FCC PART 15 SUBPART C TEST REPORT

FCC PART 15.247

Report Reference No.....	**: BSL23111710-P01R01**
FCC ID.....	**: 2BCSV-SANGSTREL**
Compiled by (position+printed name+signature)..	: Engineer/ Cindy Zheng
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Date of issue.....	: December 11, 2023

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Testing Laboratory Name.....	**: BSL Testing Co., Ltd.**
Address.....	: 1/F, Building B, Xinshidai GR Park,Shiyan Street, Bao'an District, Shenzhen,Guangdong, 518052, People's Republic of China
Applicant's name.....	**: Shenzhen Hebai Optical Acoustics Co., Ltd**
Address.....	: No.12, Tongfuyu Industrial Zone, Xinhe Community, Fuhai Street, Baoan District, Shenzhen City
Test specification.....	**:**
Standard.....	: **FCC Part 15.247**

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Equipment description.....	**: Sport Audio Glasses**
Trade Mark.....	: N/A
Manufacturer.....	: Shenzhen Hebai Optical Acoustics Co., Ltd
Model/Type reference.....	: SANGSTRE Liszt
Listed Models	: VocalSkull Sports
Modulation	: GFSK
Frequency.....	From 2402MHz to 2480MHz
Ratings.....	: DC 3.7V from battery or DC 5.0V from USB Port
Result.....	: **PASS**

TEST REPORT

Equipment under Test	:	**Sport Audio Glasses**
Model /Type	:	SANGSTRE Liszt
Listed Models	:	VocalSkull Sports
Model Declaration	:	PCB board, structure and internal of these model(s) are the same,So no additional models were tested.
Applicant	:	**Shenzhen Hebai Optical Acoustics Co., Ltd**
Address	:	No.12, Tongfuyu Industrial Zone, Xinhe Community, Fuhai Street, Baoan District, Shenzhen City
Manufacturer	:	**Shenzhen Hebai Optical Acoustics Co., Ltd**
Address	:	No.12, Tongfuyu Industrial Zone, Xinhe Community, Fuhai Street, Baoan District, Shenzhen City

Test Result:	**PASS**

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

Contents

1 TEST STANDARDS 4

2 SUMMARY 5

2.1 General Remarks 5
2.2 Product Description 5
2.3 Equipment Under Test 5
2.4 Short description of the Equipment under Test (EUT) 5
2.5 EUT operation mode 6
2.6 Block Diagram of Test Setup 6
2.7 Related Submittal(s) / Grant (s) 6
2.8 Modifications 6

3 TEST ENVIRONMENT 7

3.1 Address of the test laboratory 7
3.2 Test Facility 7
3.3 Environmental conditions 7
3.4 Summary of measurement results 8
3.5 Statement of the measurement uncertainty 8
3.6 Equipments Used during the Test 9

4 TEST CONDITIONS AND RESULTS 11

4.1 AC Power Conducted Emission 11
4.2 Radiated Emissions and Band Edge 14
4.3 Maximum Peak Output Power 21
4.4 Power Spectral Density 22
4.5 6dB Bandwidth 24
4.6 Out-of-band Emissions 26
4.7 Antenna Requirement 29

5 TEST SETUP PHOTOS OF THE EUT 30

6 PHOTOS OF THE EUT 31

1 TEST STANDARDS

The tests were performed according to following standards:

FCC Rules Part 15.247: Frequency Hopping, Direct Spread Spectrum and Hybrid Systems that are in operation within the bands of 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz.
ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices
KDB558074 D01 V05r02: Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under §15.247

2 SUMMARY

2.1 General Remarks

Date of receipt of test sample	:	November 17, 2023
Testing commenced on	:	November 17, 2023
Testing concluded on	:	November 30, 2023

2.2 Product Description

Product Description:	Sport Audio Glasses
Model/Type reference:	SANGSTRE Liszt
Power supply:	DC 3.7V from battery or DC 5.0V from USB Port
Adapter information (Auxiliary test supplied by testing Lab）	Model: EP-TA20CBC Input: AC 100-240V 50/60Hz Output: DC 5V 2A Firmware Version: EPTA5.14.2 Manufacture: Huizhou Dongyang Yienbi Electronics Co., Ltd
Testing sample ID：	BSL23111710-P01R01-1# (Engineer sample), BSL23111710-P01R01-2# (Normal sample)
Bluetooth BLE	
Supported type:	Bluetooth low Energy
Modulation:	GFSK
Operation frequency:	2402MHz to 2480MHz
Channel number:	40
Channel separation:	2 MHz
Antenna type:	Ceramic Antenna
Antenna gain:	2.66 dBi

2.3 Equipment Under Test

Power supply system utilised

Power supply voltage	:	○	230V / 50 Hz	○	120V / 60Hz
		○	12 V DC	○	24 V DC
		●	Other (specified in blank below)		

DC 3.7V from battery or DC 5.0V from USB Port

2.4 Short description of the Equipment under Test (EUT)

This is a BLE Sport Audio Glasses.
For more details, refer to the user's manual of the EUT.

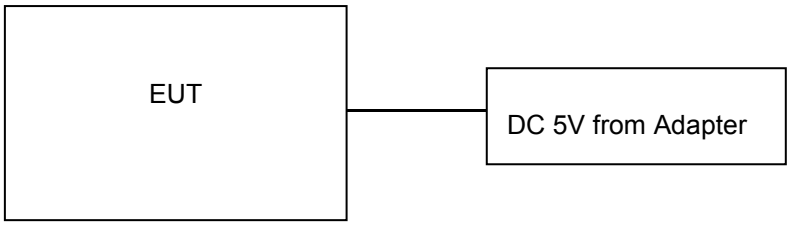
2.5 EUT operation mode

The Applicant provides communication tools software(Engineer mode) to control the EUT for staying in continuous transmitting (Duty Cycle more than 98%) and receiving mode for testing .There are 40 channels provided to the EUT and Channel 00/19/39 were selected to test.

Operation Frequency：

Channel	Frequency (MHz)
00	**2402**
01	2404
02	2406
⋮	⋮
19	**2440**
⋮	⋮
37	2476
38	2478
39	**2480**

2.6 Block Diagram of Test Setup



2.7 Related Submittal(s) / Grant (s)

This submittal(s) (test report) is intended for the device filing to comply with Section 15.247 of the FCC Part 15, Subpart C Rules.

2.8 Modifications

No modifications were implemented to meet testing criteria.

3 TEST ENVIRONMENT

3.1 Address of the test laboratory

BSL Testing Co., Ltd.
1/F, Building B, Xinshidai GR Park,Shiyan Street, Bao'an District, Shenzhen,Guangdong, 518052, People's Republic of China

3.2 Test Facility

FCC-Registration No.: 562200 Designation Number: CN1338
BSL Testing Co.,Ltd. has been listed on the US Federal Communications Commission list of test facilities recognized to perform electromagnetic emissions measurements.

Industry Canada Registration Number. Is: 11093A CAB identifier: CN0019
The Laboratory has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing.

