FCC 47 CFR PART 15 SUBPART C
TEST REPORT

For

Product Name: DIGITAL PIANO

Brand Name: N/A

Model No.: ALLEGRO III

Series Model.: N/A

FCC ID: OCDALLEGROIII

Test Report Number:

C181109R01-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

No.10 Weiye Rd., Innovation park, Eco&Tec,
Development Zone, Kunshan City, Jiangsu, China

TEL: 86-512-57355888

FAX: 86-512-57370818

TESTING CERT #2541.01

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Revision History

Rev.	Issue Date	Report NO.	Effect Page	Contents
00	November 23, 2018	C181109R01-RPB1	ALL	N/A

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1 TEST RESULT CERTIFICATION

Product Name:	DIGITAL PIANO
Trade Name:	N/A
Model Name:	ALLEGRO III
Series Model:	N/A
Applicant Discrepancy:	Initial
Device Category:	mobile unit
Date of Test:	November 15, 2018 to November 22, 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:

Jeff fang

Jeff.Fang
Manager
Compliance Certification Services Inc.

Reviewed by:

James.Yan

James.Yan
RF Section Manager
Compliance Certification Services Inc.

2 EUT DESCRIPTION

Product Name:	DIGITAL PIANO
Trade Name:	N/A
Model Name:	ALLEGRO 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: -1.12dBm
Average output Power:	Bluetooth LE4.0: -2.41dBm
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: OCDALLEGROIII*** 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 SUMMARY OF THE TEST RESULT

FCC 47 CFR Part 15, Subpart C 15.247			
Part	**Rule section**	**Description of Test**	**Result**
8.1	47 CFR Part 15, Subpart C 15.247	6db Bandwidth	Compliance
8.2	47 CFR Part 15, Subpart C 15.247	Peak Power	Compliance
8.3	47 CFR Part 15, Subpart C 15.247	Peak Power Spectral Density	Compliance
8.4	47 CFR Part 15, Subpart C 15.247	Spurious Emissions	Compliance
8.5	47 CFR Part 15, Subpart C 15.247	Radiated Emissions	Compliance
8.6	47 CFR Part 15, Subpart C 15.247	Powerline Conducted Emissions	Compliance

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4 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.

4.1 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.

4.2 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.

4.3 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.

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4.4 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 0 was reported only, because this data rate has the highest RF output power at preliminary tests.

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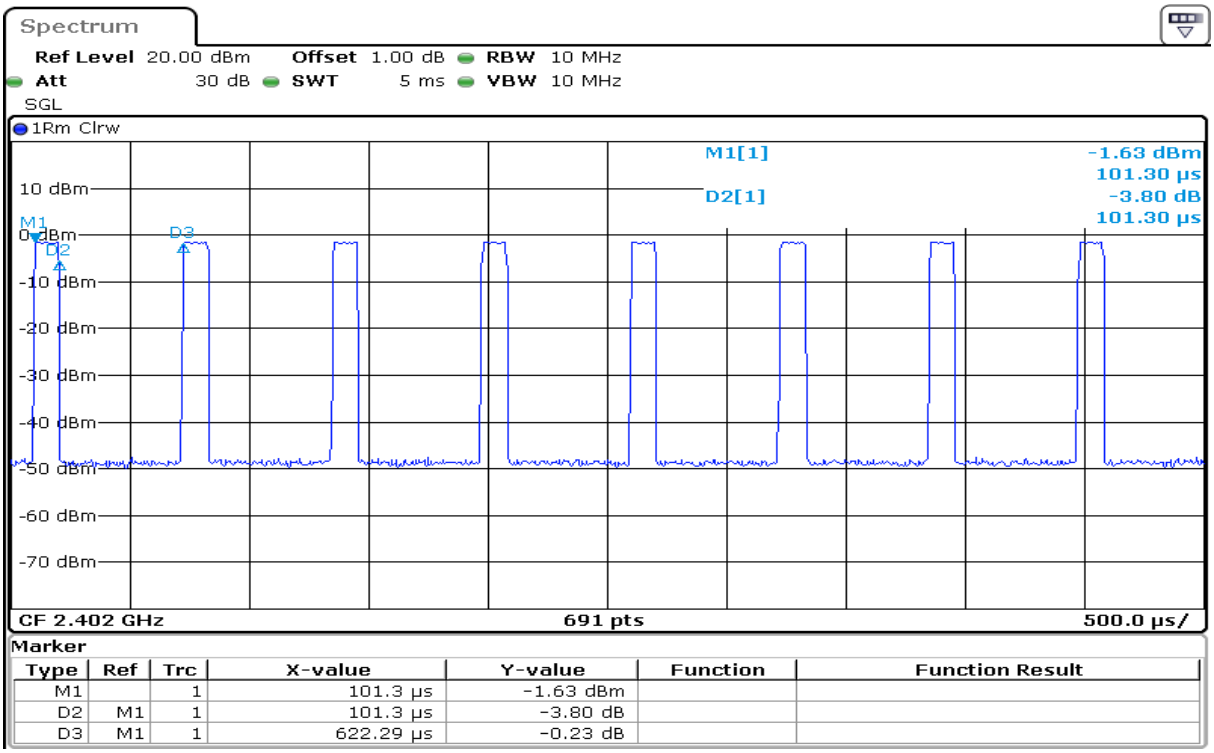
4.5 Duty cycle

