

FCC REPORT

Applicant: Ecovacs Robotics Co., Ltd.

Address of Applicant: No. 18 You Xiang Road, Wuzhong District, Suzhou City, Jiangsu Province, P.R.China

Manufacturer: Ecovacs Robotics Co., Ltd.

Address of Manufacturer: No. 18 You Xiang Road, Wuzhong District, Suzhou City, Jiangsu Province, P.R.China

Factory: SHENZHEN CHUAN QISHENG INDUSTRIAL Co.,LTD

Address of Factory: 3F West,Building No.2,Jiuzhou Industrial Park,Jiazitang Village East Songbai Road,Gongming Street, Guangming New District,Shenzhen City,P.R.China

Equipment Under Test (EUT)

Product Name: 2.4G wireless module

Model No.: TS-D01-09

FCC ID: 2AAL3-TSD0109

Applicable standards: FCC CFR Title 47 Part 15 Subpart C Section 15.249:2017

Date of sample receipt: January 05, 2018

Date of Test: January 08-15, 2018

Date of report issued: January 16, 2018

Test Result : PASS *

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

Authorized Signature:



Robinson Lo

Laboratory Manager

This results shown in this test report refer only to the sample(s) tested, this test report cannot be reproduced, except in full, without prior written permission of the company. The report would be invalid without specific stamp of test institute and the signatures of compiler and approver.

2 Version

Version No.	Date	Description
00	January 16, 2018	Original

Prepared By:

Bill. Yuan

Date:

January 16, 2018

Project Engineer

Check By:

Andy. Wu

Date:

January 16, 2018

Reviewer

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4 Test Summary

Test Item	Section in CFR 47	Result
Antenna requirement	15.203	Pass
AC Power Line Conducted Emission	15.207	Pass
Field strength of the fundamental signal	15.249 (a)	Pass
Spurious emissions	15.249 (a) (d)/15.209	Pass
Band edge	15.249 (d)/15.205	Pass
20dB Occupied Bandwidth	15.215 (c)	Pass

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

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

4.1 Measurement Uncertainty

Test Item	Frequency Range	Measurement Uncertainty	Notes
Radiated Emission	9kHz ~ 30MHz	$\pm 4.34\text{dB}$	(1)
Radiated Emission	30MHz ~ 1000MHz	$\pm 4.24\text{dB}$	(1)
Radiated Emission	1GHz ~ 26.5GHz	$\pm 4.68\text{dB}$	(1)
AC Power Line Conducted Emission	0.15MHz ~ 30MHz	$\pm 3.45\text{dB}$	(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 Name:	2.4G wireless module
Model No.:	TS-D01-09
Sample(s) Status:	Engineer sample
Quantity of tested samples	1
Serial No.:	JR02E349458
Tested Sample(s) ID:	GTS201712000165-1
Hardware Version:	TS-Y373-08
Software Version:	V1.2
Operation Frequency:	2437MHz
Channel numbers:	1
Modulation type:	GFSK
Antenna Type:	PCB antenna
Antenna gain:	1.5 dBi(declare by Applicant)
Power supply:	DC 3.3V

Operation Frequency each of channel	
Channel	Frequency
1	2437MHz

Test Frequency:

Channel	Frequency
1	2437MHz

5.2 Test mode

Transmitting mode	Keep the EUT in continuously transmitting mode.
<i>Remark: During the test, the dutycycle >98%, 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.</i>	

Per-test mode.

We have verified the construction and function in typical operation, The EUT was placed on three different polar directions; i.e. X axis, Y axis, Z axis. which was shown in this test report and defined as follows:

Axis	X	Y	Z
Field Strength(dBuV/m)	86.12	87.17	85.33

5.3 Description of Support Units

Manufacturer	Description	Model	Serial Number
MEILI	DC POWER SUPPLY	MCH-305A	011121168

5.4 Test Facility

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

- **Industry Canada (IC) —Registration No.: 9079A-2**

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-2, August 15, 2016

5.5 Test Location

All tests were performed at:

Global United Technology Services Co., Ltd.

Address: No. 301-309, 3/F., Jinyuan Business Building, No.2, Laodong Industrial Zone, Xixiang Road, Baoan District, Shenzhen, Guangdong, China 518102

Tel: 0755-27798480

Fax: 0755-27798960

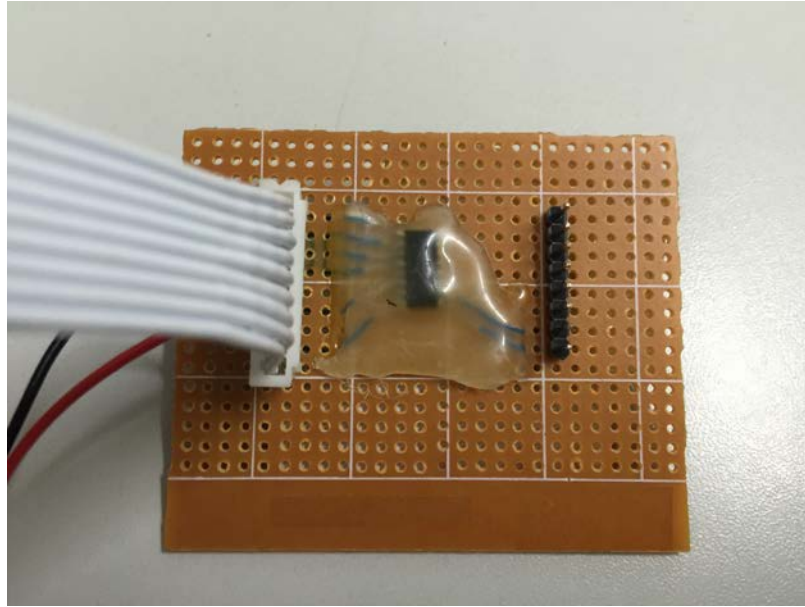
5.6 Other Information Requested by the Customer

None.

5.7 Additional Instructions

EUT Settings:

Engineering plate fixed transmit.