A2LA-Lab Cert. No.: 4707.01
BSL Testing Co.,Ltd. has been listed by American Association for Laboratory Accreditation to perform electromagnetic emission measurement.

The 3m-Semi anechoic test site fulfils CISPR 16-1-4 according to ANSI C63.10 and CISPR 16-1-4:2010.

3.3 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:
Radiated Emission:

Temperature:	23 ° C
Humidity:	44 %
Atmospheric pressure:	950-1050mbar

AC Main Conducted testing：

Temperature:	24 ° C
Humidity:	47 %
Atmospheric pressure:	950-1050mbar

Conducted testing：

Temperature:	24 ° C
Humidity:	46 %
Atmospheric pressure:	950-1050mbar

3.4 Summary of measurement results

Test Specification clause	Test case	Test Mode	Test Channel	Recorded In Report		Test result
§15.247(e)	Power spectral density	BLE 1Mpbs	☒ Lowest ☒ Middle ☒ Highest	BLE 1Mpbs	☒ Lowest ☒ Middle ☒ Highest	complies
§15.247(a)(2)	Spectrum bandwidth – 6 dB bandwidth	BLE 1Mpbs	☒ Lowest ☒ Middle ☒ Highest	BLE 1Mpbs	☒ Lowest ☒ Middle ☒ Highest	complies
§15.247(b)(3)	Maximum output Peak power	BLE 1Mpbs	☒ Lowest ☒ Middle ☒ Highest	BLE 1Mpbs	☒ Lowest ☒ Middle ☒ Highest	complies
§15.247(d)	Band edge compliance conducted	BLE 1Mpbs	☒ Lowest ☒ Highest	BLE 1Mpbs	☒ Lowest ☒ Highest	complies
§15.205	Band edge compliance radiated	BLE 1Mpbs	☒ Lowest ☒ Highest	BLE 1Mpbs	☒ Lowest ☒ Highest	complies
§15.247(d)	TX spurious emissions conducted	BLE 1Mpbs	☒ Lowest ☒ Middle ☒ Highest	BLE 1Mpbs	☒ Lowest ☒ Middle ☒ Highest	complies
§15.247(d)	TX spurious emissions radiated	BLE 1Mpbs	☒ Lowest ☒ Middle ☒ Highest	BLE 1Mpbs	☒ Lowest ☒ Middle ☒ Highest	complies
§15.209(a)	TX spurious Emissions radiated Below 1GHz	BLE 1Mpbs	-/-	BLE 1Mpbs	-/-	complies
§15.107(a) §15.207	Conducted Emissions < 30 MHz	BLE 1Mpbs	-/-	BLE 1Mpbs	-/-	complies

Remark:
1. The measurement uncertainty is not included in the test result.
2. We tested all test mode and recorded worst case in report

3.5 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 TR-100028-01" Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 1" and TR-100028-02 "Electromagnetic compatibility and Radio spectrum Matters (ERM);Uncertainties in the measurement of mobile radio equipment characteristics; Part 2 " and is documented in the BSL Testing 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 BSL Testing Co., Ltd.:

Test	Range	Measurement Uncertainty	Notes
Radiated Emission	9KHz~30MHz	3.82 dB	(1)
Radiated Emission	30~1000MHz	4.06 dB	(1)
Radiated Emission	1~18GHz	5.14 dB	(1)
Radiated Emission	18-40GHz	5.38 dB	(1)
Conducted Disturbance	0.15~30MHz	2.14 dB	(1)
Transmitter power conducted	1~40GHz	0.57 dB	(1)
Conducted spurious emission	1~40GHz	1.60 dB	(1)
OBW	1~40GHz	25 Hz	(1)
PSD	1~40GHz	0.01 dBm/3KHz	(1)

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

3.6 Equipments Used during the Test

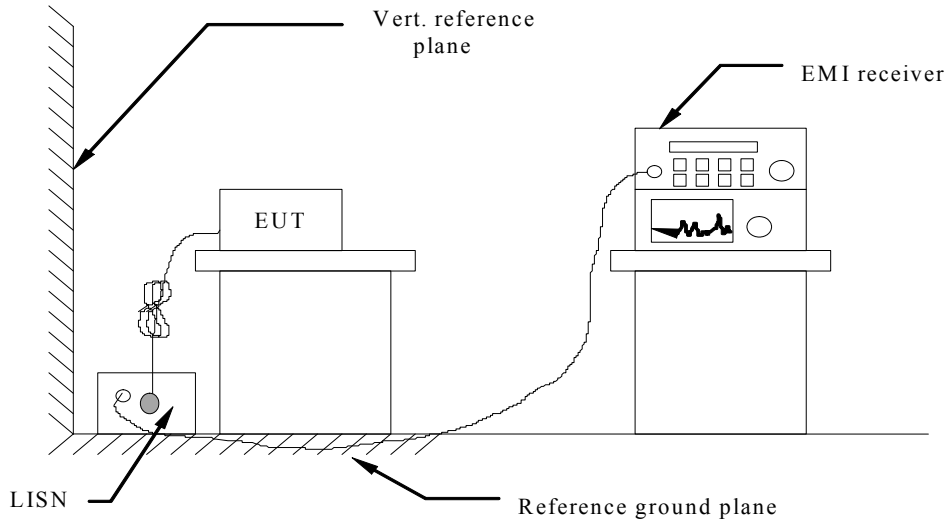
Instrument Type	Manufacturer	Model	Serial No.	Date of Cal.	Due Date
ESPI Test Receiver	ROHDE&SCHWARZ	ESPI 3	100379	2023-10-28	2024-10-27
Absorbing Clamp	ROHDE&SCHWARZ	MDS-21	100126	2023-10-28	2024-10-27
Electrostatic analog generator	LIONCEL	ESD-203B	0210502	2023-10-28	2024-10-27
Signal Generator	HP	8648A	3633A02081	2023-10-28	2024-10-27
Amplifier	A&R	500A100	17034	2023-10-28	2024-10-27
Amplifier	A&R	100W/1000M1	17028	2023-10-28	2024-10-27
Isotropic Field Monitor	A&R	FM2000	16829	2023-10-28	2024-10-27
Isotropic Field Probe	A&R	FLW220100	16755	2023-10-28	2024-10-27
Biconic Antenna	EMCO	EVOD PROTANK8	9507-2534	2023-10-28	2024-10-27
Log-periodic Antenna	A&R	AT1080	16812	2023-10-28	2024-10-27
Injection Clamp	EMTEST	F-2031-23MM	368	2023-10-28	2024-10-27
Attenuator	EMTEST	ATT6	0010222a	2023-10-28	2024-10-27
Computer	IBM	8434	1S8434KCE99BLXLO*	-	-
Oscillator	KENWOOD	AG-203D	3070002	2023-10-28	2024-10-27
Spectrum Analyzer	HAMEG	HM5012	-	-	-
Power Supply	LW	APS1502	-	-	-
5K VA AC Power Source	California Instruments	5001iX	56060	2023-10-28	2024-10-27
CDN	EM TEST	CDN M2/M3	-	2023-10-28	2024-10-27
Attenuation	EM TEST	ATT6/75	-	2023-10-28	2024-10-27
Resistance	EM TEST	R100	-	2023-10-28	2024-10-27
Electromagnetic Injection Clamp	LITTHI	EM101	35708	2023-10-28	2024-10-27
Inductive Components	EM TEST	MC2630	-	2023-10-28	2024-10-27
Antenna	EM TEST	MS100	-	2023-10-28	2024-10-27
Signal Generator	ROHDE&SCHWARZ	SMT03	100029	2023-10-28	2024-10-27
Power DJ MIXER	AR	150W1000	300999	2023-10-28	2024-10-27
Field probe	Holaday	HI-6005	105152	2023-10-28	2024-10-27
Bilog Antenna	Chase	CBL6111C	2576	2023-10-28	2024-10-27
Loop Antenna	EMCO	6502	00042960	2023-10-28	2024-10-27
ESPI Test Receiver	ROHDE&SCHWARZ	ESI7	838786/013	2023-10-28	2024-10-27
3m OATS	--	--	N/A	2023-10-28	2024-10-27
Horn Antenna	SCHWARZBECK	VULB9168	N/A	2023-10-28	2024-10-27
Horn Antenna	SCHWARZBECK	BBHA9120D	N/A	2023-10-28	2024-10-27
Power meter	Anritsu	ML2487A	6K00003613	2023-10-28	2024-10-27
Power sensor	Anritsu	MA2491A	32263	2023-10-28	2024-10-27
Bilog Antenna	Schwarebeck	VULB9163	9163/340	2023-10-28	2024-10-27
9*6*6 Anechoic	--	--	N/A	2023-10-28	2024-10-27
Test Receiver	Rohde&Schwarz	ESC17(9kHz-7GHz)	100336	2023-10-28	2024-10-27
Broadband antenna	Schwarzbeck	VULB9168	01222	2023-10-28	2024-10-27
Horn antenna	Schwarzbeck	BBHA9120D	02476	2023-10-28	2024-10-27
Preamplifier	Schwarzbeck	BBV9745	00250	2023-10-28	2024-10-27
Preamplifier	N/A	TRLA-01018G440B	21081001	2023-10-28	2024-10-27
3M method semi anechoic chamber	SKET	9m*6m*6m	2021082304	2023-10-28	2024-10-27

