



TEST REPORT

Application No.: CKSEM1909000508CR
FCC ID: 2AMVQ-LC01
IC: 22969-LC01
Applicant: Hangzhou Virtual And Reality Technology Co., LTD.
Address of Applicant: Room 901, Building 6, No.1818-2, West Wenyi Road, Yuhang Street, Yuhang District, Hangzhou, Zhejiang Province
Manufacturer: Hangzhou Virtual And Reality Technology Co., LTD.
Address of Manufacturer: Room 901, Building 6, No.1818-2, West Wenyi Road, Yuhang Street, Yuhang District, Hangzhou, Zhejiang Province
Equipment Under Test (EUT):
EUT Name: KAT loco
Model No.: LC011, LC012
Please refer to section 2 of this report which indicates which model was actually tested and which were electrically identical.
Standard(s): 47 CFR Part 15, Subpart C 15.247
RSS-247 Issue 2, February 2017
RSS-Gen Issue 5, April 2018
Date of Receipt: 2019-09-17
Date of Test: 2019-10-13 to 2019-10-14
Date of Issue: 2019-10-22

Test Result:	Pass*
---------------------	--------------

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

Eric Lin
EMC Lab Manager

The manufacturer should ensure that all products in series production are in conformity with the product sample detailed in this report. If the product in this report is used in any configuration other than that detailed in the report, the manufacturer must ensure the new system complies with all relevant standards. Any mention of SGS International Electrical Approvals or testing done by SGS International Electrical Approvals in connection with, distribution or use of the product described in this report must be approved by SGS International Electrical Approvals in writing.



Unless otherwise agreed in writing, this document is issued by the Company subject to its General Conditions of Service printed overleaf, available on request or accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx> and, for electronic format documents, subject to Terms and Conditions for Electronic Documents at <http://www.sgs.com/en/Terms-and-Conditions/Terms-e-Documents.aspx>. Attention is drawn to the limitation of liability, indemnification and jurisdiction issues defined therein. Any holder of this document is advised that information contained hereon reflects the Company's findings at the time of its intervention only and within the limits of Client's instructions, if any. The Company's sole responsibility is to its Client and this document does not exonerate parties to a transaction from exercising all their rights and obligations under the transaction documents. This document cannot be reproduced except in full, without prior written approval of the Company. Any unauthorized alteration, forgery or falsification of the content or appearance of this document is unlawful and offenders may be prosecuted to the fullest extent of the law. Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 30 days only.
Attention: To check the authenticity of testing / inspection report & certificate, please contact us at telephone: (86-755) 8307 1443, or email: CN.Doccheck@sgs.com

No.10, Weiye Road, Innovation Park, Kunshan, Jiangsu, China 215300
中国·江苏·昆山市留学院创业园伟业路10号 邮编 215300

t(86-512)57355888 f(86-512)57370818 www.sgsgroup.com.cn
t(86-512)57355888 f(86-512)57370818 sgs.china@sgs.com

Revision Recordd			
Version	Description	Date	Remark
00	Original	2019-10-22	/

Authorized for issue by:			
		<i>Ken Yao</i>	
		Ken Yao / Project Engineer	
		<i>Eric Lin</i>	
		Eric Lin / Reviewer	

2 Test Summary

Radio Spectrum Technical Requirement				
Item	FCC Requirement	IC Requirement	Method	Result
Antenna Requirement	47 CFR Part 15, Subpart C 15.203 & 15.247(c)	RSS-Gen Clause 6.8	N/A	Customer Declaration

N/A: Not applicable

Radio Spectrum Matter Part				
Item	FCC Requirement	IC Requirement	Method	Result
Conducted Emissions at AC Power Line (150kHz-30MHz)	47 CFR Part 15, Subpart C 15.207	RSS-Gen Clause 8.8	ANSI C63.10 (2013) Section 6.2	Pass
Minimum 6dB Bandwidth	47 CFR Part 15, Subpart C 15.247a(2)	RSS-247 Clause 5.2(a)	ANSI C63.10 (2013) Section 11.8.1	Pass
Conducted Peak Output Power	47 CFR Part 15, Subpart C 15.247(b)(3)	RSS-247 Clause 5.4(d)	ANSI C63.10 (2013) Section 11.9.1	Pass
Power Spectrum Density	47 CFR Part 15, Subpart C 15.247(e)	RSS-247 Clause 5.2(b)	ANSI C63.10 (2013) Section 11.10.2	Pass
Conducted Band Edges Measurement	47 CFR Part 15, Subpart C 15.247(d)	RSS-247 Clause 5.5	ANSI C63.10 (2013) Section 11.13.3.2	Pass
Conducted Spurious Emissions	47 CFR Part 15, Subpart C 15.247(d)	RSS-247 Clause 5.5	ANSI C63.10 (2013) Section 11.11	Pass
Radiated Emissions which fall in the restricted bands	47 CFR Part 15, Subpart C 15.209 & 15.247(d)	Section 3.3 & RSS-Gen Section 8.9	ANSI C63.10 (2013) Section 6.10.5	Pass
Radiated Spurious Emissions	47 CFR Part 15, Subpart C 15.209 & 15.247(d)	Section 3.3 & RSS-Gen Section 8.9	ANSI C63.10 (2013) Section 6.4,6.5,6.6	Pass
99% Bandwidth	-	RSS-Gen Section 6.7	ANSI C63.10 Section 6.9.3	Pass
Frequency Stability	-	RSS-Gen Section 8.11	RSS-Gen Section 6.11	Pass

Note1:

Frequency stability requested in RSS GEN S8.11 has been complied since the result of band edge can demonstrate.

Note2: Declaration of EUT Family Grouping:

The model LC011 mentioned in this report and they are the similar in electrical and electronic characters. Only the model LC012 was tested since LC012 has one more compass than LC011.

3 Contents

	Page
1 COVER PAGE.....	1
2 TEST SUMMARY.....	3
3 CONTENTS.....	4
4 GENERAL INFORMATION	5
4.1 DETAILS OF E.U.T.....	5
4.2 DESCRIPTION OF SUPPORT UNITS.....	5
4.3 MEASUREMENT UNCERTAINTY	6
4.4 TEST LOCATION	7
4.5 TEST FACILITY	7
4.6 DEVIATION FROM STANDARDS	7
4.7 ABNORMALITIES FROM STANDARD CONDITIONS	7
5 EQUIPMENT LIST	8
6 RADIO SPECTRUM TECHNICAL REQUIREMENT	9
6.1 ANTENNA REQUIREMENT	9
7 RADIO SPECTRUM MATTER TEST RESULTS	10
7.1 CONDUCTED EMISSIONS AT AC POWER LINE (150kHz-30MHz)	10
7.2 MINIMUM 6dB BANDWIDTH	14
7.3 CONDUCTED PEAK OUTPUT POWER	15
7.4 POWER SPECTRUM DENSITY	16
7.5 CONDUCTED BAND EDGES MEASUREMENT	17
7.6 CONDUCTED SPURIOUS EMISSIONS	18
7.7 RADIATED EMISSIONS WHICH FALL IN THE RESTRICTED BANDS.....	19
7.8 RADIATED SPURIOUS EMISSIONS	24
8 TEST SETUP PHOTOGRAPHS.....	30
9 EUT CONSTRUCTIONAL DETAILS.....	30

4 General Information

4.1 Details of E.U.T.

Power supply:	DC 3.7V, 370mAh by rechargeable battery DC 5V by PC
Test voltage:	DC 5V
Antenna Gain	2.1dBi
Antenna Type	PCB Antenna
Channel Spacing	2MHz
Modulation Type	GFSK
Number of Channels	40
Operation Frequency	2402MHz to 2480MHz

4.2 Description of Support Units

Description	Manufacturer	Model No.	Serial No.
Notebook	G480	Lenovo	N/A
Serial port adapter plate	/	XDS110	/
Test Software	/	SmartRF_Studio_7	/

4.3 Measurement Uncertainty

The following relevant measurement uncertainties have been estimated and determined following the ETSI Technical Report, ETR 028

Parameter	Uncertainty
RF output power, conducted	$\pm 1.1\text{dB}$
All emissions, radiated	$\pm 4.3\text{dB}$
Temperature	$\pm 1^{\circ}\text{C}$
Humidity test	$\pm 3\%$
Supply voltages	$\pm 0.2\%$

These uncertainties represent an expanded uncertainty expressed approximately at the 95% confidence level using a coverage factor of $k=2$.

4.4 Test Location

All tests were performed at:

Compliance Certification Services Inc.

No.10Weiye Rd., Innovation park, Eco&Tec, Development Zone, Kunshan City, Jiangsu, China.

Tel: +86-512-57355888 Fax: +86-512-57370818

No tests were sub-contracted.

4.5 Test Facility

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

- **CNAS (No. CNAS L4354)**

CNAS has accredited Compliance Certification Services (Kunshan) Inc. to ISO/IEC 17025:2005 General Requirements for the Competence of Testing and Calibration Laboratories (CNAS-CL01 Accreditation Criteria for the Competence of Testing and Calibration Laboratories) for the competence in the field of testing.

