FCC 47 CFR PART 15 SUBPART C

TEST REPORT

For

Product Name: Mangobot Coding Set

Brand Name: Little Tinkerer

Model No.: MC1001

Series Model.: N/A

FCC ID: 2AQUSMC1001

Test Report Number:

C181015R01-RPB1

Issued for

Beijing Little Tinkerer Co. Ltd

Room 511, 5th Floor, Block B, Building 1, No. 2, Yongcheng North Road, Haidian District, Beijing

Issued by

Compliance Certification Services Inc.

Kun shan Laboratory

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TESTING CERT #2541.01

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Revision History

Rev.	Issue Date	Report NO.	Effect Page	Contents
00	October 22, 2018	C181015R01-RPB1	ALL	N/A

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1 TEST RESULT CERTIFICATION

Product Name:	Mangobot Coding Set
Trade Name:	Little Tinkerer
Model Name:	MC1001
Series Model:	N/A
Applicant Discrepancy:	Initial
Device Category:	mobile unit
Date of Test:	October 15, 2018 to October 16, 2018
Applicant:	**Beijing Little Tinkerer Co. Ltd** Room 511, 5th Floor, Block B, Building 1, No. 2, Yongcheng North Road, Haidian District, Beijing
Manufacturer:	**Beijing Little Tinkerer Co. Ltd** Room 511, 5th Floor, Block B, Building 1, No. 2, Yongcheng North Road, Haidian District, Beijing
Application Type:	Certification

APPLICABLE STANDARDS	
STANDARD	**TEST RESULT**
FCC 47 CFR Part 15 Subpart C	No non-compliance noted

The above equipment was tested by Compliance Certification Services Inc. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10:2013 and the energy emitted by the sample EUT tested as described in this report is in compliance with the requirements of FCC Rules Part 15.207, 15.209, 15.247.

The test results of this report relate only to the tested sample EUT identified in this report.

Approved by:

Jeff.Fang
RF Manager
Compliance Certification Services Inc.

Tested by:

Lily.Wang
Test Engineer
Compliance Certification Services Inc.

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2 EUT DESCRIPTION

Product Name:	Mangobot Coding Set
Trade Name:	Little Tinkerer
Model Name:	MC1001
Series Model:	N/A
Model Discrepancy:	N/A
EUT Power Rating:	DC 4.5-5.5V
Frequency Range :	Bluetooth:2402 ~ 2480 MHz
Transmit Power :	Bluetooth LE4.2: -1.55dBm(0.700mW)
Channel Spacing	Bluetooth LE4.2: 2MHz
Modulation type:	Bluetooth LE4.2: GFSK
Transmit Data Rate :	Bluetooth LE4.2: 1 Mbps
Number of Channels :	Bluetooth LE4.2: 40 Channels
Antenna Specification :	PCB Antenna
Antenna Specification:	0 dBi

Remark:

1.The sample selected for test was engineering sample that approximated to production product and was provided by manufacturer.

2.This submittal(s) (test report) is intended for ***FCC ID: 2AQUSMC1001*** filing to comply with Section 15.207, 15.209 and 15.247 of the FCC Part 15, Subpart C Rules.

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3 TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10 and FCC CFR 47 2.1046, 2.1047, 2.1049, 2.1051, 2.1053, 2.1055, 2.1057, 15.207, 15.209 , 15.247, KDB 558074.

3.1 EUT CONFIGURATION

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner that intends to maximize its emission characteristics in a continuous normal application.

3.2 EXERCISEEUT

The EUT was operated in the engineering mode to fix the TX frequency that was for the purpose of the measurements.

According to its specifications, the EUT must comply with the requirements of the Section 15.207, 15.209 and 15.247 under the FCC Rules Part 15 Subpart C.

3.3 GENERAL TEST PROCEDURES

Conducted Emissions

The EUT is placed on the turntable, which is 0.8 m above ground plane. According to the requirements in Section 13.1.4.1 of ANSI C63.10 Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz using CISPR Quasi-peak and average detector modes.

Radiated Emissions

Under 1GHz

The EUT is placed on a turn table, which is 0.8 m above ground plane. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna, which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the maximum emissions, exploratory radiated emission measurements were made according to the requirements in Section 13.1.4.1 of ANSI C63.10.

Above 1GHz

The EUT is placed on a turn table, which is 1.5 m above ground plane. The turntable shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna, which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the maximum emissions, exploratory radiated emission measurements were made according to the requirements in Section 13.1.4.1 of ANSI C63.10.

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3.4 TEST MODE

Preliminary tests were performed in different data rate to find the worst radiated emission. The data rate shown in the table below is the worst-case rate with respect to the specific test item. Investigation has been done on all the possible configurations for searching the worst cases. The following table is a list of the test modes shown in this test report.

Test Items	Mode	Data Rate	Channel	Antenna
6dB Bandwidth	GFSK	1 Mbps	0/19/39	1
Peak Output Power	GFSK	1 Mbps	0/19/39	1
Power Spectral Density	GFSK	1 Mbps	0/19/39	1
Conducted Band Edges and Spurious Emission	GFSK	1 Mbps	0/19/39	1
Radiated Band Edges and Spurious Emission	GFSK	1 Mbps	0/19/39	1
AC Conducted Emission	CTX	-	-	-

Remark:
1. For radiated test cases below 1 GHz, the worst mode data rate channel 0 was reported only, because this data rate has the highest RF output power at preliminary tests.

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3.5 RESTRICTED BANDS OF OPERATIONS

FCC PART 15.205 RESTRICTED BANDS OF OPERATIONS:

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.0900 - 0.1100	16.420 - 16.423	399.9 - 410.0	4.50 - 5.15
0.4950 - 0.505(1)	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960.0 - 1240	7.25 - 7.75
4.1250 - 4.1280	25.50 - 25.67	1300 - 1427	8.025 - 8.500
4.17725 - 4.17775	37.50 - 38.25	1435.0 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73.0 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.2150 - 6.2180	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108.00 - 121.94	1718.8 - 1722.2	13.25 - 13.40
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.50
8.2910 - 8.2940	149.90 - 150.05	2310 - 2390	15.35 - 16.20
8.3620 - 8.3660	156.52475 - 156.52525	2483.5 - 2500.0	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.1700	3260 - 3267	23.6 - 24.0
12.2900 - 12.2930	167.72 - 173.20	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345 - 3358	36.43 - 36.5 (2)
12.57675 - 12.57725	322.0 - 335.4	3600 - 4400	
13.3600 - 13.4100			

[1] Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

[2] Above 38.6

(b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

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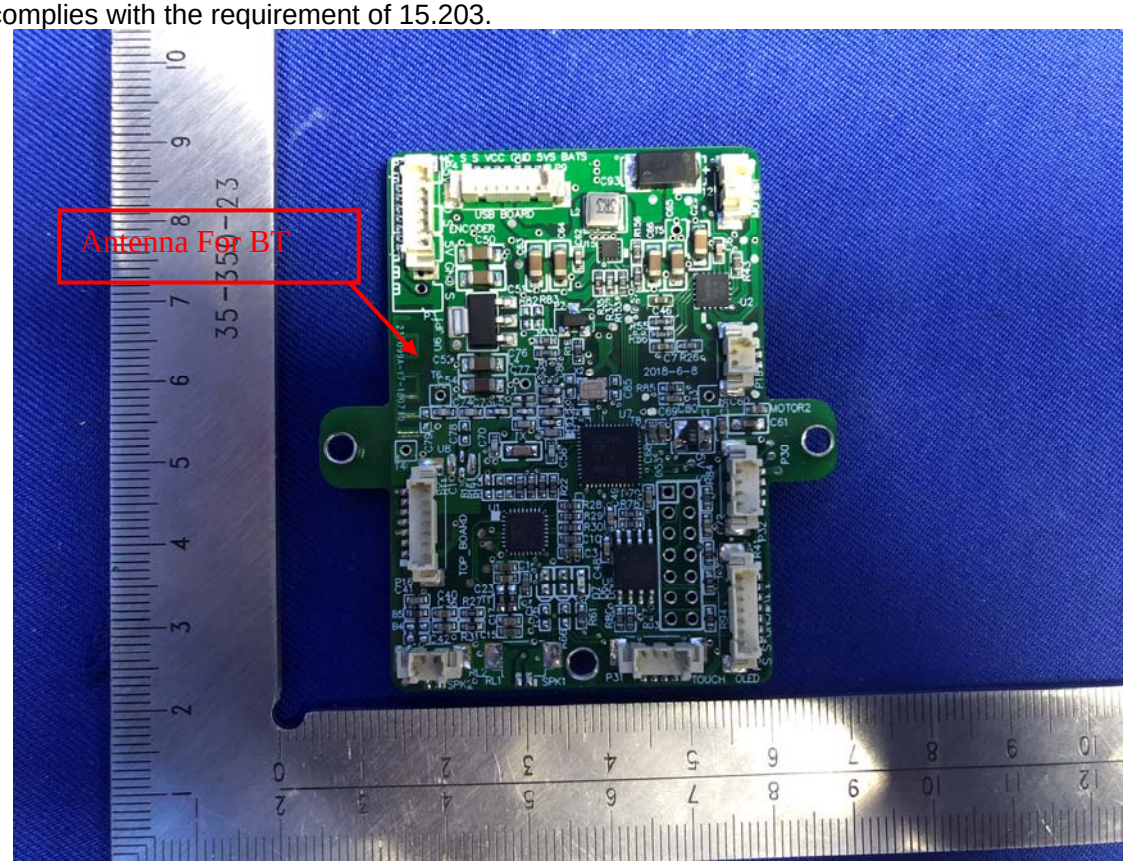
3.6 ANTENNA DESCRIPTION

According to FCC 47 CFR 15.203

"an intentional radiator antenna shall be designed to ensure that no antenna other than that furnished by the responsible party can be used with the device. The use of a permanently attached or an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section"

As the photo below, the EUT use a unique coupling to the intentional radiator attached antenna, so the EUT complies with the requirement of 15.203.



4 INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards. facilities and accreditations

5 FACILITIES AND ACCREDITATIONS

5.1 FACILTIES

All measurement facilities used to collect the measurement data are located at
CCS China Kunshan Lab at 10#Weiye Rd, Innovation Park Eco. & Tec. Development Zone Kunshan city JiangSu, (215300), CHINA.

The sites are constructed in conformance with the requirements of ANSI C63.4 and CISPR Publication 22.

5.2 EQUIPMENT

Radiated emissions are measured with one or more of the following types of linearly polarized antennas: tuned dipole, biconical, log periodic, bi-log, and/or ridged waveguide, horn. Spectrum analyzers with pre-selectors and quasi-peak detectors are used to perform radiated measurements.

Conducted emissions are measured with Line Impedance Stabilization Networks and EMI Test Receivers.

Calibrated wideband preamplifiers, coaxial cables, and coaxial attenuators are also used for making measurements.

All receiving equipment conforms to CISPR Publication 16-1, “Radio Interference Measuring Apparatus and Measurement Methods.”

5.3 LABORATORY ACCREDITATIONS AND LISTING

FCC –Designation Number: CN1172.

Compliance Certification Services Inc. Kun shan 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 our files and the Designation Number: CN1172.

The test facilities are listed with Industry Canada, Laboratory Division, 2324E-1 for 10m chamber, 2324E-2 for 3m chamber.

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5.4 TABLE OF ACCREDITATIONS

Our laboratories are accredited and approved by the following accreditation body according to ISO/IEC 17025.

Taiwan	TAF
USA	A2LA

The measuring facility of laboratories has been authorized or registered by the following approval agencies.

Canada	Industry Canada
Japan	VCCI
Taiwan	BSMI
USA	FCC

Copies of granted accreditation certificates are available for downloading from our web site, http:///www.ccsrf.com

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5.5 LIST OF MEASURING EQUIPMENT

Conducted Emissions Test Site					
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Data**	**Calibration Due**
Spectrum Analyzer	R&S	FSV40	101493	2017-12-18	2018-12-17
Power meter	Anritsu	ML2495A	1445010	2018-4-26	2019-4-25
Power sensor	Anritsu	MA2411B	1339220	2018-4-26	2019-4-25
Power SPLITTER	Mini-Circuits	ZN2PD-9G	SF078500430	N.C.R	N.C.R
DC Power Supply	AGILENT	E3632A	MY50340053	N.C.R	N.C.R
Cable	N/A	Cable-05	N/A	2018-4-24	2019-4-23
6dB Attenuator	N/A	N/A	N/A	2018-4-24	2019-4-23
Temp. / Humidity Gauge	Anymetre	TH603	CCS007	2017-10-24	2018-10-23
Test Software			EZ-EMC		

Conducted Emission					
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Data**	**Calibration Due**
EMI TEST RECEIVER	R&S	ESCI	100781	2018-2-26	2019-2-25
V (V-LISN)	SCHWARZBECK	NNLK 8129	8129-143	2017-10-29	2018-10-28
TWO-LINE V-NETWORK	R&S	ENV216	101604	2017-10-29	2018-10-28
Pulse LIMITER	R&S	ESH3-Z2	100524	2017-12-27	2018-12-26
Cable	Thermax	Cable-02	14	2017-12-27	2018-12-26
Test Software			EZ-EMC		

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977 Chamber					
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Data**	**Calibration Due**
Spectrum Analyzer	R&S	FSV40	101493	2017-12-18	2018-12-17
Spectrum Analyzer	RS	FSU26	200789	2018-7-13	2019-7-12
EMI Test Receiver	R&S	ESCI	101378	2017-12-27	2018-12-26
Amplifier	COM-POWER	PAM-840A	461332	2017-11-29	2018-11-28
Amplifier	COM-POWER	PAM-118A	551044	2018-4-26	2019-4-25
Broad-Band Horn Antenna	SCHWARZBECK	BBHA 9170	9170-515	2018-2-27	2019-2-26
Bilog Antenna	Teseq	CBL6112D	35403	2017-11-5	2018-11-4
Loop Antenna	COM-POWER	AL-130R	10160008	2018-5-8	2019-5-7
Horn-antenna	SCHWARZBECK	9120D	D:266	2018-2-26	2019-2-25
Horn-antenna	SCHWARZBECK	9120D	D:267	2017-11-5	2018-11-4
Turn Table	CT	CT123	4165	N.C.R	N.C.R
Antenna Tower	CT	CTERG23	3256	N.C.R	N.C.R
Controller	CT	CT1OO	95637	N.C.R	N.C.R
Cable	REBES MICROWAVE	Cable-93	N/A	2017-10-29	2018-10-28
Cable	REBES MICROWAVE	Cable-94	N/A	2017-10-29	2018-10-28
Cable	REBES MICROWAVE	Cable-95	N/A	2017-10-29	2018-10-28
Cable	N/A	Cable-03	N/A	2018-4-24	2019-4-23
Cable	N/A	Cable-04	N/A	2018-4-24	2019-4-23
2.4G Filter	N/A	N/A	N/A	2018-4-24	2019-4-23
Test Software			EZ-EMC		

Remark: *Each piece of equipment is scheduled for calibration once a year.*

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5.6 MEASUREMENT UNCERTAINTY

For the test methods, according to the present document, the measurement uncertainty figures shall be calculated in accordance with TR 100 028-1 [2] and shall correspond to an expansion factor (coverage factor) k = 1,96 or k = 2 (which provide confidence levels of respectively 95 % and 95,45 % in the case where the distributions characterizing the actual measurement uncertainties are normal (Gaussian)). Table 6 is based on such expansion factors.

Table 6: Maximum measurement uncertainty

Parameter	Uncertainty
RF output power, conducted	±1.129dB
Unwanted Emissions, conducted	±2.406dB
RF Power density, conducted	±2.379dB
Conducted emissions	±2.582dB
All emissions, radiated (Below 1GHz)	±4.725dB
All emissions, radiated (Above 1GHz)	± 4.818dB
Temperature	±0.3dB
Supply voltages	±0.2%

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5.7 SETUP CONFIGURATION

See test photographs attached in Appendix 1 for the actual connections between EUT and support equipment.

5.8 SUPPORT EQUIPMENT

No.	Equipment	Brand	Model	Series No.	FCC ID
1	Adapter	HUAWEI	HW-050450C00	N/A	N/A

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6 FCC PART 15.247 REQUIREMENTS

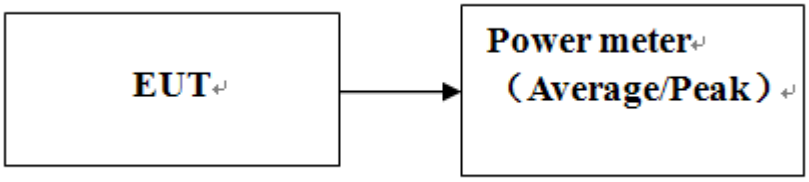
6.1 Maximum conducted output power

Limit

According to FCC part 15.247,the maximum peak output power of the intentional radiator shall not exceed the following:

For systems using digital modulation in the 2400-2483.5MHz, the limit for peak output power is 30dBm. If transmitting antenna of directional gain greater than 6dBi is used, the peak output power from the intentional radiator shall be reduced below the above stated value by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point-to-point operation, the limit has to be reduced by 1dB for every 3dB that the directional gain of the antenna exceeds 6dBi.

Test Configuration



Remark: *Each piece of equipment is scheduled for calibration once a year.*

Test Procedure

1. The testing follows the Measurement Procedure of FCC KDB No. 558074 DTS D01 Meas. Guidance v05.
2. The RF output of EUT was connected to the power meter by RF cable and attenuator. The path loss was compensated to the results for each measurement.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Measure the conducted output power and record the results in the test report.