Pointer hygrometer	M&G	ARC92570	N/A	2023-10-28	2024-10-27
Spectrometer	ROHDE&SCHWARZ	FSP 9kHz-40GHz	N/A	2023-10-28	2024-10-27
Synthesizer	ROHDE&SCHWARZ	CMW500	N/A	2023-10-28	2024-10-27
LISN	R&S	ENV216	308	2023-10-28	2024-10-27
LISN	R&S	ENV216	314	2023-10-28	2024-10-27

4 TEST CONDITIONS AND RESULTS

4.1 AC Power Conducted Emission

TEST CONFIGURATION



TEST PROCEDURE

1 The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system, a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.10-2013.
2 Support equipment, if needed, was placed as per ANSI C63.10-2013
3 All I/O cables were positioned to simulate typical actual usage as per ANSI C63.10-2013
4 The EUT received power from adapter, the adapter received AC120V/60Hz and AC 240V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
5 All support equipments received AC power from a second LISN, if any.
6 The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT.The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.
7 Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.
8 During the above scans, the emissions were maximized by cable manipulation.

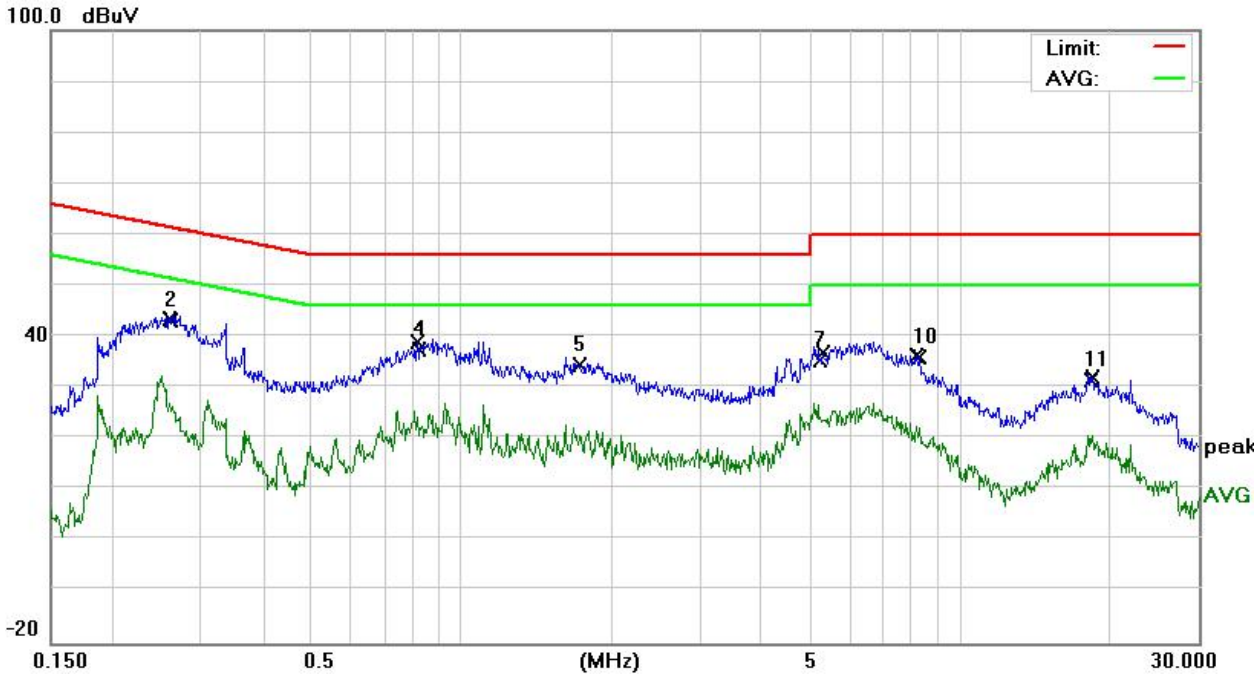
AC Power Conducted Emission Limit

For intentional device, according to § 15.207(a) AC Power Conducted Emission Limits is as following：

