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Report No.: SZEM170901018804  
Page: 1 of 34

# TEST REPORT

**Application No.:** SZEM1709010188CR (SHEM1709006020CR)  
**Applicant:** Lenbrook Industries Limited  
**Address of Applicant:** 633 Granite Court, Pickering Ontario L1W 3K1, Canada  
**Manufacturer:** Lenbrook Industries Limited  
**Address of Manufacturer:** 633 Granite Court, Pickering Ontario L1W 3K1, Canada  
**Factory:** Hansong (Nanjing) Technology Ltd.  
**Address of Factory:** 8th Kangping Road, Jiangning Economy and Technology Development Zone, Nanjing, 211106, China  
**FCC ID:** SVC-NADD3020V2  
**IC:** 152C-NADD3020V2  
**Equipment Under Test (EUT):**  
**EUT Name:** Hybrid Digital Amplifier  
**Model No.:** D3020  
**Trade mark:** NAD  
**Standards:** 47 CFR Part 15, Subpart C 15.247  
 RSS-247 Issue 2 February 2017, RSS-Gen Issue-4 November 2014  
**Date of Receipt:** 2017-09-08  
**Date of Test:** 2017-09-21 to 2017-10-28  
**Date of Issue:** 2017-11-23

<b>Test Result :</b>	<b>Pass*</b>
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\* In the configuration tested, the EUT complied with the standards specified above.



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.

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<b>Revision Record</b>				
<b>Version</b>	<b>Chapter</b>	<b>Date</b>	<b>Modifier</b>	<b>Remark</b>
00	/	2017-11-23	/	Original

<b>Authorized for issue by:</b>			
<b>Tested By</b>		<i>Foray Chen</i>	2017-10-31
		_____ Foray Chen /Project Engineer	_____ Date
<b>Checked By</b>		<i>Eric Fu</i>	2017-11-23
		_____ Eric Fu /Reviewer	_____ Date



## 2 Test Summary

Radio Spectrum Technical Requirement				
Item	Standard	Method	Requirement	Result
Antenna Requirement	47 CFR Part 15, Subpart C 15.247	N/A	47 CFR Part 15, Subpart C 15.203 & 15.247(c)	Pass

Radio Spectrum Matter Part				
Item	Standard	Method	Requirement	Result
Conducted Emissions at AC Power Line (150kHz-30MHz)	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 6.2	47 CFR Part 15, Subpart C 15.207	Pass
Minimum 6dB Bandwidth	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 11.8.1	47 CFR Part 15, Subpart C 15.247a(2)	Pass
Conducted Peak Output Power	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 11.9.1	47 CFR Part 15, Subpart C 15.247(b)(3)	Pass
Power Spectrum Density	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 11.10.2	47 CFR Part 15, Subpart C 15.247(e)	Pass
Conducted Band Edges Measurement	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 11.13.3.2	47 CFR Part 15, Subpart C 15.247(d)	Pass
Conducted Spurious Emissions	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 11.11	47 CFR Part 15, Subpart C 15.247(d)	Pass
Radiated Emissions which fall in the restricted bands	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 6.10.5	47 CFR Part 15, Subpart C 15.205 & 15.209	Pass
Radiated Spurious Emissions	47 CFR Part 15, Subpart C 15.247	ANSI C63.10 (2013) Section 6.4,6.5,6.6	47 CFR Part 15, Subpart C 15.205 & 15.209	Pass
99% Bandwidth	RSS-247 Issue 2, February 2017	ANSI C63.10 Section 6.9.3	RSS-Gen Section 6.6	Pass



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## 4 General Information

### 4.1 Details of E.U.T.

Power supply:	AC 100-240V, 50/60Hz 50W
Test voltage:	AC 120V, 60Hz
Cable:	AC cable: 170cm

### 4.1 Technical Specifications

Operation Frequency:	2402MHz-2480MHz
Modulation Type:	GFSK
Bluetooth version:	4.0 LE
Number of Channel:	40
Antenna Type:	PCB
Antenna Gain:	2 dBi

### 4.2 Description of Support Units

The EUT has been tested with associated equipment below.			
Description	Manufacturer	Model No.	Supply by
Laptop 1	LENOVO	R400	SGS

### 4.3 Measurement Uncertainty

No.	Item	Measurement Uncertainty
1	Radio Frequency	7.25 x 10 <sup>-8</sup>
2	Timeout	2s
3	Duty cycle	0.37%
4	Occupied Bandwidth	3%
5	RF conducted power	0.75dB
6	RF power density	2.84dB
7	Conducted Spurious emissions	0.75dB
8	RF Radiated power	4.5dB (below 1GHz)
		4.8dB (above 1GHz)
9	Radiated Spurious emission test	4.5dB (30MHz-1GHz)
		4.8dB (1GHz-18GHz)
10	Temperature test	1°C
11	Humidity test	3%
12	Supply voltages	1.5%
13	Time	3%



#### 4.4 Standards Applicable for Testing

**Table 1 : Tests Carried Out Under 47 CFR Part 15, Subpart C 15.247**

<b>Item</b>	<b>Status</b>
Antenna Requirement	√
Conducted Emissions at AC Power Line (150kHz-30MHz)	√
Minimum 6dB Bandwidth	√
Conducted Peak Output Power	√
20dB Bandwidth	×
Carrier Frequencies Separation	×
Hopping Channel Number	×
Dwell Time	×
Power Spectrum Density	√
Conducted Band Edges Measurement	√
Conducted Spurious Emissions	√
Radiated Emissions which fall in the restricted bands	√
Radiated Spurious Emissions	√
Other requirements Frequency Hopping Spread Spectrum System Hopping Sequence	×
99% Bandwidth	√

- × Indicates that the test is not applicable  
√ Indicates that the test is applicable



#### **4.5 Test Location**

All tests were performed at:

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

No. 1 Workshop, M-10, Middle Section, Science & Technology Park, Shenzhen, Guangdong, China.  
518057.

Tel: +86 755 2601 2053 Fax: +86 755 2671 0594

No tests were sub-contracted.

#### **4.6 Test Facility**

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

- **CNAS (No. CNAS L2929)**

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

- **A2LA (Certificate No. 3816.01)**

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

- **VCCI**

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

- **FCC –Designation Number: CN1178**

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been recognized as an accredited testing laboratory.

Designation Number: CN1178. Test Firm Registration Number: 406779.

- **Industry Canada (IC)**

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

#### **4.7 Deviation from Standards**

None

#### **4.8 Abnormalities from Standard Conditions**

None





## 5 Equipment List

Equipment	Manufacturer	Model No	Inventory No	Cal Date	Cal Due Date
<b>Conducted Emission at AC Power Line</b>					
EMI test receiver	R&S	ESR7	SHEM162-1	2016-12-29	2017-12-28
LISN	Schwarzbeck	NSLK8127	SHEM061-1	2016-12-29	2017-12-28
LISN	EMCO	3816/2	SHEM019-1	2016-12-29	2017-12-28
Pulse limiter	R&S	ESH3-Z2	SHEM029-1	2017-08-12	2018-08-11
CE test Cable	/	CE01	/	2016-12-29	2017-12-28
<b>Conducted Test</b>					
Spectrum Analyzer	R&S	FSP-30	SHEM002-1	2017-04-24	2018-04-23
Spectrum Analyzer	Agilent	N9020A	SHEM181-1	2017-07-03	2018-07-02
Power meter	R&S	NRP	SHEM057-1	2016-12-29	2017-12-28
Power Sensor	R&S	NRP-Z22	SHEM136-1	2017-07-22	2018-07-21
Power Sensor	R&S	NRP-Z91	SHEM057-2	2016-12-29	2017-12-28
Signal Generator	R&S	SMR40	SHEM058-1	2017-07-03	2018-07-02
Signal Generator	Agilent	N5182A	SHEM182-1	2017-07-03	2018-07-02
Communication Tester	R&S	CMW500	SHEM183-1	2017-07-03	2018-07-02
Switcher	Tonscend	JS0806	SHEM184-1	/	/
Splitter	Anritsu	MA1612A	SHEM185-1	/	/
Coupler	e-meca	803-S-1	SHEM186-1	/	/
High-low Temp Cabinet	Suzhou Zhihe	TL-40	SHEM087-1	2017-09-13	2018-09-12
AC Power Stabilizer	WOCEN	6100	SHEM045-1	2017-01-14	2018-01-13
DC Power Supply	QJE	QJ30003SII	SHEM046-1	2017-01-14	2018-01-13
<b>Radiated Test</b>					
EMI test receiver	R&S	ESU40	SHEM051-1	2017-09-26	2018-09-25
Spectrum Analyzer	R&S	FSP-30	SHEM002-1	2017-04-24	2018-04-23
Loop Antenna (9kHz-30MHz)	Schwarzbeck	FMZB1519	SHEM135-1	2017-04-10	2018-04-09
Antenna (25MHz-2GHz)	Schwarzbeck	VULB9168	SHEM048-1	2017-02-28	2018-02-27
Antenna (25MHz-3GHz)	Schwarzbeck	HL562	SHEM010-1	2017-02-28	2018-02-27
Horn Antenna (1-8GHz)	Schwarzbeck	HF906	SHEM009-1	2016-09-24	2018-09-23
Horn Antenna (1-18GHz)	Schwarzbeck	BBHA9120D	SHEM050-1	2017-01-14	2018-01-13
Horn Antenna (14-40GHz)	Schwarzbeck	BBHA 9170	SHEM049-1	2017-02-13	2018-01-15
Pre-amplifier (9KHz-2GHz)	CLAVIIO	BDLNA-0001-412010	SHEM164-1	2017-08-22	2018-08-21
Pre-amplifier (1-26.5GHz)	CLAVIIO	BDLNA-0118-352810	SHEM050-2	2017-08-22	2018-08-21
Band filter	LORCH	9BRX-875/X150-SR	SHEM156-1	/	/
Band filter	LORCH	13BRX-1950/X500-SR	SHEM083-2	/	/
Band filter	LORCH	5BRX-2400/X200-SR	SHEM155-1	/	/
Band filter	LORCH	5BRX-5500/X1000-SR	SHEM157-2	/	/
High pass Filter	Wainwright	WHK3.0/18G-100SS	SHEM157-1	/	/
High pass Filter	Wainwright	WHKS1700-3SS	SHEM157-3	/	/
Semi/Fully Anechoic	ST	11*6*6M	SHEM078-2	2017-07-22	2018-07-21
RE test Cable	/	RE01, RE02, RE06	/	2016-12-29	2017-12-28