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Test RESULTS

No non-compliance noted

BLE4.1 GFSK Modulation 1Mbps mode

Test mode:	Bluetooth LE4.2	**Temperature:**	23℃
Test By:	Lily.Wang	**Test Date:**	2018-10-15

Channel	Frequency (MHz)	Peak Output Power (dBm)	Limit (dBm)	e.i.r.p. (dBm)	Limit (dBm)
Low	2402	-1.55	30.00	-1.55	36.00
Mid	2440	-2.60	30.00	-2.60	36.00
High	2480	-3.42	30.00	-3.42	36.00

Channel	Frequency (MHz)	Average Output Power (dBm)	e.i.r.p. (dBm)
Low	2402	-1.64	-1.64
Mid	2440	-2.75	-2.75
High	2480	-3.69	-3.69

Note:Duty factor has been offseted with cableloss

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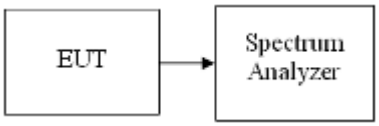
6.2 PEAK POWER SPECTRAL DENSITY

Limit

According to FCC part 15.247, the peak power spectral density shall not be greater than 8dBm in any 3kHz band at any time interval of continuous transmission.

Test Configuration



Test Procedure

1.Place the EUT on the table and set it in transmitting mode.
Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.

2.Set the spectrum analyzer as RBW = 3 kHz, VBW = 10 kHz, Span = 1.5 times the DTS bandwidth, Sweep = auto

3.Record the max reading.

4.Repeat the above procedure until the measurements for all frequencies are completed.

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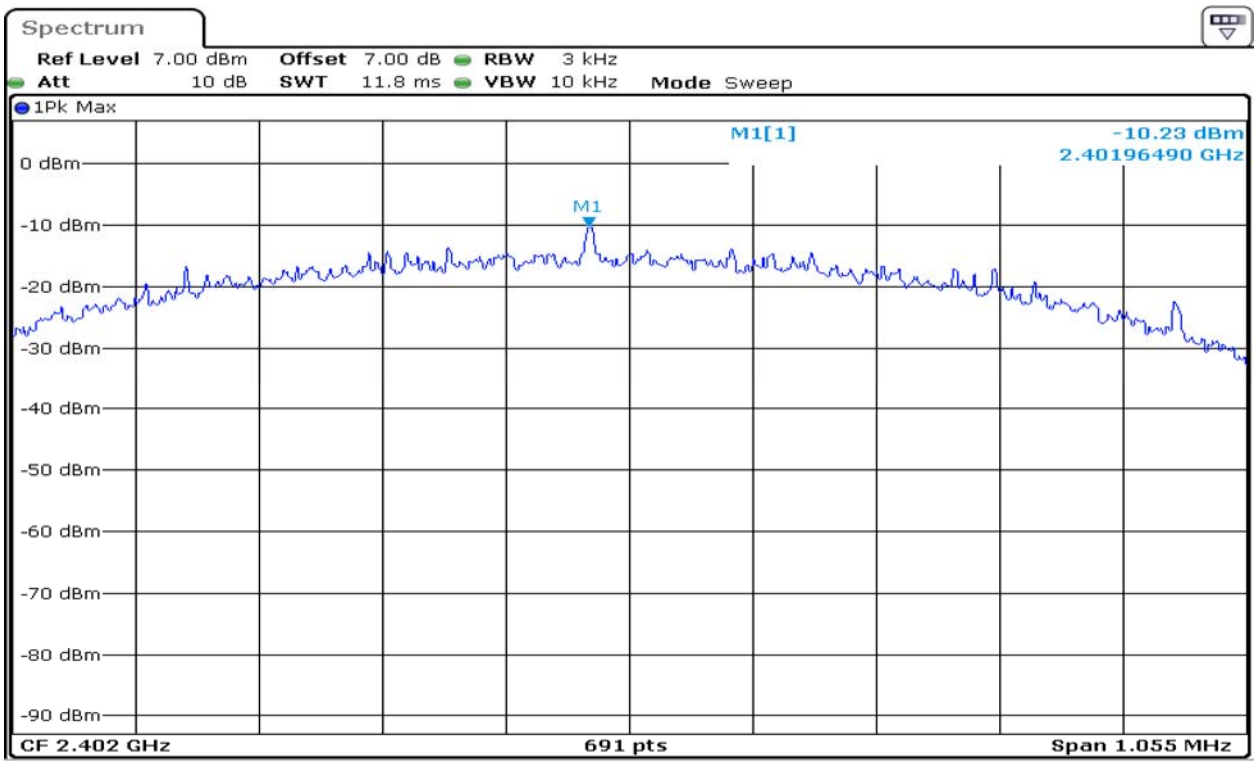
Test Results of power Spectral Density

Test mode:	Bluetooth LE4.2	Temperature:	23℃
Test By:	Lily.Wang	Test Date:	2018-10-15

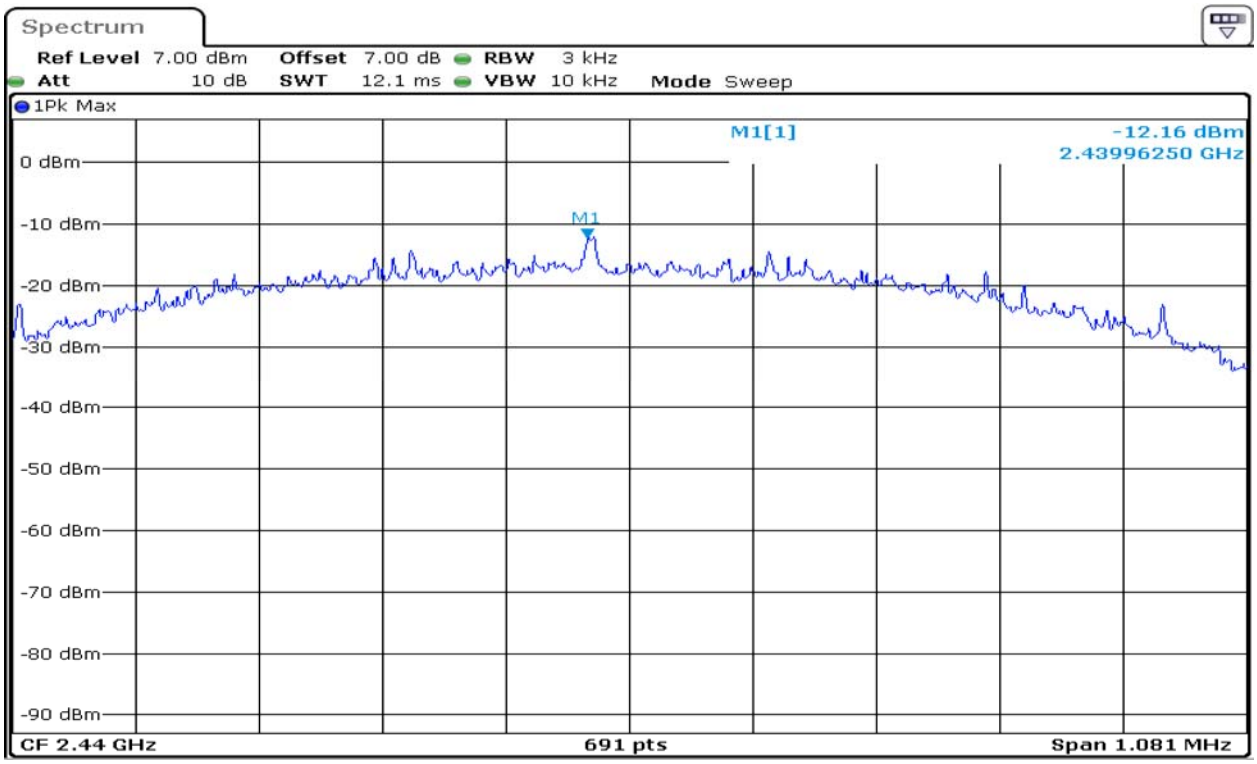
Channel	Frequency (MHz)	PSD/3kHz (dBm)	Limit (dBm)	Result
00	2402	-10.23	8	PASS
19	2440	-12.16		PASS
39	2480	-13.63		PASS

Test Plot of power Spectral Density

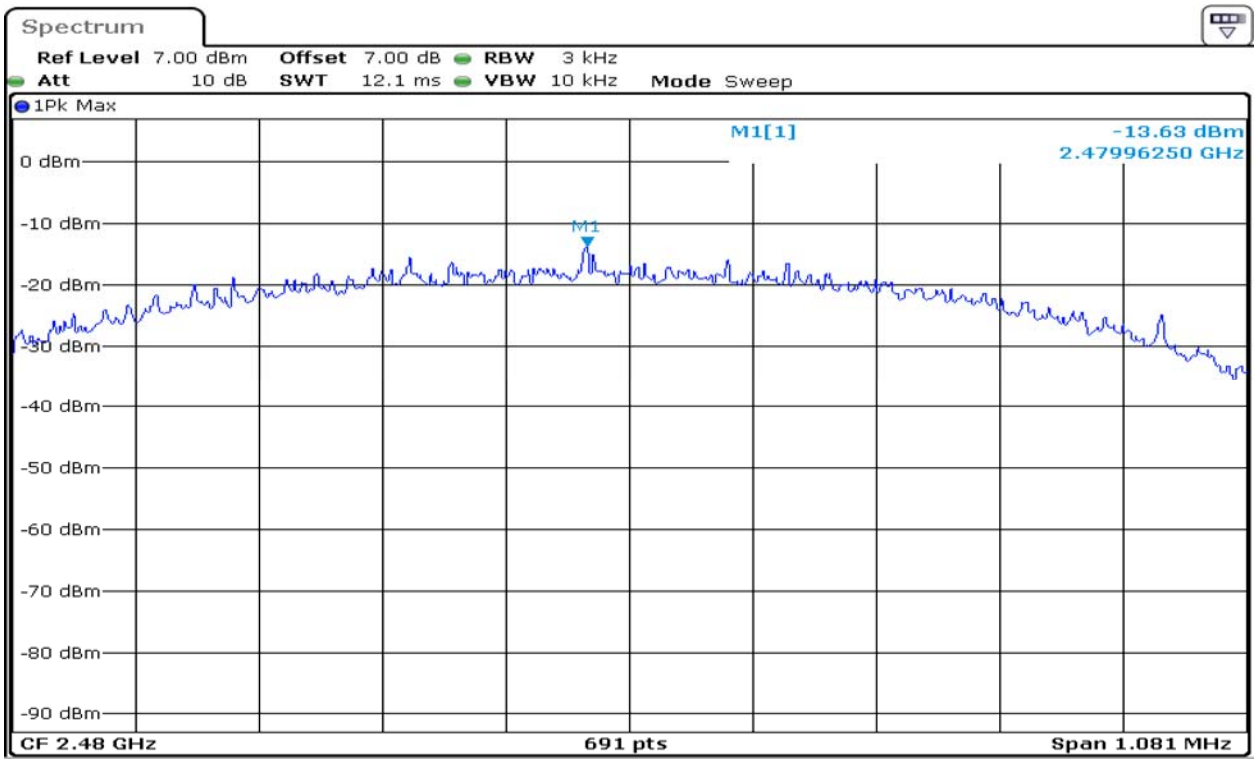
Channel 00



Channel 19



Channel 39



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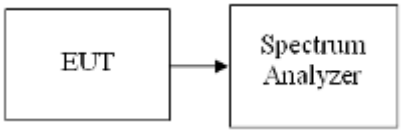
6.3 6dB Bandwidth Measurement

Limit

According to FCC part 15.247,The minimum 6 dB bandwidth shall be at least 500 kHz.

Test Configuration



Test Procedure

1. The RF output of EUT was connected to the spectrum analyzer by RF cable and attenuator. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting and enable the EUT transmit continuously.
3. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. Set the Video bandwidth (VBW) = 300 kHz. In order to make an accurate measurement. The 6 dB bandwidth must be greater than 500 kHz.
4. Measure and record the results in the test report.

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Test Results of Bandwidth

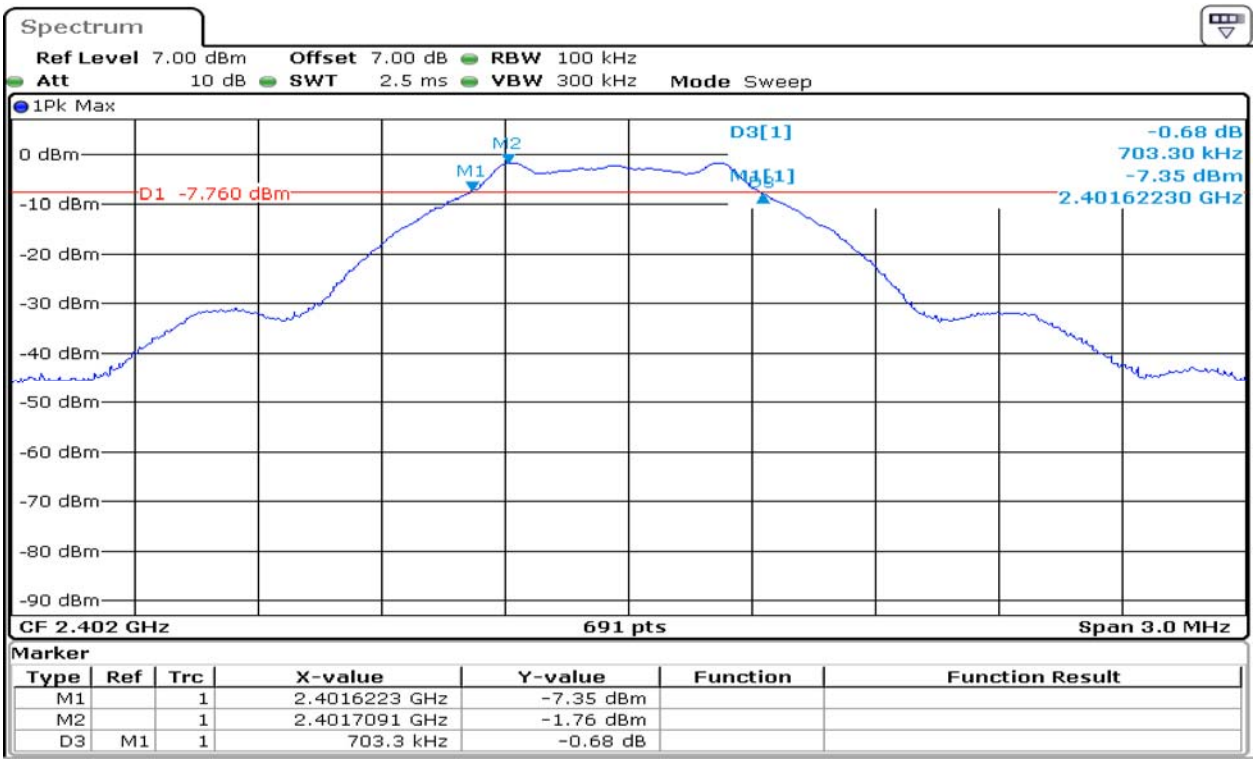
No non-compliance noted

Test mode:	Bluetooth LE4.2	Temperature:	23℃
Test By:	Lily.Wang	Test Date:	2018-10-15

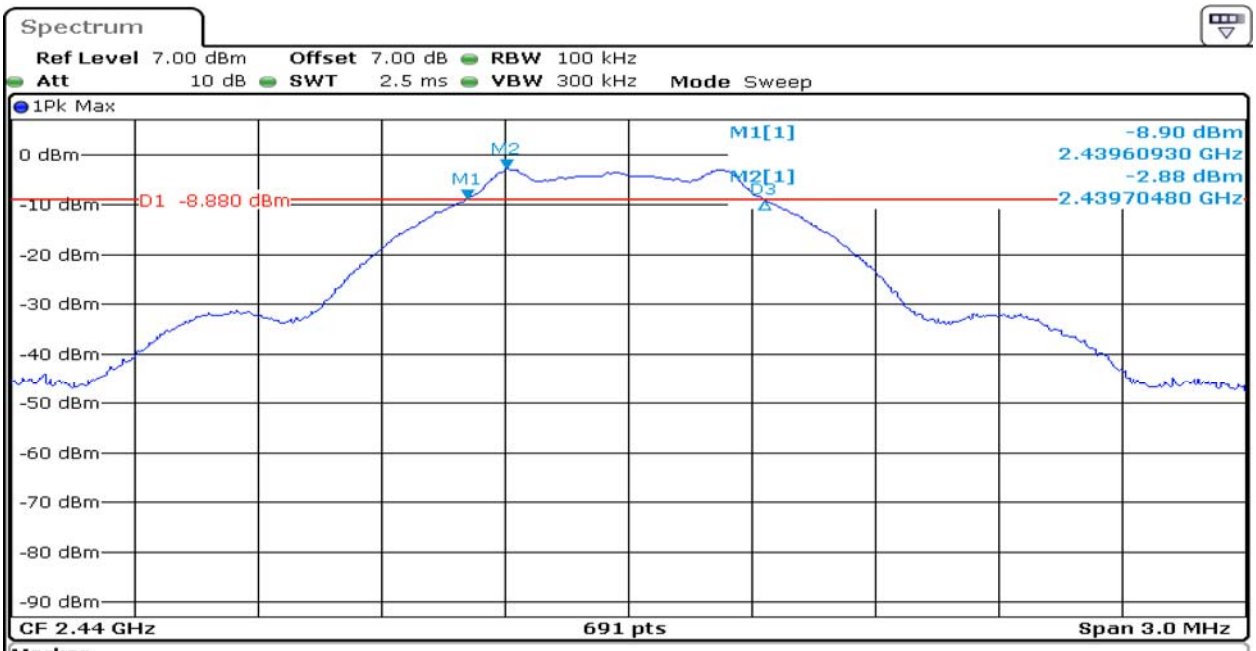
Channel	Frequency (MHz)	6dB Bandwidth (MHz)	6dB Bandwidth Limit (MHz)	Result
00	2402	0.703	0.5	Pass
19	2440	0.721	0.5	Pass
39	2480	0.729	0.5	Pass