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 RESULTS

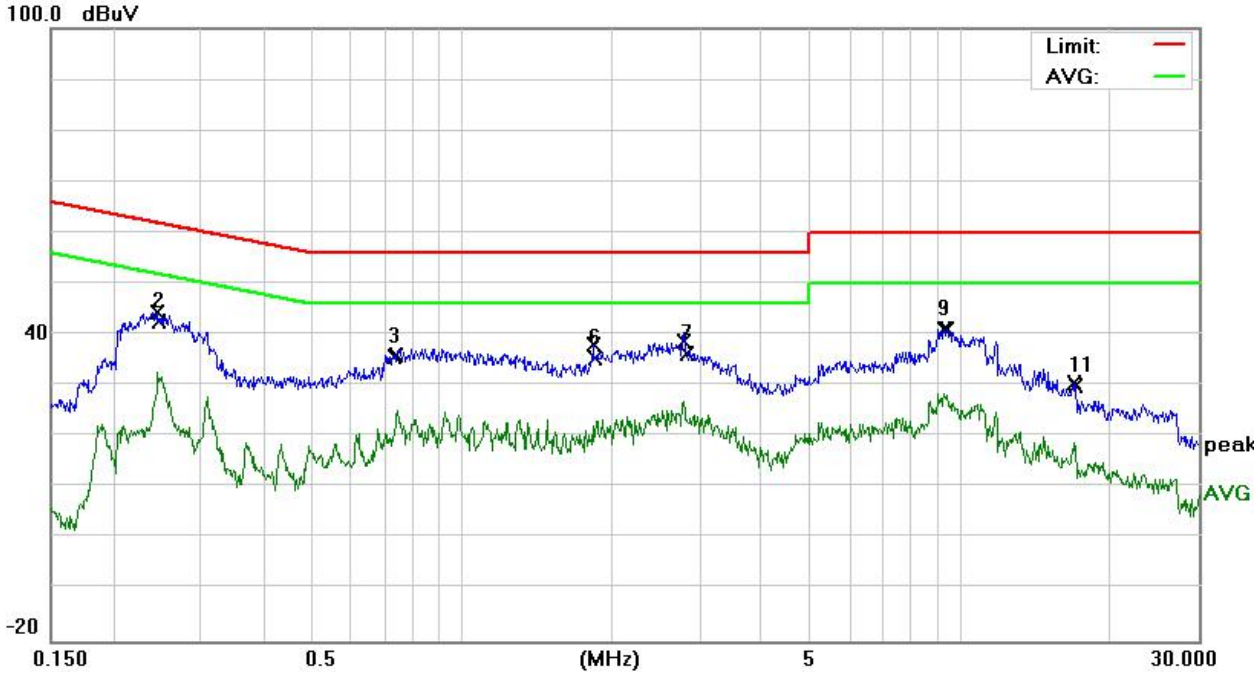
Power supply:	DC 5V from Adapter AC 120V/60Hz	Polarization	L



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1		0.2584	16.66	10.20	26.86	51.48	-24.62	AVG
2	*	0.2620	33.10	10.20	43.30	61.36	-18.06	peak
3		0.8135	14.02	10.21	24.23	46.00	-21.77	AVG
4		0.8256	27.39	10.21	37.60	56.00	-18.40	peak
5		1.7298	24.28	10.22	34.50	56.00	-21.50	peak
6		1.7298	10.38	10.22	20.60	46.00	-25.40	AVG
7		5.2298	25.15	10.35	35.50	60.00	-24.50	peak
8		5.2659	13.08	10.34	23.42	50.00	-26.58	AVG
9		8.1935	10.01	10.33	20.34	50.00	-29.66	AVG
10		8.3139	25.77	10.33	36.10	60.00	-23.90	peak
11		18.2939	20.76	10.64	31.40	60.00	-28.60	peak
12		18.2939	8.96	10.64	19.60	50.00	-30.40	AVG

Note:1).Level (dBμV)= Reading (dBμV)+ Factor (dB)
2). Factor (dB)=insertion loss of LISN (dB) + Cable loss (dB)
3). Margin(dB) = Limit (dBμV) - Level (dBμV)

Power supply:	DC 5V from Adapter AC 120V/60Hz	Polarization	N



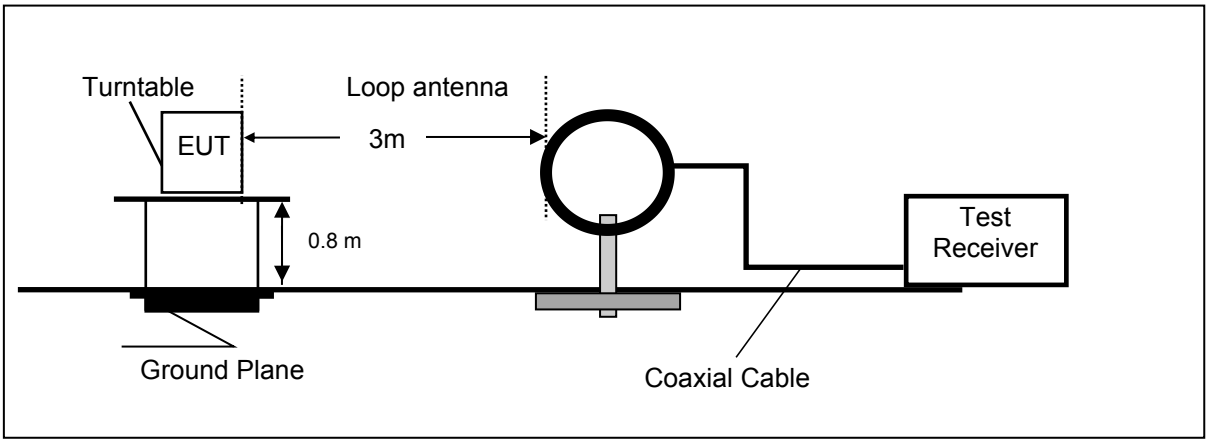
No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1		0.2459	22.37	10.20	32.57	51.89	-19.32	AVG
2		0.2467	32.40	10.20	42.60	61.86	-19.26	peak
3		0.7338	25.56	10.24	35.80	56.00	-20.20	peak
4		0.7338	10.79	10.24	21.03	46.00	-24.97	AVG
5		1.8420	8.87	10.23	19.10	46.00	-26.90	AVG
6		1.8540	25.06	10.24	35.30	56.00	-20.70	peak
7		2.8380	26.12	10.28	36.40	56.00	-19.60	peak
8		2.8380	13.06	10.28	23.34	46.00	-22.66	AVG
9	*	9.2858	30.77	10.33	41.10	60.00	-18.90	peak
10		9.3099	17.21	10.33	27.54	50.00	-22.46	AVG
11		17.0259	19.26	10.64	29.90	60.00	-30.10	peak
12		17.0259	7.65	10.64	18.29	50.00	-31.71	AVG

Note:1).Level (dBμV)= Reading (dBμV)+ Factor (dB)
2). Factor (dB)=insertion loss of LISN (dB) + Cable loss (dB)
3). Margin(dB) = Limit (dBμV) - Level (dBμV)