## 6 Radio Spectrum Technical Requirement

### 6.1 Antenna Requirement

#### 6.1.1 Test Requirement:

47 CFR Part 15, Subpart C 15.247

#### 6.1.2 Conclusion

Standard Requirement:

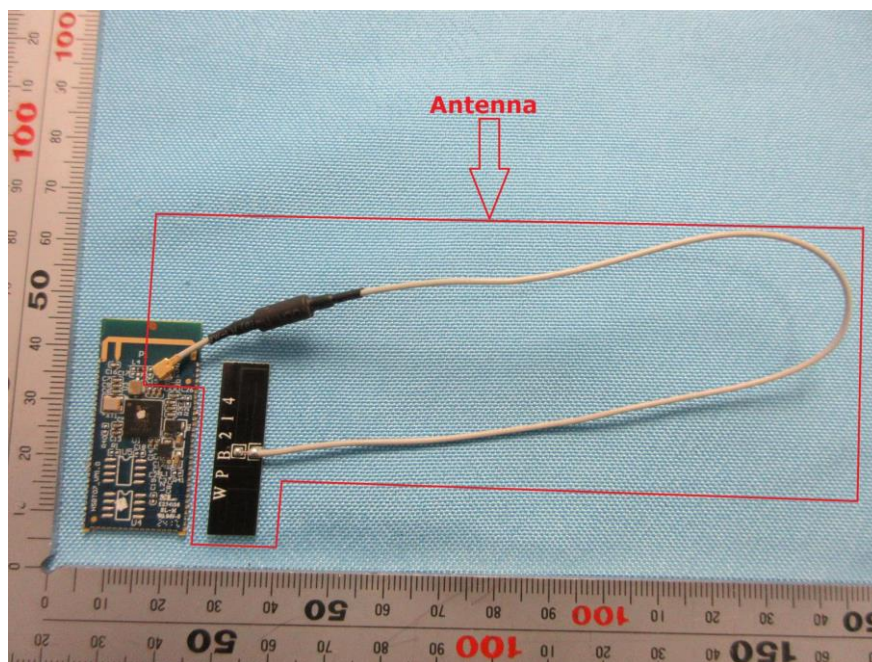
An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit 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 type is PCB and buckle the antenna connector on RF module and no consideration of replacement. The best case gain of the antenna is 2dBi.



## 7 Radio Spectrum Matter Test Results

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

Test Requirement: 47 CFR Part 15, Subpart C 15.247  
 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.

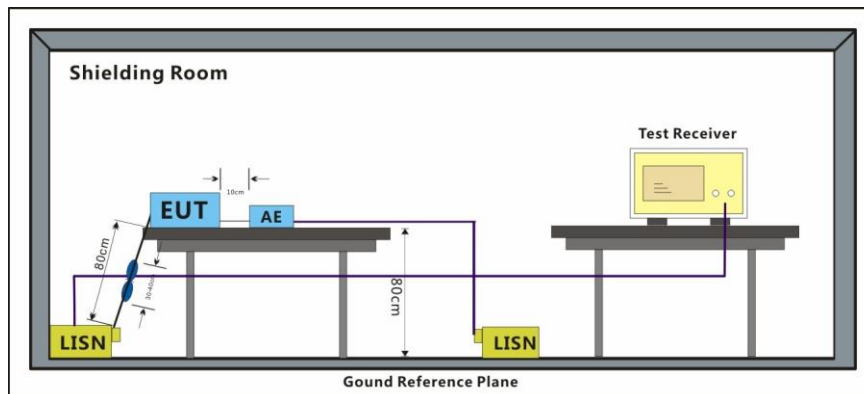
#### 7.1.1 E.U.T. Operation

Operating Environment:

Temperature: 22 °C Humidity: 50 % RH Atmospheric Pressure: 1005 mbar

Test mode a:Engineering Mode: Using test software to control EUT working in continuous transmitting and receiving, and select channel and modulation type.

#### 7.1.2 Test Setup Diagram



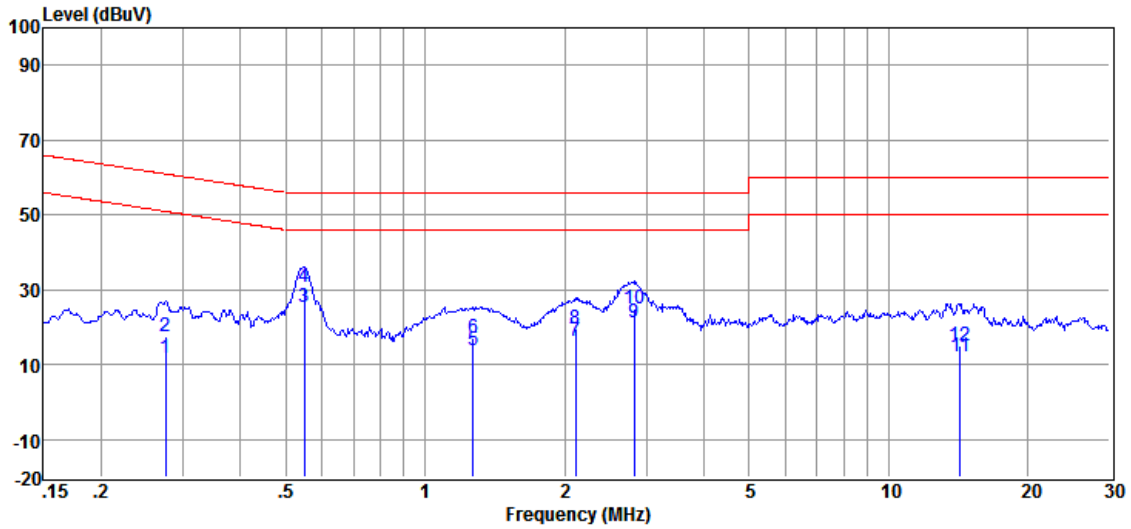


### **7.1.3 Measurement Data**

- 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 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.
- 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.



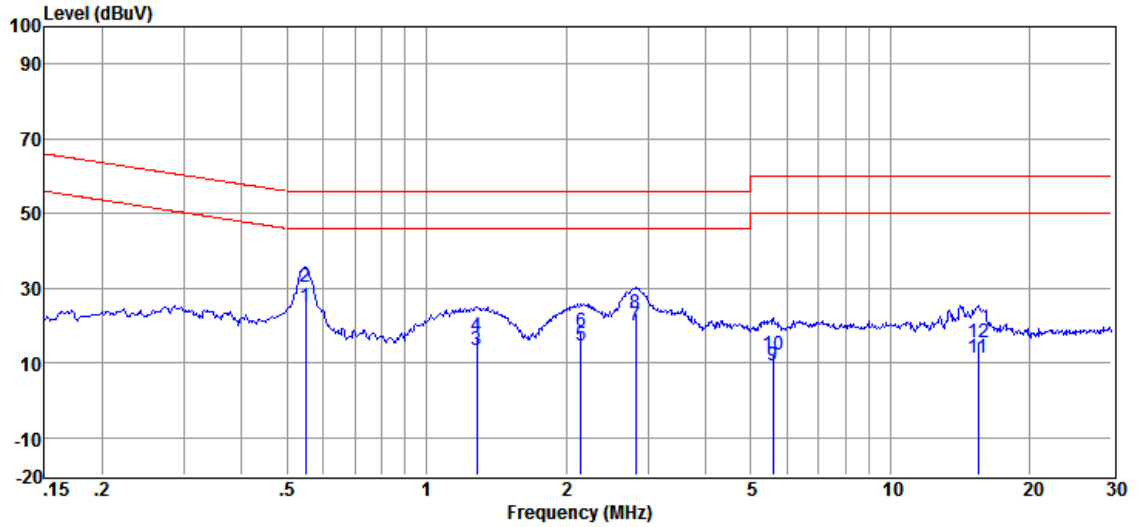
Live Line:



Item	Freq.	Read Level	LISN Factor	Cable Loss	Level	Limit Line	Over Limit	Detector
(Mark)	(MHz)	(dB $\mu$ V)	(dB)	(dB)	(dB $\mu$ V)	(dB $\mu$ V)	(dB)	
1	0.276	1.70	0.11	9.81	11.62	50.94	-39.32	Average
2	0.276	7.49	0.11	9.81	17.41	60.94	-43.53	QP
3	0.549	15.32	0.11	9.82	25.25	46.00	-20.75	Average
4	0.549	20.60	0.11	9.82	30.53	56.00	-25.47	QP
5	1.269	4.05	0.11	9.84	14.00	46.00	-32.00	Average
6	1.269	7.18	0.11	9.84	17.13	56.00	-38.87	QP
7	2.110	6.24	0.12	9.85	16.21	46.00	-29.79	Average
8	2.110	9.58	0.12	9.85	19.55	56.00	-36.45	QP
9	2.824	11.40	0.12	9.85	21.37	46.00	-24.63	Average
10	2.824	14.80	0.12	9.85	24.77	56.00	-31.23	QP
11	14.288	1.88	0.14	10.00	12.02	50.00	-37.98	Average
12	14.288	5.04	0.14	10.00	15.18	60.00	-44.82	QP



Neutral Line:



Item	Freq.	Read Level	LISN Factor	Cable Loss	Level	Limit Line	Over Limit	Detector
(Mark)	(MHz)	(dBμV)	(dB)	(dB)	(dBμV)	(dBμV)	(dB)	
1	0.549	15.06	0.11	9.82	24.99	46.00	-21.01	Average
2	0.549	20.38	0.11	9.82	30.31	56.00	-25.69	QP
3	1.282	3.57	0.11	9.84	13.52	46.00	-32.48	Average
4	1.282	6.96	0.11	9.84	16.91	56.00	-39.09	QP
5	2.155	4.66	0.12	9.85	14.63	46.00	-31.37	Average
6	2.155	8.45	0.12	9.85	18.42	56.00	-37.58	QP
7	2.824	10.14	0.13	9.85	20.12	46.00	-25.88	Average
8	2.824	13.30	0.13	9.85	23.28	56.00	-32.72	QP
9	5.594	-0.75	0.13	9.86	9.24	50.00	-40.76	Average
10	5.594	2.04	0.13	9.86	12.03	60.00	-47.97	QP
11	15.470	1.13	0.17	10.02	11.32	50.00	-38.68	Average
12	15.470	5.24	0.17	10.02	15.43	60.00	-44.57	QP

Level = Read Level + LISN/ISN Factor + Cable Loss



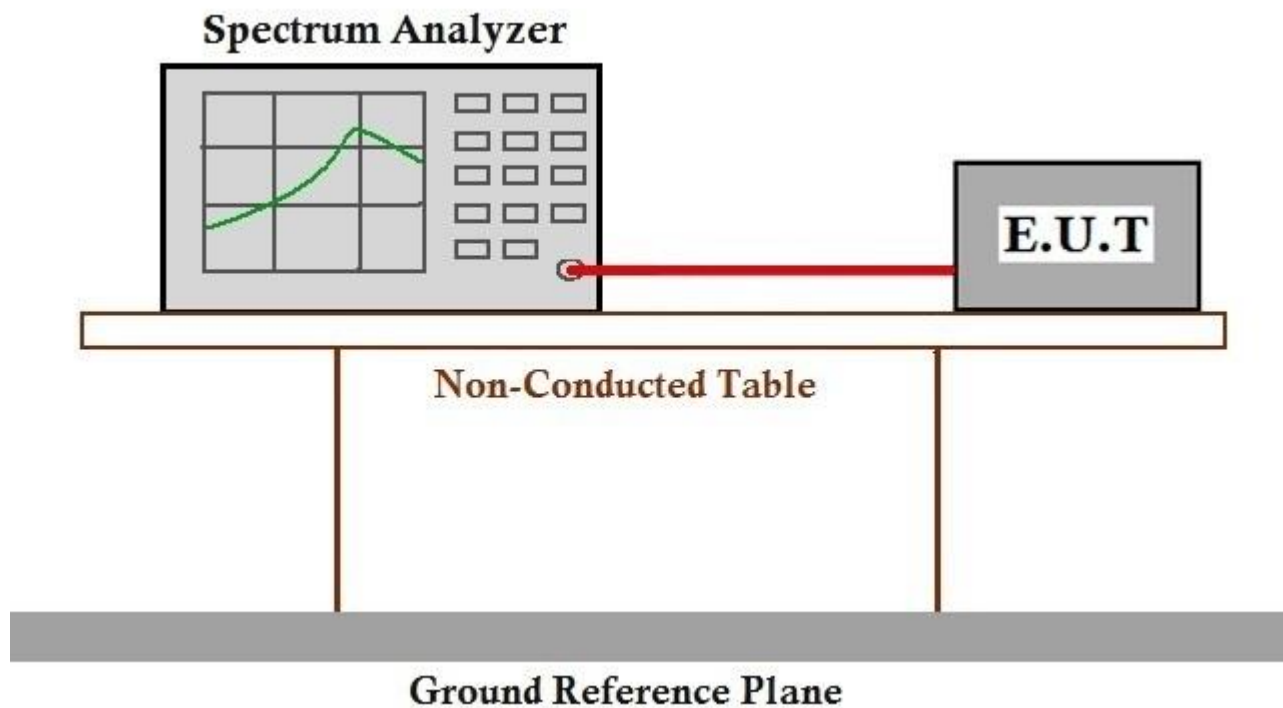
**7.2 Minimum 6dB Bandwidth**

Test Requirement: 47 CFR Part 15, Subpart C 15.247  
 Test Method: ANSI C63.10 (2013) Section 11.8.1  
 Measurement Distance: 3m  
 Limit:  $\geq 500$  kHz

**7.2.1 E.U.T. Operation**

Operating Environment:  
 Temperature: 21 °C Humidity: 45 % RH Atmospheric Pressure: 1010 mbar  
 Test mode a:Engineering Mode: Using test software to control EUT working in continuous transmitting and receiving, and select channel and modulation type.

**7.2.2 Test Setup Diagram**



**7.2.3 Measurement Data**

The detailed test data see: Appendix 15.247-BLE

### 7.3 Conducted Peak Output Power

Test Requirement: 47 CFR Part 15, Subpart C 15.247  
 Test Method: ANSI C63.10 (2013) Section 11.9.1  
 Measurement Distance: 3m  
 Limit:

Frequency range(MHz)	Output power of the intentional radiator(watt)
902-928	1 for $\geq 50$ hopping channels
	0.25 for $< 50$ hopping channels
	1 for digital modulation
2400-2483.5	1 for $\geq 75$ 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

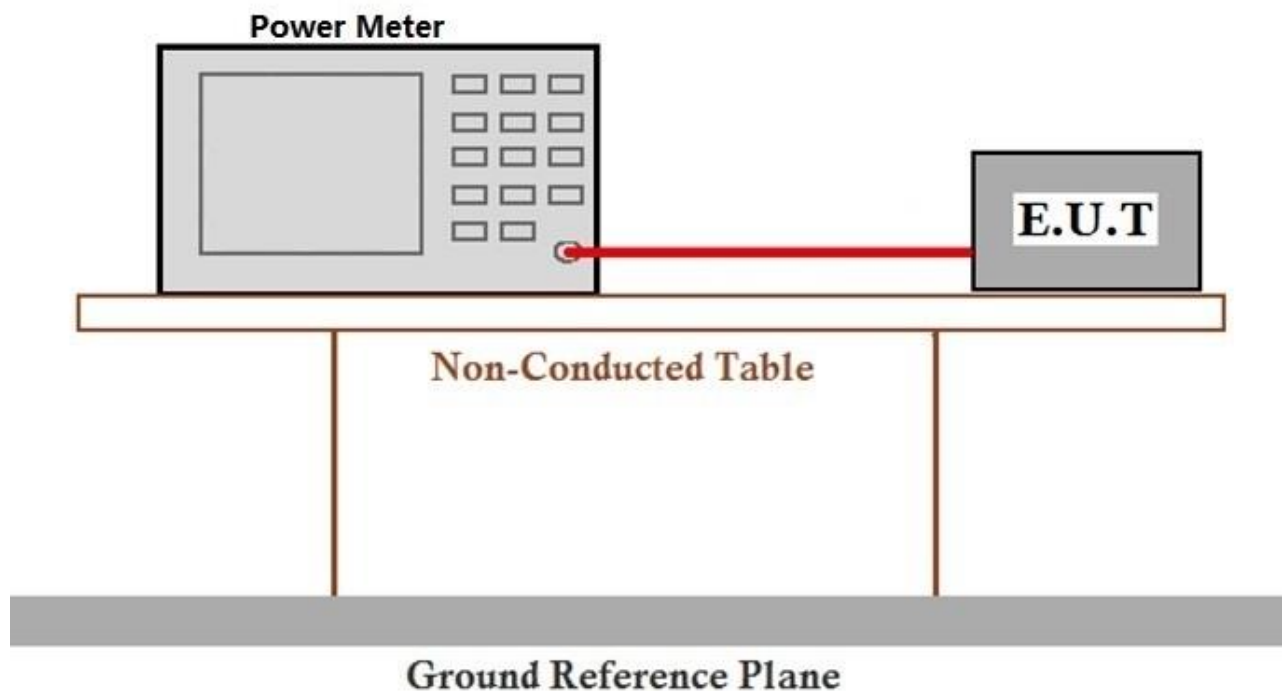
#### 7.3.1 E.U.T. Operation

Operating Environment:

Temperature: 21 °C Humidity: 45 % RH Atmospheric Pressure: 1010 mbar

Test mode a: Engineering Mode: Using test software to control EUT working in continuous transmitting and receiving, and select channel and modulation type.