Test Plot

Channel 00



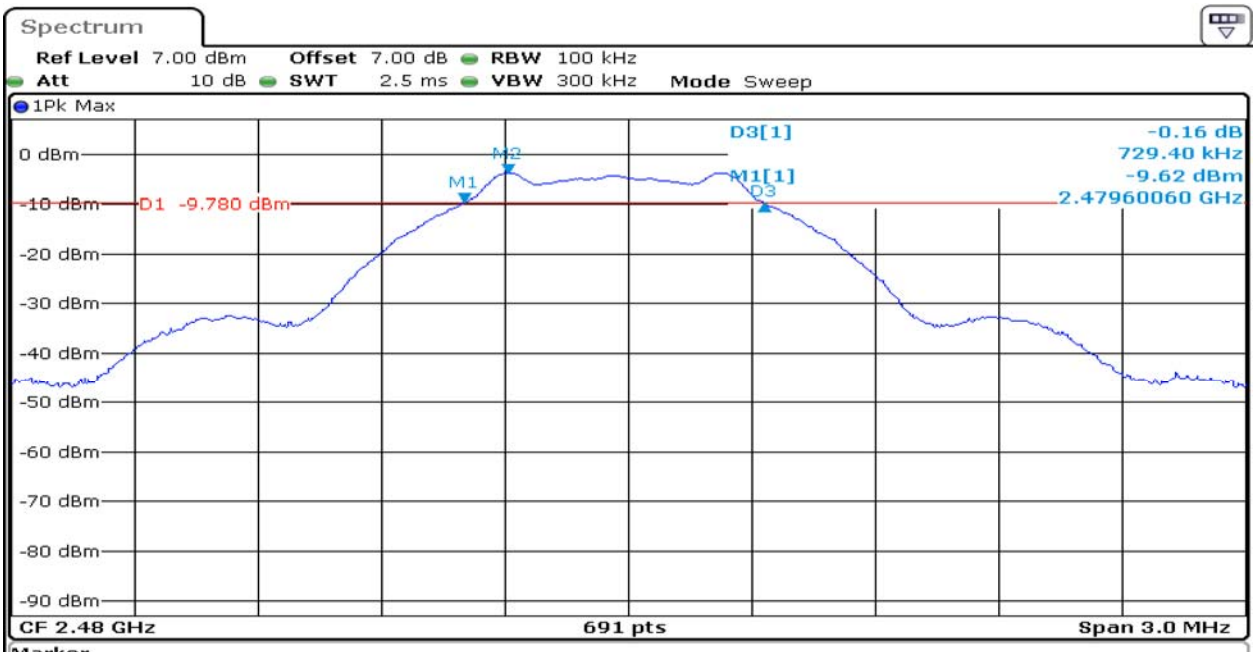
Channel 19



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4396093 GHz	-8.90 dBm		
M2		1	2.4397048 GHz	-2.88 dBm		
D3	M1	1	720.7 kHz	-0.26 dB		

Channel 39



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.4796006 GHz	-9.62 dBm		
M2		1	2.4797091 GHz	-3.78 dBm		
D3	M1	1	729.4 kHz	-0.16 dB		

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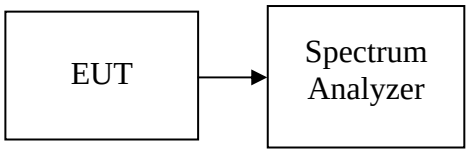
6.4 Conducted Band Edges and Spurious Emission Measurement

LIMIT

According to §15.247(d), in any 100kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator in operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100kHz 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. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in 15.209(a) (see Section 15.205(c)).

Test Configuration



TEST PROCEDURE

Conducted RF measurements of the transmitter output were made to confirm that the EUT antenna port conducted emissions meet the specified limit and to identify any spurious signals that require further investigation or measurements on the radiated emissions site.

The transmitter output is connected to the spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz.

Measurements are made over the 30MHz to 25GHz range with the transmitter set to the lowest, middle, and highest channels.

TEST RESULTSD

No non-compliance noted

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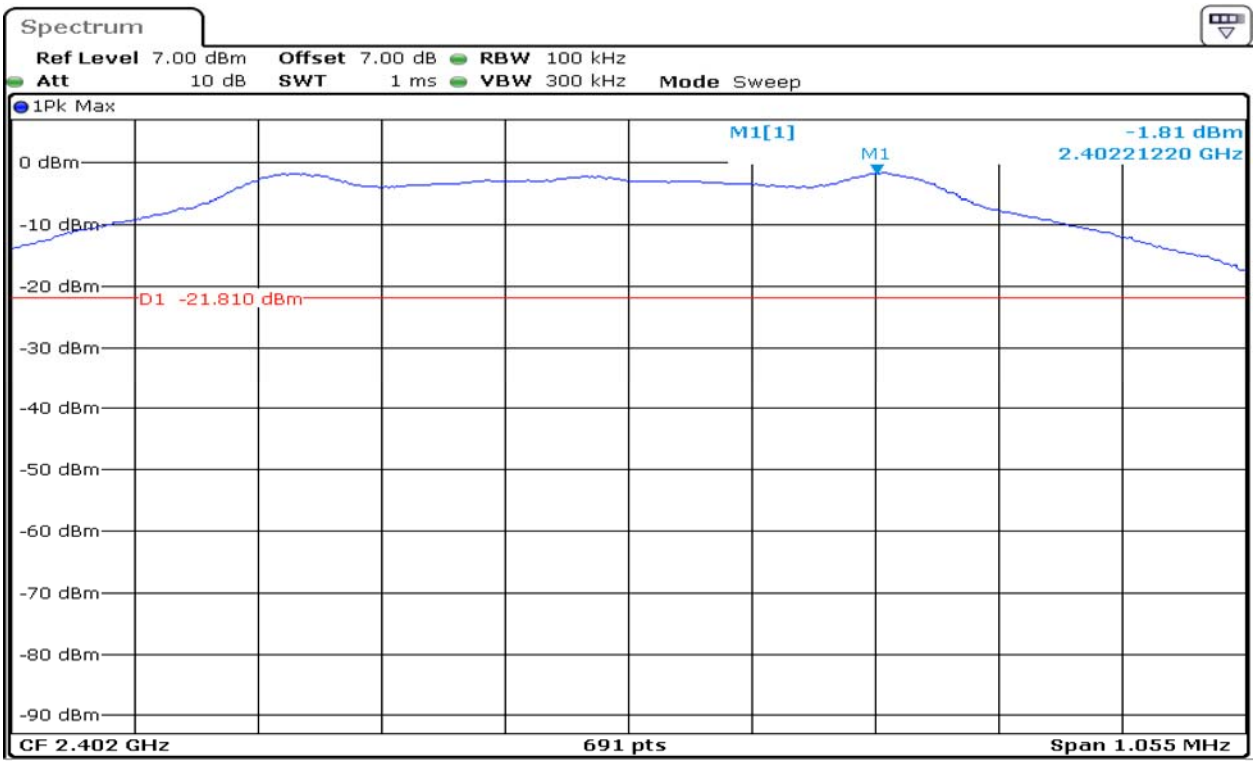
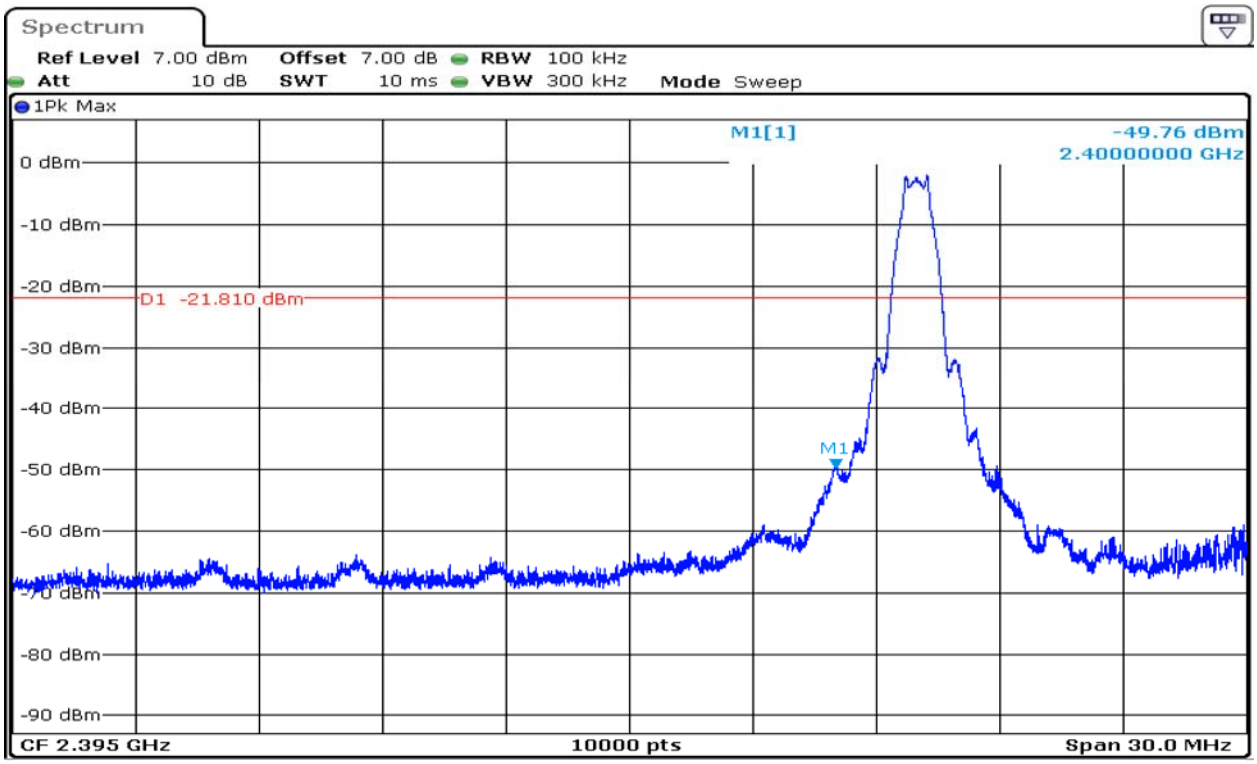
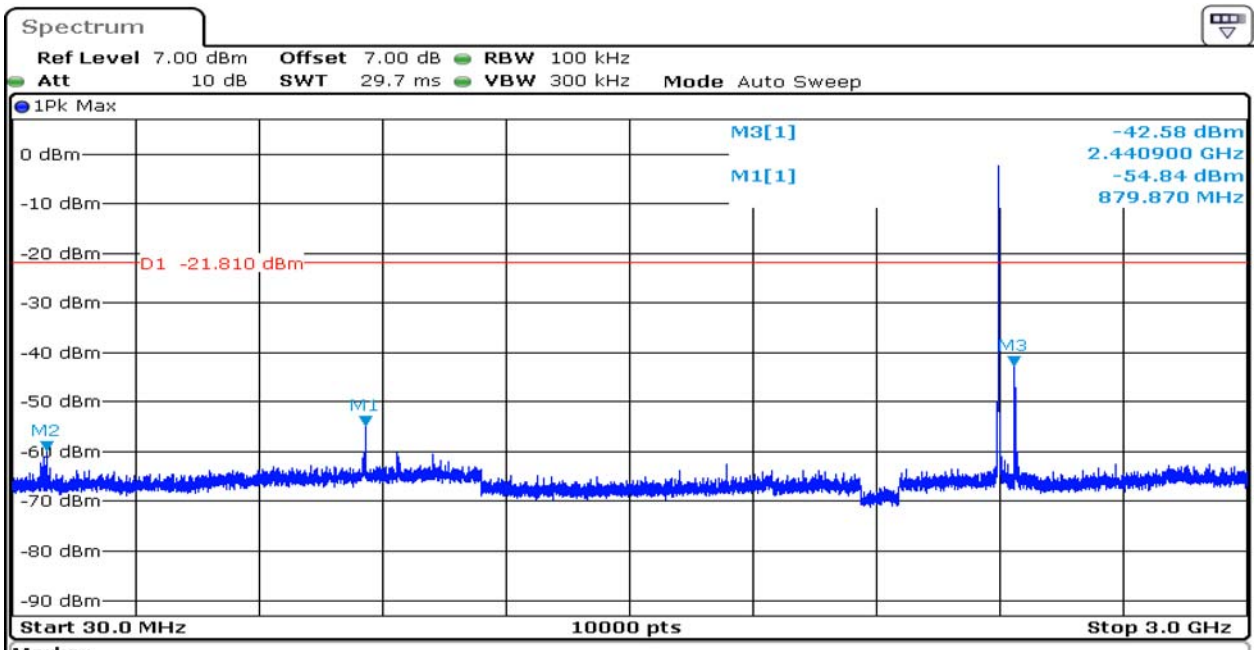
Test Plot
OUT-OF-BAND SPURIOUS EMISSIONS-CONDUCTED MEASUREMENT