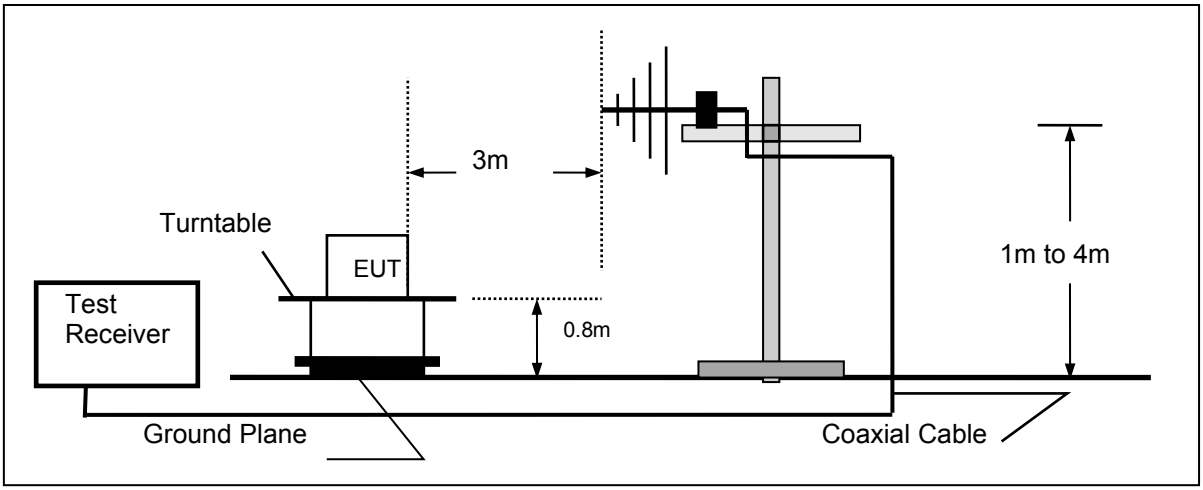
4.2 Radiated Emissions and Band Edge

TEST CONFIGURATION

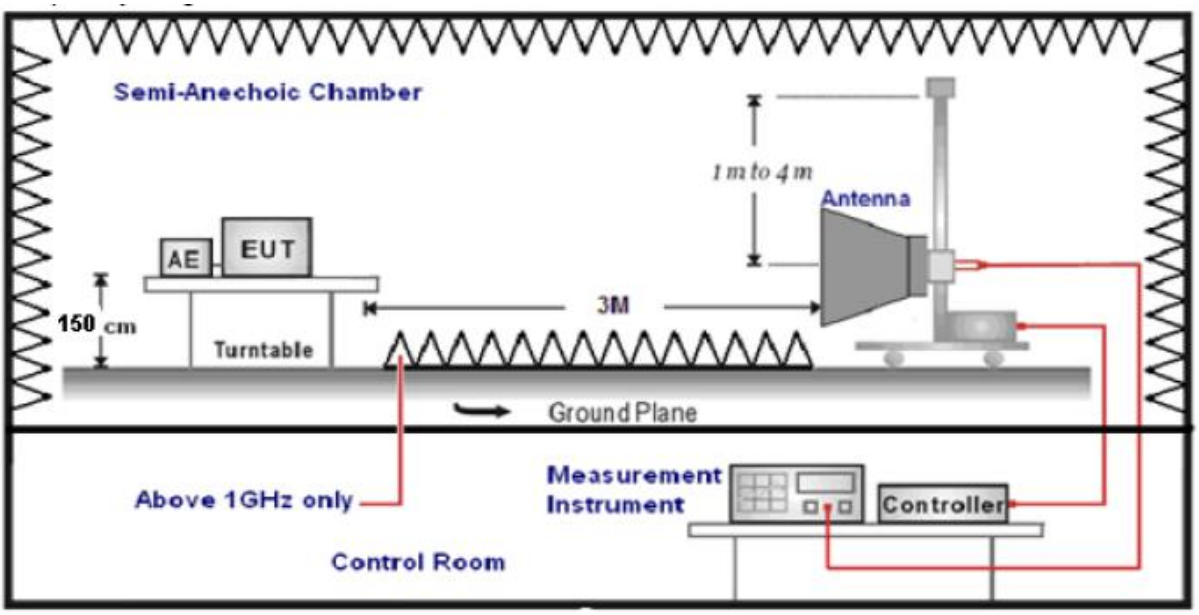
Frequency range 9 KHz – 30MHz



Frequency range 30MHz – 1000MHz



Frequency range above 1GHz-25GHz



TEST PROCEDURE

1. The EUT was placed on a turn table which is 0.8m above ground plane when testing frequency range 9 KHz –1GHz;the EUT was placed on a turn table which is 1.5m above ground plane when testing frequency range 1GHz – 25GHz.
2. Maximum procedure was performed by raising the receiving antenna from 1m to 4m and rotating the turn table from 0℃ to 360℃ to acquire the highest emissions from EUT.
3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
4. Repeat above procedures until all frequency measurements have been completed.
5. The EUT minimum operation frequency was 32.768KHz and maximum operation frequency was 2480MHz.so radiated emission test frequency band from 9KHz to 25GHz.
6. The distance between test antenna and EUT as following table states:

Test Frequency range	Test Antenna Type	Test Distance
9KHz-30MHz	Active Loop Antenna	3
30MHz-1GHz	Ultra-Broadband Antenna	3
1GHz-18GHz	Double Ridged Horn Antenna	3
18GHz-25GHz	Horn Anternna	1

7. Setting test receiver/spectrum as following table states:

Test Frequency range	Test Receiver/Spectrum Setting	Detector
9KHz-150KHz	RBW=200Hz/VBW=3KHz,Sweep time=Auto	QP
150KHz-30MHz	RBW=9KHz/VBW=100KHz,Sweep time=Auto	QP
30MHz-1GHz	RBW=120KHz/VBW=1000KHz,Sweep time=Auto	QP
1GHz-40GHz	Peak Value: RBW=1MHz/VBW=3MHz, Sweep time=Auto Average Value: RBW=1MHz/VBW=10Hz, Sweep time=Auto	Peak

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor(if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CL - AG

Where FS = Field Strength	CL = Cable Attenuation Factor (Cable Loss)
RA = Reading Amplitude	AG = Amplifier Gain
AF = Antenna Factor	

Transd=AF +CL-AG

RADIATION LIMIT

For intentional device, according to § 15.209(a), the general requirement of field strength of radiated emission from intentional radiators at a distance of 3 meters shall not exceed the following table. According to § 15.247(d), in any 100kHz bandwidth outside the frequency band in which the EUT is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the100kHz bandwidth within the band that contains the highest level of desired power.

The pre-test have done for the EUT in three axes and found the worst emission at position shown in test setup photos.