6 Test Instruments list

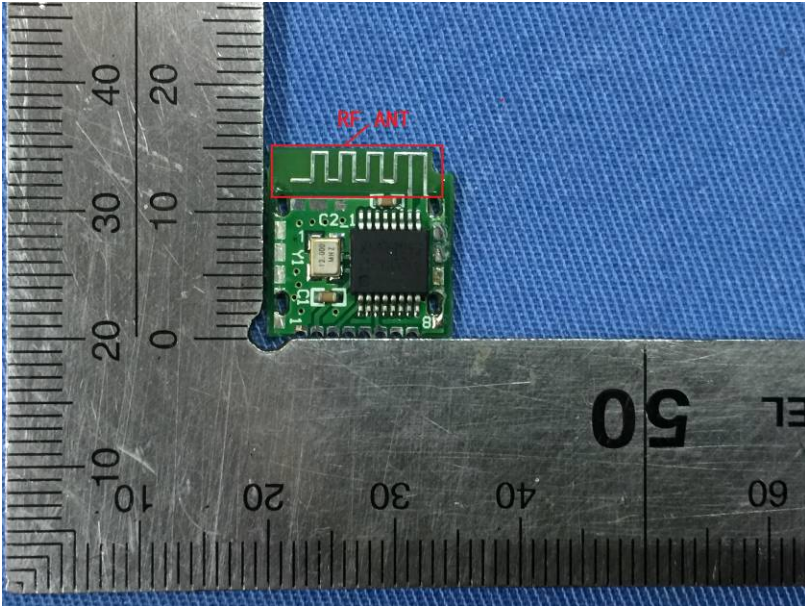
Radiated Emission:						
Item	Test Equipment	Manufacturer	Model No.	Inventory No.	Cal.Date (mm-dd-yy)	Cal.Due date (mm-dd-yy)
1	3m Semi- Anechoic Chamber	ZhongYu Electron	9.2(L)*6.2(W)* 6.4(H)	GTS250	July 03 2015	July 02 2020
2	Control Room	ZhongYu Electron	6.2(L)*2.5(W)* 2.4(H)	GTS251	N/A	N/A
3	Spectrum Analyzer	Agilent	E4440A	GTS533	June 28 2017	June 27 2018
4	EMI Test Receiver	Rohde & Schwarz	ESU26	GTS203	June 28 2017	June 27 2018
5	BiConiLog Antenna	SCHWARZBECK MESS-ELEKTRONIK	VULB9163	GTS214	June 28 2017	June 27 2018
6	Double -ridged waveguide horn	SCHWARZBECK MESS-ELEKTRONIK	9120D-829	GTS208	June 28 2017	June 27 2018
7	Horn Antenna	ETS-LINDGREN	3160	GTS217	June 28 2017	June 27 2018
8	EMI Test Software	AUDIX	E3	N/A	N/A	N/A
9	Coaxial Cable	GTS	N/A	GTS213	June 28 2017	June 27 2018
10	Coaxial Cable	GTS	N/A	GTS211	June 28 2017	June 27 2018
11	Coaxial cable	GTS	N/A	GTS210	June 28 2017	June 27 2018
12	Coaxial Cable	GTS	N/A	GTS212	June 28 2017	June 27 2018
13	Amplifier(100kHz-3GHz)	HP	8347A	GTS204	June 28 2017	June 27 2018
14	Amplifier(2GHz-20GHz)	HP	8349B	GTS206	June 28 2017	June 27 2018
15	Amplifier (18-26GHz)	Rohde & Schwarz	AFS33-18002 650-30-8P-44	GTS218	June 28 2017	June 27 2018
16	Band filter	Amindeon	82346	GTS219	June 28 2017	June 27 2018
17	Power Meter	Anritsu	ML2495A	GTS540	June 28 2017	June 27 2018
18	Power Sensor	Anritsu	MA2411B	GTS541	June 28 2017	June 27 2018

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.16 2014	May.15 2019
2	EMI Test Receiver	R&S	ESCI 7	GTS552	June 28 2017	June 27 2018
3	Coaxial Switch	ANRITSU CORP	MP59B	GTS225	June 28 2017	June 27 2018
4	Artificial Mains Network	SCHWARZBECK MESS	NSLK8127	GTS226	June 28 2017	June 27 2018
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 28 2017	June 27 2018

General used equipment:						
Item	Test Equipment	Manufacturer	Model No.	Inventory No.	Cal.Date (mm-dd-yy)	Cal.Due date (mm-dd-yy)
1	Barometer	ChangChun	DYM3	GTS257	June 28 2017	June 27 2018

7 Test results and Measurement Data

7.1 Antenna requirement

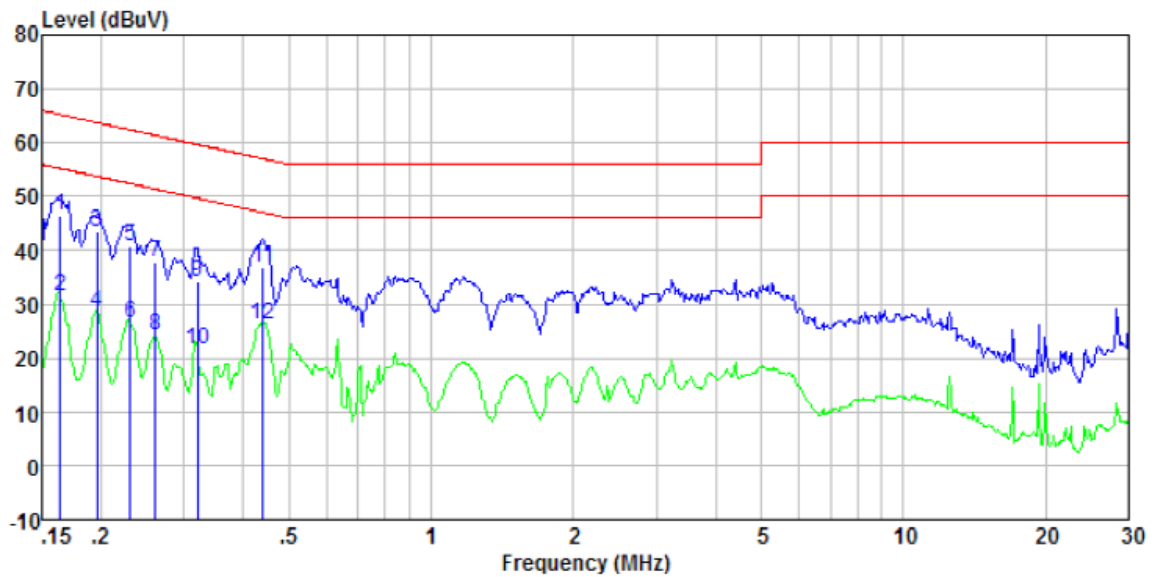
Standard requirement:	FCC Part15 C Section 15.203
15.203 requirement: An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling 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.	
EUT Antenna: <i>The antenna is PCB antenna, the best case gain of the antenna is 1.5 dBi</i> 	

7.2 Conducted Emissions

Test Requirement:	FCC Part15 C Section 15.207		
Test Method:	ANSI C63.10:2013		
Test Frequency Range:	150KHz to 30MHz		
Class / Severity:	Class B		
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:	Reference Plane Test table/Insulation plane <i>Remark: E.U.T: Equipment Under Test LISN: Line Impedance Stabilization Network Test table height=0.8m</i>		
Test procedure:	1. The EUT 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 results:	Pass		

