20	50.81	≤54	PASS
		AV	2483.913	-44.3	≤-41.20	50.90	≤54	PASS
		AV	2500.000	-44.48	≤-41.20	50.72	≤54	PASS
		Peak	2483.500	-38.25	≤-21.20	56.95	≤74	PASS
		Peak	2491.565	-32.15	≤-21.20	63.05	≤74	PASS
		Peak	2500.000	-36.13	≤-21.20	59.07	≤74	PASS

Test plot as follows:

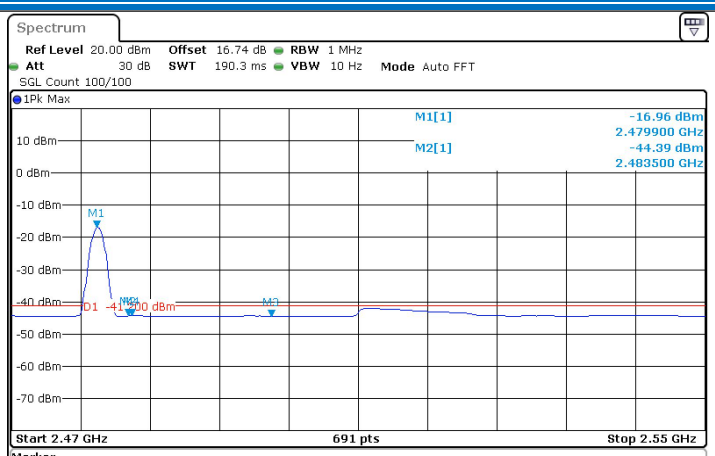
BLE_1M_Ant1_Low_2402_AV



BLE_1M_Ant1_Low_2402_Peak



BLE_1M_Ant1_High_2480_AV

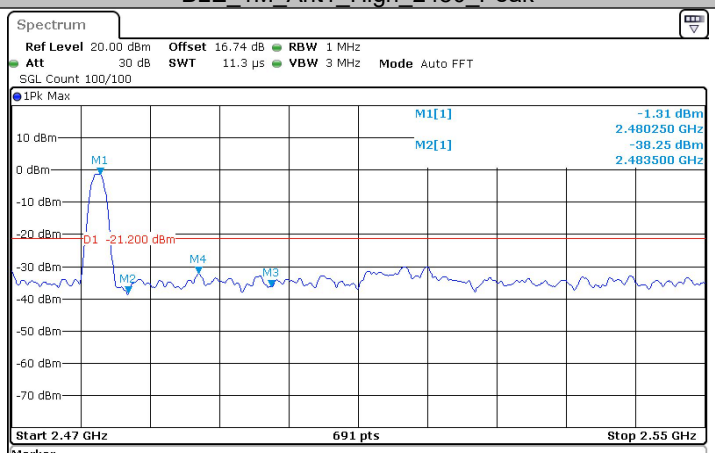


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4799 GHz	-16.96 dBm		
M2		1	2.4835 GHz	-44.39 dBm		
M3		1	2.5 GHz	-44.48 dBm		
M4		1	2.483913 GHz	-44.30 dBm		

Date: 12.MAR.2025 11:03:00

BLE_1M_Ant1_High_2480_Peak

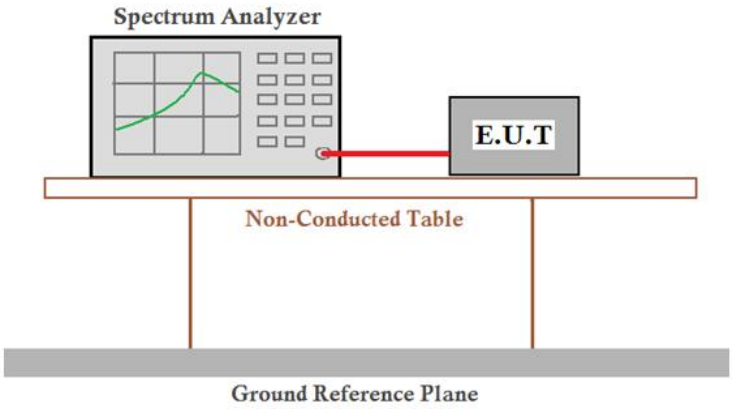


Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.48025 GHz	-1.31 dBm		
M2		1	2.4835 GHz	-38.25 dBm		
M3		1	2.5 GHz	-36.13 dBm		
M4		1	2.491565 GHz	-32.15 dBm		