Frequency (MHz)	Distance (Meters)	Radiated (dBμV/m)	Radiated (μV/m)
0.009-0.49	3	20log(2400/F(KHz))+40log(300/3)	2400/F(KHz)
0.49-1.705	3	20log(24000/F(KHz))+ 40log(30/3)	24000/F(KHz)
1.705-30	3	20log(30)+ 40log(30/3)	30
30-88	3	40.0	100
88-216	3	43.5	150
216-960	3	46.0	200
Above 960	3	54.0	500

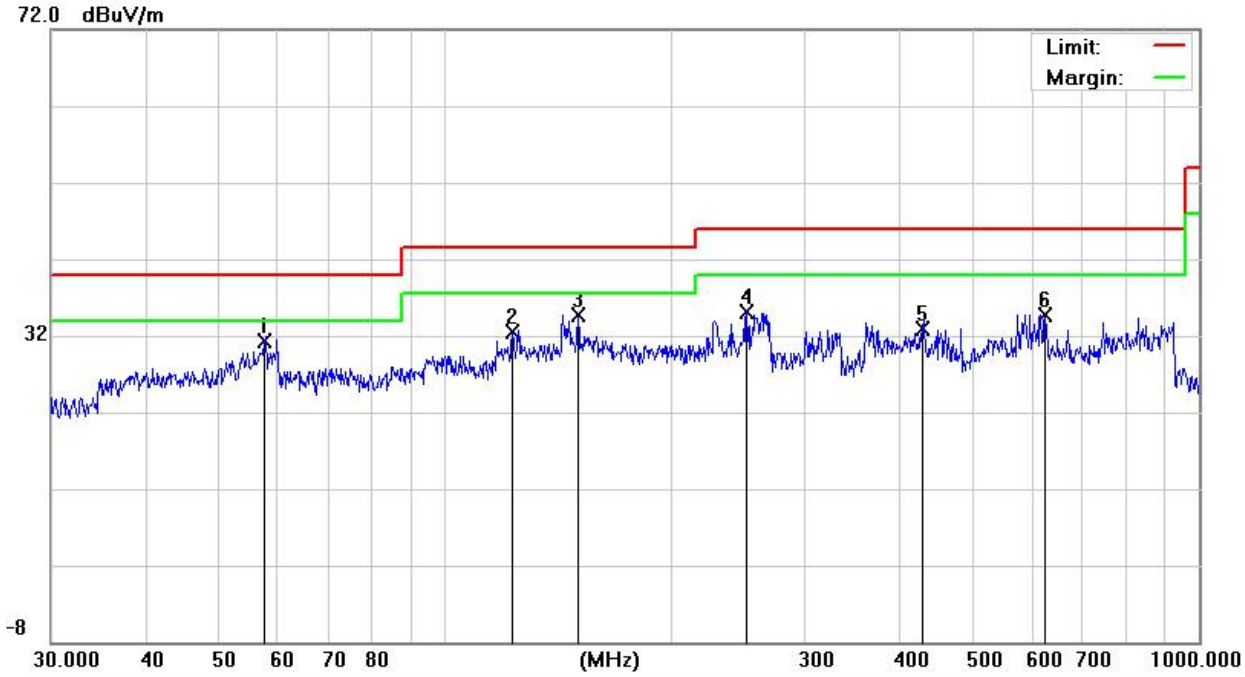
TEST RESULTS

Remark:

1. This test was performed with EUT in X, Y, Z position and the worse case was found when EUT in X position.
2. BLE 1Mpbs were tested at Low, Middle, and High channel and recorded worst mode at BLE 1Mpbs.
3. Radiated emission test from 9 KHz to 10th harmonic of fundamental was verified, and no emission found except system noise floor in 9 KHz to 30MHz and not recorded in this report.

For 30MHz-1GHz

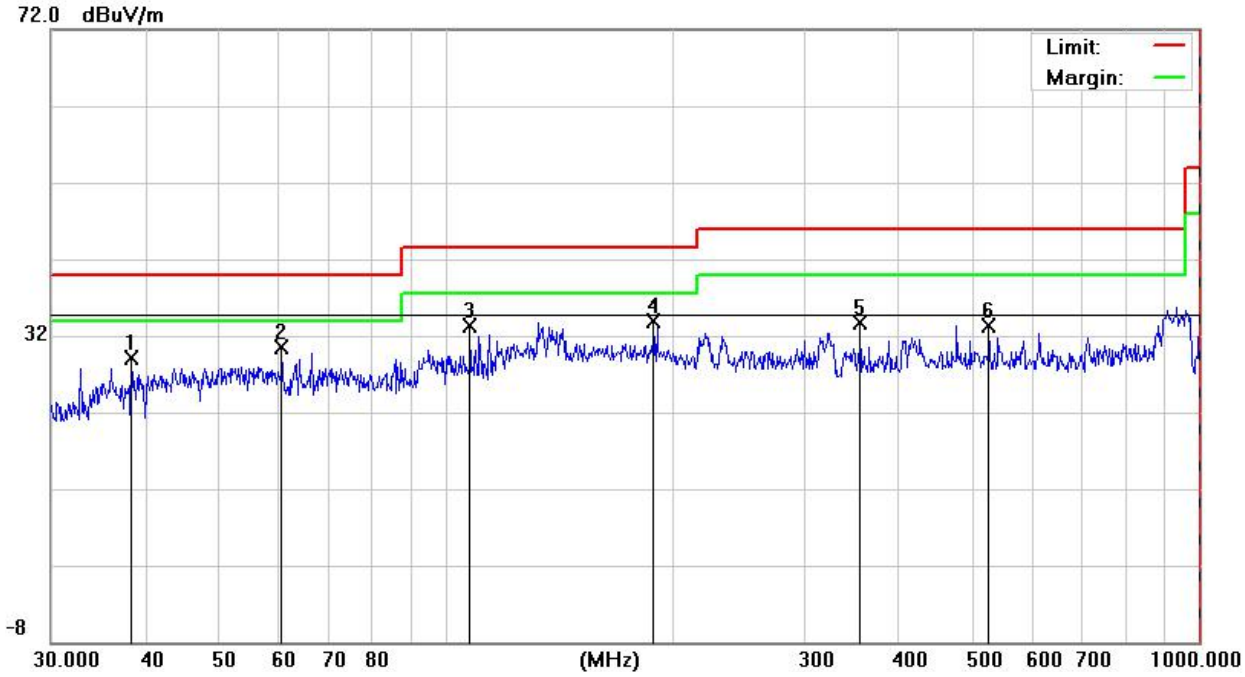
Horizontal



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1	*	57.5938	25.73	5.67	31.40	40.00	-8.60	peak
2		122.8340	20.44	12.16	32.60	43.50	-10.90	peak
3		150.0107	22.97	11.73	34.70	43.50	-8.80	peak
4		251.1802	21.52	13.68	35.20	46.00	-10.80	peak
5		429.5228	14.11	18.79	32.90	46.00	-13.10	peak
6		625.0778	11.20	23.60	34.80	46.00	-11.20	peak

Note:1).Level (dBμV/m)= Reading (dBμV)+ Factor (dB/m)
2). Factor(dB/m)=Antenna Factor (dB/m) + Cable loss (dB) - Pre Amplifier gain (dB)
3). Margin(dB) = Limit (dBμV/m) - Level (dBμV/m)

Vertical



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1		38.3462	14.99	14.21	29.20	40.00	-10.80	peak
2	*	60.7043	25.20	5.30	30.50	40.00	-9.50	peak
3		107.8876	21.91	11.39	33.30	43.50	-10.20	peak
4		189.0740	24.76	9.14	33.90	43.50	-9.60	peak
5		355.4273	17.29	16.41	33.70	46.00	-12.30	peak
6		526.3967	12.15	21.05	33.20	46.00	-12.80	peak

