Shenzhen Centre Quality Accreditation Technology Co., Ltd.

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Report No.: CQASZ160401301E-01
Report Version: V01

MEASUREMENT REPORT
Test Report

Applicant:	Tinylogics Ltd
Address of Applicant:	St John's Innovation Centre, Cowley Road, Cambridge, United Kingdom CB4 0WS
Manufacturer:	Tinylogics Ltd
Address of Manufacturer:	St John's Innovation Centre, Cowley Road, Cambridge, United Kingdom CB4 0WS
Equipment Under Test (EUT):	
Product:	Smart Pillbox
Model No.:	M1602A, M1602B, M1602C, M1602D, M1602E
Test Model No.:	M1602A
Brand Name:	Memo Box
FCC ID:	2AH3P-M1602
Standards:	47 CFR Part 15, Subpart C
Date of Test:	2016-04-20 to 2016-05-05
Date of Issue:	2016-05-05
Test Result :	**PASS***

Reviewed By: Aaron Ma

(Aaron Ma)

Approved By: Owen Zhou

(Owen Zhou)

Shenzhen Centre Quality Accreditation Technology Co., Ltd.

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

2 Version

Revision History Of Report

Report No.	Version	Description	Issue Date
CQASZ160401301E-01	Rev.01	Initial report	2016-05-05

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	N/A
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

N/A: Not Applicable, the EUT is battery power supply.

4 Contents

5 General Information

5.1 Client Information

Applicant:	Tinylogics Ltd
Address of Applicant:	St John's Innovation Centre, Cowley Road, Cambridge, United Kingdom CB4 0WS
Manufacturer:	Tinylogics Ltd
Address of Manufacturer:	St John's Innovation Centre, Cowley Road, Cambridge, United Kingdom CB4 0WS

5.2 General Description of EUT

Product Name:	Smart Pillbox
Model No.:	M1602A, M1602B, M1602C, M1602D, M1602E
Test Model No.:	M1602A
Trade Mark:	Memo Box
Hardware Version:	V1.0
Software Version:	V1.0
Operation Frequency:	2402MHz~2480MHz
Bluetooth Version:	V4.0 BLE
Modulation Type:	GFSK
Number of Channel:	40
Sample Type:	Portable production
Test Software of EUT:	RF Test (manufacturer declare)
Antenna Type:	PCB Antenna
Antenna Gain:	0dBi
Power Supply:	DC3.0V (2 x 1.5V A76 button battery)

Remark:
Model No.: M1602A, M1602B, M1602C, M1602D, M1602E

Only the model M1602A was tested, since the electrical circuit design, layout, components used and internal wiring were identical for the above models, with difference being color of appearance, pack and model name.

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
Test Mode:	Use test software (RF test) to set the lowest frequency, the middle frequency and the highest frequency keep transmitting of the EUT. Note: In the process of transmitting of EUT, the duty cycle ＞98%.

5.4 Description of Support Units

The EUT has been tested with associated equipment below.

Description	Manufacturer	Model No.
button battery	BIKE	A76
Notebook	Lenovo	Lenovo ideapad 100-14IBY
Note: The button battery is new.		

5.5 Test Location

All tests were performed at:

Shenzhen CTL Testing Technology Co., Ltd., Shenzhen EMC Laboratory,

1/F.-A, Baisha Technology Park, No.3011, Shahexi Road, Nanshan District, Shenzhen, Guangdong, China

5.6 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 CTL 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 CTL laboratory is reported:

Test	Range	Uncertainty	Notes
Radiated Emission	30~1000MHz	4.10dB	(1)
Radiated Emission	1~12.75GHz	4.32dB	(1)
Radiated Emission	12.75GHz-25GHz	4.68dB	(1)
Conducted Disturbance	0.15~30MHz	3.20dB	(1)

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

5.7 Test Facility

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

FCC-Registration No.: 970318

Shenzhen CTL Testing Technology Co., Ltd. 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 970318, December 19, 2013.

IC Registration No.: 9618B

The 3m alternate test site of Shenzhen CTL Testing Technology Co., Ltd. EMC Laboratory has been registered by Certification and Engineer Bureau of Industry Canada for the performance of with Registration No.: 9618B on November 13, 2013.

5.8 Deviation from Standards

None.

5.9 Abnormalities from Standard Conditions

None.

5.10 Other Information Requested by the Customer

None.

5.11 Equipment List

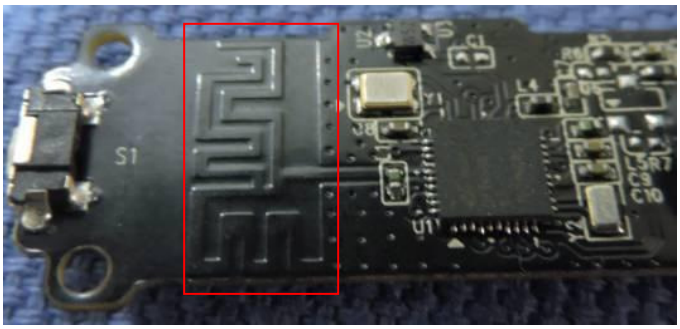
Item	Test Equipment	Manufacturer	Model No.	Serial No.	Calibration Due Date
1	Bilog Antenna	Sunol Sciences Corp.	JB1	A061713	2016/06/01
2	EMI Test Receiver	ROHDE & SCHWARZ	ESCI3	103710	2016/06/01
3	Spectrum Analyzer	Agilent	E4407B	MY45108355	2016/05/20
4	Controller	EM Electronics	Controller EM 1000	N/A	2016/05/20
5	Horn Antenna	Sunol Sciences Corp.	DRH-118	A062013	2016/05/18
6	Ultra-Broadband Antenna	ShwarzBeck	BBHA9170	25841	2016/05/18
7	Active Loop Antenna	Daze	ZN30900A	N/A	2016/05/18
8	Spectrum Analyzer	R&S	FSU	MY41440676	2016/05/18
9	Microwave Preamplifier	HP	8349B	3155A00882	2016/05/18
10	Preamplifier	HP	8447D	3113A07663	2016/05/18
11	Transient Limiter	Com-Power	LIT-153	532226	2016/06/01
12	Temperature/Humidity Meter	Gangxing	CTH-608	02	2016/05/19
13	Climate Chamber	ESPEC	EL-10KA	A20120523	2016/05/19
14	High-Pass Filter	K&L	9SH10-2700/X12750-O/O	N/A	2016/05/19
15	High-Pass Filter	K&L	41SH10-1375/U12750-O/O	N/A	2016/05/19
16	RF Cable(0-1GHz)	HUBER+SUHNER	RG174	N/A	2016/05/19
17	RF Cable(1-25GHz)	HUBER+SUHNER	RG214	N/A	2016/05/19
18	The temporary antenna Connector	MMCX-SMA	1547	23657478	2016/05/19

Note:

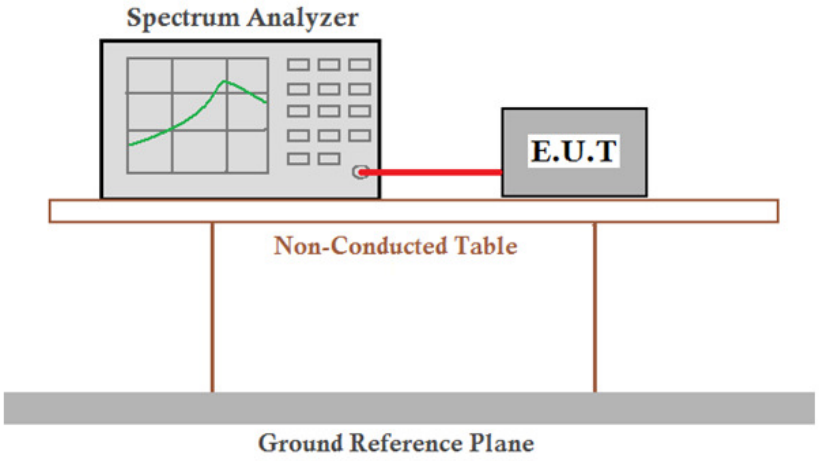
The temporary antenna connector is soldered on the PCB board in order to perform conducted tests and this temporary antenna connector is listed in the equipment list.

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 Peak Output Power

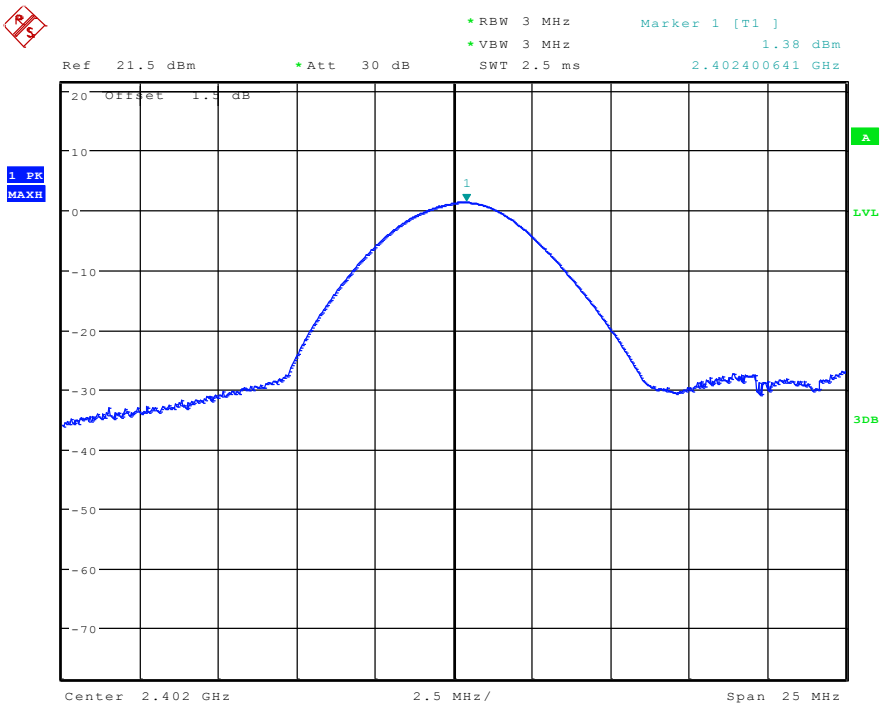
Test Requirement:	47 CFR Part 15C Section 15.247 (b)(1)
Test Method:	ANSI C63.10 2013
Test Setup:	 *Remark:* *Offset the High-Frequency cable loss 1.5dB in the spectrum analyzer.*
Limit:	30dBm
Test Mode:	Transmitting with GFSK modulation.
Instruments Used:	Refer to section 5.10 for details.
Test Results:	Pass

Measurement Data

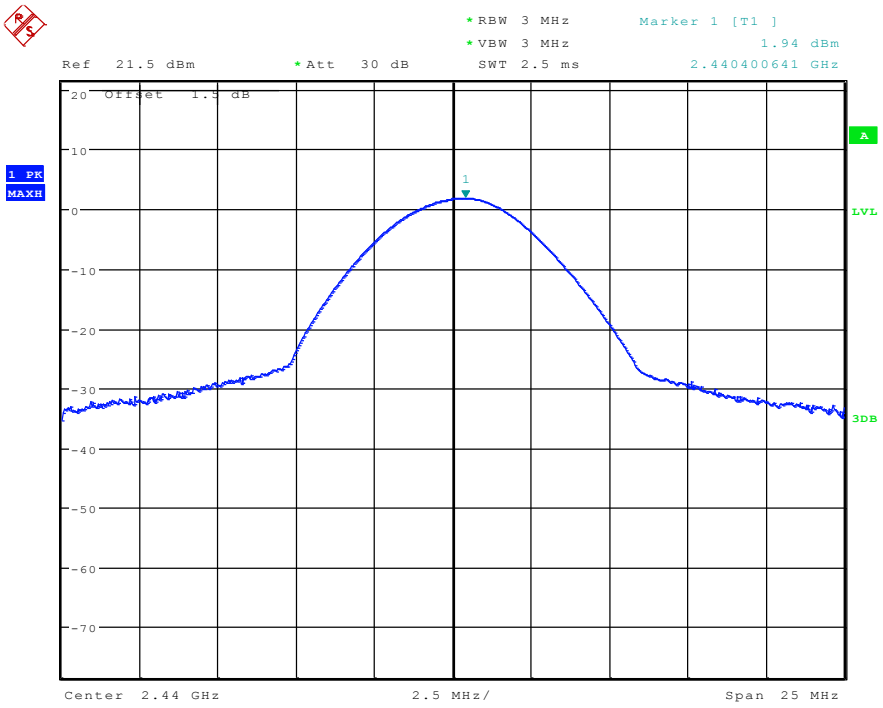
GFSK mode			
Test channel	Peak Output Power (dBm)	Limit (dBm)	Result
Lowest	1.38	30.00	Pass
Middle	1.94	30.00	Pass
Highest	1.97	30.00	Pass

Test plot as follows:

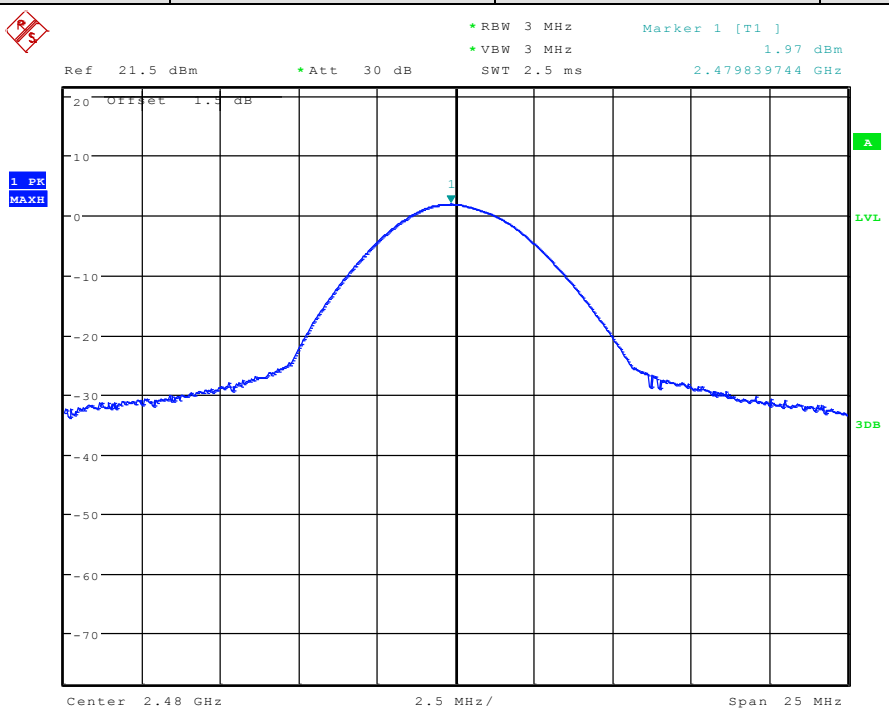
Test mode:	GFSK	Test channel:	Lowest



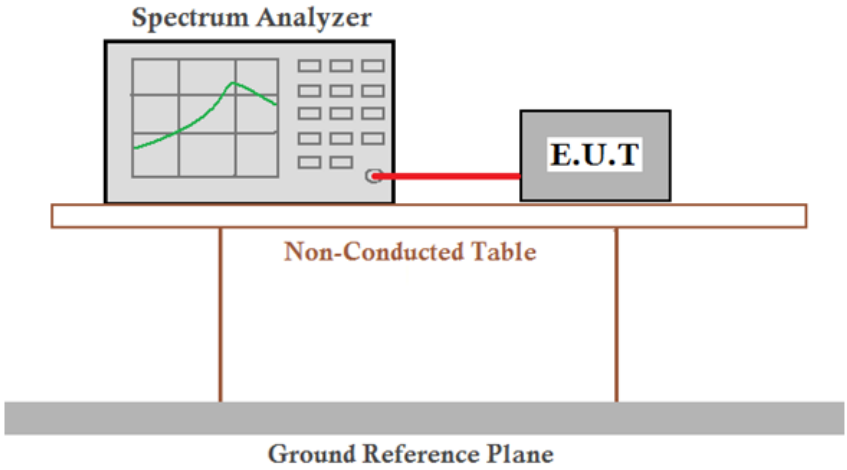
Test mode:	GFSK	Test channel:	Middle



Test mode:	GFSK	Test channel:	Highest



6.3 6dB Occupy Bandwidth

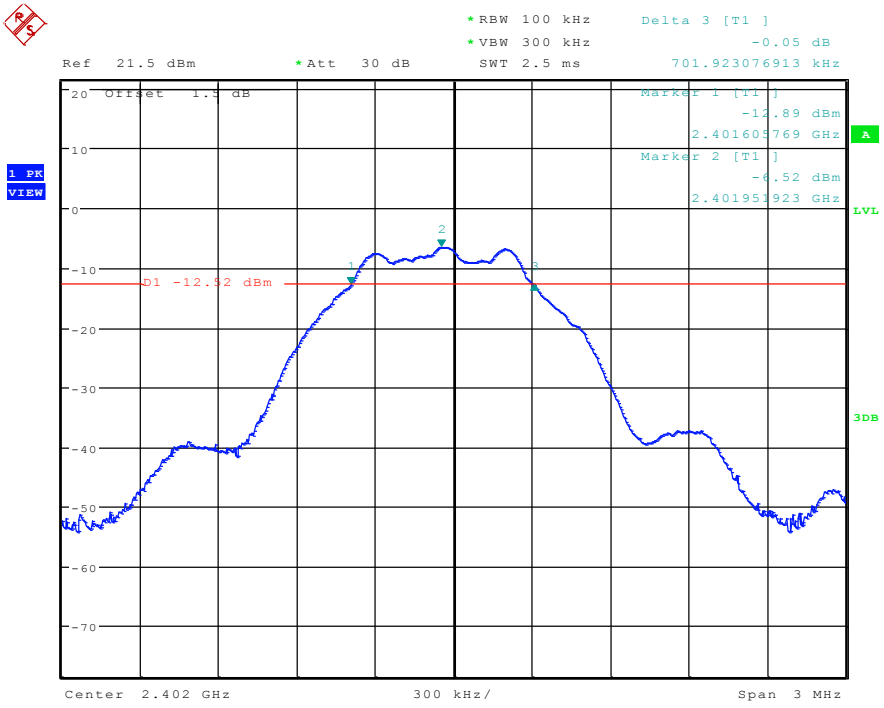
Test Requirement:	47 CFR Part 15C Section 15.247 (a)(2)
Test Method:	ANSI C63.10 2013
Test Setup:	
Limit:	≥ 500 kHz
Test Mode:	Transmitting with GFSK modulation.
Instruments Used:	Refer to section 5.10 for details.
Test Results:	Pass

Measurement Data

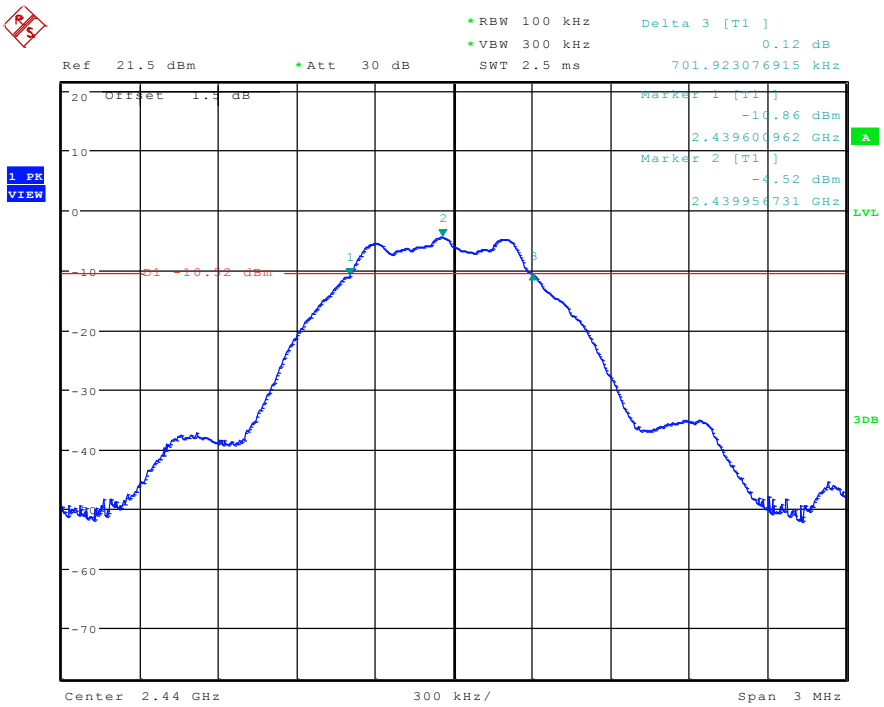
GFSK mode			
Test channel	6dB Occupy Bandwidth (MHz)	Limit (kHz)	Result
Lowest	0.702	≥500	Pass
Middle	0.702	≥500	Pass
Highest	0.726	≥500	Pass

Test plot as follows:

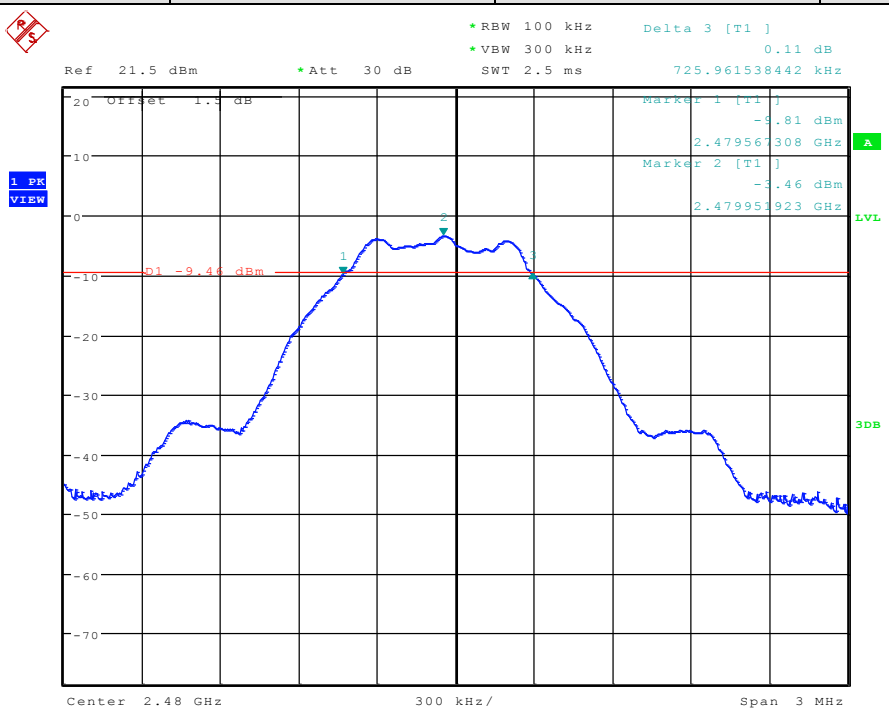
Test mode:	GFSK	Test channel:	Lowest



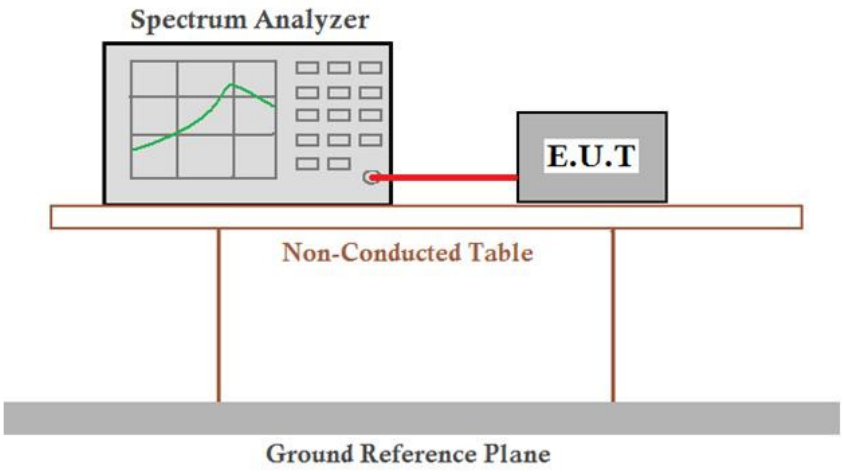
Test mode:	GFSK	Test channel:	Middle



Test mode:	GFSK	Test channel:	Highest



6.4 Power Spectral Density

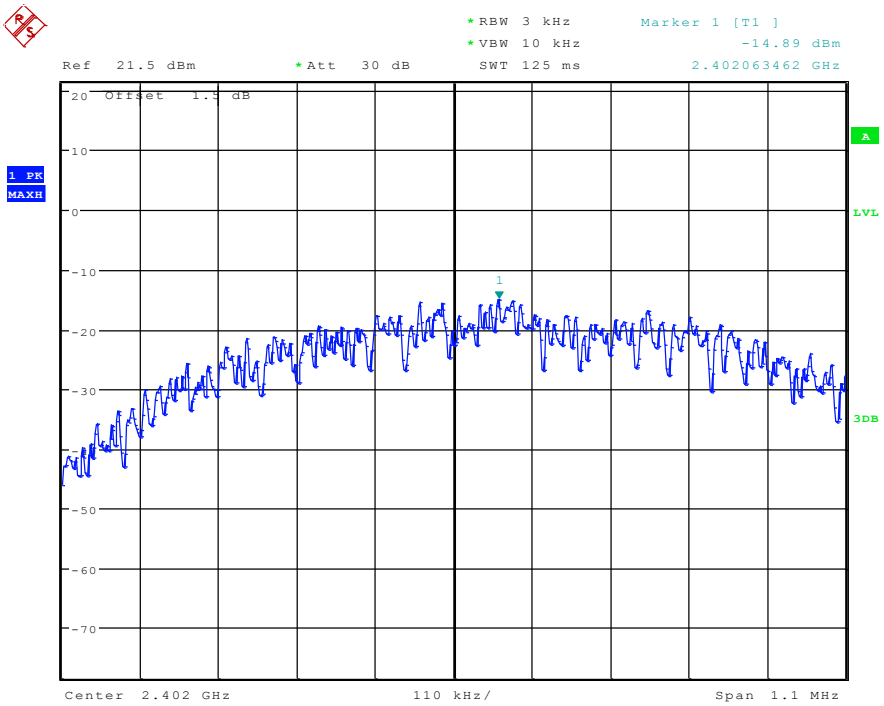
Test Requirement:	47 CFR Part 15C Section 15.247 (e)
Test Method:	ANSI C63.10 2013
Test Setup:	
Limit:	≤8.00dBm/3kHz
Test Mode:	Transmitting with GFSK modulation.
Instruments Used:	Refer to section 5.10 for details.
Test Results:	Pass

Measurement Data

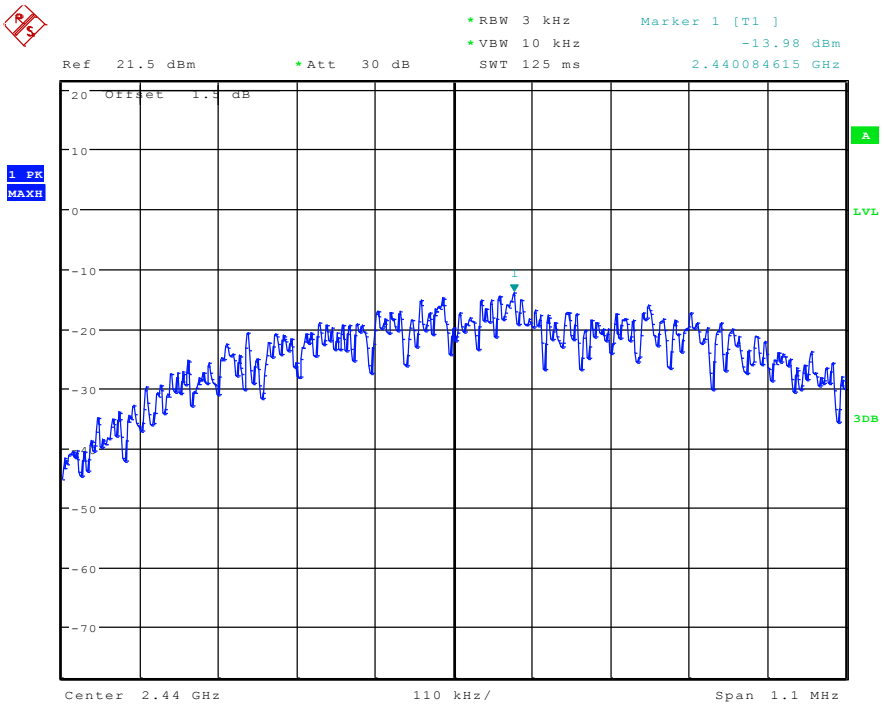
GFSK mode			
Test channel	Power Spectral Density (dBm/3kHz)	Limit (dBm/3kHz)	Result
Lowest	-14.89	≤8.00	Pass
Middle	-13.98	≤8.00	Pass
Highest	-14.19	≤8.00	Pass

Test plot as follows:

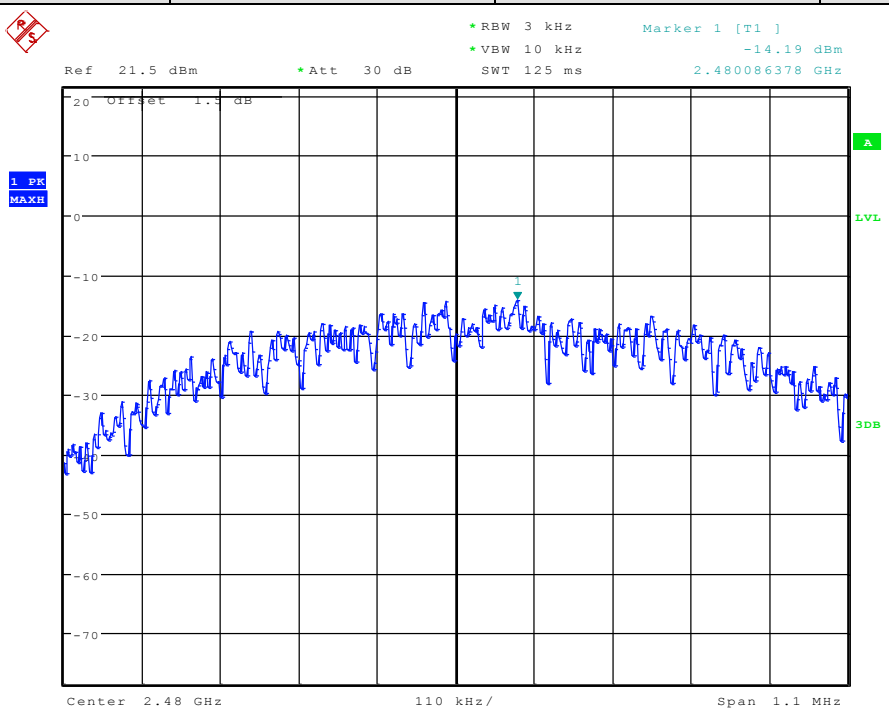
Test mode:	GFSK	Test channel:	Lowest



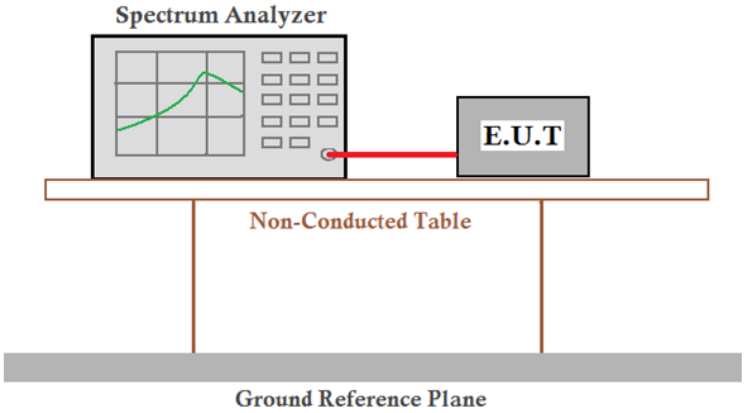
Test mode:	GFSK	Test channel:	Middle



Test mode:	GFSK	Test channel:	Highest

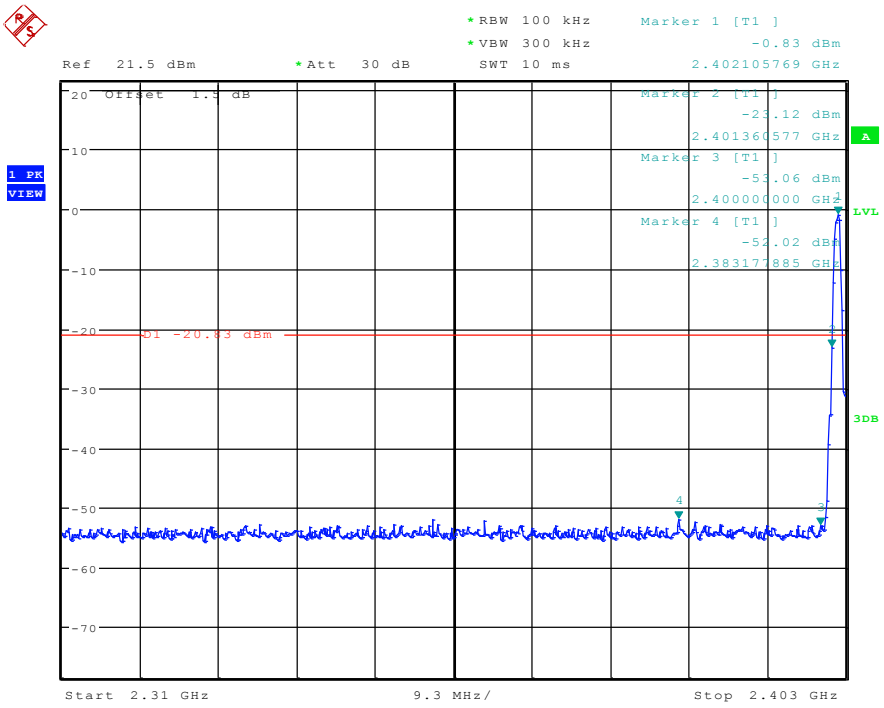


6.5 Band-edge for RF Conducted Emissions

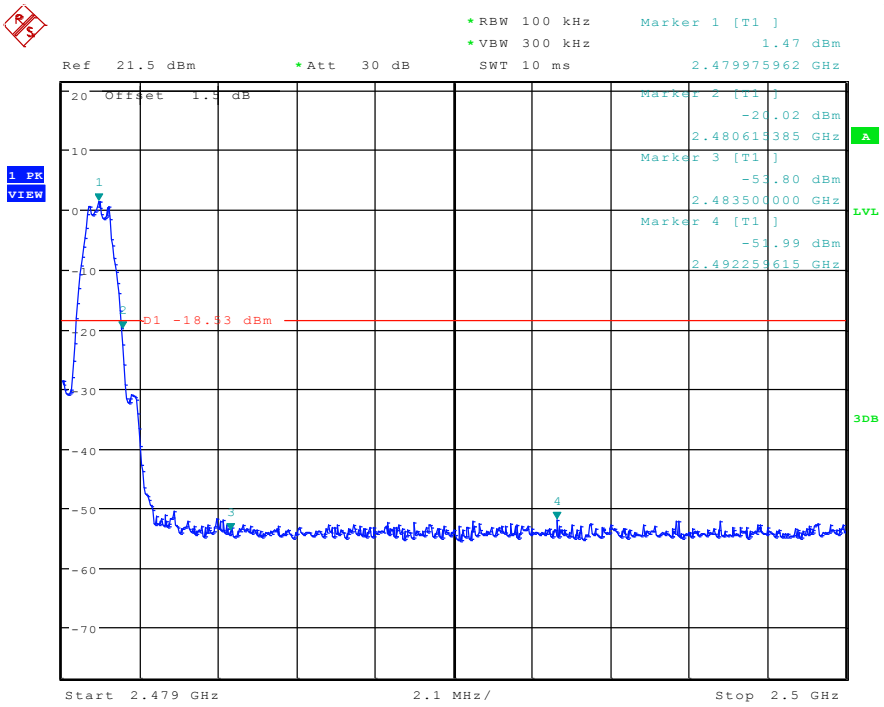
Test Requirement:	47 CFR Part 15C Section 15.247 (d)
Test Method:	ANSI C63.10 2013
Test Setup:	 Remark: Offset the High-Frequency cable loss 1.5dB in the spectrum analyzer.
Limit:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio 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.
Instruments Used:	Refer to section 5.10 for details.
Test Results:	Pass

Test plot as follows:

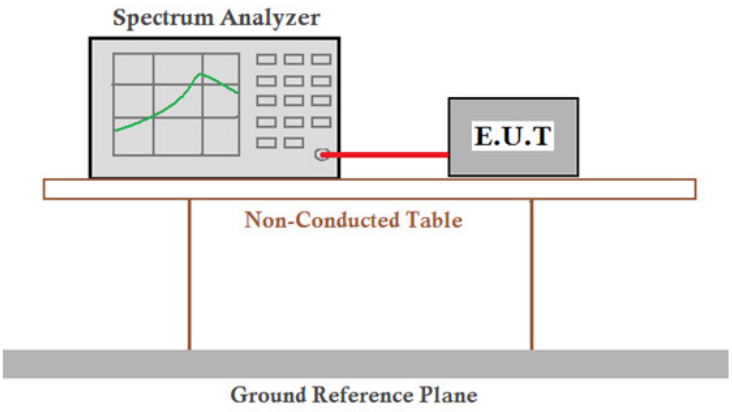
Test mode:	GFSK	Test channel:	Lowest



Test mode:	GFSK	Test channel:	Highest

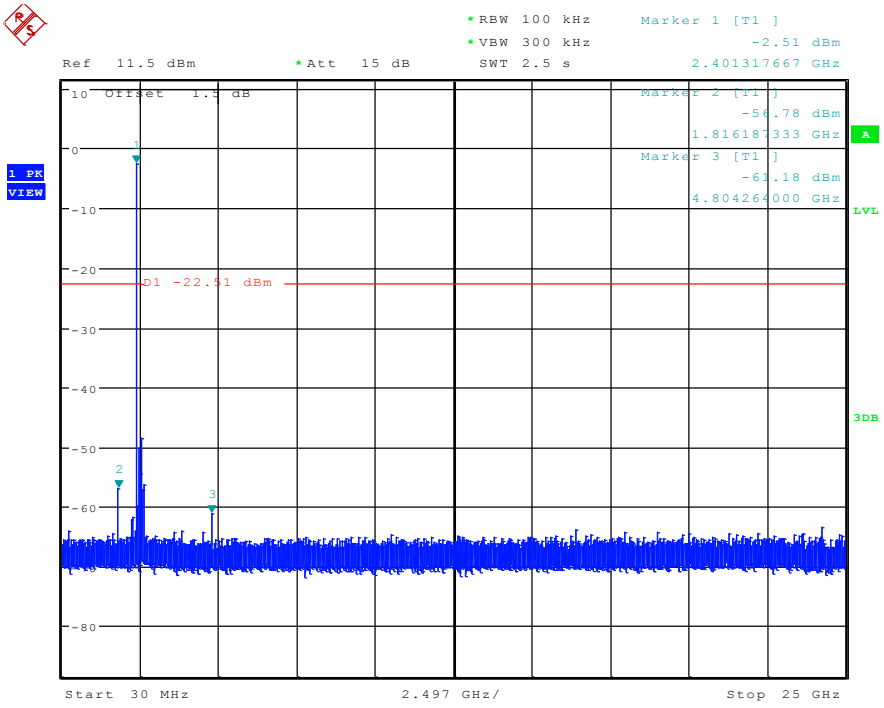


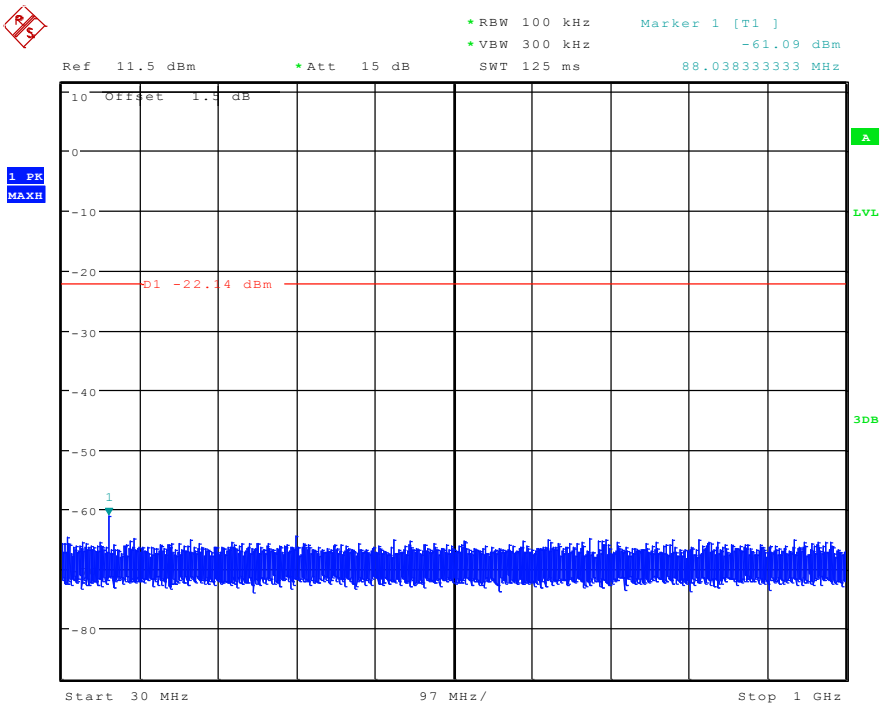
6.6 Spurious RF Conducted Emissions

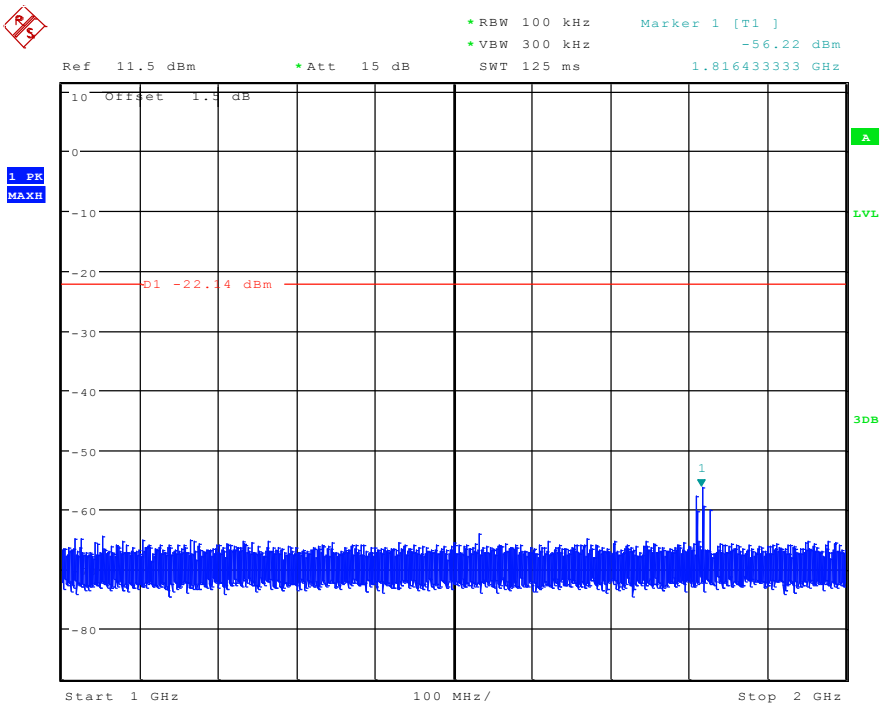
Test Requirement:	47 CFR Part 15C Section 15.247 (d)
Test Method:	ANSI C63.10 2013
Test Setup:	 Remark: Offset the High-Frequency cable loss 1.5dB in the spectrum analyzer.
Limit:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio 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.
Instruments Used:	Refer to section 5.10 for details.
Test Results:	Pass

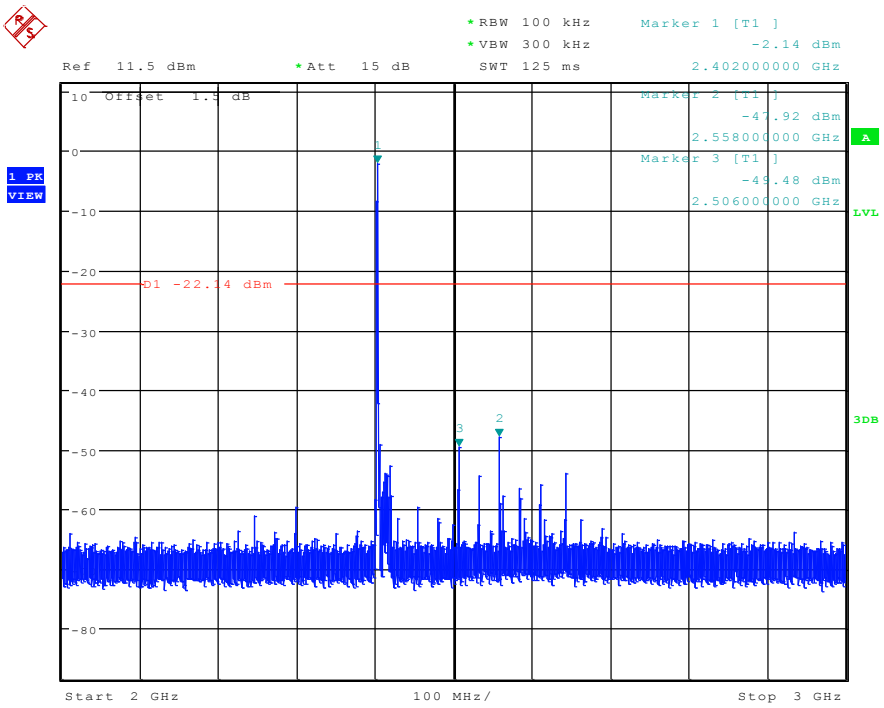
Test plot as follows:

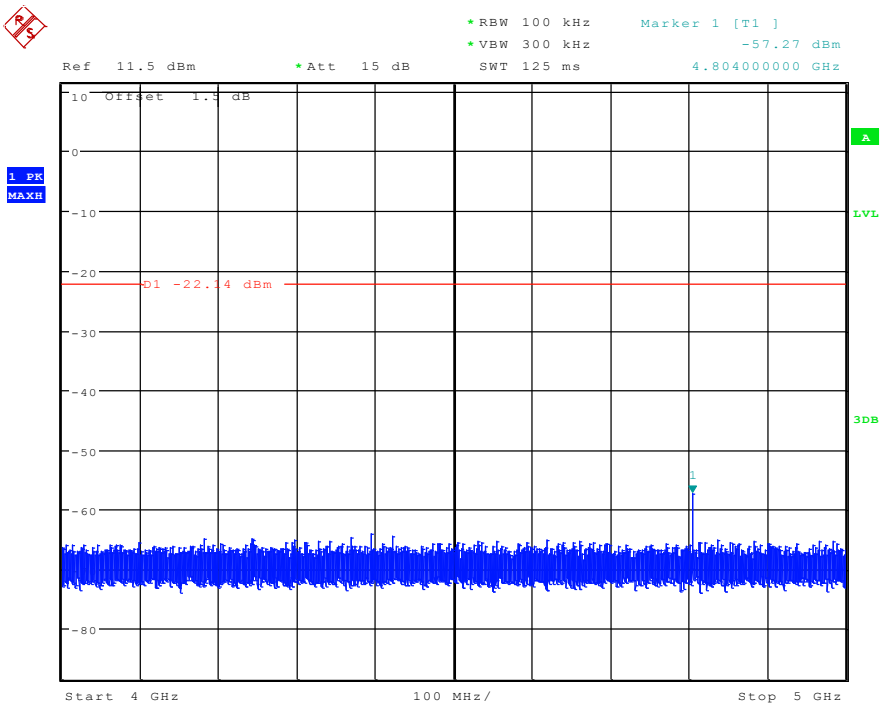
Test mode:	GFSK	Test channel:	Lowest

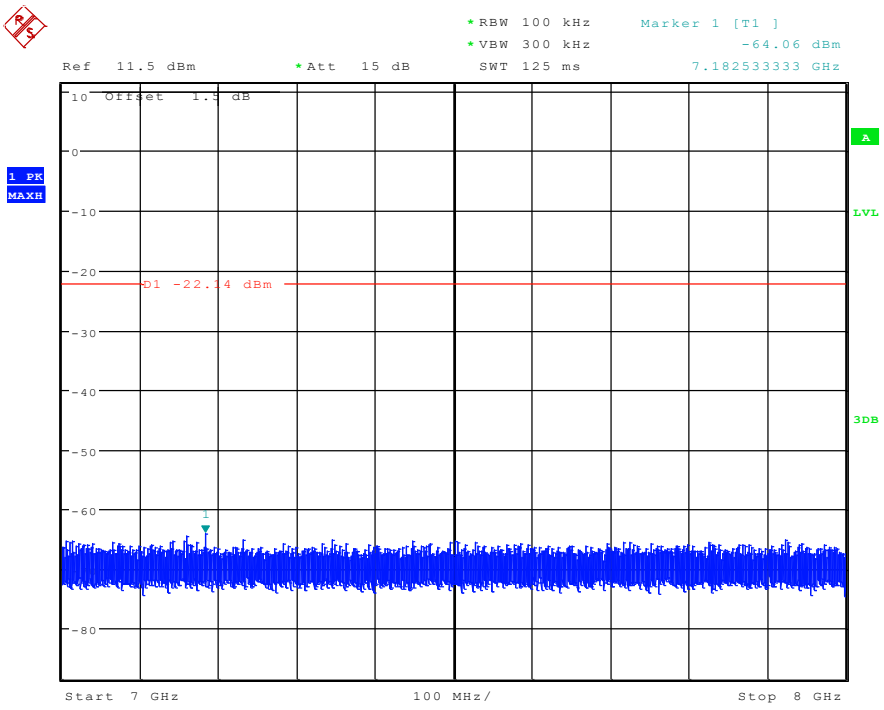




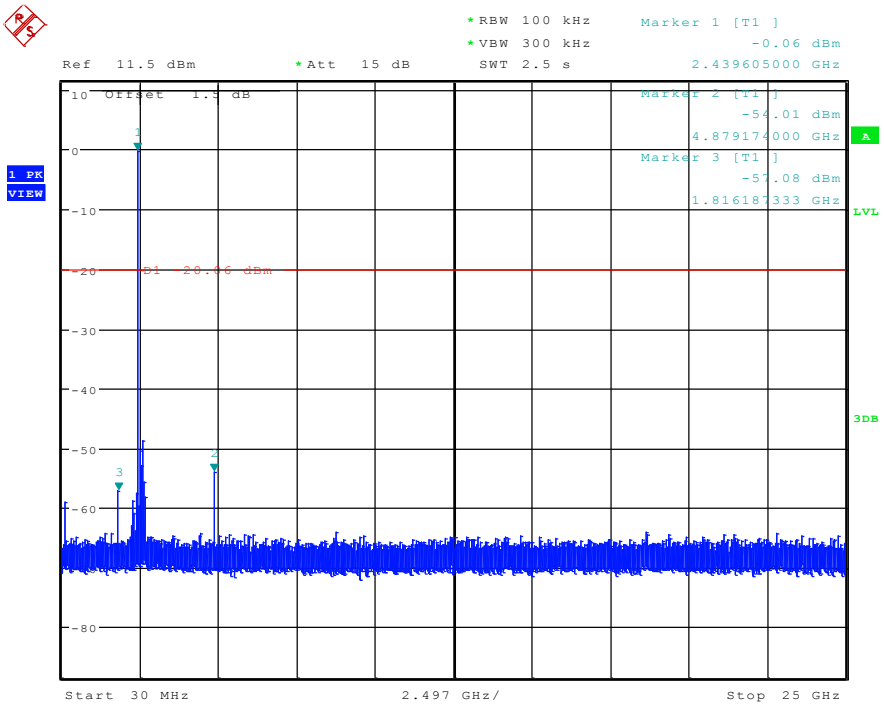

RBW 100 kHz
VBW 300 kHz
SWT 125 ms
Marker 1 [T1]
-56.22 dBm
1.816433333 GHz
Ref 11.5 dBm
Att 15 dB
Offset 1.5 dB
1 PK
MAXH
A
LVL
3DB
D1 -22.14 dBm
Start 1 GHz
100 MHz/
Stop 2 GHz

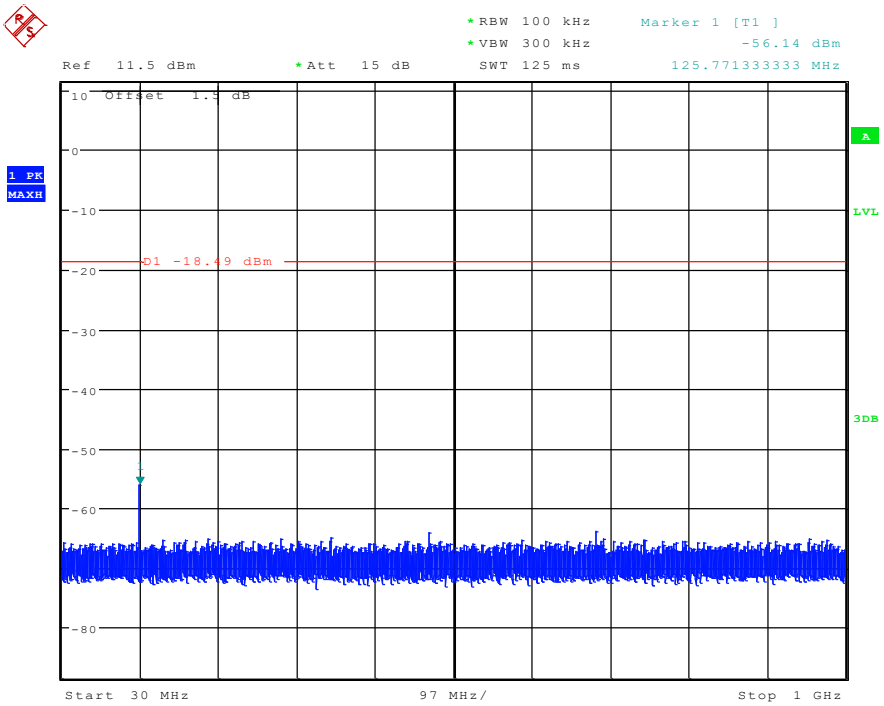

RBW 100 kHz
VBW 300 kHz
SWT 125 ms
Marker 1 [T1]
-2.14 dBm
2.402000000 GHz
Marker 2 [T1]
-47.92 dBm
2.558000000 GHz
Marker 3 [T1]
-49.48 dBm
2.506000000 GHz
Ref 11.5 dBm
Att 15 dB
Offset 1.5 dB
1 PK
VIEW
A
LVL
3DB
D1 -22.14 dBm
Start 2 GHz
100 MHz/
Stop 3 GHz

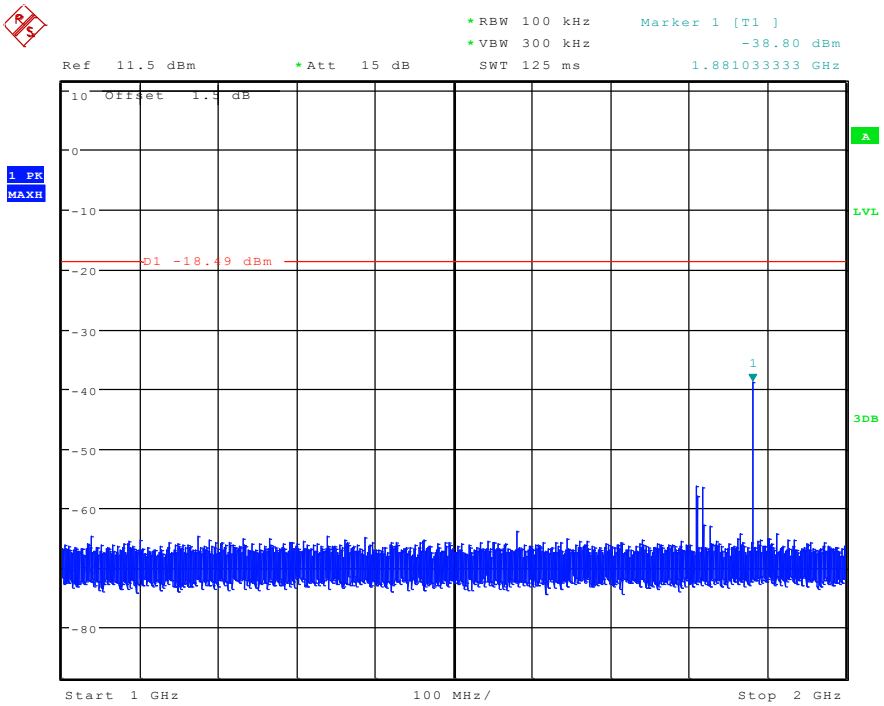

RBW 100 kHz
VBW 300 kHz
SWT 125 ms
Marker 1 [T1]
-57.27 dBm
4.804000000 GHz
Ref 11.5 dBm
Att 15 dB
Offset 1.5 dB
1 PK
MAXH
A
LVL
3DB
D1 -22.14 dBm
Start 4 GHz
100 MHz/
Stop 5 GHz

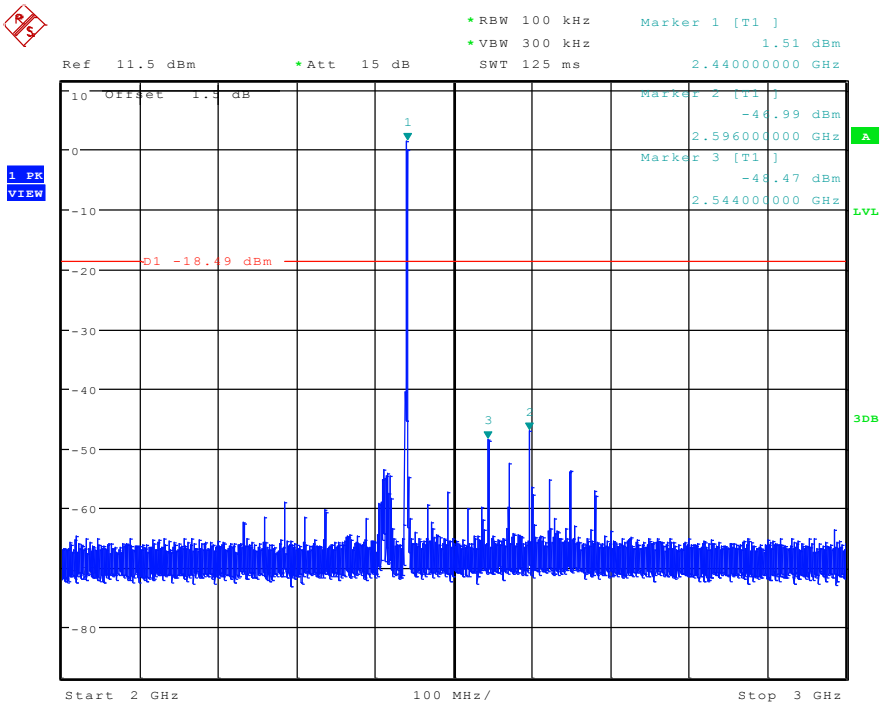

RBW 100 kHz
VBW 300 kHz
SWT 125 ms
Marker 1 [T1]
-64.06 dBm
7.182533333 GHz
Ref 11.5 dBm
Att 15 dB
Offset 1.5 dB
1 PK
MAXH
A
LVL
3DB
D1 -22.14 dBm
Start 7 GHz
100 MHz/
Stop 8 GHz

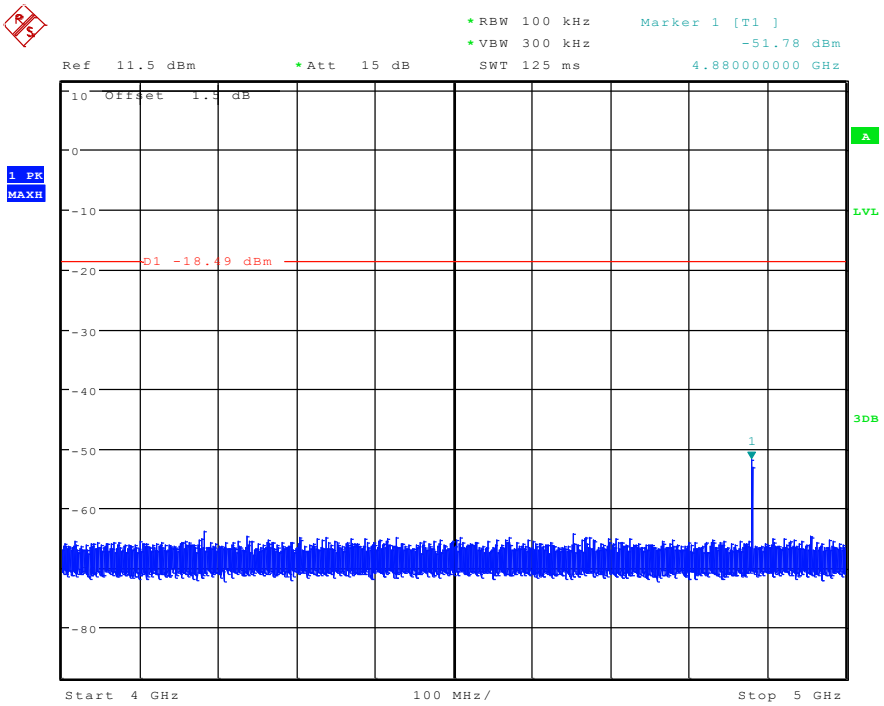
Test mode:	GFSK	Test channel:	Middle

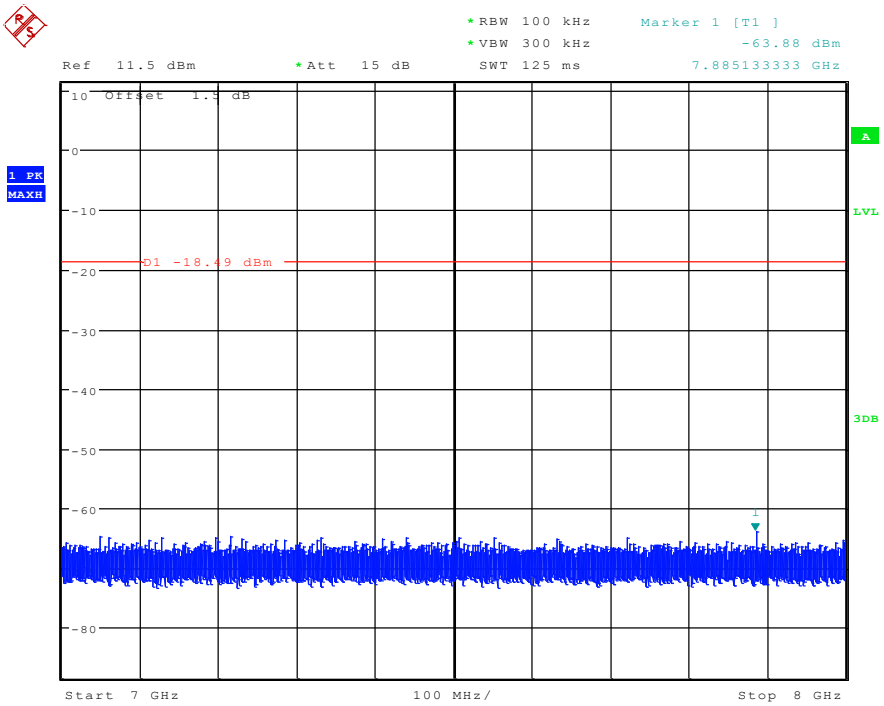




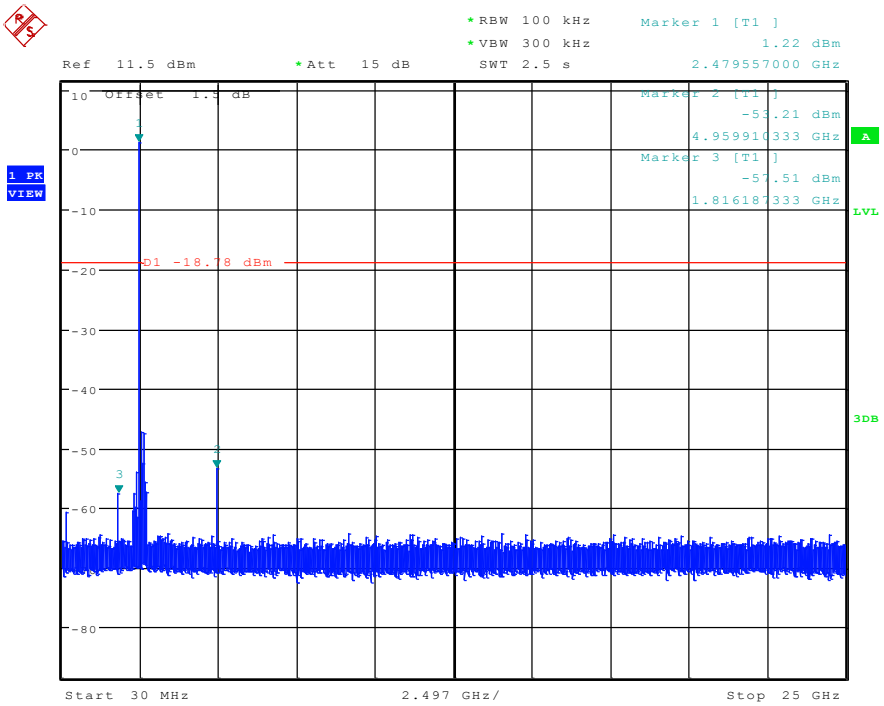

RBW 100 kHz
VBW 300 kHz
SWT 125 ms
Marker 1 [T1]
-38.80 dBm
1.881033333 GHz
Ref 11.5 dBm
Att 15 dB
Offset 1.5 dB
1 PK
MAXH
D1 -18.49 dBm
A
LVL
3DB
Start 1 GHz
100 MHz/
Stop 2 GHz

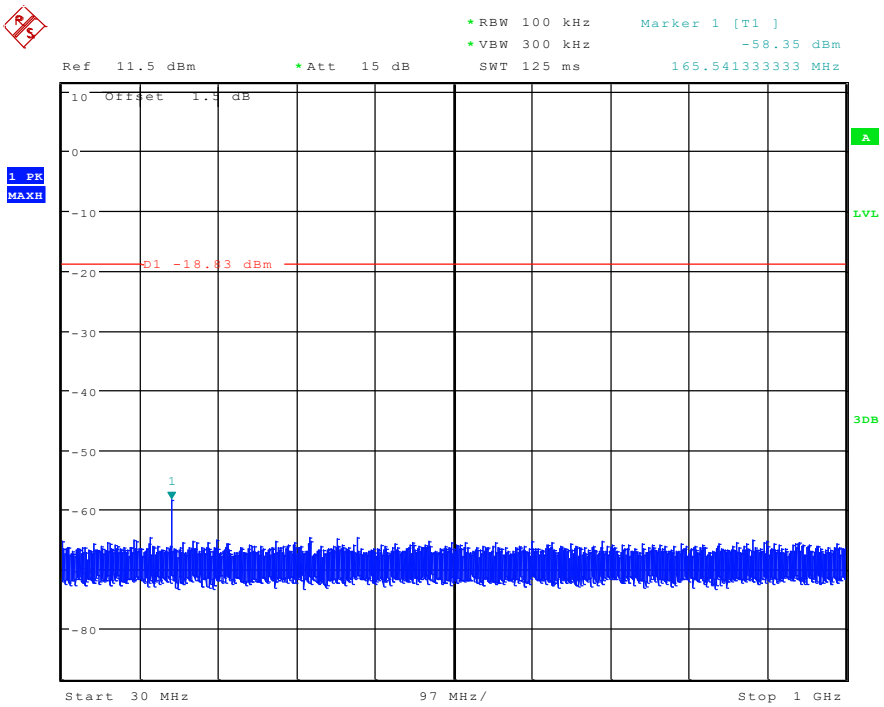

RBW 100 kHz
VBW 300 kHz
SWT 125 ms
Marker 1 [T1]
1.51 dBm
2.440000000 GHz
Marker 2 [T1]
-46.99 dBm
2.596000000 GHz
Marker 3 [T1]
-48.47 dBm
2.544000000 GHz
Ref 11.5 dBm
Att 15 dB
Offset 1.5 dB
1 PK
VIEW
D1 -18.49 dBm
A
LVL
3DB
Start 2 GHz
100 MHz/
Stop 3 GHz

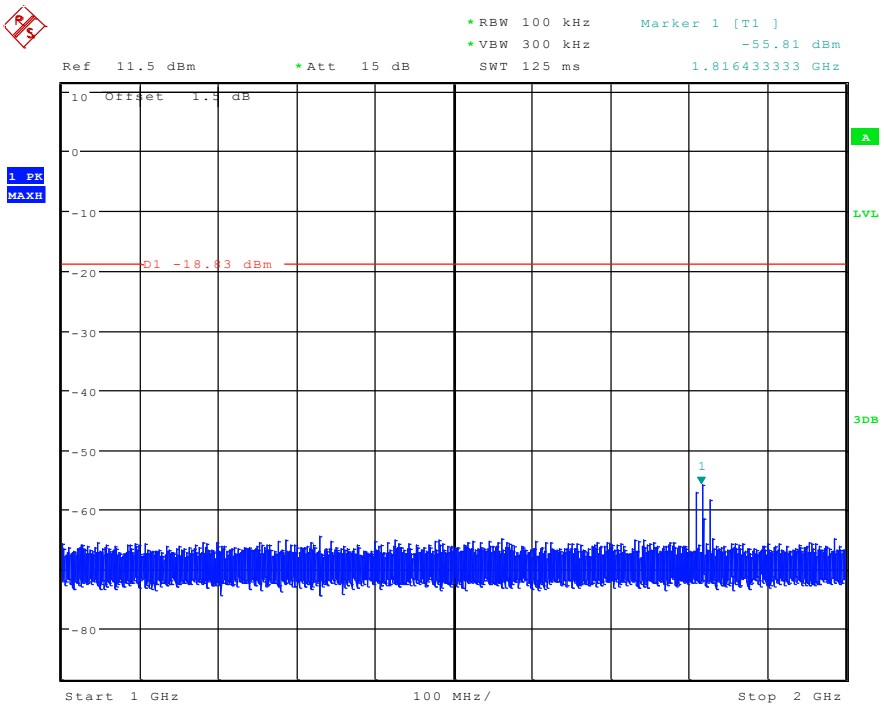

RBW 100 kHz
VBW 300 kHz
SWT 125 ms
Marker 1 [T1]
-51.78 dBm
4.880000000 GHz
Ref 11.5 dBm
Att 15 dB
Offset 1.5 dB
1 PK
MAXH
D1 -18.49 dBm
A
LVL
3DB
Start 4 GHz
100 MHz/
Stop 5 GHz

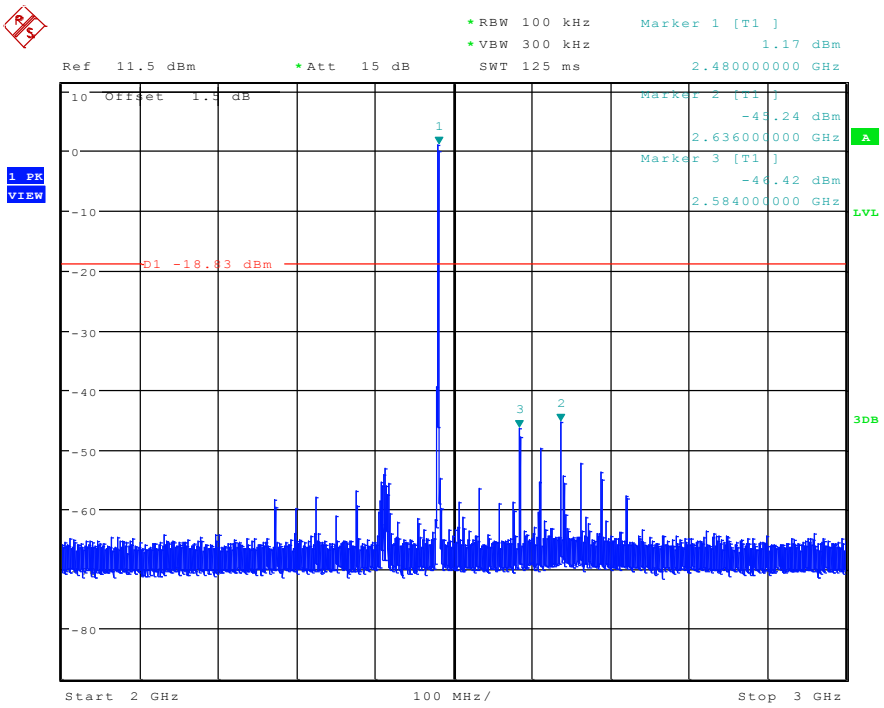

RBW 100 kHz
VBW 300 kHz
SWT 125 ms
Marker 1 [T1]
-63.88 dBm
7.885133333 GHz
Ref 11.5 dBm
Att 15 dB
Offset 1.5 dB
1 PK
MAXH
D1 -18.49 dBm
A
LVL
3DB
Start 7 GHz
100 MHz/
Stop 8 GHz

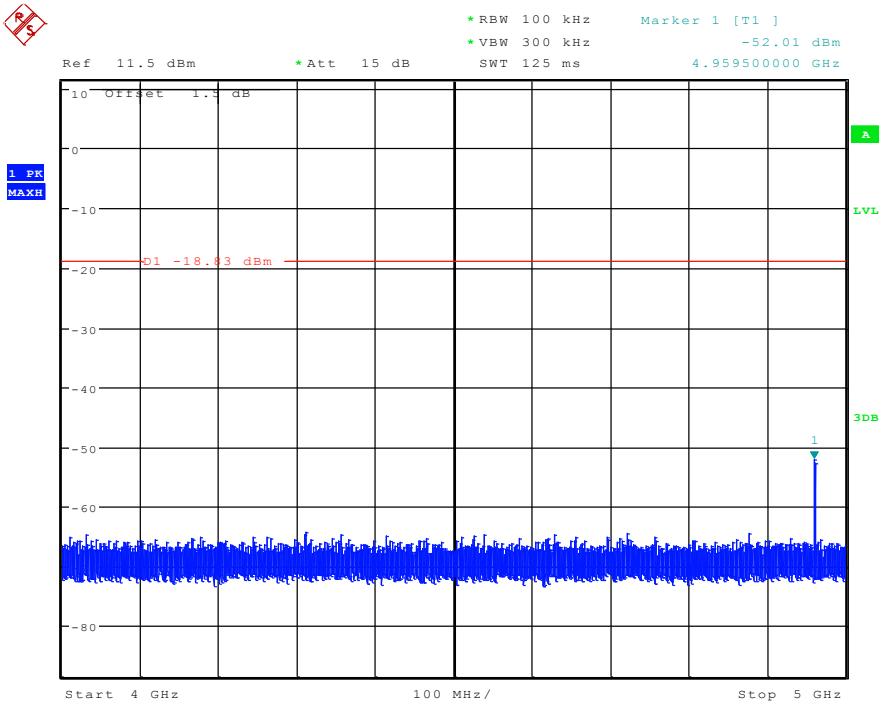
Test mode:	GFSK	Test channel:	Highest

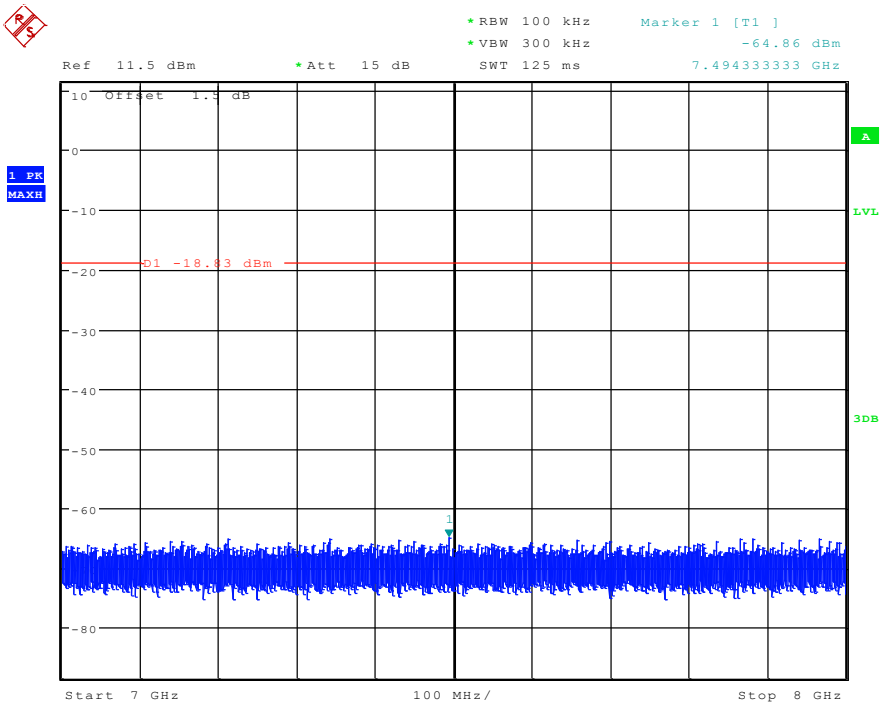





RBW 100 kHz
VBW 300 kHz
Ref 11.5 dBm
Att 15 dB
SWT 125 ms
Marker 1 [T1]
-55.81 dBm
1.816433333 GHz
Offset 1.5 dB
1 PK
MAXH
D1 -18.83 dBm
A
LVL
3DB
Start 1 GHz
100 MHz/
Stop 2 GHz


RBW 100 kHz
VBW 300 kHz
Ref 11.5 dBm
Att 15 dB
SWT 125 ms
Marker 1 [T1]
1.17 dBm
2.480000000 GHz
Marker 2 [T1]
-45.24 dBm
2.636000000 GHz
Marker 3 [T1]
-46.42 dBm
2.584000000 GHz
Offset 1.5 dB
1 PK
VIEW
D1 -18.83 dBm
A
LVL
3DB
Start 2 GHz
100 MHz/
Stop 3 GHz





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.

6.7 Radiated Spurious Emission

6.7.1 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:	

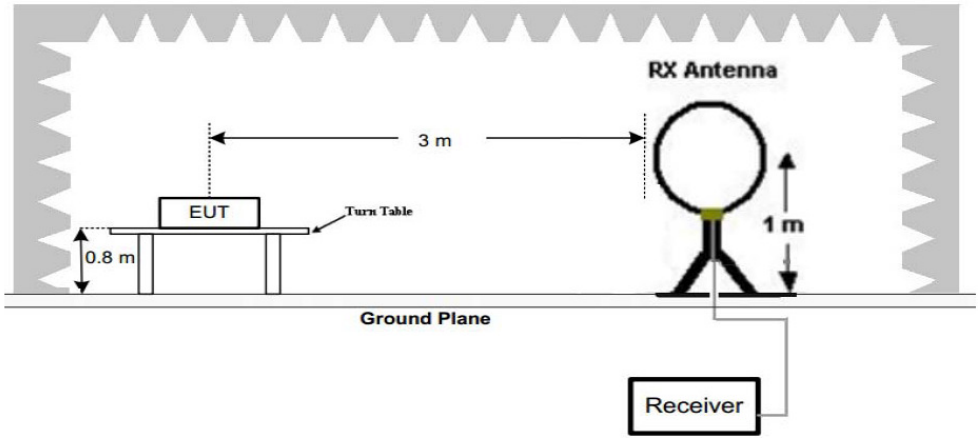


Figure 1. Below 30MHz

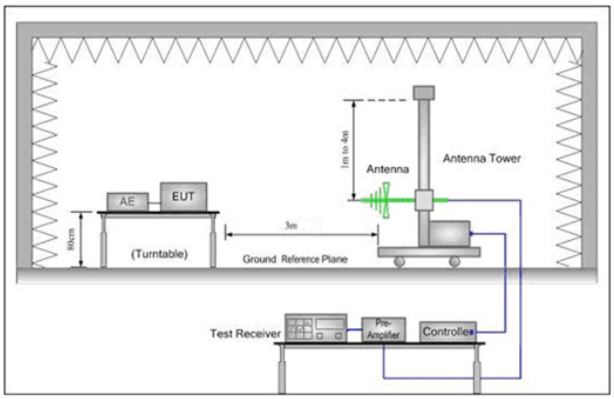


Figure 2. 30MHz to 1GHz

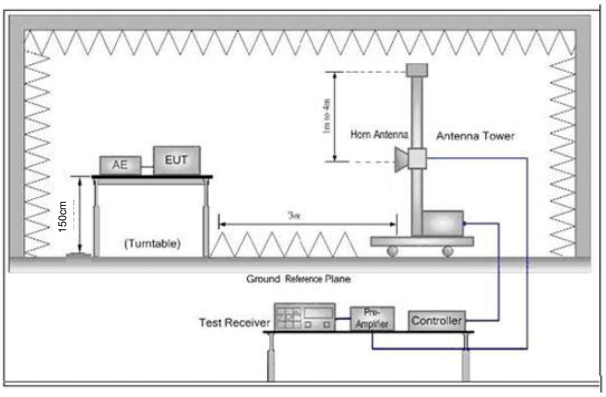
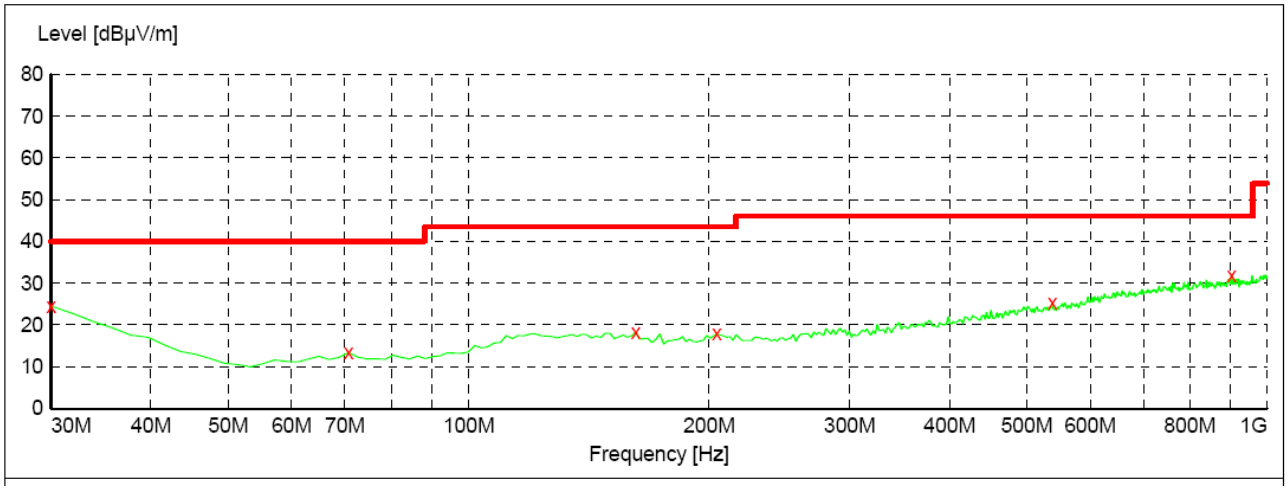


Figure 3. Above 1 GHz

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

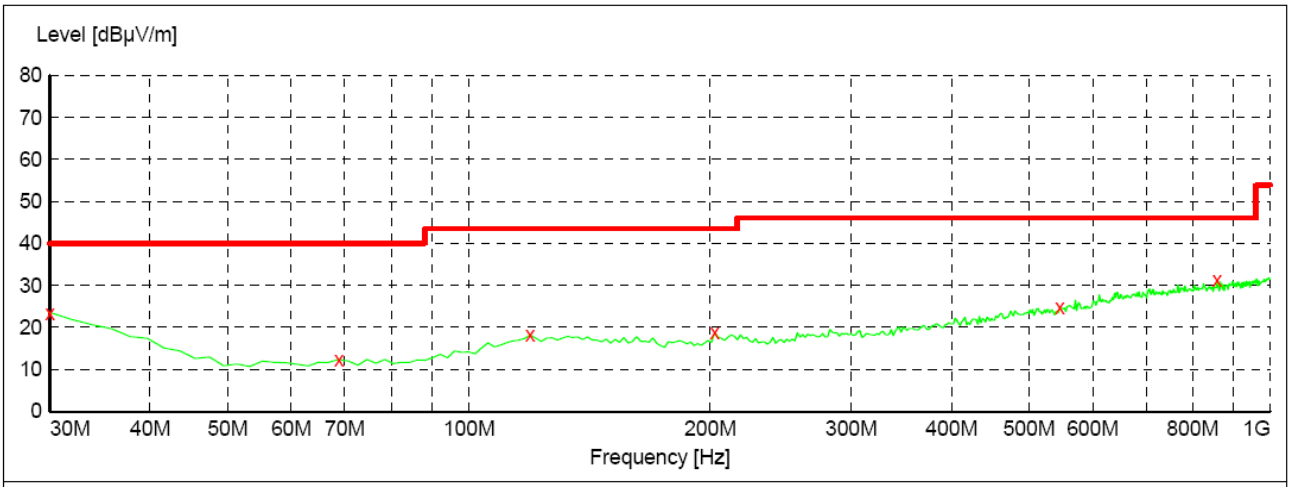
	and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading. e. The test-receiver system was set to Peak Detect Function 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:	Transmitting with GFSK modulation. Pretest the EUT at Transmitting mode, found Transmitting mode 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

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



Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Det.
30.000000	24.50	20.8	40.0	15.5	-QP-
70.740000	13.40	8.2	40.0	26.6	-QP-
161.920000	18.30	13.6	43.5	25.2	-QP-
204.600000	17.90	14.1	43.5	25.6	-QP-
538.280000	25.40	20.6	46.0	20.6	-QP-
903.000000	32.00	26.0	46.0	14.0	-QP-

Test mode:	Transmitting mode	Horizontal



Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Det.
30.000000	23.50	20.8	40.0	16.5	-QP-
68.800000	12.40	8.2	40.0	27.6	-QP-
119.240000	18.20	14.7	43.5	25.3	-QP-
202.660000	18.80	14.1	43.5	24.7	-QP-
546.040000	24.70	20.8	46.0	21.3	-QP-
858.380000	31.40	25.3	46.0	14.6	-QP-

Transmitter Emission above 1GHz

Worse case mode:	GFSK	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
4804	48.32	-5.18	43.14	74	-30.86	peak	H
4804	36.07	-5.18	30.89	54	-23.11	AVG	H
7206	49.65	-6.45	43.20	74	-30.80	peak	H
7206	35.32	-6.45	28.87	54	-25.13	AVG	H
4804	48.55	-5.18	43.37	74	-30.63	peak	V
4804	36.02	-5.18	30.84	54	-23.16	AVG	V
7206	48.93	-6.45	42.48	74	-31.52	peak	V
7206	35.90	-6.45	29.45	54	-24.55	AVG	V

Worse case mode:	GFSK	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	48.55	-5.19	43.36	74	-30.64	peak	H
4880	36.24	-5.19	31.05	54	-22.95	AVG	H
7320	50.02	-6.47	43.55	74	-30.45	peak	H
7320	35.30	-6.47	28.83	54	-25.17	AVG	H
4880	48.78	-5.19	43.59	74	-30.41	peak	V
4880	36.30	-5.19	31.11	54	-22.89	AVG	V
7320	49.86	-6.47	43.39	74	-30.61	peak	V
7320	35.01	-6.47	28.54	54	-25.46	AVG	V

Worse case mode:	GFSK	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
4960	50.20	-5.20	45.00	74	-29.00	peak	H
4960	37.24	-5.20	32.04	54	-21.96	AVG	H
7440	50.87	-6.47	44.40	74	-29.60	peak	H
7440	36.88	-6.47	30.41	54	-23.59	AVG	H
4960	49.60	-5.20	44.40	74	-29.60	peak	V
4960	37.92	-5.20	32.72	54	-21.28	AVG	V
7440	50.96	-6.47	44.49	74	-29.51	peak	V
7440	36.27	-6.47	29.80	54	-24.20	AVG	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 8GHz 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.

6.8 Restricted bands around fundamental frequency

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)
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:

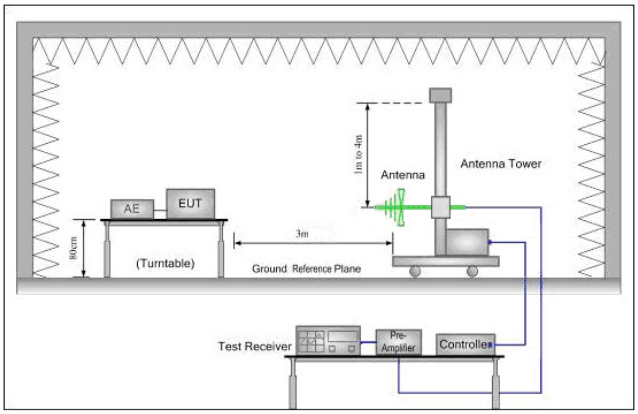


Figure 1. 30MHz to 1GHz

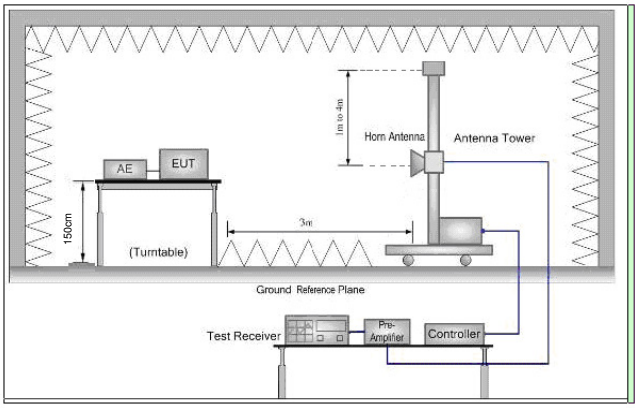


Figure 2. Above 1 GHz

Test Procedure:

a. 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.The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

b. 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.

c. 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. d. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. e. 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 f. Test the EUT in the lowest channel , the Highest channel g. 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. h. 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, found the Transmitting mode 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

Worse case mode:	GFSK	Test channel:	Lowest	Remark:	Vertical

Frequency	Meter Reading	Factor	Emission Level	Limits	Over	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2390	48.95	-4.36	44.59	74	-29.41	peak
2390	35.26	-4.36	30.90	54	-23.10	AVG
2402.40	95.23	-4.37	90.86	74	16.86	peak
2402.40	80.41	-4.37	76.04	54	22.04	AVG

Worse case mode:	GFSK	Test channel:	Lowest	Remark:	Horizontal

Frequency	Meter Reading	Factor	Emission Level	Limits	Over	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2390	48.24	-4.36	43.88	74	-30.12	peak
2390	35.29	-4.36	30.93	54	-23.07	AVG
2402.42	92.58	-4.37	88.21	74	14.21	peak
2402.42	77.25	-4.37	72.88	54	18.88	AVG

Worse case mode:	GFSK	Test channel:	Highest	Remark:	Vertical

Frequency	Meter Reading	Factor	Emission Level	Limits	Over	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2479.88	96.75	-4.22	92.53	74	18.53	peak
2479.88	82.41	-4.22	78.19	54	24.19	AVG
2483.5	54.55	-4.22	50.33	74	-23.67	peak
2483.5	48.29	-4.22	44.07	54	-9.93	AVG

Worse case mode:	GFSK	Test channel:	Highest	Remark:	Horizontal

Frequency	Meter Reading	Factor	Emission Level	Limits	Over	Detector Type
(MHz)	(dBμV)	(dB)	(dBμV/m)	(dBμV/m)	(dB)	
2479.87	93.95	-4.22	89.73	74	15.73	peak
2479.87	77.28	-4.22	73.06	54	19.06	AVG
2483.5	54.03	-4.22	49.81	74	-24.19	peak
2483.5	46.79	-4.22	42.57	54	-11.43	AVG

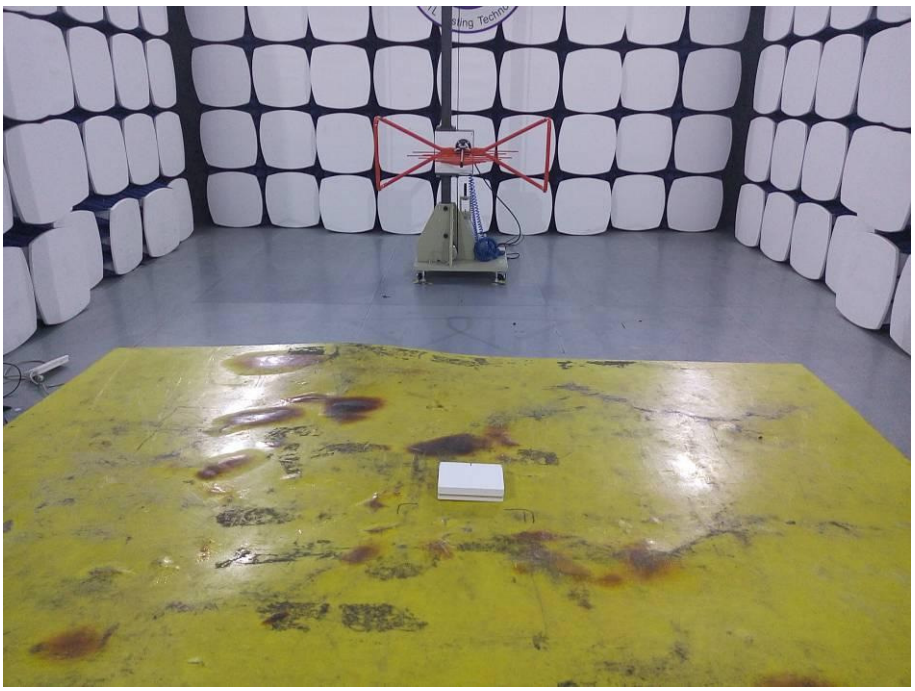
Note:
The field strength is calculated by adding the Antenna Factor, Cable Factor & Preamplifier. The basic equation with a sample calculation is as follows:

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

7 Photographs - EUT Test Setup

Test model No.: M1602A

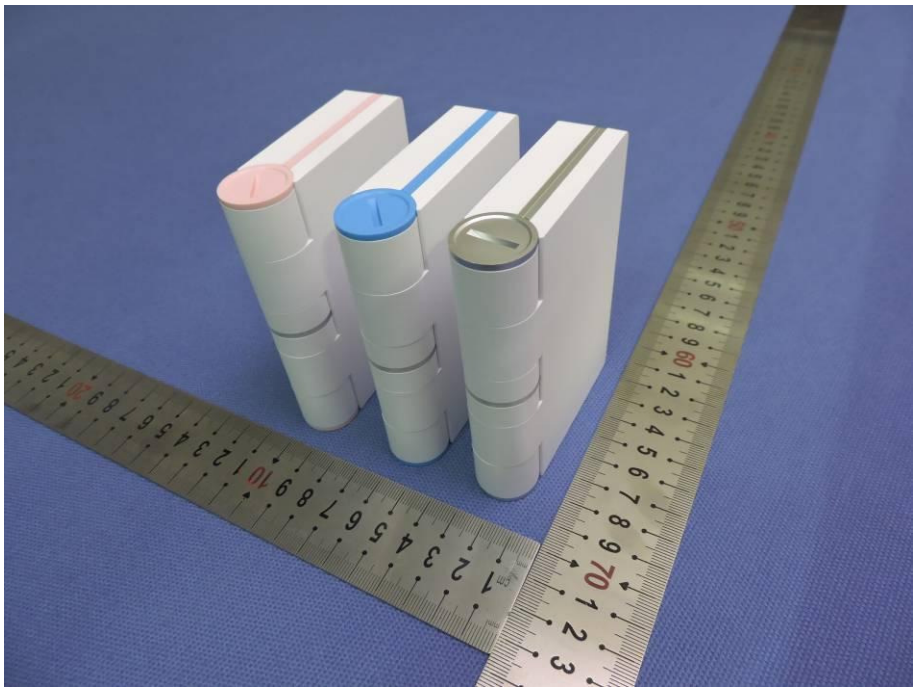
7.1 Radiated Emission



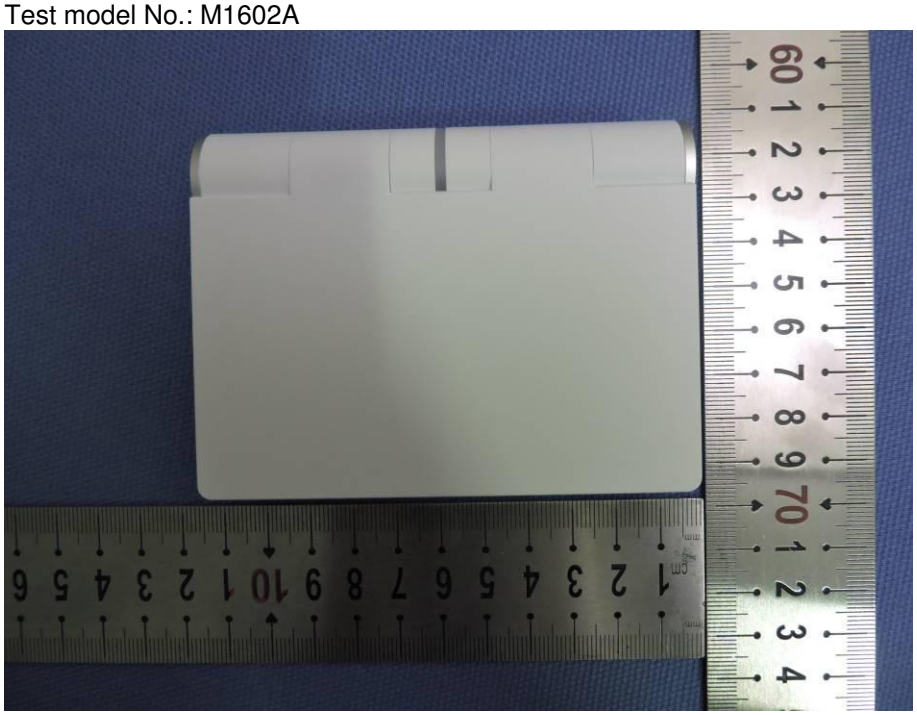
Below 1GHz: The EUT is placed in the 0.8 m high test table

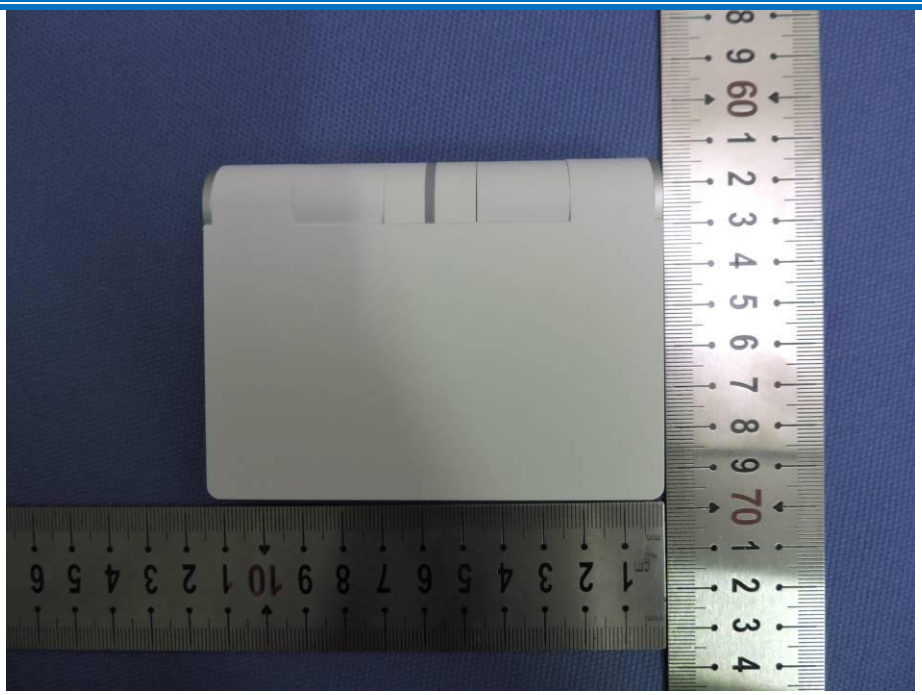
Above 1GHz: The EUT is placed in the 1.5 m high styrofoam block, the styrofoam block placed in the 0.8 m high test table

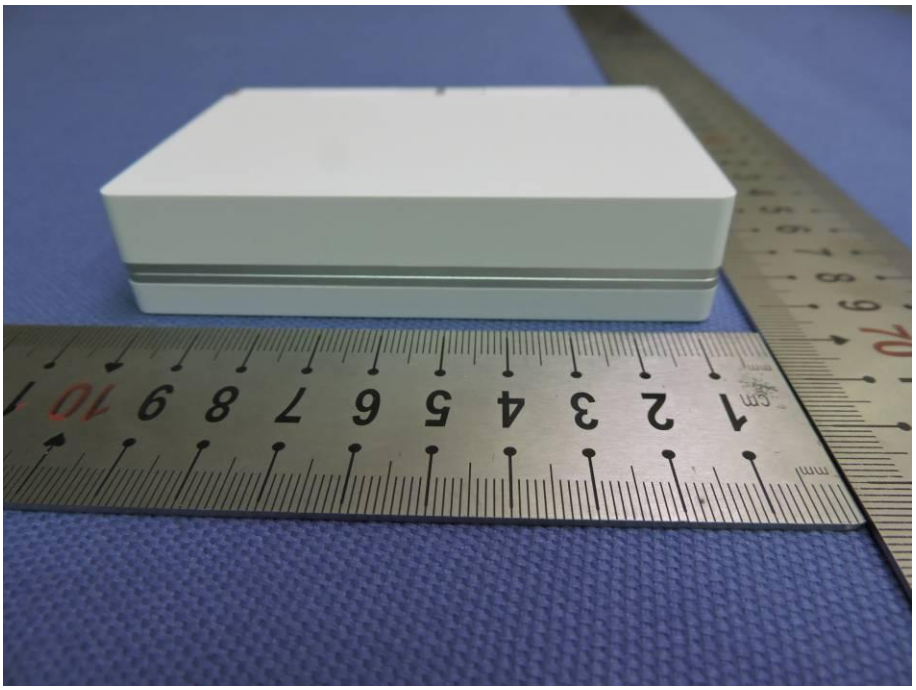
8 Photographs - EUT Constructional Details

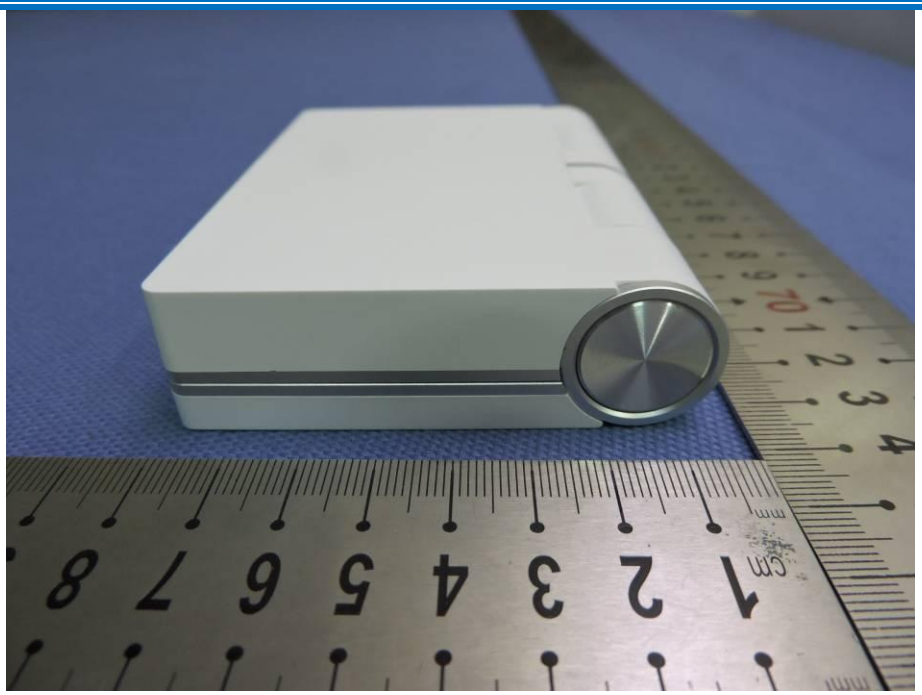


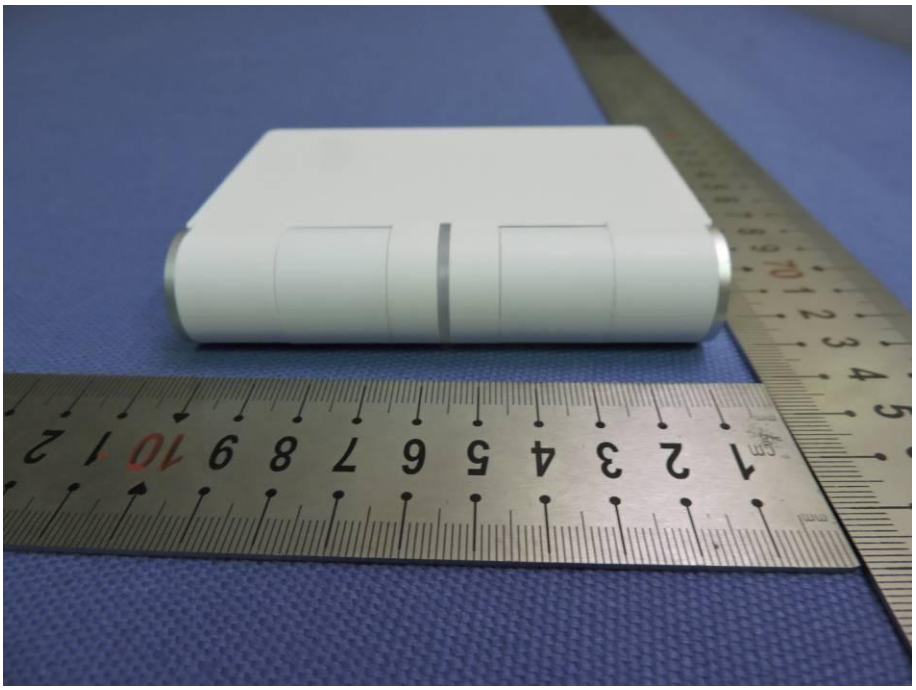
Test model No.: M1602A

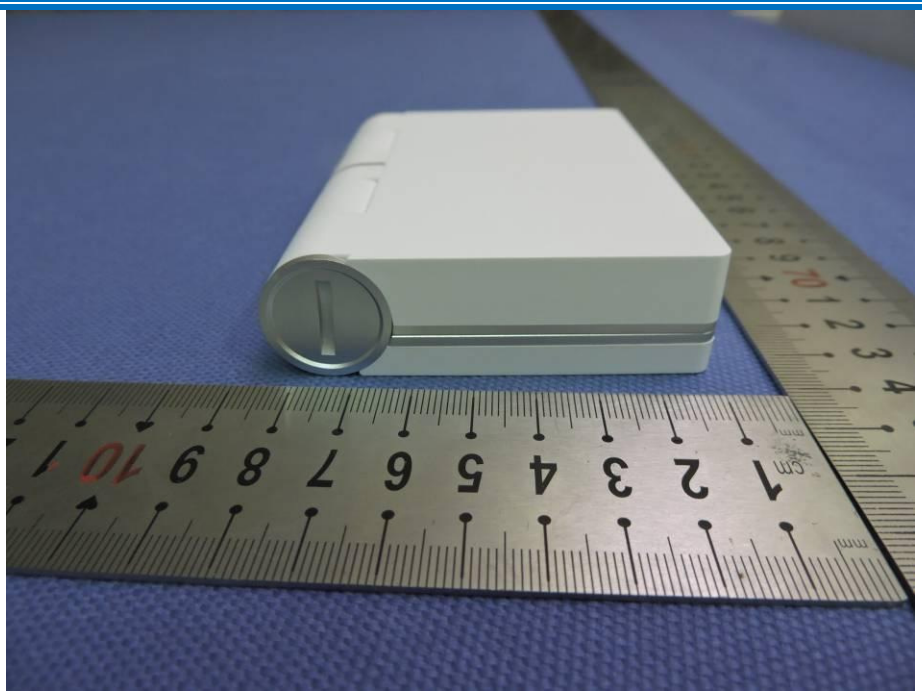


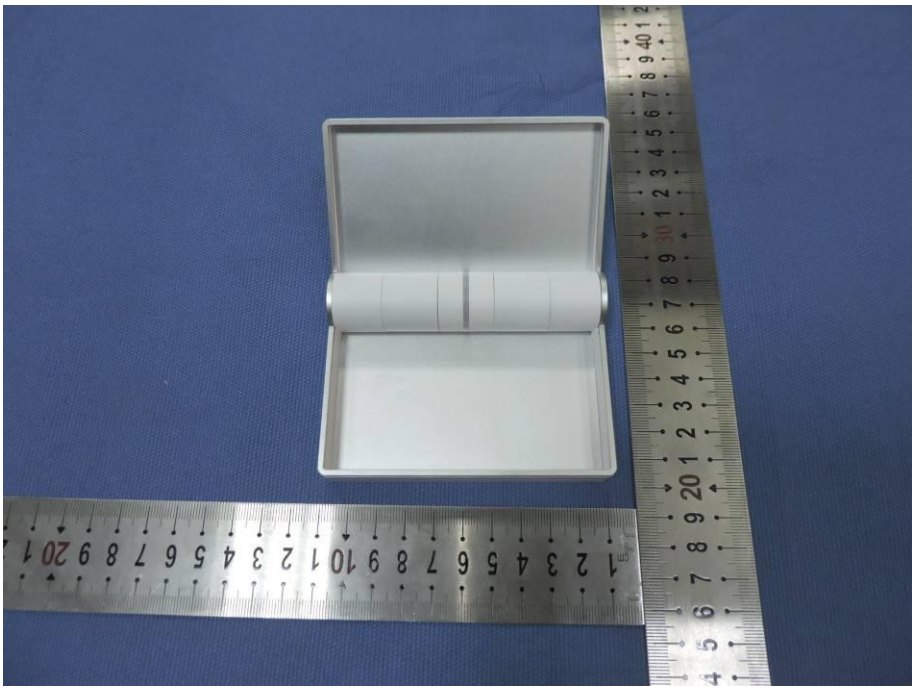


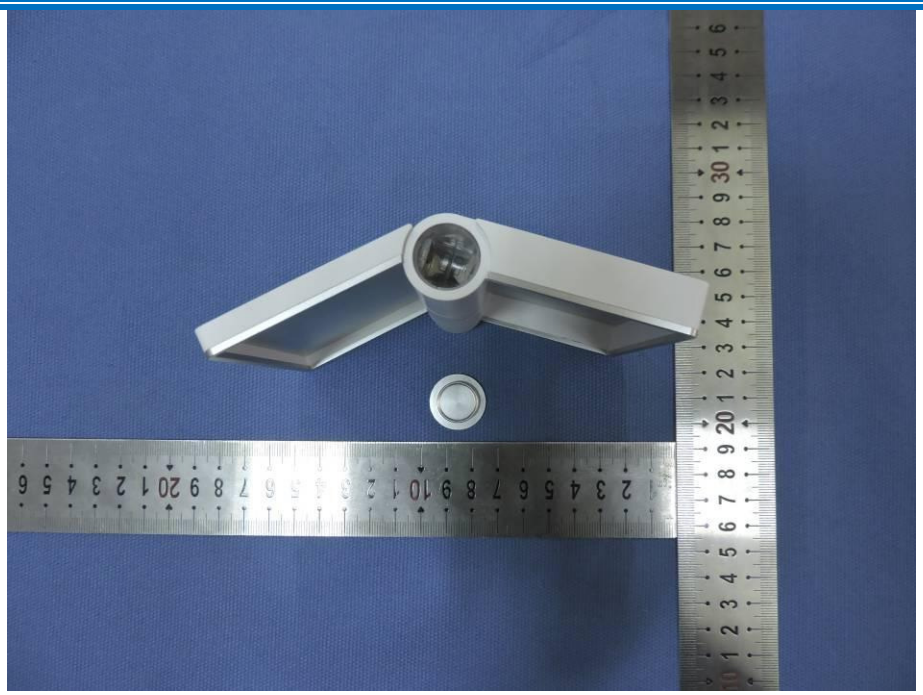


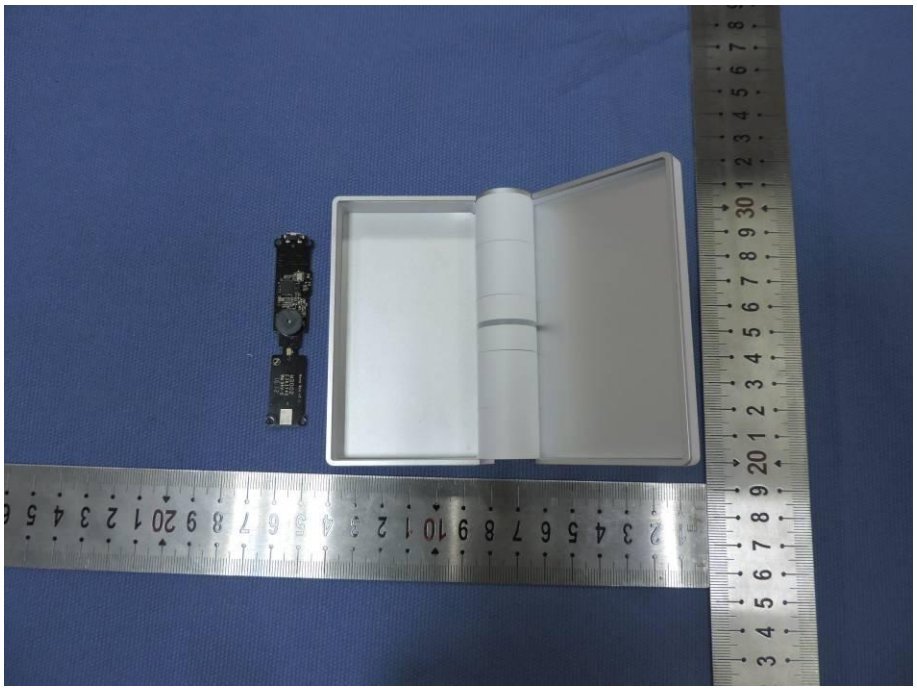


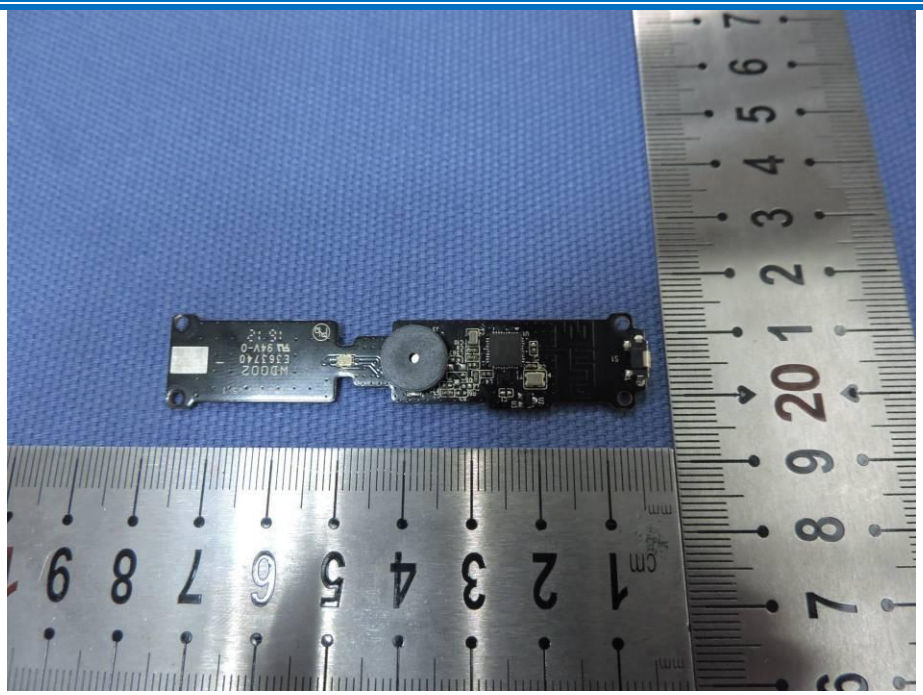


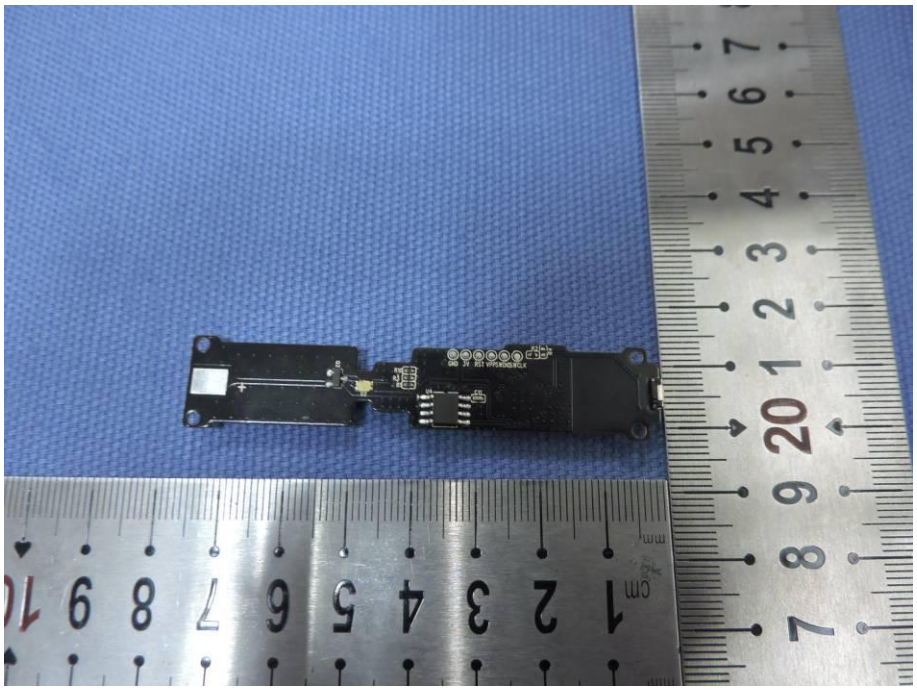


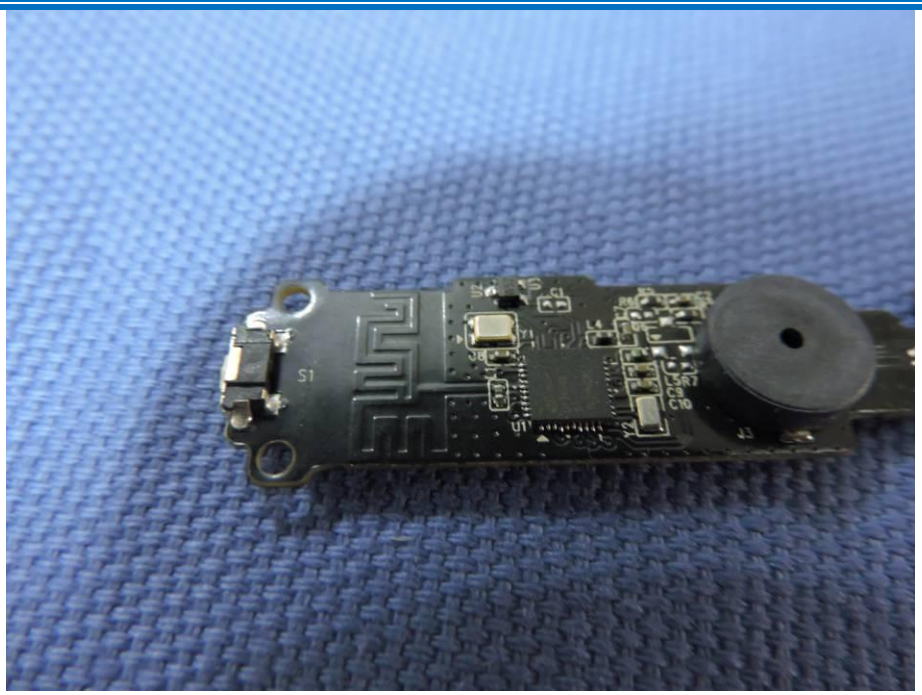












END OF THE REPORT