- **A2LA (Certificate No. 2541.01)**

Compliance Certification Services (Kunshan) Inc. is accredited by the American Association for Laboratory Accreditation (A2LA). Certificate No. 2541.01.

- **FCC –Designation Number: CN1172**

Compliance Certification Services Inc. has been recognized as an accredited testing laboratory. Designation Number: CN1172. Test Firm Registration Number: 995260.

- **Industry Canada (IC) – IC Assigned Code: 2324E**

The 10m and 3m Semi-anechoic chamber of Compliance Certification Services (Kunshan) Inc. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 2324E-1 for 10m chamber, 2324E-2 for 3m chamber.

- **VCCI (Member No.: 1938)**

The 3m and 10m Semi-anechoic chamber and Shielded Room of Compliance Certification Services (Kunshan) Inc. has been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-1600, C-1707, T-1499, G-216 respectively.

4.6 Deviation from Standards

None

4.7 Abnormalities from Standard Conditions

None

5 Equipment List

Name of Equipment	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due
Vector Signal Generator	R&S	SMU200A	102744	02/25/2019	02/24/2020
Signal Analyzer	R&S	FSV40	101493	12/26/2018	12/25/2019
Pre-Amplifier	CCSRF	AMP1277	001	12/26/2018	12/25/2019
Amplifier	COM-POWER	PAM-840A	461332	10/28/2018	10/27/2019
Bilog Antenna	Schwarzbeck	VULB9160	9160-3342	04/29/2019	04/28/2020
Bilog Antenna	Sunol	JB1	A110204-1	04/21/2019	04/20/2020
Horn-antenna	Schwarzbeck	BBHA9120D	266	02/25/2019	02/24/2020
Horn-antenna	Schwarzbeck	BBHA9170	171	02/27/2018	02/27/2021
Filter	MICRO-TRONICS	BRM50701	5	N.C.R	N.C.R
AC Power Source	EXTECH	6605	1570106	N.C.R	N.C.R
DC Power Supply	AGILENT	E3632A	MY50340053	N.C.R	N.C.R
Power-MIMO power measurement test set	Aglient	MIMO Power 4*4	-	02/25/2019	02/24/2020
6dB Attenuator	Mini-Circuits	NAT-6-2W	15542-1	N.C.R	N.C.R
Temp. / Humidity Chamber	TERCHY	MHK-120AK	X30109	04/22/2019	04/21/2020
Spectrum Analyzer	RS	FSU26	200789	07/03/2019	07/02/2020
Software	Fard technology co.,ltd	EZ-EMC	1.1.1.2	N/A	N/A
Wideband Radio Communication Tester	R&S	CMW500	104184	05/12/2019	05/11/2020

6 Radio Spectrum Technical Requirement

6.1 Antenna Requirement

6.1.1 Test Requirement:

47 CFR Part 15, Subpart C 15.203 & 15.247(c)

6.1.2 Conclusion

Standard Requirement:

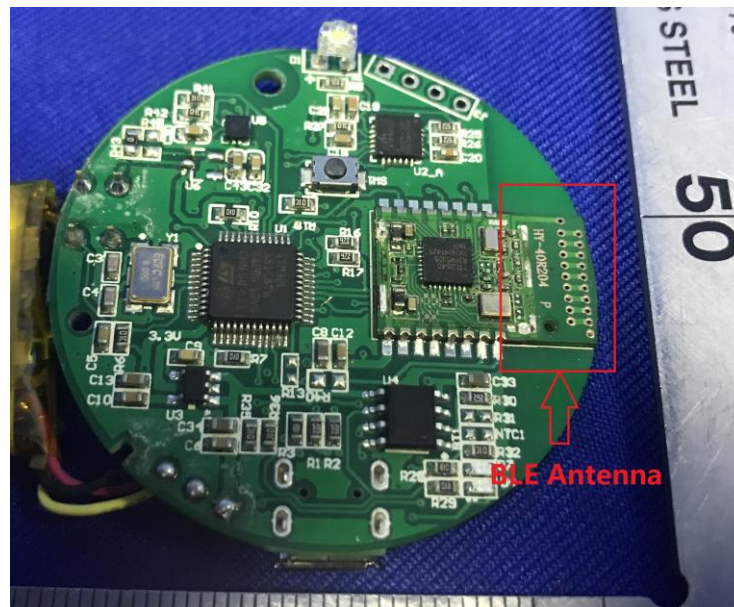
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

15.247(b) (4) requirement:

The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

EUT Antenna:

The antenna is PCB antenna and no consideration of replacement. The best case gain of the antenna is 2.1dBi.



7 Radio Spectrum Matter Test Results

7.1 Conducted Emissions at AC Power Line (150kHz-30MHz)

Test Requirement 47 CFR Part 15, Subpart C 15.207

Test Method: ANSI C63.10 (2013) Section 6.2

Limit:

Frequency of emission(MHz)	Conducted limit(dBμV)	
	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.

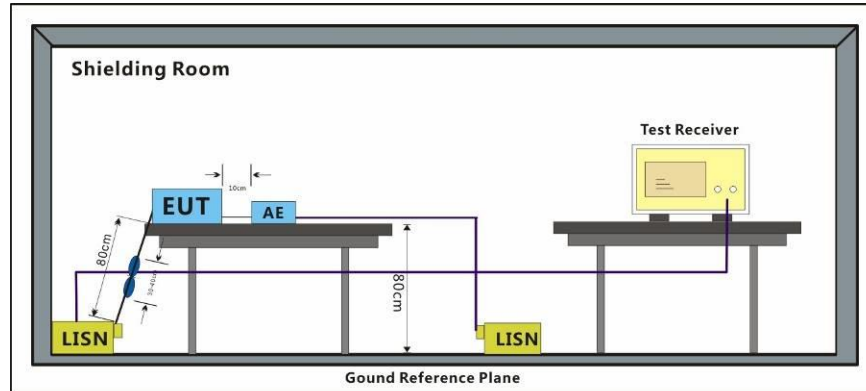
7.1.1 E.U.T. Operation

Operating Environment:

Temperature: 22 °C Humidity: 50 % RH Atmospheric Pressure: 1020 mbar

Test mode a:TX mode_Keep the EUT in charging and continuously transmitting mode with GFSK modulation type.

7.1.2 Test Setup Diagram



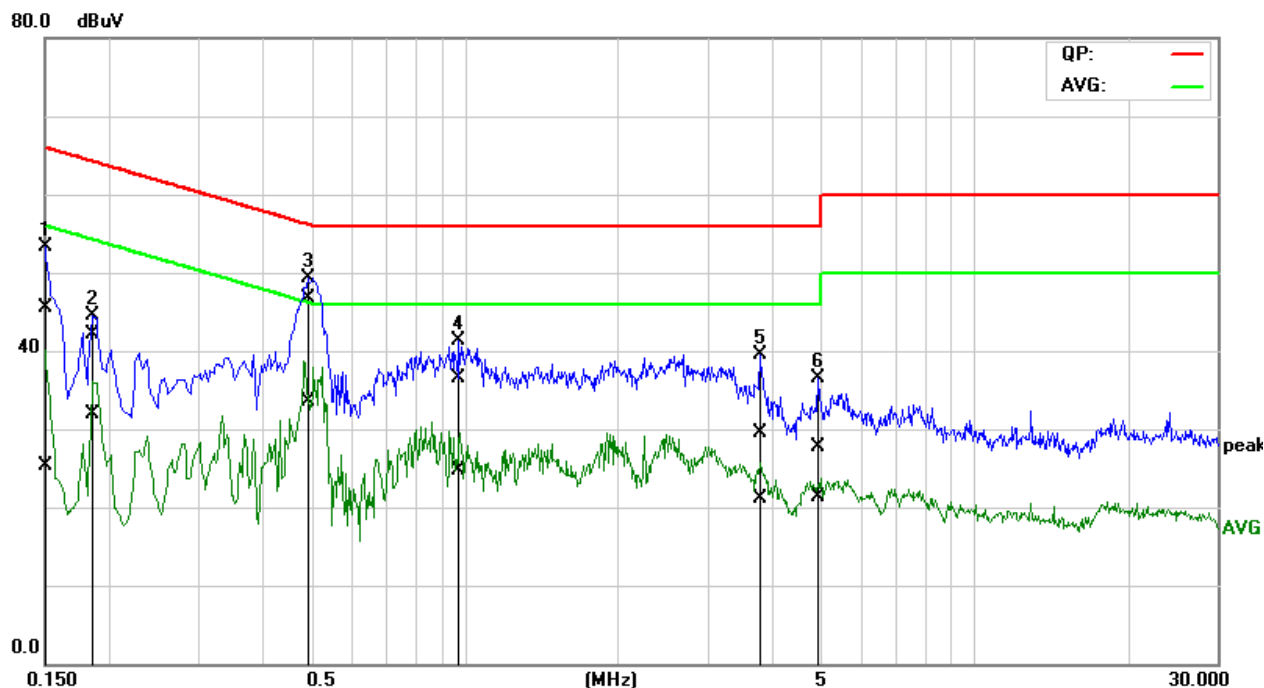
7.1.3 Measurement Procedure and Data

- 1) The mains terminal disturbance voltage test was conducted in a shielded room.
- 2) The worst case is the lowest channel. Only the worst case is recorded in the report.
- 3) The EUT was connected to AC power source through a LISN 1 (Line Impedance Stabilization Network) which provides a 50ohm/50μH + 5ohm 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.
- 4) 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,
- 5) 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.
- 6) 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.