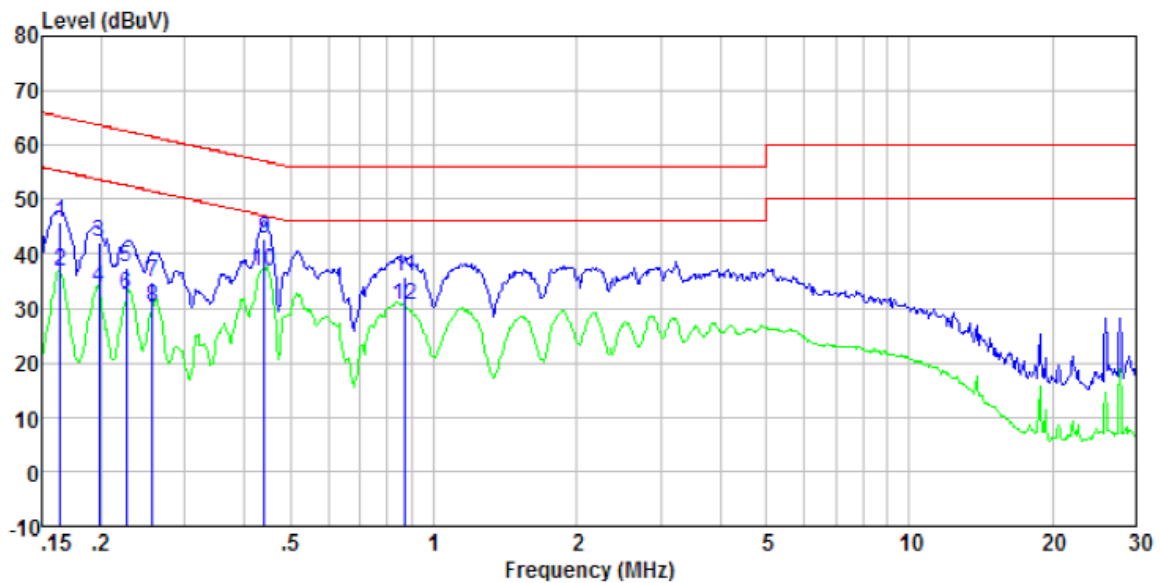
Measurement data

Line:



Freq MHz	Reading level dBuV	LIISN/ISN factor dB	Cable loss dB	level dBuV	Limit level dBuV	Over limit dB	Remark
0.164	45.97	0.42	0.12	46.51	65.25	-18.74	QP
0.164	30.89	0.42	0.12	31.43	55.25	-23.82	Average
0.197	42.93	0.43	0.13	43.49	63.76	-20.27	QP
0.197	27.96	0.43	0.13	28.52	53.76	-25.24	Average
0.230	40.23	0.43	0.12	40.78	62.44	-21.66	QP
0.230	25.97	0.43	0.12	26.52	52.44	-25.92	Average
0.260	37.40	0.44	0.11	37.95	61.42	-23.47	QP
0.260	23.55	0.44	0.11	24.10	51.42	-27.32	Average
0.320	33.79	0.44	0.10	34.33	59.71	-25.38	QP
0.320	20.95	0.44	0.10	21.49	49.71	-28.22	Average
0.440	36.47	0.40	0.11	36.98	57.07	-20.09	QP
0.440	25.66	0.40	0.11	26.17	47.07	-20.90	Average

Neutral:

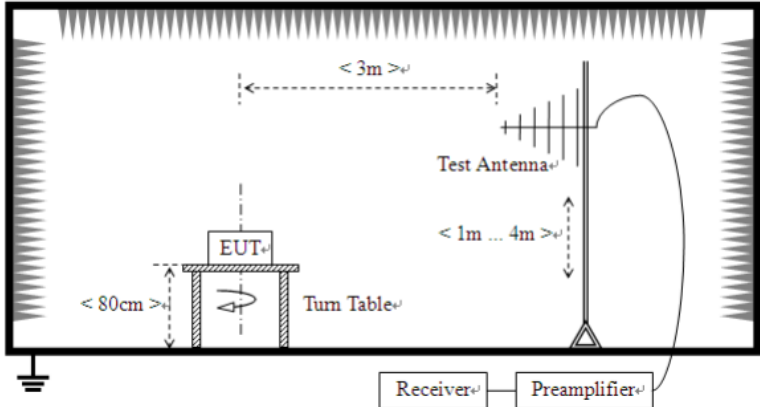


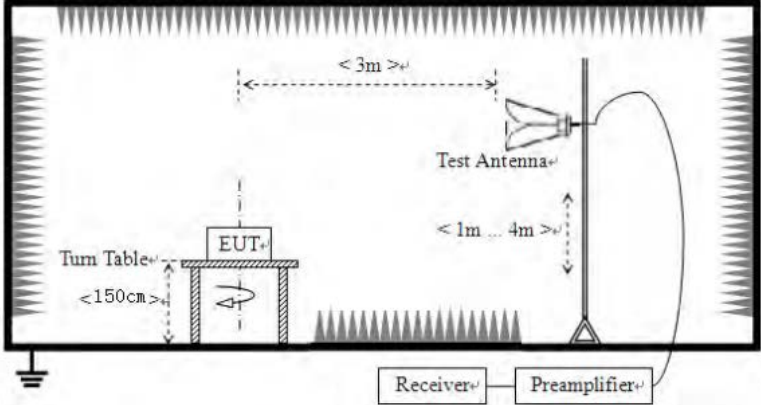
Freq MHz	Reading level dBuV	LISN/ISN factor dB	Cable loss dB	level dBuV	Limit level dBuV	Over limit dB	Remark
0.164	45.10	0.42	0.12	45.64	65.25	-19.61	QP
0.164	36.44	0.42	0.12	36.98	55.25	-18.27	Average
0.198	41.51	0.43	0.13	42.07	63.71	-21.64	QP
0.198	33.25	0.43	0.13	33.81	53.71	-19.90	Average
0.226	37.01	0.43	0.12	37.56	62.61	-25.05	QP
0.226	31.98	0.43	0.12	32.53	52.61	-20.08	Average
0.256	34.15	0.44	0.11	34.70	61.56	-26.86	QP
0.256	29.65	0.44	0.11	30.20	51.56	-21.36	Average
0.440	42.19	0.40	0.11	42.70	57.07	-14.37	QP
0.440	36.47	0.40	0.11	36.98	47.07	-10.09	Average
0.871	35.29	0.26	0.13	35.68	56.00	-20.32	QP
0.871	30.27	0.26	0.13	30.66	46.00	-15.34	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 Radiated Emission Method

