TEST REPORT

Product Name:	True Wireless Earbuds
FCC ID:	2AX8D-ET350
Trademark:	astrum
Model Number:	ET350, ET310, ET320, ET325, ET330, ET340, ET360, ET370 ET380, ET390
Prepared For:	Astrum Holdings Limited
Address:	1618, Asia Trade Centre,79 Lei Muk Road, Kwai Chung, New Territories, Hong Kong
Manufacturer:	Shenzhen Aier Technology Co., Ltd
Address:	1909, building 1, square 9, Liaofeng Road, Shajing street, Bao'an District, Shenzhen, China
Prepared By:	Shenzhen CTB Testing Technology Co., Ltd.
Address:	Floor 1&2, Building A, No. 26 of Xinhe Road, Xinqiao Street, Baoan District, Shenzhen China
Sample Received Date:	Nov. 6, 2020
Sample tested Date:	Nov. 6, 2020 to Nov. 10, 2020
Issue Date:	Nov. 10, 2020
Report No.:	CTB201109013RFX
Test Standards	FCC Part15.247 ANSI C63.10:2013
Test Results	PASS
Remark:	This is Bluetooth radio test report.

Compiled by:	Reviewed by:	Approved by:
Arron Liu	Bin Mei	Rita Xiao / Director

The test report is effective only with both signature and specialized stamp. This result(s) shown in this report refer only to the sample(s) tested. Without written approval of Shenzhen CTB Testing Technology Co., Ltd. this report can't be reproduced except in full. The tested sample(s) and the sample information are provided by the client.

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(Note: N/A means not applicable)

1. VERSION

Report No.	Issue Date	Description	Approved
CTB201109013RFX	Nov. 10, 2020	Original	Valid

2. TEST SUMMARY

The Product has been tested according to the following specifications:

Test Item	Test Requirement	Test method	Result
AC Power Line Conducted Emission	47 CFR Part 15 Subpart C Section 15.207	ANSI C63.10-2013	PASS
Radiated Spurious emissions	47 CFR Part 15 Subpart C Section 15.205/15.209	ANSI C63.10-2013	PASS
Band edge and RF Conducted Spurious Emissions	47 CFR Part 15 Subpart C Section 15.247(d)/15.205(a)	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
Bandwidth	47 CFR Part 15 Subpart C Section 15.247 (a)(2)	ANSI C63.10-2013	PASS
Power Spectral Density	47 CFR Part 15Subpart C Section 15.247 (e)	ANSI C63.10-2013/ KDB 558074 D01v04	PASS
Antenna Requirement	47 CFR Part 15 Subpart C Section 15.203/15.247 (c)	ANSI C63.10-2013	PASS

Remark:
Test according to ANSI C63.4-2014 & ANSI C63.10-2013.

3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the Product as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

Item	Uncertainty
Occupancy bandwidth	54.3kHz
Conducted output power Above 1G	0.9dB
Conducted output power below 1G	0.9dB
Power Spectral Density , Conduction	0.9dB
Conduction spurious emissions	2.0dB
Out of band emission	2.0dB
3m camber Radiated spurious emission(30MHz-1GHz)	4.6dB
3m chamber Radiated spurious emission(1GHz-18GHz)	5.1dB
3m chamber Radiated spurious emission(18GHz-40GHz)	3.4dB
humidity uncertainty	5.5%
Temperature uncertainty	0.63℃
frequency	1×10-7
Conducted Emission (150KHz-30MHz)	3.2 dB
Radiated Emission(30MHz ~ 1000MHz)	4.8 dB
Radiated Emission(1GHz ~6GHz)	4.9 dB

4. PRODUCT INFORMATION AND TEST SETUP

4.1 Product Information

Model(s):	ET350, ET310, ET320, ET325, ET330, ET340, ET360, ET370 ET380, ET390.
Model Description:	All model's the function, software and electric circuit are the same, only with the product size and model named different. Test sample model: ET350
Bluetooth Version:	Bluetooth 5.0
Hardware Version:	V1.0
Software Version:	V1.0

Operation Frequency:	Bluetooth: 2402-2480MHz
Max. RF output power:	Bluetooth: -1.70dBm
Type of Modulation:	Bluetooth: GFSK
Antenna installation:	Chip Antenna
Antenna Gain:	Bluetooth: 1dBi
Ratings:	DC 3.7V from battery DC 5.0V charging from adapter

4.2 Test Setup Configuration

See test photographs attached in EUT TEST SETUP PHOTOGRAPHS for the actual connections between Product and support equipment.

4.3 Support Equipment

Item	Equipment	Mfr/Brand	Model/Type No.	Series No.	Note
1	True Wireless Earbuds	astrum	ET350	N/A	EUT

Notes:

1. All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
2. Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

4.4 Channel List

CH No.	Frequency (MHz)	CH No.	Frequency (MHz)	CH No.	Frequency (MHz)	CH No.	Frequency (MHz)
0	2402	1	2404	2	2406	3	2408
4	2410	5	2412	6	2414	7	2416
8	2418	9	2420	10	2422	11	2424
12	2426	13	2428	14	2430	15	2432
16	2434	17	2436	18	2438	19	2440
20	2442	21	2444	22	2446	23	2448
24	2450	25	2452	26	2454	27	2456
28	2458	29	2460	30	2462	31	2464
32	2466	33	2468	34	2470	35	2472
36	2474	37	2476	38	2478	39	2480

4.5 Test Mode

All test mode(s) and condition(s) mentioned were considered and evaluated respectively by performing full tests, the worst data were recorded and reported.

Test mode	Low channel	Middle channel	High channel
Transmitting (GFSK)	2402MHz	2440MHz	2480MHz

4.6 Test Environment

Humidity(%):	55
Atmospheric Pressure(kPa):	101.1
Normal Voltage(DC):	3.7V
Normal Temperature(℃)	25
Low Temperature(℃)	0
High Temperature(℃)	40

5. TEST FACILITY AND TEST INSTRUMENT USED

5.1 Test Facility

All measurement facilities used to collect the measurement data are located at Floor 1&2, Building A, No. 26 of Xinhe Road, Xinqiao Street, Baoan District, Shenzhen China. The site and apparatus are constructed in conformance with the requirements of ANSI C63.4 and CISPR 16-1-1 other equivalent standards.