CH Low

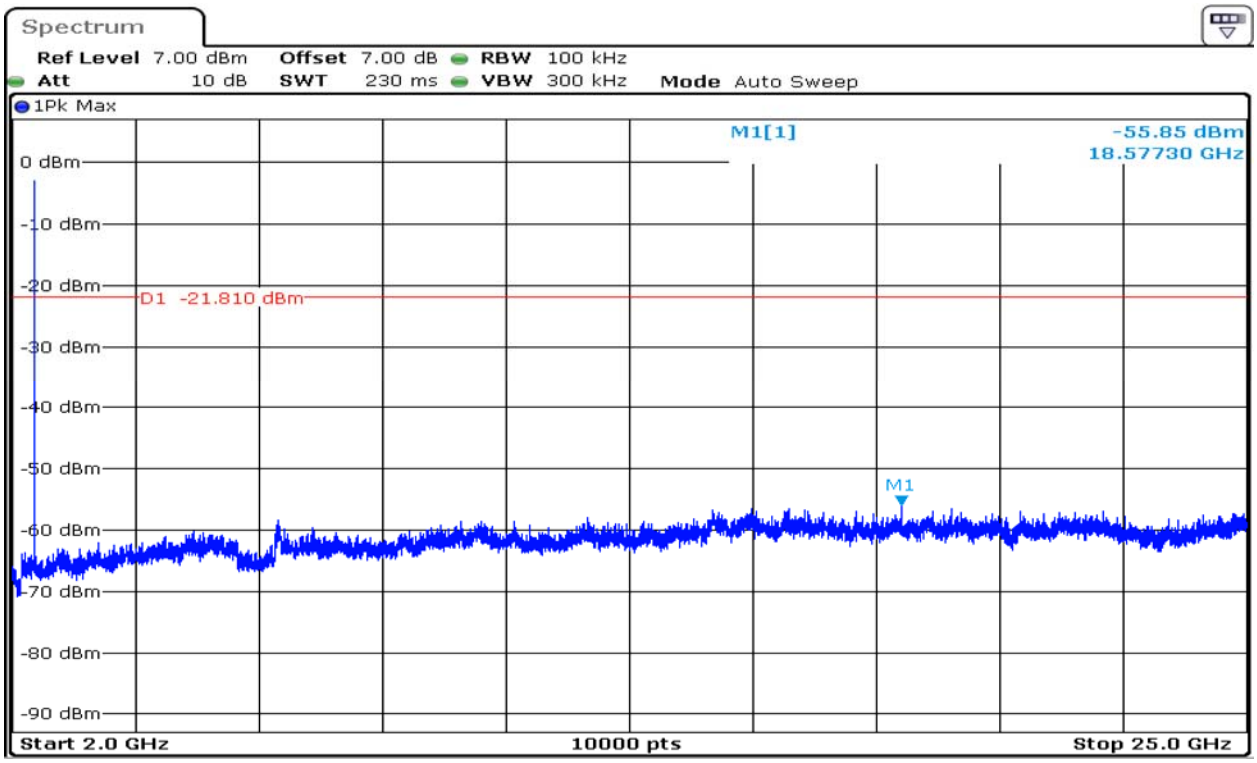




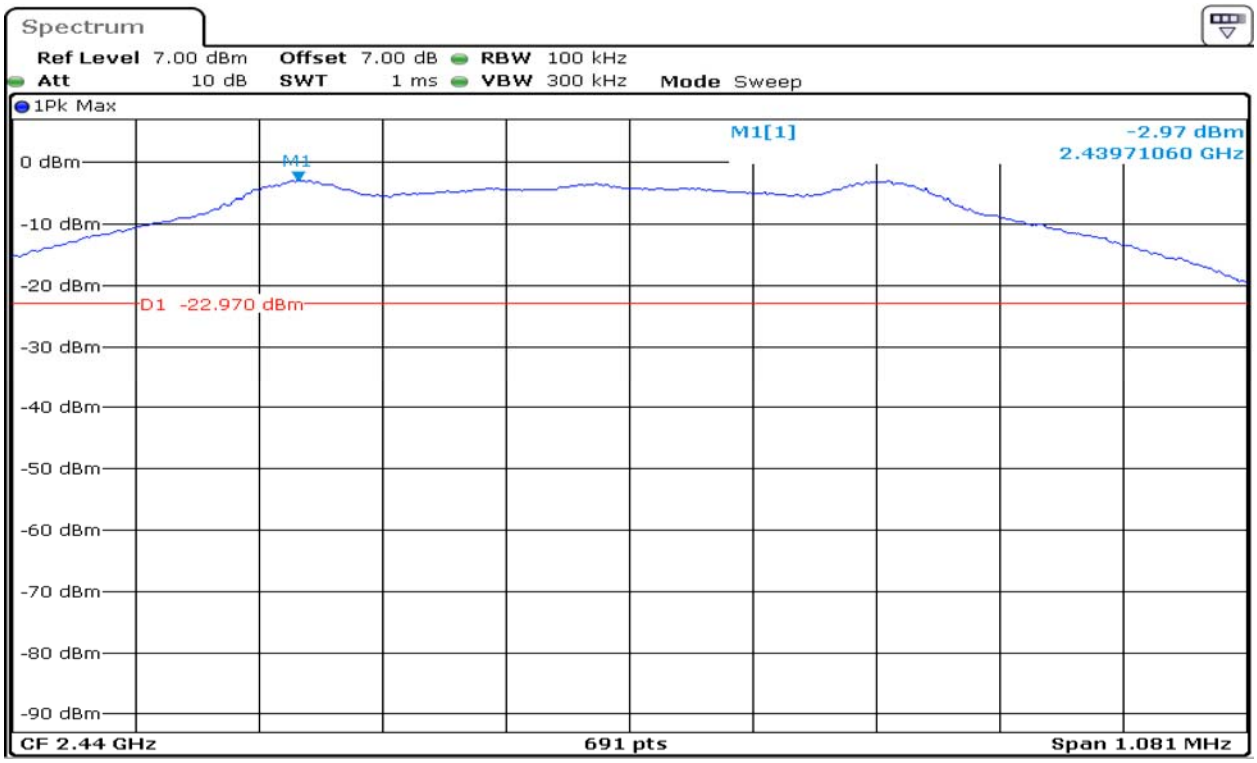


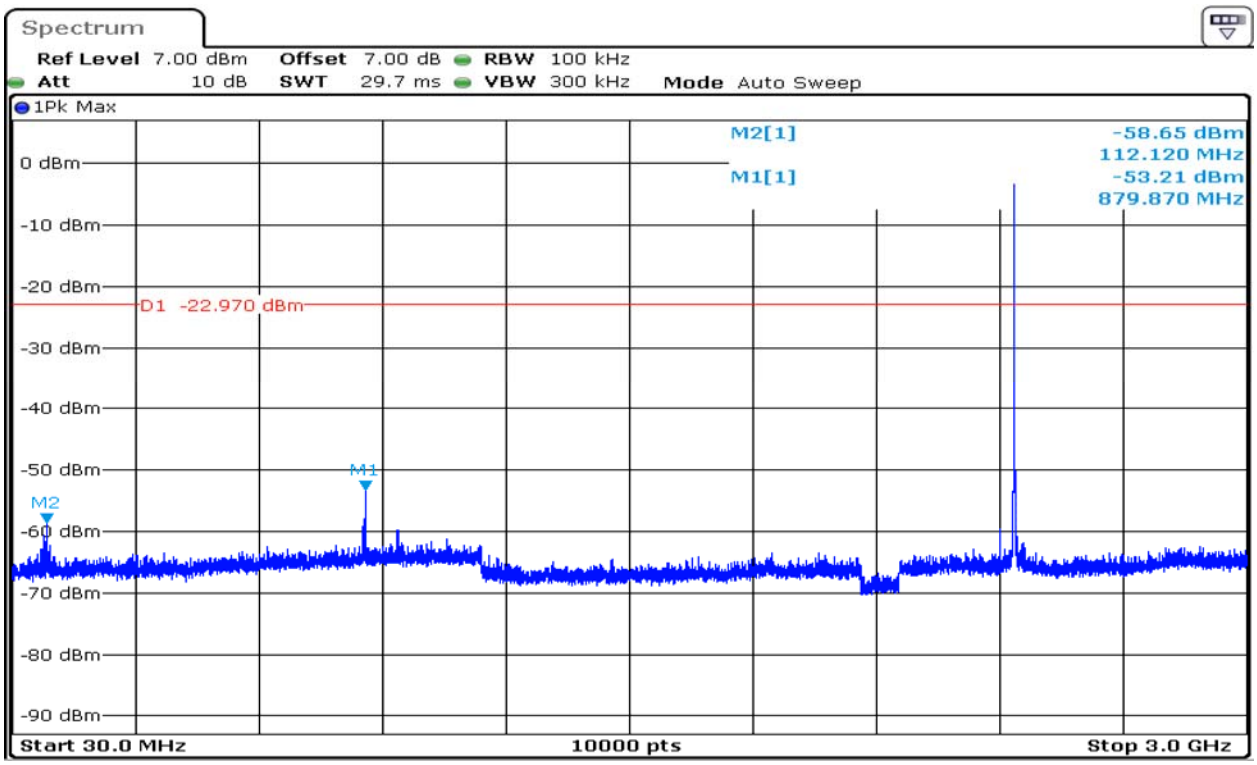
Marker

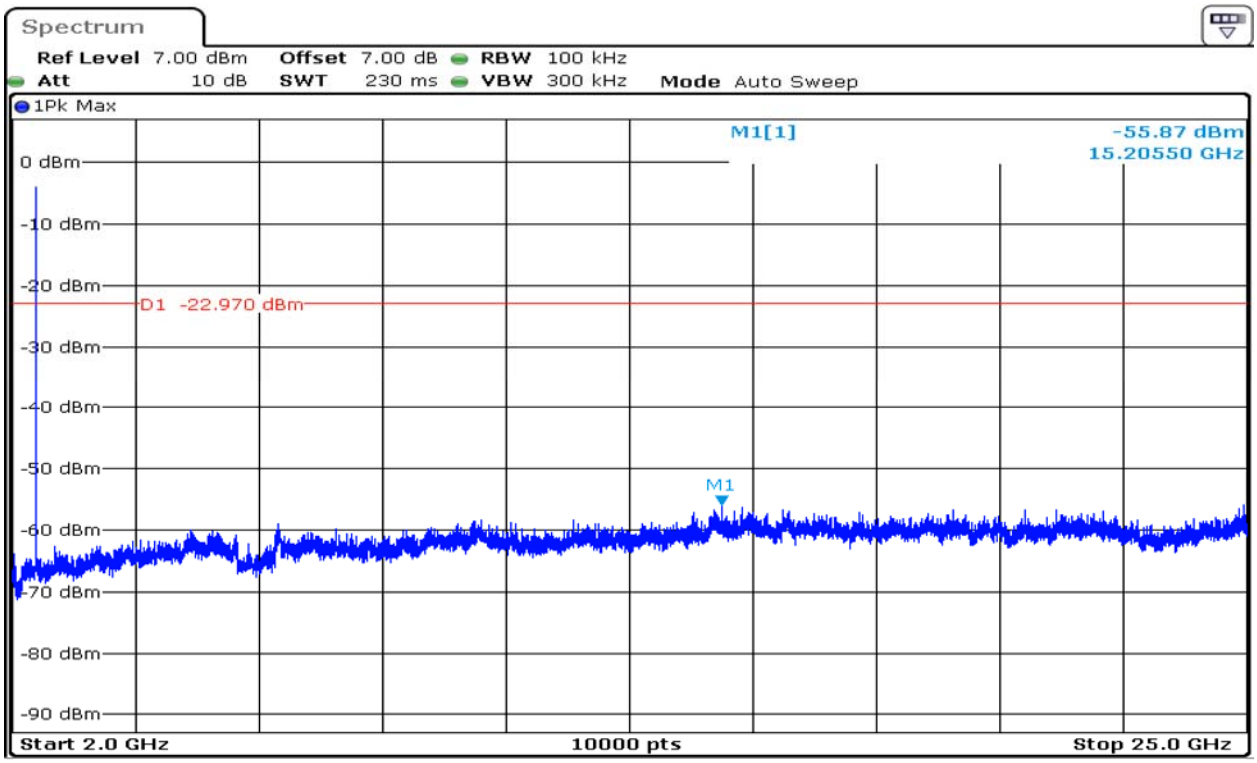
Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	879.87 MHz	-54.84 dBm		
M2		1	112.12 MHz	-59.74 dBm		
M3		1	2.4409 GHz	-42.58 dBm		



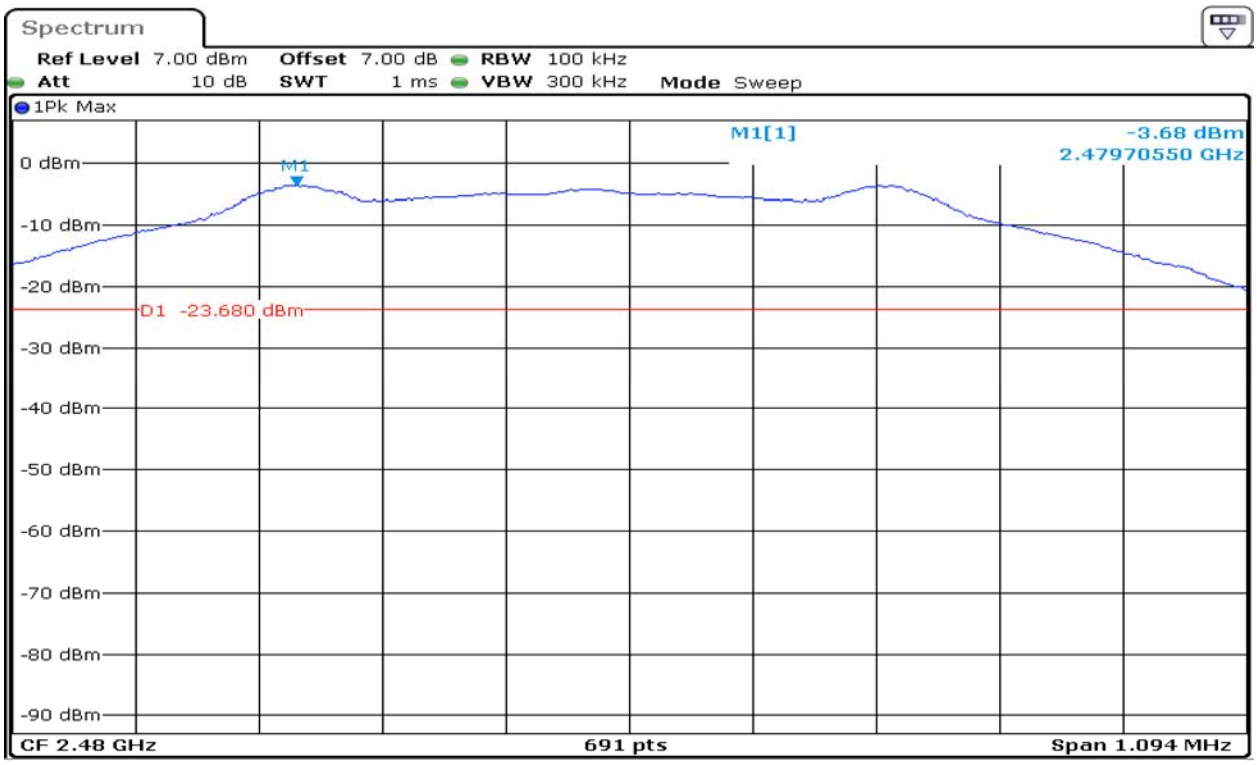
CH Mid

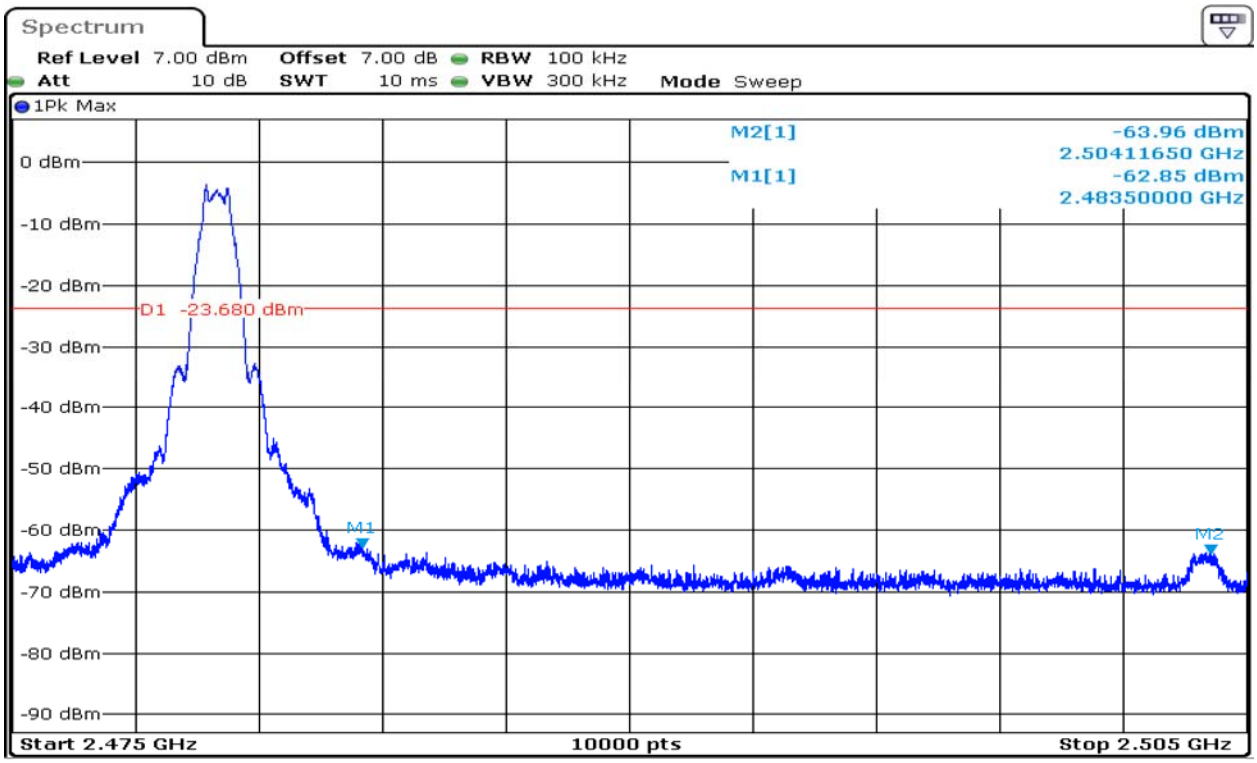

Spectrum
Ref Level 7.00 dBm Offset 7.00 dB RBW 100 kHz
Att 10 dB SWT 1 ms VBW 300 kHz Mode Sweep
1Pk Max
M1[1] -2.97 dBm
2.43971060 GHz
M1
D1 -22.970 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
-90 dBm
CF 2.44 GHz
691 pts
Span 1.081 MHz

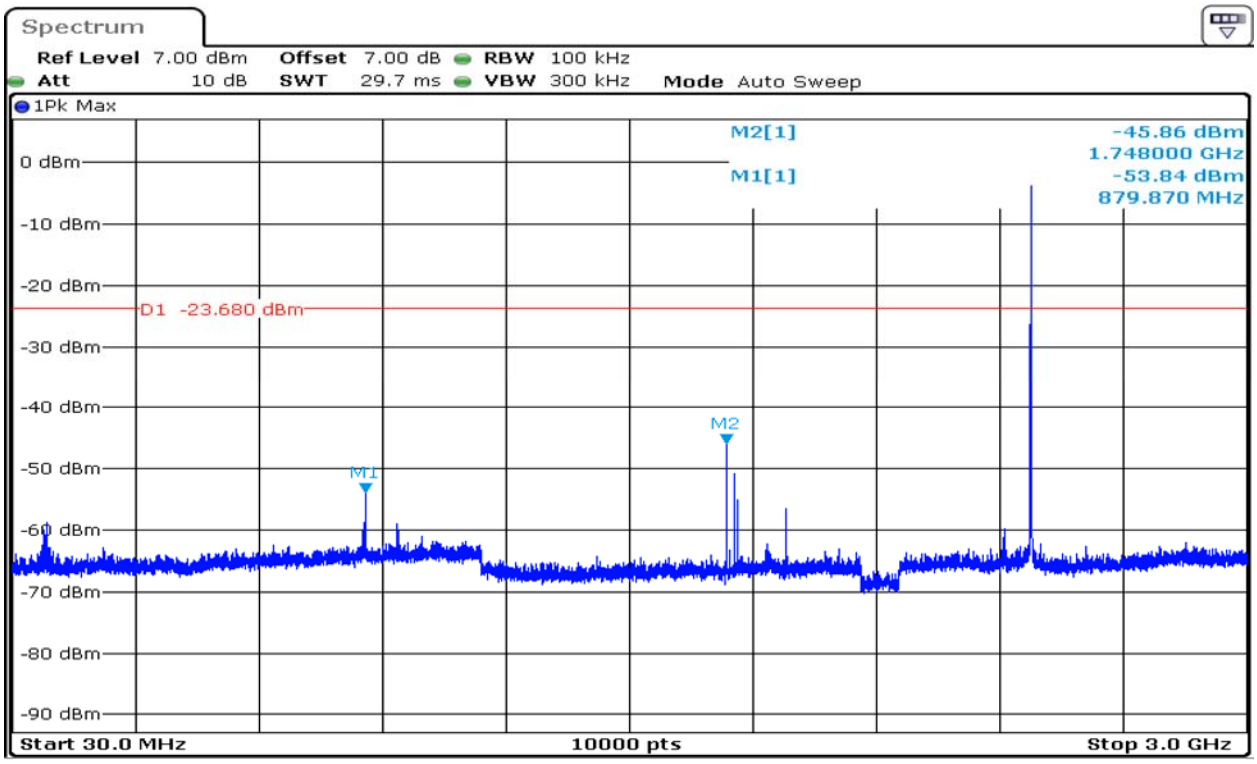

Spectrum
Ref Level 7.00 dBm Offset 7.00 dB RBW 100 kHz
Att 10 dB SWT 29.7 ms VBW 300 kHz Mode Auto Sweep
1Pk Max
M2[1] -58.65 dBm
112.120 MHz
M1[1] -53.21 dBm
879.870 MHz
D1 -22.970 dBm
M1
M2
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
-90 dBm
Start 30.0 MHz
10000 pts
Stop 3.0 GHz