Note:1).Level (dBμV/m)= Reading (dBμV)+ Factor (dB/m)
2). Factor(dB/m)=Antenna Factor (dB/m) + Cable loss (dB) - Pre Amplifier gain (dB)
3). Margin(dB) = Limit (dBμV/m) - Level (dBμV/m)

For 1GHz to 25GHz

GFSK (above 1GHz)

Frequency(MHz):			2402		Polarity:		HORIZONTAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
4804.00	56.52	PK	74	17.48	60.88	32.40	5.11	41.87	-4.36
4804.00	46.33	AV	54	7.67	50.69	32.40	5.11	41.87	-4.36
7206.00	54.86	PK	74	19.14	55.49	36.58	6.43	43.64	-0.63
7206.00	44.92	AV	54	9.08	45.55	36.58	6.43	43.64	-0.63

Frequency(MHz):			2402		Polarity:		VERTICAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
4804.00	57.18	PK	74	16.82	61.54	32.40	5.11	41.87	-4.36
4804.00	47.08	AV	54	6.92	51.44	32.40	5.11	41.87	-4.36
7206.00	54.52	PK	74	19.48	55.15	36.58	6.43	43.64	-0.63
7206.00	44.92	AV	54	9.08	45.55	36.58	6.43	43.64	-0.63

Frequency(MHz):			2440		Polarity:		HORIZONTAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
4880.00	57.59	PK	74	16.41	61.54	32.56	5.34	41.85	-3.95
4880.00	47.31	AV	54	6.69	51.26	32.56	5.34	41.85	-3.95
7320.00	55.13	PK	74	18.87	55.49	36.54	6.81	43.71	-0.36
7320.00	44.98	AV	54	9.02	45.34	36.54	6.81	43.71	-0.36

Frequency(MHz):			2440		Polarity:		VERTICAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
4880.00	56.29	PK	74	17.71	60.24	32.56	5.34	41.85	-3.95
4880.00	46.53	AV	54	7.47	50.48	32.56	5.34	41.85	-3.95
7320.00	55.33	PK	74	18.67	55.69	36.54	6.81	43.71	-0.36
7320.00	45.17	AV	54	8.83	45.53	36.54	6.81	43.71	-0.36

Frequency(MHz):			2480		Polarity:		HORIZONTAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
4960.00	56.78	PK	74	17.22	60.24	32.73	5.64	41.83	-3.46
4960.00	47.02	AV	54	6.98	50.48	32.73	5.64	41.83	-3.46
7440.00	55.57	PK	74	18.43	55.63	36.50	7.23	43.79	-0.06
7440.00	45.80	PK	54	8.20	45.86	36.50	7.23	43.79	-0.06

Frequency(MHz):			2480		Polarity:		VERTICAL		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
4960.00	56.99	PK	74	17.01	60.45	32.73	5.64	41.83	-3.46
4960.00	47.40	AV	54	6.60	50.86	32.73	5.64	41.83	-3.46
7440.00	55.10	PK	74	18.90	55.16	36.50	7.23	43.79	-0.06
7440.00	45.29	PK	54	8.71	45.35	36.50	7.23	43.79	-0.06

REMARKS:

1. Emission level (dBuV/m) =Raw Value (dBuV)+Correction Factor (dB/m)
2. Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)- Pre-amplifier
3. Margin value = Limit value- Emission level.
4. -- Mean the PK detector measured value is below average limit.
5. The other emission levels were very low against the limit.

Results of Band Edges Test (Radiated)

GFSK

Frequency(MHz):			**2402**		**Polarity:**		**HORIZONTAL**		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
2390.00	50.83	PK	74	23.17	61.25	27.42	4.31	42.15	-10.42
2390.00	49.43	AV	54	4.57	59.85	27.42	4.31	42.15	-10.42
Frequency(MHz):			**2402**		**Polarity:**		**VERTICAL**		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
2390.00	47.21	PK	74	26.79	57.63	27.42	4.31	42.15	-10.42
2390.00	45.00	AV	54	9.00	55.42	27.42	4.31	42.15	-10.42
Frequency(MHz):			**2480**		**Polarity:**		**HORIZONTAL**		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
2483.50	43.03	PK	74	30.97	53.14	27.70	4.47	42.28	-10.11
2483.50	40.13	AV	54	13.87	50.24	27.70	4.47	42.28	-10.11
Frequency(MHz):			**2480**		**Polarity:**		**VERTICAL**		
Frequency (MHz)	Emission Level (dBuV/m)		Limit (dBuV/m)	Margin (dB)	Raw Value (dBuV)	Antenna Factor (dB/m)	Cable Factor (dB)	Pre-amplifier (dB)	Correction Factor (dB/m)
2483.50	38.58	PK	74	35.42	48.69	27.70	4.47	42.28	-10.11
2483.50	37.01	AV	54	16.99	47.12	27.70	4.47	42.28	-10.11

REMARKS:
1. Emission level (dBuV/m) =Raw Value (dBuV)+Correction Factor (dB/m)
2. Correction Factor (dB/m) = Antenna Factor (dB/m)+Cable Factor (dB)- Pre-amplifier
3. Margin value = Limit value- Emission level.
4. -- Mean the PK detector measured value is below average limit.
5. The other emission levels were very low against the limit.

4.3 Maximum Peak Output Power

Limit

The Maximum Peak Output Power Measurement is 30dBm.

Test Procedure

Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power sensor.

Test Configuration

Test Results

Type	Channel	Output power (dBm)	Limit (dBm)	Result
GFSK 1Mbps	00	-8.112	30.00	Pass
	19	-8.869		
	39	-9.145		

Note: 1.The test results including the cable lose.S

4.4 Power Spectral Density

Limit

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

Test Procedure

1. Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.
2. Set the RBW ≥ 3 kHz.
3. Set the VBW ≥ 3× RBW.
4. Set the span to 1.5 times the DTS channel bandwidth.
5. Detector = peak.
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 power level.
10. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.
11. The resulting peak PSD level must be 8dBm.

Test Configuration

Test Results

Type	Channel	Power Spectral Density (dBm/3KHz)	Limit (dBm/3KHz)	Result
GFSK 1Mbps	00	-30.144	8.00	Pass
	19	-29.398		
	39	-29.012		

Test plot as follows:

BLE GFSK 1Mpbs

CH00

CH19

CH39

4.5 6dB Bandwidth

Limit

For digital modulation systems, the minimum 6 dB bandwidth shall be at least 500 kHz

Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with 100 KHz RBW and 300 KHz VBW. The 6dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 6dB.