#### 7.3.2 Test Setup Diagram



#### 7.3.3 Measurement Data

The detailed test data see: Appendix 15.247-BLE



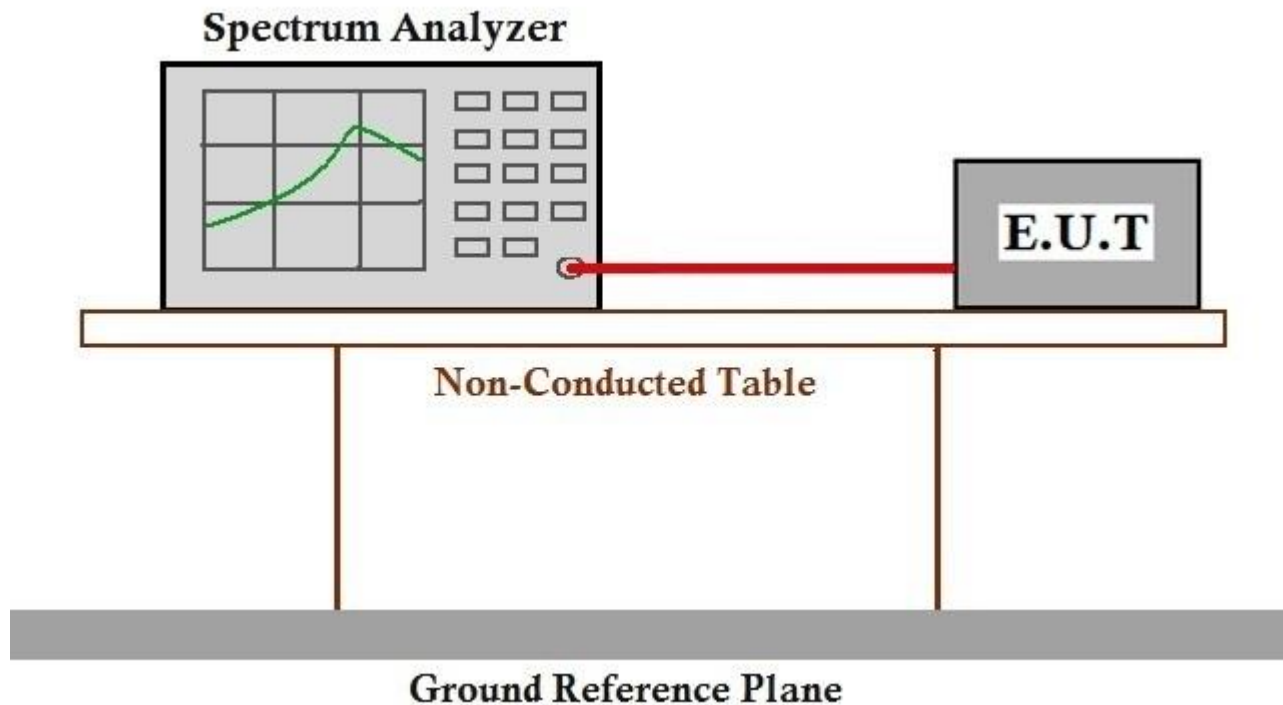
### 7.4 Power Spectrum Density

Test Requirement: 47 CFR Part 15, Subpart C 15.247  
 Test Method: ANSI C63.10 (2013) Section 11.10.2  
 Measurement Distance: 3m  
 Limit:  $\leq 8\text{dBm}$  in any 3 kHz band during any time interval of continuous transmission

#### 7.4.1 E.U.T. Operation

Operating Environment:  
 Temperature: 21 °C Humidity: 45 % RH Atmospheric Pressure: 1010 mbar  
 Test mode a: Engineering Mode: Using test software to control EUT working in continuous transmitting and receiving, and select channel and modulation type.

#### 7.4.2 Test Setup Diagram



#### 7.4.3 Measurement Data

The detailed test data see: Appendix 15.247-BLE

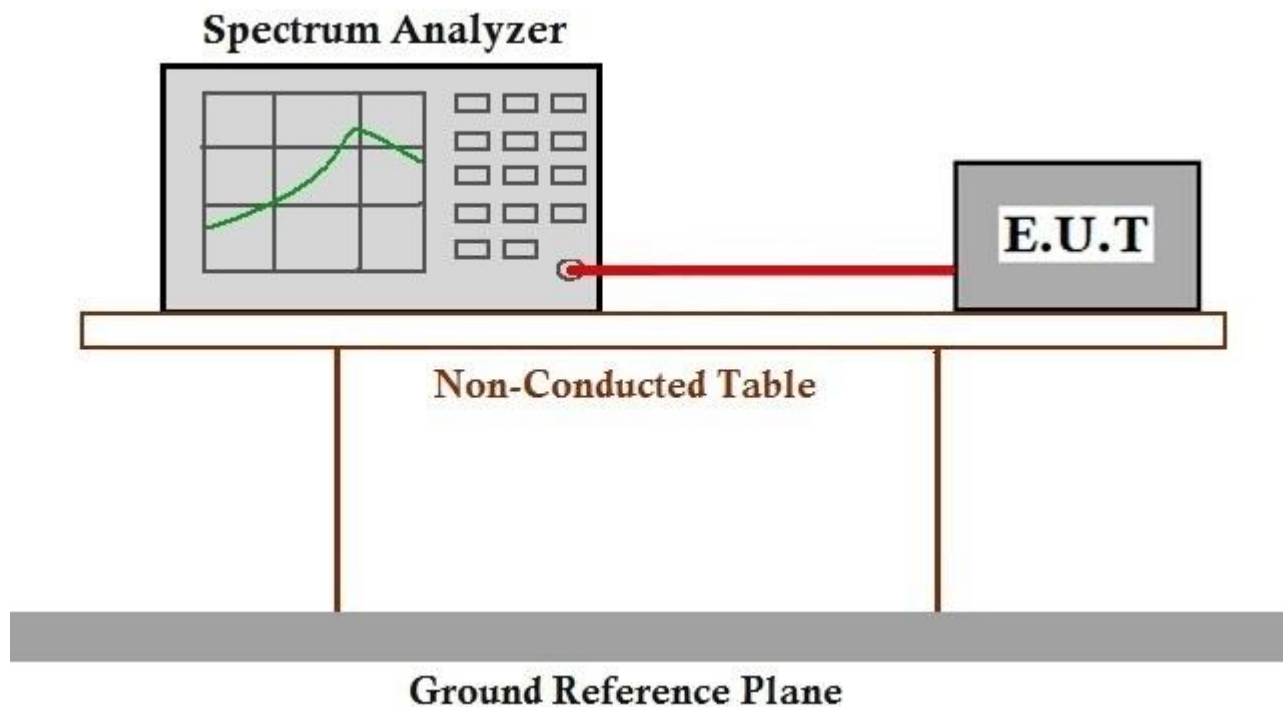
## 7.5 Conducted Band Edges Measurement

Test Requirement:	47 CFR Part 15, Subpart C 15.247
Test Method:	ANSI C63.10 (2013) Section 11.13.3.2
Measurement Distance:	3m
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 transmi

### 7.5.1 E.U.T. Operation

Operating Environment:	
Temperature:	21 °C Humidity: 45 % RH Atmospheric Pressure: 1010 mbar
Test mode	a:Engineering Mode: Using test software to control EUT working in continuous transmitting and receiving, and select channel and modulation type.