Remark 1: LISN=Read Level+ Cable Loss+ LISN Factor

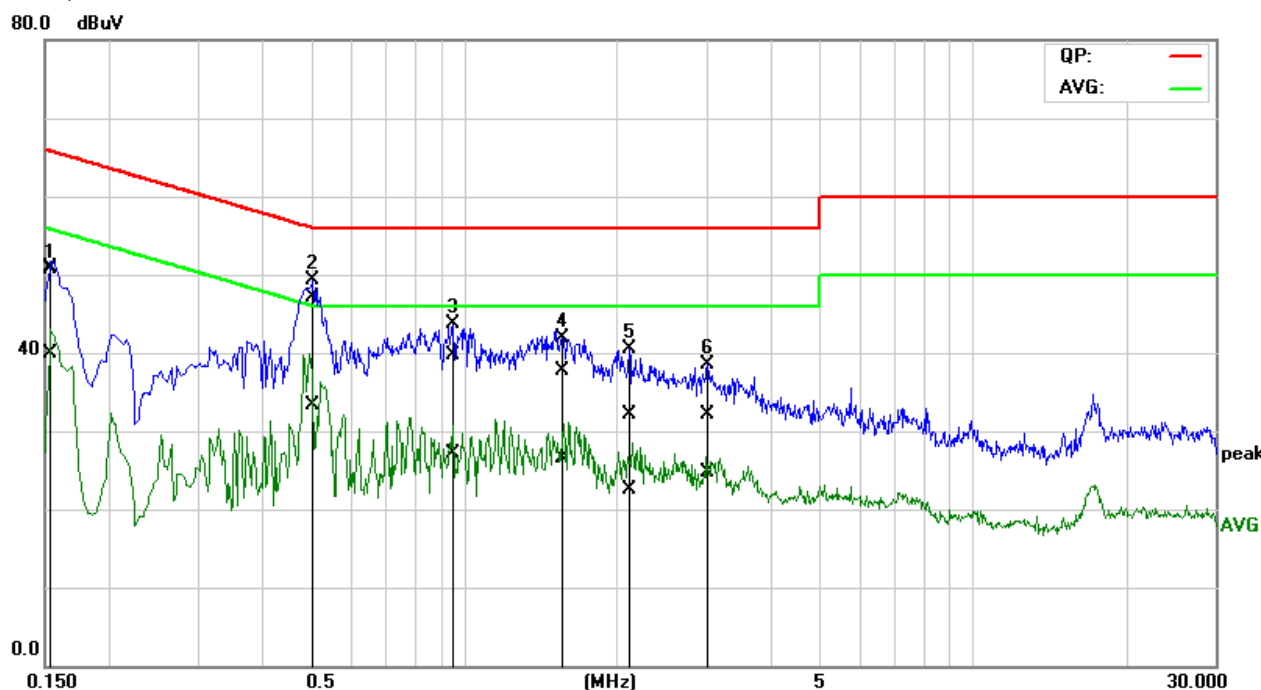
Remark 2: Bluetooth function can work in charging mode

Mode:a; Line:Live Line



No.	Frequency (MHz)	QuasiPeak reading (dBuV)	Average reading (dBuV)	Correction factor (dB)	QuasiPeak result (dBuV)	Average result (dBuV)	QuasiPeak limit (dBuV)	Average limit (dBuV)	QuasiPeak margin (dB)	Average margin (dB)	Remark
1	0.1511	26.08	5.82	19.52	45.60	25.34	65.93	55.94	-20.33	-30.60	Pass
2	0.1836	22.53	12.30	19.51	42.04	31.81	64.32	54.32	-22.28	-22.51	Pass
3*	0.4946	27.21	13.94	19.52	46.73	33.46	56.09	46.09	-9.36	-12.63	Pass
4	0.9659	16.93	5.25	19.55	36.48	24.80	56.00	46.00	-19.52	-21.20	Pass
5	3.7661	9.85	1.45	19.62	29.47	21.07	56.00	46.00	-26.53	-24.93	Pass
6	4.9292	8.06	1.66	19.65	27.71	21.31	56.00	46.00	-28.29	-24.69	Pass

Mode:a; Line:Neutral Line



No.	Frequency (MHz)	QuasiPeak reading (dBuV)	Average reading (dBuV)	Correction factor (dB)	QuasiPeak result (dBuV)	Average result (dBuV)	QuasiPeak limit (dBuV)	Average limit (dBuV)	QuasiPeak margin (dB)	Average margin (dB)	Remark
1	0.1500	31.42	20.47	19.50	50.92	39.97	65.99	56.00	-15.07	-16.03	Pass
2*	0.5004	27.64	13.80	19.51	47.15	33.31	56.00	46.00	-8.85	-12.69	Pass
3	0.9531	20.14	7.53	19.54	39.68	27.07	56.00	46.00	-16.32	-18.93	Pass
4	1.5475	18.11	7.02	19.56	37.67	26.58	56.00	46.00	-18.33	-19.42	Pass
5	2.0966	12.56	2.94	19.57	32.13	22.51	56.00	46.00	-23.87	-23.49	Pass
6	2.9762	12.50	5.20	19.60	32.10	24.80	56.00	46.00	-23.90	-21.20	Pass

7.2 Minimum 6dB Bandwidth

Test Requirement 47 CFR Part 15, Subpart C 15.247a(2)
 Test Method: ANSI C63.10 (2013) Section 11.8.1
 Limit: ≥ 500 kHz

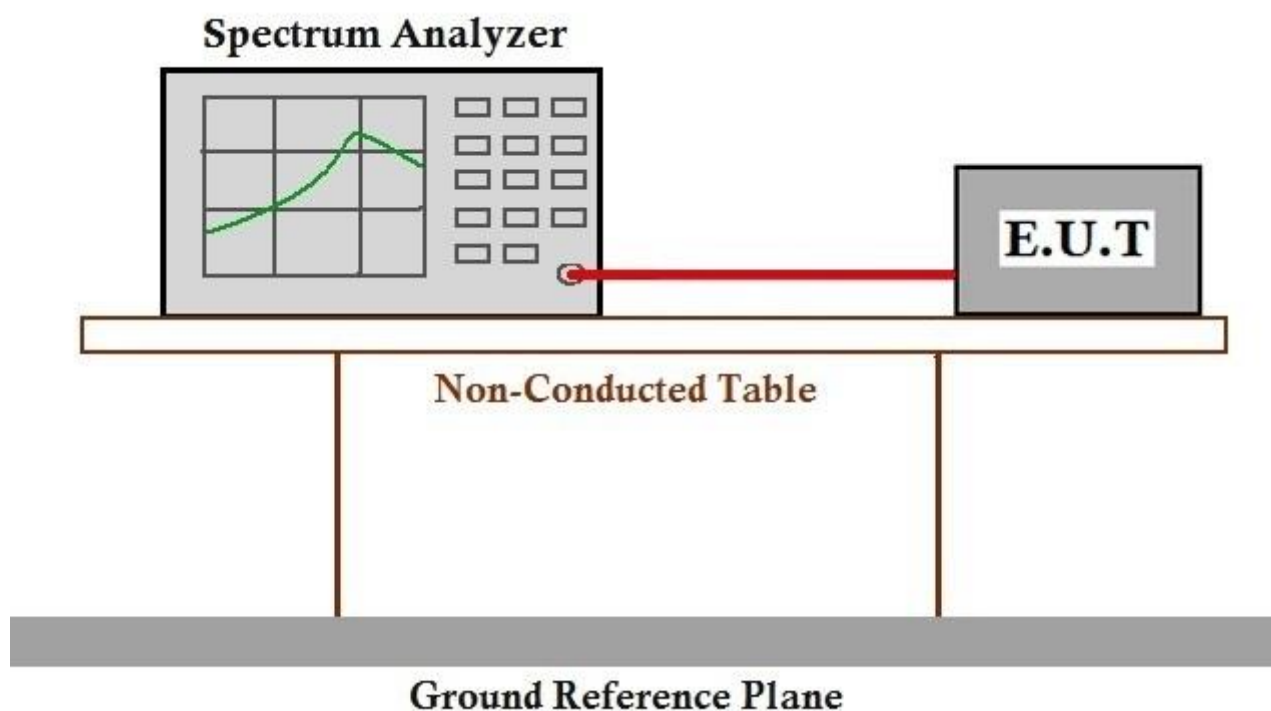
7.2.1 E.U.T. Operation

Operating Environment:

Temperature: 20 °C Humidity: 50 % RH Atmospheric Pressure: 1010 mbar

Test mode a:TX mode_Keep the EUT in charging and continuously transmitting mode with GFSK modulation type.

