Test Report

Applicant:	Computime Ltd.
Address of Applicant:	6/F, Bldg 20E, Phase 3, Hong Kong Science Park, 20 Science Park East Ave, Shatin, New Territories, Hong Kong
Manufacturer/Factory:	COMPUTIME ELECTRONICS (SHENZHEN) CO., LTD.
Address of Manufacturer/Factory:	Computime Technology Pk, Dan Zhu Tou Cun Buji, Longgang Region Shenzhen China
Equipment Under Test (EUT)	
Product Info:	ZigBee module
Model No.:	CTL3212
Trade Mark:	Computime
FCC ID:	2AAUQ-CTL3212
IC:	1700A-CTL3212
Applicable standards:	FCC CFR Title 47 Part 15 Subpart C Section 15.247 RSS-Gen Issue 5: March 2019, Amendment 1. RSS-247 Issue 2: February 2017
Date of sample receipt:	October 14, 2019
Date of Test:	October 15-24, 2019
Date of report issued:	October 24, 2019
Test Result :	PASS *

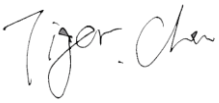
* In the configuration tested, the EUT complied with the standards specified above.

Authorized Signature:

Robinson Lo
Laboratory Manager

2 Version

Version No.	Date	Description
00	*October 24, 2019*	*Original*

Prepared By:  ***Date:*** *October 24, 2019*

Project Engineer

Check By:  ***Date:*** *October 24, 2019*

Reviewer

3 Contents

4 Test Summary

Test Item	Section	Result
Antenna requirement	FCC part 15.203/15.247 (c) RSS-Gen Section 6.8	Pass
AC Power Line Conducted Emission	FCC part 15.207 RSS-Gen Section 8.8	Pass
Conducted Peak Output Power	FCC part 15.247 (b)(3) RSS-247 Section 5.4(d)	Pass
Channel Bandwidth & 99% OCB	FCC part 15.247 (a)(2) RSS-247 Section 5.2(a) RSS-Gen Section 6.7	Pass
Power Spectral Density	FCC part 15.247 (e) RSS-247 Section 5.2(b)	Pass
Band Edge	FCC part 15.247(d) RSS-247 Section 5.5	Pass
Spurious Emission	FCC part 15.205/15.209 RSS-Gen Section 3.3 & 8.9 & 8.10	Pass
Frequency stability	RSS-Gen Section 6.11& Section 8.11	Pass

Pass: The EUT complies with the essential requirements in the standard.

Remark： Test according to ANSI C63.10:2013

4.1 Measurement Uncertainty

Test Item	Frequency Range	Measurement Uncertainty	Notes
Radiated Emission	30MHz-200MHz	3.8039dB	(1)
Radiated Emission	200MHz-1GHz	3.9679dB	(1)
Radiated Emission	1GHz-18GHz	4.29dB	(1)
Radiated Emission	18GHz-40GHz	3.30dB	(1)
AC Power Line Conducted Emission	0.15MHz ~ 30MHz	3.44dB	(1)
Note (1): The measurement uncertainty is for coverage factor of k=2 and a level of confidence of 95%.			

5 General Information

5.1 General Description of EUT

Product Info:	ZigBee module
Model No.:	CTL3212
Serial No.:	N/A
Hardware version:	3.0
Software version:	v1.0
Test sample(s) ID:	GTS201910000059-1
Sample(s) Status	Engineer sample
Operation Frequency:	2405MHz~2480MHz
Channel numbers:	16
Channel separation:	5MHz
Modulation type:	O-QPSK
Antenna Type:	PCB Antenna
Antenna gain:	7.28dBi (Declared by manufacturer)
Power supply:	DC 3.3V

Operation Frequency each of channel							
Channel	Frequency	Channel	Frequency	Channel	Frequency	Channel	Frequency
11	2405MHz	15	2425MHz	19	2445MHz	23	2465MHz
12	2410MHz	16	2430MHz	20	2450MHz	24	2470MHz
13	2415MHz	17	2435MHz	21	2455MHz	25	2475MHz
14	2420MHz	18	2440MHz	22	2460MHz	26	2480MHz

Note:

In section 15.31(m), regards to the operating frequency range over 10 MHz, the Lowest frequency, the middle frequency, and the highest frequency of channel were selected to perform the test, and the selected channel see below:

Channel	Frequency
The lowest channel	2405MHz
The middle channel	2440MHz
The Highest channel	2480MHz

5.2 Test mode

Transmitting mode	Keep the EUT in continuously transmitting mode.
Remark: During the test, the test voltage was tuned from 85% to 115% of the nominal rated supply voltage, and found that the worst case was under the nominal rated supply condition. So the report just shows that condition's data.	

5.3 Description of Support Units

Manufacturer	Description	Model	Serial Number
Apple	PC	A1278	C1MN99ERDTY3

5.4 Deviation from Standards

None.

5.5 Abnormalities from Standard Conditions

None.

5.6 Test Facility

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

● **FCC —Registration No.: 381383**

Global United Technology Services Co., Ltd., Shenzhen EMC Laboratory has been registered and fully described in a report filed with the (FCC) Federal Communications Commission. The acceptance letter from the FCC is maintained in files. Registration 381383.

● **IC —Registration No.: 9079A**

The 3m Semi-anechoic chamber of Global United Technology Services Co., Ltd. has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No.: 9079A

● **NVLAP (LAB CODE:600179-0)**

Global United Technology Services Co., Ltd., is accredited by the National Voluntary Laboratory Accreditation Program (NVLAP). LAB CODE:600179-0

5.7 Test Location

All tests were performed at:

Global United Technology Services Co., Ltd.
Address: No. 123-128, Tower A, Jinyuan Business Building, No.2, Laodong Industrial Zone, Xixiang Road, Baoan District, Shenzhen, Guangdong, China 518102
Tel: 0755-27798480
Fax: 0755-27798960

5.8 Additional instructions

Software (Used for test) from client

Special test command provide by manufacturer, power set default, test version V1.0

6 Test Instruments list

Radiated Emission:						
Item	**Test Equipment**	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal.Date (mm-dd-yy)**	**Cal.Due date (mm-dd-yy)**
1	3m Semi- Anechoic Chamber	ZhongYu Electron	9.2(L)*6.2(W)* 6.4(H)	GTS250	July. 03 2015	July. 02 2020
2	Control Room	ZhongYu Electron	6.2(L)*2.5(W)* 2.4(H)	GTS251	N/A	N/A
3	EMI Test Receiver	Rohde & Schwarz	ESU26	GTS203	June. 26 2019	June. 25 2020
4	BiConiLog Antenna	SCHWARZBECK MESS-ELEKTRONIK	VULB9163	GTS214	June. 26 2019	June. 25 2020
5	Double -ridged waveguide horn	SCHWARZBECK MESS-ELEKTRONIK	BBHA 9120 D	GTS208	June. 26 2019	June. 25 2020
6	Horn Antenna	ETS-LINDGREN	3160	GTS217	June. 26 2019	June. 25 2020
7	EMI Test Software	AUDIX	E3	N/A	N/A	N/A
8	Coaxial Cable	GTS	N/A	GTS213	June. 26 2019	June. 25 2020
9	Coaxial Cable	GTS	N/A	GTS211	June. 26 2019	June. 25 2020
10	Coaxial cable	GTS	N/A	GTS210	June. 26 2019	June. 25 2020
11	Coaxial Cable	GTS	N/A	GTS212	June. 26 2019	June. 25 2020
12	Amplifier(100kHz-3GHz)	HP	8347A	GTS204	June. 26 2019	June. 25 2020
13	Amplifier(2GHz-20GHz)	HP	84722A	GTS206	June. 26 2019	June. 25 2020
14	Amplifier (18-26GHz)	Rohde & Schwarz	AFS33-18002 650-30-8P-44	GTS218	June. 26 2019	June. 25 2020
15	Band filter	Amindeon	82346	GTS219	June. 26 2019	June. 25 2020
16	Power Meter	Anritsu	ML2495A	GTS540	June. 26 2019	June. 25 2020
17	Power Sensor	Anritsu	MA2411B	GTS541	June. 26 2019	June. 25 2020
18	Wideband Radio Communication Tester	Rohde & Schwarz	CMW500	GTS575	June. 26 2019	June. 25 2020
19	Splitter	Agilent	11636B	GTS237	June. 26 2019	June. 25 2020
20	Loop Antenna	ZHINAN	ZN30900A	GTS534	June. 26 2019	June. 25 2020
21	Breitband hornantenne	SCHWARZBECK	BBHA 9170	GTS579	Oct. 19 2019	Oct. 18 2020
22	Amplifier	TDK	PA-02-02	GTS574	Oct. 19 2019	Oct. 18 2020
23	Amplifier	TDK	PA-02-03	GTS576	Oct. 19 2019	Oct. 18 2020
24	PSA Series Spectrum Analyzer	Rohde & Schwarz	FSP	GTS578	June. 26 2019	June. 25 2020

Conducted Emission						
Item	**Test Equipment**	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal.Date (mm-dd-yy)**	**Cal.Due date (mm-dd-yy)**
1	Shielding Room	ZhongYu Electron	7.3(L)x3.1(W)x2.9(H)	GTS252	May.15 2019	May.14 2022
2	EMI Test Receiver	R&S	ESCI 7	GTS552	June. 26 2019	June. 25 2020
3	Coaxial Switch	ANRITSU CORP	MP59B	GTS225	June. 26 2019	June. 25 2020
4	Artificial Mains Network	SCHWARZBECK MESS	NSLK8127	GTS226	June. 26 2019	June. 25 2020
5	Coaxial Cable	GTS	N/A	GTS227	N/A	N/A
6	EMI Test Software	AUDIX	E3	N/A	N/A	N/A
7	Thermo meter	KTJ	TA328	GTS233	June. 26 2019	June. 25 2020
8	Absorbing clamp	Elektronik-Feinmechanik	MDS21	GTS229	June. 26 2019	June. 25 2020
9	ISN	SCHWARZBECK	NTFM 8158	GTD565	June. 26 2019	June. 25 2020

RF Conducted Test:						
Item	**Test Equipment**	**Manufacturer**	**Model No.**	**Serial No.**	**Cal.Date (mm-dd-yy)**	**Cal.Due date (mm-dd-yy)**
1	MXA Signal Analyzer	Agilent	N9020A	GTS566	June. 26 2019	June. 25 2020
2	EMI Test Receiver	R&S	ESCI 7	GTS552	June. 26 2019	June. 25 2020
3	Spectrum Analyzer	Agilent	E4440A	GTS533	June. 26 2019	June. 25 2020
4	MXG vector Signal Generator	Agilent	N5182A	GTS567	June. 26 2019	June. 25 2020
5	ESG Analog Signal Generator	Agilent	E4428C	GTS568	June. 26 2019	June. 25 2020
6	USB RF Power Sensor	DARE	RPR3006W	GTS569	June. 26 2019	June. 25 2020
7	RF Switch Box	Shongyi	RFSW3003328	GTS571	June. 26 2019	June. 25 2020
8	EMI Test Receiver	R&S	ESCI 7	GTS552	June. 26 2019	June. 25 2020
9	Programmable Constant Temp & Humi Test Chamber	WEWON	WHTH-150L-40-880	GTS572	June. 26 2019	June. 25 2020

General used equipment:						
Item	**Test Equipment**	**Manufacturer**	**Model No.**	**Inventory No.**	**Cal.Date (mm-dd-yy)**	**Cal.Due date (mm-dd-yy)**
1	Humidity/ Temperature Indicator	KTJ	TA328	GTS243	June. 26 2019	June. 25 2020
2	Barometer	ChangChun	DYM3	GTS255	June. 26 2019	June. 25 2020

7 Test results and Measurement Data

7.1 Antenna requirement

Standard requirement:	FCC Part15 C Section 15.203 /247(c)

FCC Part 15.203 requirement:

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

15.247(c) (1)(i) requirement:

(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.