5.2 Test Instrument Used

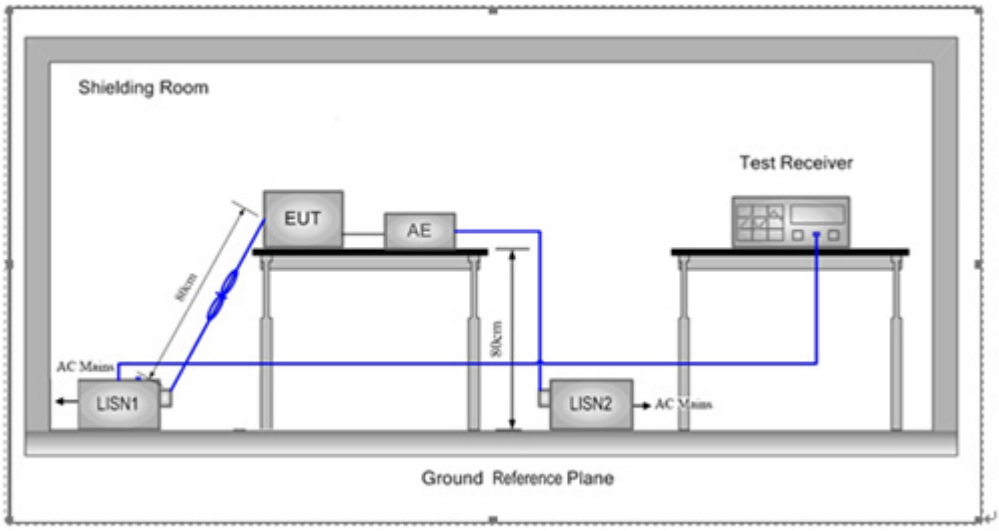
Item	Equipment	Manufacturer	Type No.	Serial No.	Last calibration	Calibrated until
1	Spectrum Analyzer	Agilent	N9020A	MY52090073	Oct. 17, 2020	Oct. 16, 2021
2	Power Sensor	Agilent	U2021XA	MY56120032	Nov. 02, 2020	Nov. 01, 2021
3	Power Sensor	Agilent	U2021XA	MY56120034	Nov. 02, 2020	Nov. 01, 2021
4	Communication test set	R&S	CMW500	118735	Nov. 02, 2020	Nov. 01, 2021
5	Spectrum Analyzer	R&S	FSP40	100550	Nov. 02, 2020	Nov. 01, 2021
6	Signal Generator	Agilent	N5181A	MY49060920	Nov. 02, 2020	Nov. 01, 2021
7	Signal Generator	Agilent	N5182A	MY47420195	Nov. 02, 2020	Nov. 01, 2021
8	Communication test set	R&S	CMU200	119978	Nov. 02, 2020	Nov. 01, 2021
9	band rejection filter	Shenxiang	MSF2400-2483.5MS-1154	20181015001	Nov. 02, 2020	Nov. 01, 2021
10	band rejection filter	Shenxiang	MSF5150-5850MS-1155	20181015001	Nov. 02, 2020	Nov. 01, 2021
11	band rejection filter	Xingbo	XBLBQ-DZA120	190821-1-1	Nov. 02, 2020	Nov. 01, 2021
12	BT&WI-FI Automatic test software	Micowave	MTS8310	Ver. 2.0.0.0	\	\
13	Rohde & Schwarz SFU Broadcast Test System	R&S	SFU	101017	Nov. 02, 2020	Nov. 01, 2021
14	Temperature humidity chamber	Hongjing	TH-80CH	DG-15174	Nov. 02, 2020	Nov. 01, 2021
15	234G Automatic test software	Micowave	MTS8200	Ver. 2.0.0.0	\	\
16	966 chamber	C.R.T.	966 Room	966	Nov. 10, 2020	Nov. 09, 2021

17	Receiver	R&S	ESPI	100362	Nov. 02, 2020	Nov. 01, 2021
18	Amplifier	HP	8447E	2945A02747	Nov. 03, 2020	Nov. 02, 2021
19	Amplifier	Agilent	8449B	3008A01838	Nov. 03, 2020	Nov. 02, 2021
20	TRILOG Broadband Antenna	Schwarzbeck	VULB 9163	869	Nov. 02, 2020	Nov. 01, 2021
21	Horn Antenna	Schwarzbeck	BBHA9120D	1911	Nov. 02, 2020	Nov. 01, 2021
22	Software	Fala	EZ-EMC	FA-03A2 RE	\	\
23	3-Loop Antenna	Daze	ZN30401	17014	Nov. 02, 2020	Nov. 01, 2021
24	loop antenna	ZHINAN	ZN30900A	/	Nov. 02, 2020	Nov. 01, 2021
25	Horn antenna	A/H/System	SAS-574	588	Nov. 02, 2020	Nov. 01, 2021
26	Amplifier	AEROFLEX	/	S/N/ 097	Nov. 02, 2020	Nov. 01, 2021

Item	Conducted emissions Test					
27	**Equipment**	**Manufacturer**	**Model#**	**Serial#**	**Last Cal.**	**Next Cal.**
28	AMN	ROHDE&S CHWARZ	ESH3-Z5	831551852	Nov.02,2020	Nov. 01, 2021
29	Pulse limiter	ROHDE&S CHWARZ	ESH3Z2	357881052	Nov.02,2020	Nov. 01, 2021
30	EMI TEST RECEIVER	ROHDE&S CHWARZ	ESCS30	834115/006	Nov.02,2020	Nov. 01, 2021
31	Coaxial cable	ZDECL	Z302S	18091904	Nov.02,2020	Nov. 01, 2021
32	ISN	TESEQ	NTFM8158	NTFM8158# 183	Nov.02,2020	Nov. 01, 2021
33	EMI TEST RECEIVER	ROHDE&S CHWARZ	ESCI	10428	Nov.02,2020	Nov. 01, 2021
34	Software	Fala	EZ-EMC	EMC-CON 3A1.1	\	\

6. AC POWER LINE CONDUCTED EMISSION

6.1 Block Diagram Of Test Setup



6.2 Limit

Frequency (MHz)	Maximum RF Line Voltage (dBμV)			
	CLASS A		CLASS B	
	Q.P.	Ave.	Q.P.	Ave.
0.15 - 0.50	79	66	66-56*	56-46*
0.50 - 5.00	73	60	56	46
5.00 - 30.0	73	60	60	50

* Decreasing linearly with the logarithm of the frequency

6.3 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.

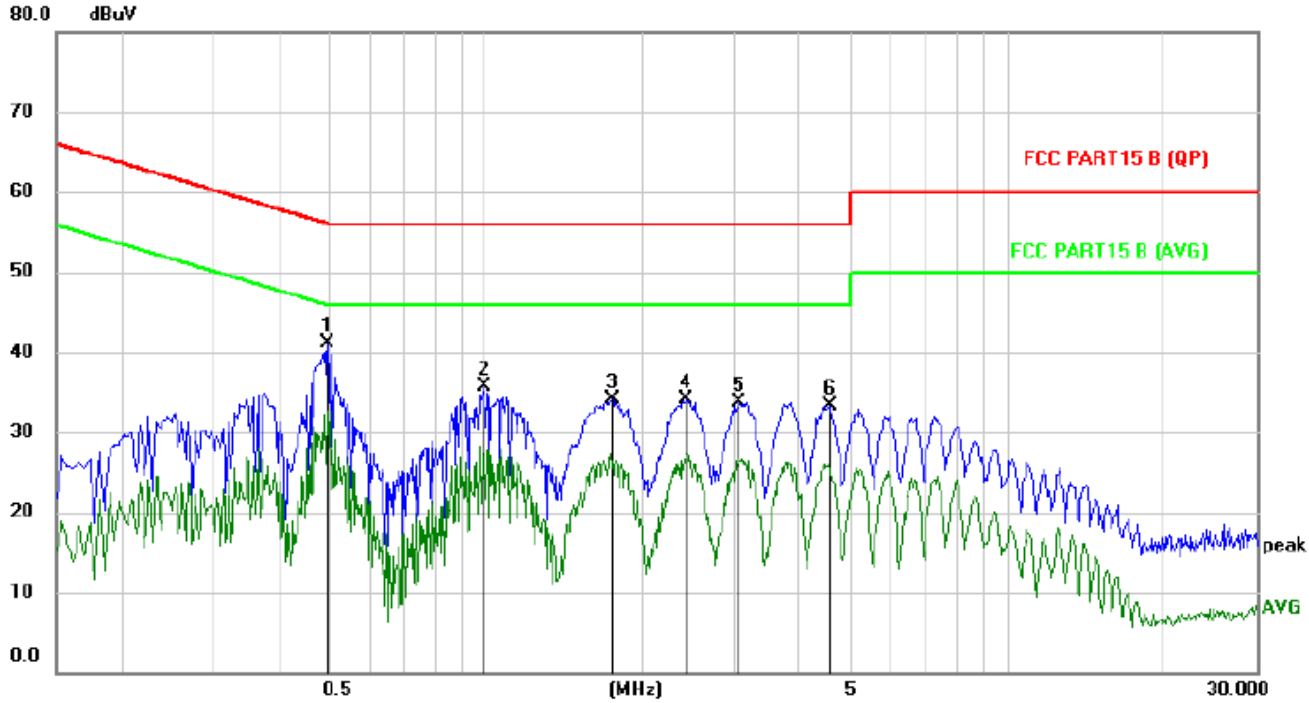
5) In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10 on conducted measurement.