7.2.2 Test Setup Diagram



7.2.3 Measurement Procedure and Data

The detailed test data see: Appendix B for CKSEM1909000508CR

7.3 Conducted Peak Output Power

Test Requirement 47 CFR Part 15, Subpart C 15.247(b)(3)

Test Method: ANSI C63.10 (2013) Section 11.9.1

Limit:

Frequency range(MHz)	Output power of the intentional radiator(watt)
902-928	1 for ≥ 50 hopping channels
	0.25 for $25 \leq$ hopping channels < 50
	1 for digital modulation
2400-2483.5	1 for ≥ 75 non-overlapping hopping channels
	0.125 for all other frequency hopping systems
	1 for digital modulation
5725-5850	1 for frequency hopping systems and digital modulation

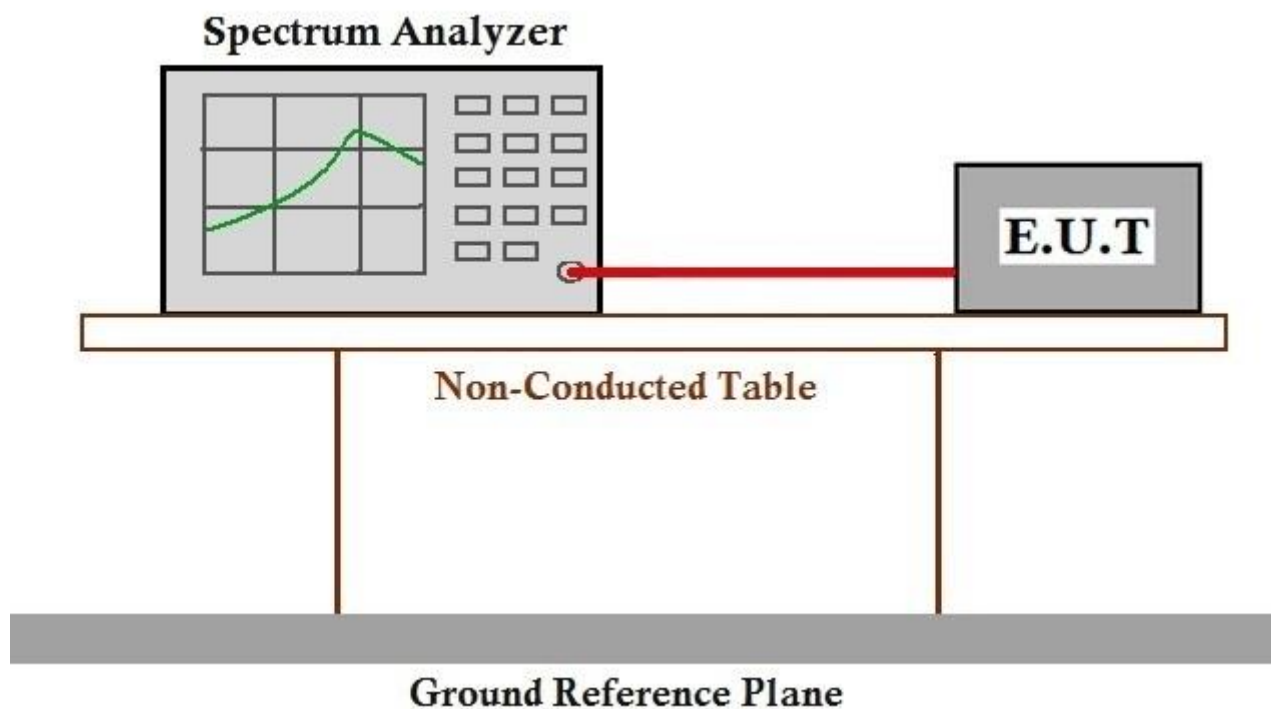
7.3.1 E.U.T. Operation

Operating Environment:

Temperature: 20 °C Humidity: 50 % RH Atmospheric Pressure: 1010 mbar

Test mode a:TX mode_Keep the EUT in charging and continuously transmitting mode with all modulation types. All data rates for each modulation type have been tested and found the data rate @ 1Mbps is the worst case of BLE; Only the data of worst case is recorded

7.3.2 Test Setup Diagram



7.3.3 Measurement Procedure and Data

The detailed test data see: Appendix B for CKSEM1909000508CR

7.4 Power Spectrum Density

Test Requirement	47 CFR Part 15, Subpart C 15.247(e)
Test Method:	ANSI C63.10 (2013) Section 11.10.2
Limit:	≤8dBm in any 3 kHz band during any time interval of continuous transmission

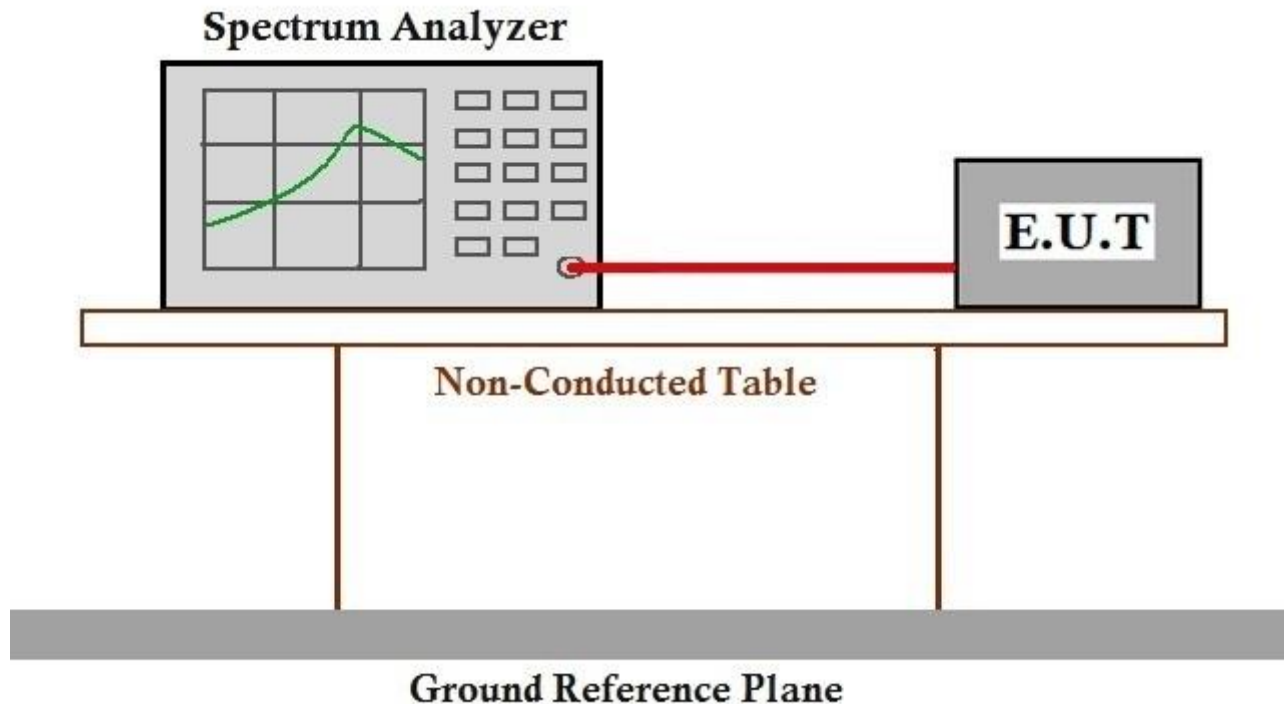
7.4.1 E.U.T. Operation

Operating Environment:

Temperature: 20 °C Humidity: 50 % RH Atmospheric Pressure: 1010 mbar

Test mode a:TX mode_Keep the EUT in charging and continuously transmitting mode with all modulation types. All data rates for each modulation type have been tested and found the data rate @ 1Mbps is the worst case of BLE; Only the data of worst case is recorded

7.4.2 Test Setup Diagram



7.4.3 Measurement Procedure and Data

The detailed test data see: Appendix B for CKSEM1909000508CR

7.5 Conducted Band Edges Measurement

Test Requirement	47 CFR Part 15, Subpart C 15.247(d)
Test Method:	ANSI C63.10 (2013) Section 11.13.3.2
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))