Test Configuration

Test Results

Type	Channel	6dB Bandwidth (MHz)	Limit (KHz)	Result
GFSK 1Mbps	00	0.5029	≥500	Pass
	19	0.5026		
	39	0.5035		

Test plot as follows:

BLE GFSK 1Mpbs

CH00

CH19

CH39

4.6 Out-of-band Emissions

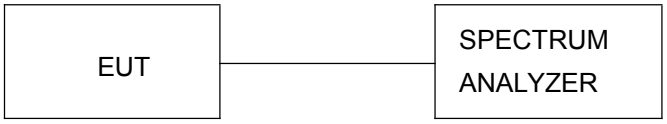
Limit

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 con-ducted or a radiated measurement, pro-vided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter com-plies 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.

Test Procedure

Connect the transmitter output to spectrum analyzer using a low loss RF cable, and set the spectrum analyzer to RBW=100 kHz, VBW= 300 kHz, peak detector , and max hold. Measurements utilizing these setting are made of the in-band reference level, bandedge and out-of-band emissions.

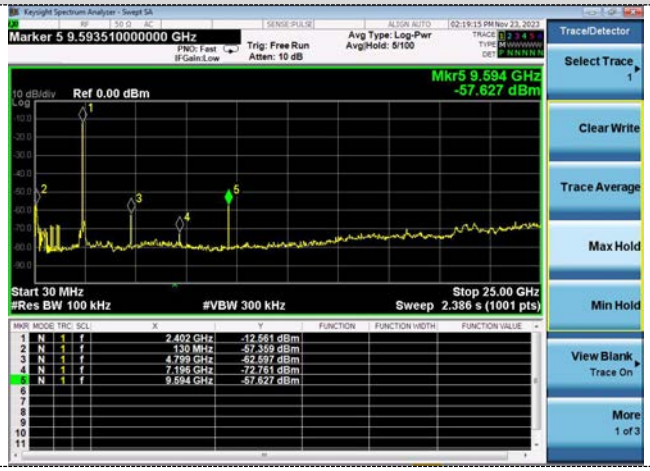
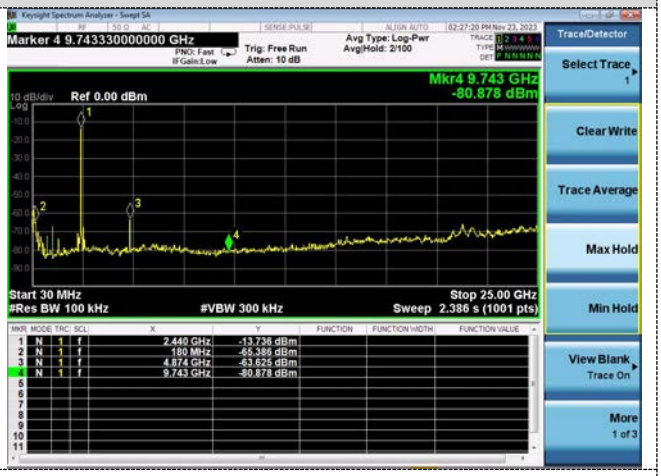
Test Configuration

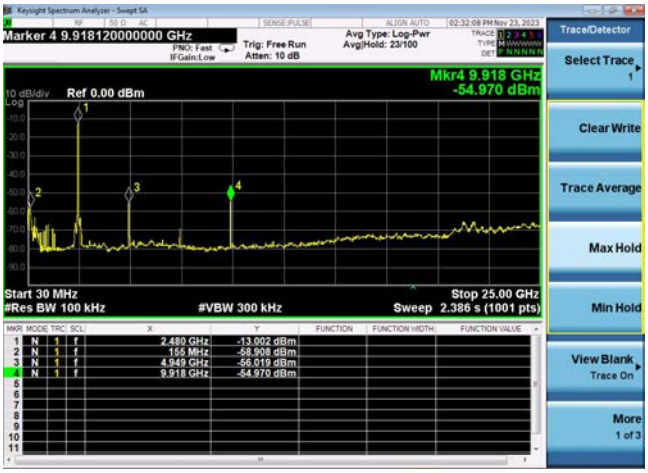


Test Results

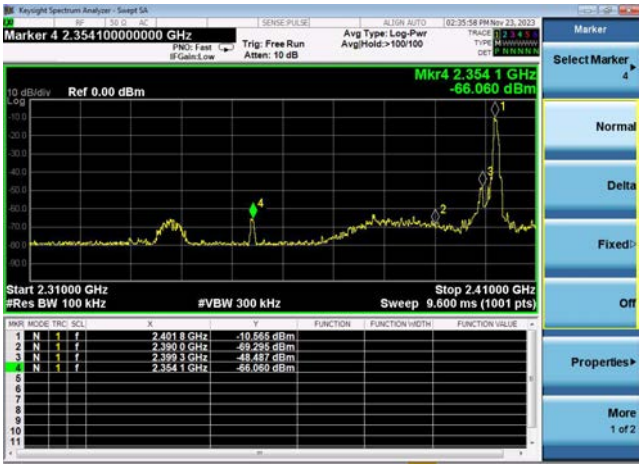
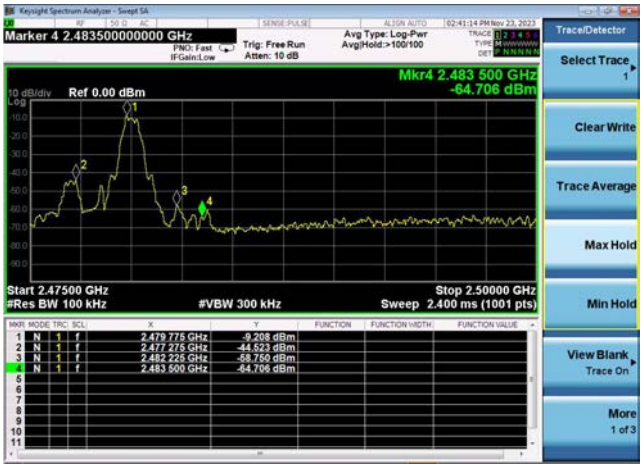
Remark: The measurement frequency range is from 30MHz to the 10th harmonic of the fundamental frequency. The lowest, middle and highest channels are tested to verify the spurious emissions and bandage measurement data.

Test plot as follows:

GFSK 1Mbps (CH00)	GFSK 1Mbps (CH19)
	
30MHz-25G	30MHz-25G

GFSK 1Mbps (CH39)	
	
30MHz-25G	

Band-edge Measurements for RF Conducted Emissions:

BLE GFSK 1Mpbs	
	
Left bandedge	Right bandedge

4.7 Antenna Requirement

Standard Applicable

For intentional device, according to FCC 47 CFR Section 15.203:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, 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

FCC CFR Title 47 Part 15 Subpart C Section 15.247(c) (1) (I):

(i) Systems operating in the 2400-2483.5 MHz band that is used exclusively for fixed. Point-to-point operations may employ transmitting antennas with directional gain greater than 6dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6dBi.

Antenna Connected Construction

The maximum gain of antenna was 2.66 dBi.

Remark:The antenna gain is provided by the customer , if the data provided by the customer is not accurate, BSL Testing Co., Ltd. does not assume any responsibility.