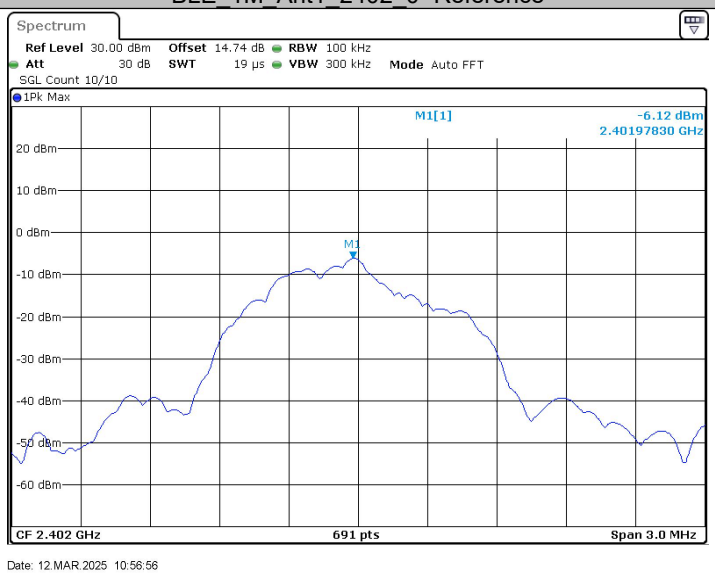
Date: 12.MAR.2025 11:01:50

5.7 Spurious RF Conducted Emissions

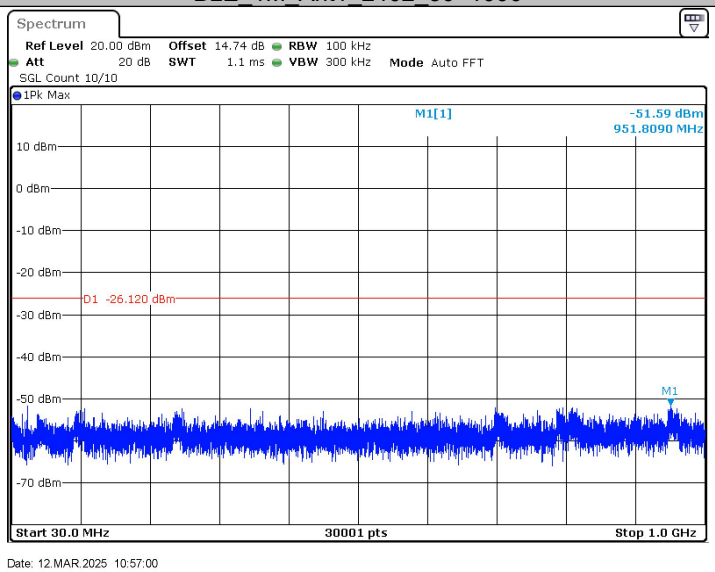
Test Requirement:	47 CFR Part 15C Section 15.247 (d)
Test Method:	ANSI C63.10 2013
Test Setup:	 *Remark: Offset=Cable loss+ attenuation factor.*
Limit:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.
Test Mode:	Transmitting with GFSK modulation.
Test Results:	Pass

Test plot as follows:

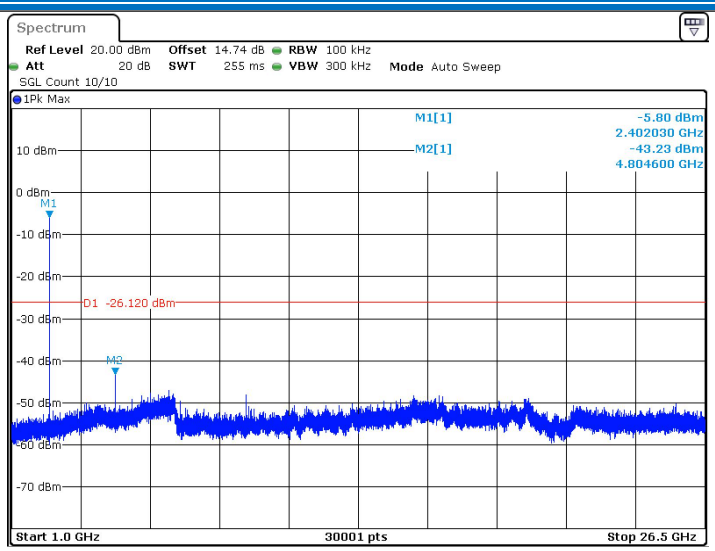
BLE_1M_Ant1_2402_0~Reference



BLE_1M_Ant1_2402_30~1000

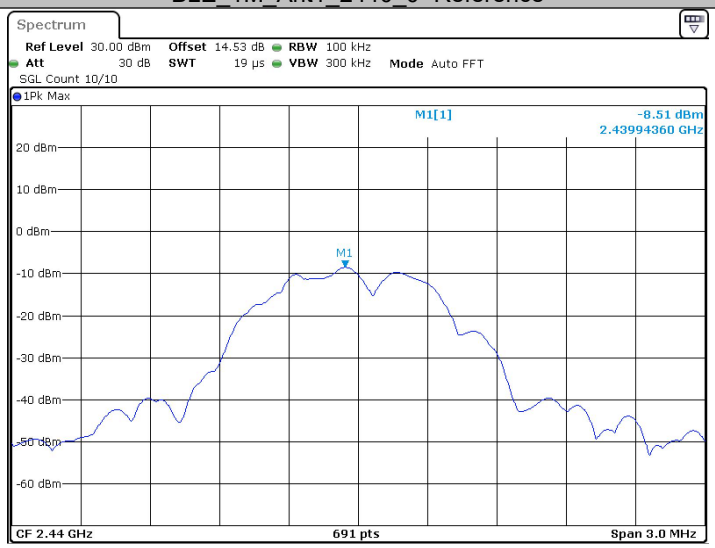


BLE_1M_Ant1_2402_1000~26500



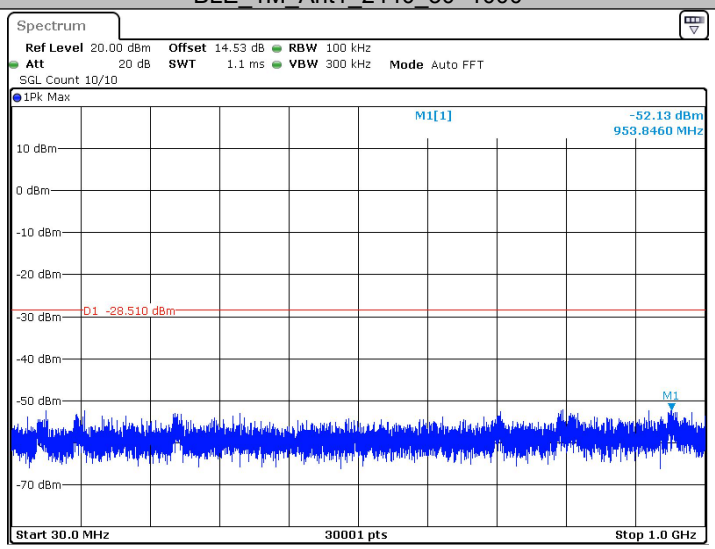
Date: 12.MAR.2025 10:57:11

BLE_1M_Ant1_2440_0~Reference



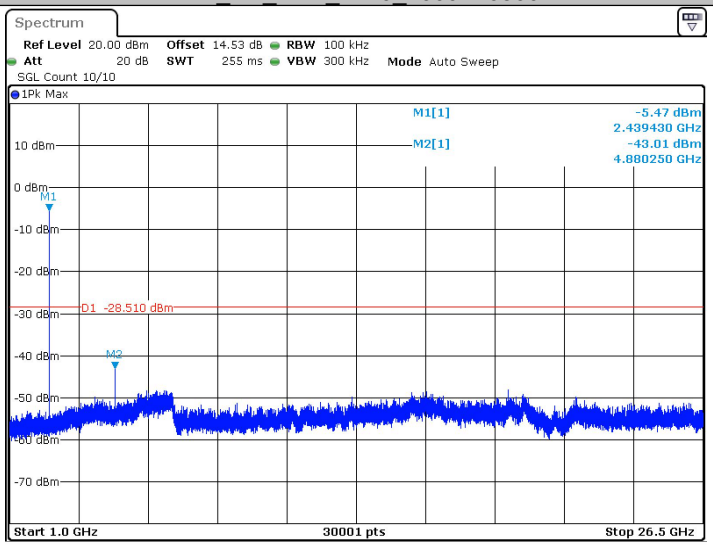
Date: 12.MAR.2025 11:00:29

BLE_1M_Ant1_2440_30~1000



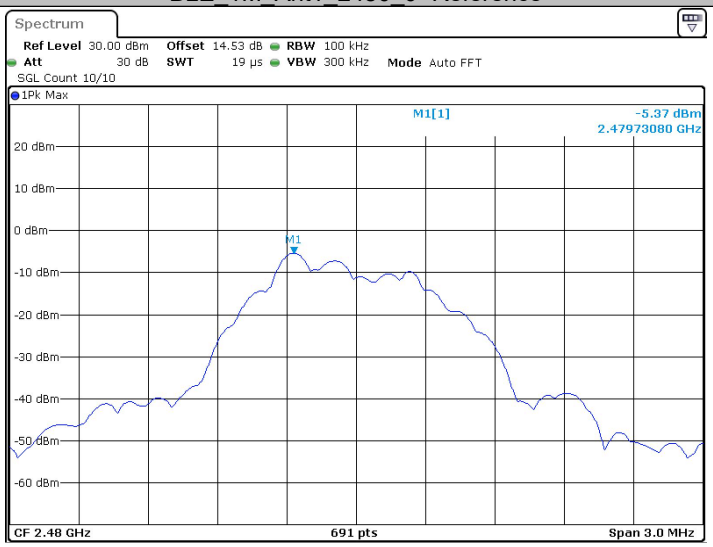
Date: 12.MAR.2025 11:00:33

BLE_1M_Ant1_2440_1000~26500



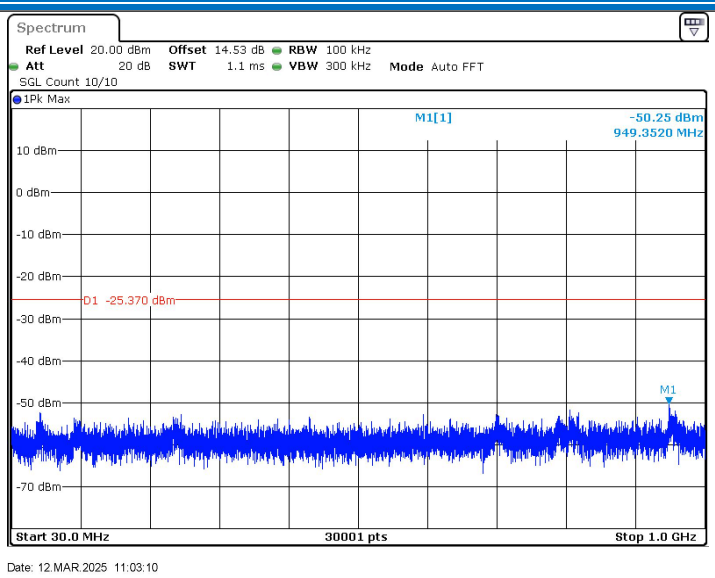
Date: 12.MAR.2025 11:00:44

BLE_1M_Ant1_2480_0~Reference

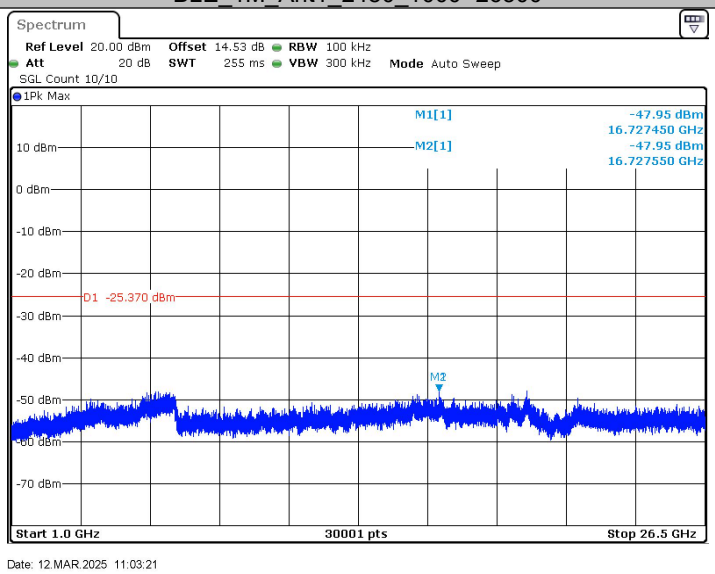


Date: 12.MAR.2025 11:03:05

BLE_1M_Ant1_2480_30~1000



BLE_1M_Ant1_2480_1000~26500



Remark:

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

5.8 Radiated Spurious Emission & Restricted bands

5.8.1 Spurious Emissions

Test Requirement:	47 CFR Part 15C Section 15.209 and 15.205
Test Method:	ANSI C63.10 2013
Test Site:	Measurement Distance: 3m (Semi-Anechoic Chamber)