Configuration	Duty Cycle (%)	T(ms)	1/T(kHz)	VBW Setting
BLE4.0	16.28	0.101	9.9	10kHz



4.6 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
[1]0.495 - 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.

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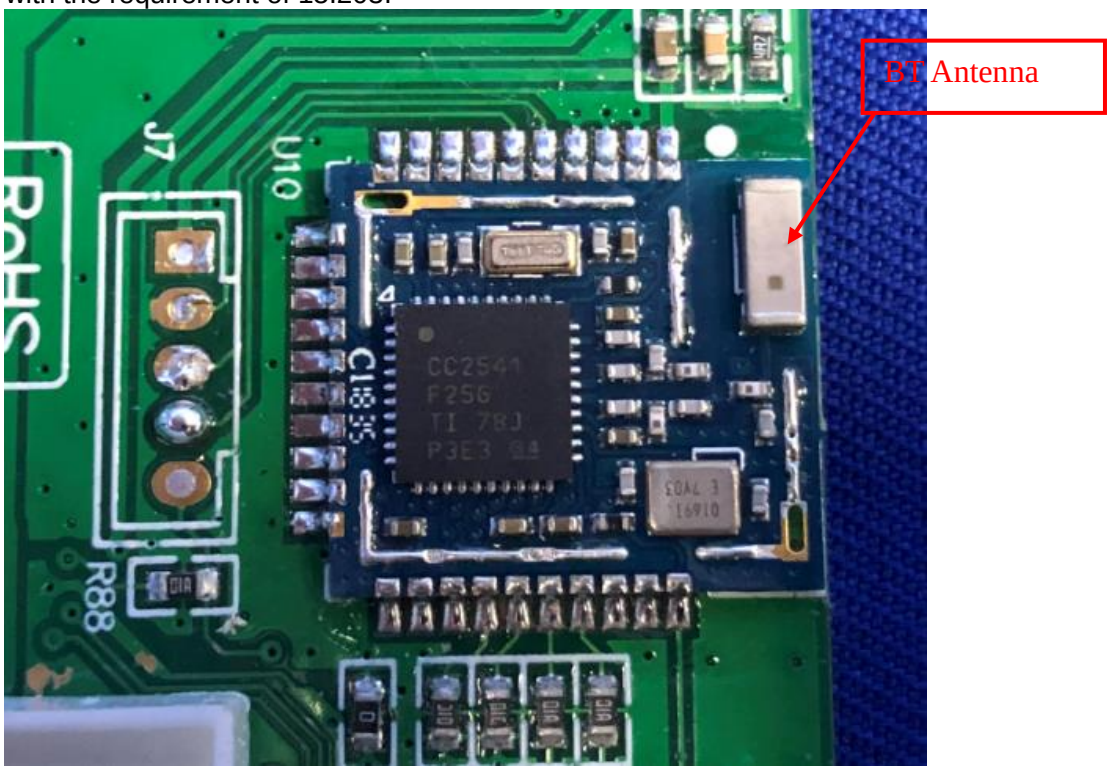
4.7 Antenna Description

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.



5 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

6 FACILITIES AND ACCREDITATIONS

6.1 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.

6.2 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.”

6.3 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.