RSS-Gen 6.8

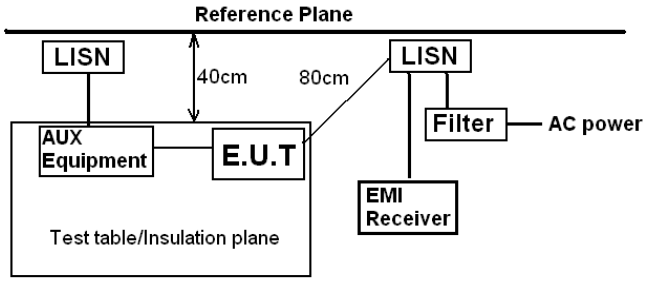
The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report (and in the notice to be included in the user manual, provided below).

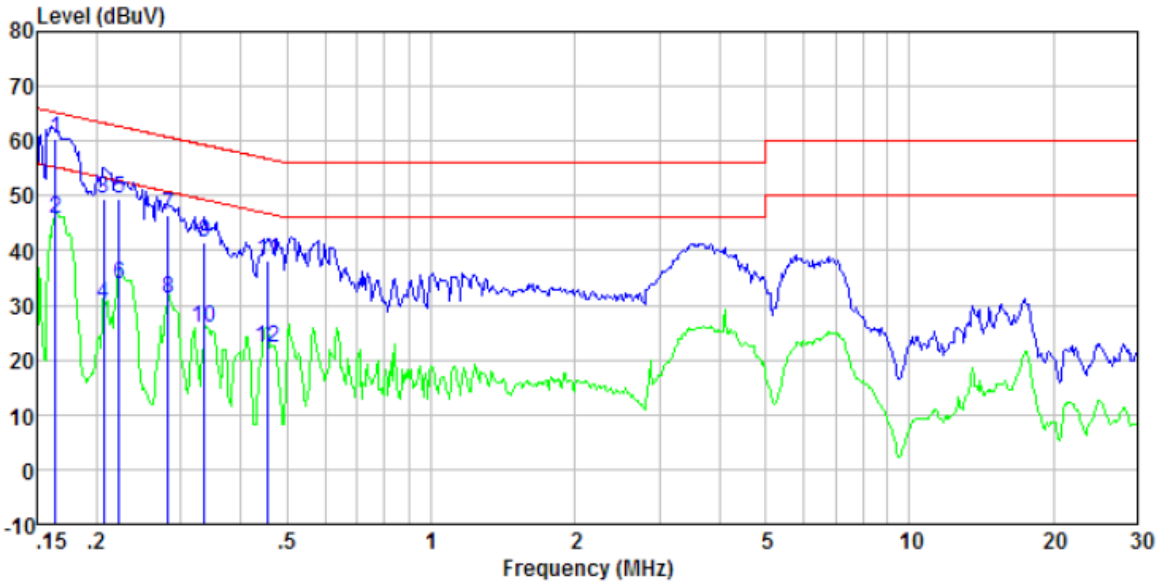
EUT Antenna:

The antenna is PCB antenna, the best case gain of the antenna is 7.28dBi, Reference to the appendix II for details.

7.2 Conducted Emissions

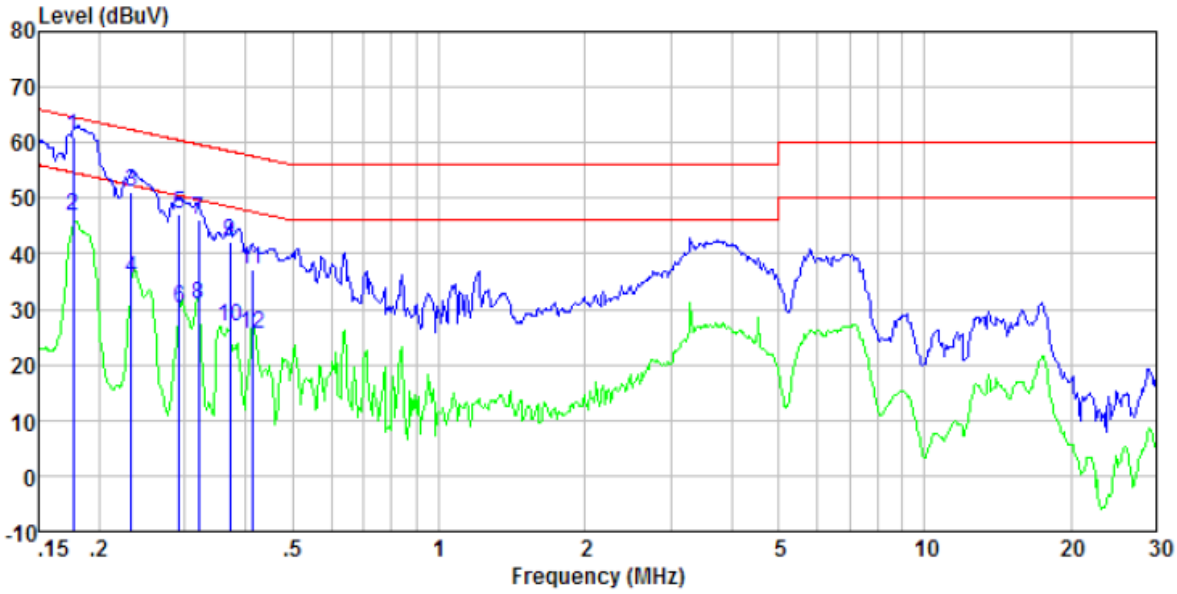
Test Requirement:	FCC Part15 C Section 15.207 RSS-Gen Section 8.8
Test Method:	ANSI C63.10:2013 and RSS-Gen
Test Frequency Range:	150KHz to 30MHz
Receiver setup:	RBW=9KHz, VBW=30KHz, Sweep time=auto
Limit:	Frequency range (MHz) / Limit (dBuV): Quasi-peak / Average 0.15-0.5: 66 to 56* / 56 to 46* 0.5-5: 56 / 46 5-30: 60 / 50 * Decreases with the logarithm of the frequency.
Test setup:	 *Remark:* *E.U.T: Equipment Under Test* *LISN: Line Impedence Stabilization Network* *Test table height=0.8m*
Test procedure:	1. The E.U.T and simulators are connected to the main power through a line impedance stabilization network (L.I.S.N.). This provides a 50ohm/50uH coupling impedance for the measuring equipment. 2. The peripheral devices are also connected to the main power through a LISN that provides a 50ohm/50uH coupling impedance with 50ohm termination. (Please refer to the block diagram of the test setup and photographs). 3. Both sides of A.C. line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.10:2013 on conducted measurement.
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test environment:	Temp.: 25 °C / Humid.: 52% / Press.: 1012mbar
Test voltage:	AC 120V, 60Hz
Test results:	Pass

Measurement data
Line:



Freq MHz	Reading level dBuV	LISN/ISN factor dB/m	Cable loss dB	Level dBuV	Limit level dBuV	Over limit dB	Remark
0.16	59.82	0.40	0.08	60.30	65.25	-4.95	QP
0.16	45.22	0.40	0.08	45.70	55.25	-9.55	Average
0.21	48.93	0.40	0.11	49.44	63.32	-13.88	QP
0.21	29.78	0.40	0.11	30.29	53.32	-23.03	Average
0.22	49.02	0.40	0.11	49.53	62.70	-13.17	QP
0.22	33.48	0.40	0.11	33.99	52.70	-18.71	Average
0.28	45.89	0.40	0.10	46.39	60.76	-14.37	QP
0.28	30.63	0.40	0.10	31.13	50.76	-19.63	Average
0.34	41.03	0.38	0.10	41.51	59.31	-17.80	QP
0.34	25.30	0.38	0.10	25.78	49.31	-23.53	Average
0.46	37.75	0.33	0.11	38.19	56.76	-18.57	QP
0.46	21.81	0.33	0.11	22.25	46.76	-24.51	Average

Neutral:

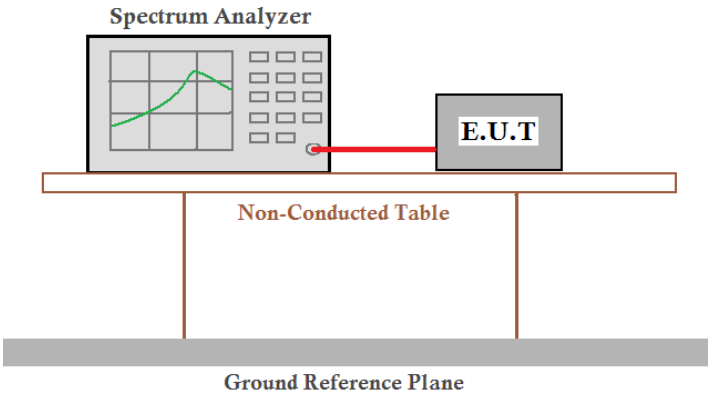


Freq MHz	Reading level dBuV	LISN/ISN factor dB/m	Cable loss dB	Level dBuV	Limit level dBuV	Over limit dB	Remark
0.18	60.57	0.40	0.09	61.06	64.64	-3.58	QP
0.18	46.45	0.40	0.09	46.94	54.64	-7.70	Average
0.23	50.57	0.40	0.11	51.08	62.35	-11.27	QP
0.23	35.07	0.40	0.11	35.58	52.35	-16.77	Average
0.29	46.55	0.40	0.10	47.05	60.46	-13.41	QP
0.29	29.80	0.40	0.10	30.30	50.46	-20.16	Average
0.32	45.52	0.39	0.10	46.01	59.71	-13.70	QP
0.32	30.35	0.39	0.10	30.84	49.71	-18.87	Average
0.37	41.68	0.36	0.10	42.14	58.47	-16.33	QP
0.37	26.24	0.36	0.10	26.70	48.47	-21.77	Average
0.41	36.70	0.35	0.11	37.16	57.59	-20.43	QP
0.41	24.97	0.35	0.11	25.43	47.59	-22.16	Average

Notes:

1. An initial pre-scan was performed on the line and neutral lines with peak detector.
2. Quasi-Peak and Average measurement were performed at the frequencies with maximized peak emission.
3. Final Level =Receiver Read level + LISN Factor + Cable Loss
4. *If the average limit is met when using a quasi-peak detector receiver, the EUT shall be deemed to meet both limits and measurement with the average detector receiver is unnecessary.*

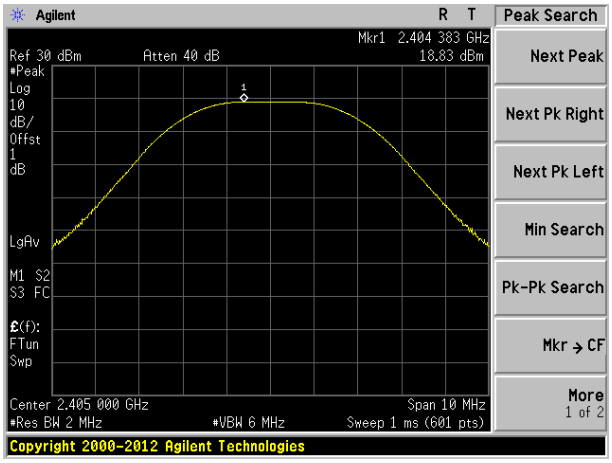
7.3 Conducted Peak Output Power

Test Requirement:	FCC Part15 C Section 15.247 (b)(3) RSS-247 Clause 5.4(d)
Test Method:	ANSI C63.10:2013 and KDB558074 D01 DTS Meas Guidance V05or02
Limit:	28.72dBm
Test setup:	
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