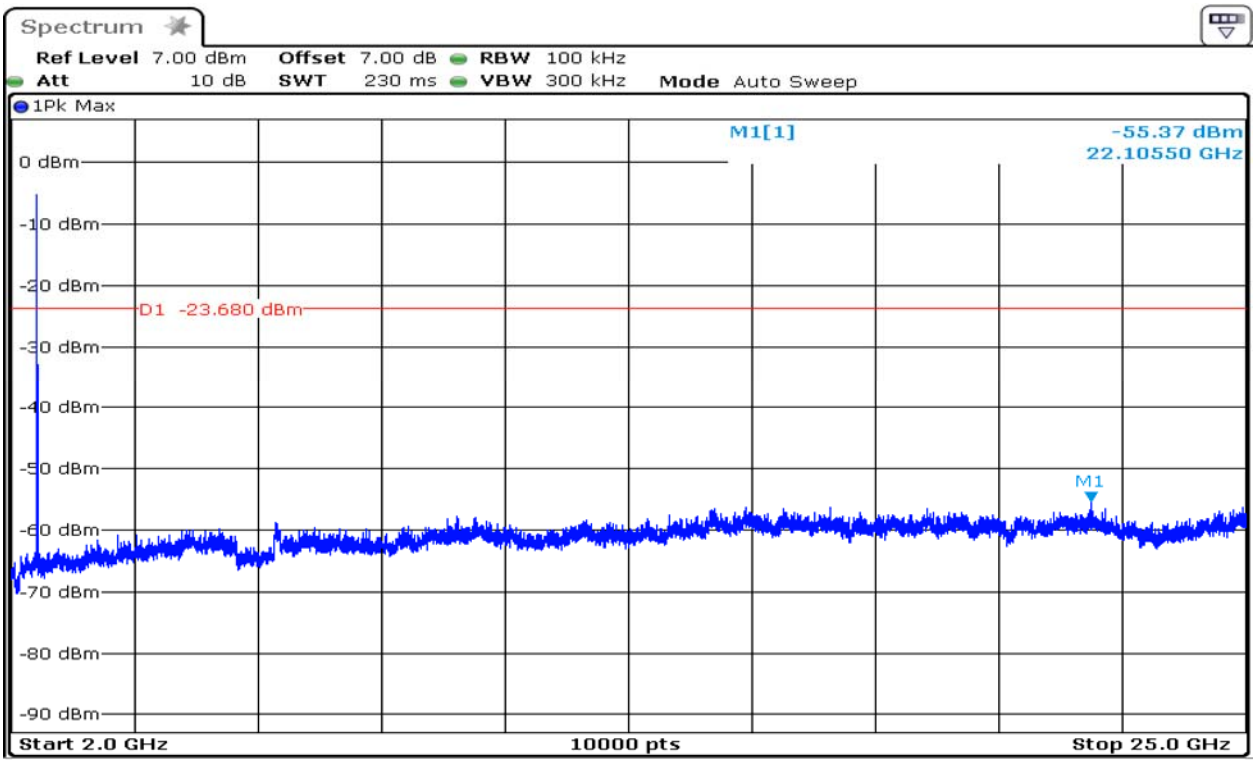

Spectrum
Ref Level 7.00 dBm Offset 7.00 dB RBW 100 kHz
Att 10 dB SWT 230 ms VBW 300 kHz Mode Auto Sweep
1Pk Max
M1[1] -55.87 dBm
15.20550 GHz
0 dBm
-10 dBm
-20 dBm
D1 -22.970 dBm
-30 dBm
-40 dBm
-50 dBm
M1
-60 dBm
-70 dBm
-80 dBm
-90 dBm
Start 2.0 GHz
10000 pts
Stop 25.0 GHz

CH High


Spectrum
Ref Level 7.00 dBm Offset 7.00 dB RBW 100 kHz
Att 10 dB SWT 1 ms VBW 300 kHz Mode Sweep
1Pk Max
M1[1] -3.68 dBm
2.47970550 GHz
0 dBm
M1
-10 dBm
-20 dBm
D1 -23.680 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
-90 dBm
CF 2.48 GHz
691 pts
Span 1.094 MHz


Spectrum
Ref Level 7.00 dBm Offset 7.00 dB RBW 100 kHz
Att 10 dB SWT 10 ms VBW 300 kHz Mode Sweep
1Pk Max
M2[1] -63.96 dBm
2.50411650 GHz
M1[1] -62.85 dBm
2.48350000 GHz
D1 -23.680 dBm
M1
M2
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
-90 dBm
Start 2.475 GHz
10000 pts
Stop 2.505 GHz


Spectrum
Ref Level 7.00 dBm Offset 7.00 dB RBW 100 kHz
Att 10 dB SWT 29.7 ms VBW 300 kHz Mode Auto Sweep
1Pk Max
M2[1] -45.86 dBm
1.748000 GHz
M1[1] -53.84 dBm
879.870 MHz
D1 -23.680 dBm
M1
M2
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
-90 dBm
Start 30.0 MHz
10000 pts
Stop 3.0 GHz


Spectrum
Ref Level 7.00 dBm Offset 7.00 dB RBW 100 kHz
Att 10 dB SWT 230 ms VBW 300 kHz Mode Auto Sweep
1Pk Max
M1[1] -55.37 dBm
22.10550 GHz
0 dBm
-10 dBm
-20 dBm
D1 -23.680 dBm
-30 dBm
-40 dBm
-50 dBm
M1
-60 dBm
-70 dBm
-80 dBm
-90 dBm
Start 2.0 GHz
10000 pts
Stop 25.0 GHz

6.5 Radiated Band Edge and Spurious Emission Measurement

LIMIT

According to FCC rules:
In any 100 kHz bandwidth outside the intentional radiator frequency band, all harmonics/spurious must be at least 20 dB below the highest emission level within the authorized band. If the output power of this device was measured by spectrum analyzer, the attenuation under this paragraph shall be 30 dB instead of 20 dB. In addition, radiated emissions which fall in the restricted bands must also comply with the FCC section 15.209 limits as below.

Frequency (MHz)	Field Strength (mV/m)	Measurement Distance (m)
30-88	100*	3
88-216	150*	3
216-960	200*	3
Above 960	500	3

Remark: *Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.*

In the above emission table, the tighter limit applies at the band edges.

Frequency (Hz)	Field Strength (µV/m at 3-meter)	Field Strength (dBµV/m at 3-meter)
30-88	100	40
88-216	150	43.5
216-960	200	46
Above 960	500	54

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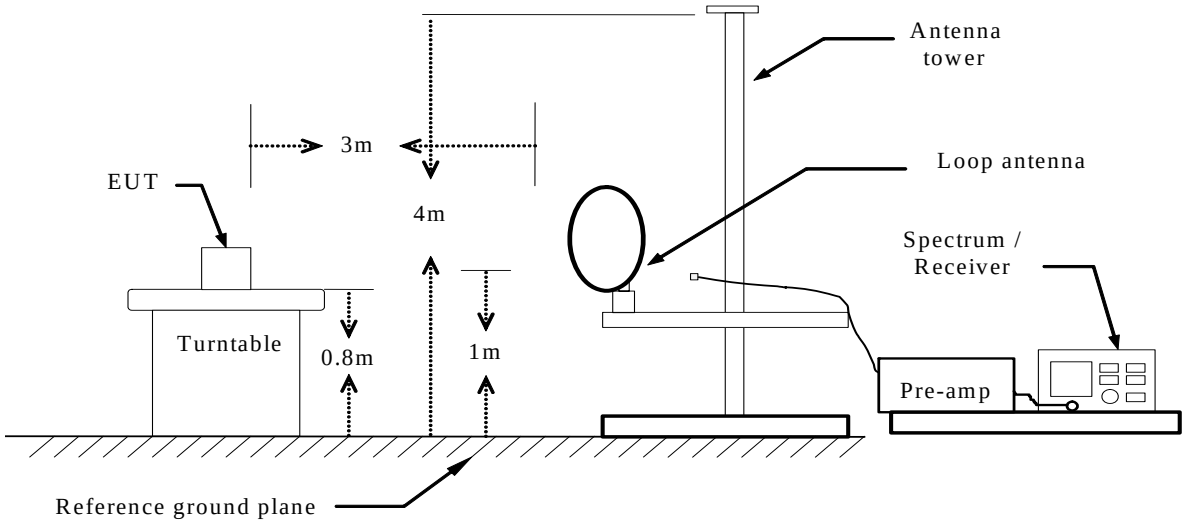
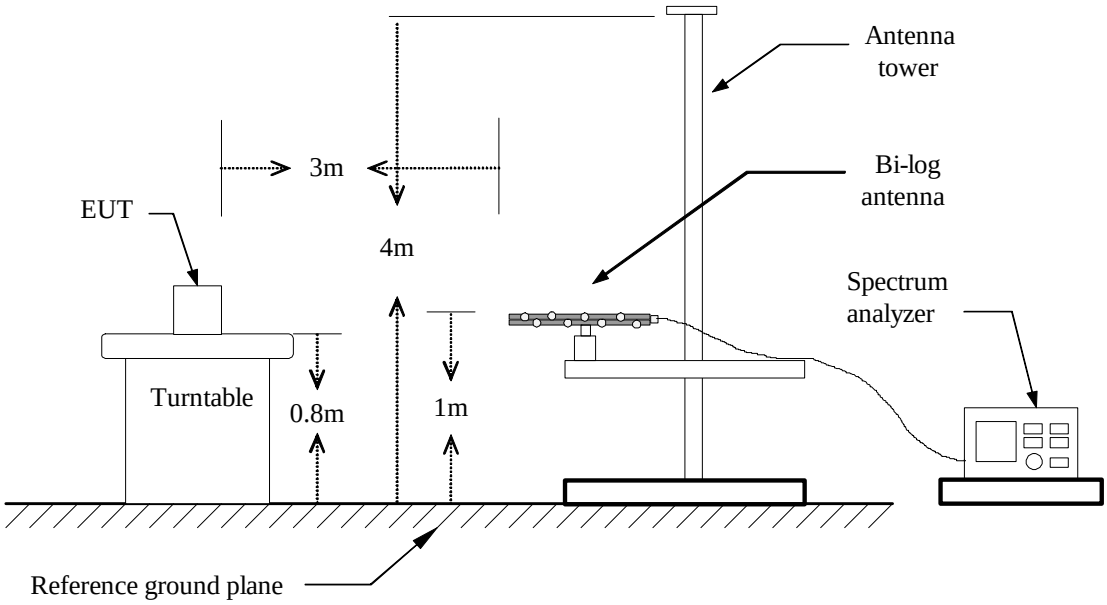
Test Configuration

Below 30MHz



Below 1 GHz



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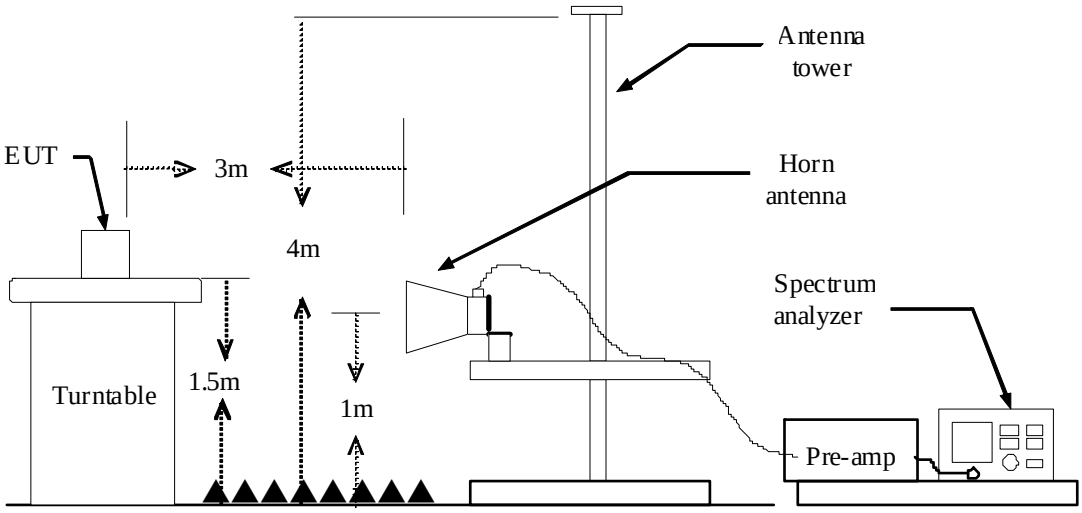
Above 1 GHz



TEST PROCEDURE

1. The EUT is placed on a turntable above ground plane, which is 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Set the spectrum analyzer in the following setting as:

Below 1GHz:

RBW=100kHz / VBW=300kHz / Sweep=AUTO

Above 1GHz:

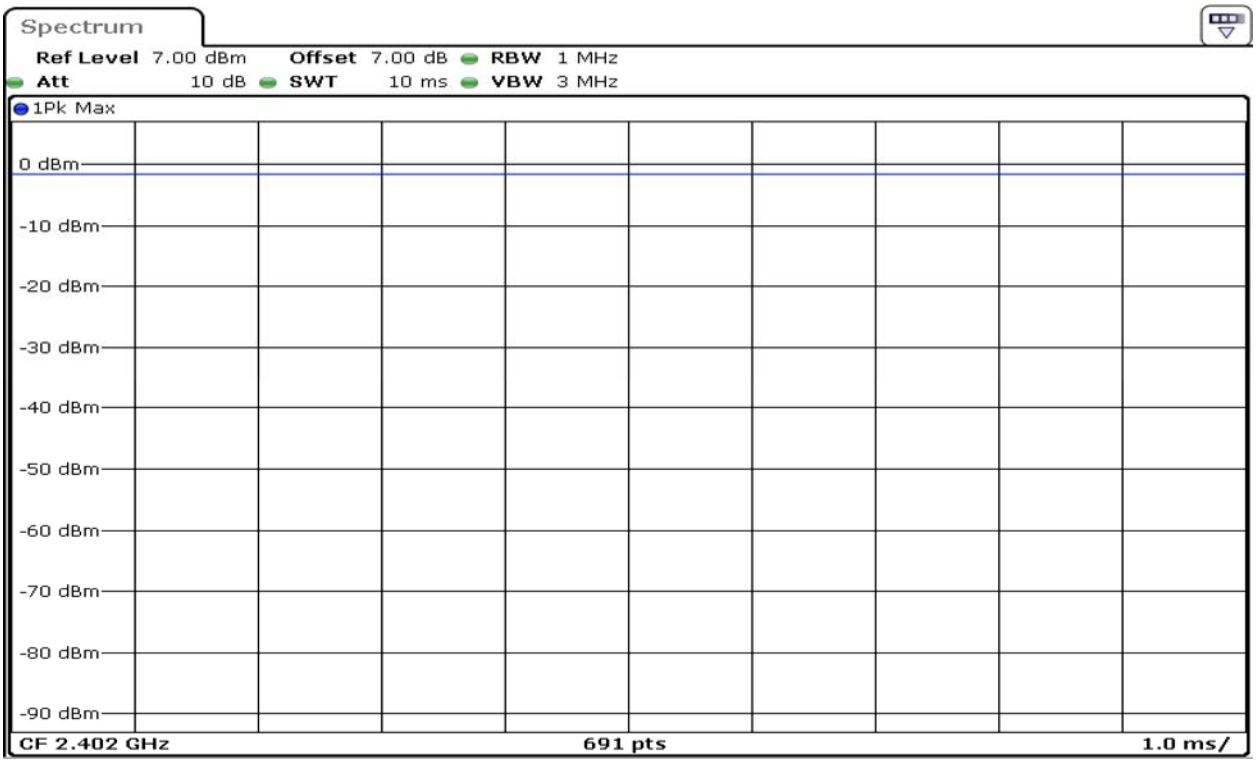
PEAK: RBW=VBW=1MHz / Sweep=AUTO

AVERAGE: RBW=1MHz / Sweep=AUTO

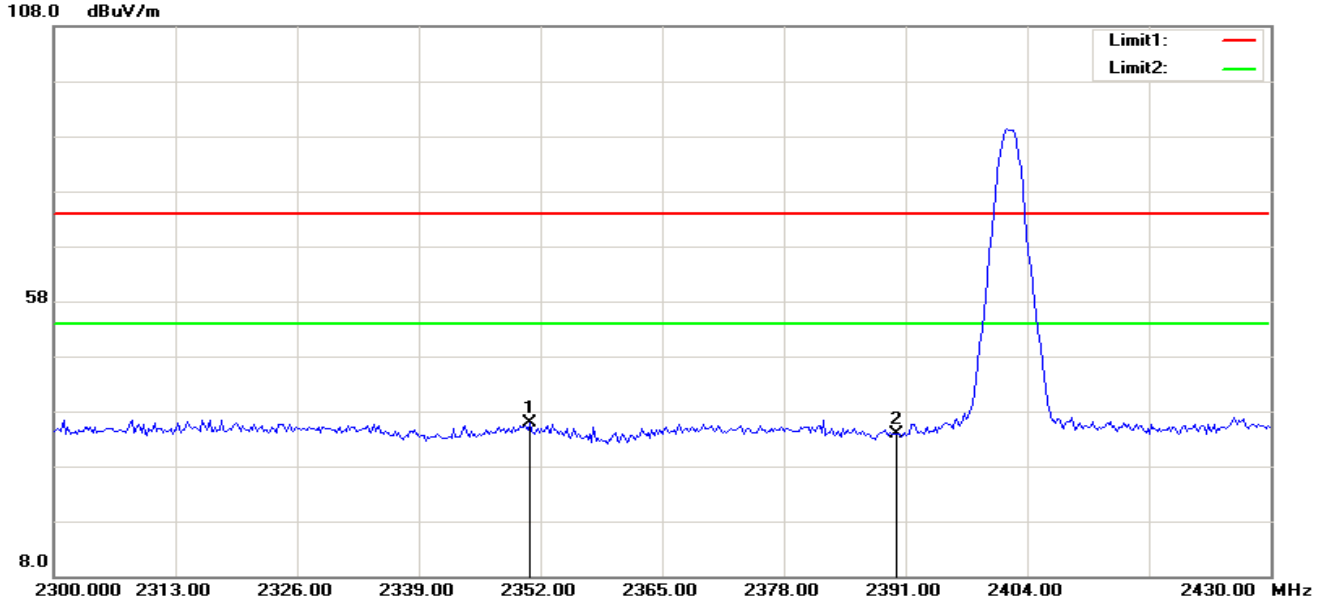
VBW=10Hz, when duty cycle is no less than 98 percent.