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6.4 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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6.5 LIST OF MEASURING EQUIPMENT

Conducted Emissions Test Site					
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Data**	**Calibration Due**
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	2018-10-30	2019-10-29

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	2018-10-28	2019-10-27
TWO-LINE V-NETWORK	R&S	ENV216	101604	2018-10-28	2019-10-27
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 ver.3A1		

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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	36996	2018-7-7	2019-7-6
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
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	2018-10-28	2019-10-27
Cable	REBES MICROWAVE	Cable-94	N/A	2018-10-28	2019-10-27
Cable	REBES MICROWAVE	Cable-95	N/A	2018-10-28	2019-10-27
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 ver.3A1		

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

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6.6 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 = 2 (which provide confidence levels of respectively 95 % 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	±1.291dB
Unwanted Emissions, conducted	±2.408dB
RF Power density, conducted	±2.374dB
Conducted emissions	±2.2485dB
All emissions, radiated (Below 1GHz)	±4.5805dB
All emissions, radiated (Above 1GHz)	±4.1140dB

6.7 SETUP CONFIGURATION

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

6.8 SUPPORT EQUIPMENT

No.	Device Type	Brand	Model	Series No.	FCC ID
1.	Notebook	acer	ZQT	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.

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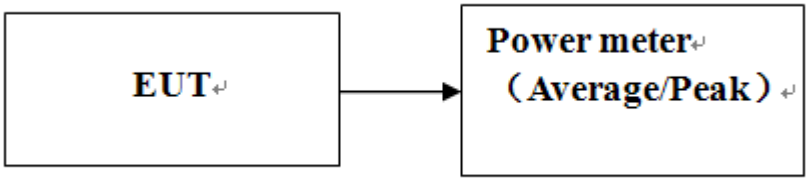
7 FCC PART 15.247 REQUIREMENTS

7.1 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 Sub-clause 11.9 of ANSI C63.10.
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

Test RESULTS

BLE4.0 GFSK Modulation 1Mbps mode

Test mode:	Bluetooth LE4.0	**Temperature:**	23℃
Test By:	Matt.yao	**Test Date:**	2018-11-15

Channel	Frequency (MHz)	Transmit Data Rate	Peak Output Power (dBm)	Limit (dBm)	Result
00	2402	1Mbps	-1.12	30.00	PASS
19	2440	1Mbps	-1.76		PASS
39	2480	1Mbps	-2.30		PASS

Channel	Frequency (MHz)	Transmit Data Rate	Average Output Power (dBm)
00	2402	1Mbps	-2.41
19	2440	1Mbps	-3.19
39	2480	1Mbps	-3.82

Remark: Duty factor has been offset with cable loss

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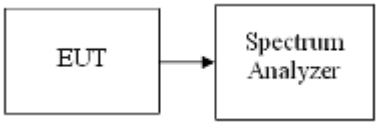
7.2 PEAK POWER SPECTRAL DENSITY

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 of Sub-clause 11.10 of ANSI C63.10
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.

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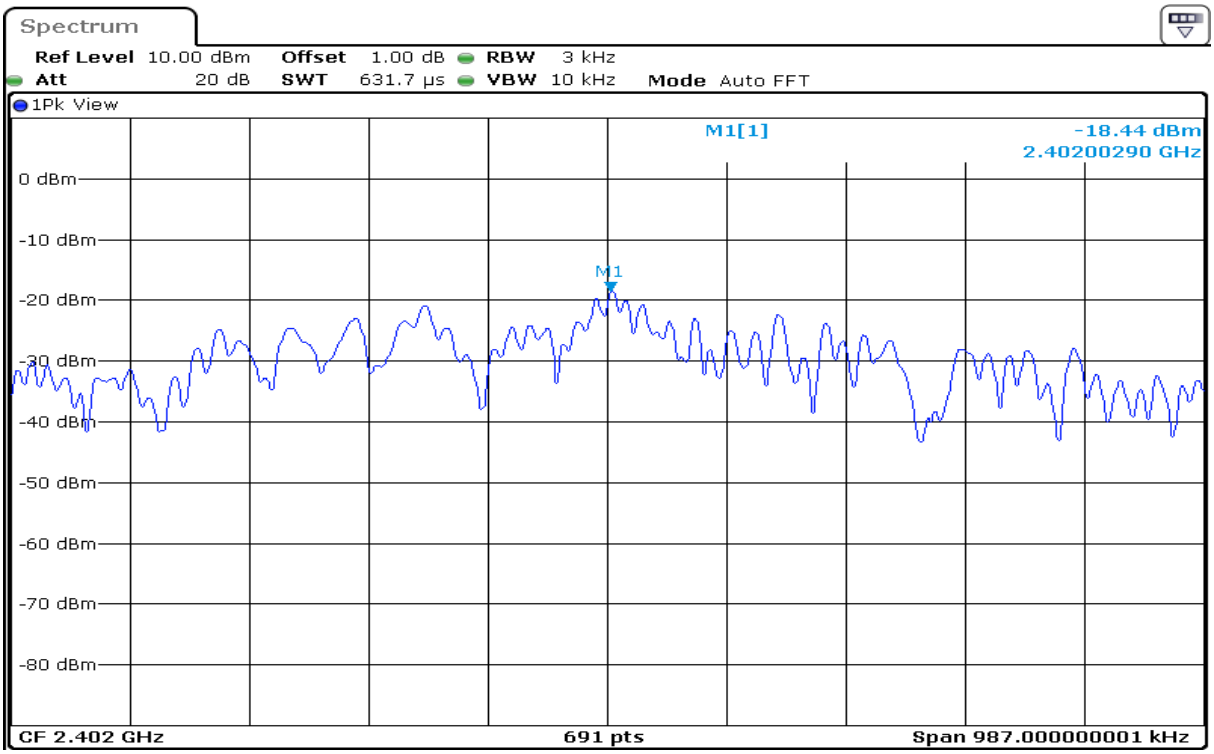
Test Results of power Spectral Density