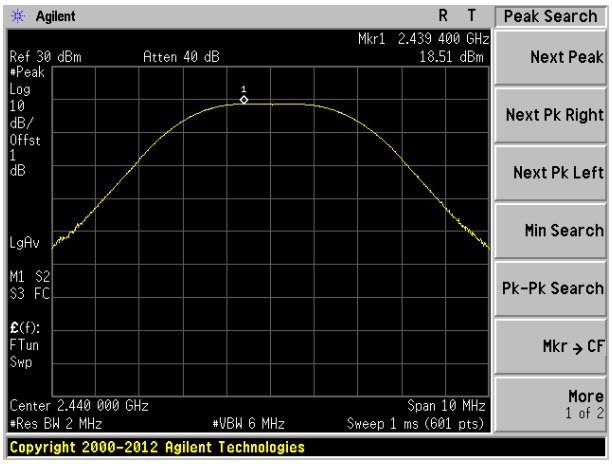
Measurement Data

Frequency (MHz)	Peak Output Power (dBm)	Limit(dBm)	Result
2405	18.83	28.72	PASS
2440	18.51		
2480	18.23		

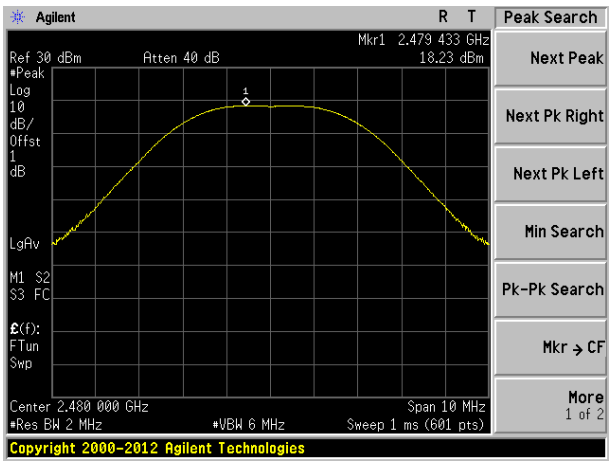
Test plot as follows:



2405MHz

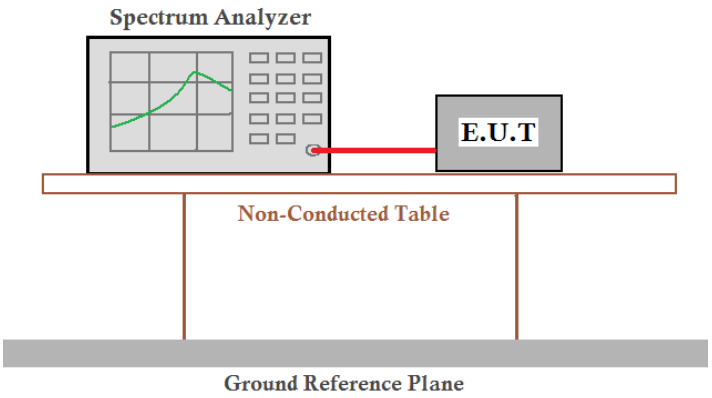


2440MHz



2480MHz

7.4 Channel Bandwidth & 99% Occupy Bandwidth

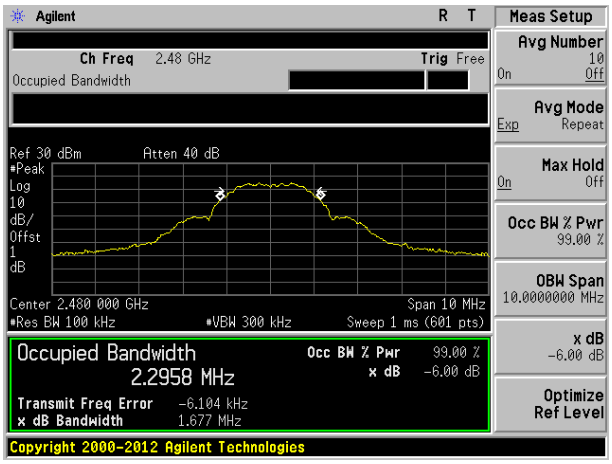
Test Requirement:	FCC Part15 C Section 15.247 (a)(2) RSS-247 Clause 5.2(a)
Test Method:	ANSI C63.10:2013 and KDB558074 D01 DTS Meas Guidance V05or02
Limit:	>500KHz
Test setup:	
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Measurement Data

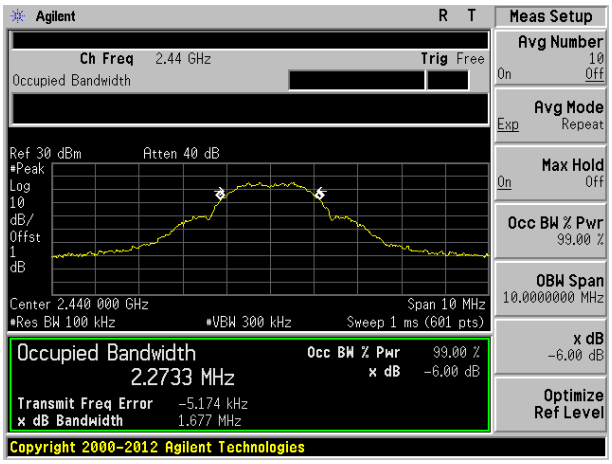
Frequency (MHz)	Channel Bandwidth (MHz)	Limit(KHz)	Result
2405	1.677	>500	Pass
2440	1.677		
2480	1.672		

Frequency (MHz)	99% Occupy Bandwidth (MHz)	Result
2405	2.2958	Pass
2445	2.2733	
2480	2.2869	

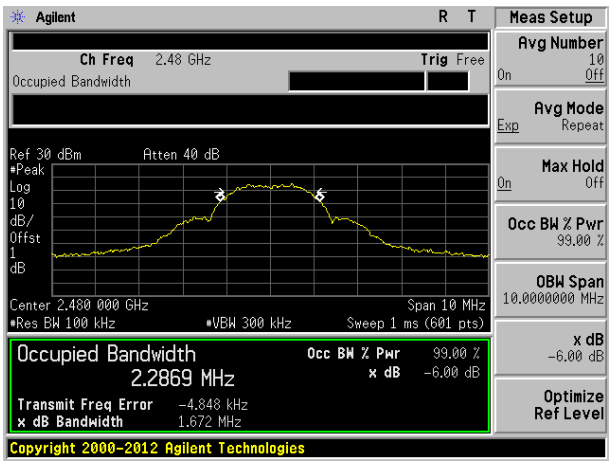
Test plot as follows:



2405MHz

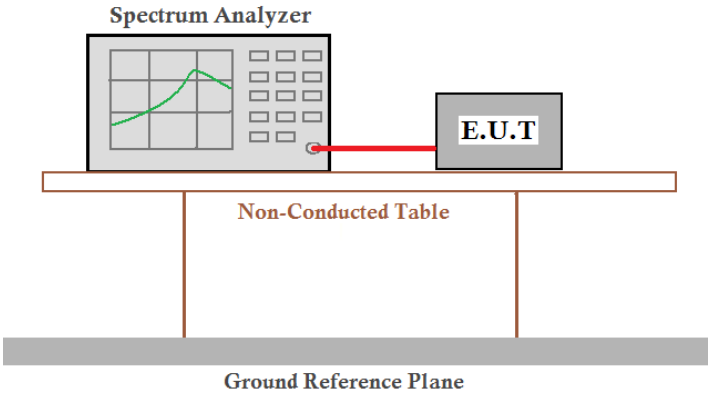


2440MHz



2480MHz

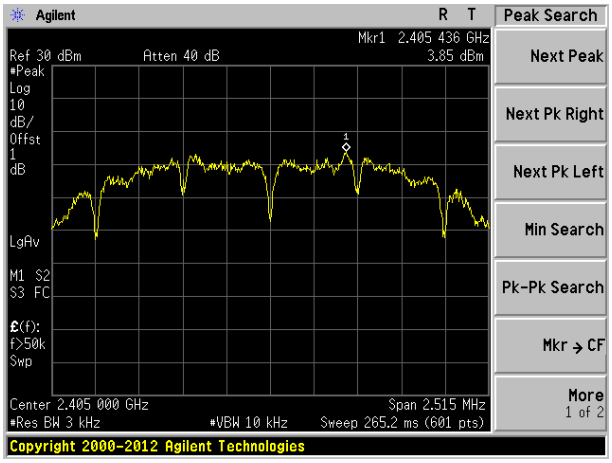
7.5 Power Spectral Density

Test Requirement:	FCC Part15 C Section 15.247 (e) RSS-247 Clause 5.2(b)
Test Method:	ANSI C63.10:2013 and KDB558074 D01 DTS Meas Guidance V05or02
Limit:	8dBm/3kHz
Test setup:	
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

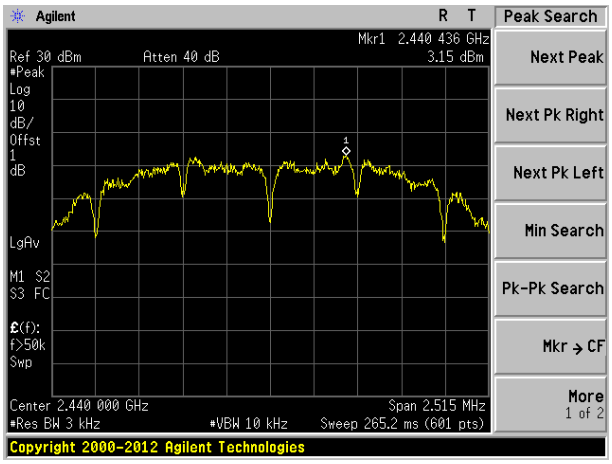
Measurement Data

Frequency (MHz)	Power Spectral Density (dBm)	Limit (dBm/3kHz)	Result
2405	3.85	8.00	Pass
2440	3.15		
2480	2.51		

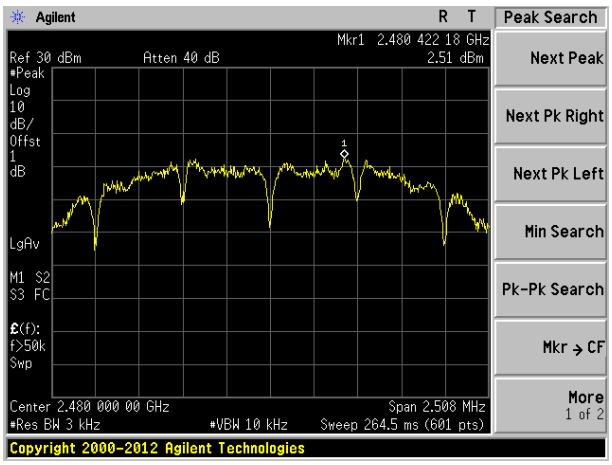
Test plot as follows:



2405MHz



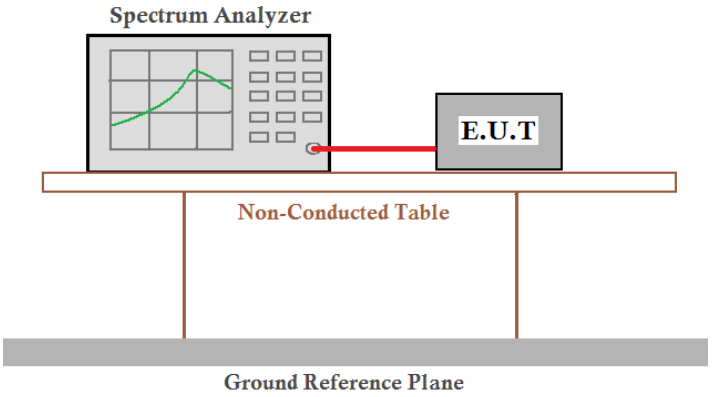
2440MHz



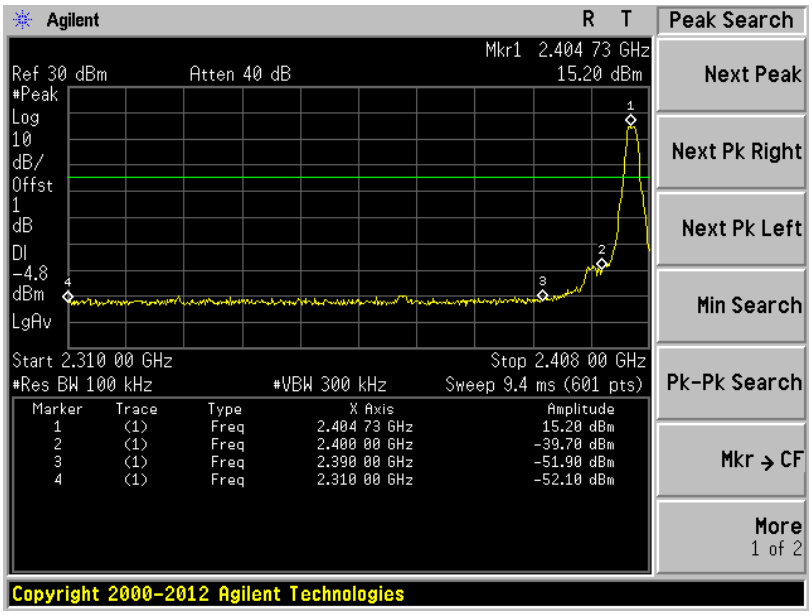
2480MHz

7.6 Band edges

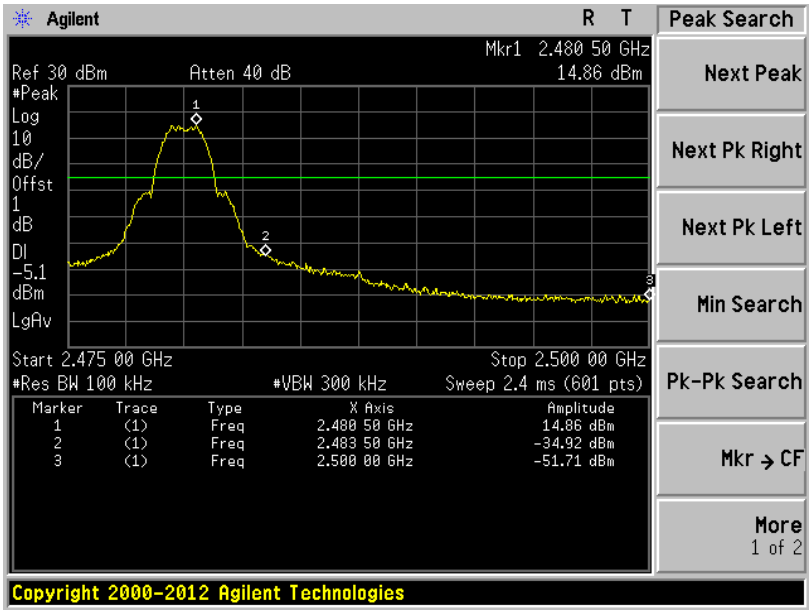
7.6.1 Conducted Emission Method

Test Requirement:	FCC Part15 C Section 15.247 (d) RSS-247 Clause 5.5 & RSS-Gen 8.9
Test Method:	ANSI C63.10:2013 and KDB558074 D01 DTS Meas Guidance V05or02
Limit:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.
Test setup:	
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Test plot as follows:

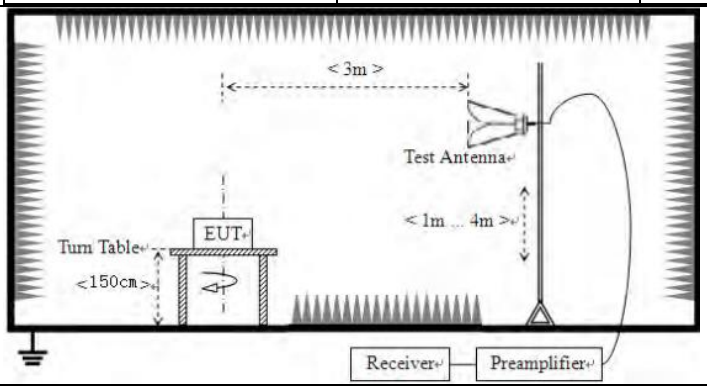


Lowest channel



Highest channel

7.6.2 Radiated Emission Method

<table>
<tr><td>Test Requirement:</td><td>FCC Part15 C Section 15.209 and 15.205
RSS-Gen Clause 8.9&8.10</td></tr>
<tr><td>Test Method:</td><td>ANSI C63.10:2013 and RSS-Gen</td></tr>
<tr><td>Test Frequency Range:</td><td>All of the restrict bands were tested, only the worst band’s (2310MHz to 2500MHz) data was showed.</td></tr>
<tr><td>Test site:</td><td>Measurement Distance: 3m</td></tr>
<tr><td>Receiver setup:</td><td>
<table>
<tr><td>Frequency</td><td>Detector</td><td>RBW</td><td>VBW</td><td>Value</td></tr>
<tr><td rowspan="2">Above 1GHz</td><td>Peak</td><td>1MHz</td><td>3MHz</td><td>Peak</td></tr>
<tr><td>RMS</td><td>1MHz</td><td>3MHz</td><td>Average</td></tr>
</table>
</td></tr>
<tr><td>Limit:</td><td>
<table>
<tr><td>Frequency</td><td>Limit (dBuV/m @3m)</td><td>Value</td></tr>
<tr><td rowspan="2">Above 1GHz</td><td>54.00</td><td>Average</td></tr>
<tr><td>74.00</td><td>Peak</td></tr>
</table>
</td></tr>
<tr><td>Test setup:</td><td> 
</td></tr>
<tr><td>Test Procedure:</td><td>1. The EUT was placed on the top of a rotating table 1.5 meters above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation.
2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
3. 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.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rota table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
6. 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.
7. The radiation measurements are performed in X, Y, Z axis positioning. And found the Y axis positioning which it is worse case, only the test worst case mode is recorded in the report.</td></tr>
<tr><td>Test Instruments:</td><td>Refer to section 6.0 for details</td></tr>
</table>

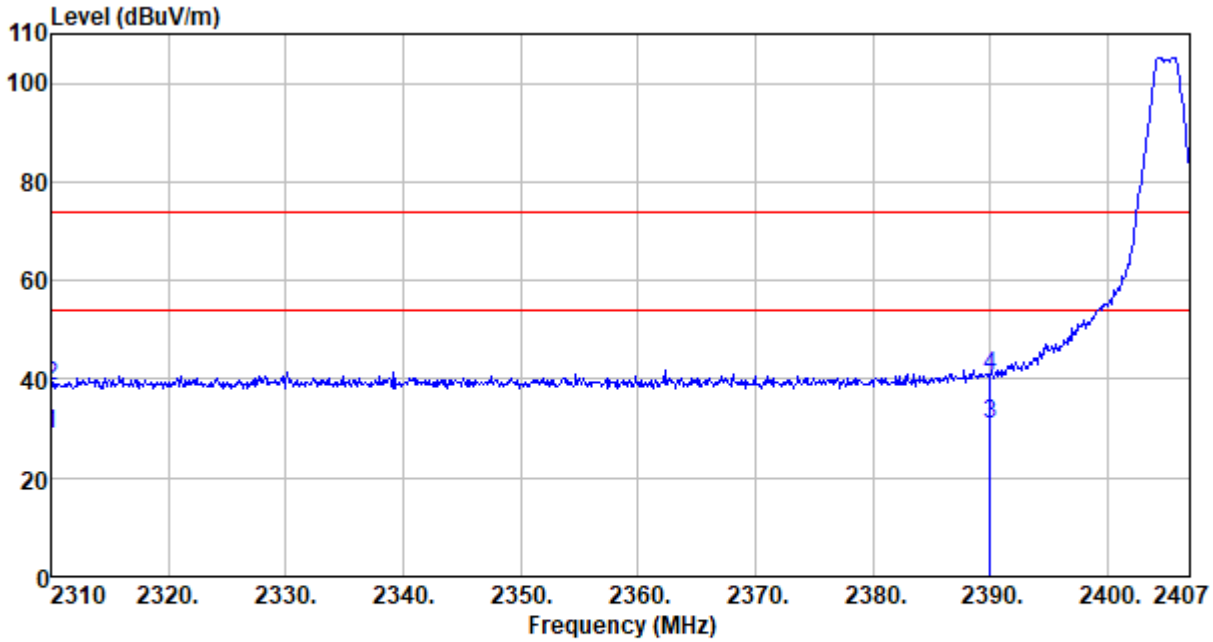
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Measurement data:

Remark: The pre-test were performed on lowest, middle and highest frequencies, only the worst case's (lowest and highest frequencies) data was showed.

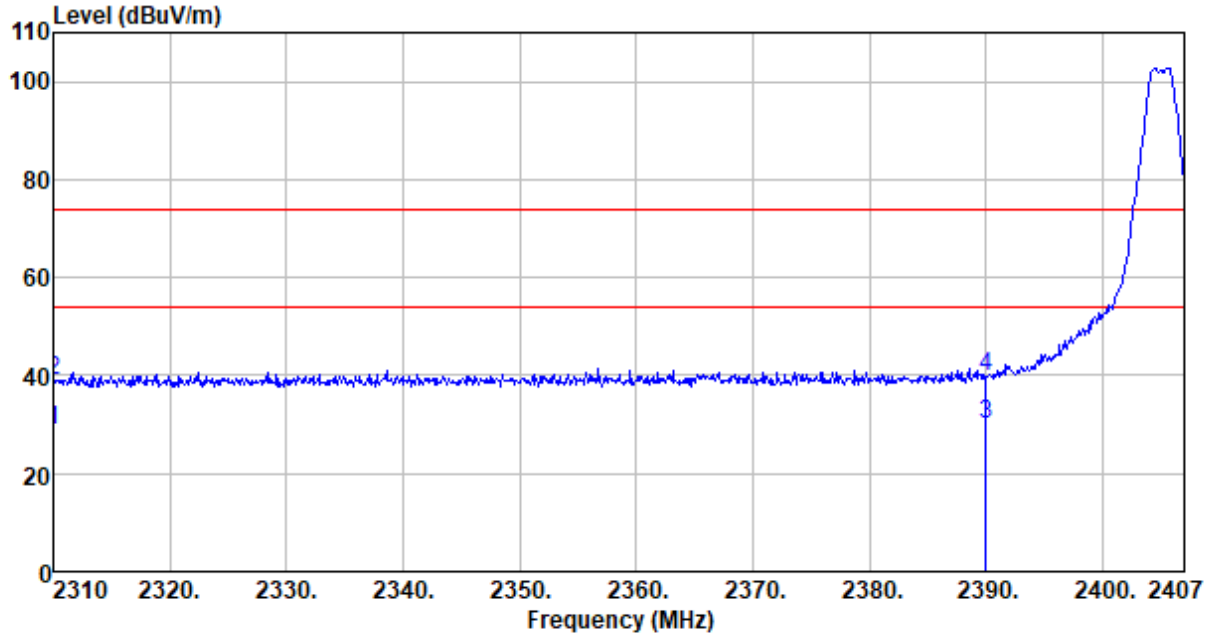
Test channel:	2405MHz

Horizontal:



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
2310.000	35.76	27.14	2.81	36.79	28.92	54.00	-25.08	Average
2310.000	45.48	27.14	2.81	36.79	38.64	74.00	-35.36	Peak
2390.025	37.42	27.37	2.91	36.85	30.85	54.00	-23.15	Average
2390.025	47.02	27.37	2.91	36.85	40.45	74.00	-33.55	Peak

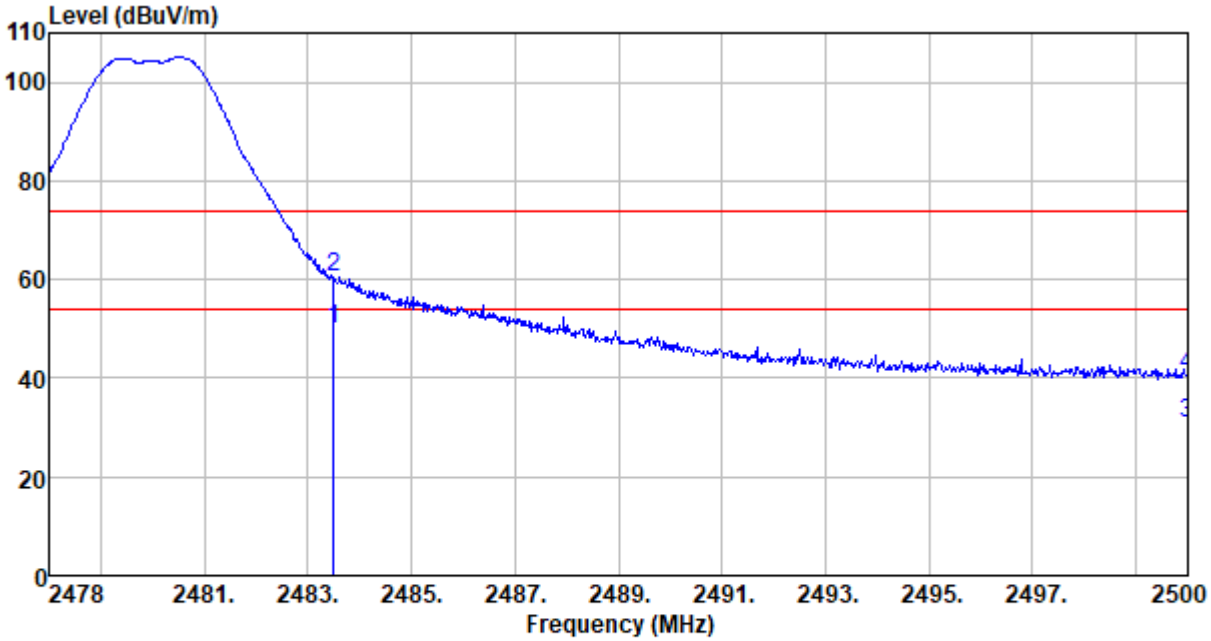
Vertical:



Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV	dBuV/m	dB	
2310.000	35.69	27.14	2.81	36.79	28.85	54.00	-25.15	Average
2310.000	45.79	27.14	2.81	36.79	38.95	74.00	-35.05	Peak
2390.025	36.70	27.37	2.91	36.85	30.13	54.00	-23.87	Average
2390.025	46.20	27.37	2.91	36.85	39.63	74.00	-34.37	Peak

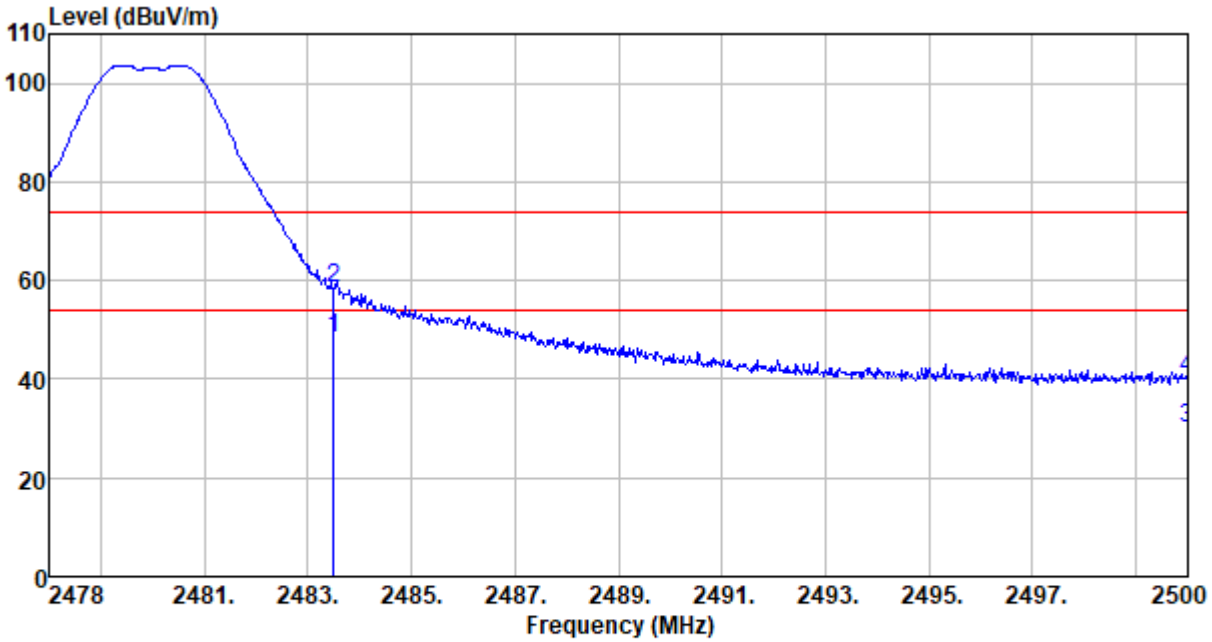
Test channel:	2480MHz

Horizontal:



Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV	dBuV/m	dB	
2483.500	56.26	27.66	2.99	36.93	49.98	54.00	-4.02	Average
2483.500	66.64	27.66	2.99	36.93	60.36	74.00	-13.64	Peak
2500.000	37.10	27.70	3.01	36.94	30.87	54.00	-23.13	Average
2500.000	46.84	27.70	3.01	36.94	40.61	74.00	-33.39	Peak

Vertical:



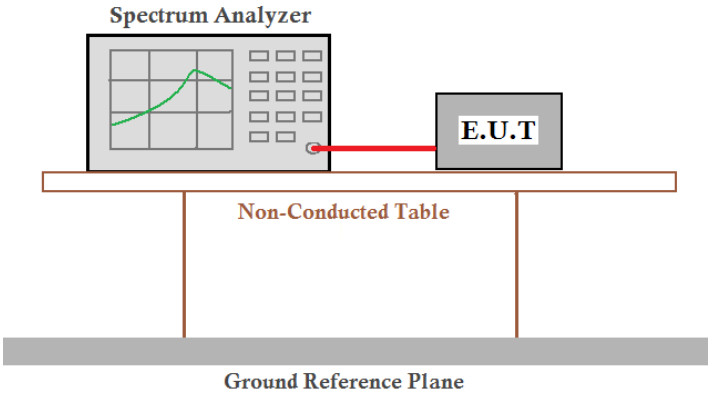
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
2483.500	54.40	27.66	2.99	36.93	48.12	54.00	-5.88	Average
2483.500	64.72	27.66	2.99	36.93	58.44	74.00	-15.56	Peak
2500.000	36.41	27.70	3.01	36.94	30.18	54.00	-23.82	Average
2500.000	46.31	27.70	3.01	36.94	40.08	74.00	-33.92	Peak

Remark:

1. *Final Level =Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor*
2. *The emission levels of other frequencies are very lower than the limit and not show in test report.*

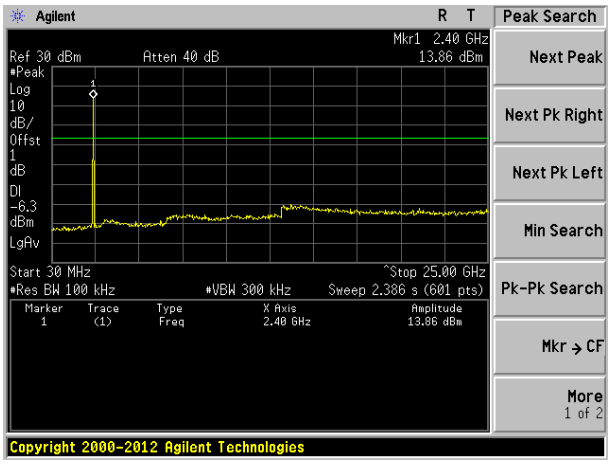
7.7 Spurious Emission

7.7.1 Conducted Emission Method

Test Requirement:	FCC Part15 C Section 15.247 (d) RSS-247 Clause 5.5
Test Method:	ANSI C63.10:2013 and KDB558074 D01 DTS Meas Guidance V05or02
Limit:	In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.
Test setup:	
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

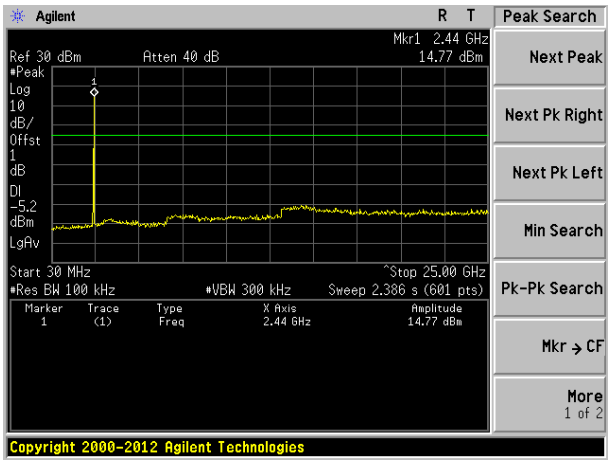
Test plot as follows:

Lowest channel



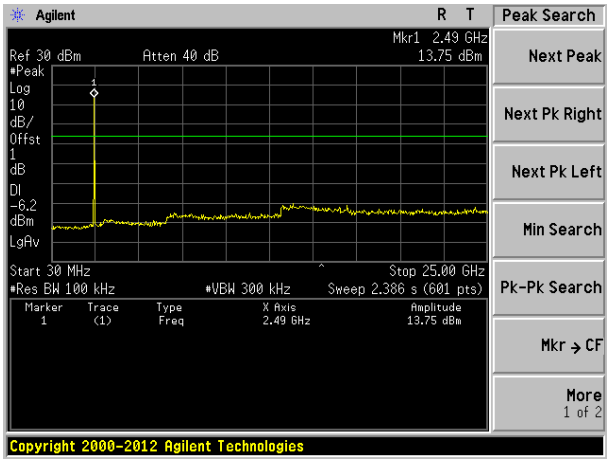
30MHz~25GHz

Middle channel



30MHz~25GHz

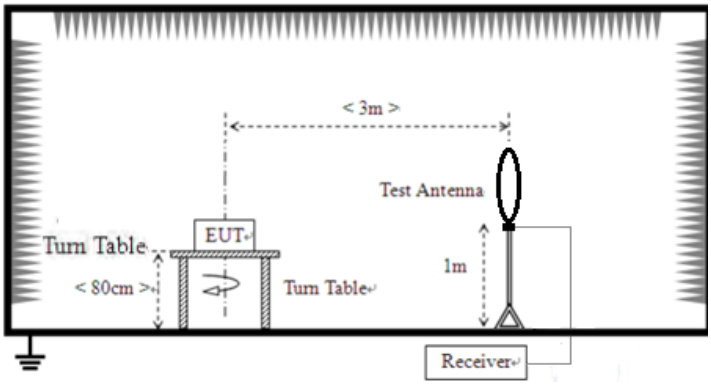
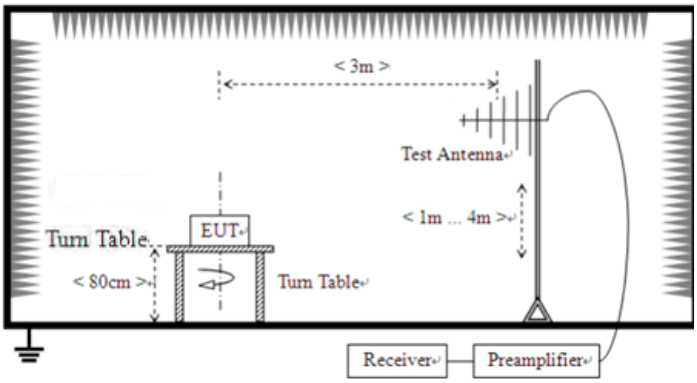
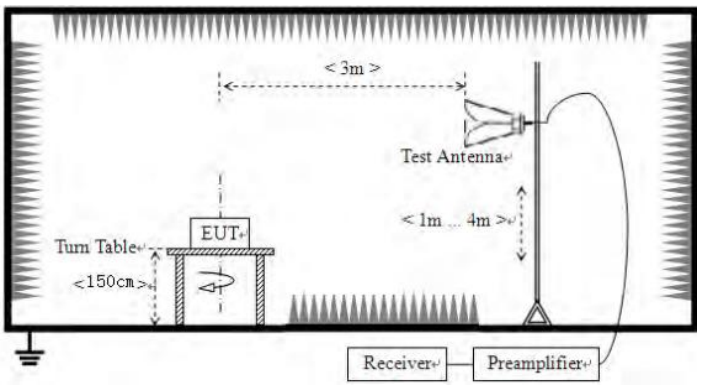
Highest channel



30MHz~25GHz

7.7.2 Radiated Emission Method

<table>
<tr><td>Test Requirement:</td><td>FCC Part15 C Section 15.209
RSS-Gen Clause 8.9&8.10</td></tr>
<tr><td>Test Method:</td><td>ANSI C63.10:2013 and RSS-Gen</td></tr>
<tr><td>Test Frequency Range:</td><td>9kHz to 25GHz</td></tr>
<tr><td>Test site:</td><td>Measurement Distance: 3m</td></tr>
<tr><td>Receiver setup:</td><td>
<table>
<tr><th>Frequency</th><th>Detector</th><th>RBW</th><th>VBW</th><th>Value</th></tr>
<tr><td>9KHz-150KHz</td><td>Quasi-peak</td><td>200Hz</td><td>600Hz</td><td>Quasi-peak</td></tr>
<tr><td>150KHz-30MHz</td><td>Quasi-peak</td><td>9KHz</td><td>30KHz</td><td>Quasi-peak</td></tr>
<tr><td>30MHz-1GHz</td><td>Quasi-peak</td><td>100KHz</td><td>300KHz</td><td>Quasi-peak</td></tr>
<tr><td rowspan="2">Above 1GHz</td><td>Peak</td><td>1MHz</td><td>3MHz</td><td>Peak</td></tr>
<tr><td>Peak</td><td>1MHz</td><td>10Hz</td><td>Average</td></tr>
</table>
</td></tr>
<tr><td>Limit:
(Spurious Emissions)</td><td>
<table>
<tr><th>Frequency</th><th>Limit (uV/m)</th><th>Value</th><th>Measurement Distance</th></tr>
<tr><td>0.009MHz-0.490MHz</td><td>2400/F(KHz)</td><td>QP</td><td>300m</td></tr>
<tr><td>0.490MHz-1.705MHz</td><td>24000/F(KHz)</td><td>QP</td><td>300m</td></tr>
<tr><td>1.705MHz-30MHz</td><td>30</td><td>QP</td><td>30m</td></tr>
<tr><td>30MHz-88MHz</td><td>100</td><td>QP</td><td rowspan="6">3m</td></tr>
<tr><td>88MHz-216MHz</td><td>150</td><td>QP</td></tr>
<tr><td>216MHz-960MHz</td><td>200</td><td>QP</td></tr>
<tr><td>960MHz-1GHz</td><td>500</td><td>QP</td></tr>
<tr><td rowspan="2">Above 1GHz</td><td>500</td><td>Average</td></tr>
<tr><td>5000</td><td>Peak</td></tr>
</table>
</td></tr>
<tr><td>Limit:
(band edge)</td><td>Emissions radiated outside of the specified frequency bands, except for harmonics, shall be attenuated by at least 50 dB below the level of the fundamental or to the general radiated emission limits in Section 15.209, whichever is the lesser attenuation.</td></tr>
</table>

Test setup:	Below 30MHz  Below 1GHz  Above 1GHz 
Test Procedure:	1. The EUT was placed on the top of a rotating table (0.8m for below 1G and 1.5m for above 1G) above the ground at a 3 meter camber. The table was rotated 360 degrees to determine the position of the highest radiation. 2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

	3. 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. 4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rota table was turned from 0 degrees to 360 degrees to find the maximum reading. 5. The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode. 6. 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.					
Test Instruments:	Refer to section 6.0 for details					
Test mode:	Refer to section 5.2 for details					
Test environment:	Temp.:	25 °C	Humid.:	52%	Press.:	1012mbar
Test voltage:	AC 120V, 60Hz					
Test results:	Pass					

Measurement data:

■ Below 30MHz

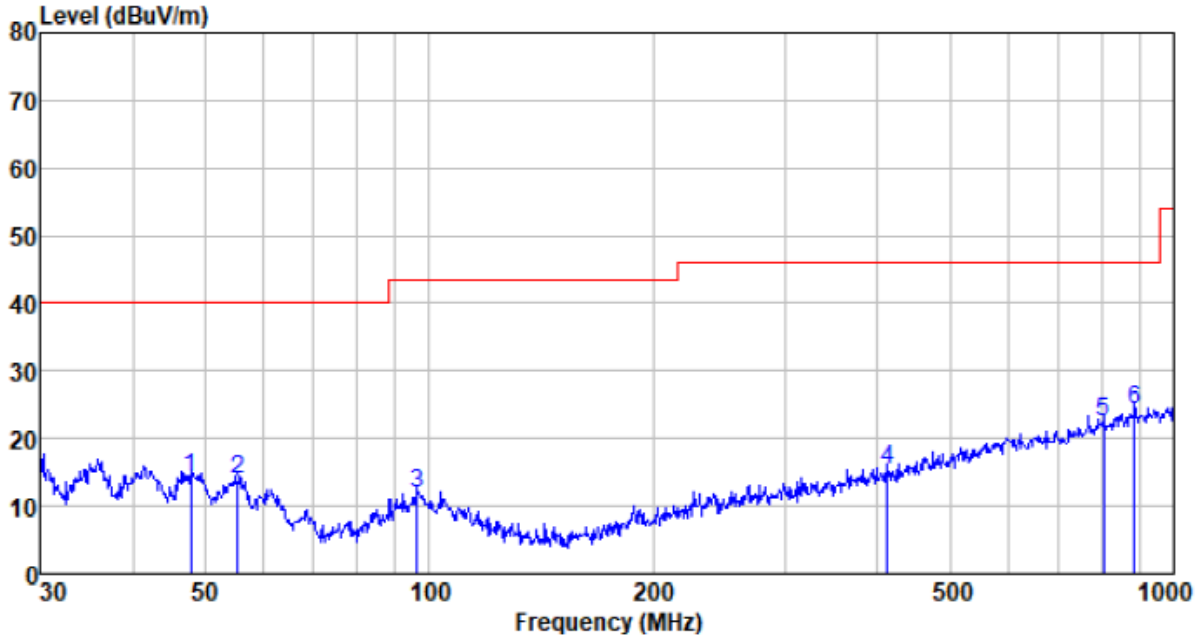
The emission from 9 kHz to 30MHz was pre-tested and found the result was 20dB lower than the limit, and according to 15.31(o), the test result no need to reported.

Remark:

Pre-scan all kind of the place mode (X-axis, Y-axis, Z-axis), and found the Y-axis which it is worse case.

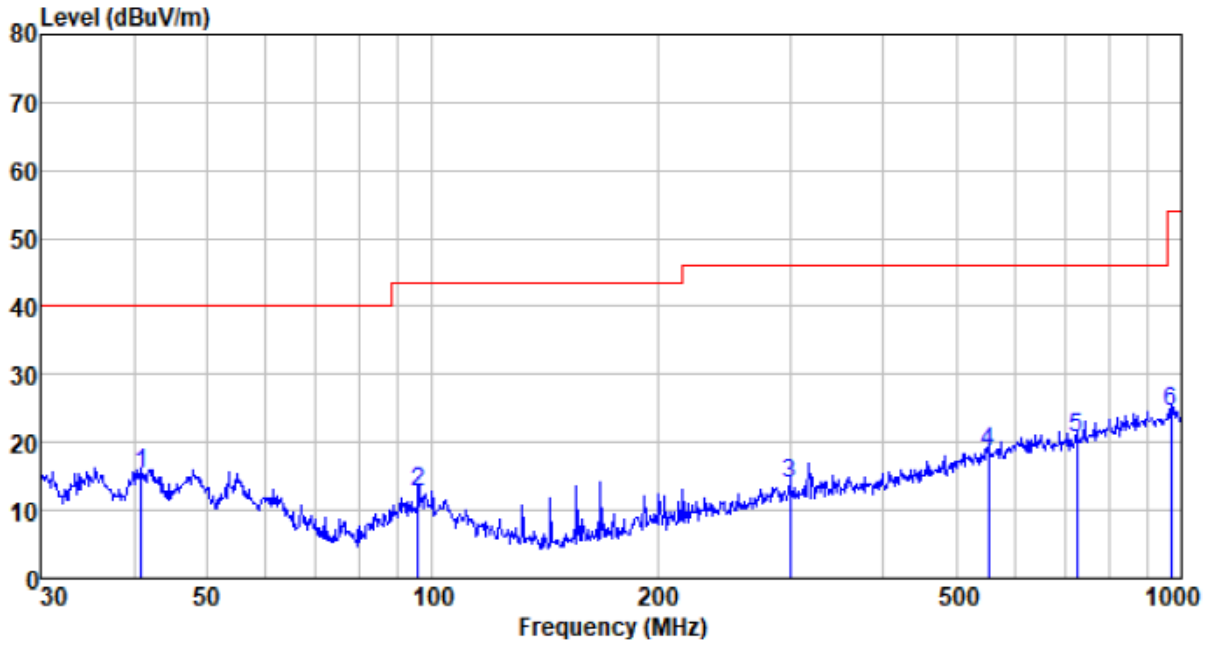
■ **Below 1GHz**

Horizontal:



Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV	dBuV/m	dB	
47.826	37.28	12.28	0.75	36.08	14.23	40.00	-25.77	QP
55.221	37.62	11.78	0.82	36.26	13.96	40.00	-26.04	QP
96.436	35.52	11.72	1.16	36.69	11.71	43.50	-31.79	QP
411.824	34.23	15.59	2.91	37.52	15.21	46.00	-30.79	QP
804.603	34.13	21.43	4.48	37.62	22.42	46.00	-23.58	QP
884.503	34.95	22.16	4.79	37.60	24.30	46.00	-21.70	QP

Vertical:

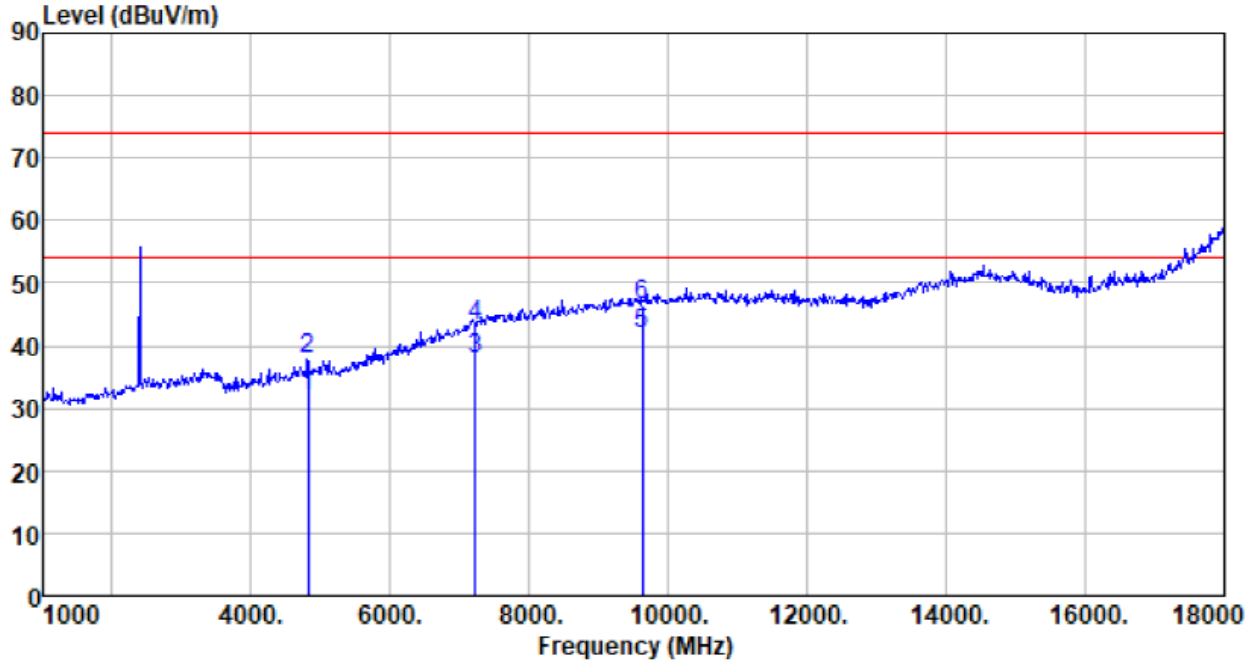


Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV	dBuV/m	dB	
40.845	38.17	12.21	0.67	35.71	15.34	40.00	-24.66	QP
95.762	36.62	11.59	1.16	36.69	12.68	43.50	-30.82	QP
300.367	35.34	13.60	2.36	37.42	13.88	46.00	-32.12	QP
552.883	34.19	18.51	3.53	37.53	18.70	46.00	-27.30	QP
724.261	34.04	20.03	4.18	37.63	20.62	46.00	-25.38	QP
968.934	34.23	22.59	5.11	37.54	24.39	54.00	-29.61	QP

■ **Above 1GHz**

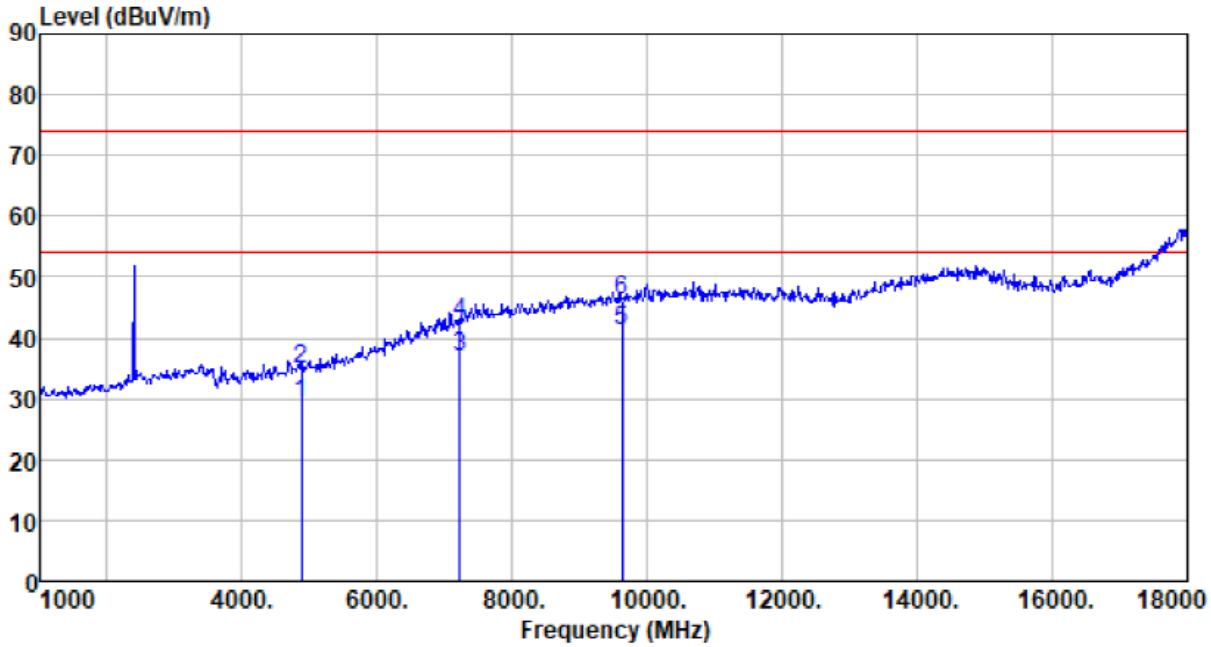
Test channel:	Lowest

Horizontal:



Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV	dBuV/m	dB	
4810.000	33.69	31.20	4.61	37.73	31.77	54.00	-22.23	Average
4810.000	39.81	31.20	4.61	37.73	37.89	74.00	-36.11	Peak
7215.000	30.74	36.20	6.50	35.63	37.81	54.00	-16.19	Average
7215.000	36.18	36.20	6.50	35.63	43.25	74.00	-30.75	Peak
9620.000	30.97	37.93	7.98	34.94	41.94	54.00	-12.06	Average
9620.000	35.60	37.93	7.98	34.94	46.57	74.00	-27.43	Peak

Vertical:



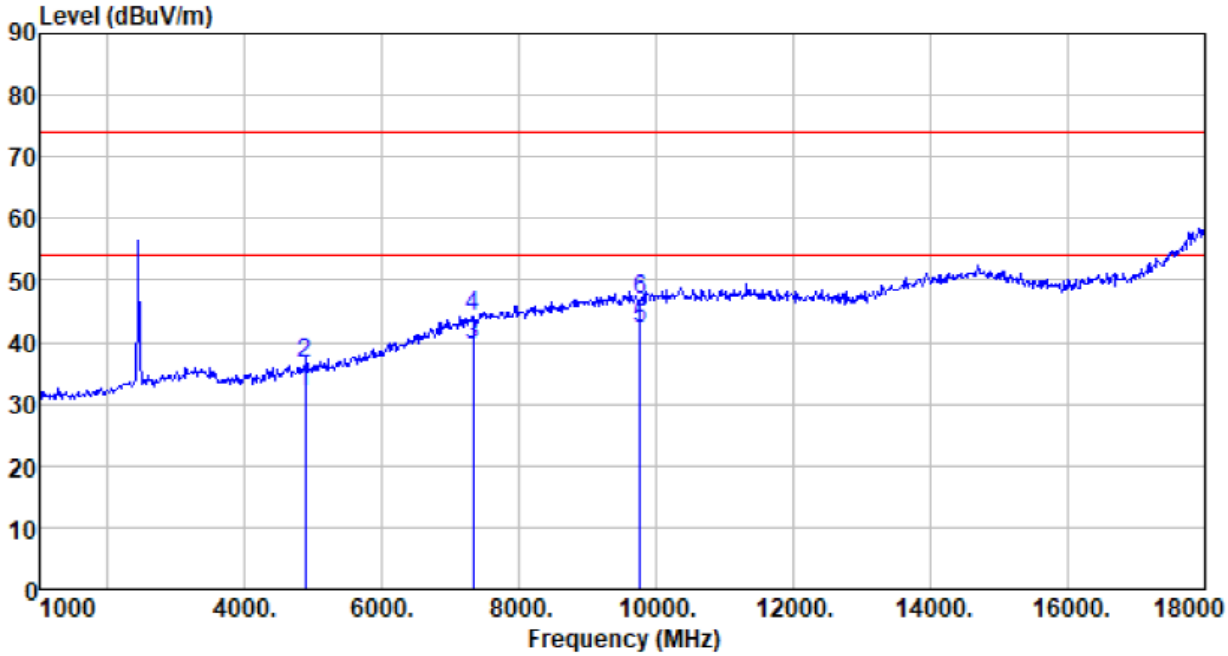
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
4880.000	31.08	31.31	4.69	37.75	29.33	54.00	-24.67	Average
4880.000	36.50	31.31	4.69	37.75	34.75	74.00	-39.25	Peak
7215.000	29.73	36.20	6.50	35.63	36.80	54.00	-17.20	Average
7215.000	35.48	36.20	6.50	35.63	42.55	74.00	-31.45	Peak
9620.000	30.25	37.93	7.98	34.94	41.22	54.00	-12.78	Average
9620.000	35.33	37.93	7.98	34.94	46.30	74.00	-27.70	Peak

Remark:

1. *Final Level =Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor*
2. *No emission found in frequency above 18GHz.*

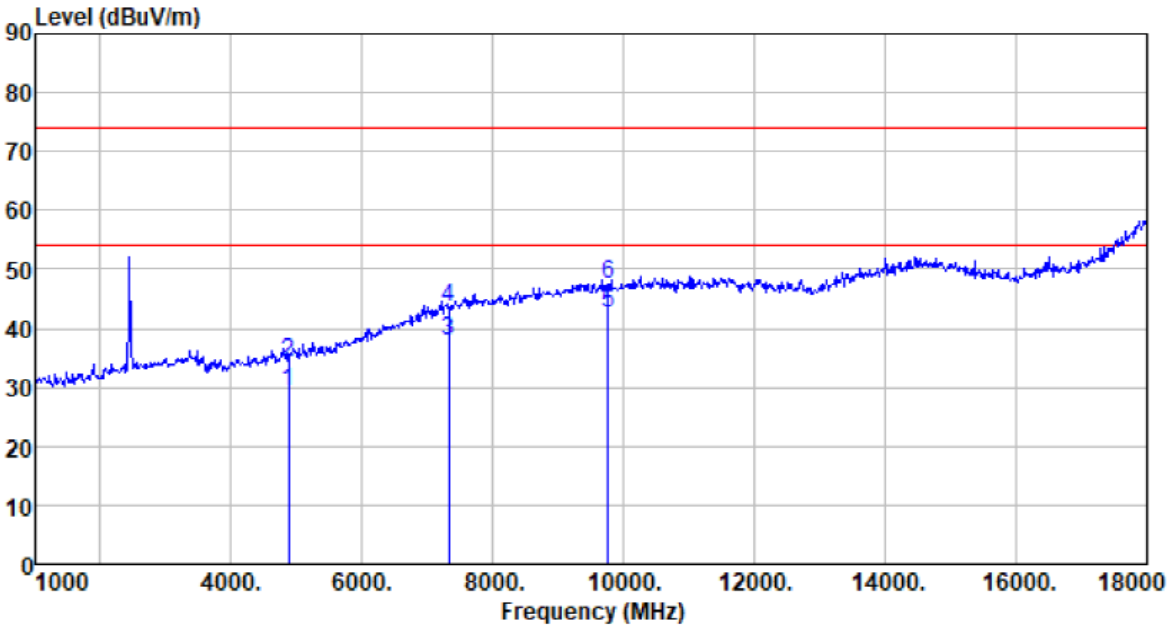
Test channel:	Middle

Horizontal:



Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV	dBuV/m	dB	
4880.000	33.73	31.31	4.69	37.75	31.98	54.00	-22.02	Average
4880.000	38.17	31.31	4.69	37.75	36.42	74.00	-37.58	Peak
7320.000	31.98	36.43	6.63	35.60	39.44	54.00	-14.56	Average
7320.000	36.60	36.43	6.63	35.60	44.06	74.00	-29.94	Peak
9760.000	31.03	38.10	8.03	35.03	42.13	54.00	-11.87	Average
9760.000	35.60	38.10	8.03	35.03	46.70	74.00	-27.30	Peak

Vertical:



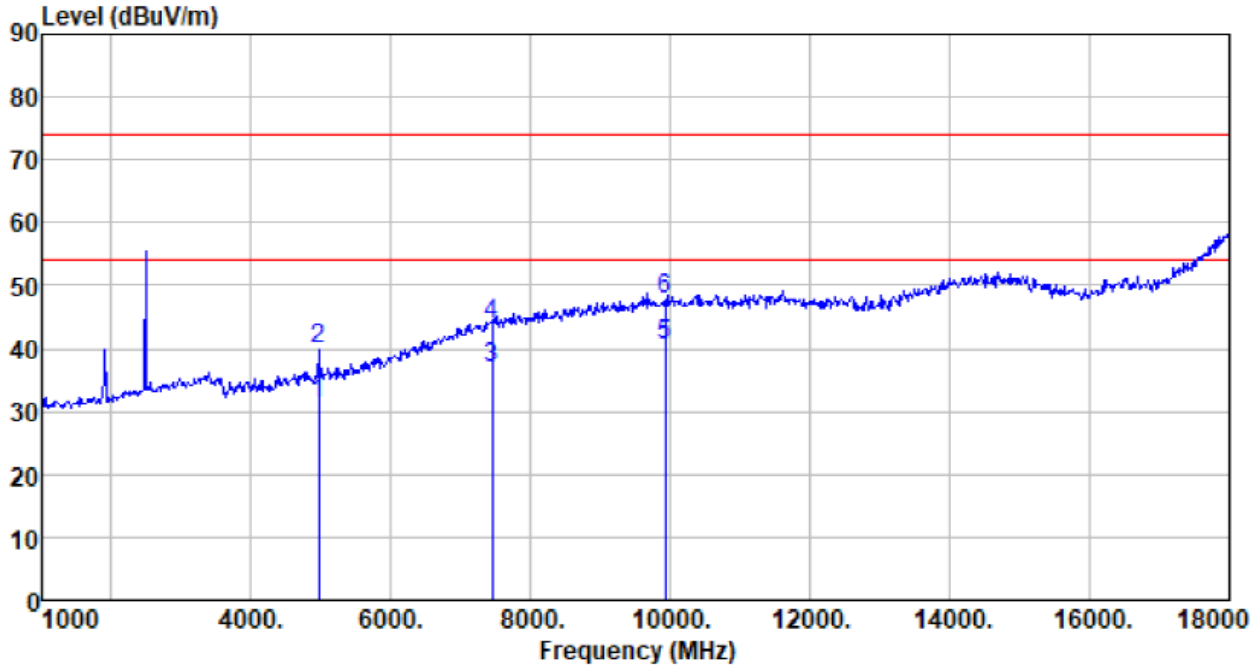
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
4880.000	31.08	31.31	4.69	37.75	29.33	54.00	-24.67	Average
4880.000	36.10	31.31	4.69	37.75	34.35	74.00	-39.65	Peak
7320.000	30.31	36.43	6.63	35.60	37.77	54.00	-16.23	Average
7320.000	36.03	36.43	6.63	35.60	43.49	74.00	-30.51	Peak
9760.000	31.40	38.10	8.03	35.03	42.50	54.00	-11.50	Average
9760.000	36.34	38.10	8.03	35.03	47.44	74.00	-26.56	Peak

Remark:

1. *Final Level =Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor*
2. *No emission found in frequency above 18GHz.*

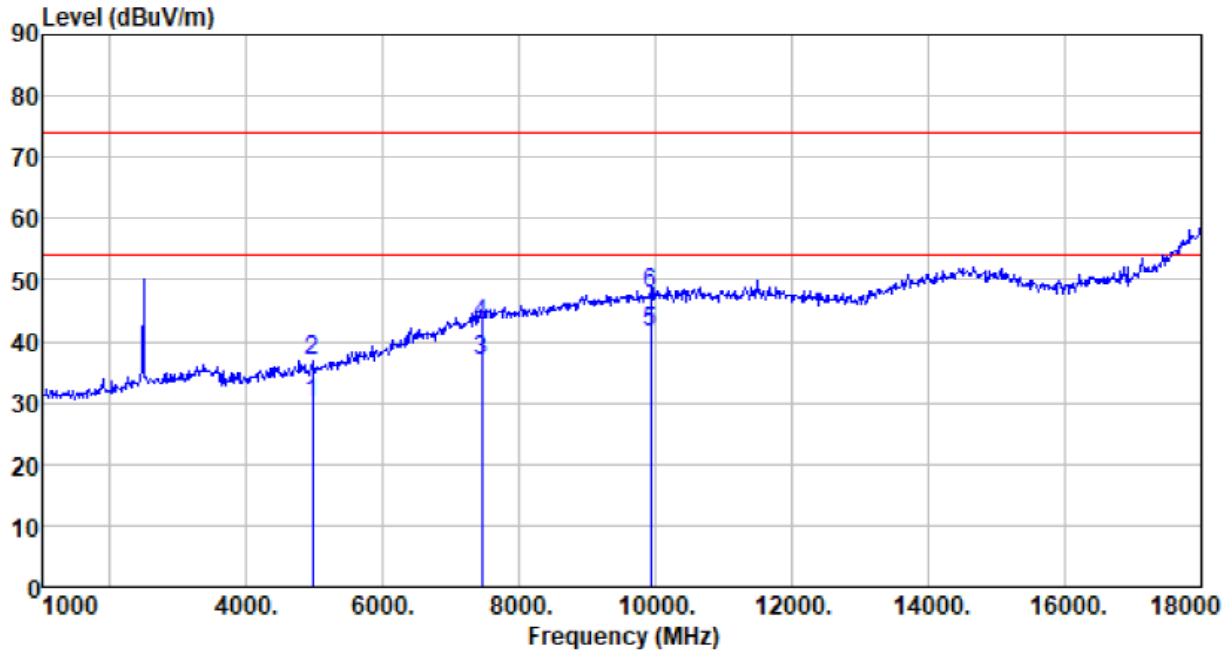
Test channel:	Highest

Horizontal:



Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV	dBuV/m	dB	
4960.000	32.88	31.44	4.79	37.78	31.33	54.00	-22.67	Average
4960.000	41.28	31.44	4.79	37.78	39.73	74.00	-34.27	Peak
7440.000	29.12	36.66	6.77	35.56	36.99	54.00	-17.01	Average
7440.000	35.81	36.66	6.77	35.56	43.68	74.00	-30.32	Peak
9920.000	29.24	38.30	8.09	35.14	40.49	54.00	-13.51	Average
9920.000	36.52	38.30	8.09	35.14	47.77	74.00	-26.23	Peak

Vertical::

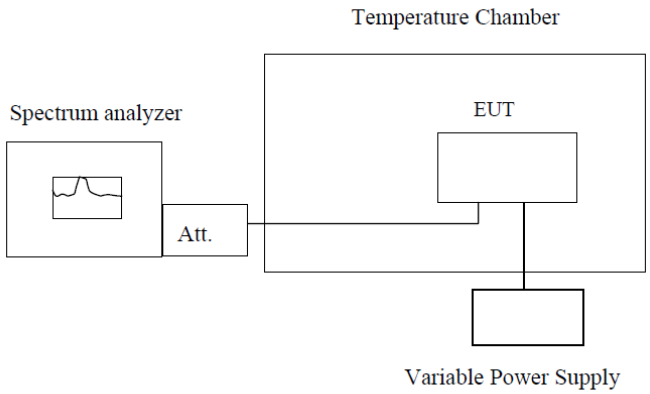


Freq	Reading level	Antenna factor	Cable loss	Preamp factor	level	Limit level	Over limit	Remark
MHz	dBuV	dB/m	dB	dB	dBuV	dBuV/m	dB	
4960.000	31.46	31.44	4.79	37.78	29.91	54.00	-24.09	Average
4960.000	38.54	31.44	4.79	37.78	36.99	74.00	-37.01	Peak
7440.000	29.00	36.66	6.77	35.56	36.87	54.00	-17.13	Average
7440.000	35.10	36.66	6.77	35.56	42.97	74.00	-31.03	Peak
9920.000	30.31	38.30	8.09	35.14	41.56	54.00	-12.44	Average
9920.000	36.73	38.30	8.09	35.14	47.98	74.00	-26.02	Peak

Remark:

1. *Final Level =Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor*
2. *No emission found in frequency above 18GHz.*

7.8 Frequency stability

Test Requirement:	RSS-Gen Section 6.11& Section 8.11
Test Method:	ANSI C63.10: 2013 & RSS-Gen
Limit:	Manufactures of devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified
Test Procedure:	The EUT was setup to ANSI C63.10, 2013; tested to 2.1055 for compliance to RSS-Gen requirements.
Test setup:	 **Note :** Measurement setup for testing on Antenna connector
Test Instruments:	Refer to section 6.0 for details
Test mode:	Refer to section 5.2 for details
Test results:	Pass

Remark: Set the EUT transmits at un-modulation mode to test frequency stability.

Measurement data:

Frequency stability versus Temp.						
Power Supply: DC 3V						
Temp. (°C)	Operating Frequency (MHz)	0 minute	2 minute	5 minute	10 minute	Pass /Fail
		Measured Frequency (MHz)	Measured Frequency (MHz)	Measured Frequency (MHz)	Measured Frequency (MHz)	
-30	2405	2405.6	2405.6	2405.3	2405.3	Pass
	2440	2440.7	2440.7	2440.1	2440.5	Pass
	2480	2480.9	2480.4	2480.2	2480.2	Pass
20	2405	2405	2405.6	2405.1	2405.3	Pass
	2440	2440.3	2440.9	2440.4	2440.5	Pass
	2480	2480.8	2480.3	2480.5	2481	Pass
50	2405	2405.9	2405.2	2405.6	2405.7	Pass
	2440	2440.8	2440.1	2440.7	2440	Pass
	2480	2480.4	2480.4	2480	2480.8	Pass
Frequency stability versus Voltage						
Temperature: 20°C						
Power Supply (Vdc)	Operating Frequency (MHz)	0 minute	2 minute	5 minute	10 minute	Pass /Fail
		Measured Frequency (MHz)	Measured Frequency (MHz)	Measured Frequency (MHz)	Measured Frequency (MHz)	
2.7	2405	2405.3	2405.7	2405.5	2405.7	Pass
	2440	2440.7	2440.6	2441	2440.7	Pass
	2480	2480.8	2480.3	2480.3	2480.5	Pass
3.3	2405	2405.3	2405.8	2406	2405.1	Pass
	2440	2440.1	2440.2	2440.1	2440.7	Pass
	2480	2480.8	2480.5	2480.2	2480.9	Pass

8 Test Setup Photo

Reference to the **appendix I** for details.

9 EUT Constructional Details

Reference to the **appendix II** for details.

------End------