### 7.5.2 Test Setup Diagram



### 7.5.3 Measurement Data

The detailed test data see: Appendix 15.247

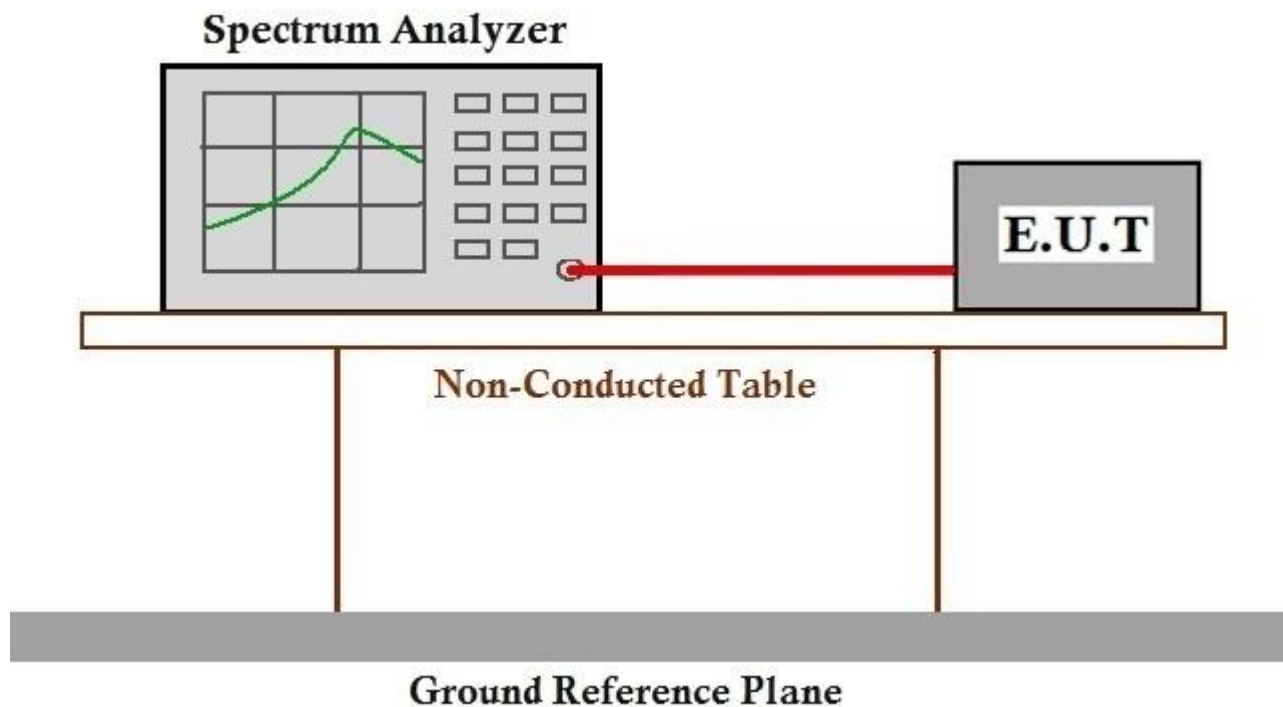
## 7.6 Conducted Spurious Emissions

Test Requirement: 47 CFR Part 15, Subpart C 15.247  
 Test Method: ANSI C63.10 (2013) Section 11.11  
 Measurement Distance: 3m  
 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 transmi

### 7.6.1 E.U.T. Operation

Operating Environment:  
 Temperature: 21 °C Humidity: 45 % RH Atmospheric Pressure: 1010 mbar  
 Test mode a:Engineering Mode: Using test software to control EUT working in continuous transmitting and receiving, and select channel and modulation type.

### 7.6.2 Test Setup Diagram



### 7.6.3 Measurement Data

The detailed test data see: Appendix 15.247-BLE



**7.7 Radiated Emissions which fall in the restricted bands**

Test Requirement: 47 CFR Part 15, Subpart C 15.247  
 Test Method: ANSI C63.10 (2013) Section 6.10.5  
 Measurement Distance: 3m  
 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.

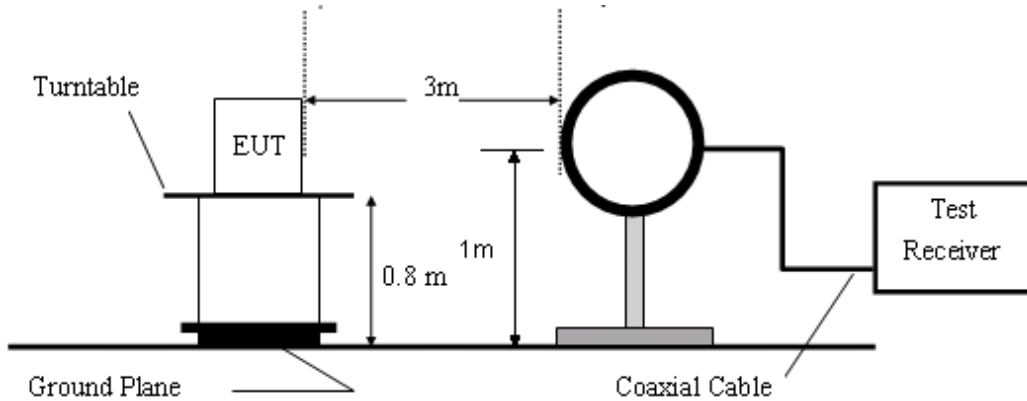
**7.7.1 E.U.T. Operation**

Operating Environment:

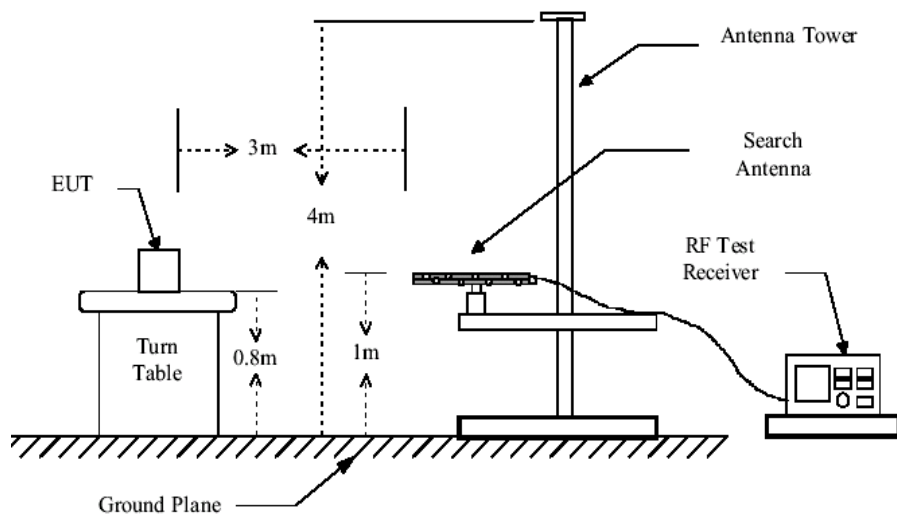
Temperature: 21 °C Humidity: 45 % RH Atmospheric Pressure: 1010 mbar

Test mode a:Engineering Mode: Using test software to control EUT working in continuous transmitting and receiving, and select channel and modulation type.