Receiver Setup:

Frequency	Detector	RBW	VBW	Remark
0.009MHz-0.090MHz	Peak	10kHz	30kHz	Peak
0.009MHz-0.090MHz	Average	10kHz	30kHz	Average
0.090MHz-0.110MHz	Quasi-peak	10kHz	30kHz	Quasi-peak
0.110MHz-0.490MHz	Peak	10kHz	30kHz	Peak
0.110MHz-0.490MHz	Average	10kHz	30kHz	Average
0.490MHz -30MHz	Quasi-peak	10kHz	30kHz	Quasi-peak
30MHz-1GHz	Quasi-peak	100 kHz	300kHz	Quasi-peak
Above 1GHz	Peak	1MHz	3MHz	Peak
	Peak	1MHz	10Hz	Average

Limit:

Frequency	Field strength (microvolt/meter)	Limit (dBuV/m)	Remark	Measurement distance (m)
0.009MHz-0.490MHz	2400/F(kHz)	-	-	300
0.490MHz-1.705MHz	24000/F(kHz)	-	-	30
1.705MHz-30MHz	30	-	-	30
30MHz-88MHz	100	40.0	Quasi-peak	3
88MHz-216MHz	150	43.5	Quasi-peak	3
216MHz-960MHz	200	46.0	Quasi-peak	3
960MHz-1GHz	500	54.0	Quasi-peak	3
Above 1GHz	500	54.0	Average	3

Note: 15.35(b), Unless otherwise specified, the limit on peak radio frequency emissions is 20dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device.