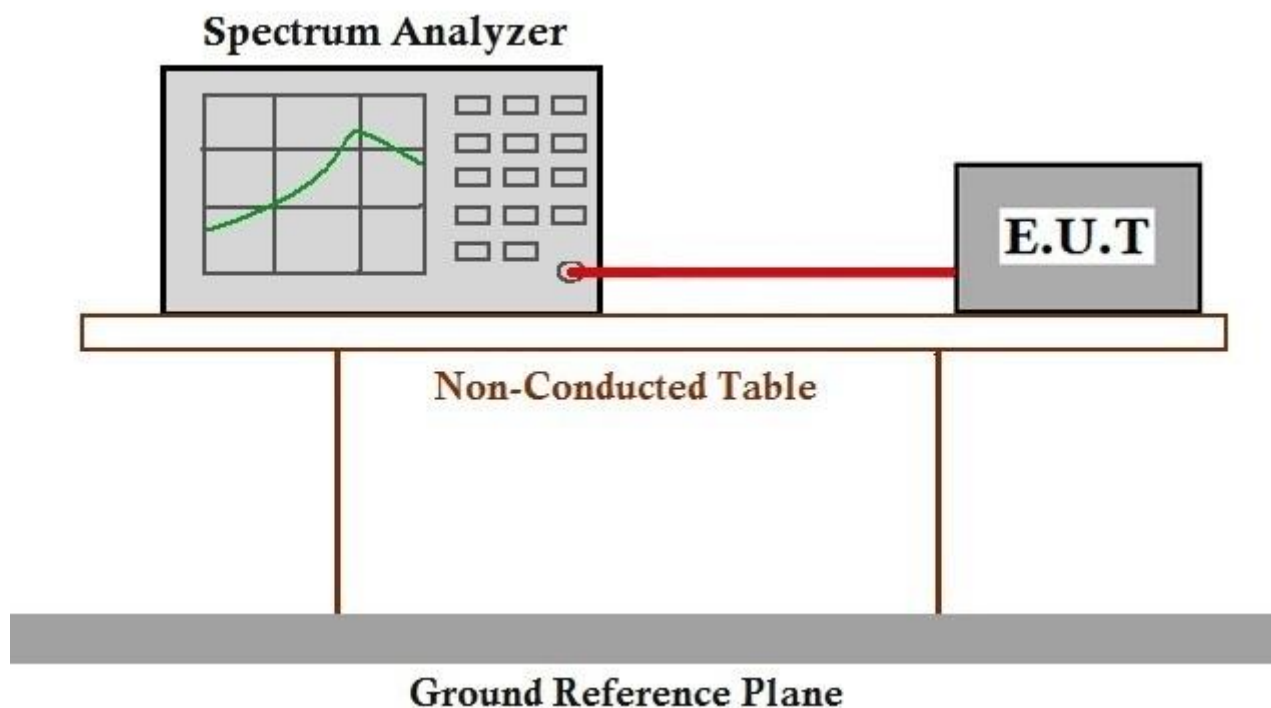
7.5.1 E.U.T. Operation

Operating Environment:

Temperature: 20 °C Humidity: 50 % RH Atmospheric Pressure: 1010 mbar

Test mode a:TX mode_Keep the EUT in charging and continuously transmitting mode with all modulation types. All data rates for each modulation type have been tested and found the data rate @ 1Mbps is the worst case of BLE; Only the data of worst case is recorded.

7.5.2 Test Setup Diagram



7.5.3 Measurement Procedure and Data

The detailed test data see: Appendix B for CKSEM1909000508CR

7.6 Conducted Spurious Emissions

Test Requirement	47 CFR Part 15, Subpart C 15.247(d)
Test Method:	ANSI C63.10 (2013) Section 11.11
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))

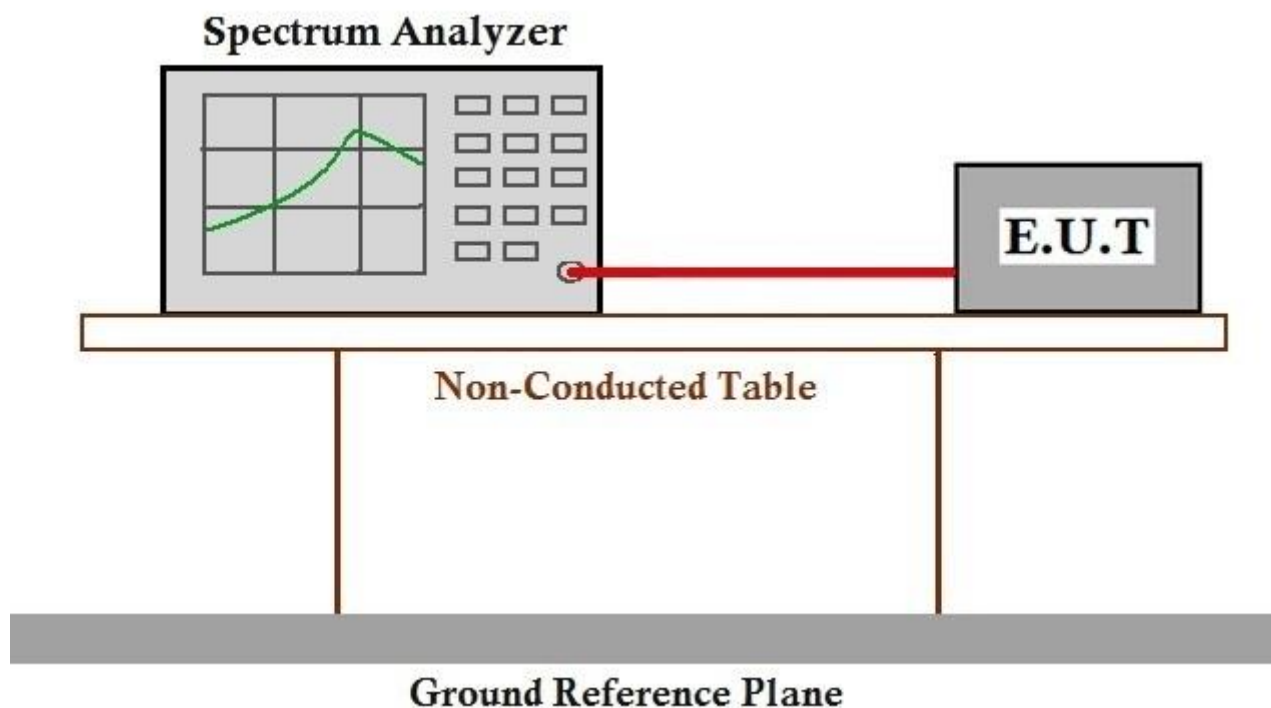
7.6.1 E.U.T. Operation

Operating Environment:

Temperature: 20 °C Humidity: 50 % RH Atmospheric Pressure: 1010 mbar

Test mode a:TX mode_Keep the EUT in charging and continuously transmitting mode with all modulation types. All data rates for each modulation type have been tested and found the data rate @ 1Mbps is the worst case of BLE; Only the data of worst case is recorded

7.6.2 Test Setup Diagram



7.6.3 Measurement Procedure and Data

The detailed test data see: Appendix B for CKSEM1909000508CR

7.7 Radiated Emissions which fall in the restricted bands

Test Requirement 47 CFR Part 15, Subpart C 15.205 & 15.209

Test Method: ANSI C63.10 (2013) Section 6.10.5

Limit:

Frequency(MHz)	Field strength(microvolts/meter)	Measurement distance(meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

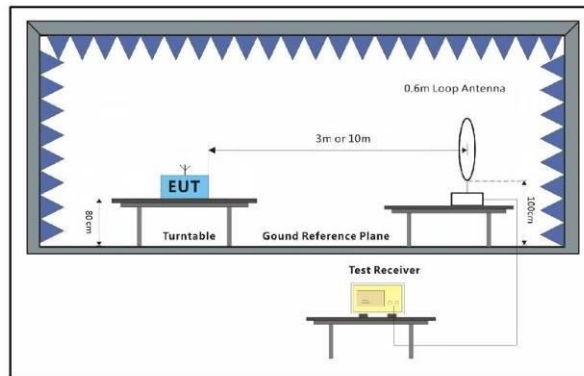
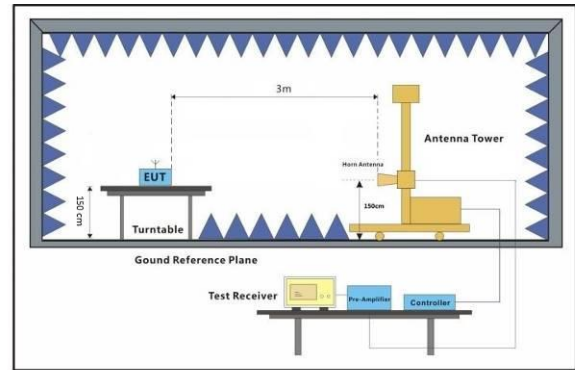
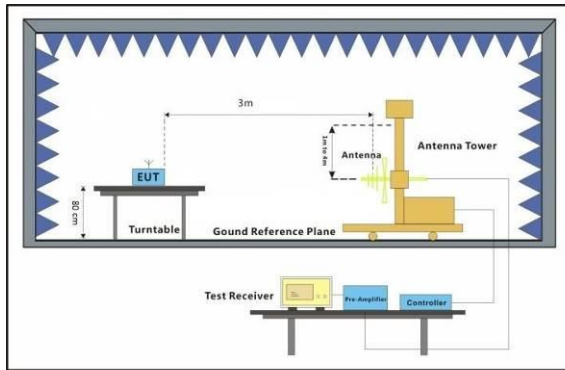
7.7.1 E.U.T. Operation