Test Requirement:	FCC Part15 C Section 15.209				
Test Method:	ANSI C63.10:2013				
Test Frequency Range:	30MHz to 25GHz				
Test site:	Measurement Distance: 3m				
Receiver setup:	Frequency	Detector	RBW	VBW	Remark
	30MHz-1GHz	Quasi-peak	120KHz	300KHz	Quasi-peak Value
	Above 1GHz	Peak	1MHz	3MHz	Peak Value
		Peak	1MHz	10Hz	Average Value
Limit: (Field strength of the fundamental signal)	Frequency		Limit (dBuV/m @3m)		Remark
	2400MHz-2483.5MHz		94.00		Average Value
Limit: (Spurious Emissions)	Frequency		Limit (dBuV/m @3m)		Remark
	30MHz-88MHz		40.00		Quasi-peak Value
	88MHz-216MHz		43.50		Quasi-peak Value
	216MHz-960MHz		46.00		Quasi-peak Value
	960MHz-1GHz		54.00		Quasi-peak Value
	Above 1GHz		54.00		Average Value
			74.00		Peak Value
Limit: (band edge)	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.				
Test setup:	Below 1GHz				
					
	Above 1GHz				

	
Test Procedure:	1. The EUT was placed on the top of a rotating table (0.8m for below 1GHz and 1.5 meters for above 1GHz) 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 results:	Pass

Measurement data:

7.3.1 Field Strength of The Fundamental Signal

Peak value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
2437.00	75.76	27.46	5.43	24.76	83.89	114.00	-30.11	Vertical
2437.00	79.04	27.46	5.43	24.76	87.17	114.00	-26.83	Horizontal

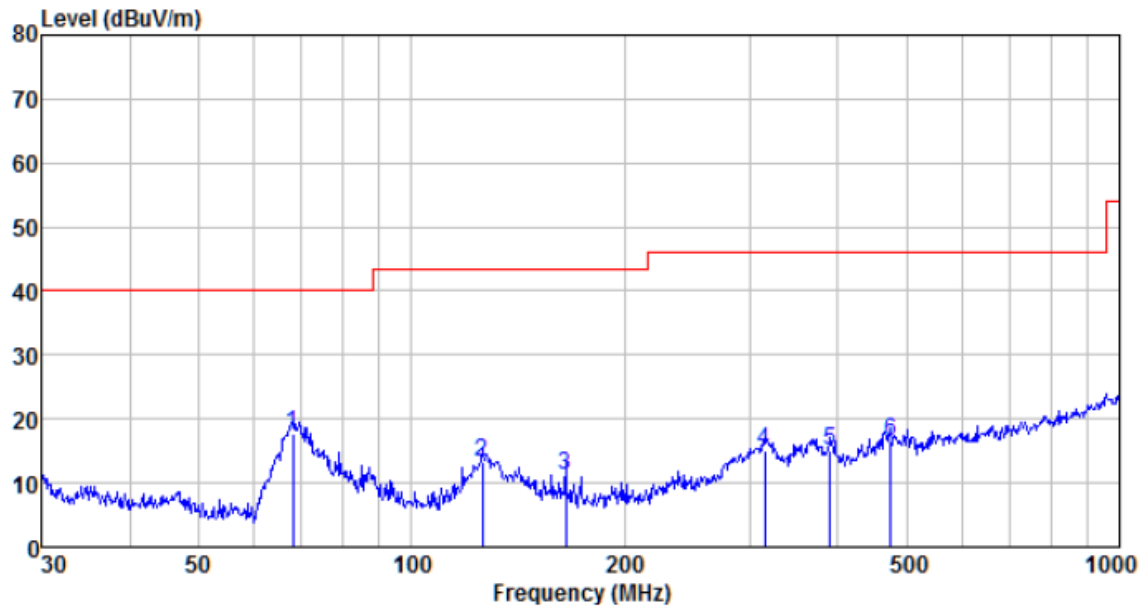
Average value:

Frequency (MHz)	Read Level (dBuV)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamplifier Factor (dB)	Level (dBuV/m)	Limit Line (dBuV/m)	Over Limit (dB)	polarization
2437.00	67.89	27.46	5.43	24.76	76.02	94.00	-17.98	Vertical
2437.00	71.17	27.46	5.43	24.76	79.30	94.00	-14.70	Horizontal

7.3.2 Spurious emissions

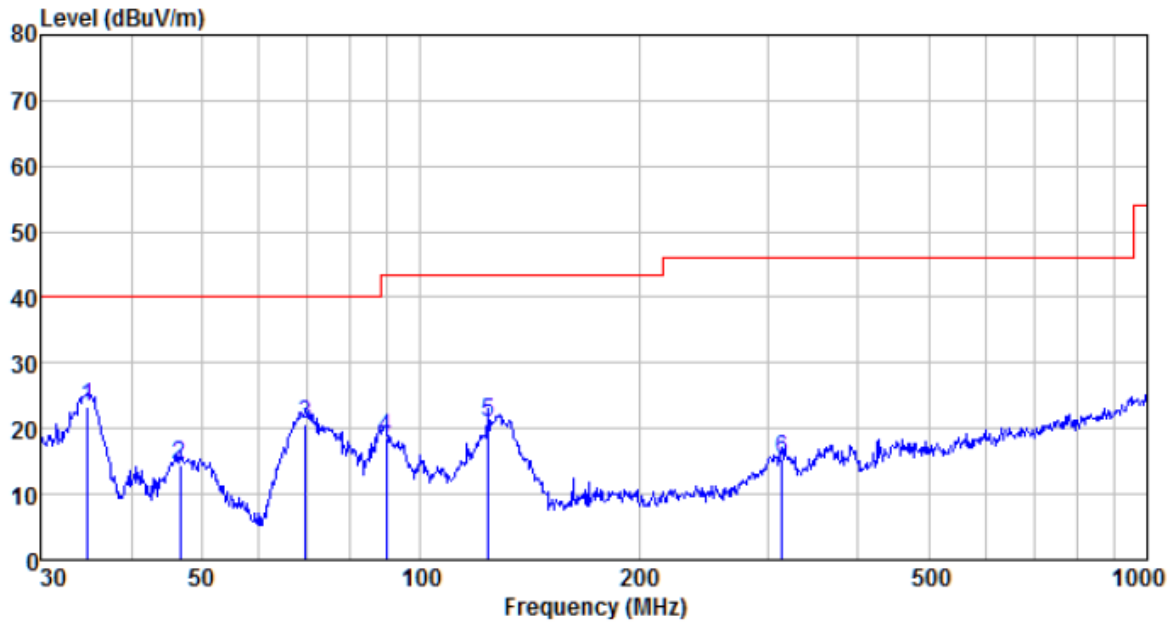
■ Below 1GHz

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
67.936	38.36	8.31	0.92	29.96	17.63	40.00	-22.37	QP
125.789	33.03	8.74	1.41	29.77	13.41	43.50	-30.09	QP
165.270	30.69	8.41	1.66	29.61	11.15	43.50	-32.35	QP
315.178	28.97	13.90	2.44	30.16	15.15	46.00	-30.85	QP
390.368	26.59	15.16	2.81	29.58	14.98	46.00	-31.02	QP
474.661	25.84	16.85	3.20	29.42	16.47	46.00	-29.53	QP