6) All modes were tested at AC 120V and 240V, only the worst result of AC 120V 60Hz was reported.

7) If a EUT received DC power from the USB Port of Notebook PC, the PC's adapter received AC120V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.

6.4 Test Result

Test Specification: Neutral

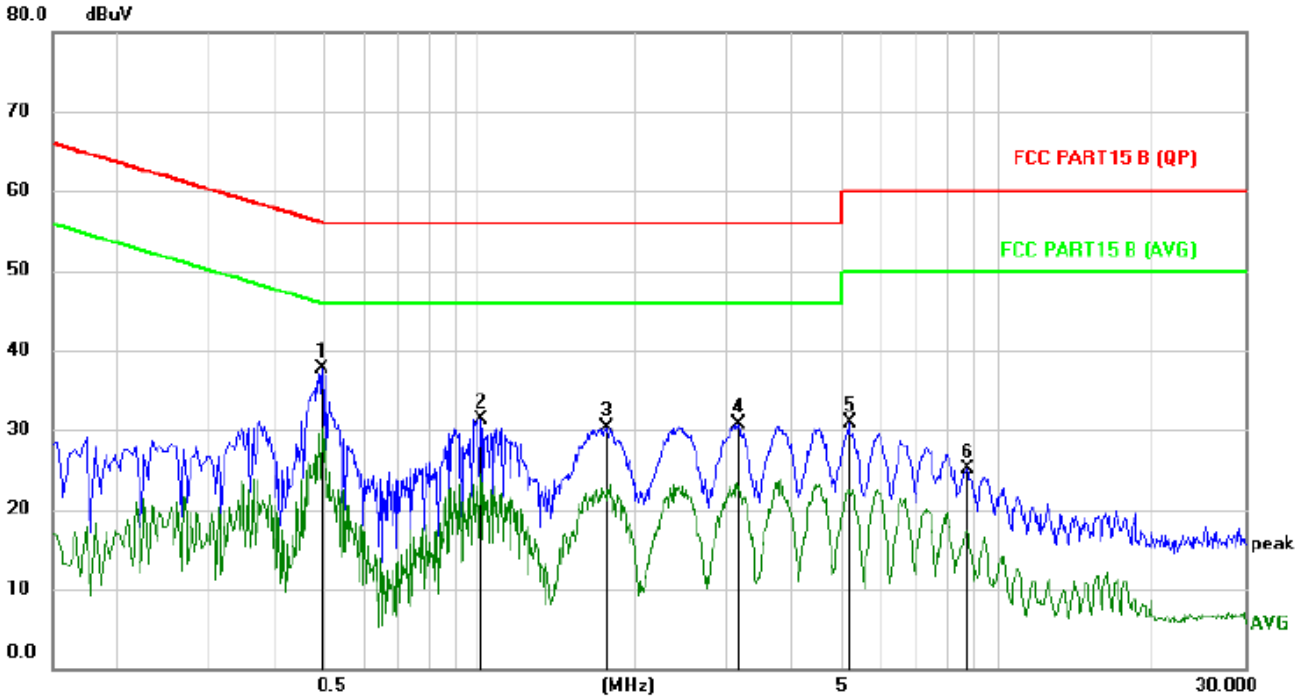


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1	*	0.4980	31.04	10.05	41.09	56.03	-14.94	peak
2		0.9980	25.42	10.23	35.65	56.00	-20.35	peak
3		1.7460	23.81	10.23	34.04	56.00	-21.96	peak
4		2.4260	23.82	10.25	34.07	56.00	-21.93	peak
5		3.0660	23.44	10.29	33.73	56.00	-22.27	peak
6		4.5540	22.90	10.37	33.27	56.00	-22.73	peak

Remark:

Factor = Cable loss + LISN factor, Margin = Measurement – Limit

Test Specification: Line



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1	*	0.4980	27.46	10.23	37.69	56.03	-18.34	peak
2		1.0060	21.25	10.15	31.40	56.00	-24.60	peak
3		1.7660	20.18	10.13	30.31	56.00	-25.69	peak
4		3.1700	20.51	10.28	30.79	56.00	-25.21	peak
5		5.1740	20.33	10.51	30.84	60.00	-29.16	peak
6		8.7380	14.44	10.59	25.03	60.00	-34.97	peak

Remark:

Factor = Cable loss + LISN factor, Margin = Measurement – Limit

7. RADIATED SPURIOUS EMISSION

7.1 Block Diagram Of Test Setup

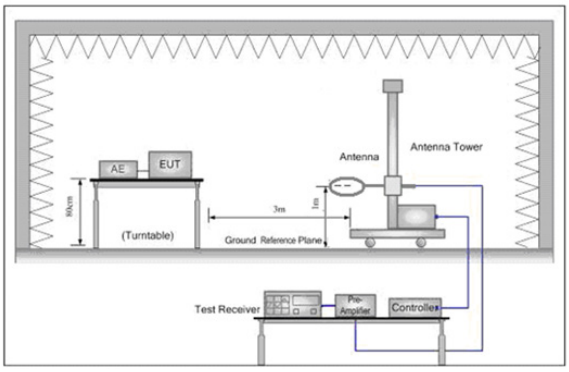


Figure 1. Below 30MHz

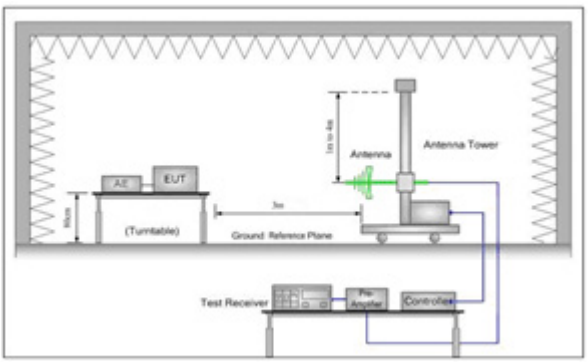
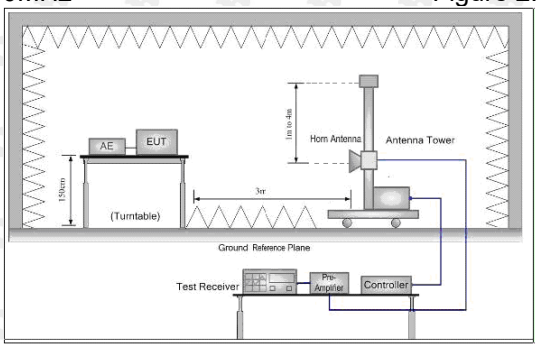


Figure 2. 30MHz to 1GHz



7.2 Limit

Spurious Emissions:

Frequency	Field strength (microvolt/meter)	Limit (dBμV/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.

7.3 Test procedure

Below 1GHz test procedure as below:

a.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.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 rota table 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.

Above 1GHz test procedure as below:

g.Different between above is the test site, change from Semi- Anechoic Chamber to fully Anechoic Chamber and change form table 0.8 meter to 1.5 meter(Above 18GHz the distance is 1 meter and table is 1.5 meter).

h.Test the EUT in the lowest channel ,the middle channel ,the Highest channel

j.Repeat above procedures until all frequencies measured was complete.