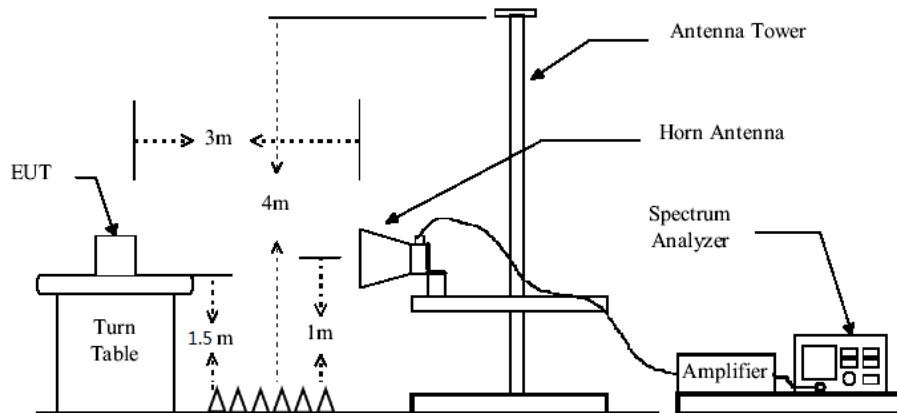
**7.7.2 Test Setup Diagram**



**Figure1. Below 30MHz radiated emissions test configuration**



**Figure2. 30MHz to 1GHz radiated emissions test configuration**



**Figure3. Above 1GHz radiated emissions test configuration**



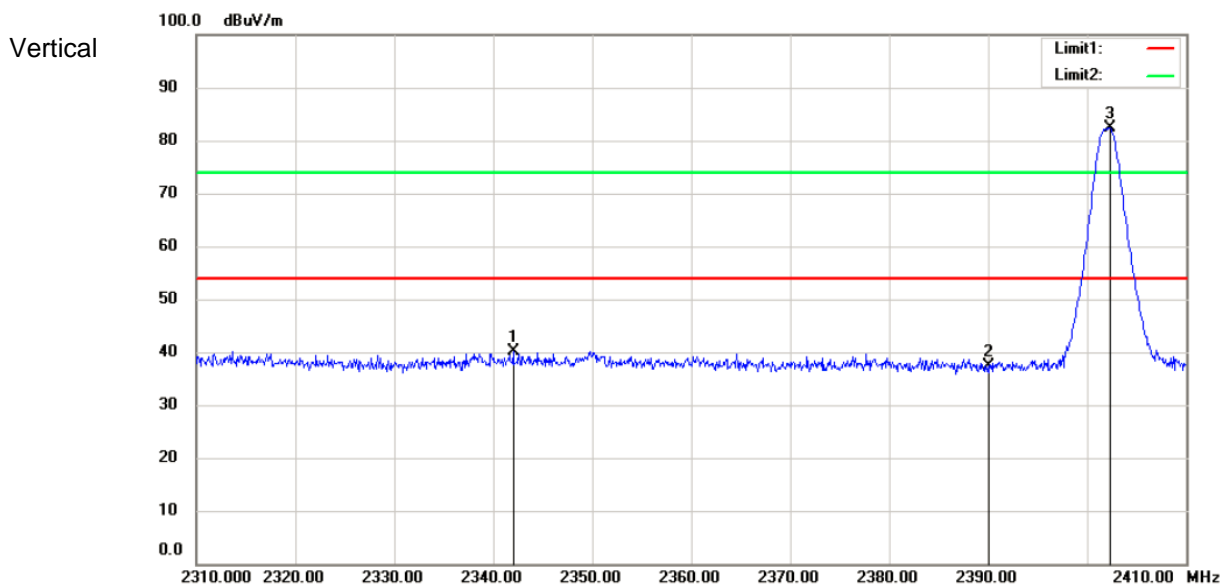
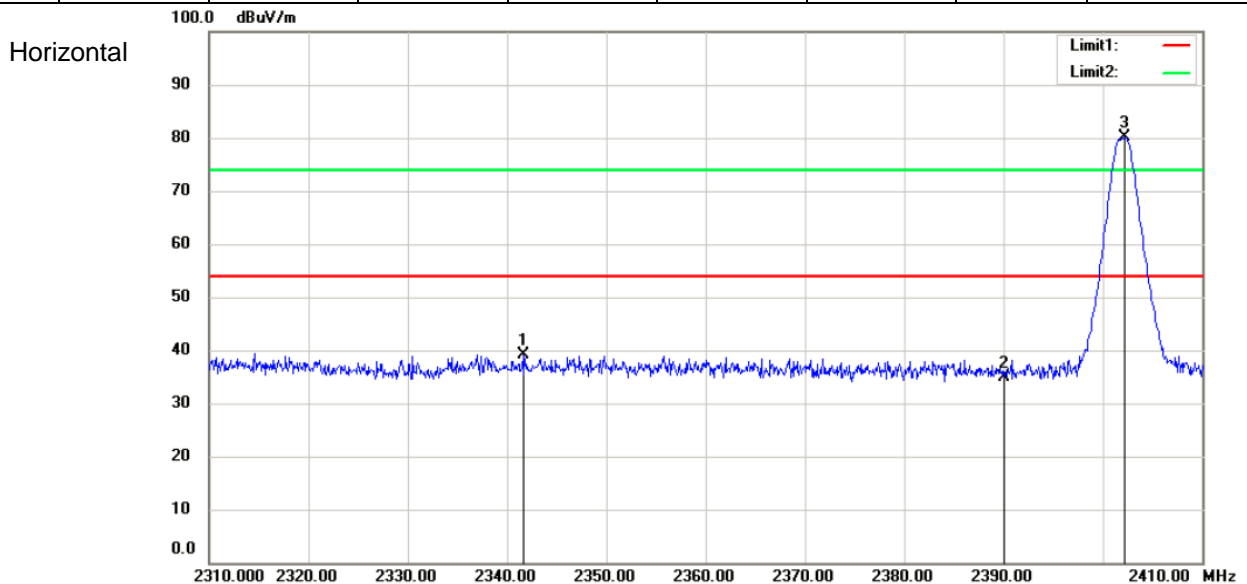
### **7.7.3 Measurement Data**

- 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.



**Lowest Channel**

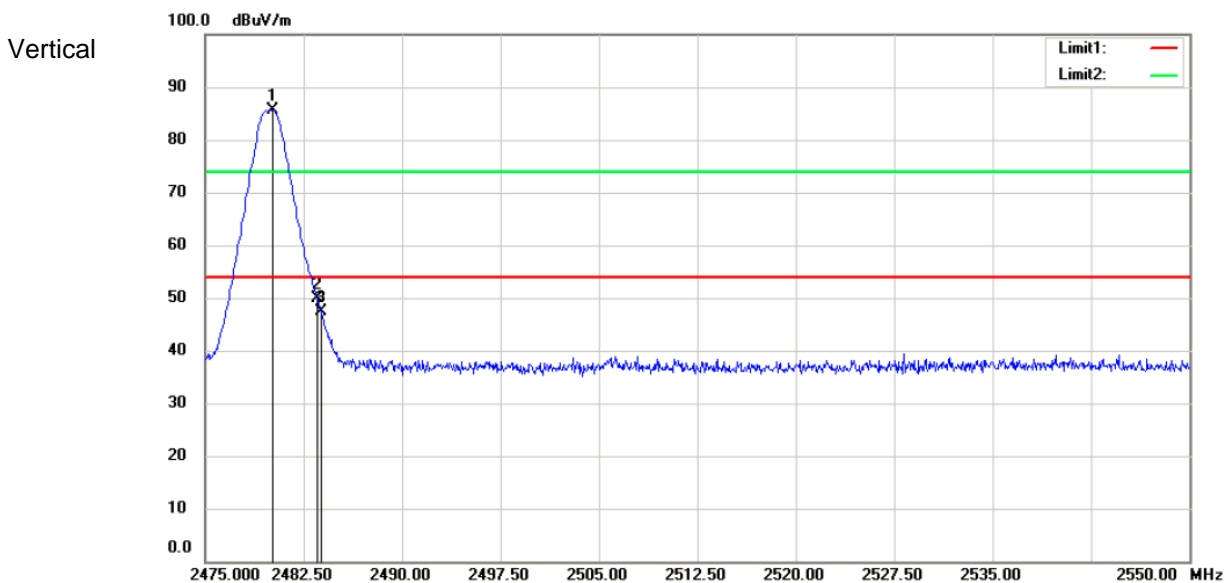
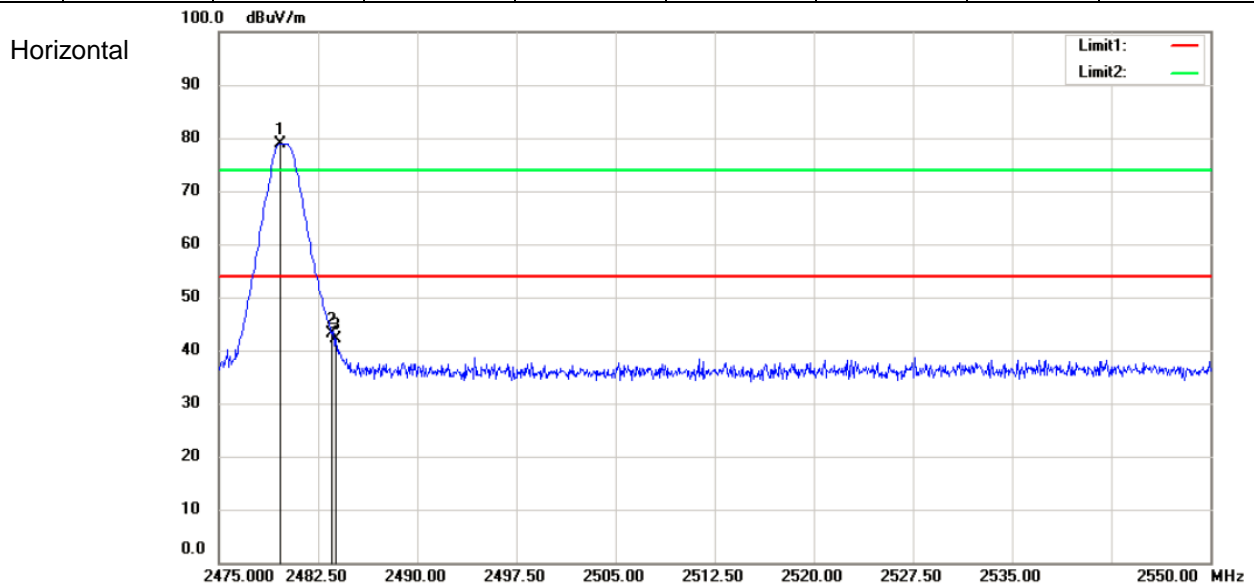
MK.	Frequency (MHz)	Reading (dBuV/m)	Corrected factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Detector	Polarization
1	2341.6	42.88	-3.75	39.13	54	-14.87	Peak	Horizontal
2	2390	38.8	-3.89	34.91	54	-19.09	Peak	Horizontal
3	2402.2	84.04	-3.92	80.12	54	26.12	Peak	Horizontal
1	2342	43.75	-3.74	40.01	54	-13.99	Peak	Vertical
2	2390	41.35	-3.89	37.46	54	-16.54	Peak	Vertical
3	2402.3	86.25	-3.92	82.33	54	28.33	Peak	Vertical





**Highest Channel**

MK.	Frequency (MHz)	Reading (dBuV/m)	Corrected factor(dB)	Result (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Detector	Polarization
1	2479.65	82.87	-4.01	78.86	54	24.86	Peak	Horizontal
2	2483.5	47.15	-4.01	43.14	54	-10.86	Peak	Horizontal
3	2483.85	46.12	-4.02	42.1	54	-11.9	Peak	Horizontal
1	2480.1	89.67	-4	85.67	54	31.67	Peak	Vertical
2	2483.5	53.86	-4.01	49.85	54	-4.15	Peak	Vertical
3	2483.85	51.42	-4.02	47.4	54	-6.6	Peak	Vertical



- Remark: 1). Test Level = Receiver Reading + Antenna Factor + Cable Loss- Preampifier Factor  
2). If the Peak value below the AV Limit, the AV test doesn't perform for this submission.