Test Setup:	

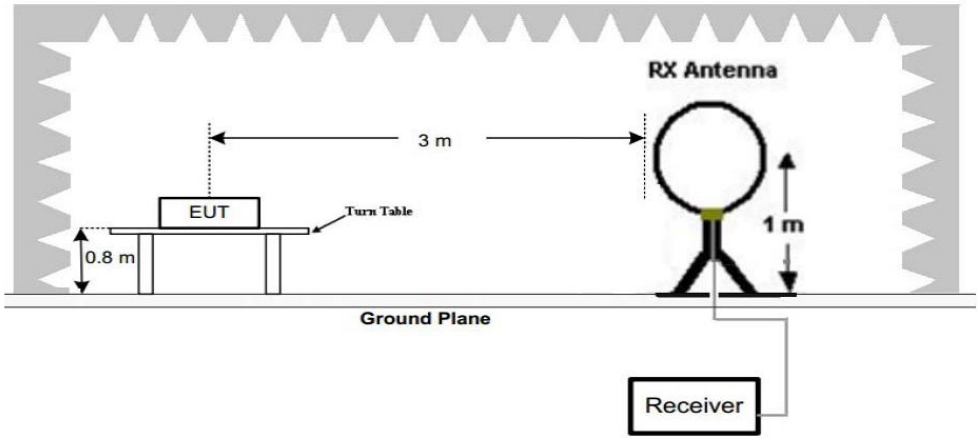


Figure 1. Below 30MHz

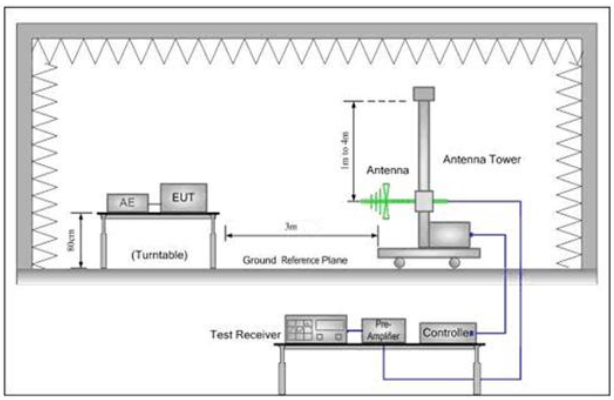


Figure 2. 30MHz to 1GHz

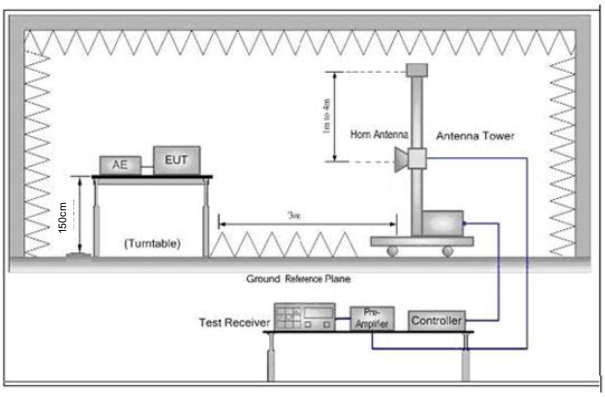


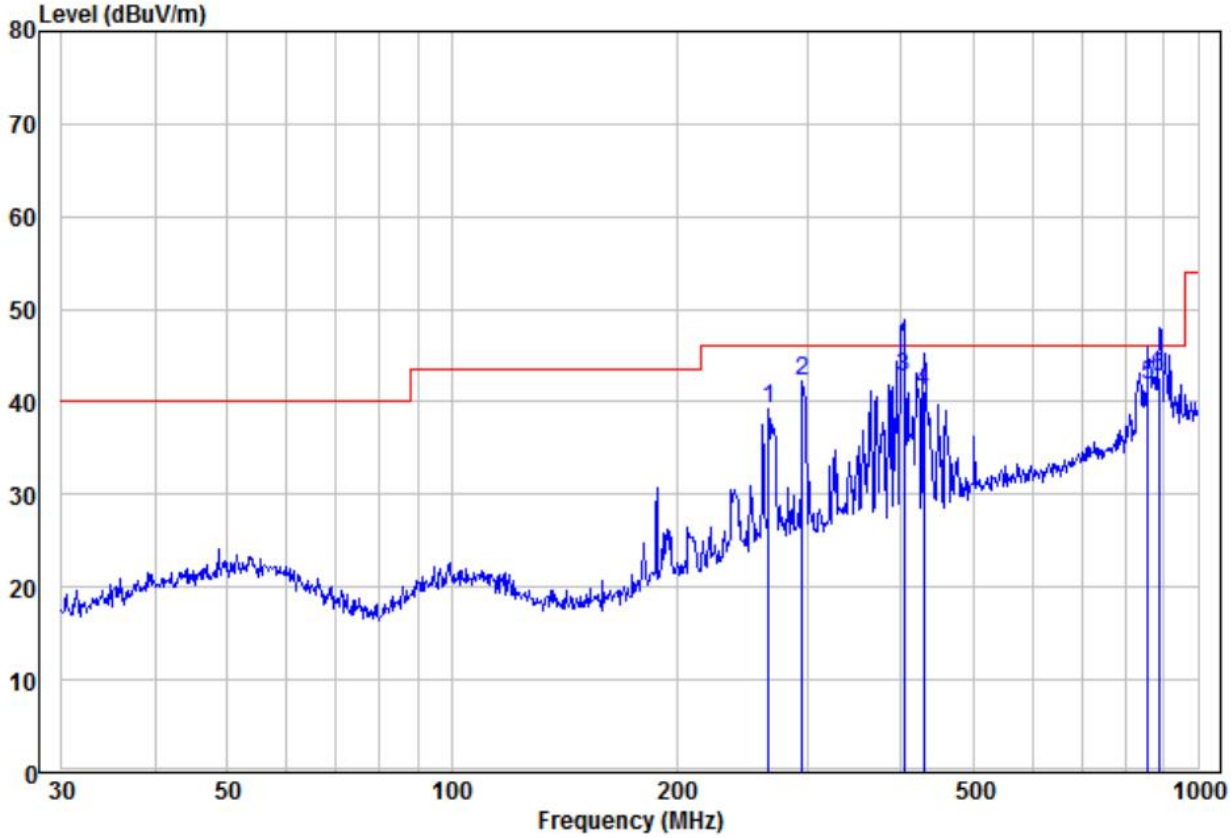
Figure 3. Above 1 GHz

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

	horizontal and vertical polarizations of the antenna are set to make the measurement. d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading. e. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet. g. Test the EUT in the lowest channel (2402MHz),the middle channel (2440MHz),the Highest channel (2480MHz) h. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case. i. Repeat above procedures until all frequencies measured was complete.
Exploratory Test Mode:	Transmitting with GFSK modulation. Transmitting mode.
Final Test Mode:	Through Pre-scan, find the 1Mbps of data type and GFSK modulation is the worst case. For below 1GHz part, through pre-scan, the worst case is the highest channel. Only the worst case is recorded in the report.
Test Results:	Pass