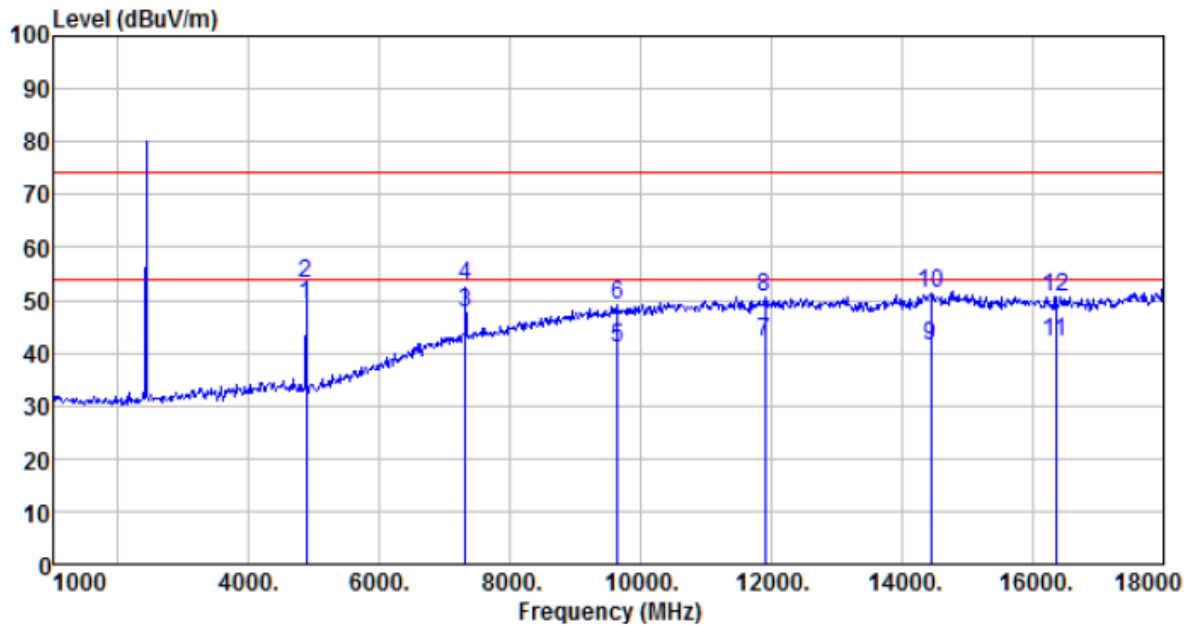
Vertical :



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
34.844	41.55	11.30	0.61	30.14	23.32	40.00	-16.68	QP
46.632	31.59	12.27	0.74	30.03	14.57	40.00	-25.43	QP
69.456	41.95	7.73	0.94	29.95	20.67	40.00	-19.33	QP
89.589	36.81	10.57	1.11	29.92	18.57	43.50	-24.93	QP
123.946	40.45	8.96	1.39	29.78	21.02	43.50	-22.48	QP
314.017	29.10	13.87	2.43	30.17	15.23	46.00	-30.77	QP

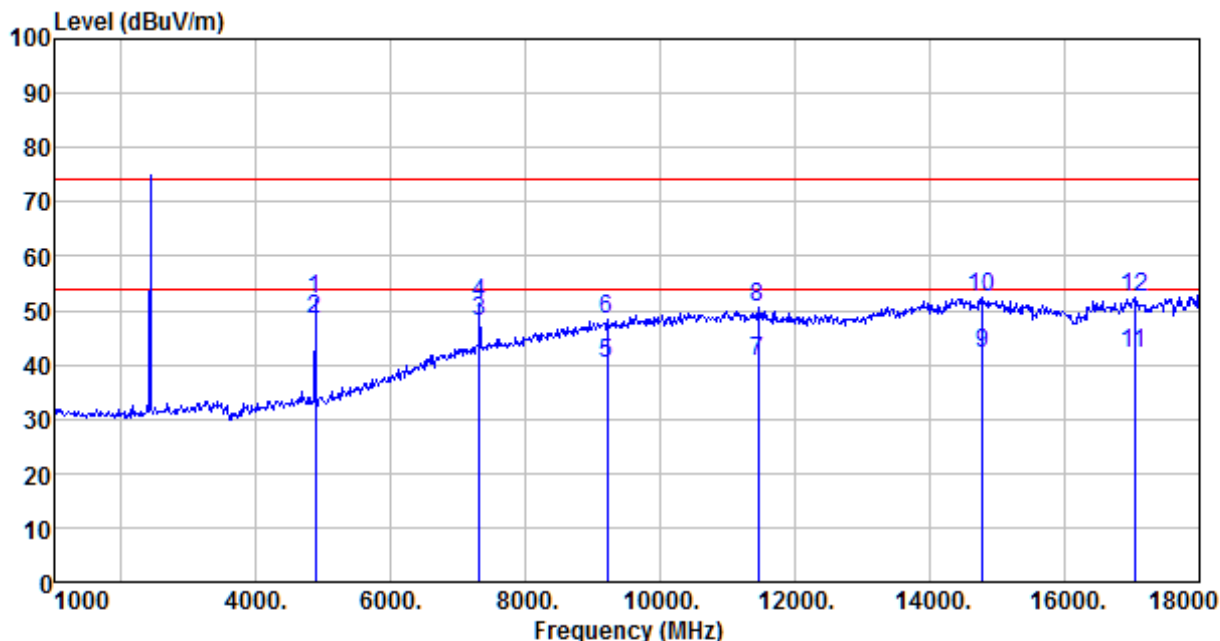
■ Above 1GHz

Horizontal:



Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamplifier factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
4874.500	46.90	31.26	8.66	37.75	49.07	54.00	-4.93	Average
4874.500	51.05	31.26	8.66	37.75	53.22	74.00	-20.78	Peak
7311.200	35.04	36.28	11.71	35.60	47.43	54.00	-6.57	Average
7311.200	40.43	36.28	11.71	35.60	52.82	74.00	-21.18	Peak
9636.000	23.90	37.87	14.16	34.95	40.98	54.00	-13.02	Average
9636.000	31.82	37.87	14.16	34.95	48.90	74.00	-25.10	Peak
11897.000	24.55	38.74	15.02	36.22	42.09	54.00	-11.91	Average
11897.000	33.00	38.74	15.02	36.22	50.54	74.00	-23.46	Peak
14430.000	19.14	41.24	17.17	36.06	41.49	54.00	-12.51	Average
14430.000	28.78	41.24	17.17	36.06	51.13	74.00	-22.87	Peak
16351.000	20.68	38.84	18.27	35.74	42.05	54.00	-11.95	Average
16351.000	29.31	38.84	18.27	35.74	50.68	74.00	-23.32	Peak