All frequencies within the “Restricted bands” have been evaluated to compliance. Except as shown in paragraph of this section, only spurious emissions are permitted in any of the frequency bands listed below:

a. FCC Part 15, Subpart C Section 15.205 Restricted bands of operation.

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
10.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.5 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	
13.36 - 13.41			



RSS-Gen section 7.2.2 Restricted bands of operation

MHz	MHz	GHz
0.090-0.110	240-285	9.0-9.2
2.1735-2.1905	322-335.4	9.3-9.5
3.020-3.026	399.9-410	10.6-12.7
4.125-4.128	608-614	13.25-13.4
4.17725-4.17775	960-1427	14.47-14.5
4.20725-4.20775	1435-1626.5	15.35-16.2
5.677-5.683	1645.5-1646.5	17.7-21.4
6.215-6.218	1660-1710	22.01-23.12
6.26775-6.26825	1718.8-1722.2	23.6-24.0
6.31175-6.31225	2200-2300	31.2-31.8
8.291-8.294	2310-2390	36.43-36.5
8.362-8.366	2655-2900	Above 38.6
8.37625-8.38675	3260-3267	
8.41425-8.41475	3332-3339	
12.29-12.293	3345.8-3358	
12.51975-12.52025	3500-4400	
12.57675-12.57725	4500-5150	
13.36-13.41	5350-5460	
16.42-16.423	7250-7750	
16.69475-16.69525	8025-8500	
16.80425-16.80475		
25.5-25.67		
37.5-38.25		
73-74.6		
74.8-75.2		
108-138		
156.52475-156.52525		
156.7-156.9		



**7.8 Radiated Spurious Emissions**

Test Requirement: 47 CFR Part 15, Subpart C 15.247  
 Test Method: ANSI C63.10 (2013) Section 6.4,6.5,6.6  
 Measurement Distance: 3m  
 Limit:

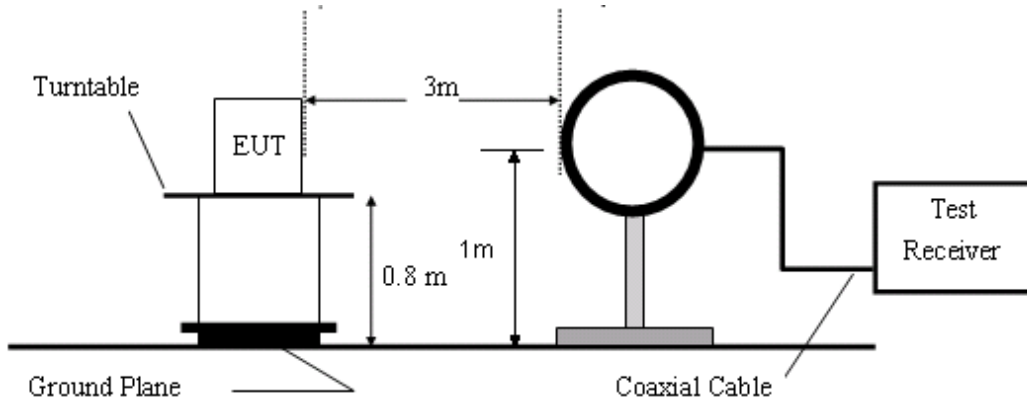
Frequency(MHz)	Field strength(microvolts/meter)	Measurement distance(meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

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.

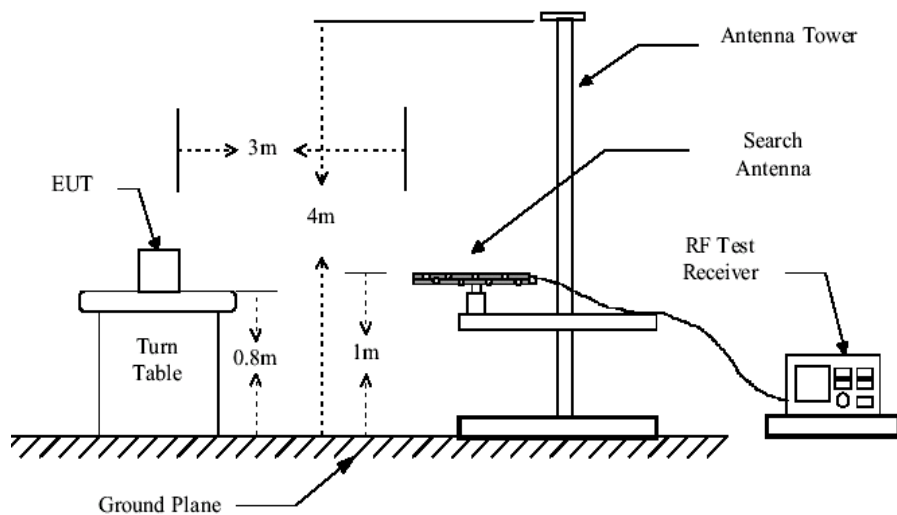
**7.8.1 E.U.T. Operation**

Operating Environment:  
 Temperature: 21 °C Humidity: 45 % RH Atmospheric Pressure: 1010 mbar  
 Test mode a:Engineering Mode: Using test software to control EUT working in continuous transmitting and receiving, and select channel and modulation type.

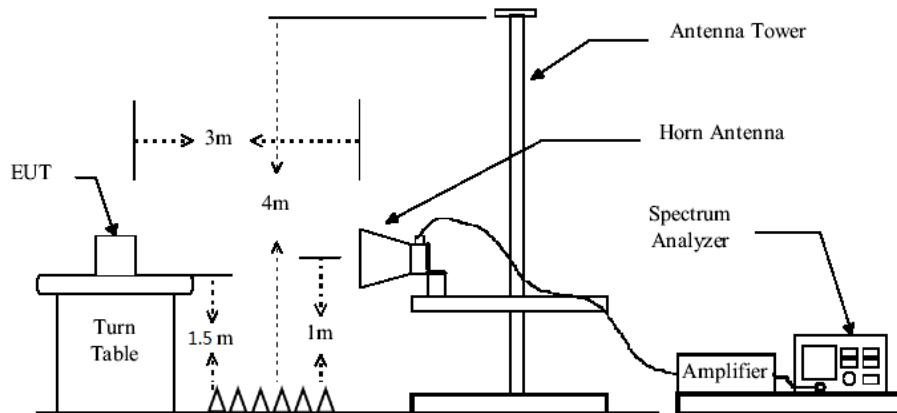
**7.8.2 Test Setup Diagram**



**Figure1. Below 30MHz radiated emissions test configuration**



**Figure2. 30MHz to 1GHz radiated emissions test configuration**



**Figure3. Above 1GHz radiated emissions test configuration**



### **7.8.3 Measurement 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.



30MHz-1GHz:

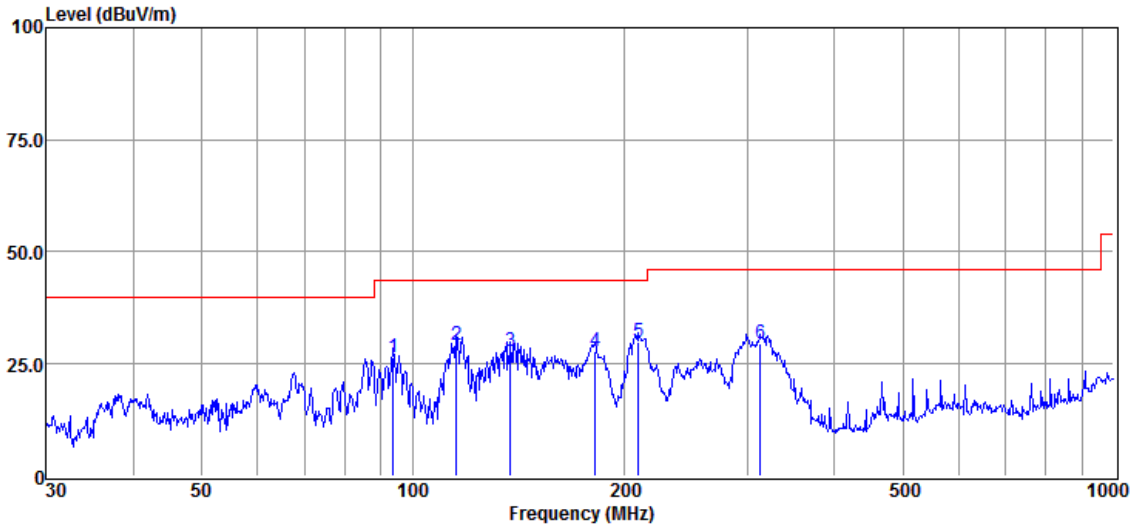
Item	Freq.	Read Level	Antenna Factor	Preamp Factor	Cable Loss	Result Level	Limit Line	Over Limit	Detector	Polarization
(Mark)	(MHz)	(dB $\mu$ V)	(dB/m)	(dB)	(dB)	(dB $\mu$ V/m)	(dB $\mu$ V/m)	(dB)		
1	85.60	62.05	8.06	42.68	0.40	27.83	40.00	-12.17	QP	Horizontal
2	115.32	58.66	9.82	42.69	0.52	26.31	43.50	-17.19	QP	Horizontal
3	133.62	58.29	12.23	42.65	0.59	28.46	43.50	-15.04	QP	Horizontal
4	179.39	57.63	11.88	42.56	0.66	27.61	43.50	-15.89	QP	Horizontal
5	238.31	58.33	11.04	42.47	0.75	27.65	46.00	-18.35	QP	Horizontal
6	274.19	53.89	12.35	42.43	0.81	24.62	46.00	-21.38	QP	Horizontal
1	93.77	60.06	8.66	42.69	0.43	26.46	43.50	-17.04	QP	Vertical
2	115.32	61.48	9.82	42.69	0.52	29.13	43.50	-14.37	QP	Vertical
3	137.90	58.38	11.59	42.64	0.60	27.93	43.50	-15.57	QP	Vertical
4	181.92	58.00	11.58	42.55	0.67	27.70	43.50	-15.80	QP	Vertical
5	210.05	61.87	9.86	42.51	0.71	29.93	43.50	-13.57	QP	Vertical
6	313.28	57.63	13.48	42.36	0.86	29.61	46.00	-16.39	QP	Vertical

