SGS-CSTC Standards Technical Services Co., Ltd.
Shenzhen Branch

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FCC REPORT

Application No:	SZEM1611009663CR
Applicant:	Micro:bit Educational Foundation
Manufacturer:	Micro:bit Educational Foundation
Factory:	Micro:bit Educational Foundation
Product Name:	BBC micro:bit
Model No.(EUT):	V1.3B
FCC ID:	2AKFPMB013B
Standards:	47 CFR Part 15, Subpart C (2015)
Date of Receipt:	2016-11-21
Date of Test:	2016-11-22 to 2016-11-28
Date of Issue:	2016-12-01
Test Result:	**PASS ***

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

Authorized Signature:

Jack Zhang
EMC Laboratory Manager

The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards. Any mention of SGS International Electrical Approvals or testing done by SGS International Electrical Approvals in connection with, distribution or use of the product described in this report must be approved by SGS International Electrical Approvals in writing.
The report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the federal government. All test results in this report can be traceable to National or International Standards.

2 Version

Revision Record				
Version	**Chapter**	**Date**	**Modifier**	**Remark**
00		2016-12-01		Original

Authorized for issue by:				
Tested By		Hank yan. **(Hank Yan) /Project Engineer**		2016-11-28 **Date**
Checked By		Eric Fu **(Eric Fu) /Reviewer**		2016-12-01 **Date**

3 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

4 Contents

5 General Information

5.1 Client Information

Applicant:	Micro:bit Educational Foundation
Address of Applicant:	12 New Fetter Lane, London, United Kingdom
Manufacturer:	Micro:bit Educational Foundation
Address of Manufacturer:	12 New Fetter Lane, London, United Kingdom
Factory:	Micro:bit Educational Foundation
Address of Factory:	12 New Fetter Lane, London, United Kingdom

5.2 General Description of EUT

Product Name:	BBC micro:bit
Model No.:	V1.3B
Operation Frequency:	2402MHz~2480MHz
Bluetooth Version:	V4.0 BLE
Modulation Type:	GFSK
Number of Channel:	40
Antenna Type:	Integral
Antenna Gain:	0dBi
Power Supply:	3.0V DC (1.5V x 2 "AAA" Size Batteries) Or DC 5.0V by USB port
Cable:	USB Cable: 10cm shield

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

5.3 Test Environment

Operating Environment:	
Temperature:	25.0 °C
Humidity:	53 % RH
Atmospheric Pressure:	1010mbar

5.4 Description of Support Units

The EUT has been tested independent unit.

5.5 Test Location

All tests were performed at:

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen Branch
No. 1 Workshop, M-10, Middle Section, Science & Technology Park, Shenzhen, Guangdong, China. 518057.
Tel: +86 755 2601 2053 Fax: +86 755 2671 0594
No tests were sub-contracted.

5.6 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

• **CNAS (No. CNAS L2929)**

CNAS has accredited SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch EMC Lab to ISO/IEC 17025:2005 General Requirements for the Competence of Testing and Calibration Laboratories (CNAS-CL01 Accreditation Criteria for the Competence of Testing and Calibration Laboratories) for the competence in the field of testing.

• **A2LA (Certificate No. 3816.01)**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 3816.01.

• **VCCI**

The 10m Semi-anechoic chamber and Shielded Room of SGS-CSTC Standards Technical Services Co., Ltd. have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: G-823, R-4188, T-1153 and C-2383 respectively.

• **FCC – Registration No.: 556682**

SGS-CSTC Standards Technical Services 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.: 556682.

• **Industry Canada (IC)**

Two 3m Semi-anechoic chambers and the 10m Semi-anechoic chamber of SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch EMC Lab have been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 4620C-1, 4620C-2, 4620C-3.

5.7 Deviation from Standards

None.

5.8 Abnormalities from Standard Conditions

None.

5.9 Other Information Requested by the Customer

None.

5.10 Equipment List

Conducted Emission						
Item	**Test Equipment**	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal. Date (yyyy-mm-dd)**	**Cal. Due date (yyyy-mm-dd)**
1	Shielding Room	ZhongYu Electron	GB-88	SEM001-06	2016-05-13	2017-05-13
2	LISN	Rohde & Schwarz	ENV216	SEM007-01	2016-10-09	2017-10-09
3	LISN	ETS-LINDGREN	3816/2	SEM007-02	2016-04-25	2017-04-25
4	8 Line ISN	Fischer Custom Communications Inc.	FCC-TLISN-T8-02	EMC0120	2016-09-28	2017-09-28
5	4 Line ISN	Fischer Custom Communications Inc.	FCC-TLISN-T4-02	EMC0121	2016-09-28	2017-09-28
6	2 Line ISN	Fischer Custom Communications Inc.	FCC-TLISN-T2-02	EMC0122	2016-09-28	2017-09-28
7	EMI Test Receiver	Rohde & Schwarz	ESCI	SEM004-02	2016-04-25	2017-04-25
8	DC Power Supply	Zhao Xin	RXN-305D	SEM011-02	2016-10-09	2017-10-09

RE in Chamber						
Item	**Test Equipment**	**Manufacturer**	**Model No.**	**Inventory No**	**Cal. Date (yyyy-mm-dd)**	**Cal. Due date (yyyy-mm-dd)**
1	10m Semi-Anechoic Chamber	SAEMC	FSAC1018	SEM001-03	2016-05-13	2017-05-13
2	EMI Test Receiver (9k-7GHz)	Rohde & Schwarz	ESR	SEM004-03	2016-04-25	2017-04-25
3	Trilog-Broadband Antenna(30M-1GHz)	Schwarzbeck	VULB9168	SEM003-18	2016-06-29	2019-06-29
4	Pre-amplifier	Sonoma Instrument Co	310N	SEM005-03	2016-07-06	2017-07-06
5	Loop Antenna	ETS-Lindgren	6502	SEM003-08	2015-08-14	2018-08-14

RE in Chamber						
Item	**Test Equipment**	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal. Date (yyyy-mm-dd)**	**Cal. Due date (yyyy-mm-dd)**
1	3m Semi-Anechoic Chamber	AUDIX	N/A	SEM001-02	2016-05-13	2017-05-13
2	EXA Spectrum Analyzer	Agilent Technologies Inc	N9010A	SEM004-09	2016-07-19	2017-07-19
3	BiConiLog Antenna (26-3000MHz)	ETS-Lindgren	3142C	SEM003-02	2014-11-15	2017-11-15
4	Amplifier (0.1-1300MHz)	HP	8447D	SEM005-02	2016-10-09	2017-10-09
5	Horn Antenna (1-18GHz)	Rohde & Schwarz	HF907	SEM003-07	2015-06-14	2018-06-14
6	Horn Antenna (18-26GHz)	ETS-Lindgren	3160	SEM003-12	2014-11-24	2017-11-24
7	Horn Antenna(26GHz-40GHz)	A.H.Systems, inc.	SAS-573	SEM003-13	2015-02-12	2018-02-12
8	Low Noise Amplifier	Black Diamond Series	BDLNA-0118-352810	SEM005-05	2016-10-09	2017-10-09
9	Band filter	Amindeon	Asi 3314	SEM023-01	N/A	N/A

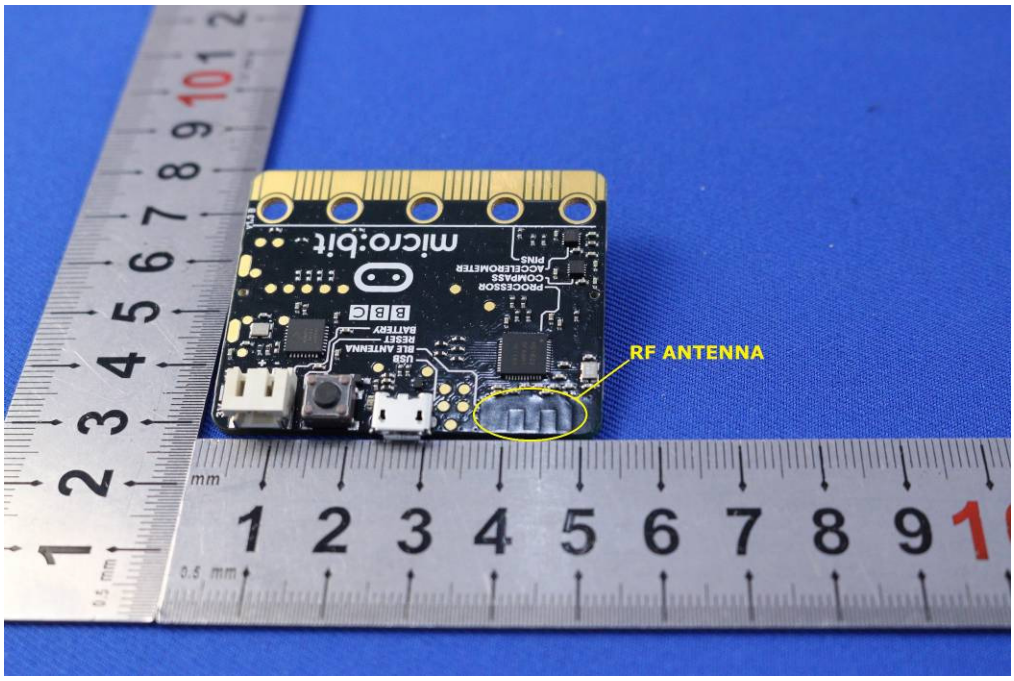
6 Test results and Measurement Data

6.1 Antenna Requirement

Standard requirement:	47 CFR Part 15C Section 15.203 /247(c)

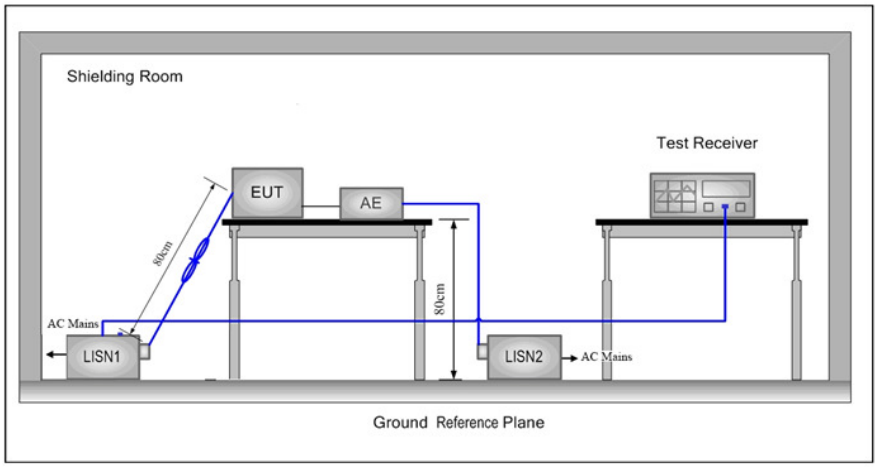
15.203 requirement:
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer 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 integrated on the main PCB and no consideration of replacement. The best case gain of the antenna is 0dBi.

6.2 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:	Transmitting with GFSK modulation. Transmitting mode.

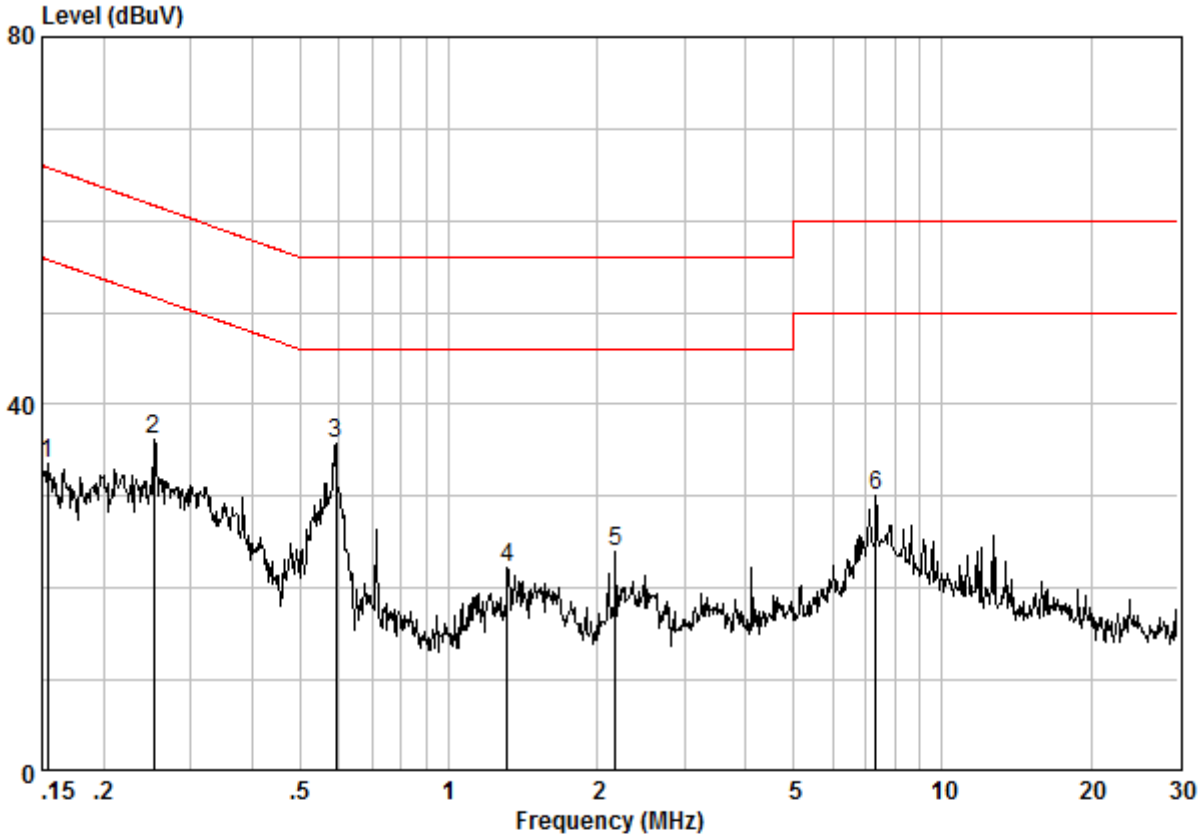
Instruments Used:	Refer to section 5.10 for details.
Test Results:	Pass

Measurement Data

An initial pre-scan was performed on the live and neutral lines with peak detector.

Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission were detected.

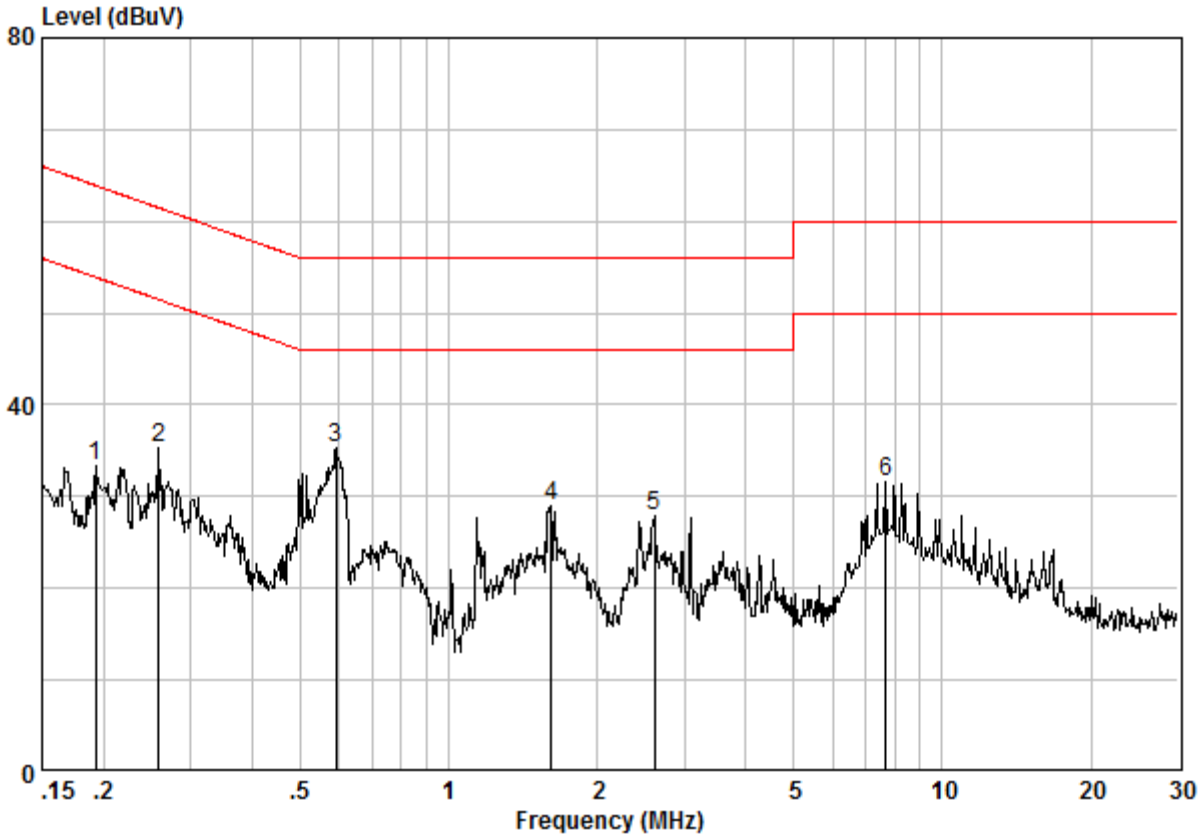
Live line:



Site : Shielding Room
Condition : CE LINE
Job No. : 9663CR
Test Mode : TX

	Freq	Cable Loss	LISN Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB	dBuV	dBuV	dBuV	dB	
1	0.15403	0.02	9.59	24.00	33.62	55.78	-22.16	Peak
2	0.25211	0.02	9.60	26.56	36.18	51.69	-15.51	Peak
3	0.59164	0.02	9.61	26.10	35.73	46.00	-10.27	Peak
4	1.317	0.03	9.60	12.64	22.27	46.00	-23.73	Peak
5	2.178	0.03	9.63	14.43	24.09	46.00	-21.91	Peak
6	7.329	0.09	9.68	20.28	30.05	50.00	-19.95	Peak

Neutral line:



Site : Shielding Room
Condition : CE NEUTRAL
Job No. : 9663CR
Test Mode : TX

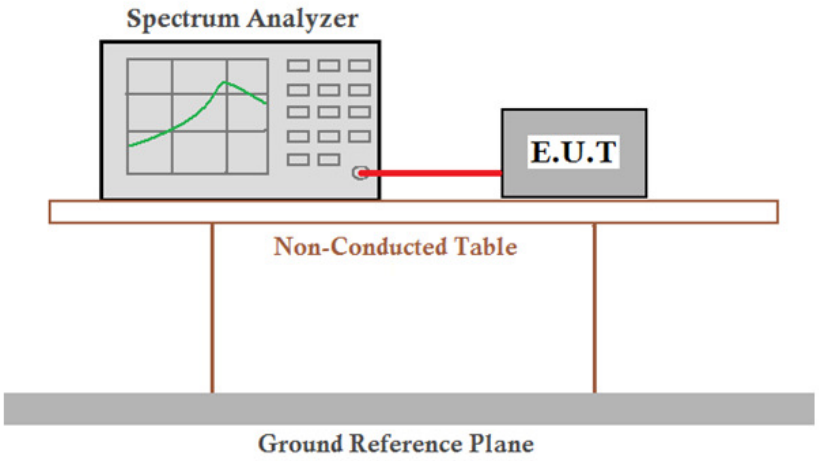
	Freq	Cable Loss	LISN Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB	dB	dBuV	dBuV	dBuV	dB	
1	0.19242	0.02	9.62	23.70	33.34	53.93	-20.59	Peak
2	0.25888	0.02	9.61	25.60	35.23	51.47	-16.24	Peak
3	0.59164	0.02	9.63	25.70	35.35	46.00	-10.65	Peak
4	1.610	0.03	9.64	19.22	28.89	46.00	-17.11	Peak
5	2.608	0.03	9.67	18.10	27.80	46.00	-18.20	Peak
6	7.687	0.09	9.75	21.77	31.62	50.00	-18.38	Peak

Notes:

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

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

6.3 Conducted Peak Output Power

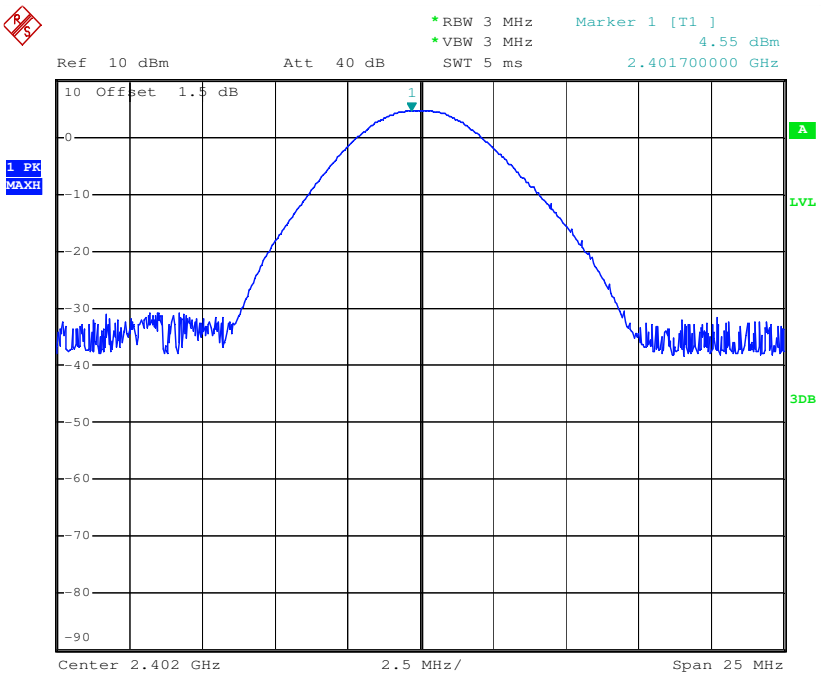
Test Requirement:	47 CFR Part 15C Section 15.247 (b)(1)
Test Method:	ANSI C63.10 :2013 Section 11.9.1
Test Setup:	 *Remark:* *Offset the High-Frequency cable loss 1.5dB in the spectrum analyzer.*
Limit:	30dBm
Test Mode:	Transmitting with GFSK modulation. Pretest the EUT at Transmitting mode (powered by battery) and Transmitting mode (powered by USB port), found the Transmitting mode (powered by battery) which it is worse case. Only the worst case is recorded in the report.
Instruments Used:	Refer to section 5.10 for details.
Test Results:	Pass

Measurement Data

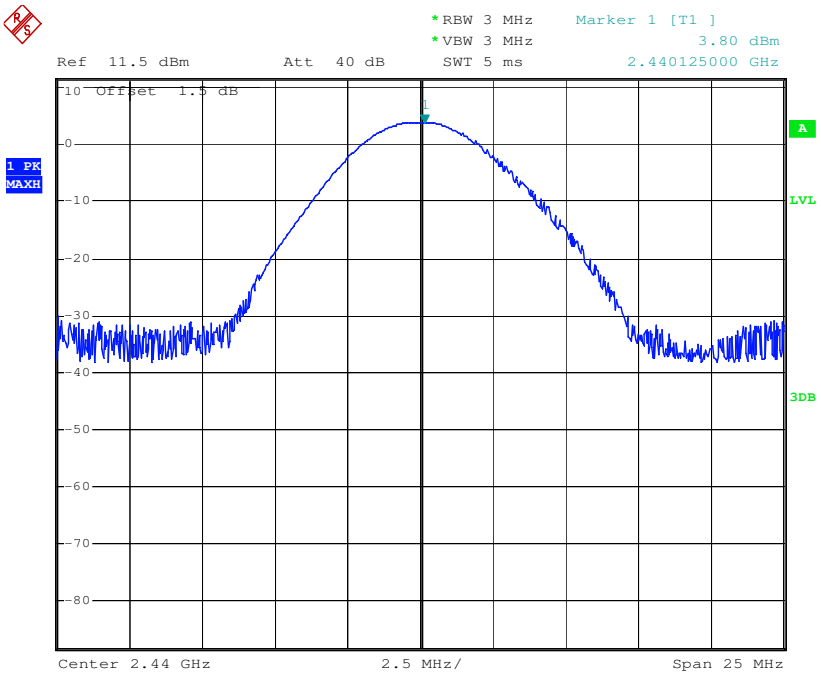
GFSK mode			
Test channel	Peak Output Power (dBm)	Limit (dBm)	Result
Lowest	4.55	30.00	Pass
Middle	3.80	30.00	Pass
Highest	2.39	30.00	Pass

Test plot as follows:

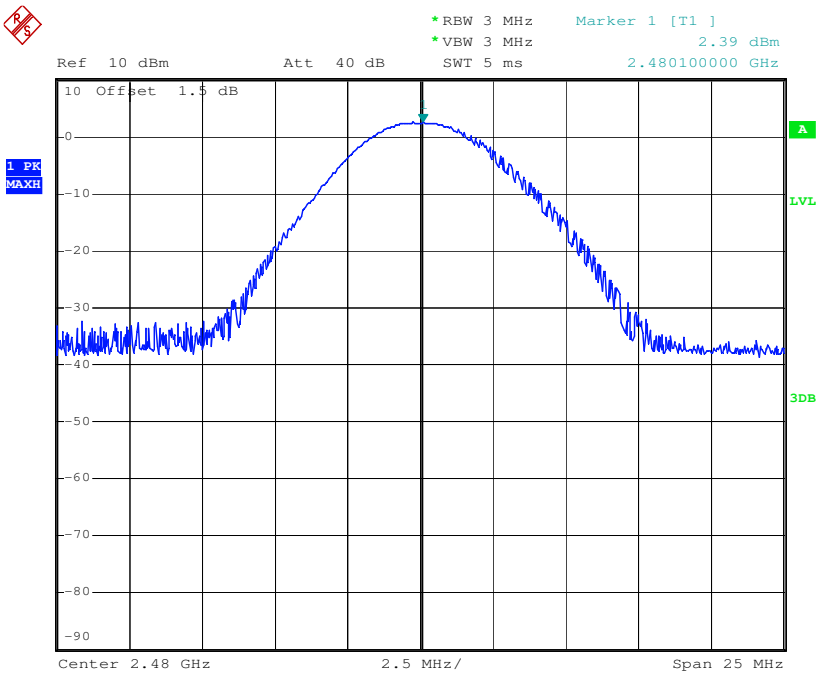
Test mode:	GFSK	Test channel:	Lowest



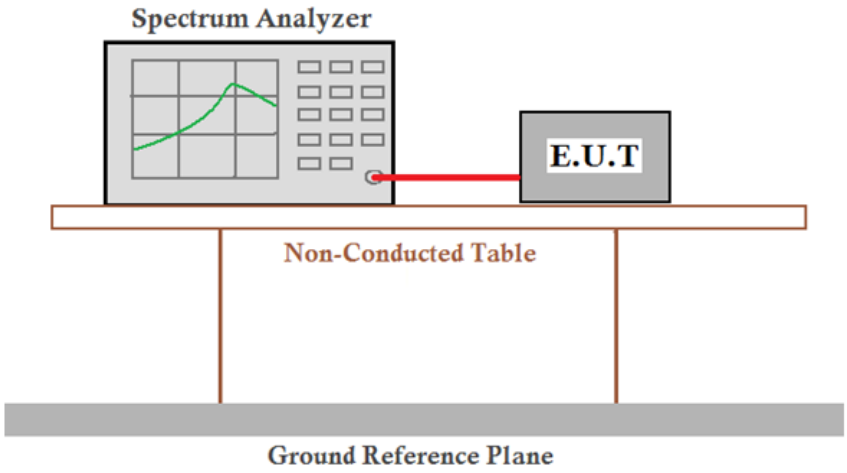
Test mode:	GFSK	Test channel:	Middle



Test mode:	GFSK	Test channel:	Highest



6.4 6dB Occupy Bandwidth

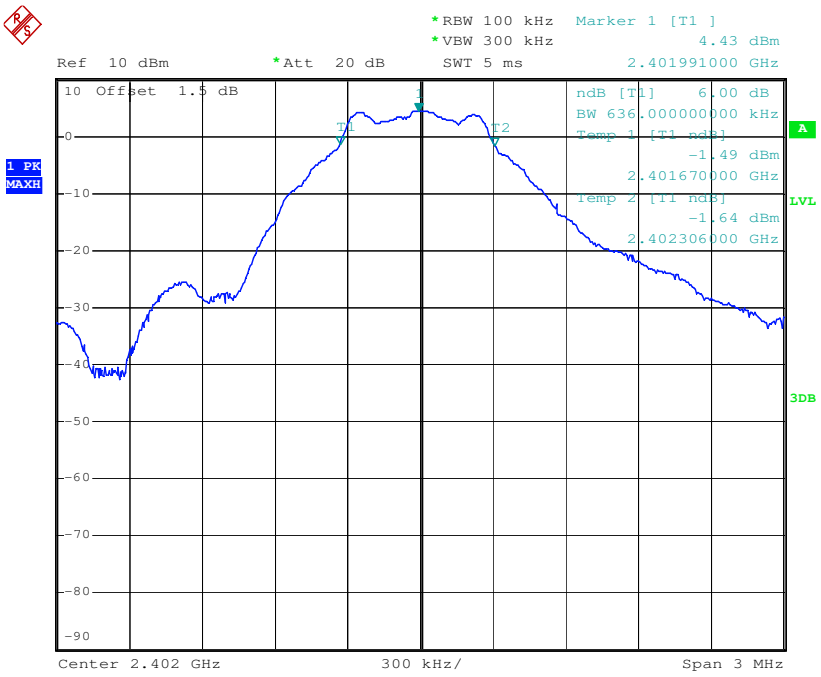
Test Requirement:	47 CFR Part 15C Section 15.247 (a)(2)
Test Method:	ANSI C63.10: 2013 Section 11.8
Test Setup:	
Limit:	≥ 500 kHz
Test Mode:	Transmitting with GFSK modulation. Pretest the EUT at Transmitting mode (powered by battery) and Transmitting mode (powered by USB port), found the Transmitting mode (powered by battery) which it is worse case. Only the worst case is recorded in the report.
Instruments Used:	Refer to section 5.10 for details.
Test Results:	Pass

Measurement Data

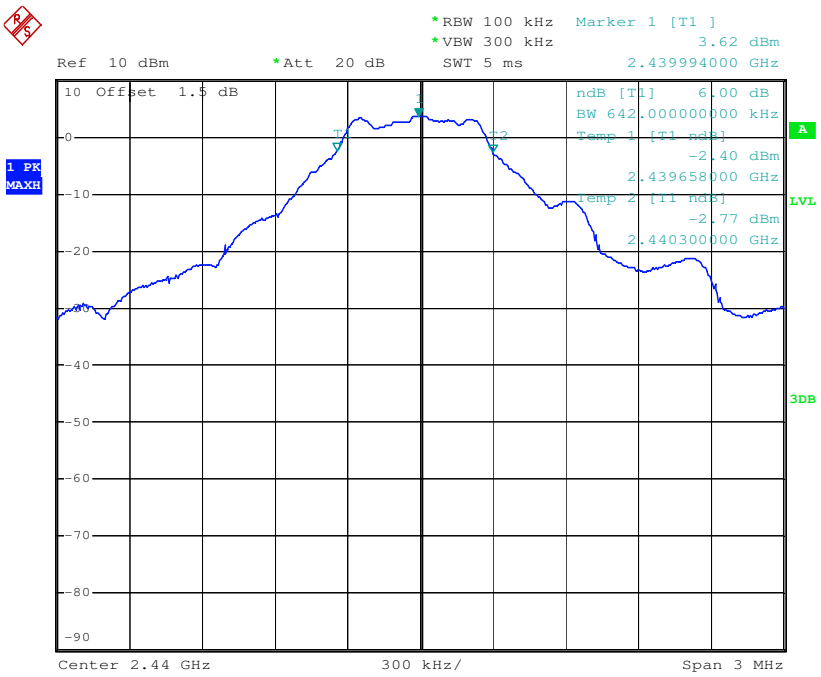
GFSK mode			
Test channel	6dB Occupy Bandwidth (MHz)	Limit (kHz)	Result
Lowest	0.636	≥500	Pass
Middle	0.642	≥500	Pass
Highest	0.642	≥500	Pass

Test plot as follows:

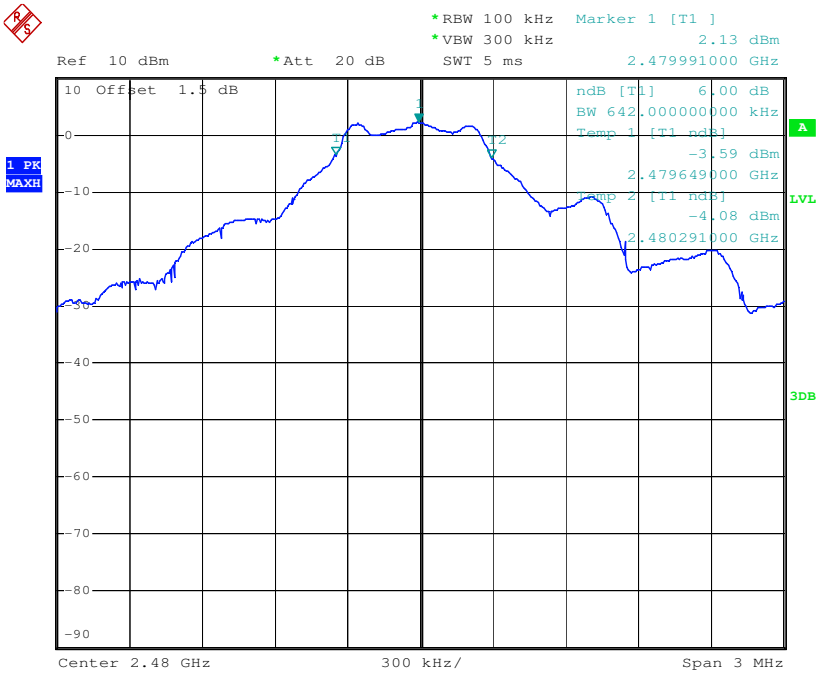
Test mode:	GFSK	Test channel:	Lowest



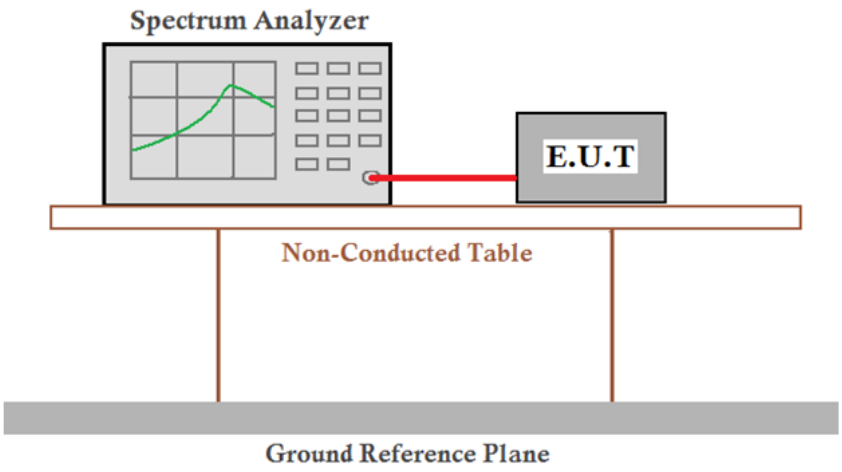
Test mode:	GFSK	Test channel:	Middle



Test mode:	GFSK	Test channel:	Highest



6.5 Power Spectral Density

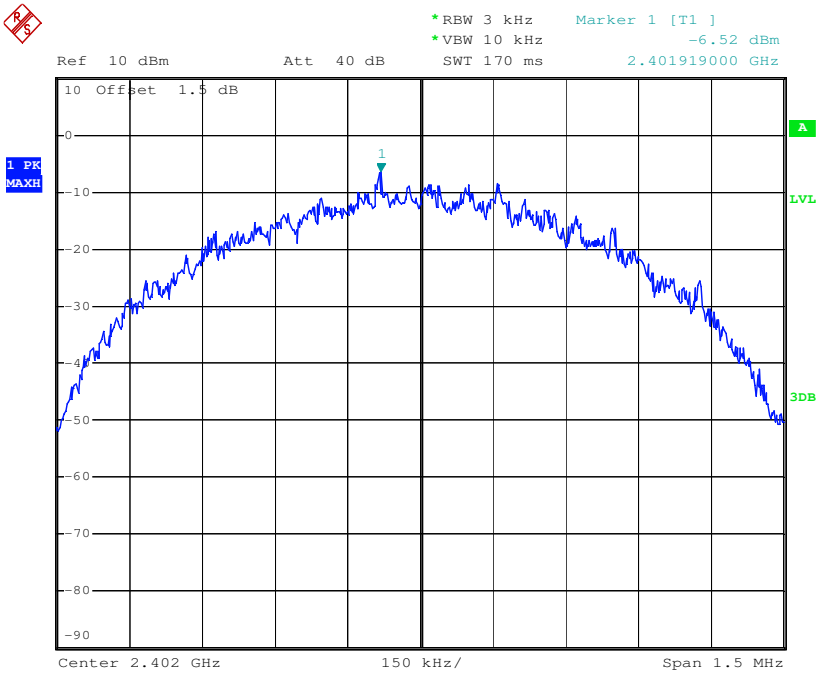
Test Requirement:	47 CFR Part 15C Section 15.247 (e)
Test Method:	ANSI C63.10 :2013 Section 11.10.2
Test Setup:	
Limit:	≤8.00dBm/3kHz
Test Mode:	Transmitting with GFSK modulation. Pretest the EUT at Transmitting mode (powered by battery) and Transmitting mode (powered by USB port), found the Transmitting mode (powered by battery) which it is worse case. Only the worst case is recorded in the report.
Instruments Used:	Refer to section 5.10 for details.
Test Results:	Pass

Measurement Data

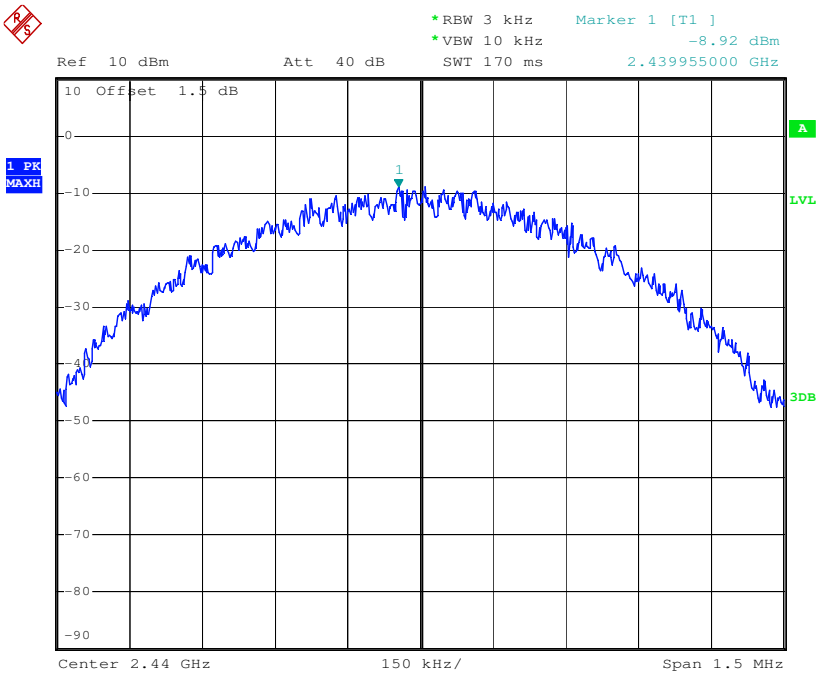
GFSK mode			
Test channel	Power Spectral Density (dBm/3kHz)	Limit (dBm/3kHz)	Result
Lowest	-6.52	≤8.00	Pass
Middle	-8.92	≤8.00	Pass
Highest	-10.50	≤8.00	Pass

Test plot as follows:

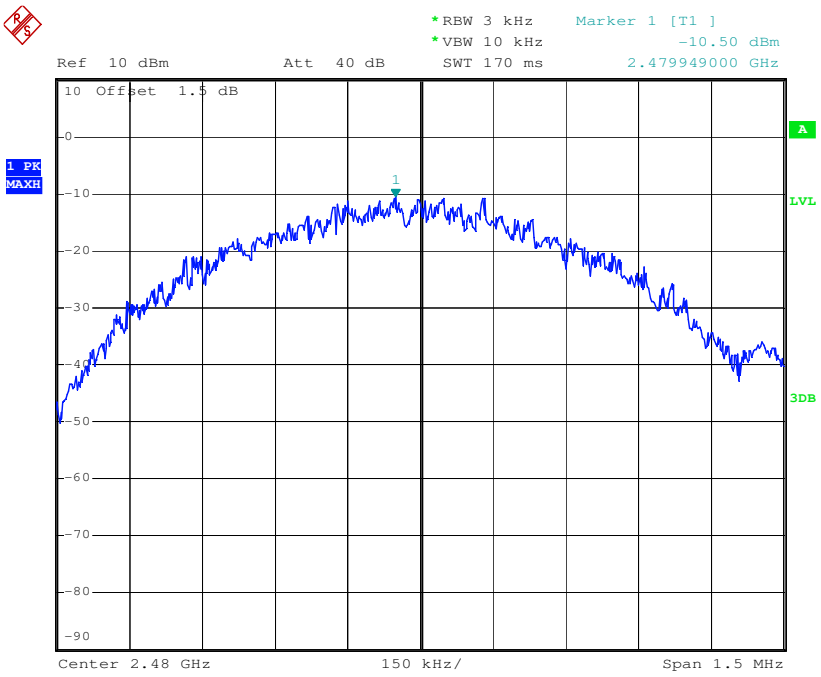
Test mode:	GFSK	Test channel:	Lowest



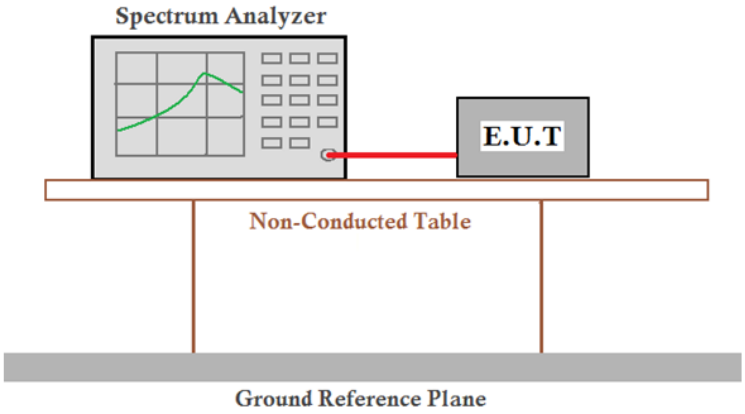
Test mode:	GFSK	Test channel:	Middle



Test mode:	GFSK	Test channel:	Highest

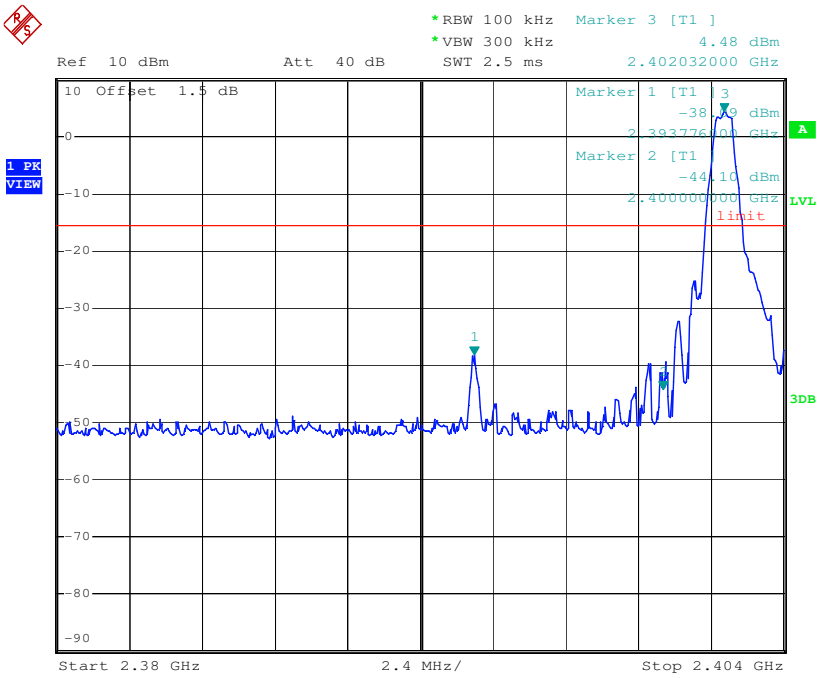


6.6 Band-edge for RF Conducted Emissions

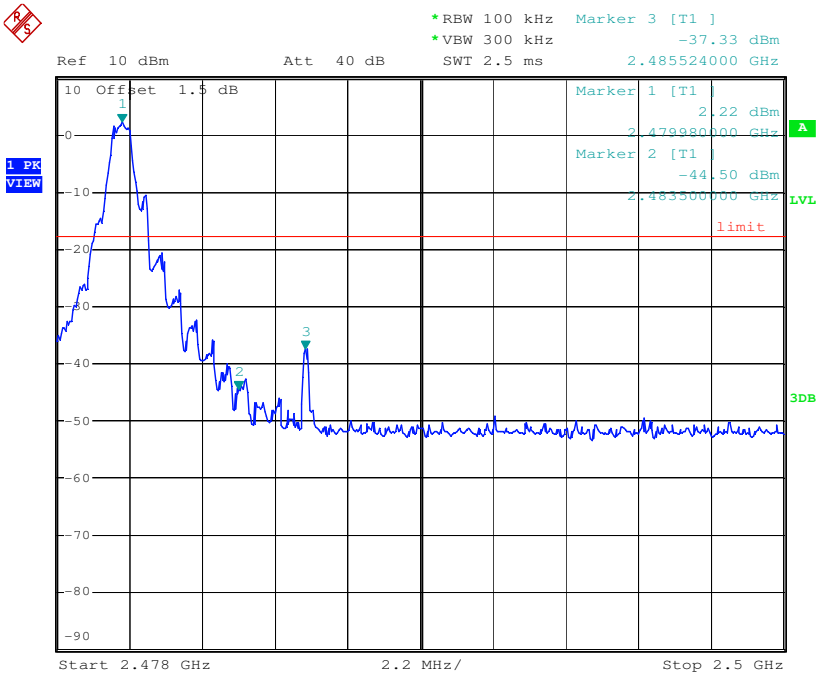
Test Requirement:	47 CFR Part 15C Section 15.247 (d)
Test Method:	ANSI C63.10: 2013 Section 11.13
Test Setup:	 Remark: Offset the High-Frequency cable loss 1.5dB in the spectrum analyzer.
Limit:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, 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. Pretest the EUT at Transmitting mode (powered by battery) and Transmitting mode (powered by USB port), found the Transmitting mode (powered by battery) which it is worse case. Only the worst case is recorded in the report.
Instruments Used:	Refer to section 5.10 for details.
Test Results:	Pass

Test plot as follows:

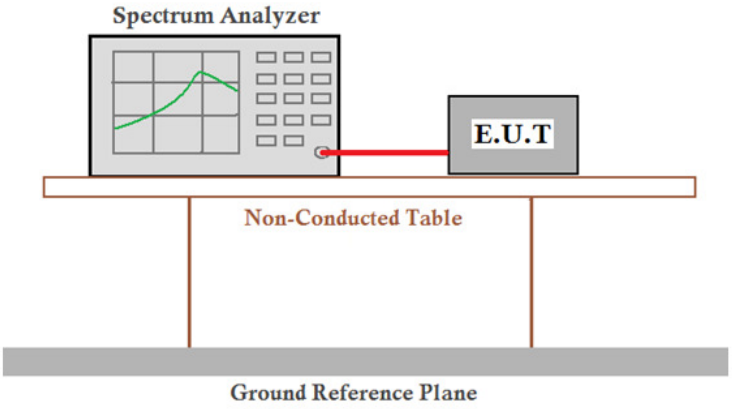
Test mode:	GFSK	Test channel:	Lowest



Test mode:	GFSK	Test channel:	Highest

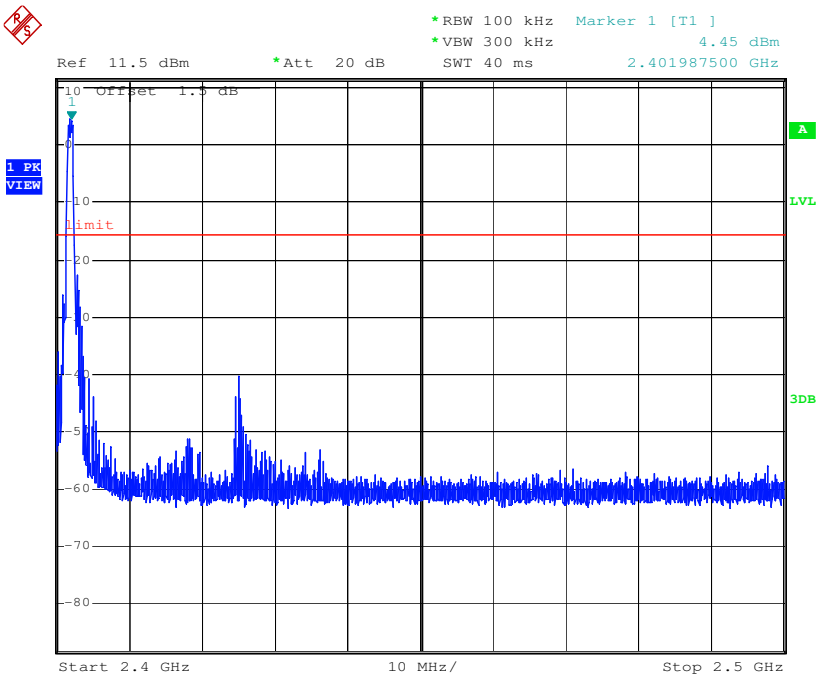


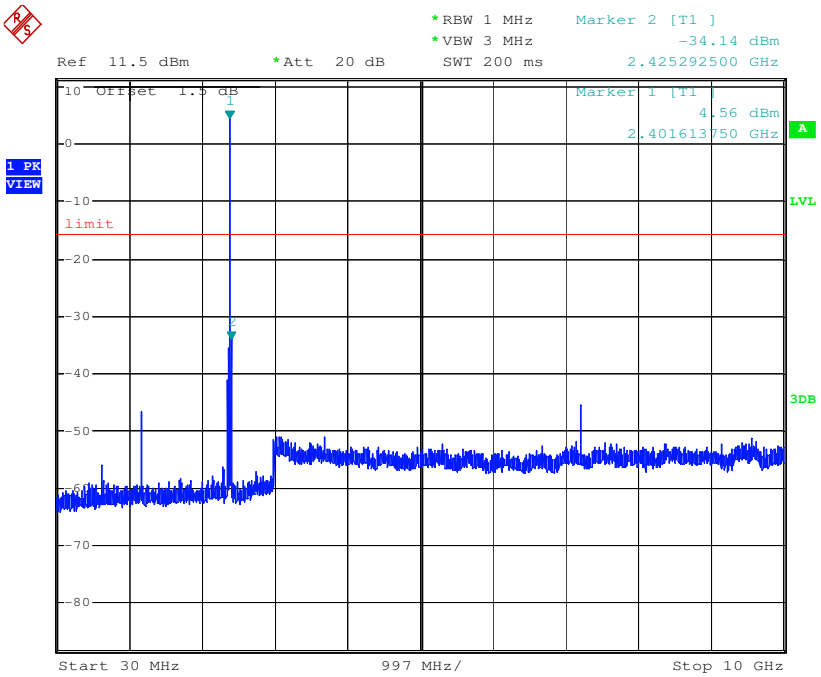
6.7 Spurious RF Conducted Emissions

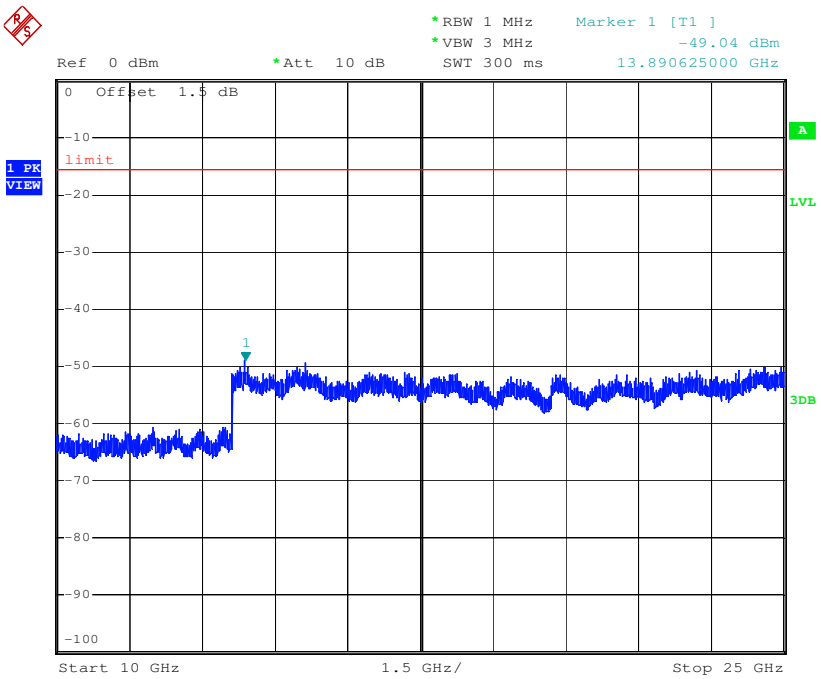
Test Requirement:	47 CFR Part 15C Section 15.247 (d)
Test Method:	ANSI C63.10: 2013 Section 11.11
Test Setup:	 Remark: Offset the High-Frequency cable loss 1.5dB in the spectrum analyzer.
Limit:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, 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. Pretest the EUT at Transmitting mode (powered by battery) and Transmitting mode (powered by USB port), found the Transmitting mode (powered by battery) which it is worse case. Only the worst case is recorded in the report.
Instruments Used:	Refer to section 5.10 for details.
Test Results:	Pass

Test plot as follows:

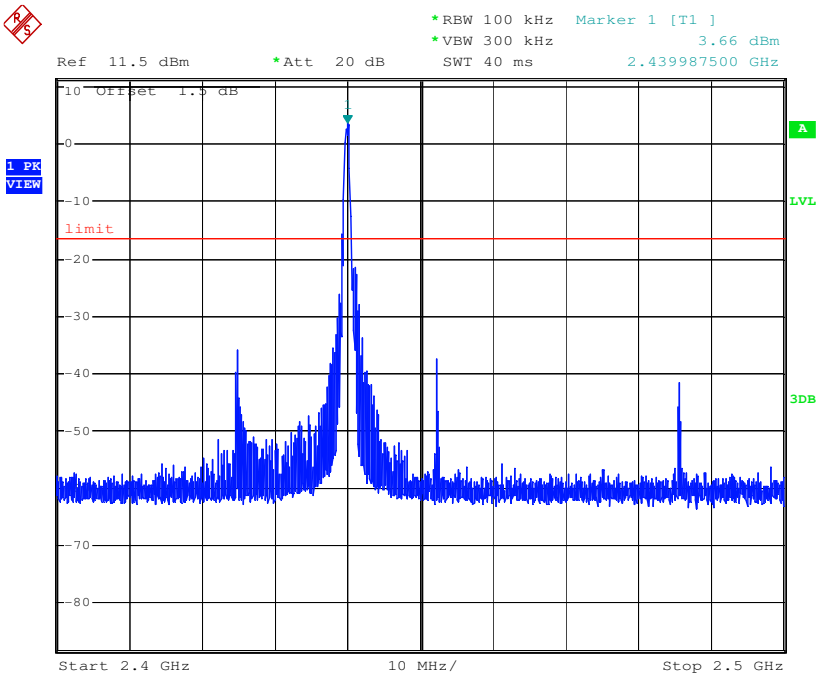
Test mode:	GFSK	Test channel:	Lowest

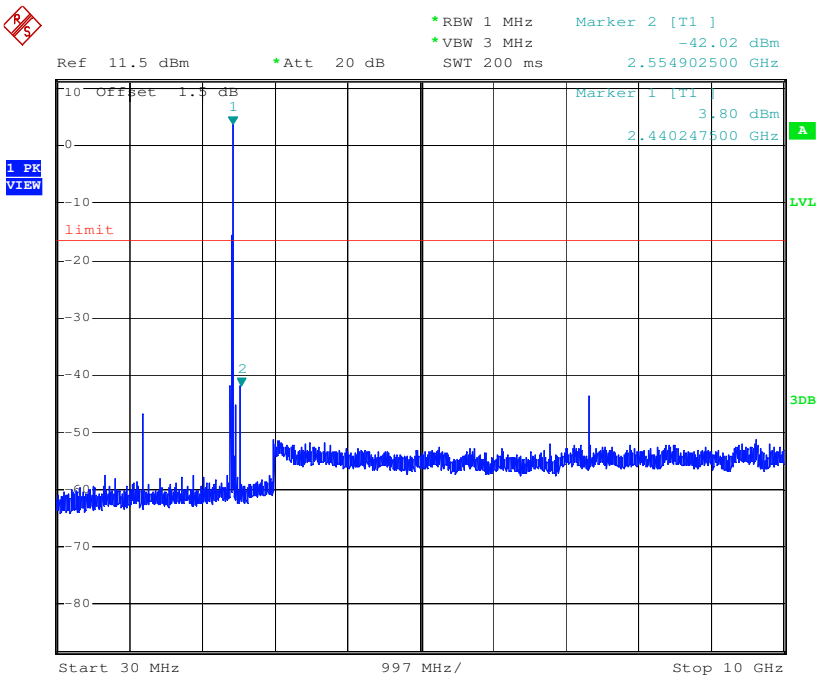


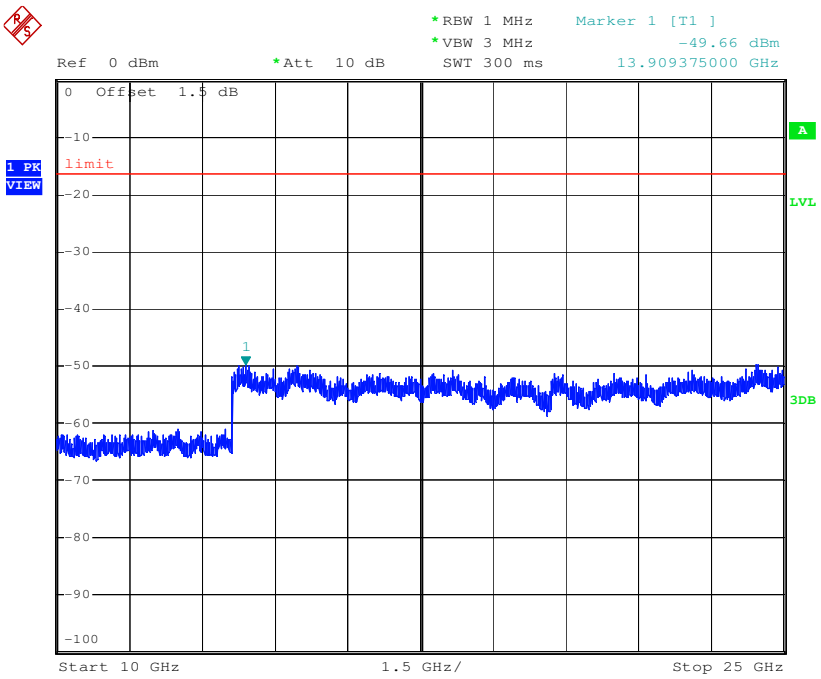




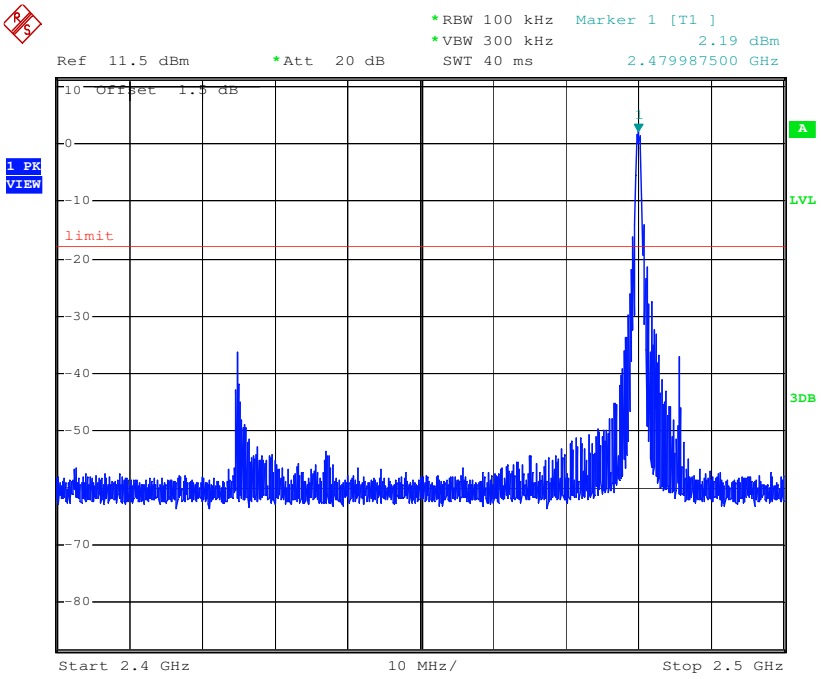
Test mode:	GFSK	Test channel:	Middle

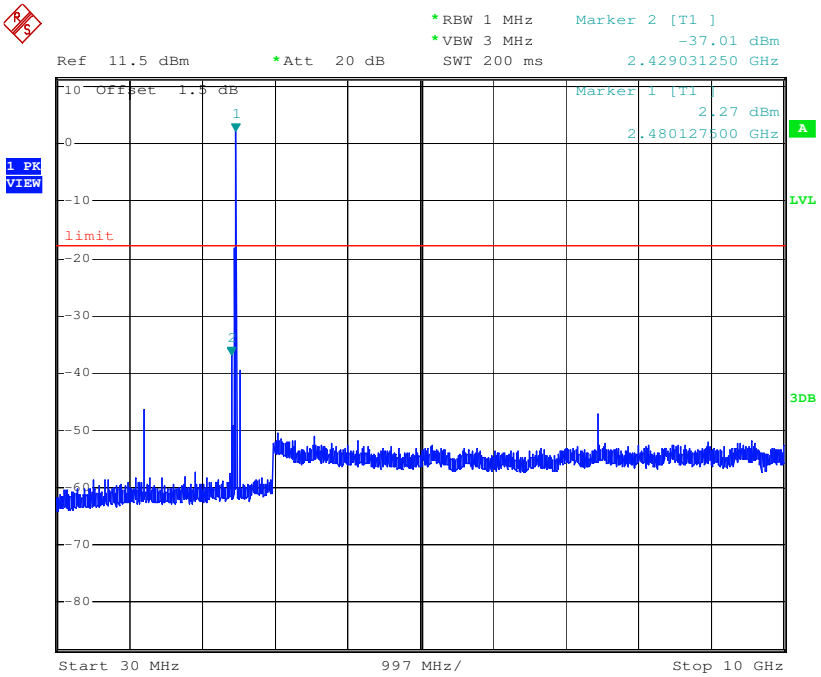


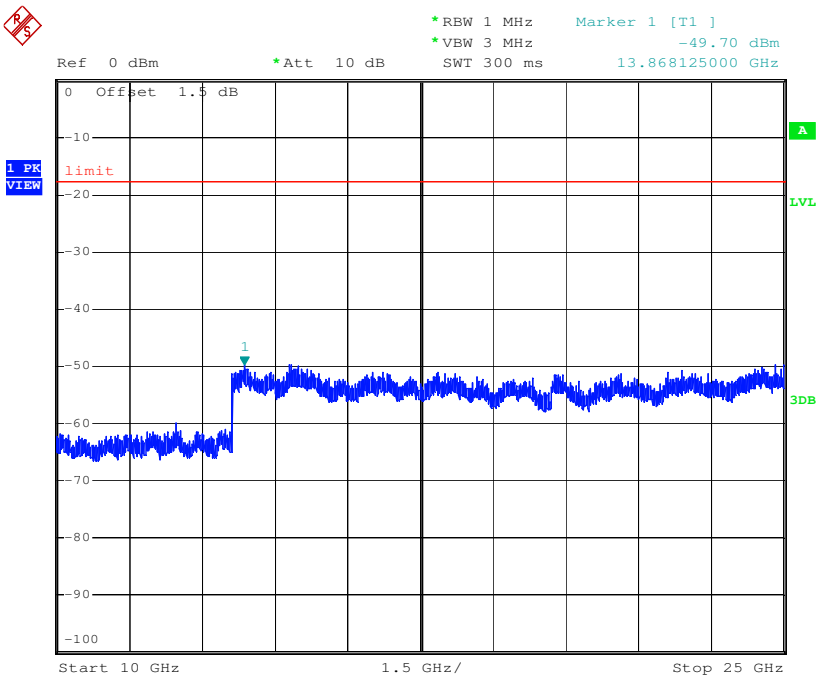




Test mode:	GFSK	Test channel:	Highest







Remark:

Use 100kHz RBW to determine the relative limit in the band 2.4GHz to 2.5GHz, and Use 1MHz RBW to measure spurious emissions in the band 30MHz to 10GHz and 10GHz to 25GHz. The sweep points set to 30001.

6.8 Radiated Spurious Emission

6.8.1 Spurious Emissions

Test Requirement:	47 CFR Part 15C Section 15.209 and 15.205
Test Method:	ANSI C63.10 :2013 Section 11.12
Test Site:	Below 1GHz: Measurement Distance: 10m (Semi-Anechoic Chamber) Above 1GHz: Measurement Distance: 3m (Full-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:	

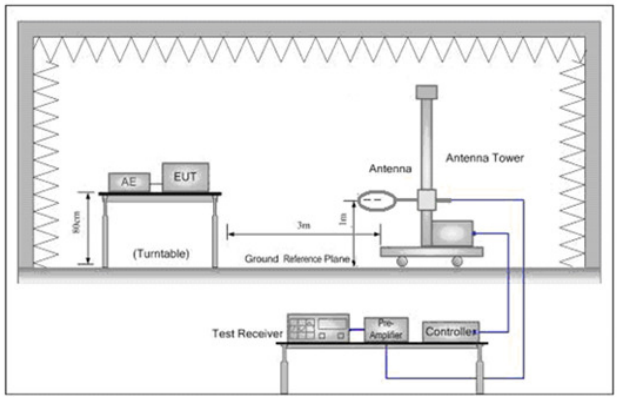


Figure 1. Below 30MHz

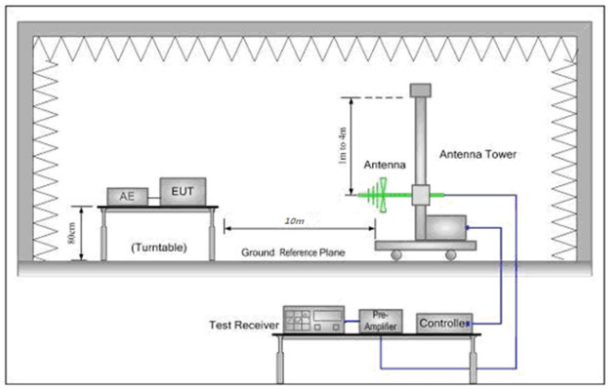


Figure 2. 30MHz to 1GHz

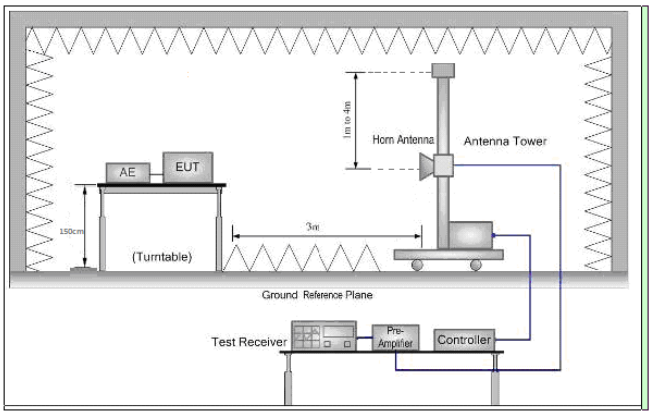


Figure 3. Above 1 GHz

Test Procedure:	a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 10 meter semi-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation. b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter full-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation. c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. d. 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. e. 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. f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. g. 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. h. Test the EUT in the lowest channel (2402MHz),the middle channel (2440MHz),the Highest channel (2480MHz) i. 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. j. Repeat above procedures until all frequencies measured was complete.
Exploratory Test Mode:	Transmitting with GFSK modulation. Transmitting mode
Final Test Mode:	Transmitting with GFSK modulation. Pretest the EUT at Transmitting mode (powered by battery) and Transmitting mode (powered by USB port), found the Transmitting mode (powered by battery) which it is worse case. For below 1GHz part, through pre-scan, the worst case is the lowest channel. Only the worst case is recorded in the report.
Instruments Used:	Refer to section 5.10 for details.
Test Results:	Pass

For frequencies below 1GHz, the test was performed at a 10m test site. According to below formulate and the test data at 10m test distance,

$L_3 / L_{10} = D_{10} / D_3$

Note:

L_3: Level @ 3m distance. Unit: uV/m;

L_{10}: Level @ 10m distance. Unit: uV/m;

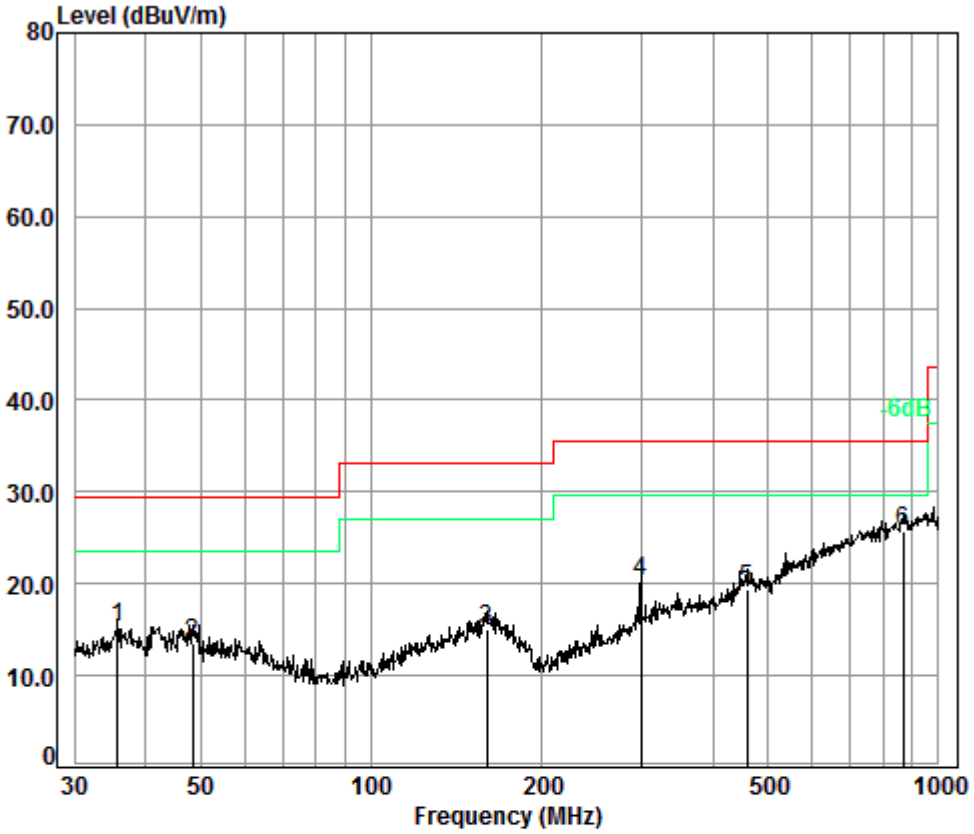
D_3: 3m distance. Unit: m

D_{10}: 10m distance. Unit: m

The level at 3m test distance is below:

Frequency (MHz)	Level @ 10m (dBuV/m)	Level @ 10m (uV/m)	Level @ 3m (uV/m)	Level @ 3m (dBuV/m)	Limit @ 3m (dBuV/m)	Margin (dB)	Ant. Polarization
35.75	15.15	5.72	19.07	25.61	40.00	-14.39	V
48.50	13.51	4.74	15.79	23.97	40.00	-16.03	V
159.78	14.94	5.58	18.62	25.40	43.50	-18.10	V
299.32	20.38	10.45	34.82	30.84	46.00	-15.16	V
460.73	19.48	9.42	31.40	29.94	46.00	-16.06	V
66.09	25.70	19.28	64.25	36.16	40.00	-3.84	V
36.90	12.63	4.28	14.27	23.09	40.00	-16.91	H
47.33	12.78	4.36	14.52	23.24	40.00	-16.76	H
57.19	14.36	5.22	17.41	24.82	40.00	-15.18	H
143.83	14.06	5.05	16.82	24.52	43.50	-18.98	H
437.12	18.74	8.65	28.83	29.20	46.00	-16.80	H
668.14	24.05	15.94	53.13	34.51	46.00	-11.49	H

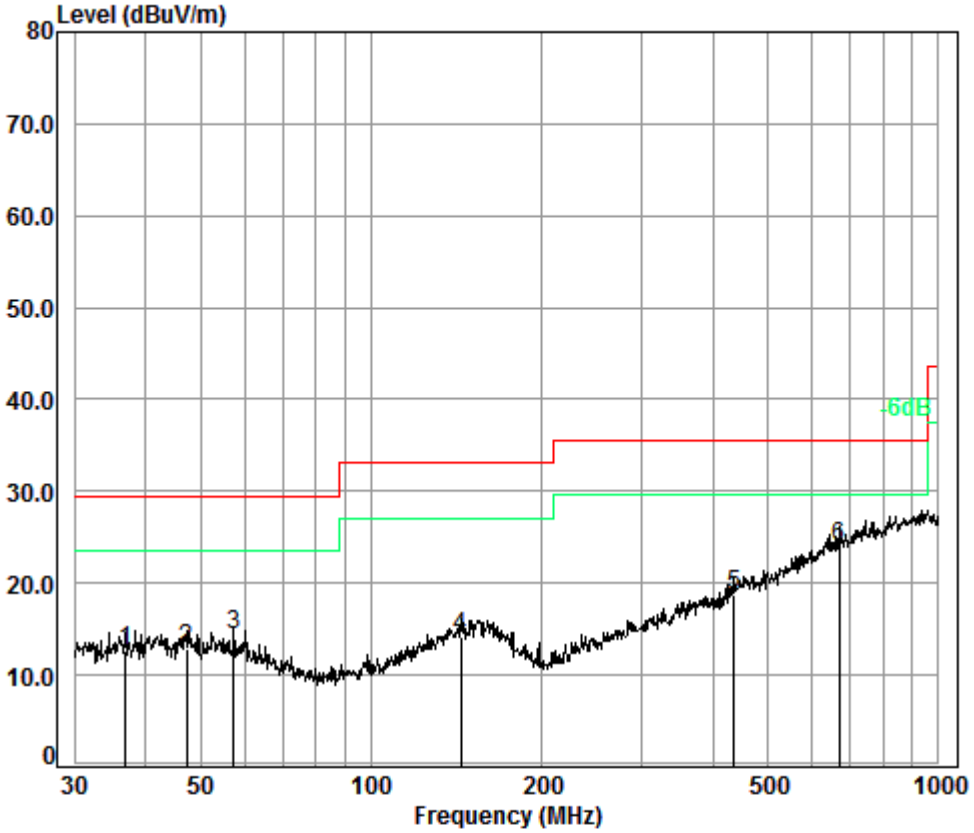
Radiated Emission below 1GHz		
30MHz~1GHz (QP)		
Test mode:	Transmitting mode	Vertical



Condition: 10m VERTICAL
Job No. : 9663CR
Test mode: TX Mode

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	35.75	6.72	12.75	32.98	28.66	15.15	29.50	-14.35
2	48.50	6.87	12.81	33.00	26.83	13.51	29.50	-15.99
3	159.78	7.50	13.39	32.73	26.78	14.94	33.10	-18.16
4	299.32	8.05	12.64	32.60	32.29	20.38	35.60	-15.22
5	460.73	8.45	16.30	32.60	27.33	19.48	35.60	-16.12
6 pp	866.09	9.43	21.79	32.53	27.01	25.70	35.60	-9.90

Test mode:	Transmitting mode	Horizontal



Condition: 10m HORIZONTAL
Job No. : 9663CR
Test mode: TX Mode

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	36.90	6.74	12.91	32.98	25.96	12.63	29.50	-16.87
2	47.33	6.85	12.84	33.00	26.09	12.78	29.50	-16.72
3	57.19	7.00	12.21	32.96	28.11	14.36	29.50	-15.14
4	143.83	7.42	13.01	32.75	26.38	14.06	33.10	-19.04
5	437.12	8.39	15.86	32.60	27.09	18.74	35.60	-16.86
6 pp	668.14	9.07	19.76	32.60	27.82	24.05	35.60	-11.55

Transmitter Emission above 1GHz								
Test mode:	GFSK		Test channel:	Lowest		Remark:	Peak	
Frequency (MHz)	Cable Loss (dB)	Antenna Factor (dB/m)	Preamp Factor (dB)	Read Level (dBuV)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
3759.672	32.95	7.73	38.59	44.31	46.40	74	-27.60	Vertical
4804.000	34.16	8.87	39.03	46.05	50.05	74	-23.95	Vertical
5769.698	34.57	9.91	39.02	44.17	49.63	74	-24.37	Vertical
7206.000	36.42	10.68	38.18	48.05	56.97	74	-17.03	Vertical
9608.000	37.52	12.50	36.99	39.41	52.44	74	-21.56	Vertical
11998.250	38.60	14.56	38.30	38.60	53.46	74	-20.54	Vertical
3847.726	33.19	7.76	38.63	45.25	47.57	74	-26.43	Horizontal
4804.000	34.16	8.87	39.03	48.27	52.27	74	-21.73	Horizontal
5930.516	34.66	10.37	39.01	45.39	51.41	74	-22.59	Horizontal
7206.000	36.42	10.68	38.18	49.62	58.54	74	-15.46	Horizontal
9608.000	37.52	12.50	36.99	39.56	52.59	74	-21.41	Horizontal
12261.500	38.76	14.34	38.57	39.31	53.84	74	-20.16	Horizontal

Test mode:	GFSK		Test channel:	Lowest		Remark:	Average	
Frequency (MHz)	Cable Loss (dB)	Antenna Factor (dB/m)	Preamp Factor (dB)	Read Level (dBuV)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
7206.000	36.42	10.68	38.18	40.87	49.79	54	-4.21	Vertical
7206.000	36.42	10.68	38.18	41.30	50.22	54	-3.78	Horizontal

Test mode:		GFSK		Test channel:	Middle		Remark:	Peak
Frequency (MHz)	Cable Loss (dB)	Antenna Factor (dB/m)	Preamp Factor (dB)	Read Level (dBuV)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
3737.975	32.89	7.72	38.58	44.30	46.33	74	-27.67	Vertical
4880.000	34.29	8.97	39.06	44.21	48.41	74	-25.59	Vertical
6069.413	34.76	10.47	38.96	45.23	51.50	74	-22.50	Vertical
7320.000	36.37	10.72	38.07	46.22	55.24	74	-18.76	Vertical
9760.000	37.55	12.58	36.92	38.86	52.07	74	-21.93	Vertical
12067.890	38.64	14.50	38.37	38.34	53.11	74	-20.89	Vertical
3759.672	32.95	7.73	38.59	44.53	46.62	74	-27.38	Horizontal
4880.000	34.29	8.97	39.06	45.86	50.06	74	-23.94	Horizontal
6043.124	34.74	10.50	38.97	45.12	51.39	74	-22.61	Horizontal
7320.000	36.37	10.72	38.07	46.06	55.08	74	-18.92	Horizontal
9760.000	37.55	12.58	36.92	39.43	52.64	74	-21.36	Horizontal
12085.370	38.65	14.49	38.39	38.27	53.02	74	-20.98	Horizontal

Test mode:		GFSK		Test channel:	Middle		Remark:	Average
Frequency (MHz)	Cable Loss (dB)	Antenna Factor (dB/m)	Preamp Factor (dB)	Read Level (dBuV)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
7320.000	36.37	10.72	38.07	40.23	49.25	54	-4.75	Vertical
7320.000	36.37	10.72	38.07	39.46	48.48	54	-5.52	Horizontal

Test mode:		GFSK		Test channel:	Highest		Remark:	Peak
Frequency (MHz)	Cable Loss (dB)	Antenna Factor (dB/m)	Preamp Factor (dB)	Read Level (dBuV)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
4018.425	33.6	7.83	38.71	45.07	47.79	74	-26.21	Vertical
4960.000	34.43	9.09	39.09	43.43	47.86	74	-26.14	Vertical
6078.201	34.76	10.46	38.95	44.14	50.41	74	-23.59	Vertical
7440.000	36.32	10.77	37.94	44.44	53.59	74	-20.41	Vertical
9920.000	37.58	12.67	36.84	39.07	52.48	74	-21.52	Vertical
12015.620	38.61	14.55	38.32	38.97	53.81	74	-20.19	Vertical
3553.389	32.36	7.65	38.49	44.33	45.85	74	-28.15	Horizontal
4960.000	34.43	9.09	39.09	45.78	50.21	74	-23.79	Horizontal
6025.661	34.72	10.53	38.98	45.22	51.49	74	-22.51	Horizontal
7440.000	36.32	10.77	37.94	47.43	56.58	74	-17.42	Horizontal
9920.000	37.58	12.67	36.84	38.76	52.17	74	-21.83	Horizontal
12243.770	38.75	14.36	38.55	38.49	53.05	74	-20.95	Horizontal

Test mode:		GFSK		Test channel:	Highest		Remark:	Average
Frequency (MHz)	Cable Loss (dB)	Antenna Factor (dB/m)	Preamp Factor (dB)	Read Level (dBuV)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	Polarization
7440.000	36.32	10.77	37.94	41.12	50.27	54	-3.73	Horizontal

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 13GHz and below 30MHz was very low, and the above harmonics were the highest point could be found when testing, so only the above harmonics had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.

3) 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 above measurements were shown in the report.

6.9 Restricted bands around fundamental frequency

Test Requirement:	47 CFR Part 15C Section 15.209 and 15.205
Test Method:	ANSI C63.10: 2013 Section 11.12
Test Site:	Below 1GHz: Measurement Distance: 3m (Semi-Anechoic Chamber) Above 1GHz: Measurement Distance: 3m (Full-Anechoic Chamber)
Limit:	

Frequency	Limit (dBuV/m @3m)	Remark
30MHz-88MHz	40.0	Quasi-peak Value
88MHz-216MHz	43.5	Quasi-peak Value
216MHz-960MHz	46.0	Quasi-peak Value
960MHz-1GHz	54.0	Quasi-peak Value
Above 1GHz	54.0	Average Value
	74.0	Peak Value

Test Setup:

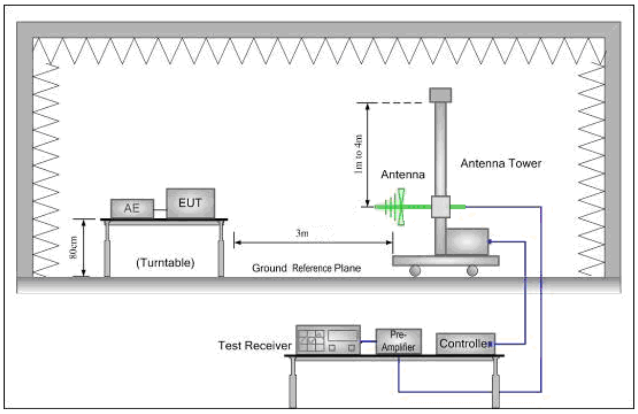


Figure 1. 30MHz to 1GHz

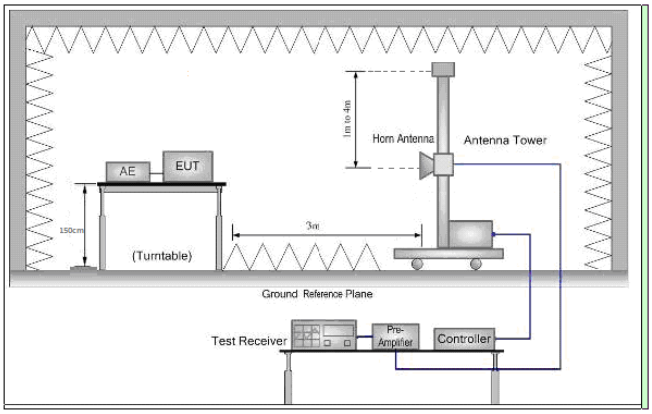


Figure 2. Above 1 GHz

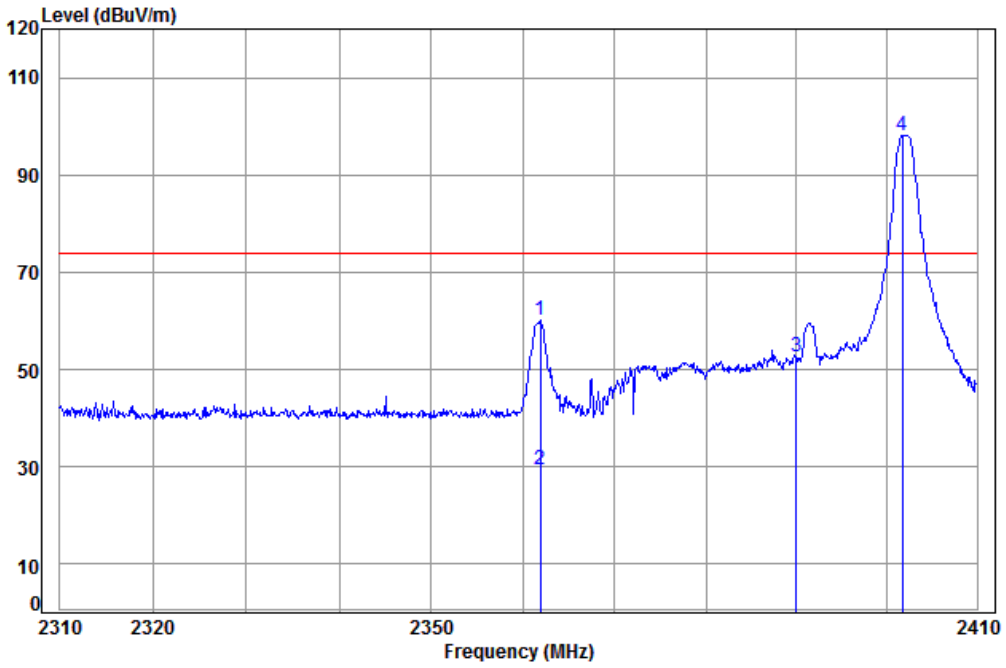
Test Procedure:

a. For below 1GHz, 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.
b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter full-anechoic camber. The table was rotated 360 degrees to determine the position of the highest radiation.
c. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
d. 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.
e. 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 and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
g. Place a marker at the end of the restricted band closest to the transmit frequency to show compliance. Also measure any emissions in the restricted bands. Save the spectrum analyzer plot. Repeat for each power and modulation for lowest and highest channel

	h. Test the EUT in the lowest channel , the Highest channel i. 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. j. Repeat above procedures until all frequencies measured was complete.
Exploratory Test Mode:	Transmitting with GFSK modulation. Transmitting mode.
Final Test Mode:	Transmitting with GFSK modulation. Pretest the EUT at Transmitting mode (powered by battery) and Transmitting mode (powered by USB port), found the Transmitting mode (powered by battery) which it is worse case. Only the worst case is recorded in the report.
Instruments Used:	Refer to section 5.10 for details.
Test Results:	Pass

Test plot as follows:

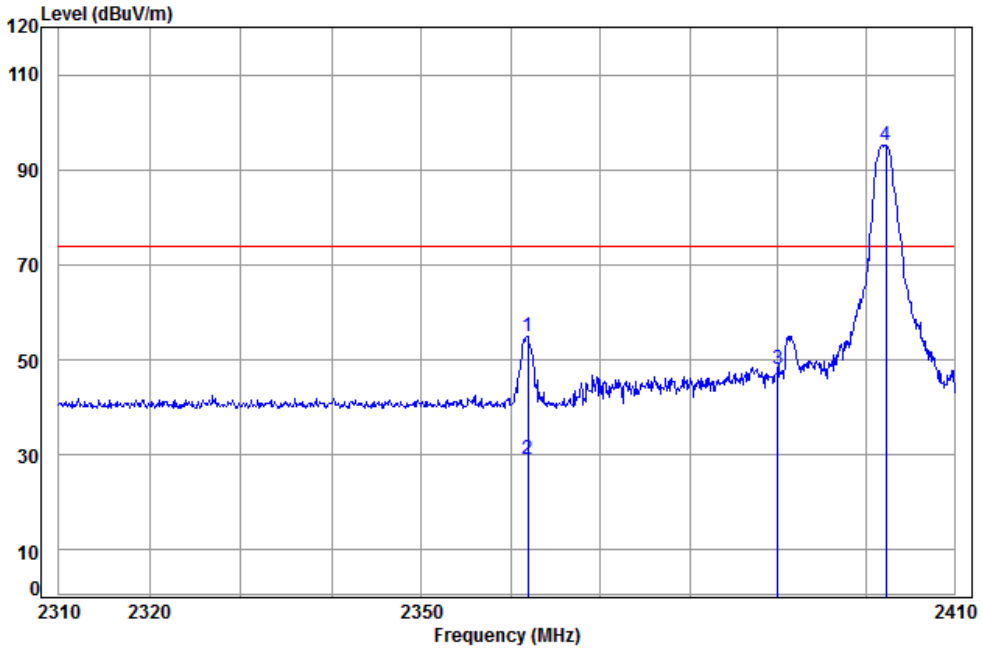
Test channel:	Lowest	Remark:	Peak	Vertical



Condition: 3m Vertical
Job No: : 9663CR
Mode: : 2402 Band edge
: BLE

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	2361.871	5.32	28.99	38.14	64.01	60.18	74.00	-13.82
2 av	2361.871	5.32	28.99	38.14	33.10	29.27	54.00	-24.73
3	2390.000	5.34	29.08	38.14	56.44	52.72	74.00	-21.28
4 pp	2401.741	5.35	29.11	38.15	101.78	98.09	74.00	24.09

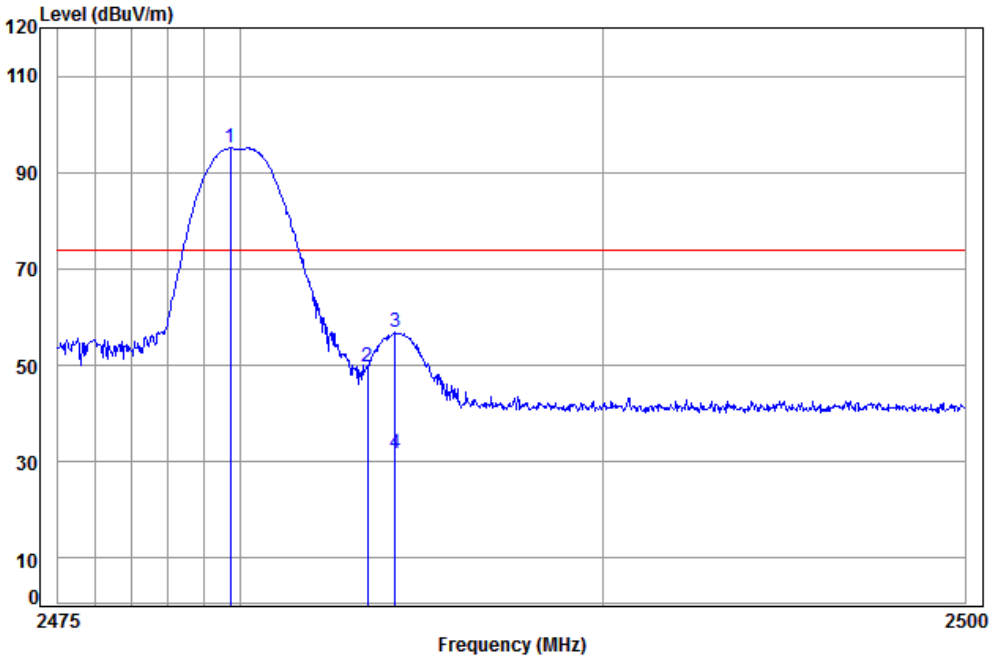
Test channel:	Lowest	Remark:	Peak	Horizontal



Condition: 3m HORIZONTAL
Job No: : 9663CR
Mode: : 2402 Band edge
: BLE

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	2361.871	5.32	28.99	38.14	58.72	54.89	74.00	-19.11
2 av	2361.871	5.32	28.99	38.14	32.89	29.06	54.00	-24.94
3	2390.000	5.34	29.08	38.14	51.79	48.07	74.00	-25.93
4 pp	2402.250	5.35	29.11	38.15	98.74	95.05	74.00	21.05

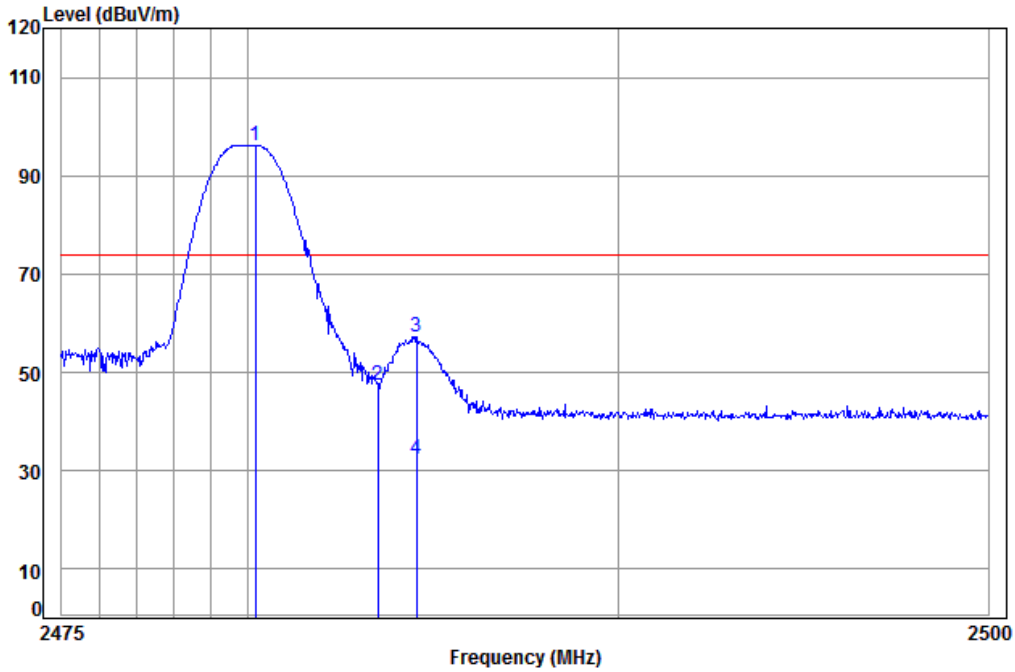
Test channel:	Highest	Remark:	Peak	Vertical



Condition: 3m Vertical
Job No: : 9663CR
Mode: : 2480 Band edge
: BLE

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	pp 2479.731	5.41	29.34	38.15	98.42	95.02	74.00	21.02
2	2483.500	5.41	29.35	38.15	53.06	49.67	74.00	-24.33
3	2484.271	5.41	29.35	38.15	60.15	56.76	74.00	-17.24
4	av 2484.271	5.41	29.35	38.15	35.12	31.73	54.00	-22.27

Test channel:	Highest	Remark:	Peak	Horizontal



Condition: 3m HORIZONTAL
Job No: : 9663CR
Mode: : 2480 Band edge
: BLE

	Freq	Cable Loss	Ant Factor	Preamp Factor	Read Level	Level	Limit Line	Over Limit
	MHz	dB	dB/m	dB	dBuV	dBuV/m	dBuV/m	dB
1	pp 2480.204	5.41	29.34	38.15	99.64	96.24	74.00	22.24
2	2483.500	5.41	29.35	38.15	50.75	47.36	74.00	-26.64
3	2484.545	5.41	29.36	38.15	60.58	57.20	74.00	-16.80
4	av 2484.545	5.41	29.36	38.15	35.69	32.31	54.00	-21.69

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

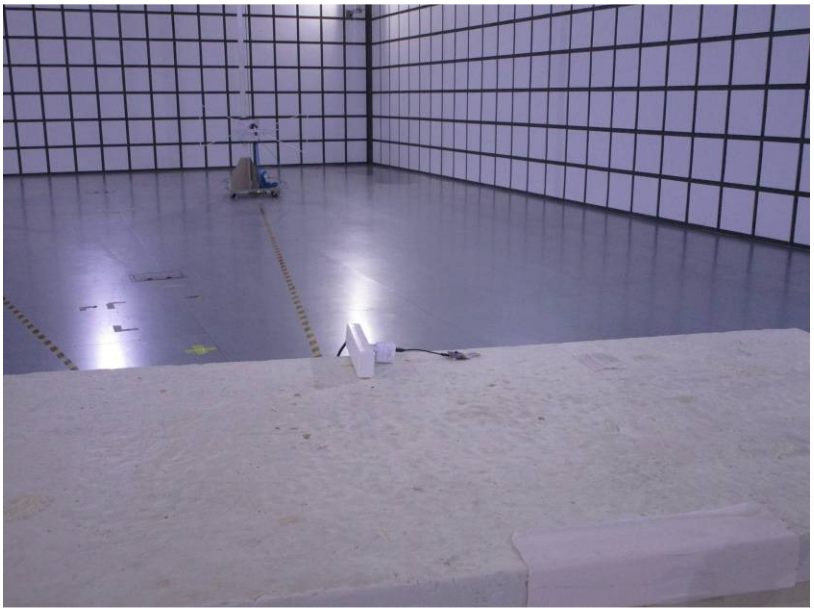
Final Test Level =Receiver Reading + Antenna Factor + Cable Factor – Preamplifier Factor

7 Photographs - EUT Test Setup

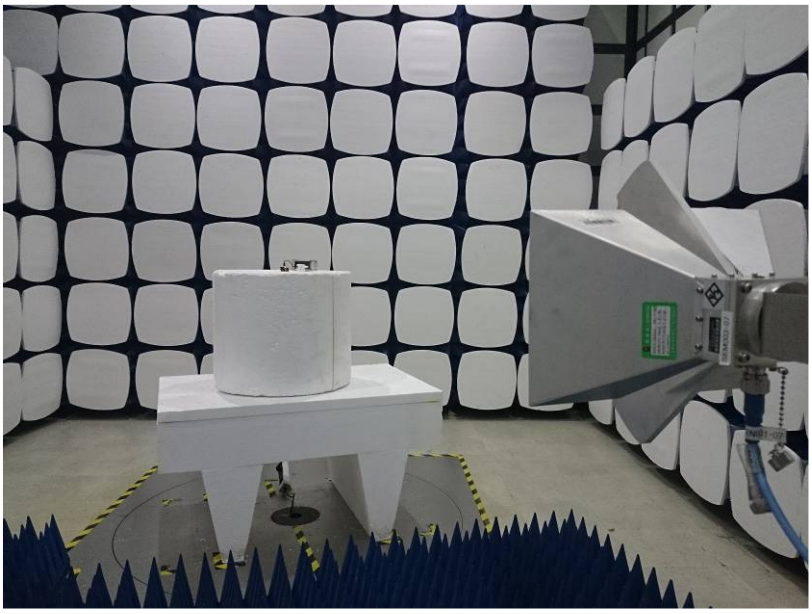
Test model No.: V1.3B

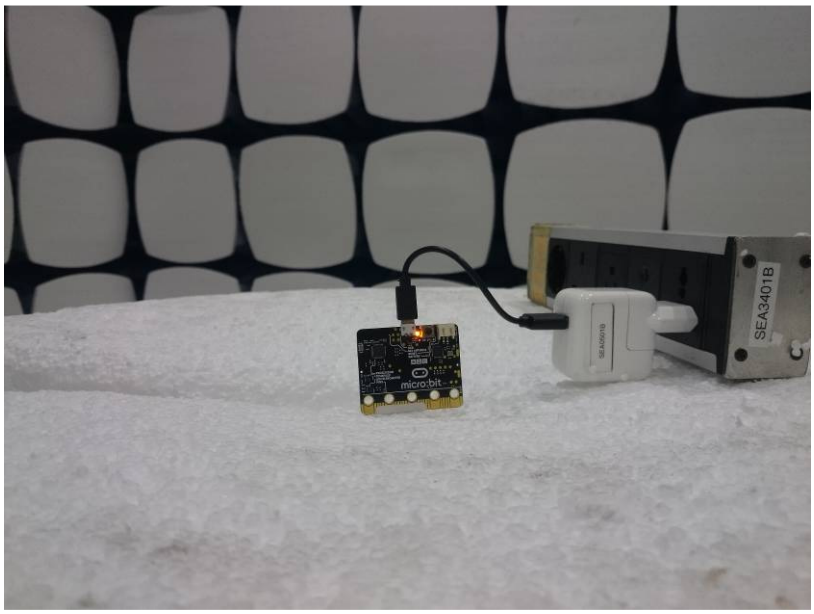
7.1 Conducted Emission

7.2 Radiated Emission



7.3 Radiated Spurious Emission





8 Photographs - EUT Constructional Details

Refer to Appendix A - Photographs of EUT Constructional Details for SZEM1611009663CR.