Vertical:



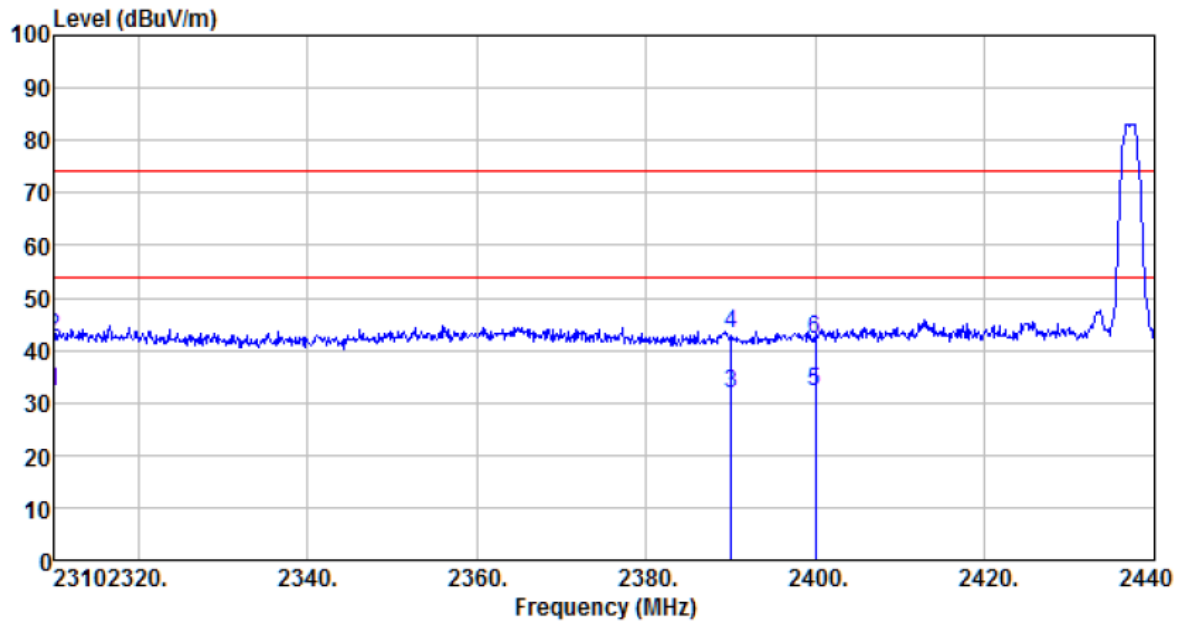
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
4874.000	49.90	31.26	8.66	37.75	52.07	74.00	-21.93	Peak
4874.000	46.05	31.26	8.66	37.75	48.22	54.00	-5.78	Average
7311.000	35.43	36.28	11.71	35.60	47.82	54.00	-6.18	Average
7311.000	39.04	36.28	11.71	35.60	51.43	74.00	-22.57	Peak
9211.000	23.43	37.64	13.82	34.65	40.24	54.00	-13.76	Average
9211.000	31.62	37.64	13.82	34.65	48.43	74.00	-25.57	Peak
11455.000	22.53	39.32	14.98	36.31	40.52	54.00	-13.48	Average
11455.000	32.54	39.32	14.98	36.31	50.53	74.00	-23.47	Peak
14787.000	19.48	40.75	17.34	35.59	41.98	54.00	-12.02	Average
14787.000	29.98	40.75	17.34	35.59	52.48	74.00	-21.52	Peak
17031.000	19.35	39.95	18.99	36.29	42.00	54.00	-12.00	Average
17031.000	29.70	39.95	18.99	36.29	52.35	74.00	-21.65	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.

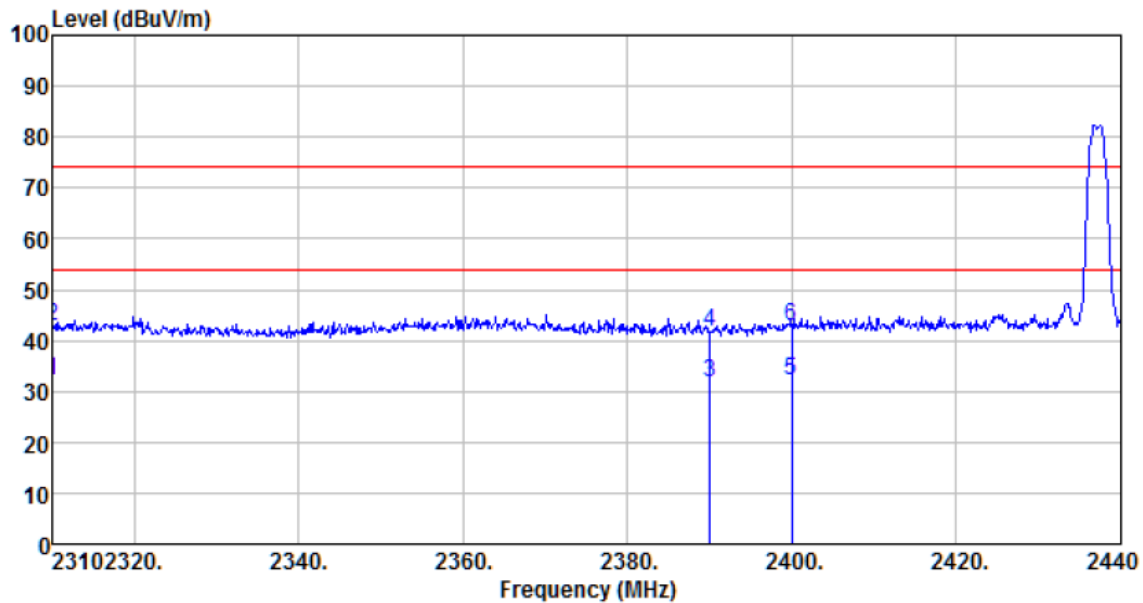
7.3.3 Bandedge emissions

Horizontal:



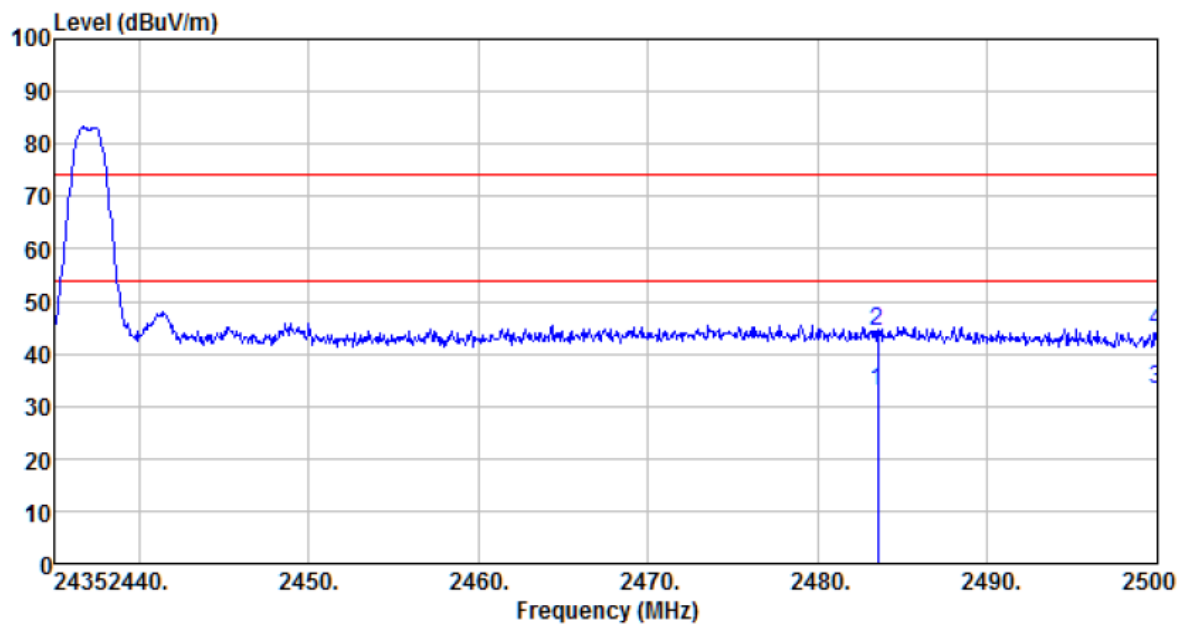
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
2310.000	24.39	27.07	5.30	24.64	32.12	54.00	-21.88	Average
2310.000	34.67	27.07	5.30	24.64	42.40	74.00	-31.60	Peak
2390.000	23.81	27.31	5.38	24.71	31.79	54.00	-22.21	Average
2390.000	35.11	27.31	5.38	24.71	43.09	74.00	-30.91	Peak
2400.000	24.01	27.31	5.39	24.72	31.99	54.00	-22.01	Average
2400.000	33.94	27.31	5.39	24.72	41.92	74.00	-32.08	Peak

Vertical:



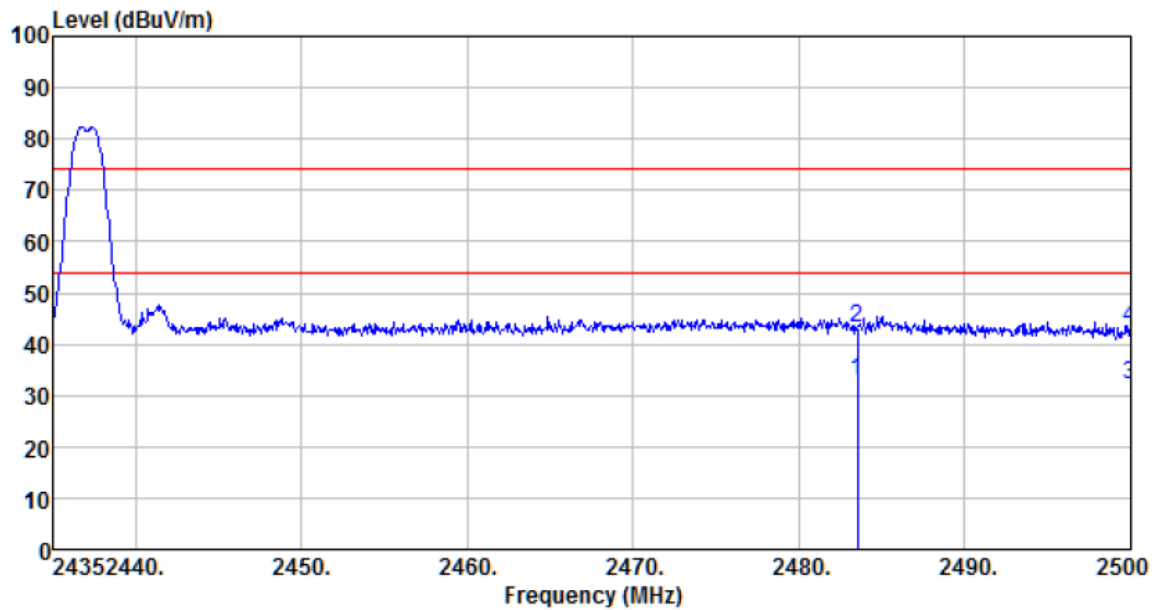
Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
2310.000	24.47	27.07	5.30	24.64	32.20	54.00	-21.80	Average
2310.000	35.00	27.07	5.30	24.64	42.73	74.00	-31.27	Peak
2390.000	23.61	27.31	5.38	24.71	31.59	54.00	-22.41	Average
2390.000	33.82	27.31	5.38	24.71	41.80	74.00	-32.20	Peak
2400.000	24.01	27.31	5.39	24.72	31.99	54.00	-22.01	Average
2400.000	34.91	27.31	5.39	24.72	42.89	74.00	-31.11	Peak

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
2483.500	24.76	27.55	5.47	24.80	32.98	54.00	-21.02	Average
2483.500	35.92	27.55	5.47	24.80	44.14	74.00	-29.86	Peak
2500.000	24.87	27.60	5.49	24.86	33.10	54.00	-20.90	Average
2500.000	35.91	27.60	5.49	24.86	44.14	74.00	-29.86	Peak

Vertical:

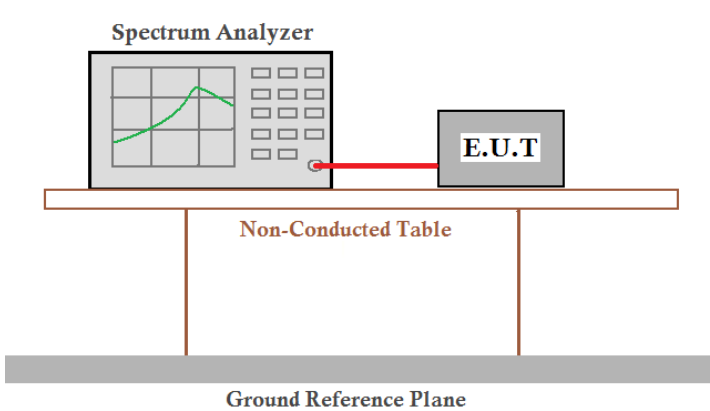


Freq MHz	Reading level dBuV	Antenna factor dB/m	Cable loss dB	Preamp factor dB	level dBuV	Limit level dBuV/m	Over limit dB	Remark
2483.500	24.78	27.55	5.47	24.80	33.00	54.00	-21.00	Average
2483.500	34.81	27.55	5.47	24.80	43.03	74.00	-30.97	Peak
2500.000	23.70	27.60	5.49	24.86	31.93	54.00	-22.07	Average
2500.000	34.80	27.60	5.49	24.86	43.03	74.00	-30.97	Peak