Remark: (1) Result Level = Read Level + Antenna Factor + Cable loss - Preamp Factor

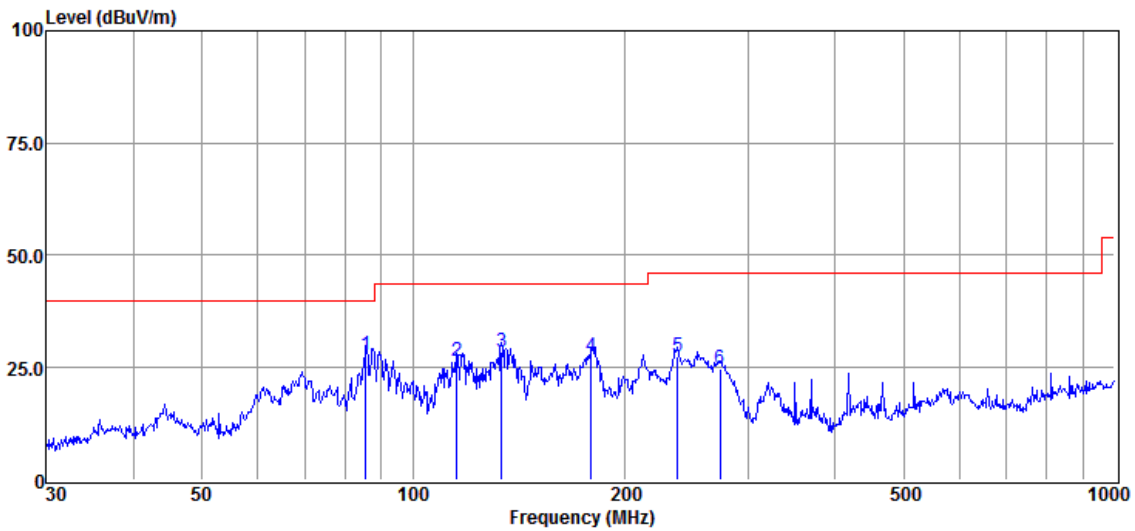
(2) No spurious emissions were detected within 20dB of limit below 30MHz



Test plot as below:  
Vertical:



Horizontal:





**Above 1GHz:**

**Lowest Channel**

Mark	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Emission (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Detector	Polarization
1	4804	37.80	6.18	43.98	54	-10.02	peak	Horizontal
2	7206	34.31	10.63	44.94	54	-9.06	peak	Horizontal
3	9608	34.62	14.38	49.00	54	-5.00	peak	Horizontal
4	4804	35.49	6.18	41.67	54	-12.33	peak	Vertical
5	7206	35.34	10.63	45.97	54	-8.03	peak	Vertical
6	9608	34.82	14.38	49.20	54	-4.80	peak	Vertical

**Middle Channel**

Mark	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Emission (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Detector	Polarization
1	4880	35.40	6.97	42.37	54	-11.63	peak	Horizontal
2	7320	37.59	11.12	48.71	54	-5.29	peak	Horizontal
3	9760	35.25	14.35	49.60	54	-4.40	peak	Horizontal
4	4880	36.38	6.97	43.35	54	-10.65	peak	Vertical
5	7320	36.16	11.12	47.28	54	-6.72	peak	Vertical
6	9760	37.26	14.35	51.61	54	-2.39	peak	Vertical

**Highest Channel**

Mark	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Emission (dBuV/m)	Limit (dBuV/m)	Over Limit (dB)	Detector	Polarization
1	4960	37.46	7.49	44.95	54	-9.05	peak	Horizontal
2	7440	35.95	11.65	47.60	54	-6.40	peak	Horizontal
3	9920	36.85	14.40	51.25	54	-2.75	peak	Horizontal
4	4960	37.81	7.49	45.30	54	-8.70	peak	Vertical
5	7440	37.92	11.65	49.57	54	-4.43	peak	Vertical
6	9920	32.77	14.40	47.17	54	-6.83	peak	Vertical

- Remark: 1) Emission = Receiver Reading + Factor  
2) Factor = Antenna Factor + Cable Loss + Pre-amplifier Factor.  
3) If the Peak value below the AV Limit, the AV test doesn't perform for this submission.



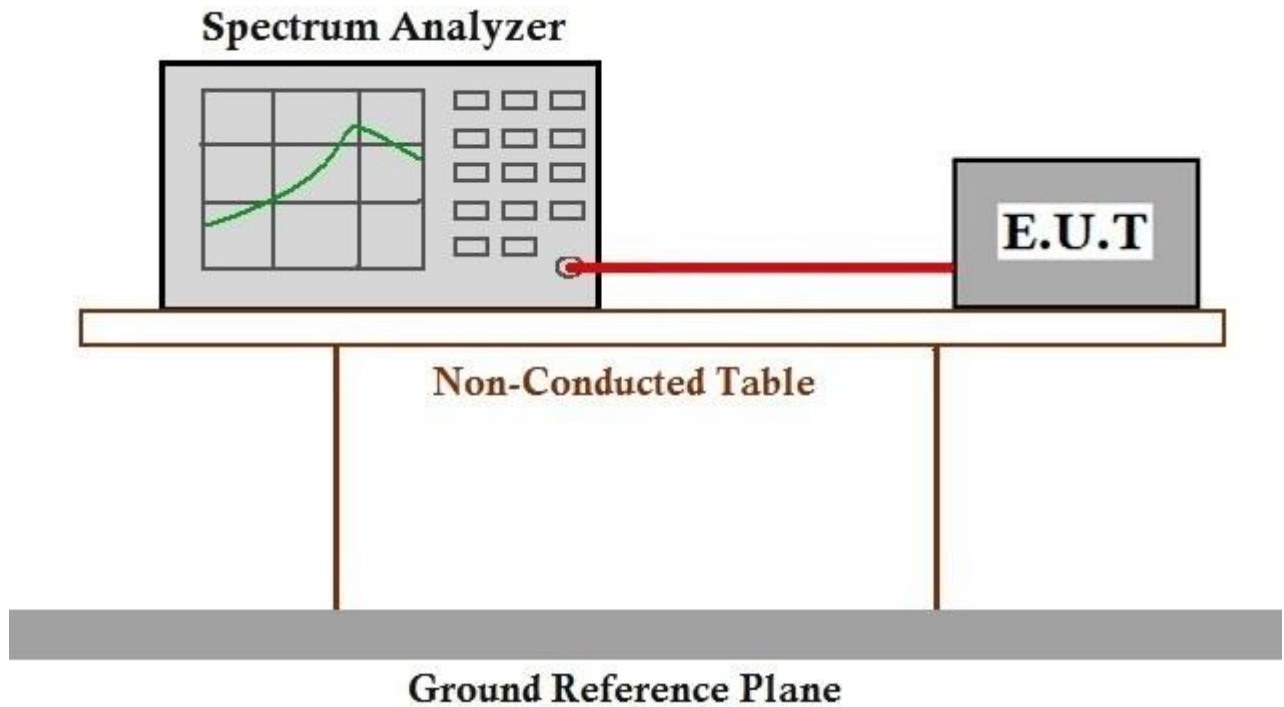
**7.9 99% Bandwidth**

Test Requirement: RSS-247 Issue 2, February 2017  
Test Method: ANSI C63.10 Section 6.9.3

**7.9.1 E.U.T. Operation**

Operating Environment:  
Temperature: 22 °C Humidity: 51 % RH Atmospheric Pressure: 1002 mbar  
Test mode a:Engineering Mode: Using test software to control EUT working in continuous transmitting and receiving, and select channel and modulation type.

**7.9.2 Test Setup Diagram**



**7.9.3 Measurement Data**

The detailed test data see: Appendix 15.247-BLE



## **8 Equipment Under Test Pictures**

Refer to the < Test Setup Photos-FCC >

## **9 EUT Constructional Details**

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

**--End of the Report--**