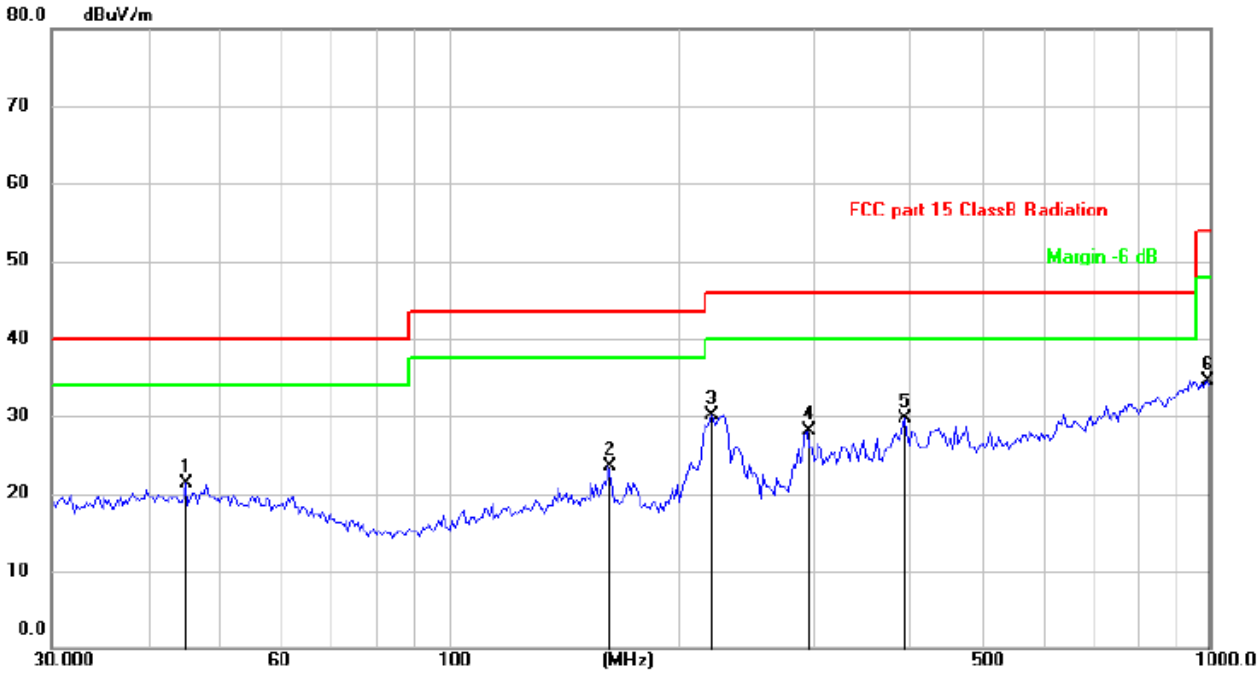
j. Full battery is usedduring test

Receiver set:

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	120 kHz	300KHz	Quasi-peak
Above 1GHz	Peak	1MHz	3MHz	Peak
	Peak	1MHz	10Hz	Average

7.4 Test Result

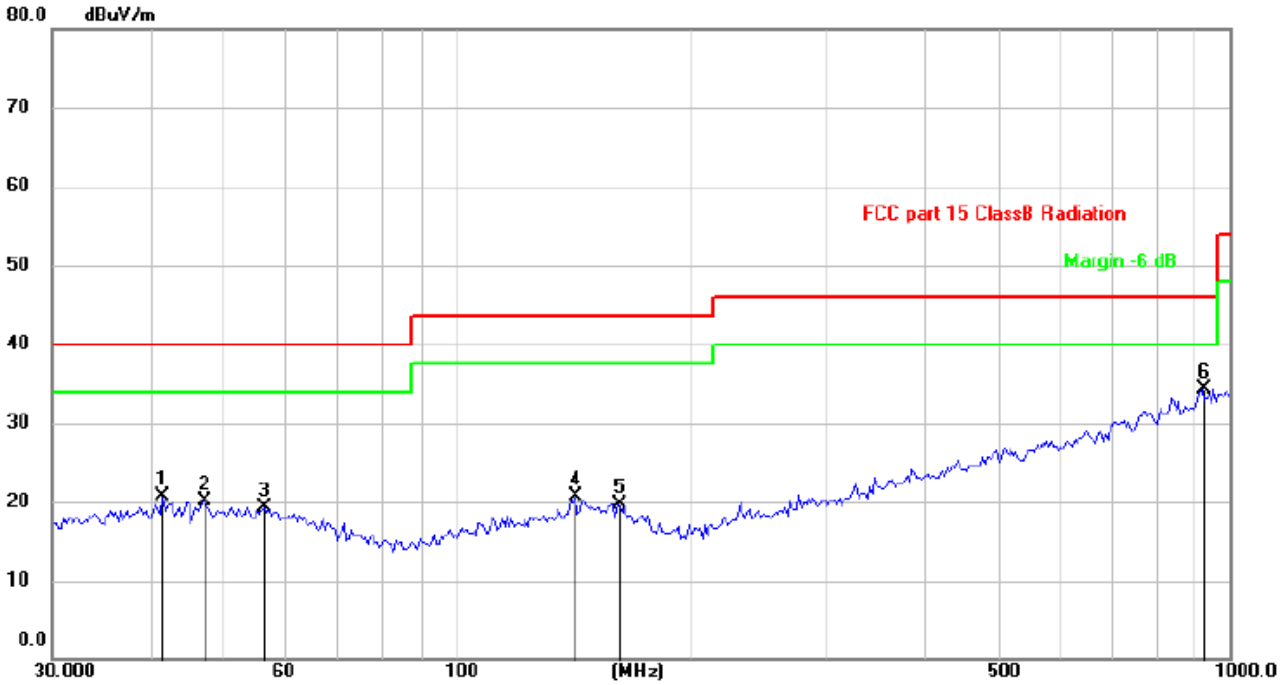
Below 1GHz Test Results:
Antenna polarity: H



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector
1		45.0583	27.11	-5.78	21.33	40.00	-18.67	peak
2		161.4742	29.97	-6.39	23.58	43.50	-19.92	peak
3	*	221.3921	38.20	-8.04	30.16	46.00	-15.84	peak
4		295.1469	33.73	-5.68	28.05	46.00	-17.95	peak
5		396.2415	31.99	-2.24	29.75	46.00	-16.25	peak
6		986.0717	26.61	7.97	34.58	54.00	-19.42	peak

Remark: Factor = Cable lose + Antenna factor - Pre-amplifier; Margin = Measurement – Limit

Antenna polarity: V



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin	
		MHz	dBuV	dB	dBuV/m	dB/m	dB	Detector
1		41.7129	26.43	-5.77	20.66	40.00	-19.34	peak
2		46.9948	26.07	-5.92	20.15	40.00	-19.85	peak
3		56.3948	25.84	-6.53	19.31	40.00	-20.69	peak
4		142.3243	27.23	-6.45	20.78	43.50	-22.72	peak
5		161.4742	26.07	-6.39	19.68	43.50	-23.82	peak
6	*	919.2866	27.05	7.22	34.27	46.00	-11.73	peak

Remark: Factor = Cable lose + Antenna factor - Pre-amplifier; Margin = Measurement – Limit

Above 1 GHz Test Results:

CH Low (2402MHz)
Horizontal:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2402	109.19	-5.84	103.35	N/A	N/A	peak
2402	94.44	-5.84	88.60	N/A	N/A	AVG
4804	58.43	-3.64	54.79	74	-19.21	peak
4804	49.99	-3.64	46.35	54	-7.65	AVG
7206	58.52	-0.95	57.57	74	-16.43	peak
7206	48.58	-0.95	47.63	54	-6.37	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2402	111.00	-5.84	105.16	N/A	N/A	peak
2402	92.35	-5.84	86.51	N/A	N/A	AVG
4804	58.33	-3.64	54.69	74	-19.31	peak
4804	49.54	-3.64	45.90	54	-8.10	AVG
7206	59.01	-0.95	58.06	74	-15.94	peak
7206	48.63	-0.95	47.68	54	-6.32	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