Remark:

1. Final Level = Receiver Read level + Antenna Factor + Cable Loss – Preamplifier Factor

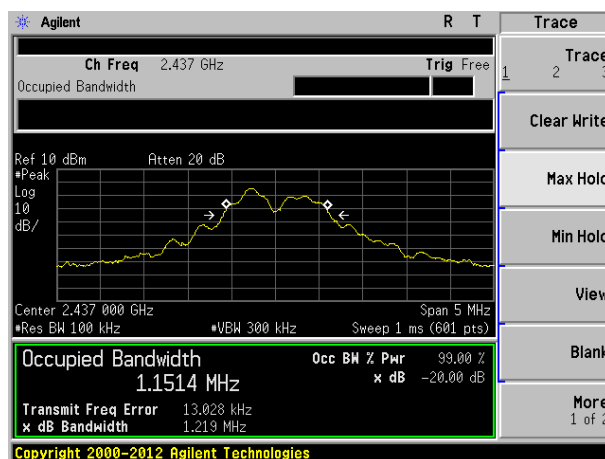
7.4 20dB Occupy Bandwidth

Test Requirement:	FCC Part15 C Section 15.249/15.215
Test Method:	ANSI C63.10:2013
Limit:	Operation Frequency range 2400MHz~2483.5MHz
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

Test Frequency	20dB bandwidth(MHz)	Result
2437MHz	1.219	Pass

Test plot as follows:



8 Test Setup Photo

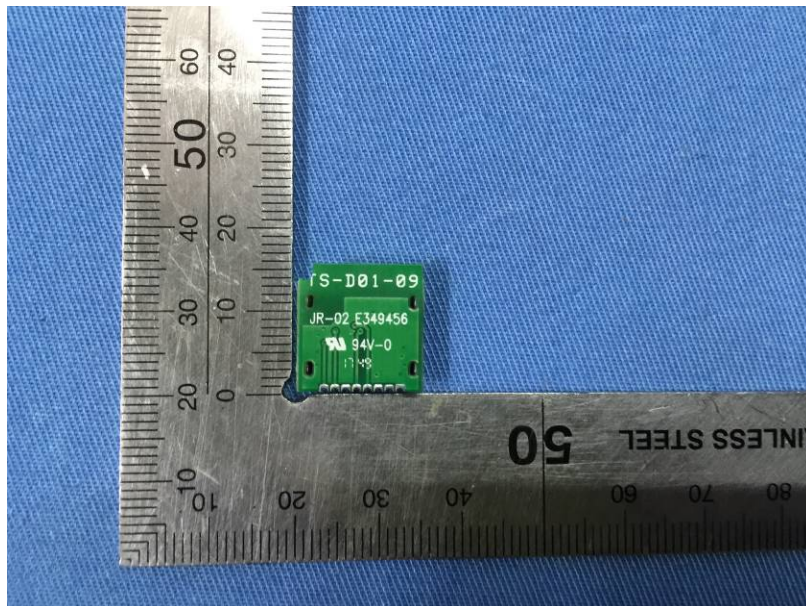
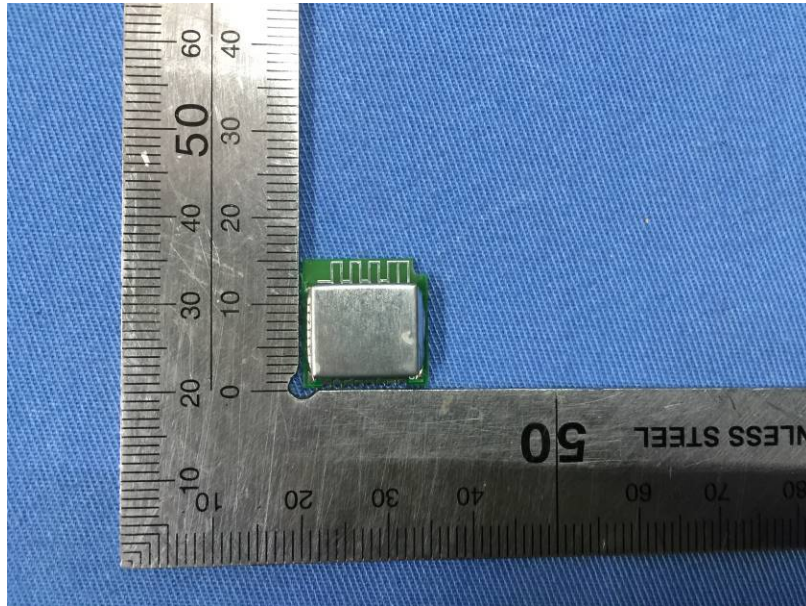
Radiated Emission

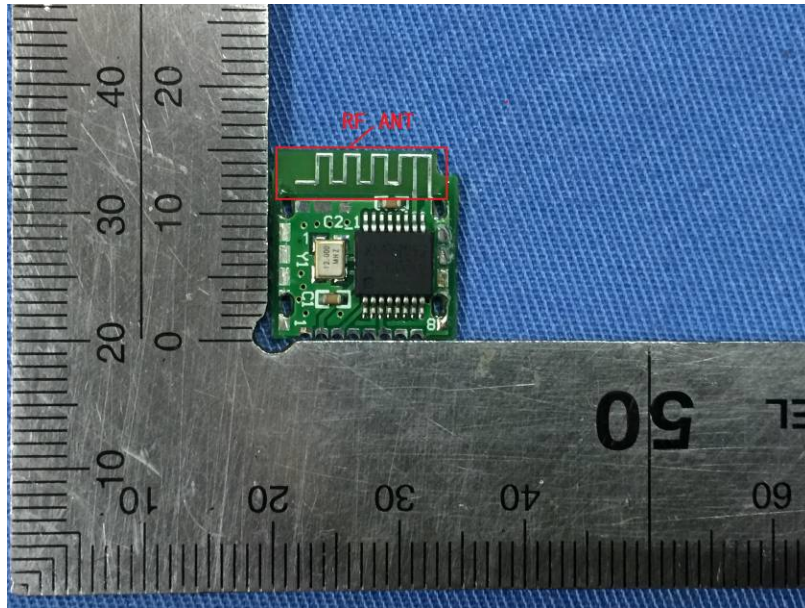


Conducted Emission



9 EUT Constructional Details





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