VBW ≧ 1/T, when duty cycle is less than 98 percent, where T is the minimum transmission duration over which the transmitter is on and is transmitting at its Maximum power control level for the tested mode of operation.

Configuration	Duty Cycle (%)	VBW
BLE	100	10Hz

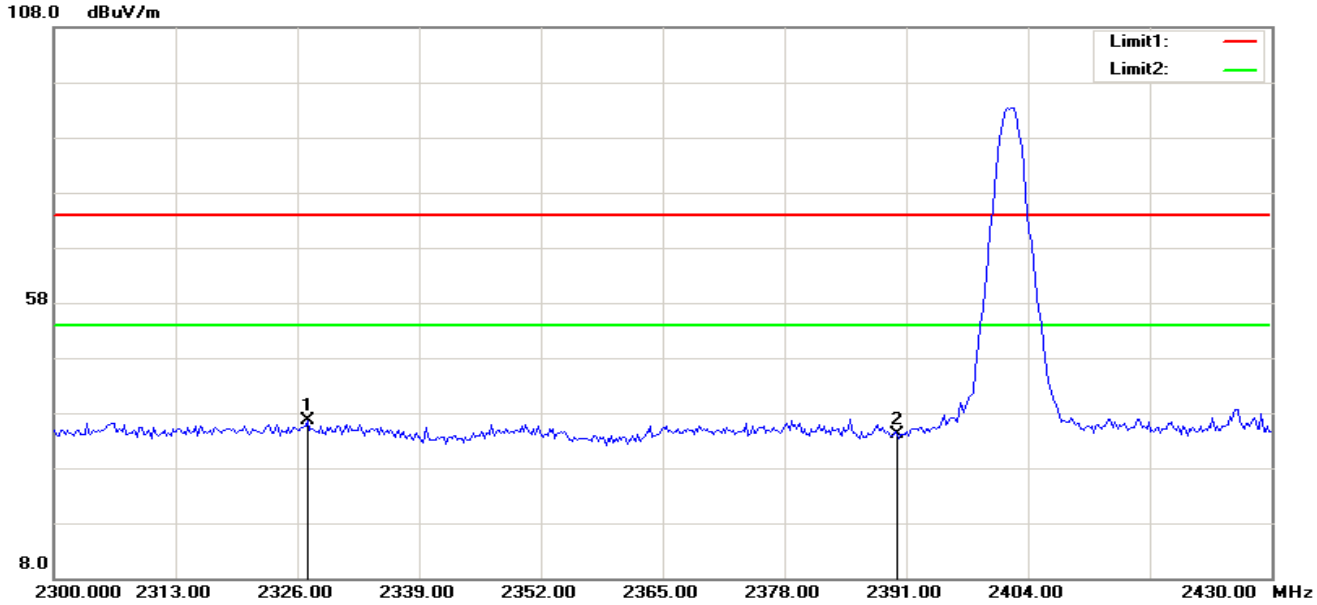


RESTRICTED BANDEDGE (BLE4.2 on Channel 0, Horizontal)



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	2350.833	45.19	-9.20	35.99	74.00	-38.01	100	183	peak
2	2390.000	42.94	-8.95	33.99	74.00	-40.01	100	199	peak

RESTRICTED BANDEDGE (BLE4.2 on Channel 0, Vertical)



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	2327.083	45.91	-9.35	36.56	74.00	-37.44	100	150	peak
2	2390.000	42.96	-8.95	34.01	74.00	-39.99	100	348	peak

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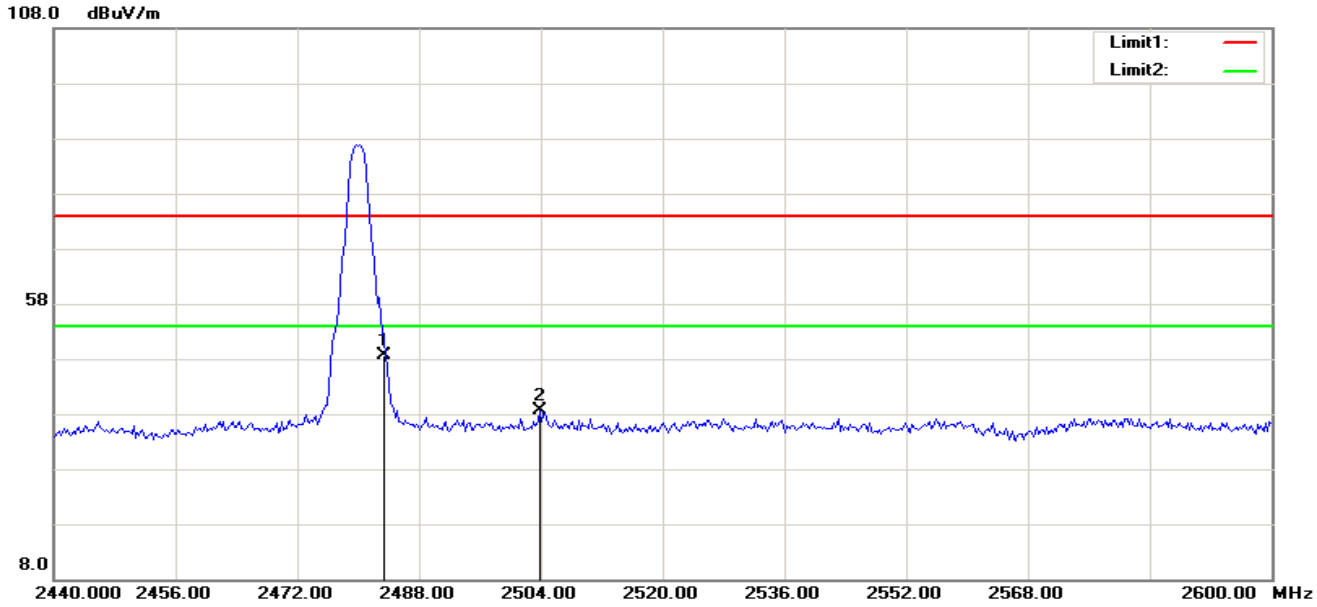
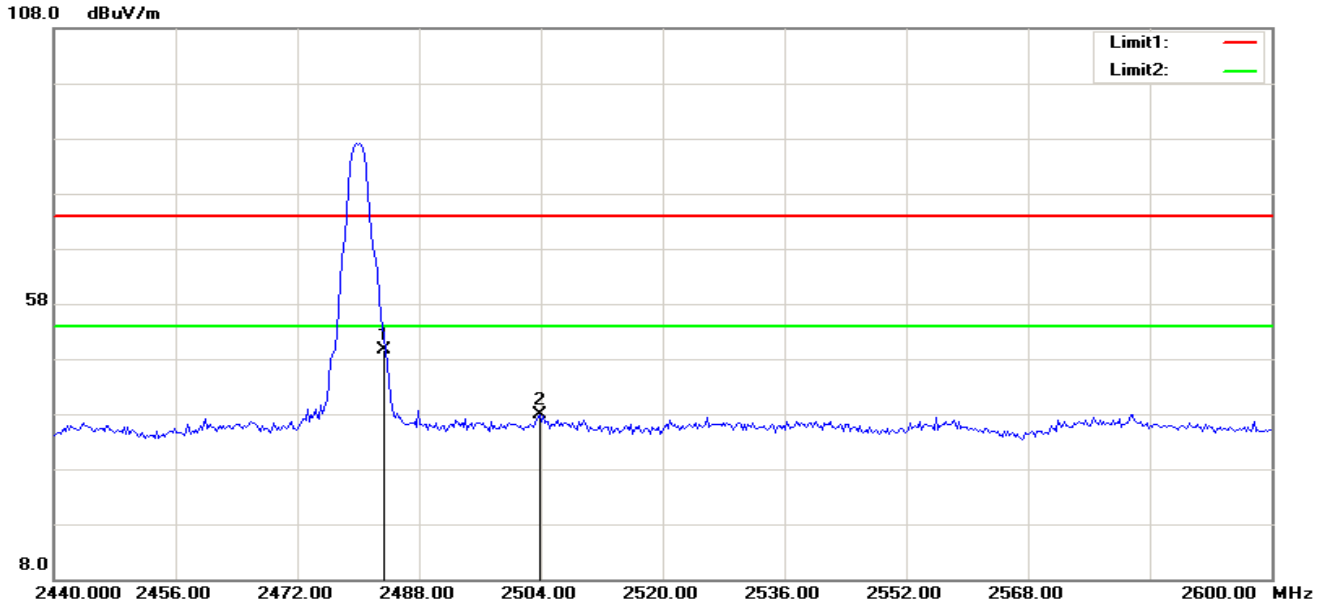
RESTRICTED BANDEDGE (BLE4.2 on Channel 39, Horizontal)



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	2483.500	56.90	-8.35	48.55	74.00	-25.45	100	118	peak
2	2503.846	46.81	-8.22	38.59	74.00	-35.41	100	119	peak

RESTRICTED BANDEDGE (BLE4.2 on Channel 39, Vertical)



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	2483.500	57.90	-8.35	49.55	74.00	-24.45	100	324	peak
2	2503.846	46.21	-8.22	37.99	74.00	-36.01	100	181	peak

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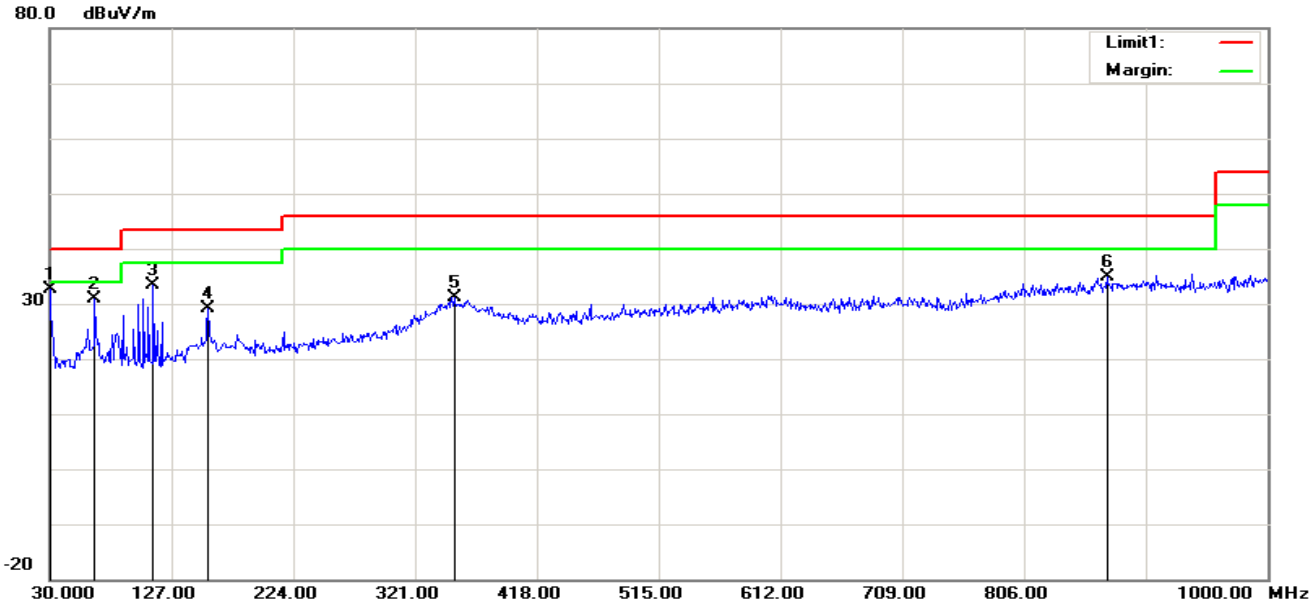
Test Result of Radiated Emission

Below 30MHz

The interference of the frequency value is lower than the limit below 20 db, measured as the background noise values and will not be recorded.

30MHz-1GHz

Operation Mode:	Bluetooth LE4.2, CH00	**Test Date:**	2018-10-16
Temperature:	25°C	**Tested by:**	Lily.Wang
Humidity:	48% RH	**Polarity:**	Hor.



Frequency (MHz)	Ant. Pol. (H/V)	Reading (dBuV)	Correction Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
30.9700	H	6.85	25.76	32.61	40.00	-7.39	peak
193.9300	H	17.31	13.61	30.92	40.00	-9.08	peak
331.8270	H	15.47	17.91	33.38	43.50	-10.12	peak
722.5800	H	11.27	17.76	29.03	43.50	-14.47	peak
898.1500	H	4.82	26.20	31.02	46.00	-14.98	peak
999.0300	H	6.12	28.70	34.82	46.00	-11.18	peak

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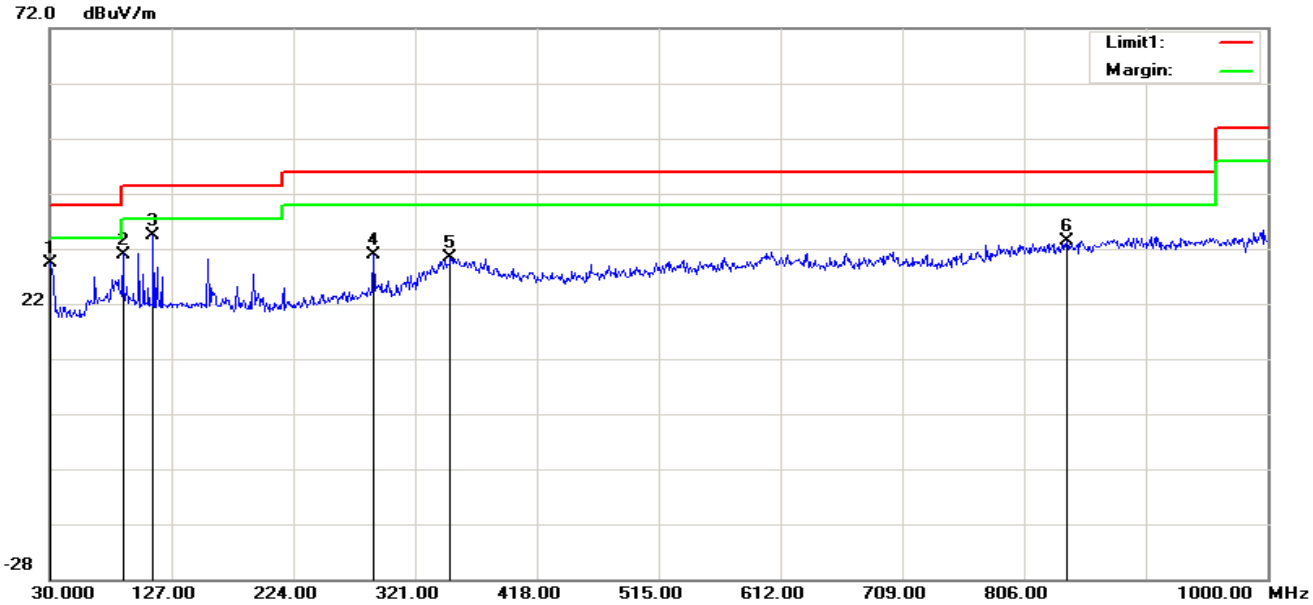
Operation Mode:	Bluetooth LE4.2, CH00	**Test Date:**	2018-10-16
Temperature:	25°C	**Tested by:**	Lily.Wang
Humidity:	48% RH	**Polarity:**	Ver.



Frequency (MHz)	Ant. Pol. (H/V)	Reading (dBuV)	Correction Factor (dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Remark
30.0000	V	3.69	25.76	29.45	40.00	-10.55	peak
88.2000	V	15.19	15.81	31.00	43.50	-12.50	peak
112.4500	V	16.43	17.91	34.34	43.50	-9.16	peak
288.0200	V	11.04	19.82	30.86	46.00	-15.14	peak
349.1300	V	4.24	26.19	30.43	46.00	-15.57	peak
839.9500	V	5.10	28.30	33.40	46.00	-12.60	peak

Notes:

1. *Mea surements above show only up to maximum emissions noted, if no specific emissions from the EUT are recorded (ie: margin>20dB from the applicable limit) and considered that's already beyond the background noise floor.*
2. *Radiated emissions measured in frequency range from 9 KHz to 1000MHz were made with an instrument using Peak detector mode.*
3. *Data of measurement within this frequency range shown " --- " in the table above means the reading of emissions are attenuated more than 20dB below the permissible limits or the field strength is too small to be measured.*
4. *The IF bandwidth of SPA between 30MHz to 1GHz was 100kHz.*

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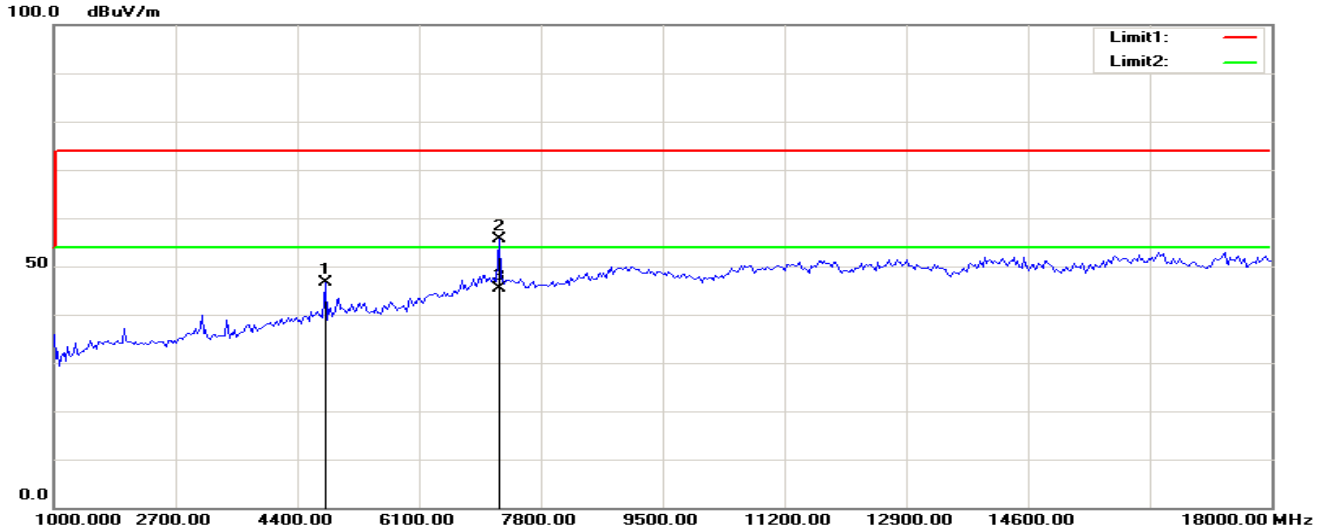
Above 1 GHz

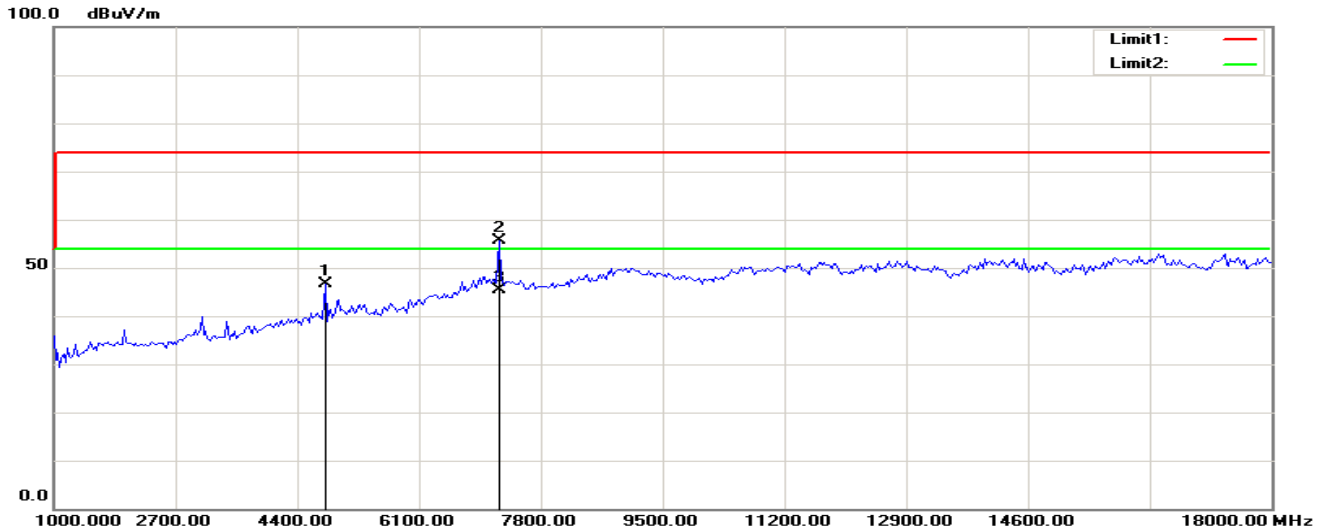
Operation Mode:	Bluetooth LE4.2	**Test Date:**	2018-10-16
Test Channel:	CH00	**Tested by:**	Lily.Wang
Temperature:	25°C	**Polarity:**	Ver. / Hor.

Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	4787.258	48.48	-1.13	47.35	74.00	-26.65	100	265	peak
2	7211.538	51.32	6.52	57.84	74.00	-16.16	100	126	peak
3	7211.538	41.33	6.52	47.85	54.00	-6.15	100	150	AVG

Vertical



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	4786.755	47.79	-1.13	46.66	74.00	-27.34	100	325	peak
2	7211.538	49.00	6.52	55.52	74.00	-18.48	100	241	peak
3	7211.538	38.95	6.52	45.47	54.00	-8.53	200	262	AVG

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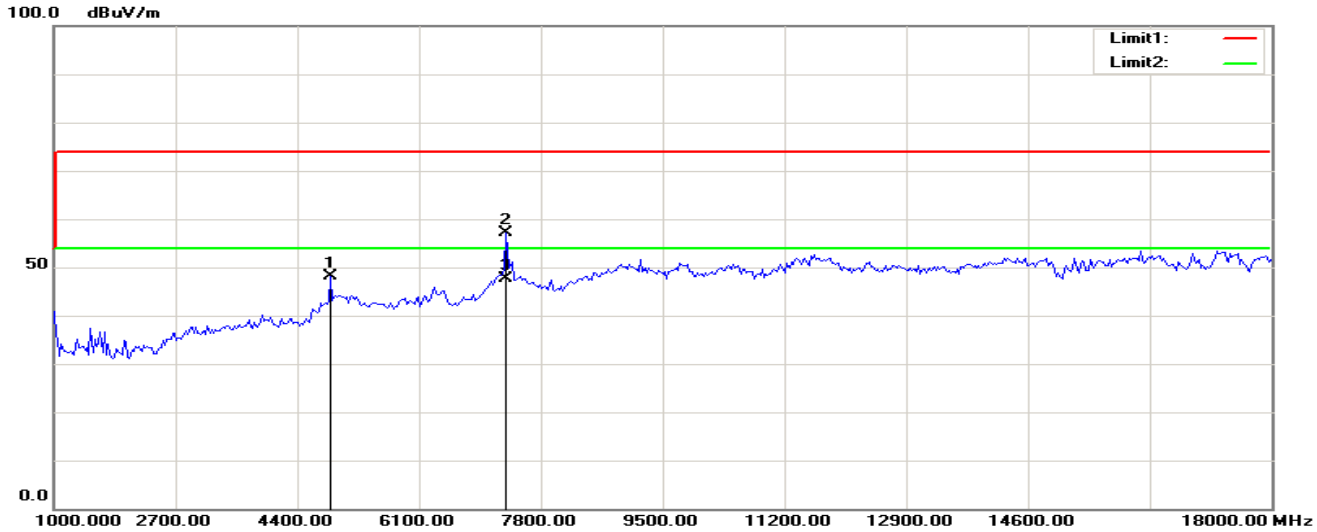
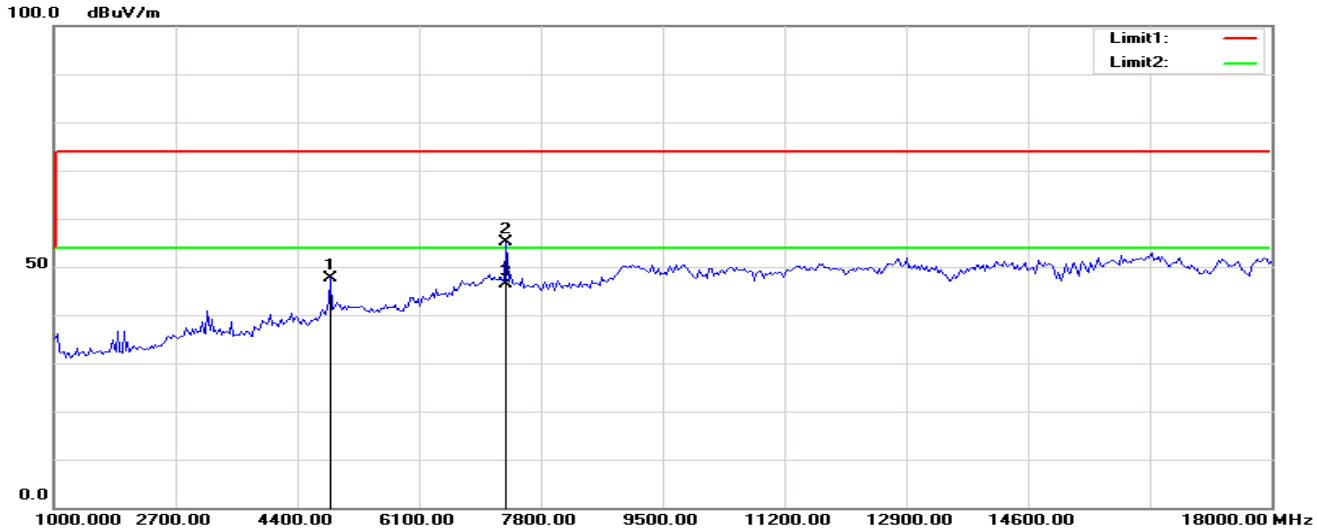
Operation Mode:	Bluetooth LE4.2	**Test Date:**	2018-10-16
Test Channel:	CH19	**Tested by:**	Lily.Wang
Temperature:	25°C	**Polarity:**	Ver. / Hor.

Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	4868.569	48.58	-0.43	48.15	74.00	-25.85	100	254	peak
2	7320.565	50.72	6.33	57.05	74.00	-16.95	100	185	peak
3	7320.565	41.36	6.33	47.69	54.00	-6.31	100	162	AVG

Vertical



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	4868.590	48.09	-0.43	47.66	74.00	-26.34	100	251	peak
2	7320.513	48.76	6.33	55.09	74.00	-18.91	100	352	peak
3	7320.513	40.03	6.33	46.36	54.00	-7.64	200	300	AVG

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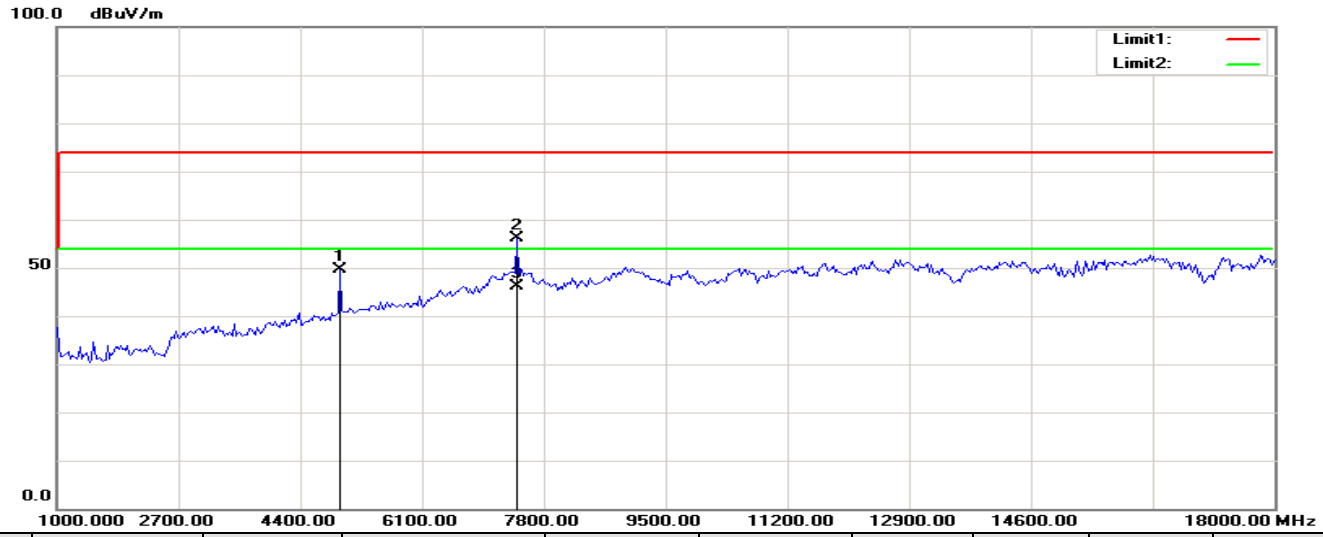
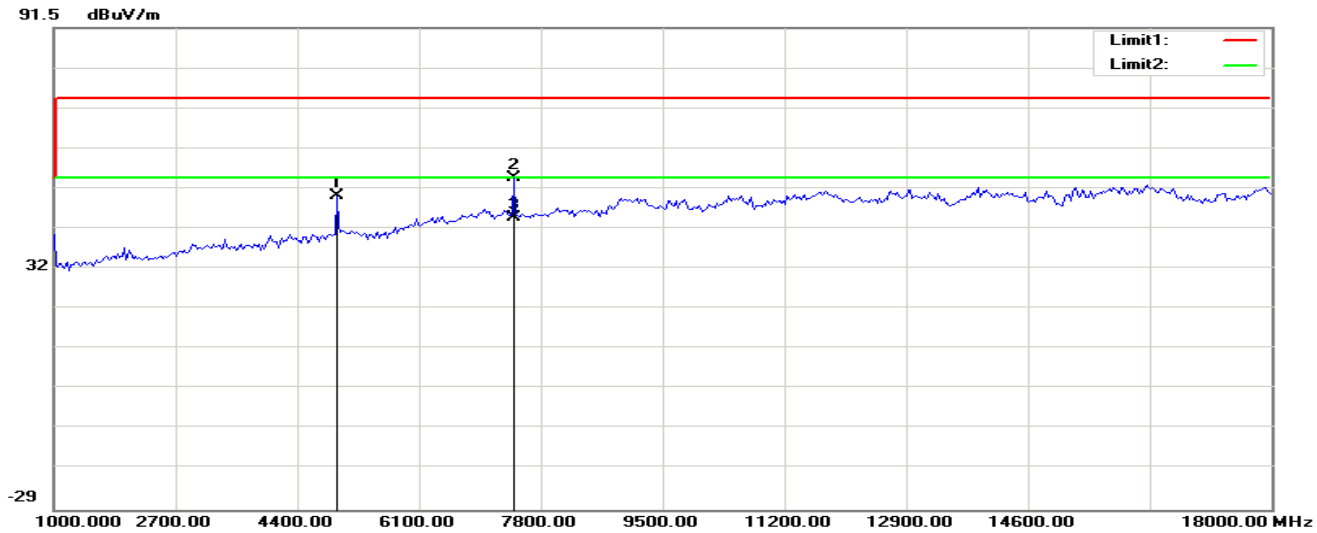
Operation Mode:	Bluetooth LE4.2	**Test Date:**	2018-10-16
Test Channel:	CH39	**Tested by:**	Lily.Wang
Temperature:	25°C	**Polarity:**	Ver. / Hor.

Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	4950.298	49.33	0.26	49.59	74.00	-24.41	100	358	peak
2	7429.469	49.89	6.14	56.03	74.00	-17.97	100	333	peak
3	7429.469	39.88	6.14	46.02	54.00	-7.98	100	236	AVG

Vertical



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	4950.320	49.26	0.26	49.52	74.00	-24.48	100	265	peak
2	7430.112	48.10	6.14	54.24	74.00	-19.76	100	120	peak
3	7430.112	38.11	6.14	44.25	54.00	-9.75	200	168	AVG

Above 18GHz

The interference of the frequency value is lower than the limit below 20 db, measured as the background noise values and will not be recorded.

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6.6 POWERLINE CONDUCTED EMISSIONS

LIMIT

ACCORDING TO FCC RULES:

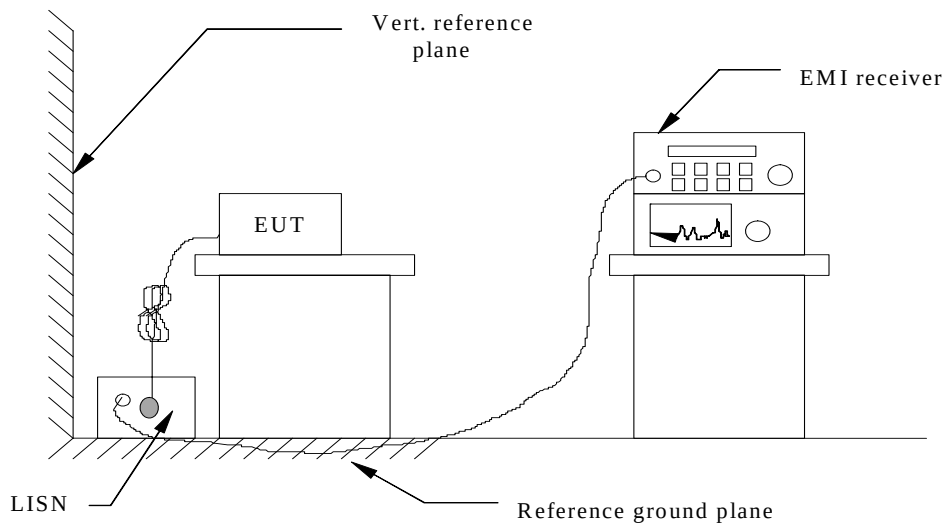
For an intentional radiator which is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed 250 microvolts (The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz). The limits at specific frequency range is listed as follows:

Frequency Range (MHz)	Limits (dBµV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56*	56 to 46*
0.50 to 5	56	46
5 to 30	60	50

** Decreases with the logarithm of the frequency.*

Compliance with this provision shall be based on the measurement of the radio frequency voltage between each power line (LINE and NEUTRAL) and ground at the power terminals.

Test Configuration



See test photographs attached in Appendix 1 for the actual connections between EUT and support equipment.

TEST PROCEDURE

1. The EUT was placed on a table, which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured were complete.

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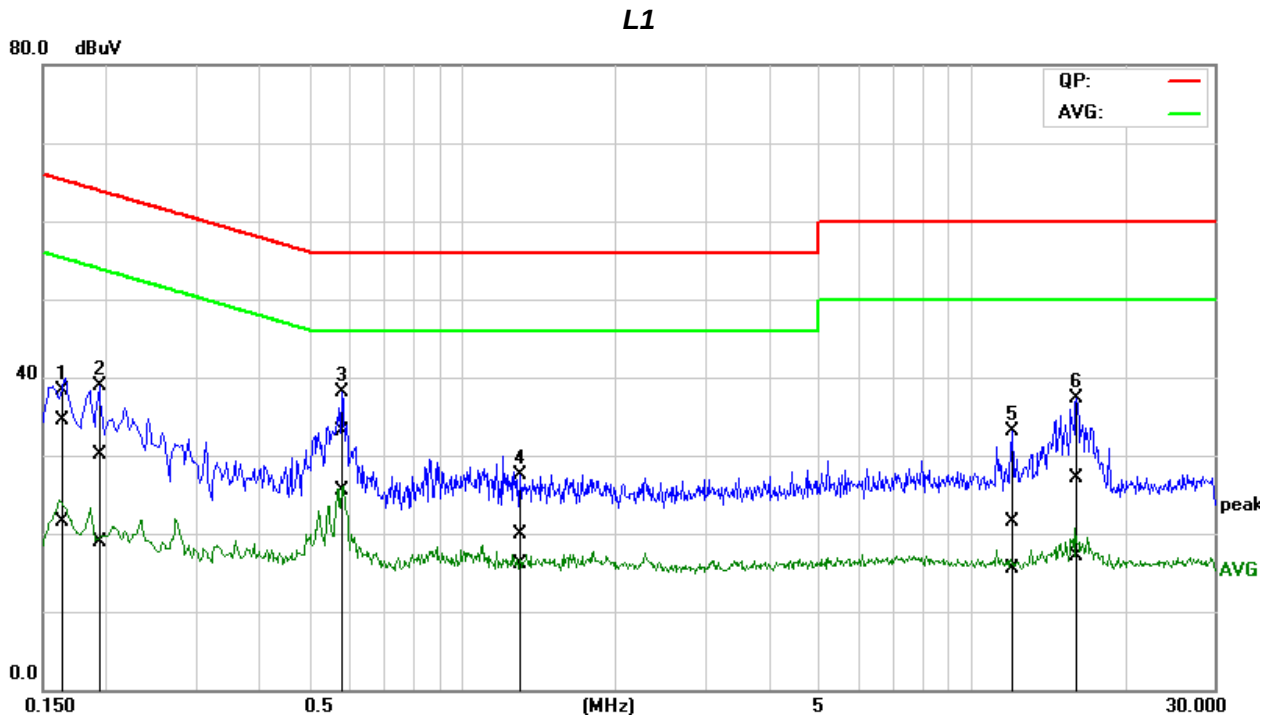
TEST RESULTS

Job No.:	C181015R01	Date:	2018/10/16
Model No.:	Little Tinkerer	Time:	16:00:46
Standard:	FCC Class B	Temp.(C)/Hum.(%):	22(C)/48%
Test item:	Conduction test	Test By:	Lily.Wang
Line:	L1	Test Voltage:	AC 120V/60Hz
Model:		Description:	



No.	Frequency	QuasiPeak reading	Average reading	Correction factor	QuasiPeak result	Average result	QuasiPeak limit	Average limit	QuasiPeak margin	Average margin	Remark
	(MHz)	(dBuV)	(dBuV)	(dB)	(dBuV)	(dBuV)	(dBuV)	(dBuV)	(dB)	(dB)	
1	0.1613	15.06	2.07	19.43	34.49	21.50	65.40	55.40	-30.91	-33.90	Pass
2	0.1938	10.58	-0.64	19.45	30.03	18.81	63.87	53.87	-33.84	-35.06	Pass
3	0.5818	13.70	6.01	19.50	33.20	25.51	56.00	46.00	-22.80	-20.49	Pass
4	1.2851	0.39	-3.49	19.57	19.96	16.08	56.00	46.00	-36.04	-29.92	Pass
5	12.0050	1.61	-4.48	19.95	21.56	15.47	60.00	50.00	-38.44	-34.53	Pass
6	16.0360	7.10	-3.01	20.06	27.16	17.05	60.00	50.00	-32.84	-32.95	Pass

Note: 1. L1 = Line One (Live Line) / L2 = Line Two (Neutral Line).

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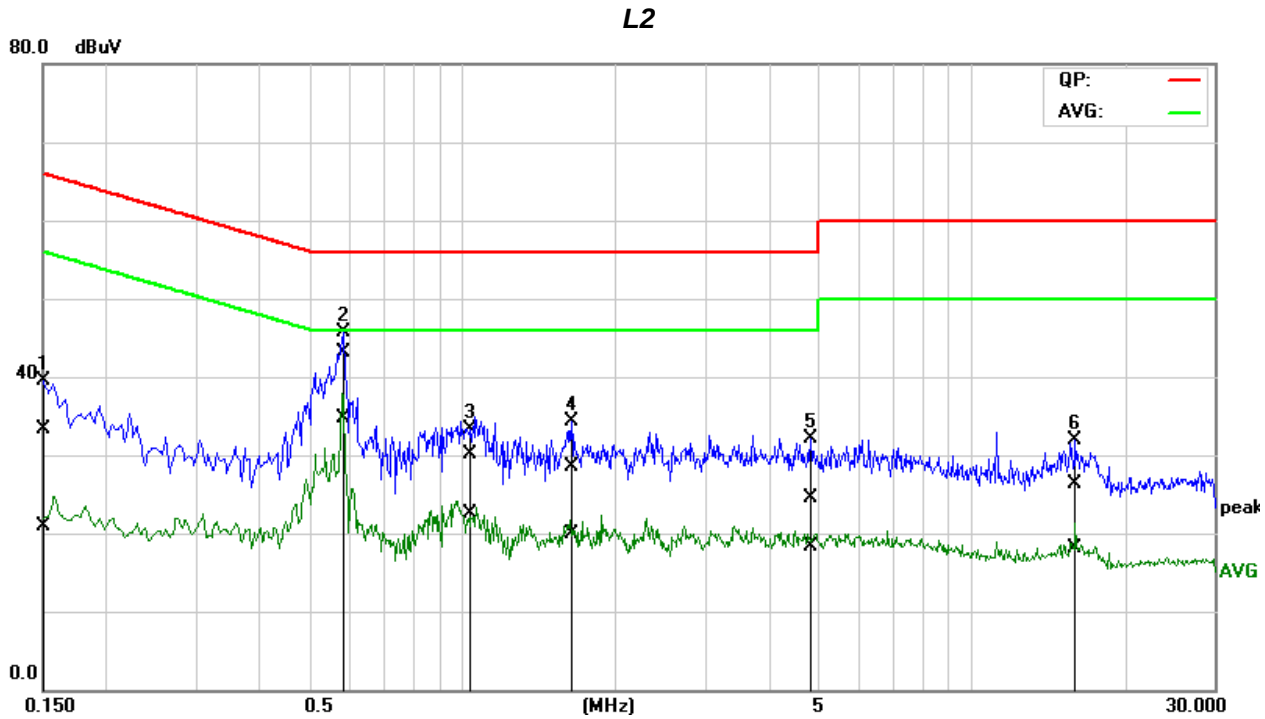
Job No.:	C181015R01	Date:	2018/10/16
Model No.:	Little Tinkerer	Time:	16:07:40
Standard:	FCC Class B	Temp.(C)/Hum.(%):	22(C)/48%
Test item:	Conduction test	Test By:	Lily.Wang
Line:	L2	Test Voltage:	AC 120V/60Hz
Model:		Description:	



No.	Frequency (MHz)	QuasiPeak reading (dBuV)	Average reading (dBuV)	Correction factor (dB)	QuasiPeak result (dBuV)	Average result (dBuV)	QuasiPeak limit (dBuV)	Average limit (dBuV)	QuasiPeak margin (dB)	Average margin (dB)	Remark
1	0.1519	13.83	1.49	19.42	33.25	20.91	65.90	55.90	-32.65	-34.99	Pass
2*	0.5836	23.63	15.22	19.49	43.12	34.71	56.00	46.00	-12.88	-11.29	Pass
3	1.0257	10.63	2.92	19.54	30.17	22.46	56.00	46.00	-25.83	-23.54	Pass
4	1.6141	9.03	0.36	19.56	28.59	19.92	56.00	46.00	-27.41	-26.08	Pass
5	4.8533	4.88	-1.38	19.67	24.55	18.29	56.00	46.00	-31.45	-27.71	Pass
6	16.0123	6.24	-1.97	20.00	26.24	18.03	60.00	50.00	-33.76	-31.97	Pass

Note: 1. L1 = Line One (Live Line) / L2 = Line Two (Neutral Line).

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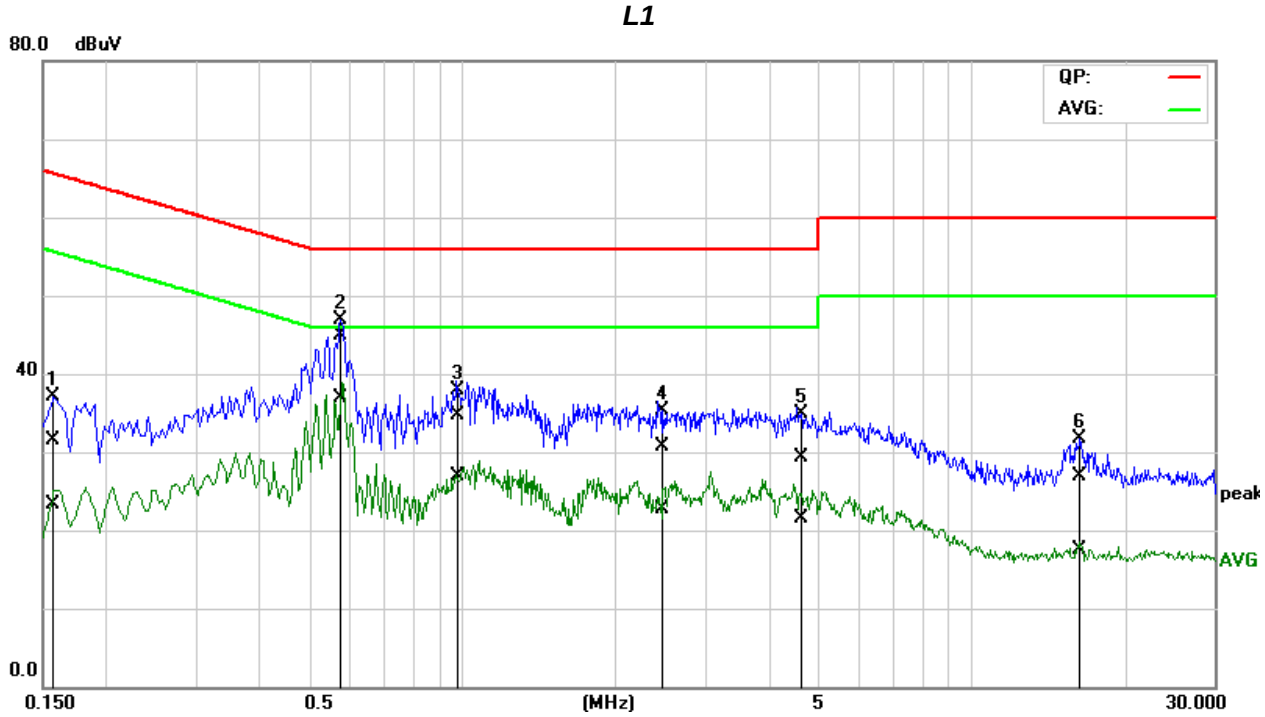
Job No.:	C181015R01	Date:	2018/10/16
Model No.:	Little Tinkerer	Time:	16:09:46
Standard:	FCC Class B	Temp.(C)/Hum.(%):	22(C)/48%
Test item:	Conduction test	Test By:	Lily.Wang
Line:	L1	Test Voltage:	AC 240V/60Hz
Model:		Description:	



No.	Frequency (MHz)	QuasiPeak reading (dBuV)	Average reading (dBuV)	Correction factor (dB)	QuasiPeak result (dBuV)	Average result (dBuV)	QuasiPeak limit (dBuV)	Average limit (dBuV)	QuasiPeak margin (dB)	Average margin (dB)	Remark
1	0.1594	14.33	2.99	19.43	33.76	22.42	65.50	55.50	-31.74	-33.08	Pass
2	0.2032	10.21	2.05	19.45	29.66	21.50	63.48	53.48	-33.82	-31.98	Pass
3*	0.5776	23.26	11.64	19.50	42.76	31.14	56.00	46.00	-13.24	-14.86	Pass
4	0.9634	12.67	2.97	19.56	32.23	22.53	56.00	46.00	-23.77	-23.47	Pass
5	1.6854	9.07	1.55	19.58	28.65	21.13	56.00	46.00	-27.35	-24.87	Pass
6	16.2636	15.77	4.46	20.06	35.83	24.52	60.00	50.00	-24.17	-25.48	Pass

Note: 1. L1 = Line One (Live Line) / L2 = Line Two (Neutral Line).

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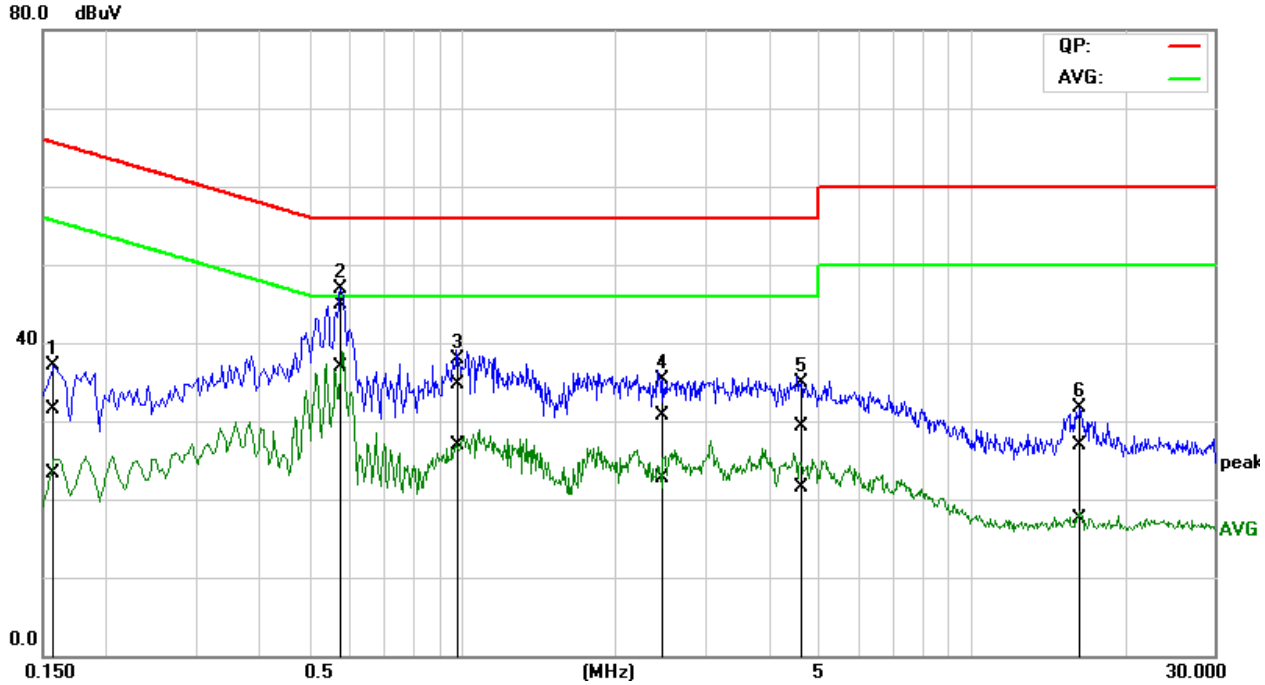
Job No.:	C181015R01	Date:	2018/10/16
Model No.:	Little Tinkerer	Time:	16:16:17
Standard:	FCC Class B	Temp.(C)/Hum.(%):	22(C)/48%
Test item:	Conduction test	Test By:	Lily.Wang
Line:	L2	Test Voltage:	AC 240V/60Hz
Model:		Description:	

L2



No.	Frequency (MHz)	QuasiPeak reading (dBuV)	Average reading (dBuV)	Correction factor (dB)	QuasiPeak result (dBuV)	Average result (dBuV)	QuasiPeak limit (dBuV)	Average limit (dBuV)	QuasiPeak margin (dB)	Average margin (dB)	Remark
1	0.1560	12.14	3.97	19.42	31.56	23.39	65.67	55.67	-34.11	-32.28	Pass
2*	0.5753	25.32	17.50	19.49	44.81	36.99	56.00	46.00	-11.19	-9.01	Pass
3	0.9867	15.20	7.32	19.54	34.74	26.86	56.00	46.00	-21.26	-19.14	Pass
4	2.4660	11.06	3.11	19.58	30.64	22.69	56.00	46.00	-25.36	-23.31	Pass
5	4.5997	9.69	1.91	19.66	29.35	21.57	56.00	46.00	-26.65	-24.43	Pass
6	16.3289	6.87	-2.48	20.00	26.87	17.52	60.00	50.00	-33.13	-32.48	Pass

Note: 1. L1 = Line One (Live Line) / L2 = Line Two (Neutral Line).

*R*emark:

1.The measuring frequencies range between 0.15 MHz and 30 MHz.

2.The emissions measured in the frequency range between 0.15 MHz and 30MHz were made with an instrument using Quasi-peak detector and Average detector.

3."---" denotes the emission level was or more than 2dB below the Average limit, and no re-check was made.

4.The IF bandwidth of SPA between 0.15MHz and 30MHz was 10KHz. The IF bandwidth of Test Receiver between 0.15MHz and 30MHz was 9kHz.

END OF REPORT

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