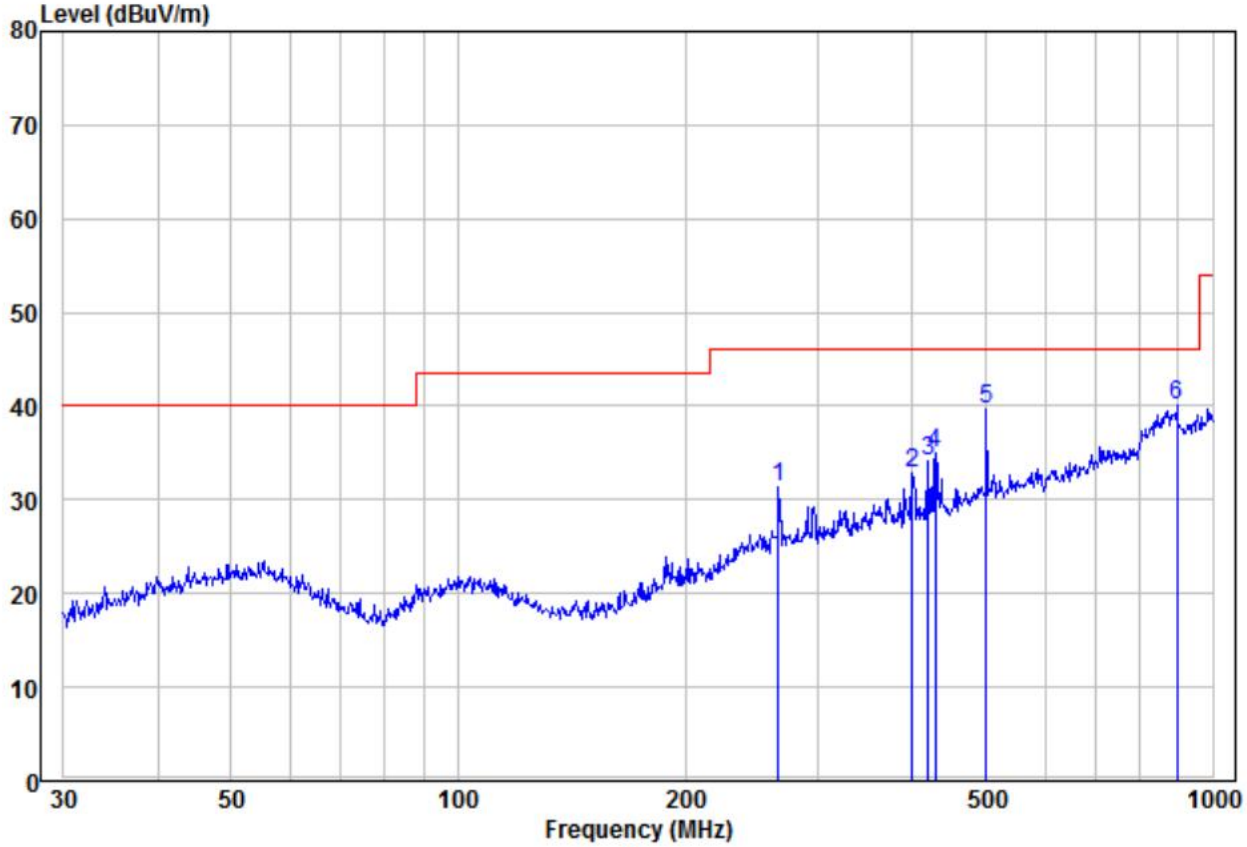
Radiated Emission below 1GHz

30MHz~1GHz, the worst case		
Test mode:	Transmitting mode	Horizontal



	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark	Pol/Phase
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		
1	265.68	22.45	16.81	39.26	46.00	-6.74	Peak	HORIZONTAL
2 pk	295.15	24.67	17.64	42.31	46.00	-3.69	Peak	HORIZONTAL
3 pp	403.25	23.50	19.26	42.76	46.00	-3.24	QP	HORIZONTAL
4	429.52	21.40	19.83	41.23	46.00	-4.77	QP	HORIZONTAL
5	857.02	12.60	29.16	41.76	46.00	-4.24	QP	HORIZONTAL
6	887.61	13.10	29.62	42.72	46.00	-3.28	QP	HORIZONTAL

30MHz~1GHz, the worst case		
Test mode:	Transmitting mode	Vertical



	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark	Pol/Phase
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		
1	265.68	14.56	16.81	31.37	46.00	-14.63	Peak	VERTICAL
2	400.43	13.69	19.20	32.89	46.00	-13.11	Peak	VERTICAL
3	420.58	14.53	19.63	34.16	46.00	-11.84	Peak	VERTICAL
4	429.52	15.13	19.83	34.96	46.00	-11.04	Peak	VERTICAL
5	501.18	17.91	21.84	39.75	46.00	-6.25	Peak	VERTICAL
6 pp	897.00	10.49	29.56	40.05	46.00	-5.95	Peak	VERTICAL

Transmitter Emission above 1GHz

Worse case mode:		GFSK(1Mbps)		Test channel:		Lowest	
Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Over (dB)	Detector Type	Ant. Pol. H/V
2390	54.93	-9.2	45.73	74	-28.27	**Peak**	**H**
2400	55.01	-9.39	45.62	74	-28.38	Peak	H
4804	51.73	-4.33	47.40	74	-26.60	Peak	H
7206	50.60	1.01	51.61	74	-22.39	Peak	H
2390	53.26	-9.2	44.06	74	-29.94	**Peak**	**V**
2400	51.96	-9.39	42.57	74	-31.43	Peak	V
4804	53.33	-4.33	49.00	74	-25.00	Peak	V
7206	49.34	1.01	50.35	74	-23.65	Peak	V

Worse case mode:		GFSK(1Mbps)		Test channel:		Middle	
Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Over (dB)	Detector Type	Ant. Pol. H/V
4880	51.49	-4.11	47.38	74	-26.62	peak	H
7320	50.87	1.51	52.38	74	-21.62	peak	H
4880	52.99	-4.11	48.88	74	-25.12	peak	V
7320	50.25	1.51	51.76	74	-22.24	peak	V

Worse case mode:		GFSK(1Mbps)		Test channel:		Highest	
Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Over (dB)	Detector Type	Ant. Pol. H/V
2483.5	**55.64**	**-9.29**	**46.35**	**74**	**-27.65**	**Peak**	**H**
4960	50.77	-4.04	46.73	74	-27.27	Peak	H
7440	48.53	1.57	50.10	74	-23.90	Peak	H
2483.5	**55.64**	**-9.29**	**46.35**	**74**	**-27.65**	**Peak**	**V**
4960	51.47	-4.04	47.43	74	-26.57	Peak	V
7440	49.02	1.57	50.59	74	-23.41	Peak	V