Operating Environment:

Temperature: 20 °C Humidity: 50 % RH Atmospheric Pressure: 1010 mbar

Test mode a:TX mode_Keep the EUT in charging and continuously transmitting mode with all modulation types. All data rates for each modulation type have been tested and found the data rate @ 1Mbps is the worst case of BLE; Only the data of worst case is recorded

7.7.2 Test Setup Diagram



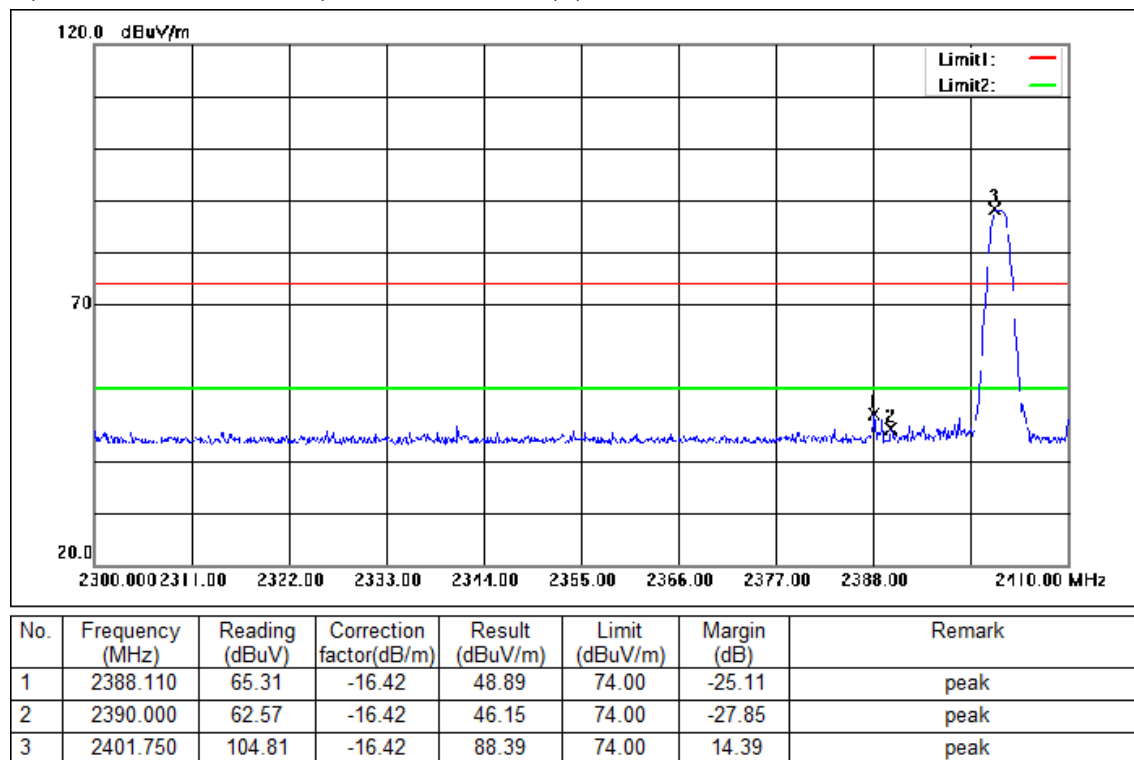
7.7.3 Measurement Procedure and Data

- a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
- h. Test the EUT in the lowest channel, the middle channel, the Highest channel.
- i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
- j. Repeat above procedures until all frequencies measured was complete.

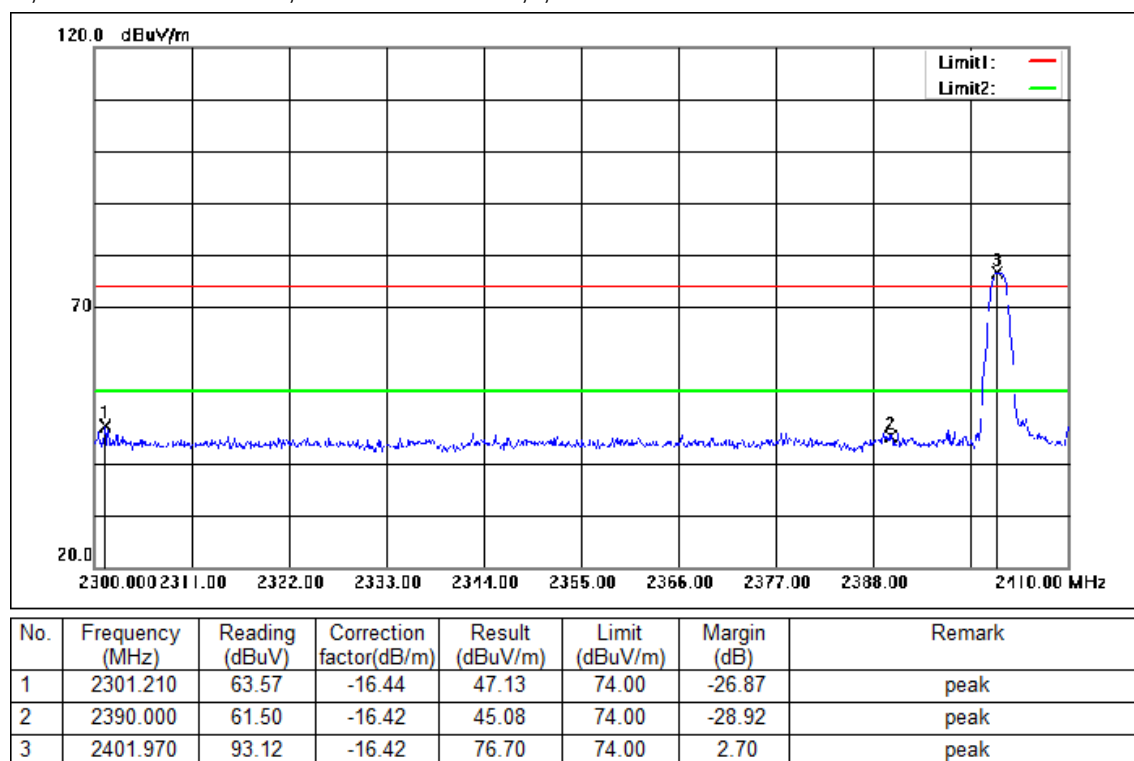
Remark 1: $\text{Level} = \text{Read Level} + \text{Cable Loss} + \text{Antenna Factor} - \text{Preamp Factor}$

Remark 2: For frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown in the report.

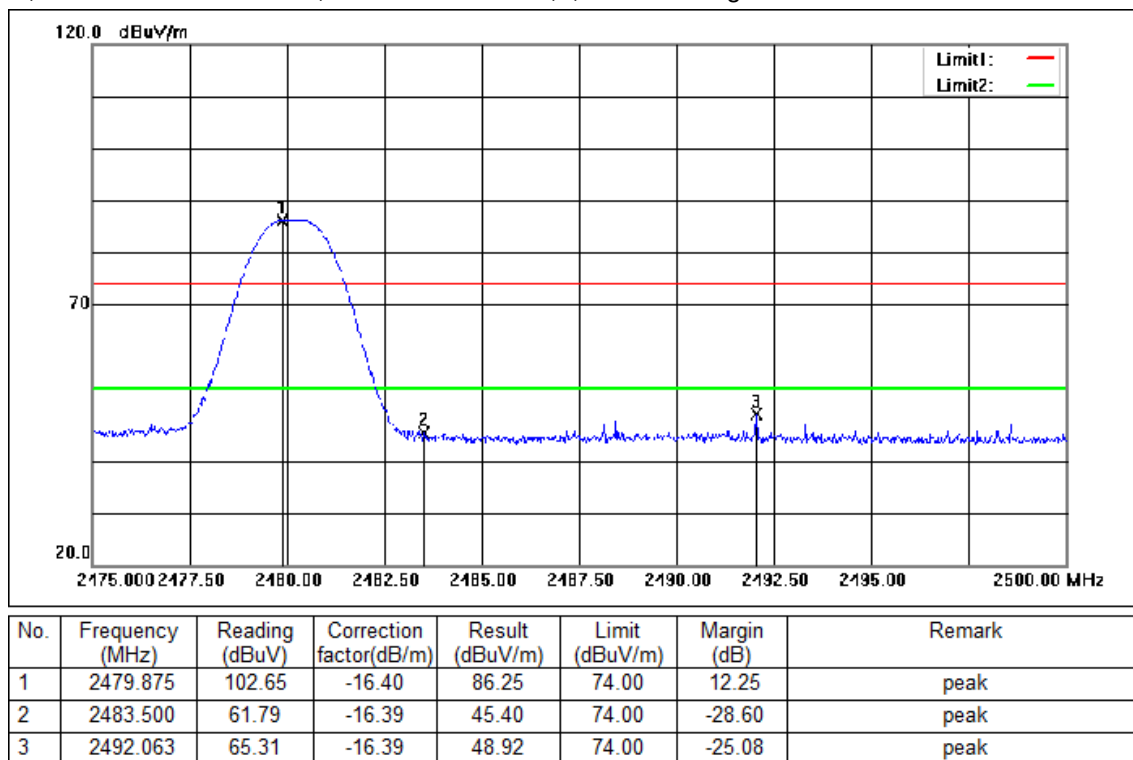
Mode:a; Polarization:Horizontal; Modulation:GFSK; ; Channel:Low



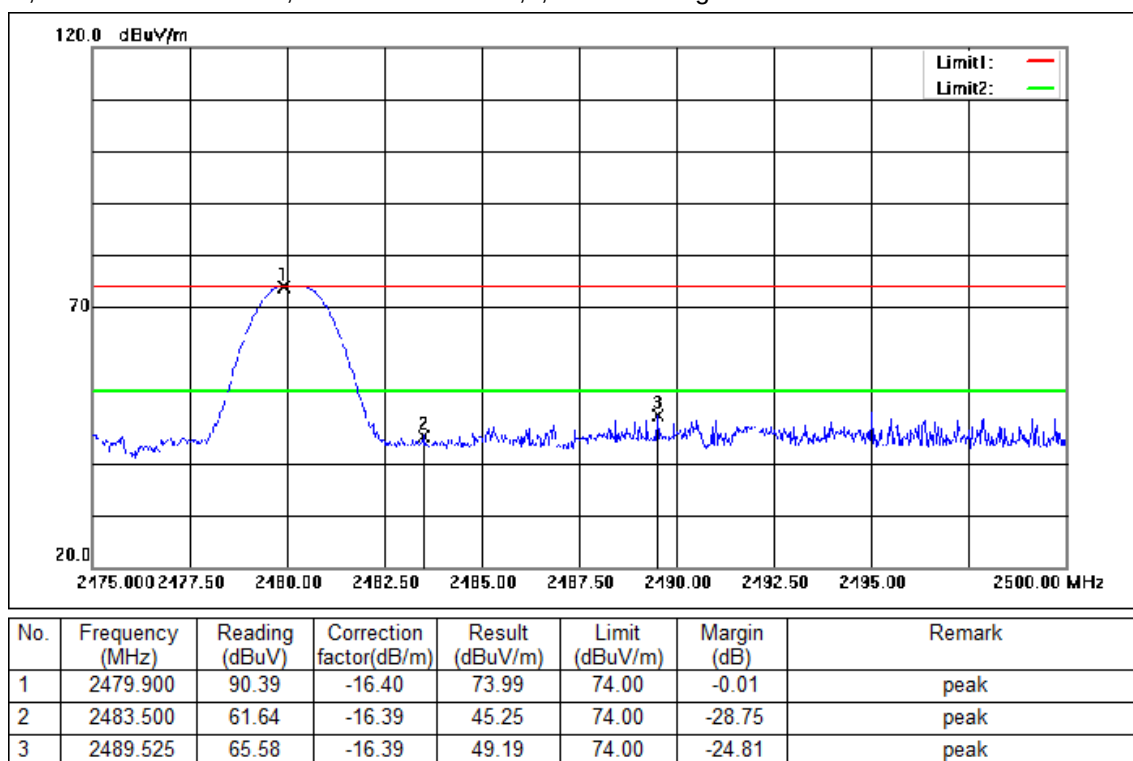
Mode:a; Polarization:Vertical; Modulation:GFSK; ; Channel:Low



Mode:a; Polarization:Horizontal; Modulation:GFSK; ; Channel:High



Mode:a; Polarization:Vertical; Modulation:GFSK; ; Channel:High



7.8 Radiated Spurious Emissions

Test Requirement 47 CFR Part 15, Subpart C 15.205 & 15.209

Test Method: ANSI C63.10 (2013) Section 6.4,6.5,6.6

Limit:

Frequency(MHz)	Field strength(microvolts/meter)	Measurement distance(meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Remark: The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90kHz, 110-490kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation.

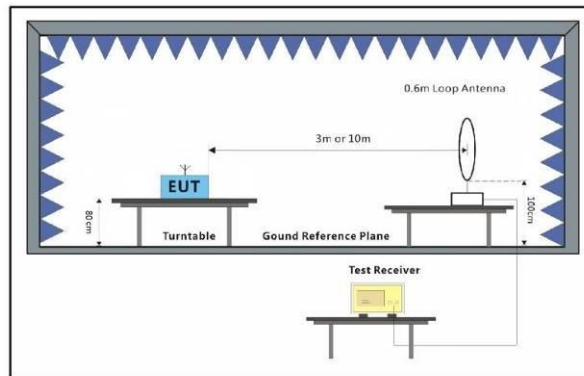
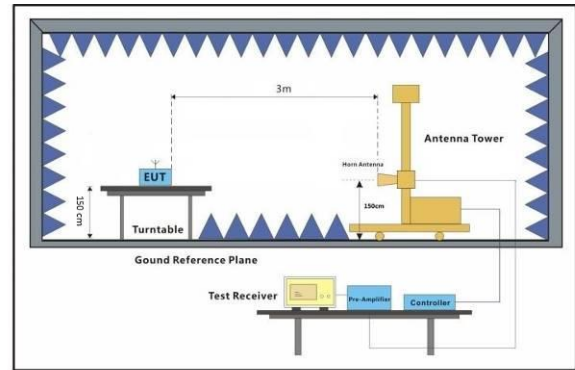
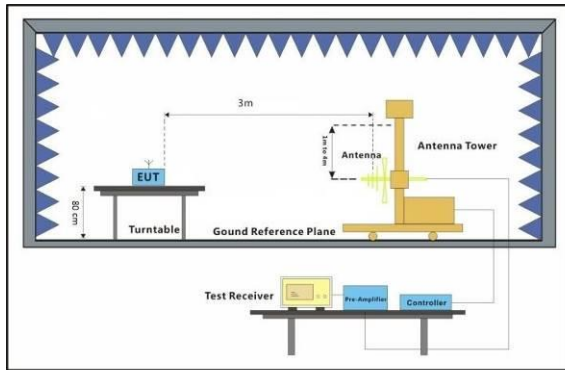
7.8.1 E.U.T. Operation

Operating Environment:

Temperature: 20 °C Humidity: 50 % RH Atmospheric Pressure: 1010 mbar

Test mode a:TX mode_Keep the EUT in charging and continuously transmitting mode with all modulation types. All data rates for each modulation type have been tested and found the data rate @ 1Mbps is the worst case of BLE; Only the data of worst case is recorded

7.8.2 Test Setup Diagram



7.8.3 Measurement Procedure and Data

- a. For below 1GHz, the EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 or 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. For above 1GHz, the EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter fully-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.
- c. The EUT was set 3 or 10 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- d. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- e. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
- f. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
- g. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.
- h. Test the EUT in the lowest channel, the middle channel, the Highest channel.
- i. The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the X axis positioning which it is the worst case.
- j. Repeat above procedures until all frequencies measured was complete.

Remark:

1) For emission below 1GHz, through pre-scan found the worst case is the lowest channel. Only the worst case is recorded in the report.

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

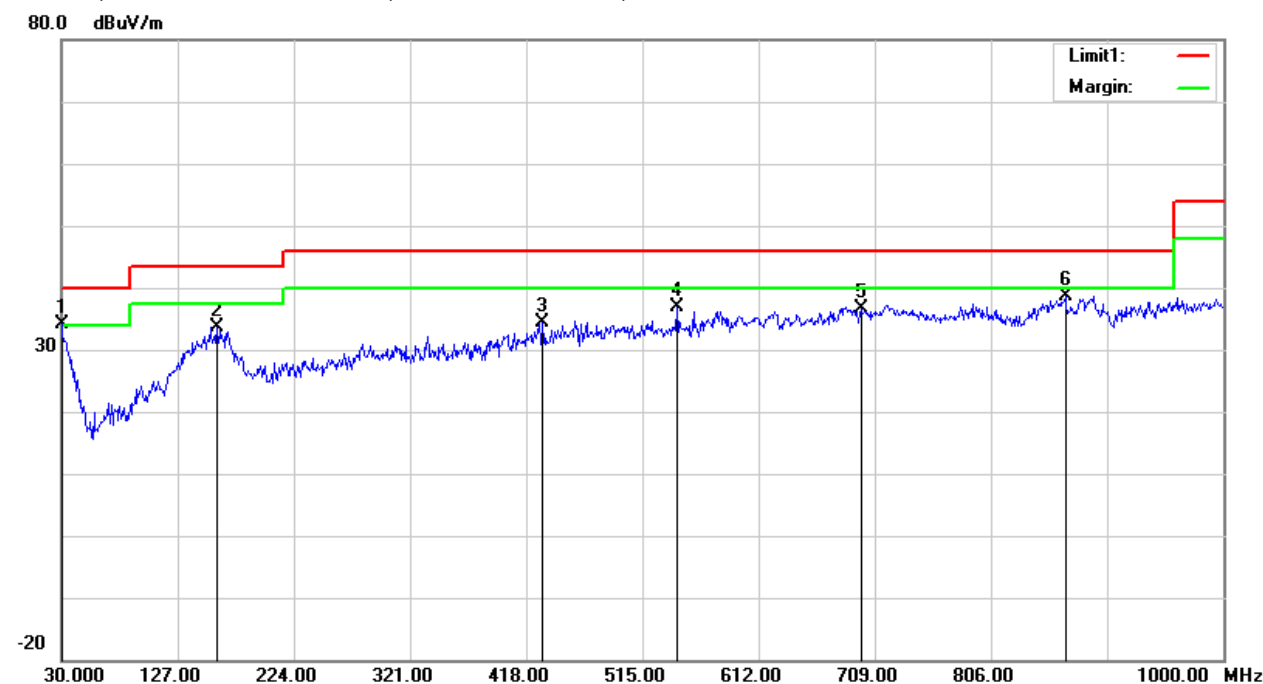
Final Test Level = Receiver Reading + Antenna Factor + Cable Factor – Preamplifier Factor

3) Scan from 9kHz to 25GHz, the disturbance above 18GHz and below 30MHz was very low. The points marked on above plots are the highest emissions could be found when testing, so only above points had been displayed. The amplitude of spurious emissions from the radiator which are attenuated more than 20dB below the limit need not be reported.

4) For frequencies above 1GHz, the field strength limits are based on average limits. However, the peak field strength of any emission shall not exceed the maximum permitted average limits specified above by more than 20 dB under any condition of modulation. For the emissions whose peak level is lower than the average limit, only the peak measurement is shown

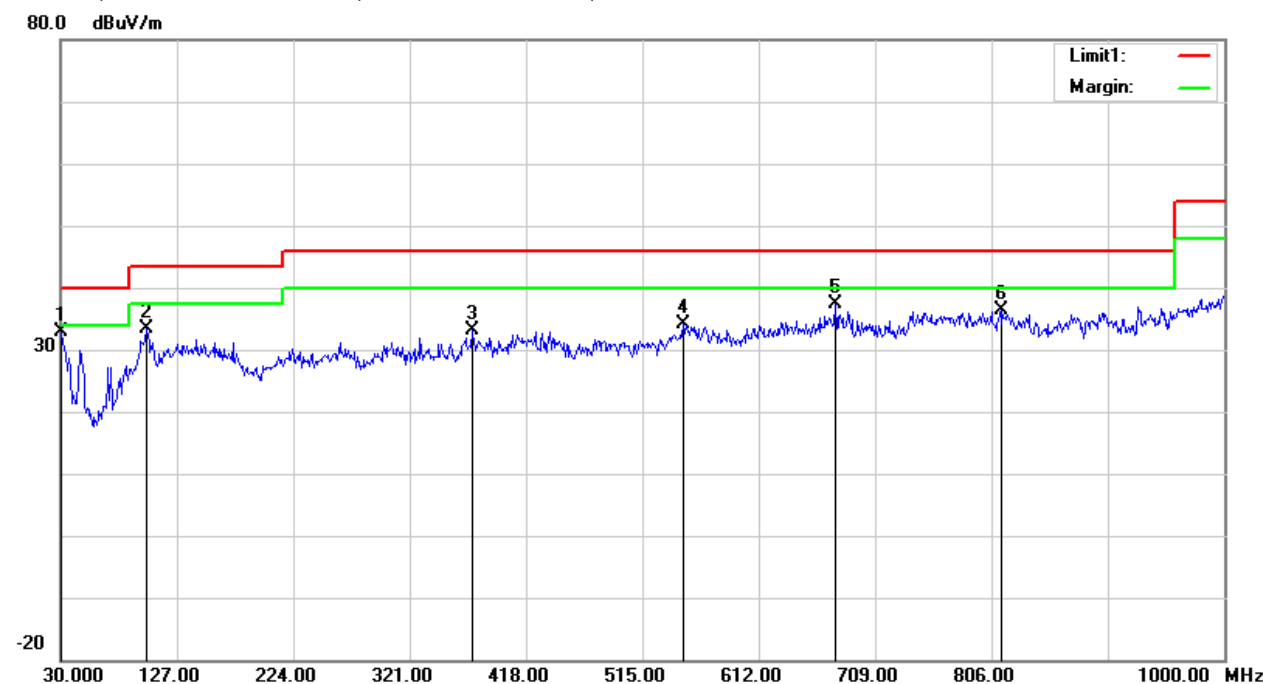
30MHz-1GHz

Mode:a; Polarization:Horizontal; Modulation:GFSK; Channel:Low



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	30.0000	7.87	26.19	34.06	40.00	-5.94	200	82	QP
2	159.9800	14.33	19.32	33.65	43.50	-9.85	200	15	QP
3	431.5800	9.93	24.48	34.41	46.00	-11.59	200	188	QP
4	544.1000	11.17	25.66	36.83	46.00	-9.17	154	360	QP
5	697.3600	9.12	27.44	36.56	46.00	-9.44	400	360	QP
6	868.0800	9.66	28.97	38.63	46.00	-7.37	100	9	QP

Mode:a; Polarization:Vertical; Modulation:GFSK; Channel:Low



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	30.9700	7.38	25.62	33.00	40.00	-7.00	400	360	QP
2	101.7800	14.71	18.61	33.32	43.50	-10.18	200	329	QP
3	373.3800	9.71	23.32	33.03	46.00	-12.97	200	220	QP
4	548.9500	8.33	25.73	34.06	46.00	-11.94	301	82	QP
5	676.0200	10.07	27.20	37.27	46.00	-8.73	400	360	QP
6	813.7600	7.63	28.77	36.40	46.00	-9.60	200	59	QP

Above 1GHz

Mode:a; Polarization:Horizontal; Modulation:GFSK ; Channel:Low

Frequency MHz	RX_R dBuV	Factor dB	Emission dBuV/m	Limit dBuV/m	Over Limit dB	Detector
4804	40.18	6.18	46.36	54	-7.64	peak
7206	35.27	10.63	45.9	54	-8.1	peak
9608	37.5	14.38	51.88	54	-2.12	peak

Mode:a; Polarization:Vertical; Modulation:GFSK ; Channel:Low

Frequency MHz	RX_R dBuV	Factor dB	Emission dBuV/m	Limit dBuV/m	Over Limit dB	Detector
4804	36.29	6.18	42.47	54	-11.53	peak
7206	33.83	10.63	44.46	54	-9.54	peak
9608	37.56	14.38	51.94	54	-2.06	peak

Mode:a; Polarization:Horizontal; Modulation:GFSK ; Channel:middle

Frequency MHz	RX_R dBuV	Factor dB	Emission dBuV/m	Limit dBuV/m	Over Limit dB	Detector
4880	35.46	6.97	42.43	54	-11.57	peak
7320	34.84	11.12	45.96	54	-8.04	peak
9760	35	14.35	49.35	54	-4.65	peak

Mode:a; Polarization:Vertical; Modulation:GFSK ; Channel:middle

Frequency MHz	RX_R dBuV	Factor dB	Emission dBuV/m	Limit dBuV/m	Over Limit dB	Detector
4880	34.51	6.97	41.48	54	-12.52	peak
7320	35.56	11.12	46.68	54	-7.32	peak
9760	34.27	14.35	48.62	54	-5.38	peak

Mode:a; Polarization:Horizontal; Modulation:GFSK ; Channel:High

Frequency MHz	RX_R dBuV	Factor dB	Emission dBuV/m	Limit dBuV/m	Over Limit dB	Detector
4960	41.19	7.49	48.68	54	-5.32	peak
7440	34.66	11.65	46.31	54	-7.69	peak
9920	36.88	14.4	51.28	54	-2.72	peak

Mode:a; Polarization:Vertical; Modulation:GFSK ; Channel:High

Frequency MHz	RX_R dBuV	Factor dB	Emission dBuV/m	Limit dBuV/m	Over Limit dB	Detector
4960	38.28	7.49	45.77	54	-8.23	peak
7440	35.15	11.65	46.8	54	-7.2	peak
9920	36.19	14.4	50.59	54	-3.41	peak

8 Test Setup Photographs

Refer to the < Test Setup photos >.

9 EUT Constructional Details

Refer to the < External Photos > & < Internal Photos >.

- End of the Report -