CH Middle (2440MHz)
Horizontal:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2440	107.90	-5.71	102.19	N/A	N/A	peak
2440	91.19	-5.71	85.48	N/A	N/A	AVG
4880	55.31	-3.51	51.80	74	-22.20	peak
4880	45.16	-3.51	41.65	54	-12.35	AVG
7320	57.29	-0.82	56.47	74	-17.53	peak
7320	47.20	-0.82	46.38	54	-7.62	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2440	106.37	-5.71	100.66	N/A	N/A	peak
2440	92.81	-5.71	87.10	N/A	N/A	AVG
4880	54.41	-3.51	50.90	74	-23.10	peak
4880	46.14	-3.51	42.63	54	-11.37	AVG
7320	57.86	-0.82	57.04	74	-16.96	peak
7320	46.44	-0.82	45.62	54	-8.38	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

CH High (2480MHz)
Horizontal:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2480	106.97	-5.65	101.32	N/A	N/A	peak
2480	92.18	-5.65	86.53	N/A	N/A	AVG
4960	54.94	-3.43	51.51	74	-22.49	peak
4960	47.10	-3.43	43.67	54	-10.33	AVG
7440	55.67	-0.75	54.92	74	-19.08	peak
7440	46.77	-0.75	46.02	54	-7.98	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2480	106.24	-5.65	100.59	N/A	N/A	peak
2480	91.05	-5.65	85.40	N/A	N/A	AVG
4960	55.95	-3.43	52.52	74	-21.48	peak
4960	47.44	-3.43	44.01	54	-9.99	AVG
7440	56.87	-0.75	56.12	74	-17.88	peak
7440	46.91	-0.75	46.16	54	-7.84	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Remark:
(1) Measuring frequencies from 1 GHz to the 25 GHz。
(2). All modes of GFSK were test at Low, Middle, and High channel, only the worst result of GFSK Low Channel was reported for below 1GHz test.
(3). For BT above 1GHz test all modes of GFSK were test at Low, Middle, and High channel, only the worst result of GFSK was reported.
(4). By preliminary testing and verifying three axis (X, Y and Z) position of EUT transmitted status, it was found that “Z axis” position was the worst, and test data recorded in this report.
(5). Radiated emission test from 9kHz to 10th harmonic of fundamental was verified, and no emission found except system noise floor in 9kHz to 30MHz and not recorded in this report.

Restricted bands around fundamental frequency (Radiated)

Operation Mode: TX CH Low (2402MHz)
Horizontal (Worst case)

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2310	55.01	-5.81	49.20	74	-24.80	peak
2310	/	-5.81	/	54	/	AVG
2390	55.99	-5.84	50.15	74	-23.85	peak
2390	/	-5.84	/	54	/	AVG
2400	55.28	-5.84	49.44	74	-24.56	peak
2400	/	-5.84	/	54	/	AVG

Vertical:

Frequency (MHz)	Meter Reading (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2310	54.82	-5.81	49.01	74	-24.99	peak
2310	/	-5.81	/	54	/	AVG
2390	55.96	-5.84	50.12	74	-23.88	peak
2390	/	-5.84	/	54	/	AVG
2400	57.74	-5.84	51.90	74	-22.10	peak
2400	/	-5.84	/	54	/	AVG

Operation Mode: TX CH High (2480MHz)
Horizontal (Worst case)

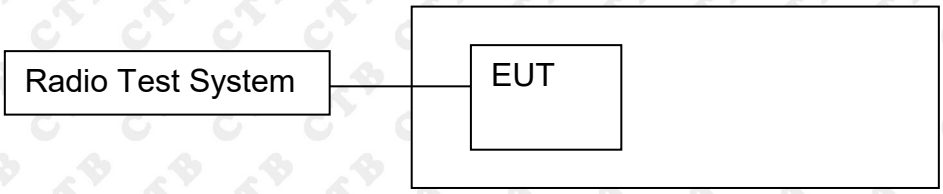
Frequency (MHz)	Reading Result (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2483.50	56.03	-5.65	50.38	74	-23.62	peak
2483.50	/	-5.65	/	54	/	AVG
2500.00	54.59	-5.65	48.94	74	-25.06	peak
2500.00	/	-5.65	/	54	/	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						

Vertical:

Frequency (MHz)	Reading Result (dBμV)	Factor (dB)	Emission Level (dBμV/m)	Limits (dBμV/m)	Margin (dB)	Detector Type
2483.50	54.30	-5.65	48.65	74	-25.35	peak
2483.50	/	-5.65	/	54	/	AVG
2500.00	55.48	-5.65	49.83	74	-24.17	peak
2500.00	/	-5.65	/	54	/	AVG
Remark: Factor = Antenna Factor + Cable Loss – Pre-amplifier.						
Remark: All the other emissions not reported were too low to read and deemed to comply with FCC limit.						

8. BAND EDGE AND RF COUNDUCTED SPURIOUS EMISSIONS

8.1 Block Diagram Of Test Setup



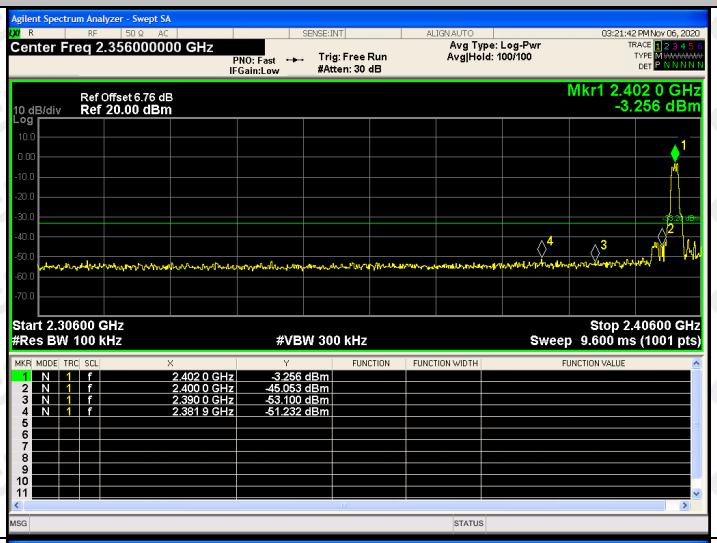
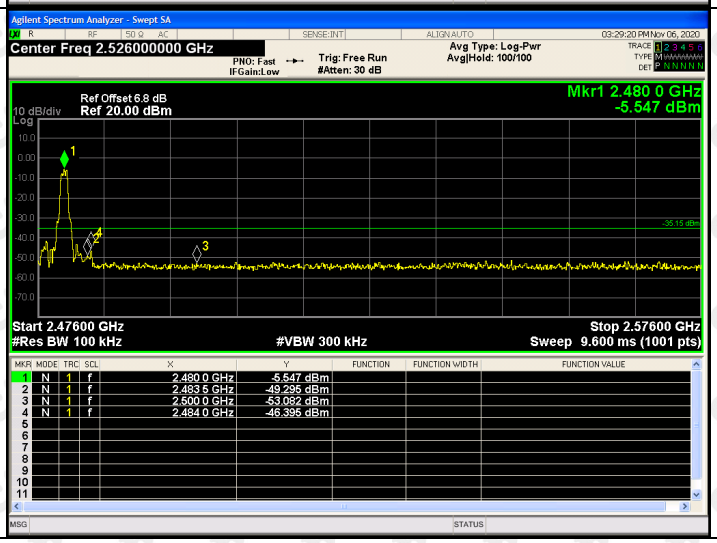
8.2 Limit

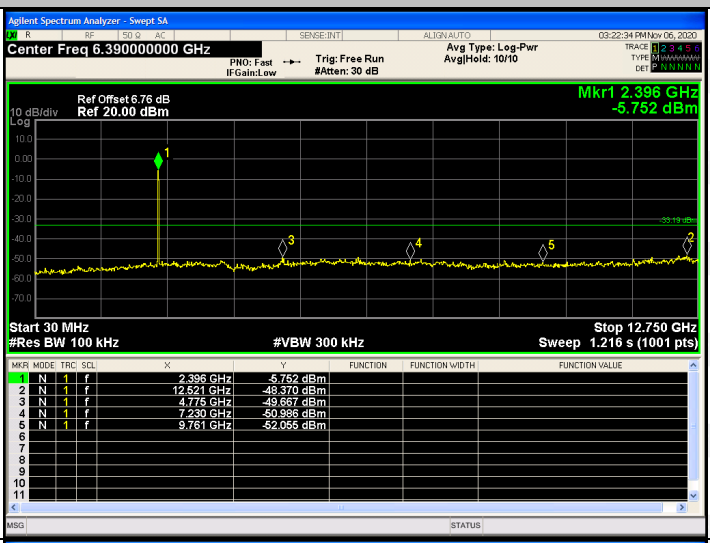
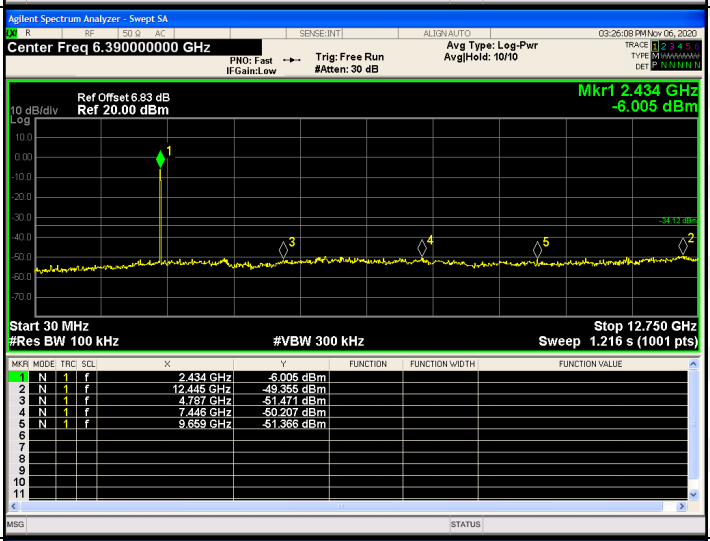
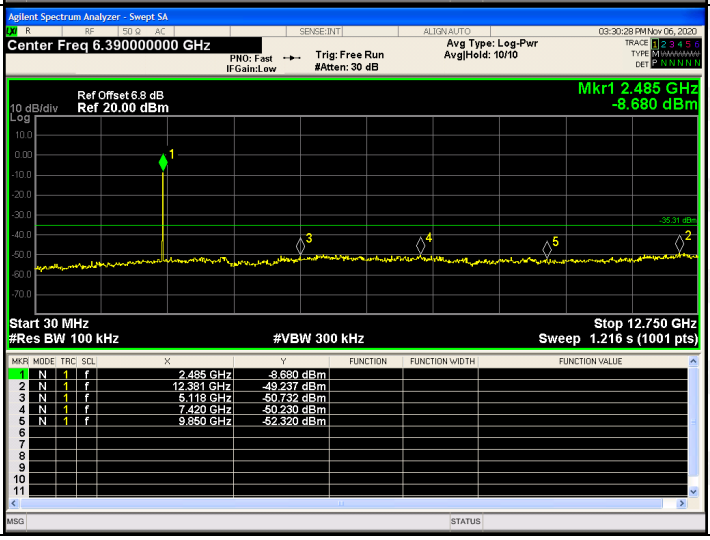
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

8.3 Test procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum;
2. Set the spectrum analyzer:
Blow 30MHz:
RBW = 100kHz, VBW = 300kHz, Sweep = auto
Detector function = peak, Trace = max hold
Above 30MHz:
RBW = 100KHz, VBW = 300KHz, Sweep = auto
Detector function = peak, Trace = max hold

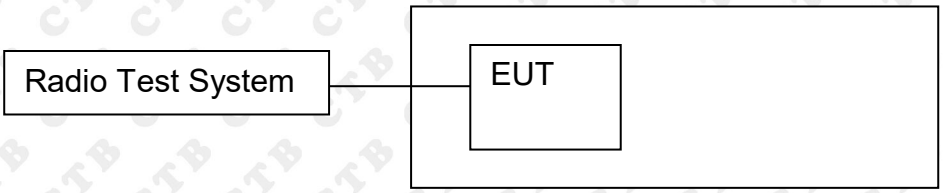
8.4 Test Result

BAND EDGE Graphs			
GFSK/LCH			
GFSK/HCH			

RF Conducted Spurious Emissions Graphs		
GFSK/LCH		
GFSK/MCH		
GFSK/HCH		

9. COUDUCTED OUTPUT POWER

9.1 Block Diagram Of Test Setup



9.2 Limit

FCC Part15 (15.247) , Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(b)(3)	Output Power	1 watt or 30dBm	2400-2483.5	PASS

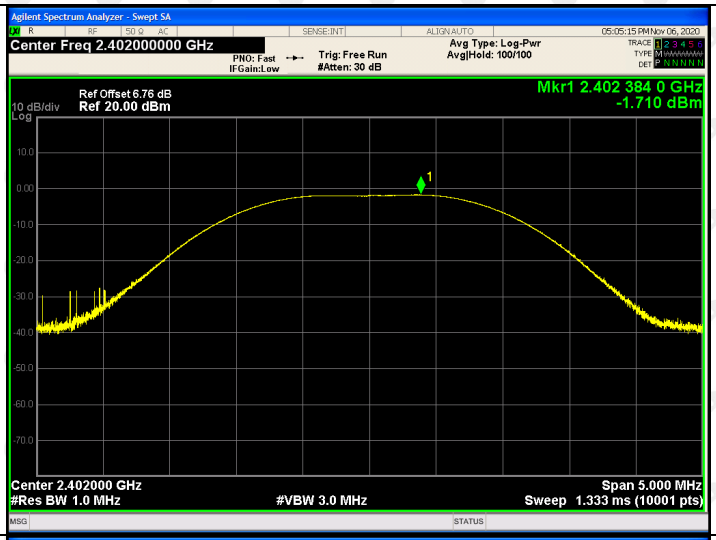
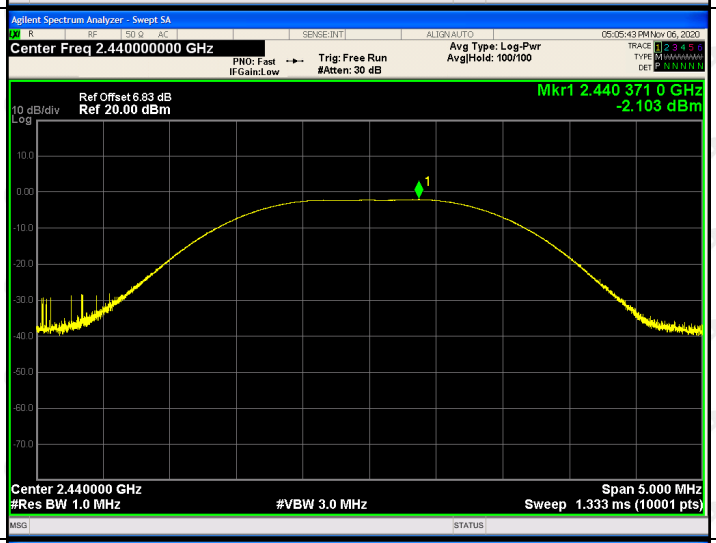
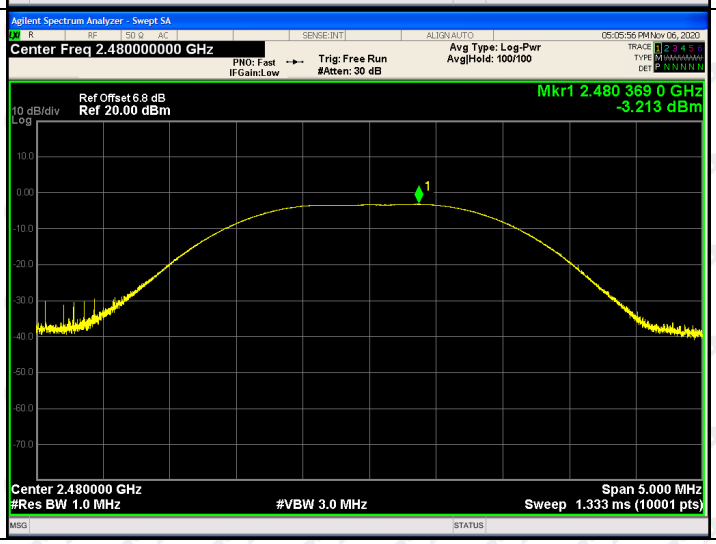
9.3 Test procedure

1. Remove the antenna from the EUT and then connect a low RF cable from the antenna port to the spectrum.
2. Set the spectrum analyzer: RBW = 1MHz. VBW = 3MHz. Channel power measurement. Sweep = auto; Detector Function = Peak.
3. Keep the EUT in transmitting at lowest, middle and highest channel individually. Record the max value.

9.4 Test Result

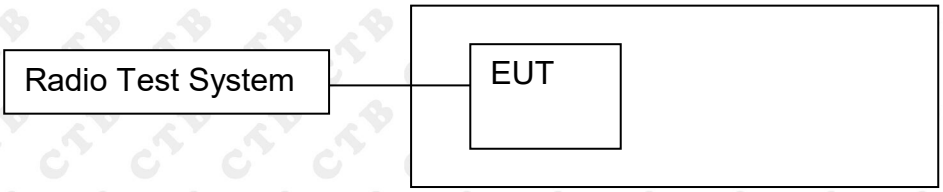
Mode	Channel.	Maximum Output Power [dBm]	Limit[dBm]	Verdict
GFSK	LCH	-1.71	30	PASS
	MCH	-2.103	30	PASS
	HCH	-3.213	30	PASS

Test Graph:

GFSK Low channel			
GFSK Mid channel			
GFSK High channel			

10. 6DB OCCUPIED BANDWIDTH

10.1 Block Diagram Of Test Setup



10.2 Limit

FCC Part15 (15.247) , Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247(a)(2)	Bandwidth	>= 500KHz (6dB bandwidth)	2400-2483.5	PASS

10.3 Test procedure

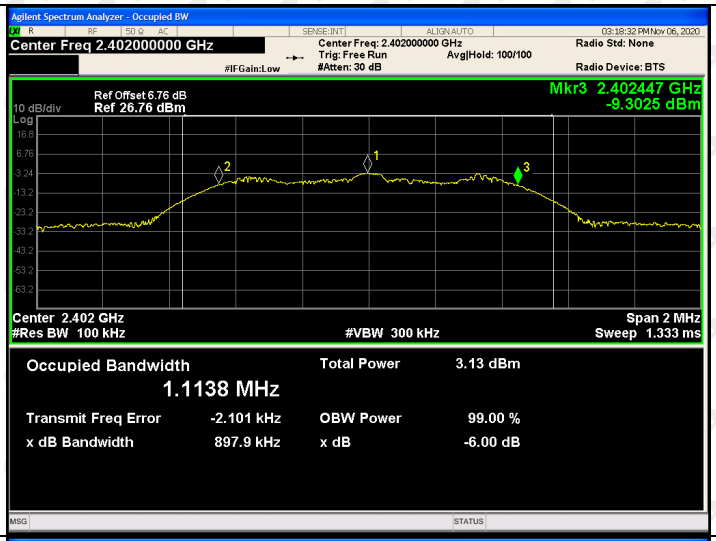
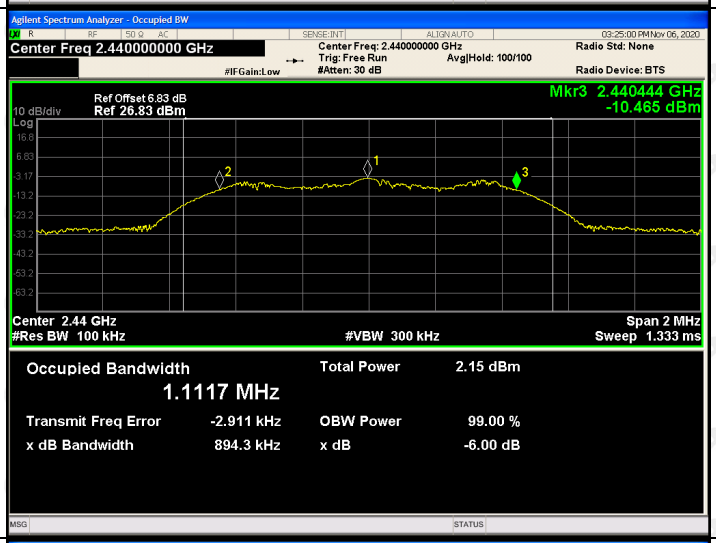
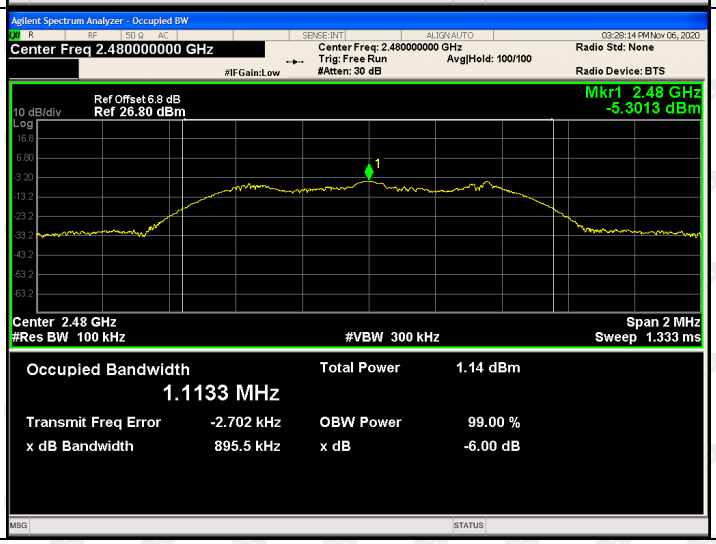
1. Rem1. Set RBW = 100 kHz.
2. Set the video bandwidth (VBW) ≥ 3 x RBW.
3. Detector = Peak.
4. Trace mode = max hold.
5. Sweep = auto couple.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

10.4 Test Result

Test Mode	Frequency	6dB Bandwidth (MHz)	Result
GFSK	Low channel	0.898	**PASS**
	Mid channel	0.894	**PASS**
	High channel	0.896	**PASS**

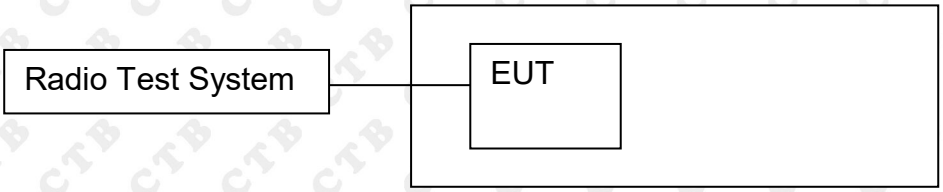
Note: All modes of operation were Pre-scan and the worst-case emissions are reported.

Test Graph:

GFSK Low channel			
GFSK Mid channel			
GFSK High channel			

11. POWER SPECTRAL DENSITY

11.1 Block Diagram Of Test Setup



11.2 Limit

FCC Part15 (15.247) , Subpart C				
Section	Test Item	Limit	Frequency Range (MHz)	Result
15.247	Power Spectral Density	8 dBm (in any 3KHz)	2400-2483.5	PASS

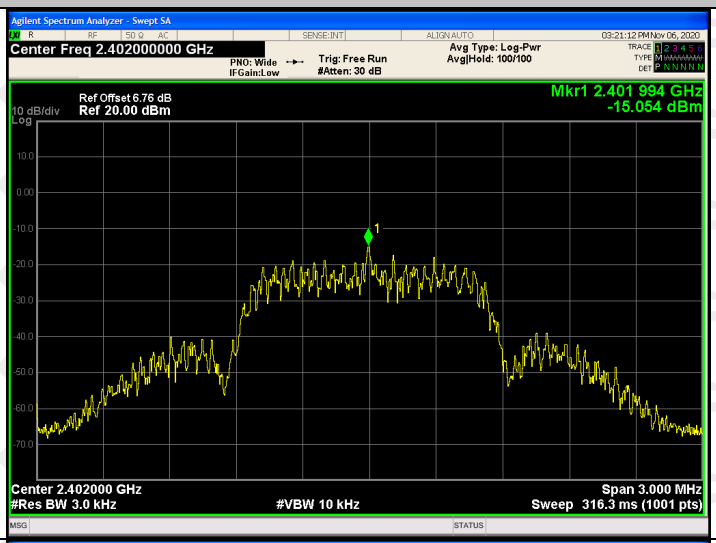
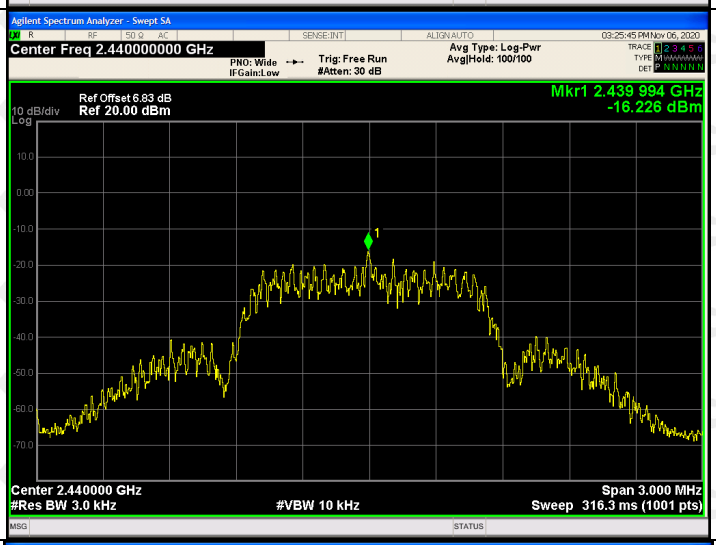
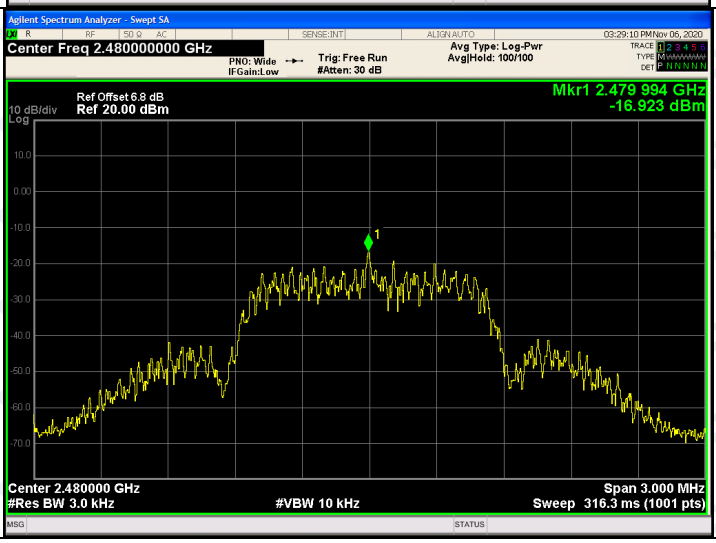
11.3 Test procedure

1. Set analyzer center frequency to DTS channel center frequency.
2. Set the span to 1.5 times the DTS bandwidth.
3. Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
4. Set the VBW ≥ 3 x RBW.
5. Detector = RMS.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Use the peak marker function to determine the maximum amplitude level within the RBW.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

11.4 Test Result

Mode	Channel.	Power Spectral Density (dBm/3KHz)	Limit(dBm/3KHz)	Verdict
GFSK	LCH	-15.054	8	PASS
GFSK	MCH	-16.226	8	PASS
GFSK	HCH	-16.923	8	PASS

Test Graph

Graphs			
GFSK/LCH			
GFSK/MCH			
GFSK/HCH			

12. ANTENNA REQUIREMENT

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.

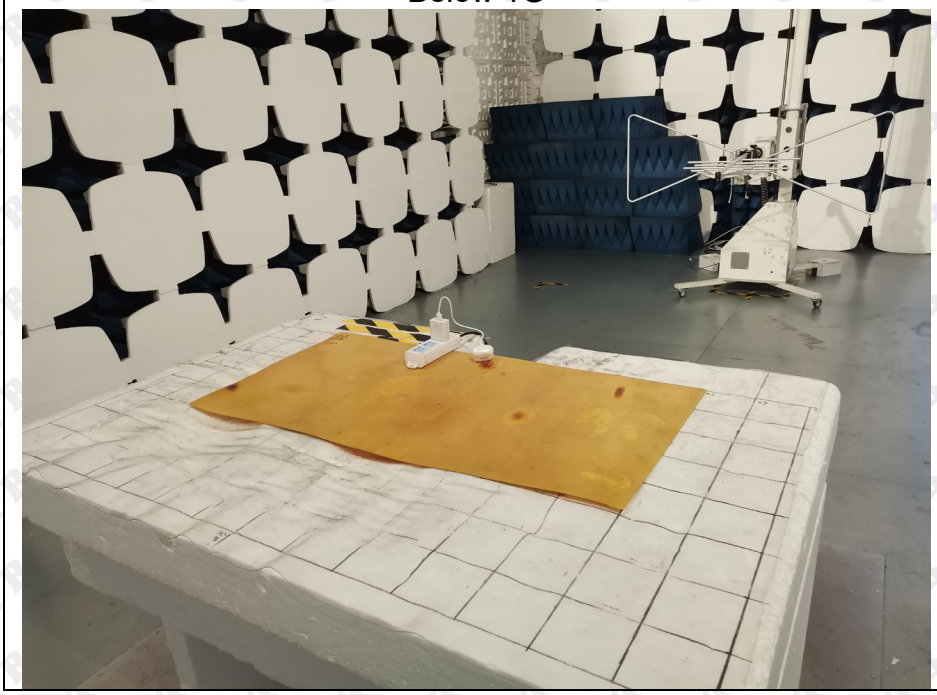
EUT Antenna:

The antenna is Chip Antenna. The best case gain of the antenna is 1.0dBi.

13. EUT TEST SETUP PHOTOGRAPHS

Radiated Emission

Below 1G



Above 1G

Conducted Emission

※※※※※ END OF REPORT ※※※※※