Remark:

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

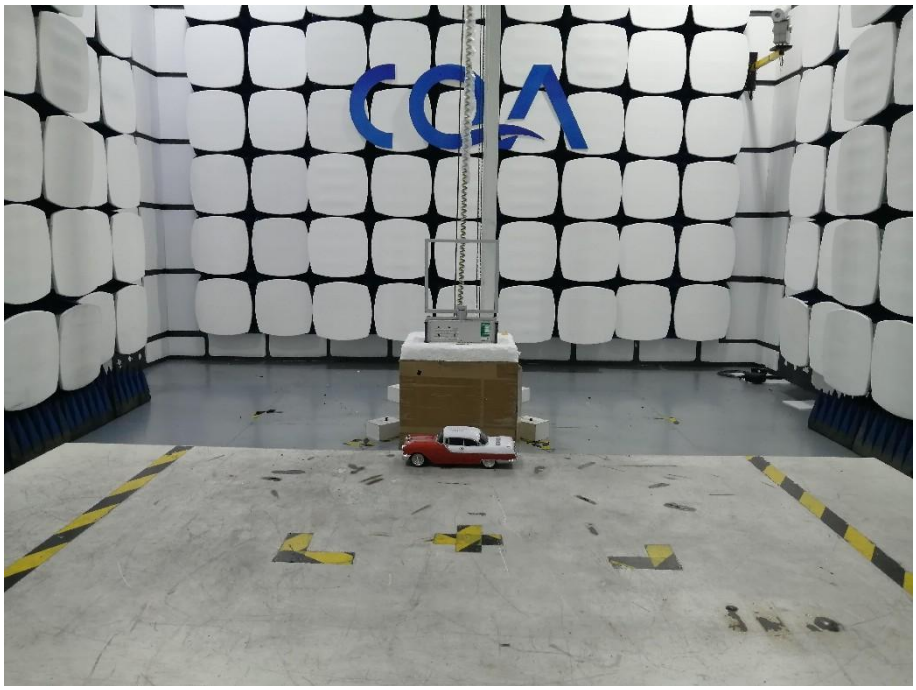
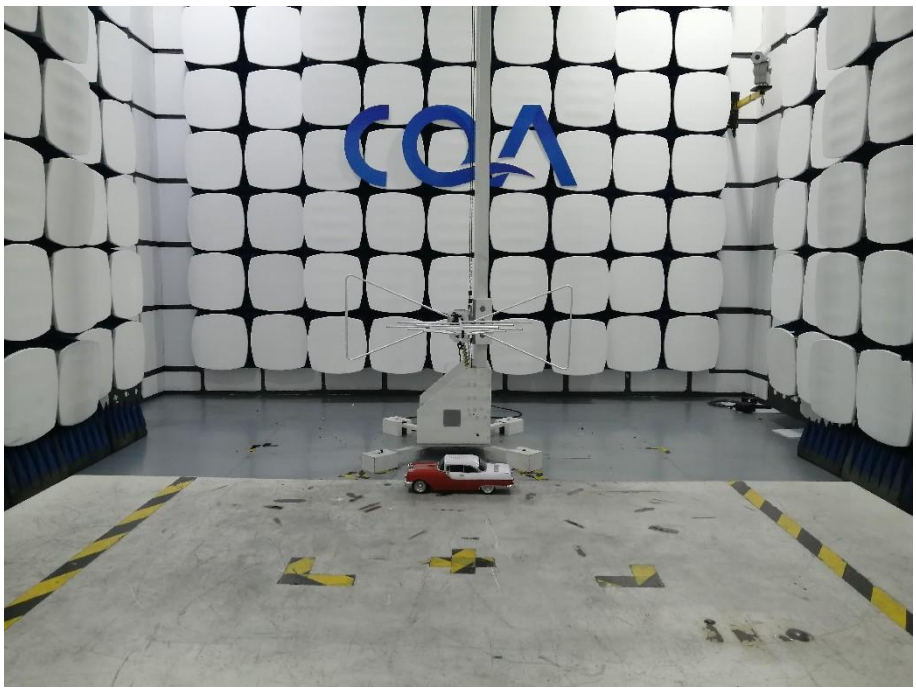
   Final Test Level =Receiver Reading + Antenna Factor + Cable Factor – Preamplifier Factor

2) Scan from 9kHz to 25GHz, the disturbance above 10GHz and below 30MHz was very low. As shown in this section, for frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. So, only the peak measurements were shown in the report.

6 Photographs - EUT Test Setup

6.1 Radiated Spurious Emission

9kHz~30MHz:



30MHz~1GHz: