

FCC 47 CFR PART 15 SUBPART C TEST REPORT

For

Product Name: DIGITAL PIANO

Brand Name: N/A

Model No.: LEGATO III

Series Model.: N/A

FCC ID: OCDLEGATOIII

Test Report Number:

C180724R01-RPB1

Issued for

Ringway Tech(Jiangsu) Co.,Ltd.

No. 101 Hanjiang West Road, Changzhou, Jiangsu, China

Issued by

Compliance Certification Services Inc.

Kun shan Laboratory

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Revision History

Rev.	Issue Date	Report NO.	Effect Page	Contents
00	July 30, 2018	C180724R01-RPB1	ALL	N/A

1 TEST RESULT CERTIFICATION

Product Name:	DIGITAL PIANO
Trade Name:	N/A
Model Name:	LEGATO III
Series Model:	N/A
Applicant Discrepancy:	Initial
Device Category:	Mobile unit
Date of Test:	July 25, 2018 ~July 30, 2018
Applicant:	Ringway Tech(Jiangsu) Co.,Ltd. No. 101 Hanjiang West Road, Changzhou,Jiangsu, China
Manufacturer:	Ringway Tech(Jiangsu) Co.,Ltd. No. 101 Hanjiang West Road, Changzhou,Jiangsu, China
Application Type:	Certification

APPLICABLE STANDARDS

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

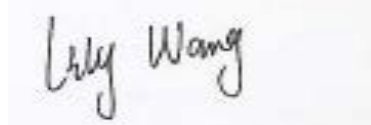
The above equipment was tested by Compliance Certification Services Inc. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10:2013 and the energy emitted by the sample EUT tested as described 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:



Tested by:



Jeff.Fang
RF Manager
Compliance Certification Services Inc.

Lily.Wang
Test Engineer
Compliance Certification Services Inc.

2 EUT DESCRIPTION

Product Name:	DIGITAL PIANO
Trade Name:	N/A
Model Name:	LEGATO III
Series Model:	N/A
Model Discrepancy:	N/A
Power Adapter:	Model: OH-1015A1201000U3-UL INPUT:100-240V~ 50/60Hz 350mA OUTPUT:12V==1000mAh
Frequency Range:	Bluetooth:2402 ~ 2480 MHz
Peak output Power:	Bluetooth LE4.0: -0.19dBm
Average output Power:	Bluetooth LE4.0: -1.56dBm
Channel Spacing	Bluetooth LE4.0: 2MHz
Modulation type:	Bluetooth LE4.0: GFSK
Transmit Data Rate:	Bluetooth LE4.0: 1 Mbps
Number of Channels:	Bluetooth LE4.0: 40 Channels
Antenna Specification:	Chip Antenna gain 2.5dBi

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: OCDLEGATOIII** filing to comply with Section 15.207, 15.209 and 15.247 of the FCC Part 15, Subpart C Rules.

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 and KDB558074.

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 EXERCISE EUT

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 6.2 of ANSI C63.10 2013 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 6.4 & 6.5 of ANSI C63.10:2013.

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 6.6 of ANSI C63.10:2013.

3.4 TEST Mode

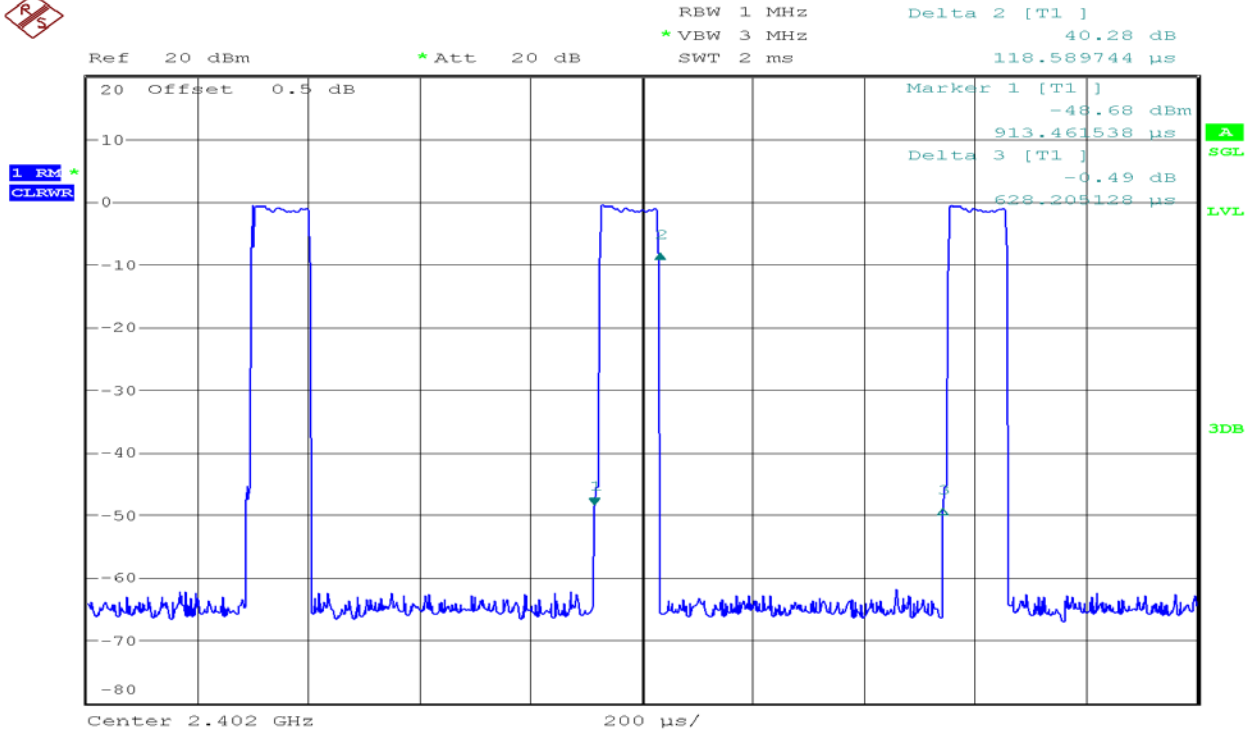
Preliminary tests were performed in different data rate to find the worst radiated emission. The data rate shown in the table below is the worst-case rate with respect to the specific test item. Investigation has been done on all the possible configurations for searching the worst cases. The following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

Remark1: For radiated test cases below 1 GHz, the worst mode data rate channel 39 was reported only, because this data rate has the highest RF output power at preliminary tests.

3.5 Duty cycle

Configuration	Duty Cycle (%)	VBW
BLE4.0	18.95	10kHz



3.6 RESTRICTED BANDS OF OPERATIONS

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
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
10.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	(²)
13.36 - 13.41			

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

² Above 38.6

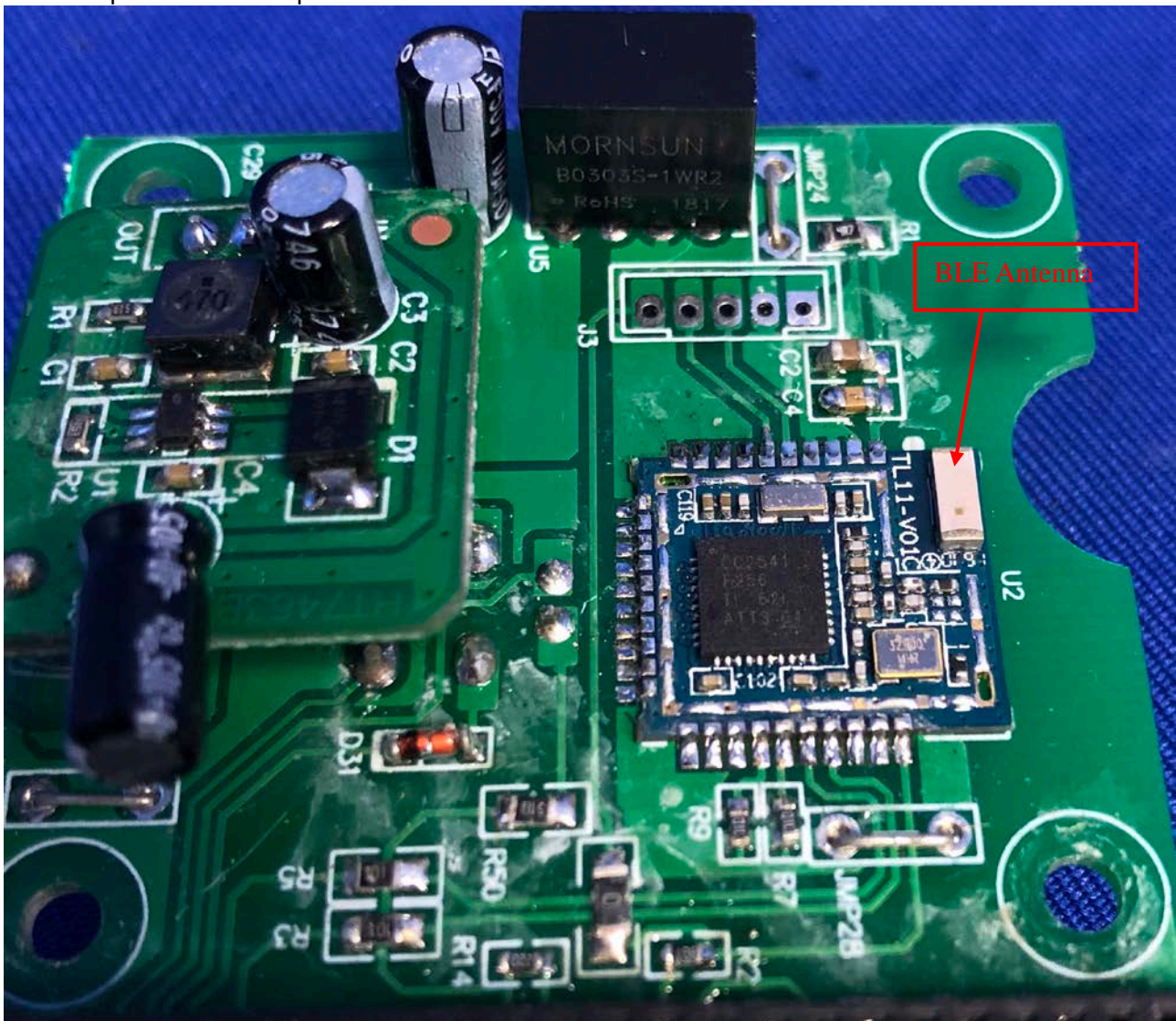
Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement 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.

3.7 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.

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>

5.5 LIST OF MEASURING EQUIPMENT

Conducted Emissions Test Site					
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Data	Calibration Due
Spectrum Analyzer	Agilent	E4446A	MY44020154	2017-9-4	2018-9-3
Spectrum Analyzer	RS	FSU26	200789	2018-7-13	2019-7-12
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
Cable	N/A	Cable-06	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 Date	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		

977 Chamber					
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Data	Calibration Due
Spectrum Analyzer	Agilent	E4446A	MY44020154	2017-9-4	2018-9-3
Spectrum Analyzer	RS	FSU26	200789	2018-7-13	2019-7-12
EMI Test Receiver	R&S	ESCI	101378	2017-12-26	2018-12-25
Amplifier	COM-POWER	PAM-840A	461332	2017-11-29	2018-11-28
Amplifier	MITEQ	JS41-00101800-32-10P	1675713	2018-7-13	2019-7-12
Broad-Band Horn Antenna	SCHWARZBECK	BBHA 9170	9170-515	2018-2-27	2019-2-26
Bilog Antenna	SCHAFFNER	CBL6143	5078	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	CT100	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
Filter 5150MHz-5350MHz	N/A	N/A	N/A	2018-4-24	2019-4-23
Filter 5725MHz-5850MHz	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.

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	$\pm 1.129\text{dB}$
Unwanted Emissions, conducted	$\pm 2.406\text{dB}$
RF Power density, conducted	$\pm 2.379\text{dB}$
Conducted emissions	$\pm 2.582\text{dB}$
All emissions, radiated (Below 1GHz)	$\pm 4.725\text{dB}$
All emissions, radiated (Above 1GHz)	$\pm 4.818\text{dB}$
Temperature	$\pm 0.3\text{dB}$
Supply voltages	$\pm 0.2\%$

5.7 SETUP CONFIGURATION

See test photographs attached in Setup photo for the actual connections between EUT and support equipment.

5.8 SUPPORT EQUIPMENT

No.	Device Type	Brand	Model	Series No.	FCC ID
N/A	N/A	N/A	N/A	N/A	N/A

Remark:

- 1.All the equipment/cables were placed in the worst-case configuration to maximize the emission during the test.
- 2.Grounding was established in accordance with the manufacturer's requirements and conditions for the intended use.

6 FCC PART 15.247 REQUIREMENTS

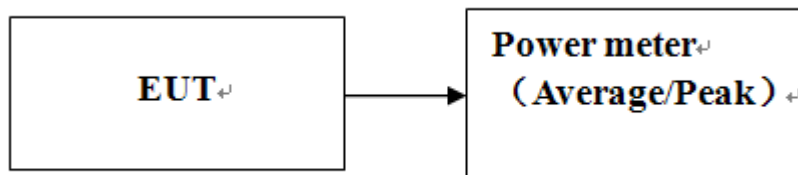
6.1 PEAK POWER

Limit of peak output power

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 v04.
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.

Test Results

No non-compliance noted

Test RESULTS

BLE4.0 GFSK Modulation 1Mbps mode

Test mode:	Bluetooth LE4.0	Temperature:	23°C
Test By:	Lily.Wang	Test Date:	2018-7-25

Channel	Frequency (MHz)	Transmit Data Rate	Peak Output Power (dBm)	Limit (dBm)	Result
00	2402	1Mbps	-0.19	30.00	PASS
19	2440	1Mbps	-0.94		PASS
39	2480	1Mbps	-1.22		PASS

Channel	Frequency (MHz)	Transmit Data Rate	Average Output Power (dBm)
00	2402	1Mbps	-1.56
19	2440	1Mbps	-2.39
39	2480	1Mbps	-2.86

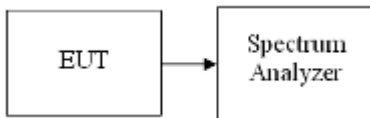
Remark: Duty factor has been offset with cable loss

6.2 PEAK POWER SPECTRAL DENSITY

Limit

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. The testing follows Measurement Procedure 10.2 Method PKPSD of FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v04
2. 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.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 3 kHz. Video bandwidth VBW = 10 kHz In order to make an accurate measurement, set the span to 1.5 times DTS Channel Bandwidth. (6dB BW)
5. Detector = peak, Sweep time = auto couple, Trace mode = max hold, Allow trace to fully stabilize. Use the peak marker function to determine the maximum power level.
6. Measure and record the results in the test report.

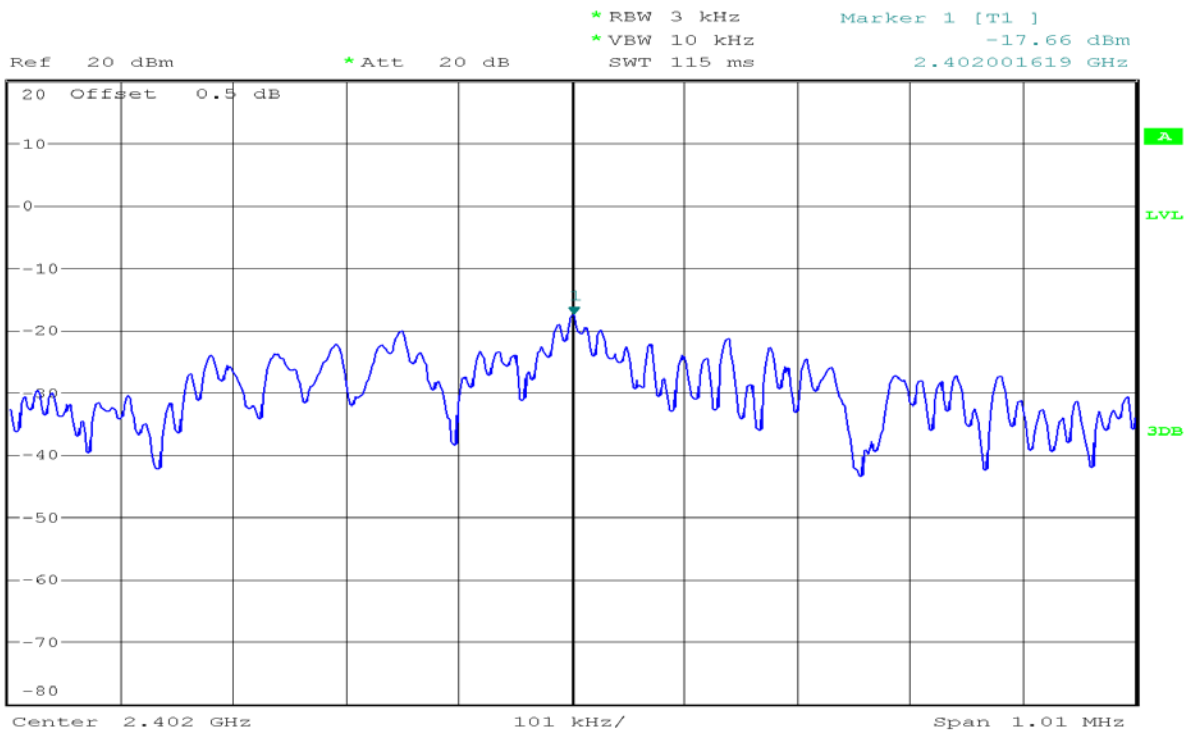
Test Results of power Spectral Density

Test mode:	Bluetooth LE4.0	Temperature:	23°C
Test By:	Lily.Wang	Test Date:	2018-7-25

Channel	Frequency (MHz)	PSD/3kHz (dBm)	Limit (dBm)	Result
00	2402	-17.66	8	PASS
19	2440	-18.15		PASS
39	2480	-18.94		PASS

Test Plot of power Spectral Density

Channel 00

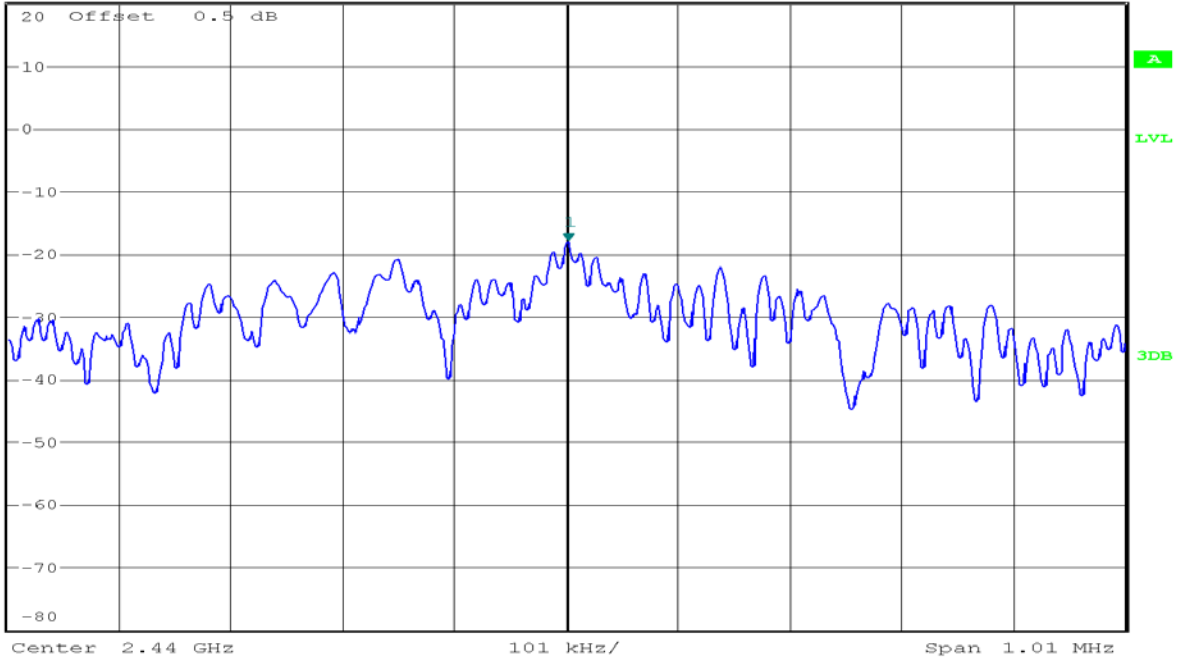


Channel 19



Ref 20 dBm *Att 20 dB *RBW 3 kHz Marker 1 [T1] -18.15 dBm
 *VBW 10 kHz 2.440001619 GHz
 SWT 115 ms

1 PK
MATCH

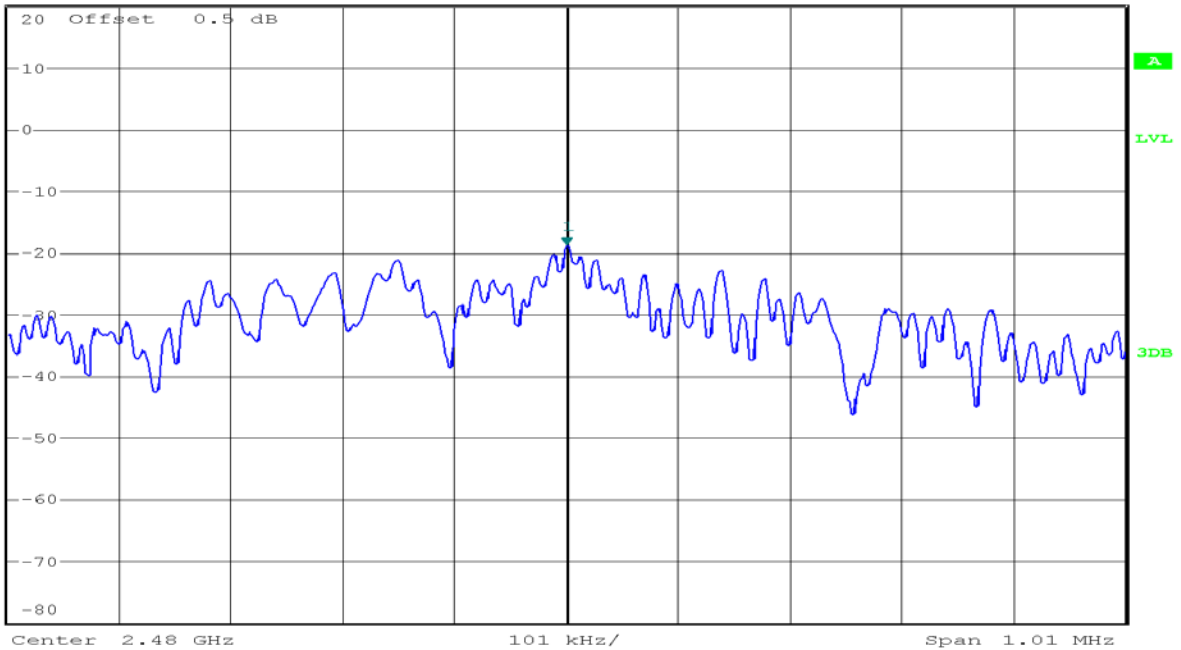


Channel 39



Ref 20 dBm *Att 20 dB *RBW 3 kHz Marker 1 [T1] -18.94 dBm
 *VBW 10 kHz 2.480000000 GHz
 SWT 115 ms

1 PK
MATCH

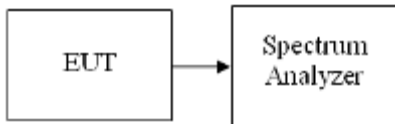


6.3 6dB Bandwidth Measurement

Limit of 6dB Bandwidth

The minimum 6 dB bandwidth shall be at least 500 kHz.

Test Configuration



Test Procedure

1. The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v04.
2. 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.
3. Set to the maximum power setting and enable the EUT transmit continuously.
4. 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.
5. Measure and record the results in the test report.

Test Results of Bandwidth

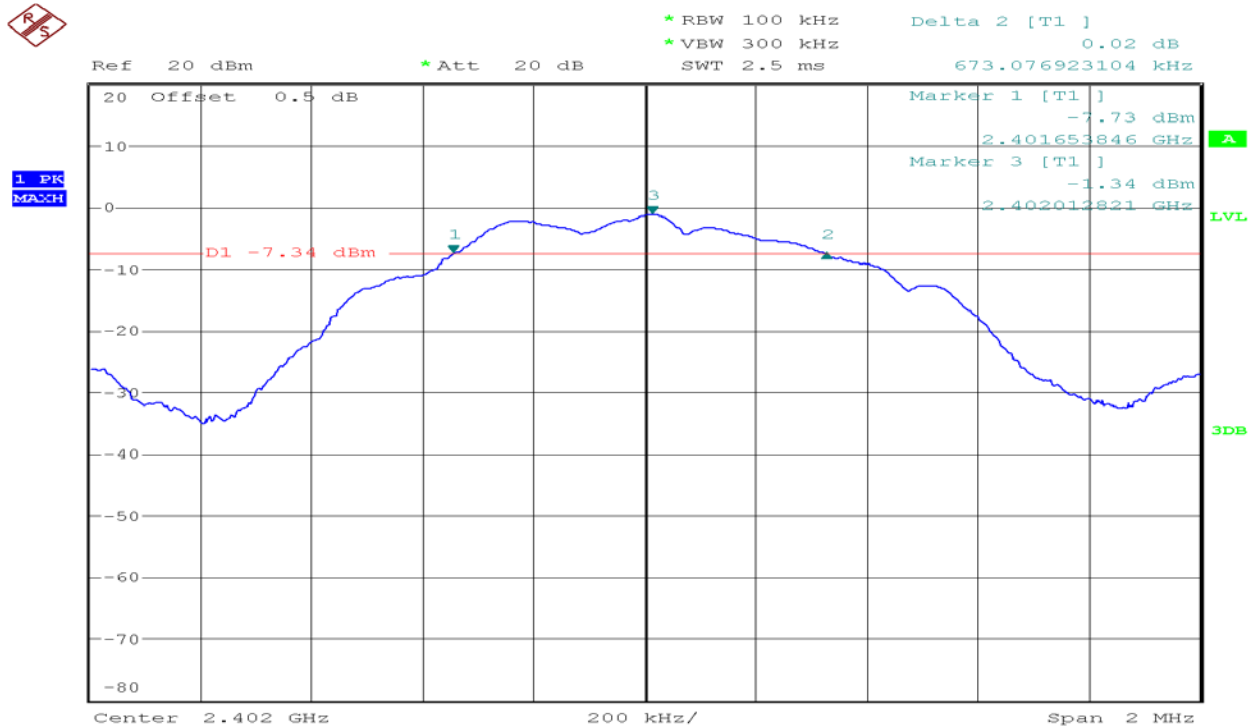
No non-compliance noted

Test mode:	Bluetooth LE4.0	Temperature:	23°C
Test By:	Lily.Wang	Test Date:	2018-7-25

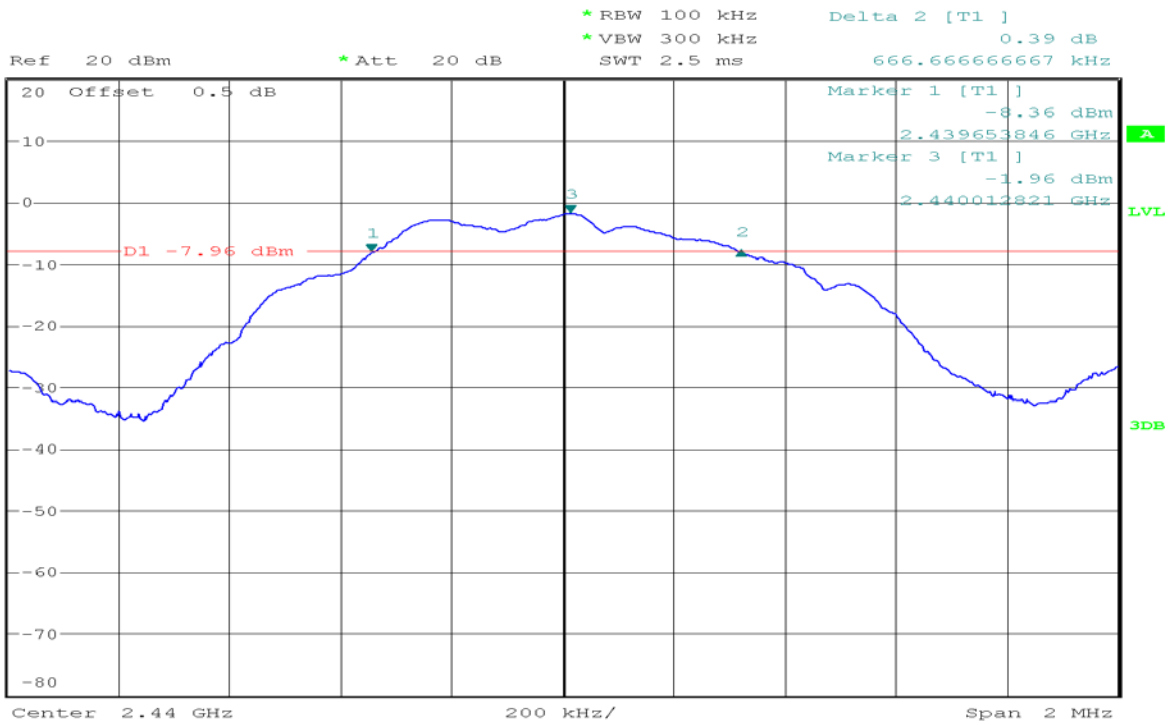
Channel	Frequency (MHz)	6dB Bandwidth (MHz)	6dB Bandwidth Limit (MHz)	Result
00	2402	0.673	0.5	Pass
19	2440	0.667	0.5	Pass
39	2480	0.670	0.5	Pass

Test Plot

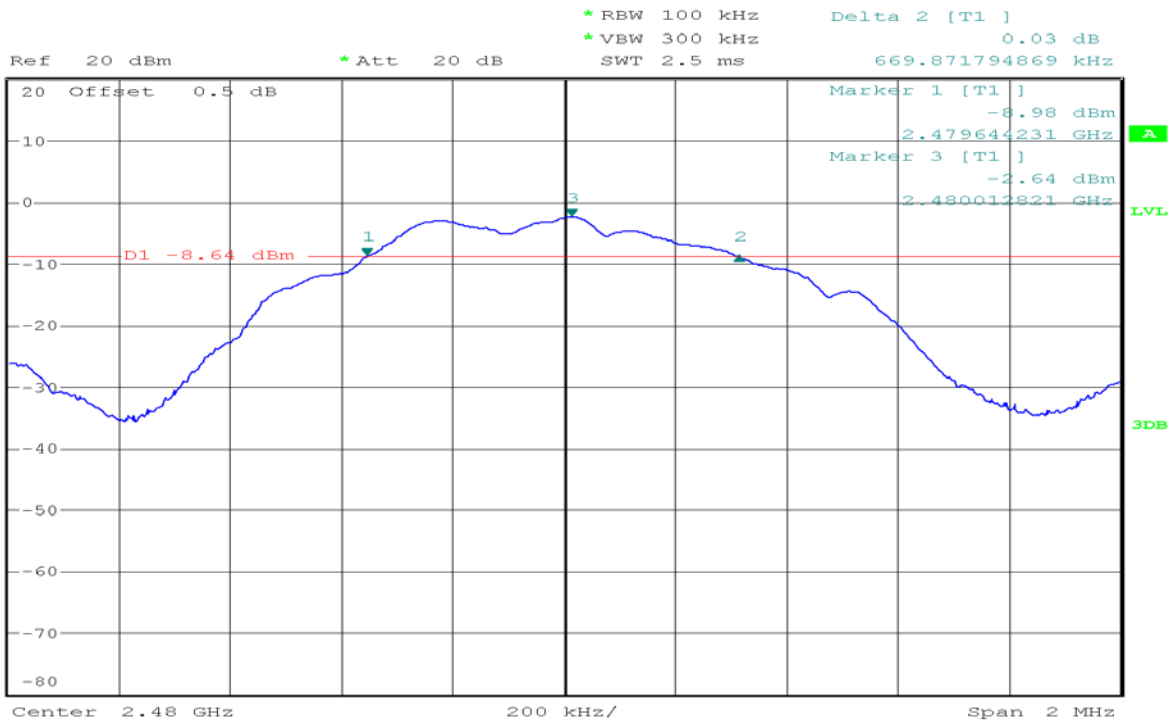
Channel 00



Channel 19



Channel 39

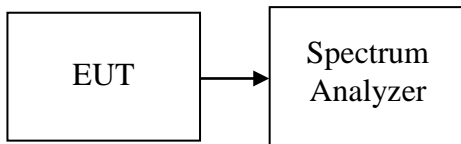


6.4 Conducted Band Edges and Spurious Emission Measurement

LIMIT

According to §15.247(d), in any 100 kHz bandwidth outside the frequency bands 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, 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.

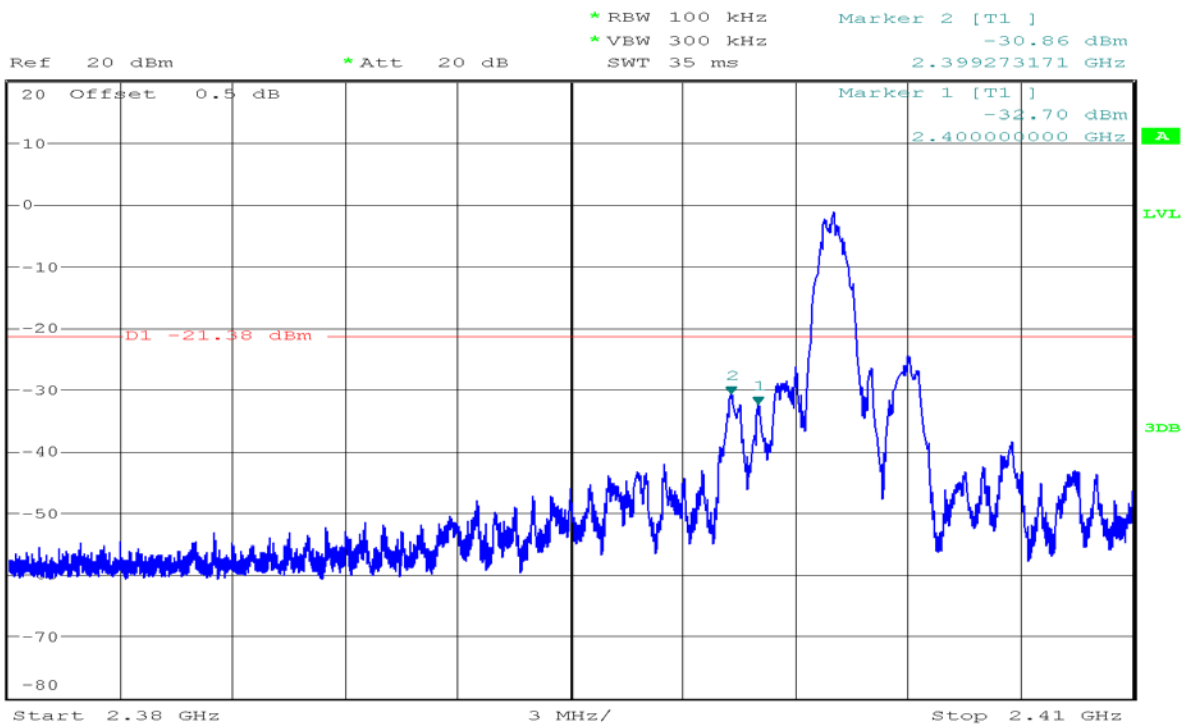
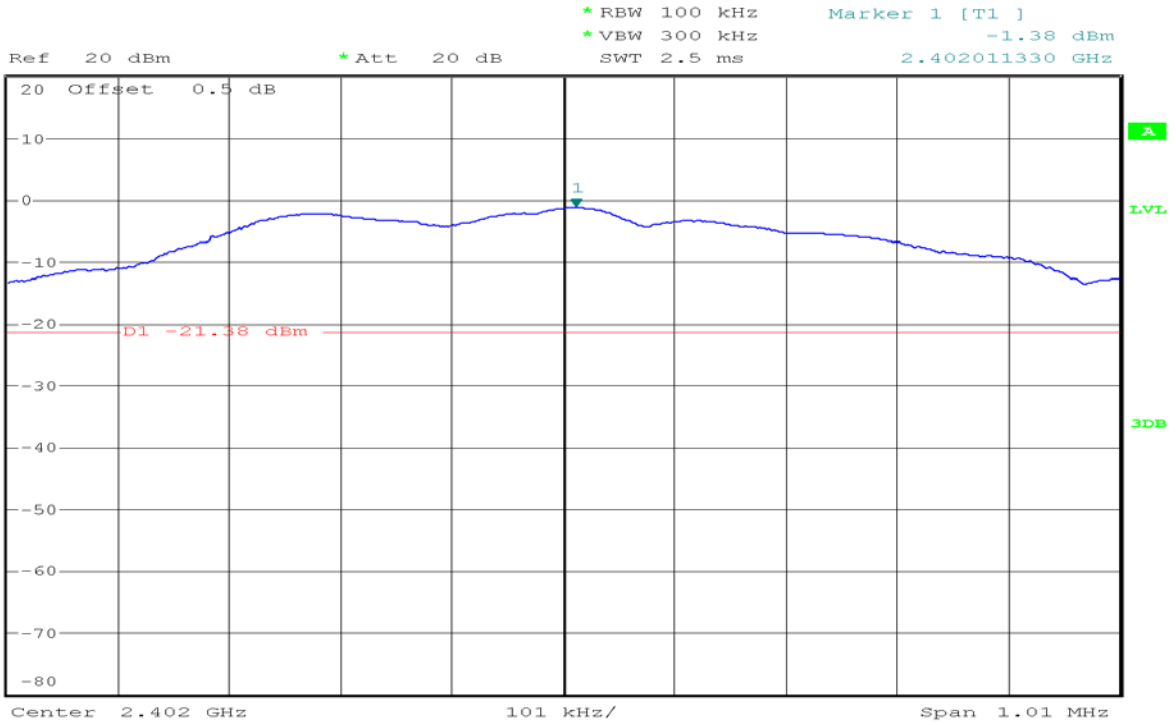
Measurements are made over the 30MHz to 25GHz range with the transmitter set to the lowest, middle, and highest channels.

TEST RESULTS

No non-compliance noted

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

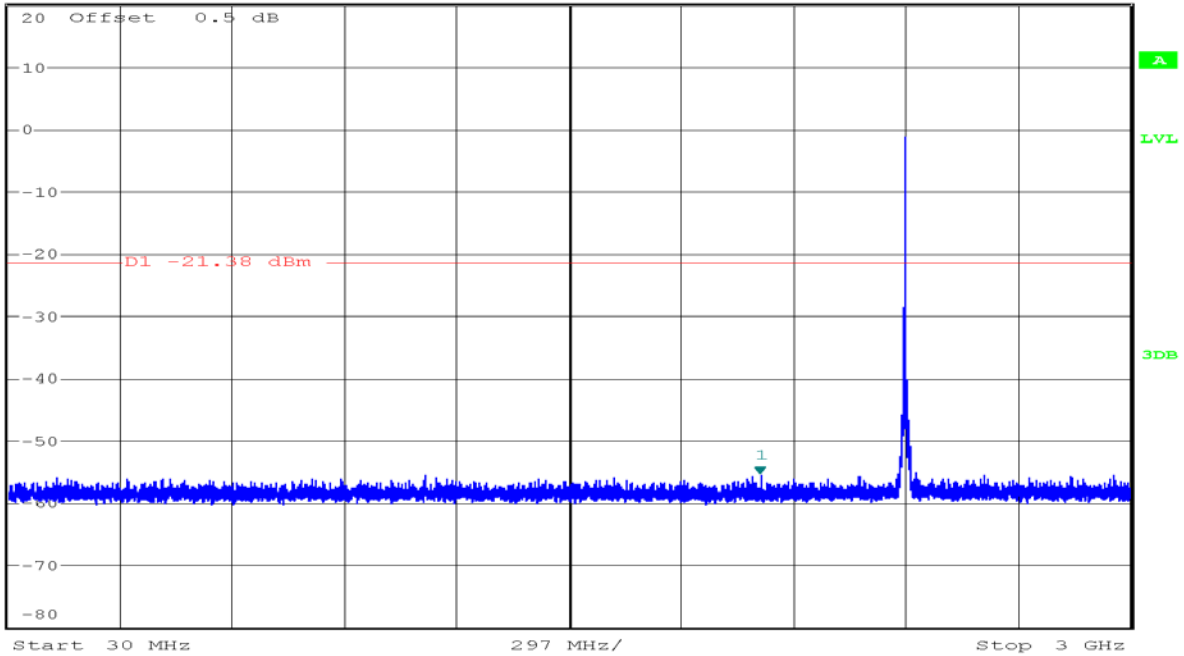
CH Low





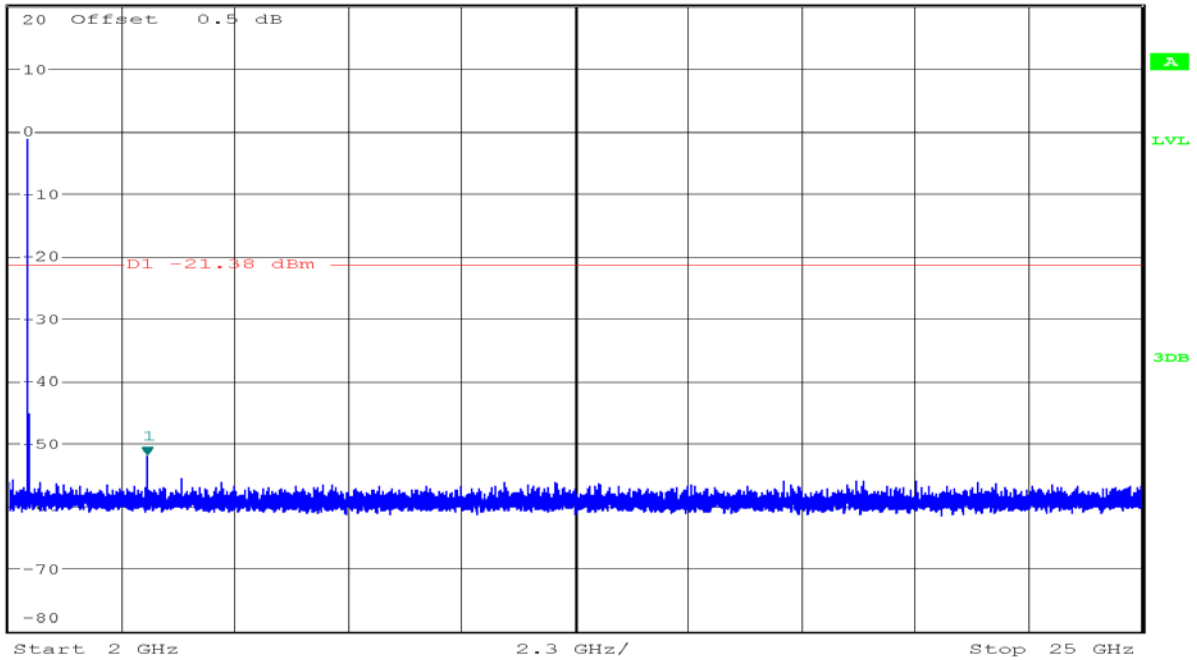
Ref 20 dBm *Att 20 dB *RBW 100 kHz Marker 1 [T1] -55.43 dBm
*VBW 300 kHz SWT 300 ms 2.021348780 GHz

1 PK
MATCH



Ref 20 dBm *Att 20 dB *RBW 100 kHz Marker 1 [T1] -51.87 dBm
*VBW 300 kHz SWT 2.3 s 4.804878049 GHz

1 PK
MATCH

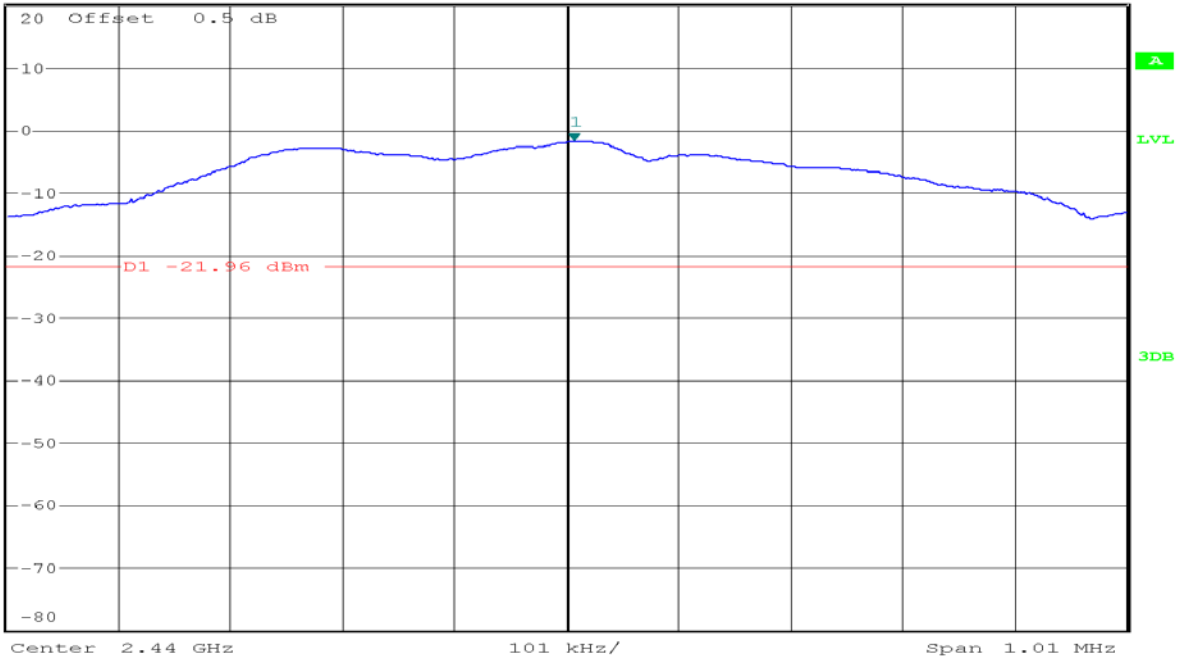


CH Mid



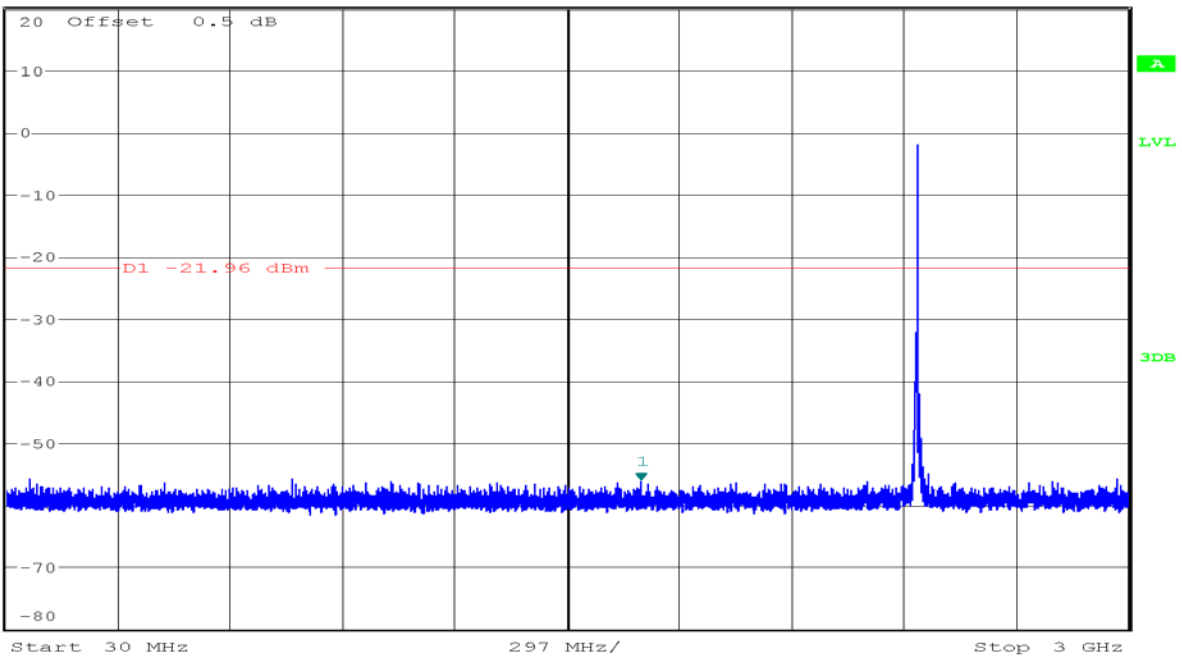
Ref 20 dBm * Att 20 dB * RBW 100 kHz Marker 1 [T1]
 * VBW 300 kHz -1.96 dBm
 SWT 2.5 ms 2.440006733 GHz

1 PK
MATCH



Ref 20 dBm * Att 20 dB * RBW 100 kHz Marker 1 [T1]
 * VBW 300 kHz -56.10 dBm
 SWT 300 ms 1.711671951 GHz

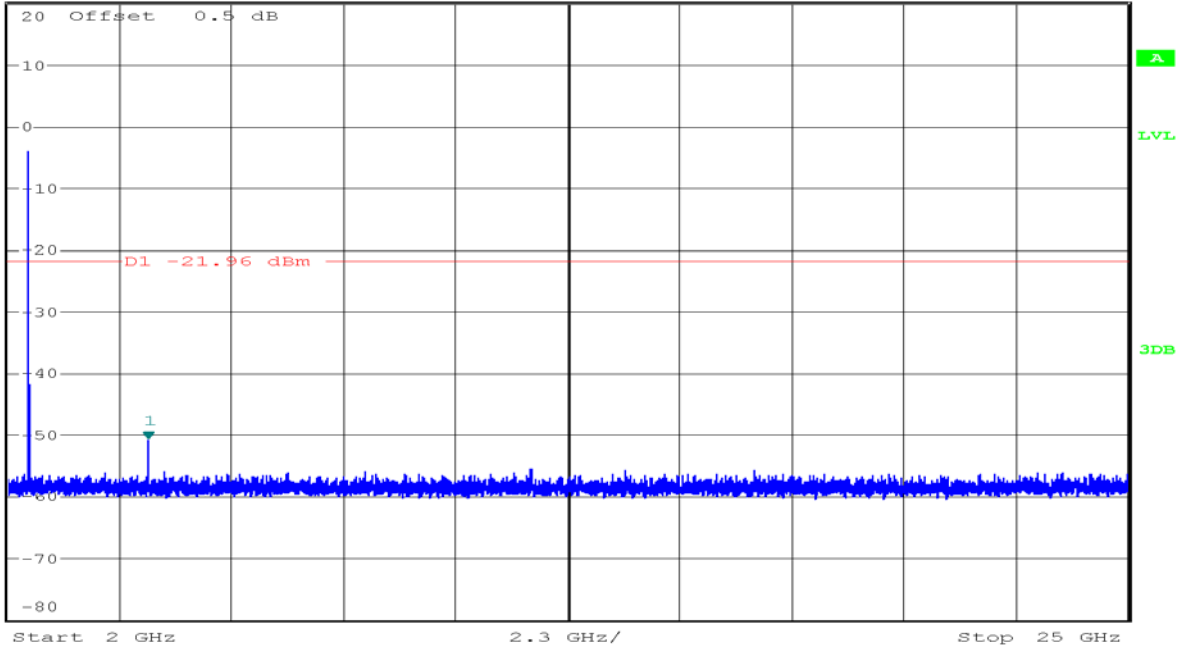
1 PK
MATCH





Ref 20 dBm * Att 20 dB * RBW 100 kHz Marker 1 [T1]
 * VBW 300 kHz -50.86 dBm
 SWT 2.3 s 4.877804878 GHz

1 PK
MATCH

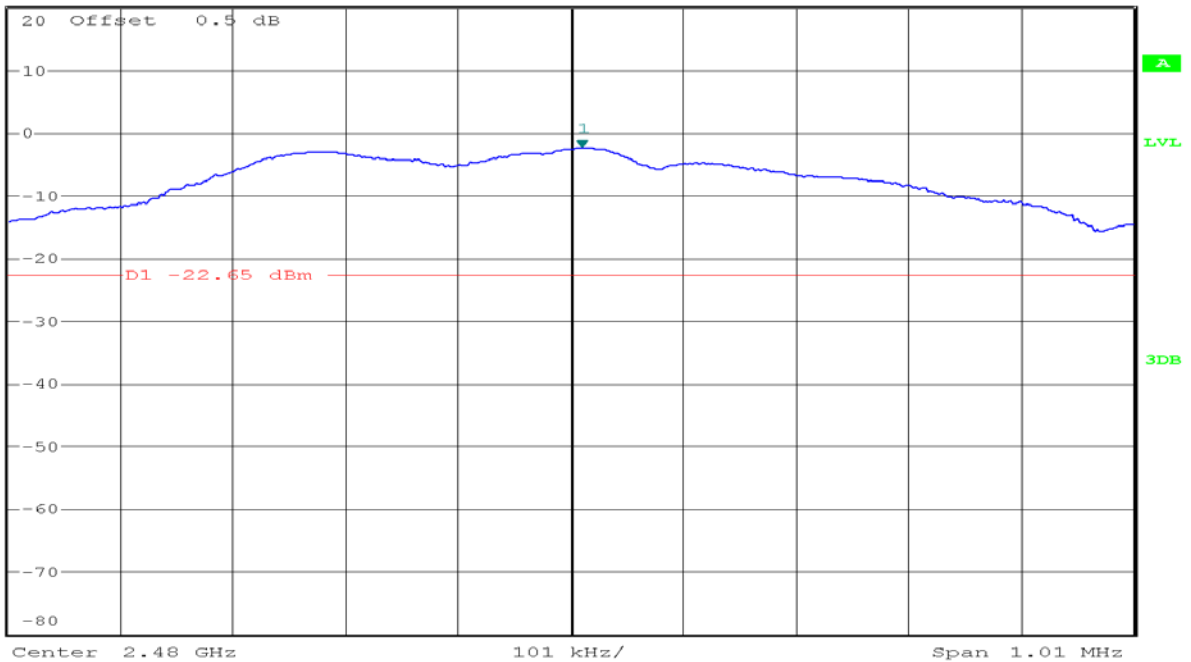


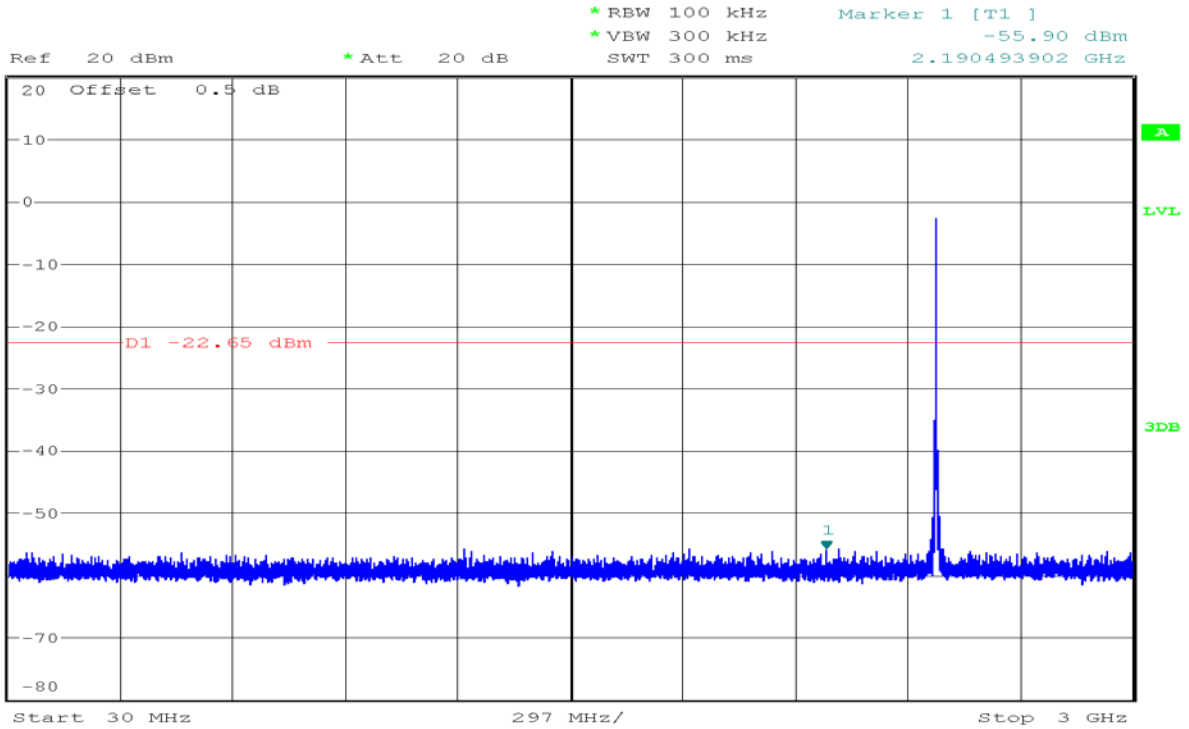
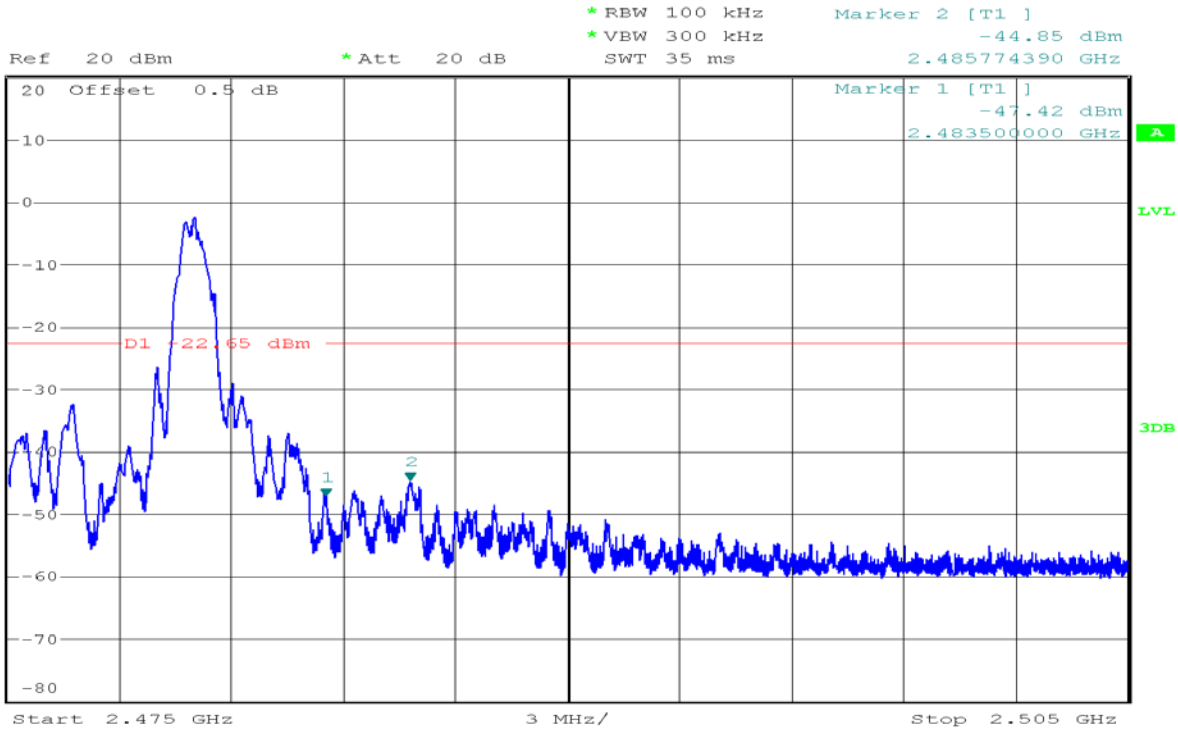
CH High



Ref 20 dBm * Att 20 dB * RBW 100 kHz Marker 1 [T1]
 * VBW 300 kHz -2.65 dBm
 SWT 2.5 ms 2.480010100 GHz

1 PK
MATCH

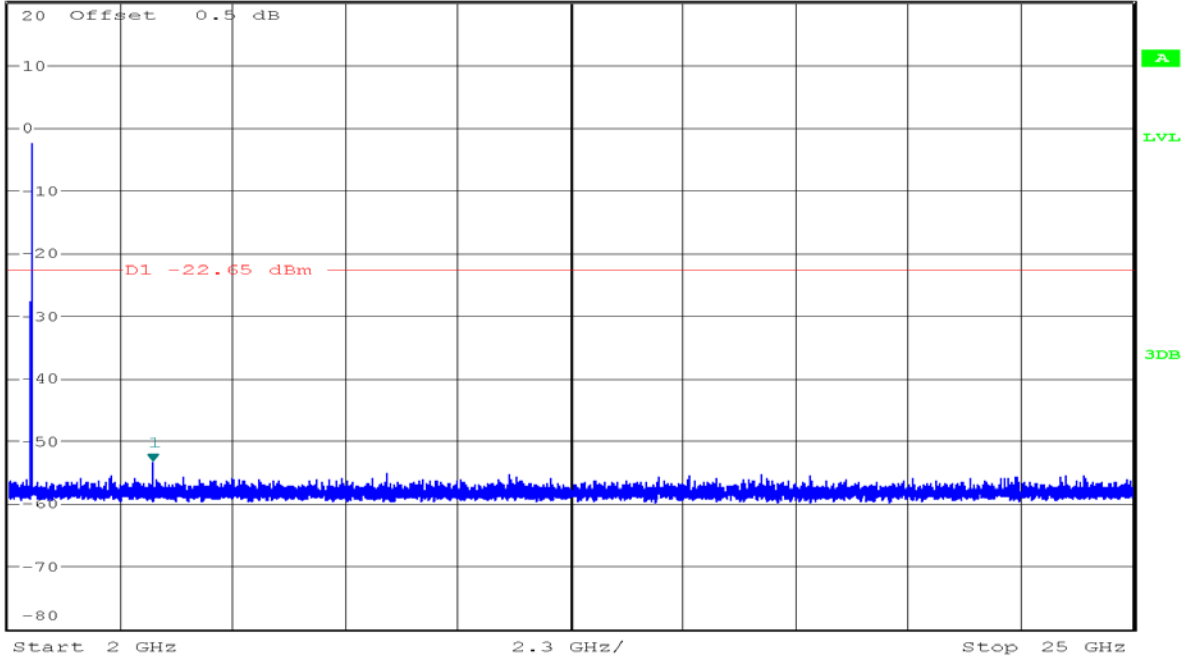






Ref 20 dBm * Att 20 dB * RBW 100 kHz Marker 1 [T1]
* VBW 300 kHz -53.51 dBm
SWT 2.3 s 4.959146341 GHz

1 PK
MAXH



6.5 Radiated Band Edge and Spurious Emission Measurement

LIMIT

Radiated emissions from 9 kHz to 25 GHz were measured according to the methods defines in ANSI C63.10-2013. The EUT was placed above the ground plane, 0.8 meter for frequency below 1GHz and 1.5 meter for frequency above 1GHz. The interface cables and equipment positions were varied within limits of reasonable applications to determine the positions producing maximum radiated emissions

1. According to §15.209(a), except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

FREQUENCIES(MHz)	FIELD STRENGTH (microvolts/meter)	MEASUREMENT DISTANCE(meters)
0.009~0.490	2400/F(kHz)	300
0.490~1.705	24000/F(kHz)	30
1.705~30.0	30	30
30~88	100	3
88~216	150	3
216~960	200	3
Above 960	500	3

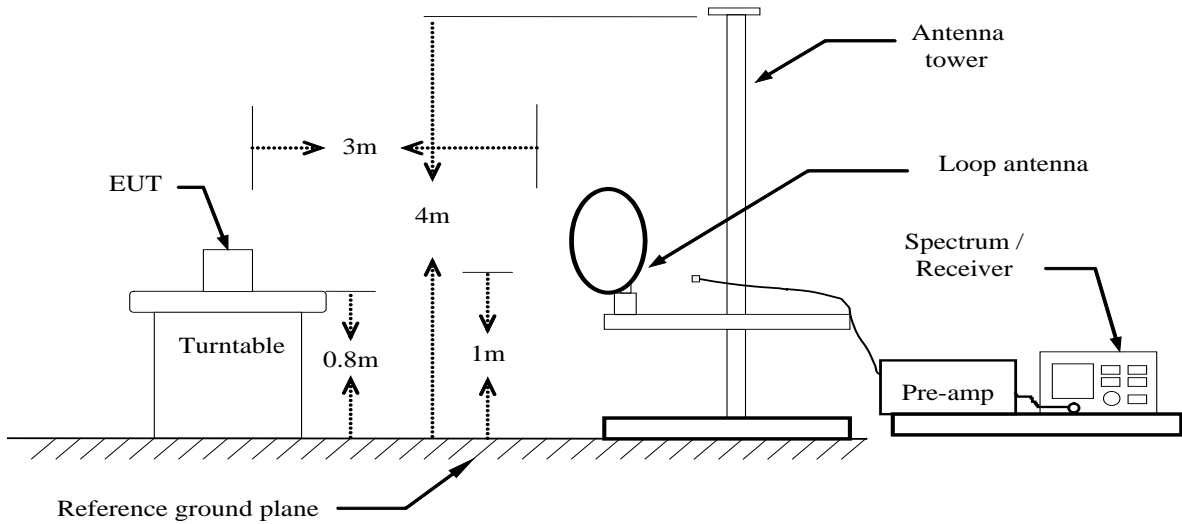
Remark: Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of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

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

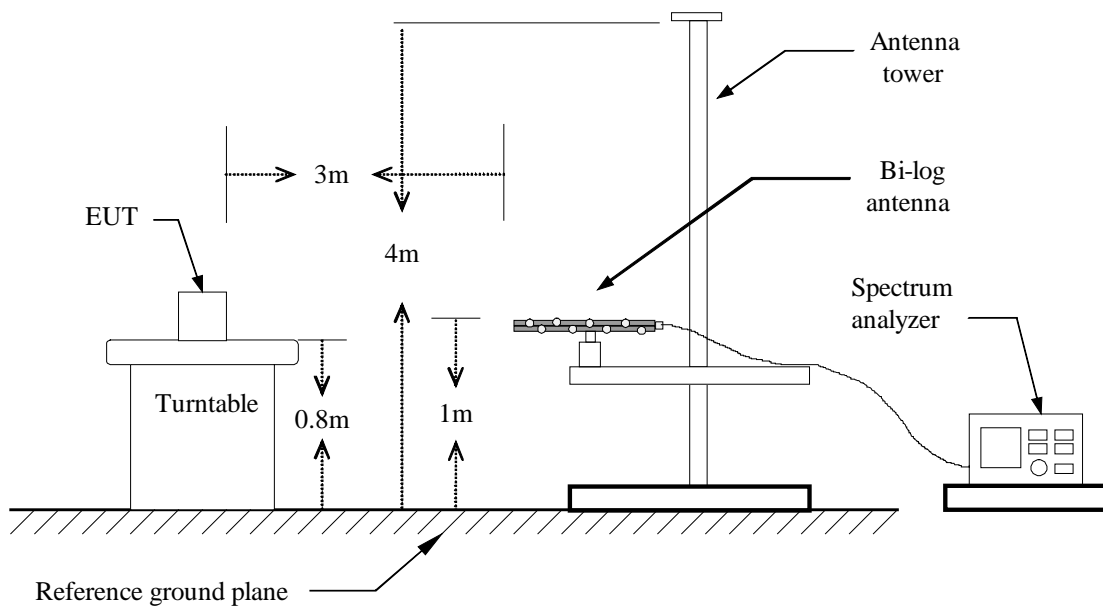
Frequency (MHz)	Field Strength (μ V/m at 3-meter)	Field Strength (dB μ V/m at 3-meter)
30-88	100	40
88-216	150	43.5
216-960	200	46
Above 960	500	54

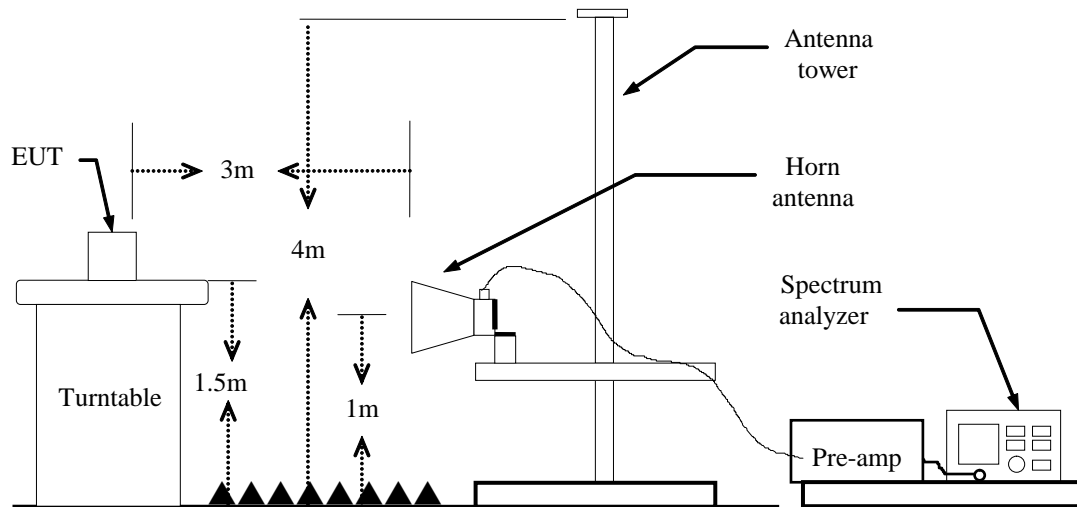
Test Configuration

Below 30MHz



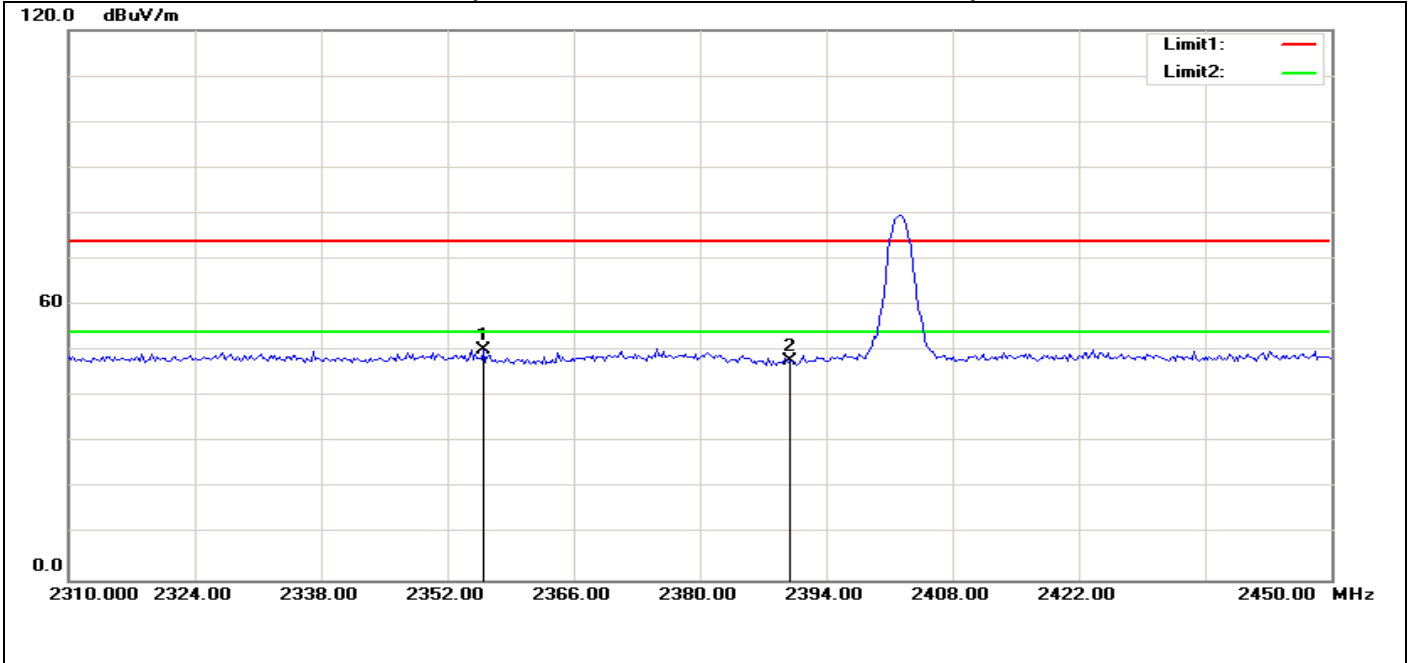
Below 1 GHz



Above 1 GHz**TEST PROCEDURE**

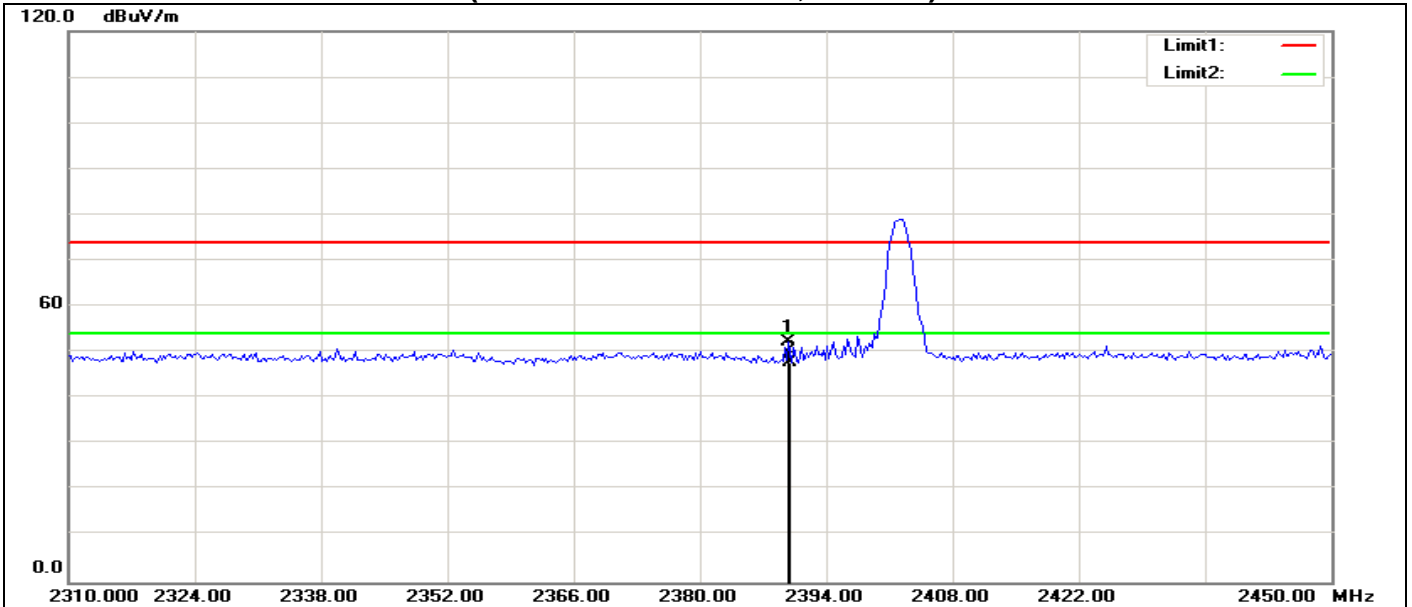
1. The testing follows FCC KDB Publication No. 558074 D01 DTS Meas. Guidance v04.
2. The EUT was arranged to its worst case and then tune the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading. A pre-amp and a high pass filter are used for the test in order to get better signal level.
3. 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.
4. The EUT was set 3 meters from the interference receiving antenna, which was mounted on the top of a variable height antenna tower.
5. Corrected Reading: Antenna Factor + Cable Loss + Read Level - Preamp Factor = Level
6. For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.
7. Use the following spectrum analyzer settings:
 - (1) Span shall wide enough to fully capture the emission being measured;
 - (2) Set RBW=100 kHz for $f < 1$ GHz; VBW =3 RBW; Sweep = auto; Detector function = peak; Trace = max hold;
 - (3) Set RBW = 1 MHz, VBW= 3MHz for $f > 1$ GHz for peak measurement.
 For average measurement:
 - VBW = 10 Hz, when duty cycle is no less than 98 percent.
 - VBW $\geq 1/T$, 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.

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



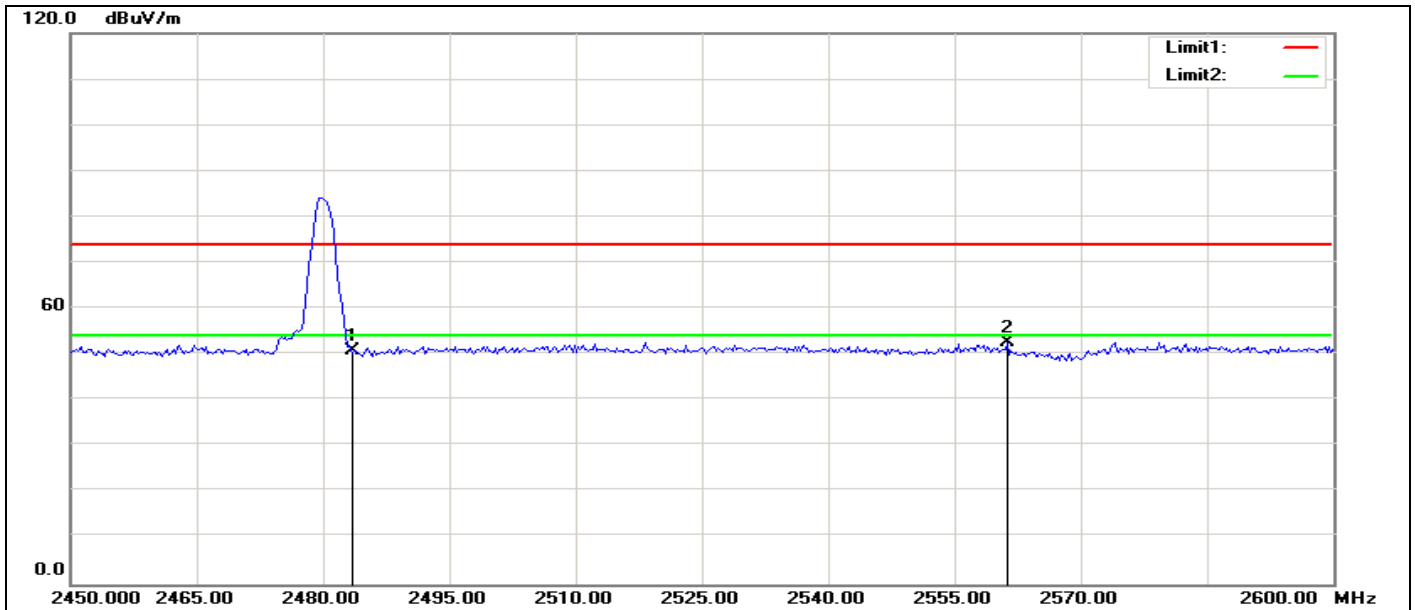
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	2355.994	57.95	-7.69	50.26	74.00	-23.74	100	358	peak
2	2390.000	55.55	-7.57	47.98	74.00	-26.02	200	112	peak

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



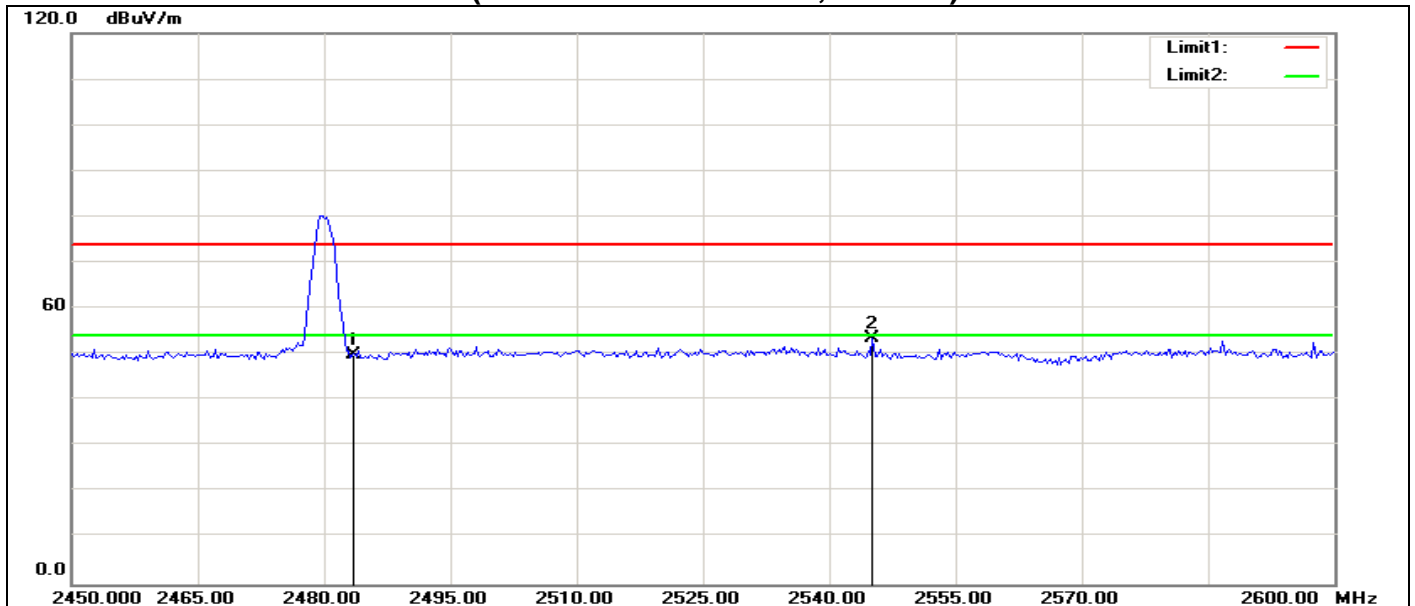
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	2389.872	59.93	-7.57	52.36	74.00	-21.64	100	309	peak
2	2390.000	55.31	-7.57	47.74	74.00	-26.26	200	181	peak

RESTRICTED BANDEDGE (BLE4.0 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	58.02	-7.26	50.76	74.00	-23.24	200	358	peak
2	2561.298	59.58	-7.04	52.54	74.00	-21.46	100	103	peak

RESTRICTED BANDEDGE (BLE4.0 on Channel 39, Vertical)



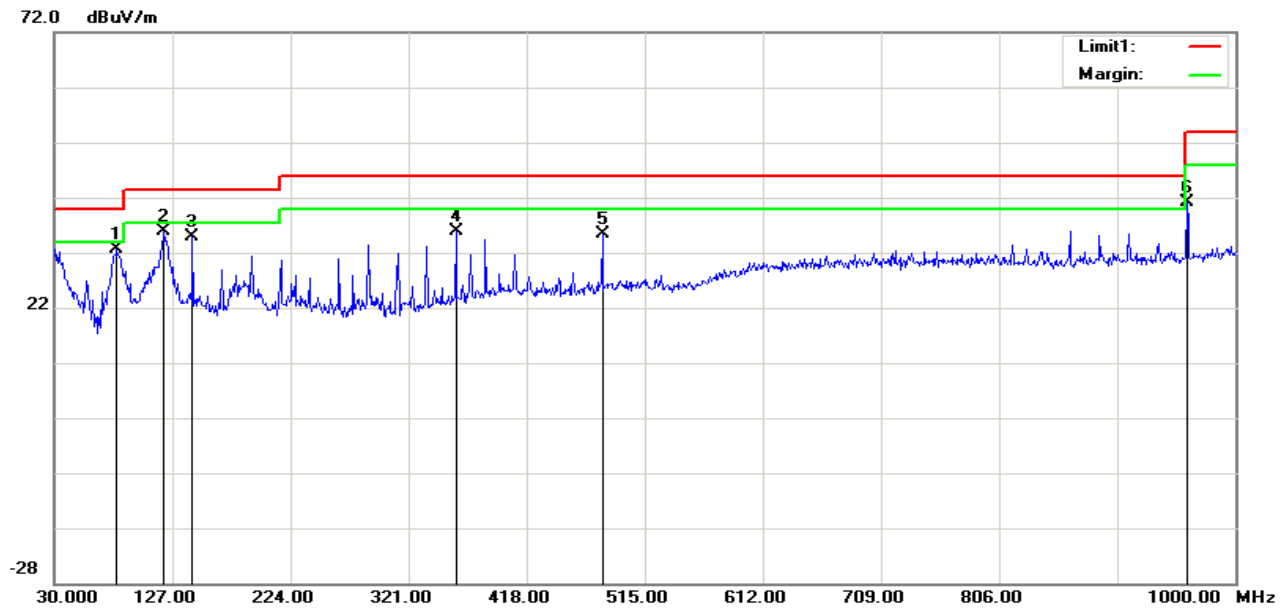
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	2483.500	57.08	-7.26	49.82	74.00	-24.18	100	219	peak
2	2545.192	60.66	-7.09	53.57	74.00	-20.43	100	334	peak

Test Result of Radiated Emission

Below 30MHz and above 18GHz. The measured value have enough margin over 20dB than the limit, therefore they are not reported.

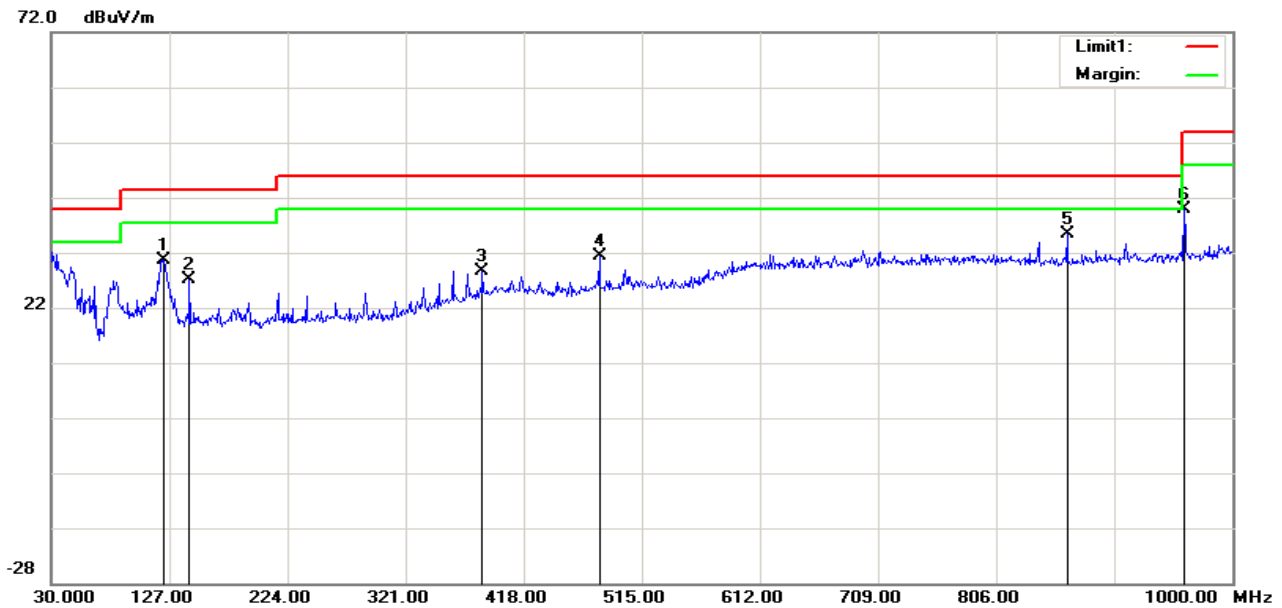
30MHz-1GHz

Operation Mode:	Normal Link	Test Date:	2018-7-26
Temperature:	25°C	Tested by:	Lily.Wang
Humidity:	48% RH	Polarity:	Hor.



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	81.4100	20.92	11.67	32.59	40.00	-7.41	200	210	peak
2	120.2100	21.87	13.92	35.79	43.50	-7.71	200	38	peak
3	143.4900	20.64	14.25	34.89	43.50	-8.61	200	354	peak
4	359.8000	16.27	19.50	35.77	46.00	-10.23	100	310	peak
5	480.0800	13.60	21.76	35.36	46.00	-10.64	200	0	peak
6	960.2300	14.21	26.87	41.08	54.00	-12.92	100	356	peak

Operation Mode:	Normal Link	Test Date:	2018-7-26
Temperature:	25°C	Tested by:	Lily.Wang
Humidity:	48% RH	Polarity:	Ver.



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	122.1500	16.71	13.94	30.65	43.50	-12.85	100	57	peak
2	143.4900	12.94	14.25	27.19	43.50	-16.31	300	63	peak
3	384.0500	7.98	20.72	28.70	46.00	-17.30	100	24	peak
4	480.0800	9.73	21.76	31.49	46.00	-14.51	200	360	peak
5	864.2000	9.26	26.09	35.35	46.00	-10.65	100	71	peak
6	960.2300	12.89	26.87	39.76	54.00	-14.24	100	24	peak

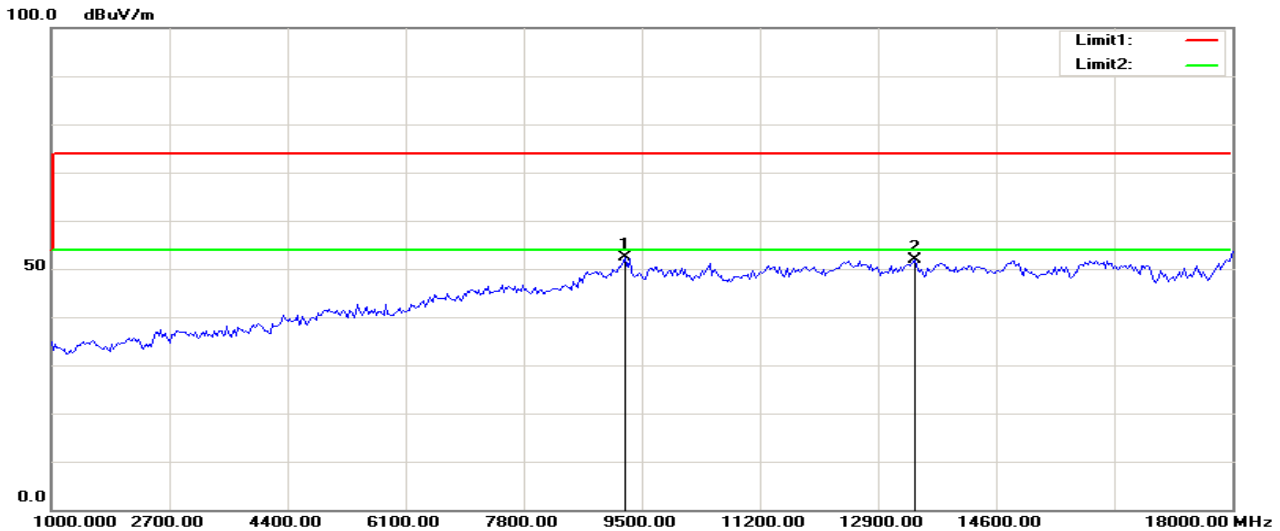
Notes:

1. Measurements 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.

Above 1 GHz

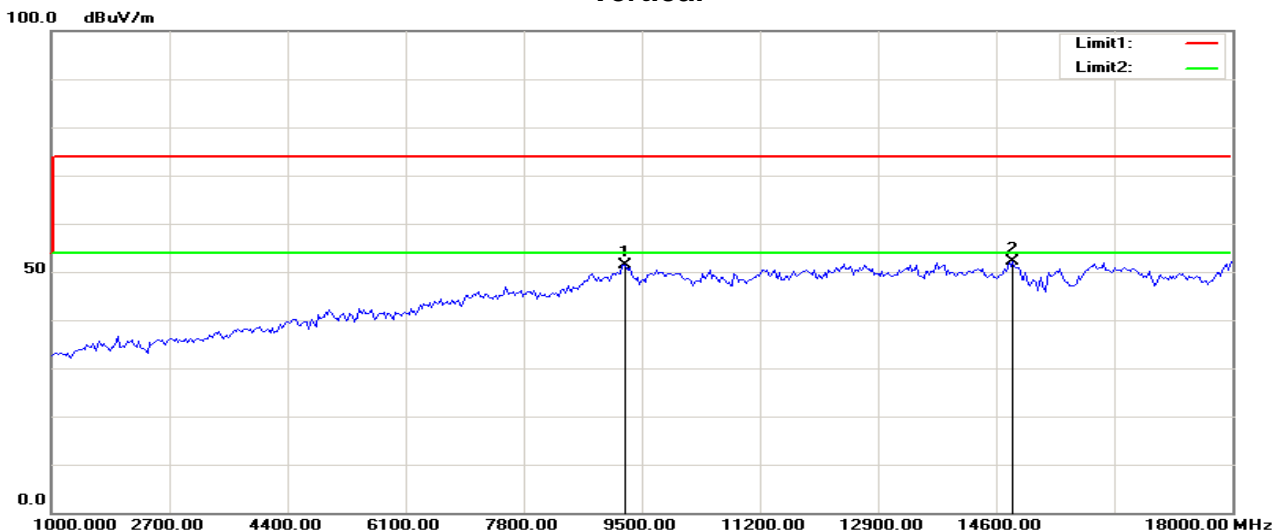
Operation Mode: Bluetooth LE4.0 **Test Date:** 2018-7-26
Test Channel: CH00 **Tested by:** Lily.Wang
Temperature: 25°C **Polarity:** Ver. / Hor.

Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	9254.808	41.59	10.75	52.34	74.00	-21.66	100	326	peak
2	13423.077	36.95	14.95	51.90	74.00	-22.10	100	93	peak

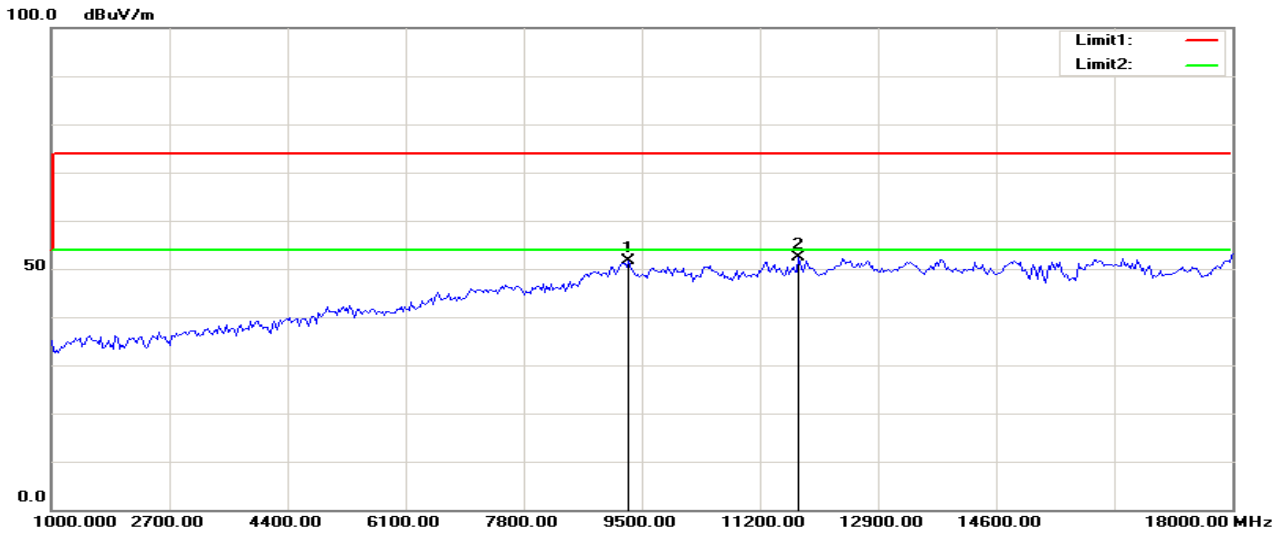
Vertical



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	9254.808	40.72	10.75	51.47	74.00	-22.53	100	128	peak
2	14839.744	35.74	16.27	52.01	74.00	-21.99	100	229	peak

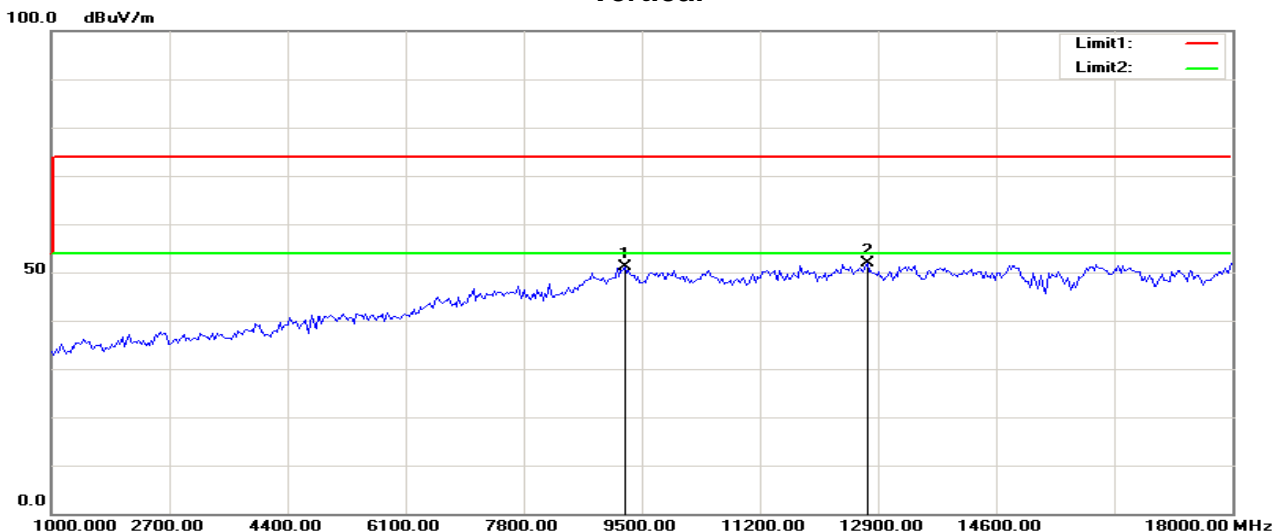
Operation Mode: Bluetooth LE4.0 **Test Date:** 2018-7-26
Test Channel: CH19 **Tested by:** Lily.Wang
Temperature: 25°C **Polarity:** Ver. / Hor.

Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	9309.295	40.79	10.86	51.65	74.00	-22.35	100	118	peak
2	11761.218	38.94	13.54	52.48	74.00	-21.52	100	206	peak

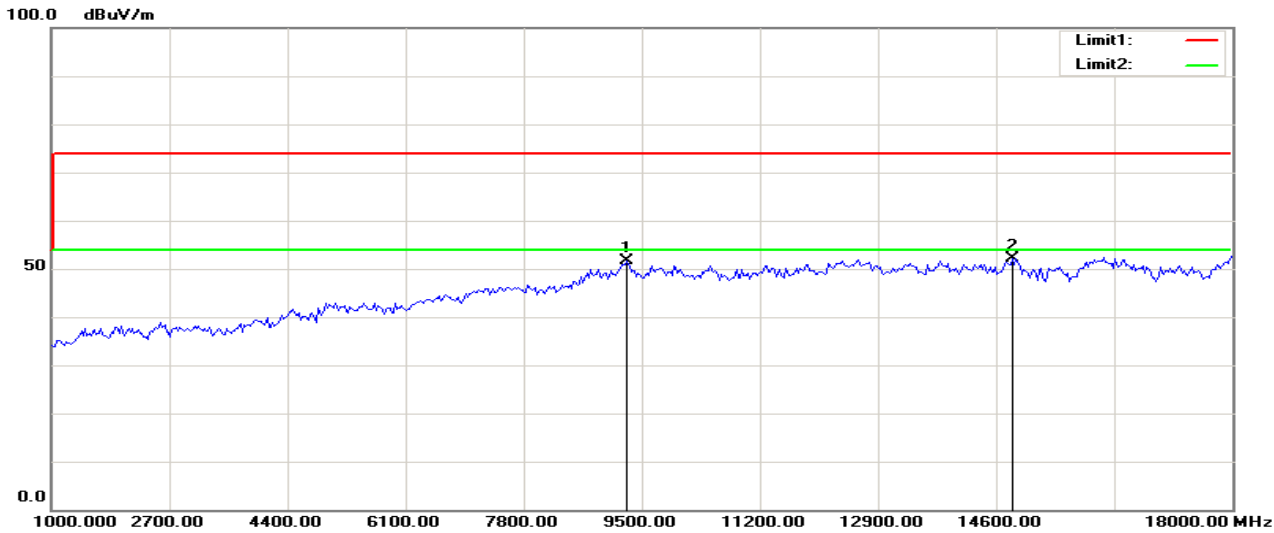
Vertical



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	9254.808	40.28	10.75	51.03	74.00	-22.97	100	159	peak
2	12741.987	36.83	15.11	51.94	74.00	-22.06	100	218	peak

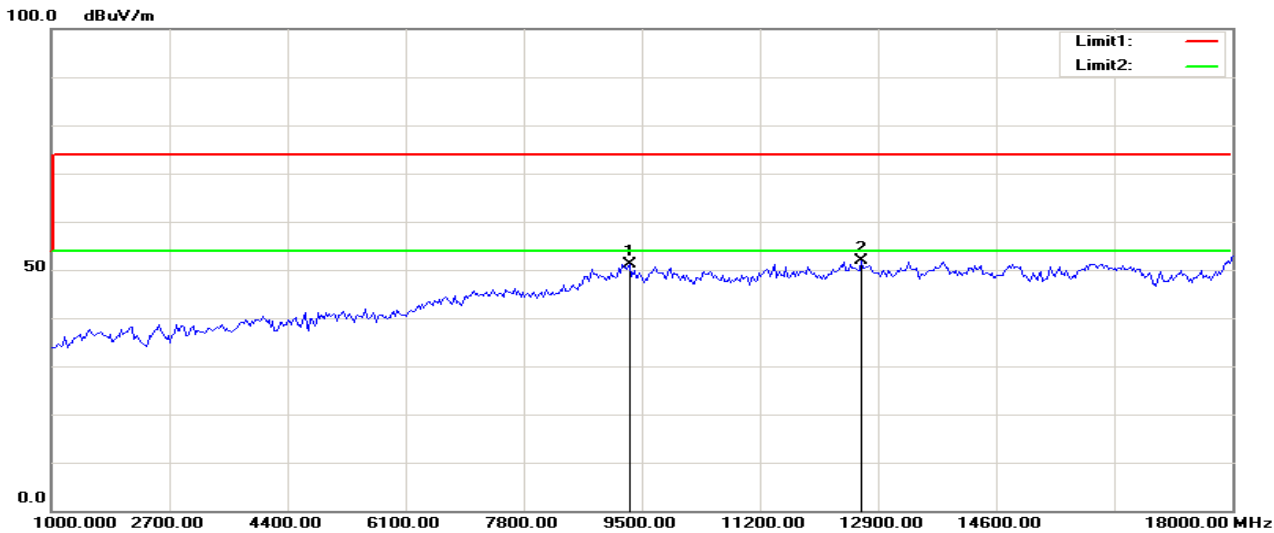
Operation Mode: Bluetooth LE4.0 **Test Date:** 2018-7-26
Test Channel: CH39 **Tested by:** Lily.Wang
Temperature: 25°C **Polarity:** Ver. / Hor.

Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	9282.051	40.78	10.80	51.58	74.00	-22.42	100	205	peak
2	14839.744	35.85	16.27	52.12	74.00	-21.88	100	127	peak

Vertical



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	9336.539	40.32	10.92	51.24	74.00	-22.76	100	83	peak
2	12660.256	36.64	15.31	51.95	74.00	-22.05	100	225	peak

6.6 POWERLINE CONDUCTED EMISSIONS

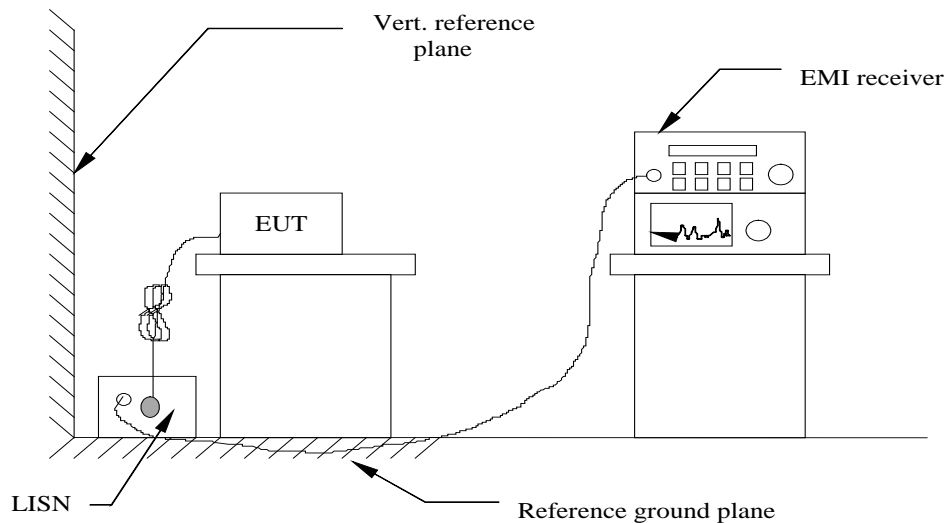
LIMIT

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 (dB μ V)	
	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

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 Setup photo for the actual connections between EUT and support equipment.

TEST PROCEDURE

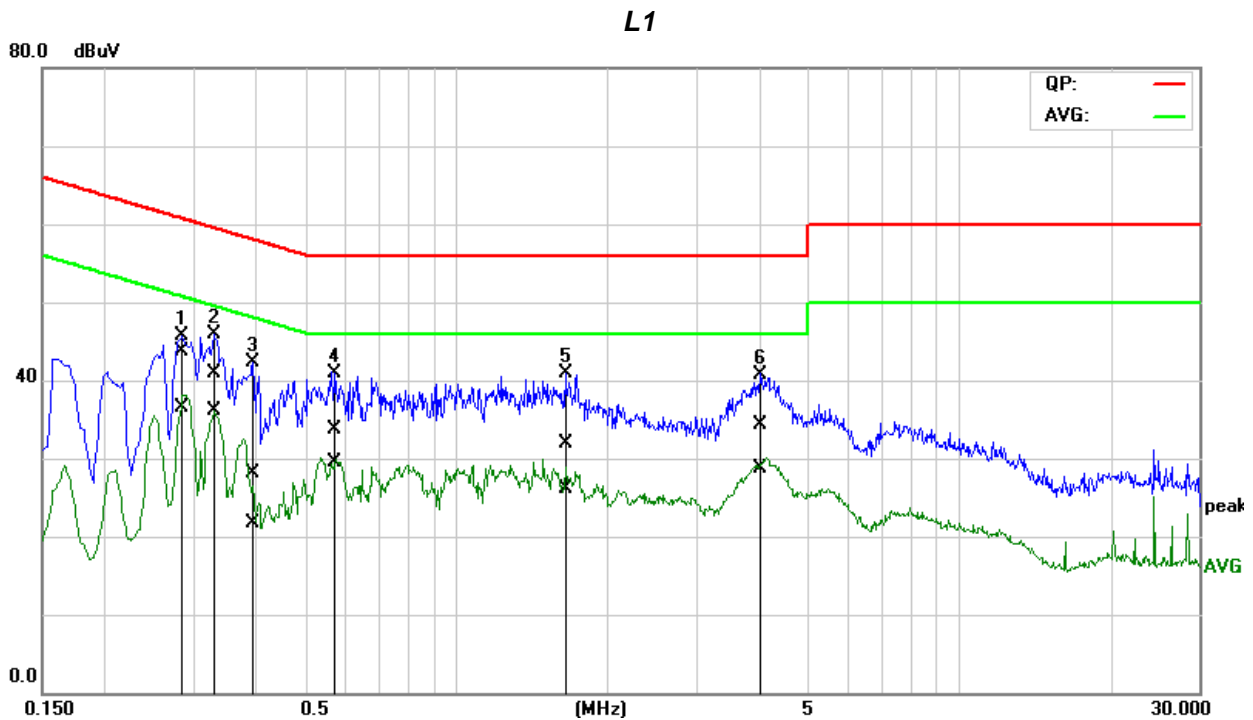
1. The EUT was placed on a table, which is 0.8m above ground plane.
2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
3. Repeat above procedures until all frequency measured were complete.

TEST RESULTS

The initial step in collecting conducted data is a spectrum analyzer peak scan of the measurement range. Significant peaks are then marked as shown on the following data page, and these signals are then quasi-peaked.

Test Data

Job No.:	C180724R01	Date:	2018/7/30
Model No.:	LEGATO III	Time:	9:48:11
Standard:	FCC Class B	Temp.(C)/Hum.(%):	22(C)/41%
Test item:	Conduction test	Test By:	Lily.Wang
Line:	L1	Test Voltage:	AC 120V/60Hz
Model:		Description:	

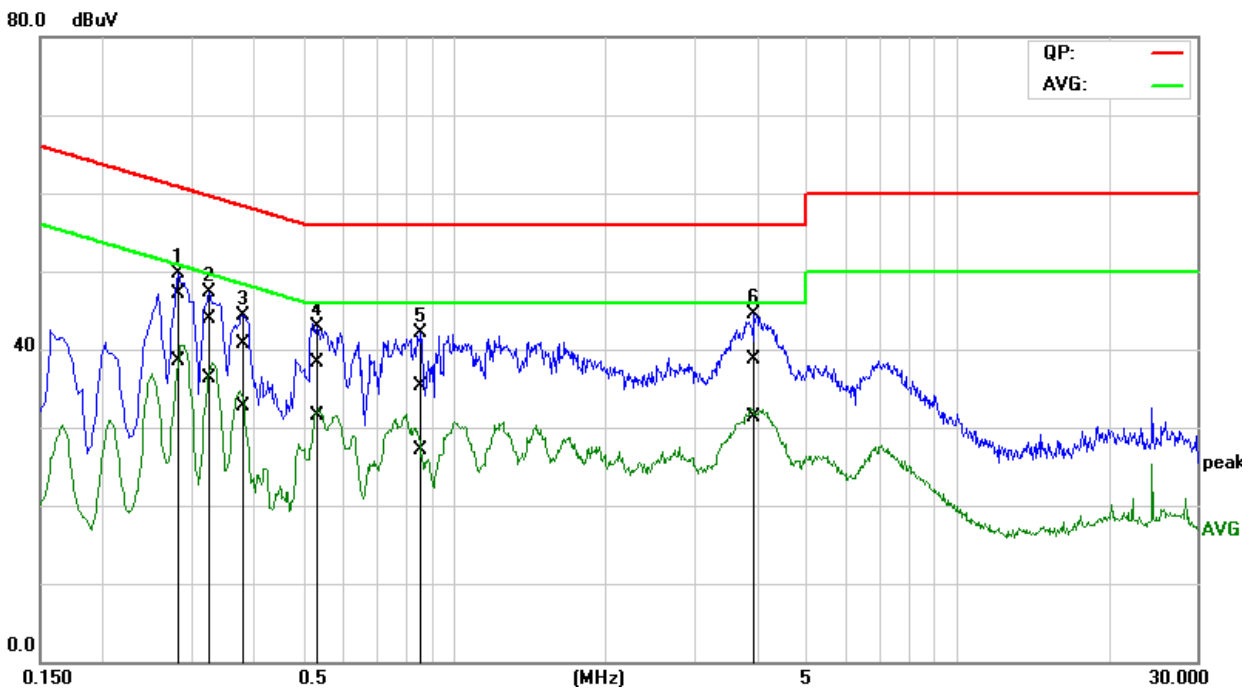


No.	Frequency (MHz)	QuasiPeak reading (dBuV)	Average reading (dBuV)	Correction factor (dB)	QuasiPeak result (dBuV)	Average result (dBuV)	QuasiPeak limit (dBuV)	Average limit (dBuV)	QuasiPeak margin (dB)	Average margin (dB)	Remark
1*	0.2817	24.16	17.03	19.47	43.63	36.50	60.77	50.77	-17.14	-14.27	Pass
2	0.3297	21.43	16.55	19.48	40.91	36.03	59.46	49.46	-18.55	-13.43	Pass
3	0.3926	8.61	2.14	19.49	28.10	21.63	58.01	48.01	-29.91	-26.38	Pass
4	0.5787	14.29	10.06	19.50	33.79	29.56	56.00	46.00	-22.21	-16.44	Pass
5	1.6436	12.39	6.51	19.58	31.97	26.09	56.00	46.00	-24.03	-19.91	Pass
6	3.9569	14.59	8.98	19.66	34.25	28.64	56.00	46.00	-21.75	-17.36	Pass

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

Job No.:	C180724R01	Date:	2018/7/30
Model No.:	LEGATO III	Time:	9:53:30
Standard:	FCC Class B	Temp.(C)/Hum.(%):	22(C)/41%
Test item:	Conduction test	Test By:	Lily.Wang
Line:	L2	Test Voltage:	AC 120V/60Hz
Model:		Description:	

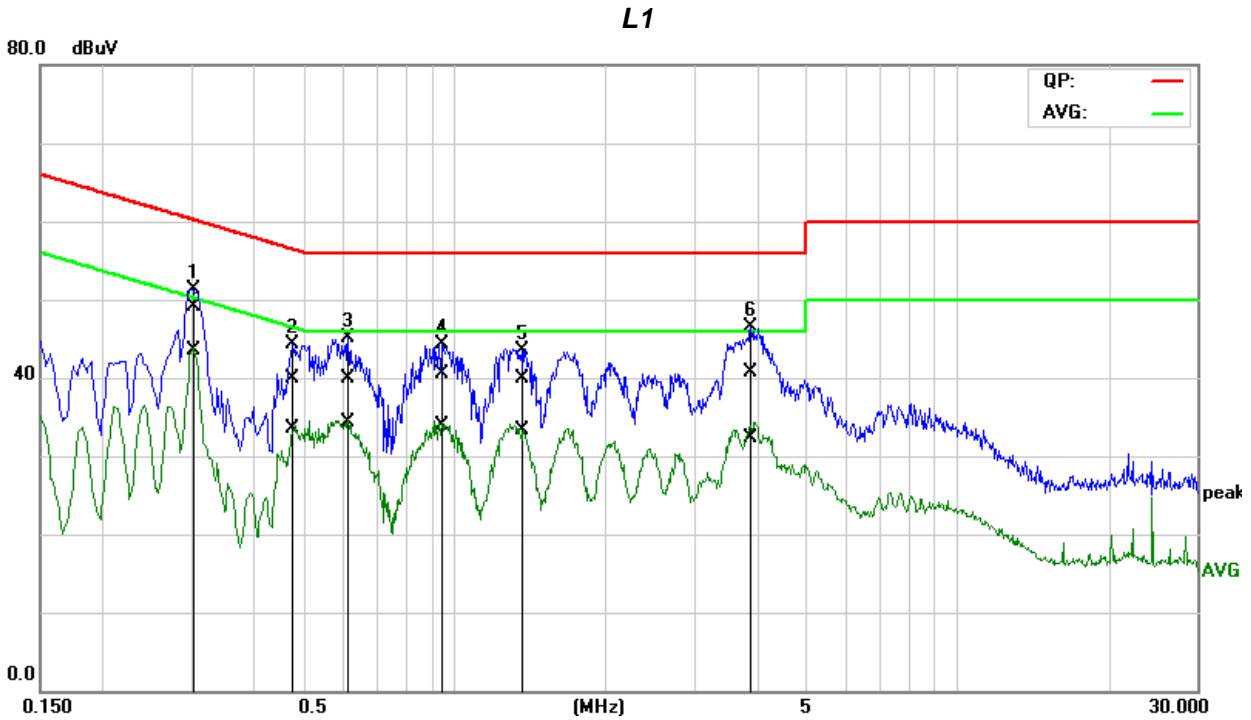
L2



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*	0.2820	27.56	19.10	19.46	47.02	38.56	60.76	50.76	-13.74	-12.20	Pass
2	0.3237	24.50	16.87	19.47	43.97	36.34	59.61	49.61	-15.64	-13.27	Pass
3	0.3815	21.15	13.27	19.47	40.62	32.74	58.25	48.25	-17.63	-15.51	Pass
4	0.5304	18.90	12.08	19.49	38.39	31.57	56.00	46.00	-17.61	-14.43	Pass
5	0.8557	15.83	7.51	19.54	35.37	27.05	56.00	46.00	-20.63	-18.95	Pass
6	3.9789	18.99	11.57	19.64	38.63	31.21	56.00	46.00	-17.37	-14.79	Pass

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

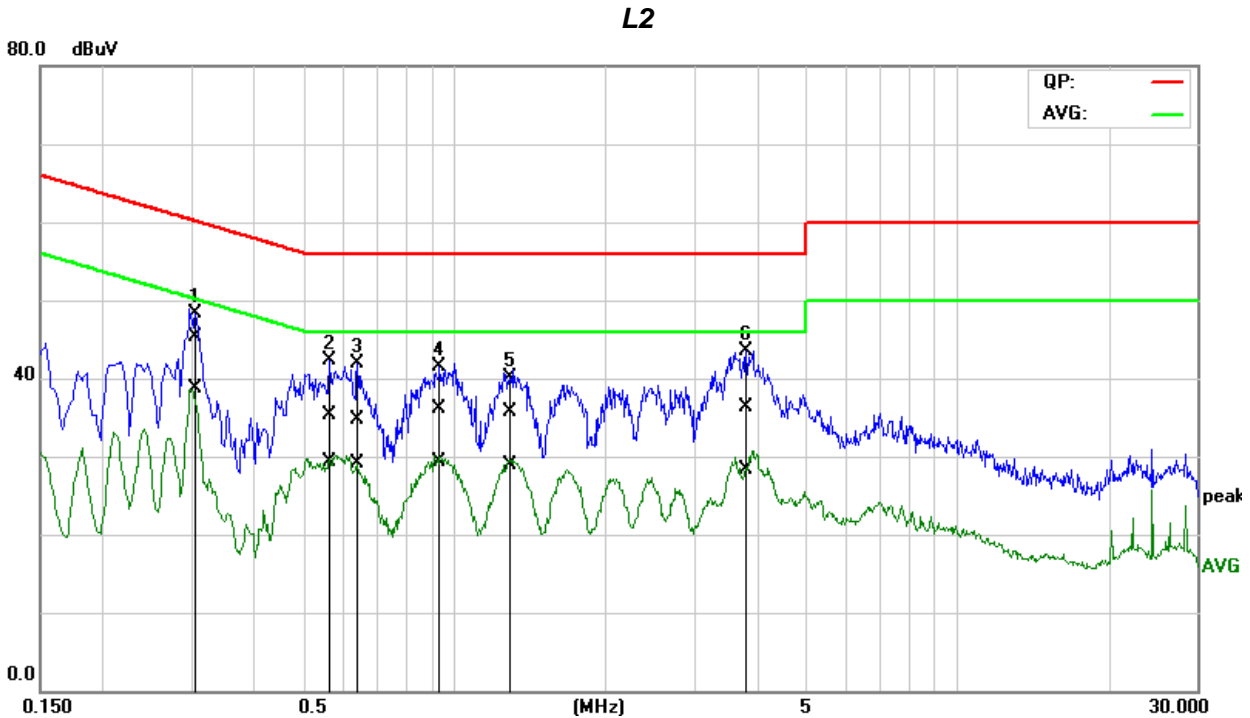
Job No.:	C180724R01	Date:	2018/7/30
Model No.:	LEGATO III	Time:	9:33:25
Standard:	FCC Class B	Temp.(C)/Hum.(%):	22(C)/41%
Test item:	Conduction test	Test By:	Lily.Wang
Line:	L1	Test Voltage:	AC 240V/60Hz
Model:		Description:	



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*	0.3039	29.66	24.04	19.48	49.14	43.52	60.14	50.14	-11.00	-6.62	Pass
2	0.4782	20.38	13.95	19.49	39.87	33.44	56.37	46.37	-16.50	-12.93	Pass
3	0.6142	20.34	14.72	19.50	39.84	34.22	56.00	46.00	-16.16	-11.78	Pass
4	0.9373	21.00	14.29	19.55	40.55	33.84	56.00	46.00	-15.45	-12.16	Pass
5	1.3393	20.42	13.75	19.57	39.99	33.32	56.00	46.00	-16.01	-12.68	Pass
6	3.8416	21.10	12.66	19.65	40.75	32.31	56.00	46.00	-15.25	-13.69	Pass

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

Job No.:	C180724R01	Date:	2018/7/30
Model No.:	LEGATO III	Time:	9:39:04
Standard:	FCC Class B	Temp.(C)/Hum.(%):	22(C)/41%
Test item:	Conduction test	Test By:	Lily.Wang
Line:	L2	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*	0.3020	25.81	19.15	19.47	45.28	38.62	60.19	50.19	-14.91	-11.57	Pass
2	0.5678	15.86	9.72	19.49	35.35	29.21	56.00	46.00	-20.65	-16.79	Pass
3	0.6403	15.29	9.65	19.50	34.79	29.15	56.00	46.00	-21.21	-16.85	Pass
4	0.9296	16.55	9.78	19.54	36.09	29.32	56.00	46.00	-19.91	-16.68	Pass
5	1.2801	16.15	9.39	19.55	35.70	28.94	56.00	46.00	-20.30	-17.06	Pass
6	3.8243	16.71	8.61	19.63	36.34	28.24	56.00	46.00	-19.66	-17.76	Pass

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

Remark:

- The measuring frequencies range between 0.15 MHz and 30 MHz.
- 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.
- "---" denotes the emission level was or more than 2dB below the Average limit, and no re-check was made.
- 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