Test mode:	Bluetooth LE4.0	Temperature:	23℃
Test By:	Matt.yao	Test Date:	2018-11-15

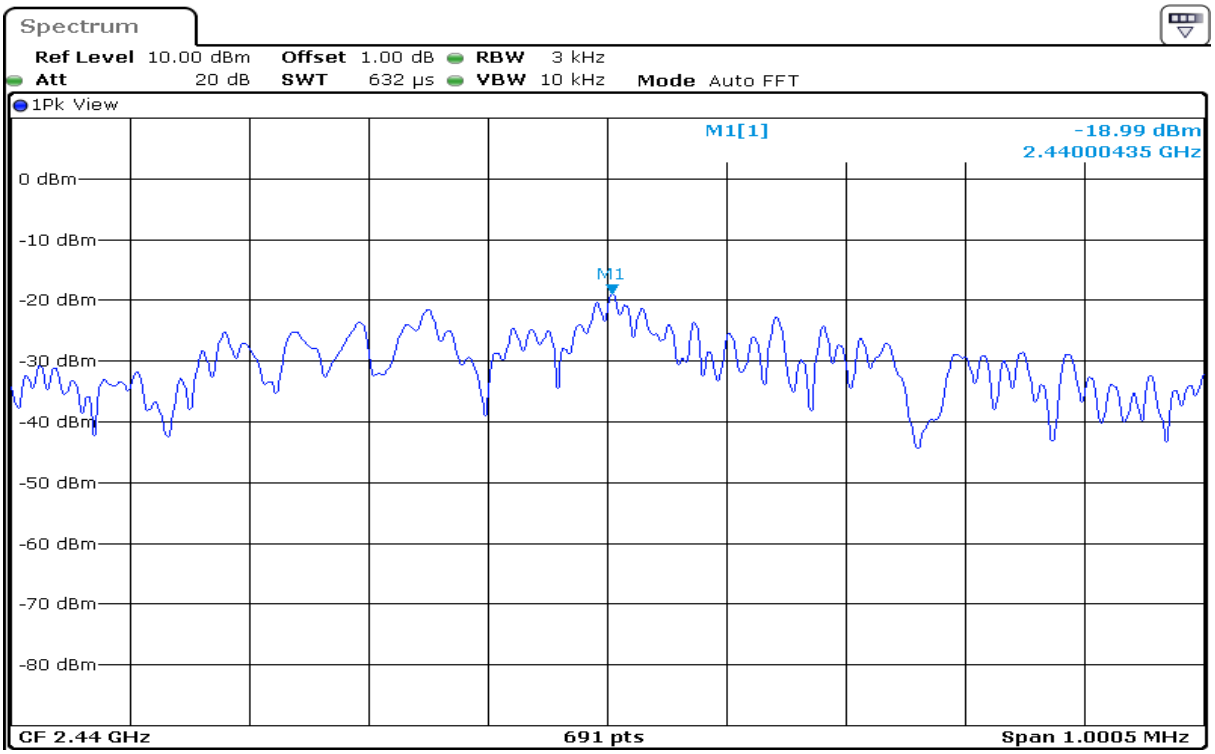
Channel	Frequency (MHz)	PSD/3kHz (dBm)	Limit (dBm)	Result
00	2402	-18.44	8	PASS
19	2440	-18.99		PASS
39	2480	-19.70		PASS

Test Plot of power Spectral Density

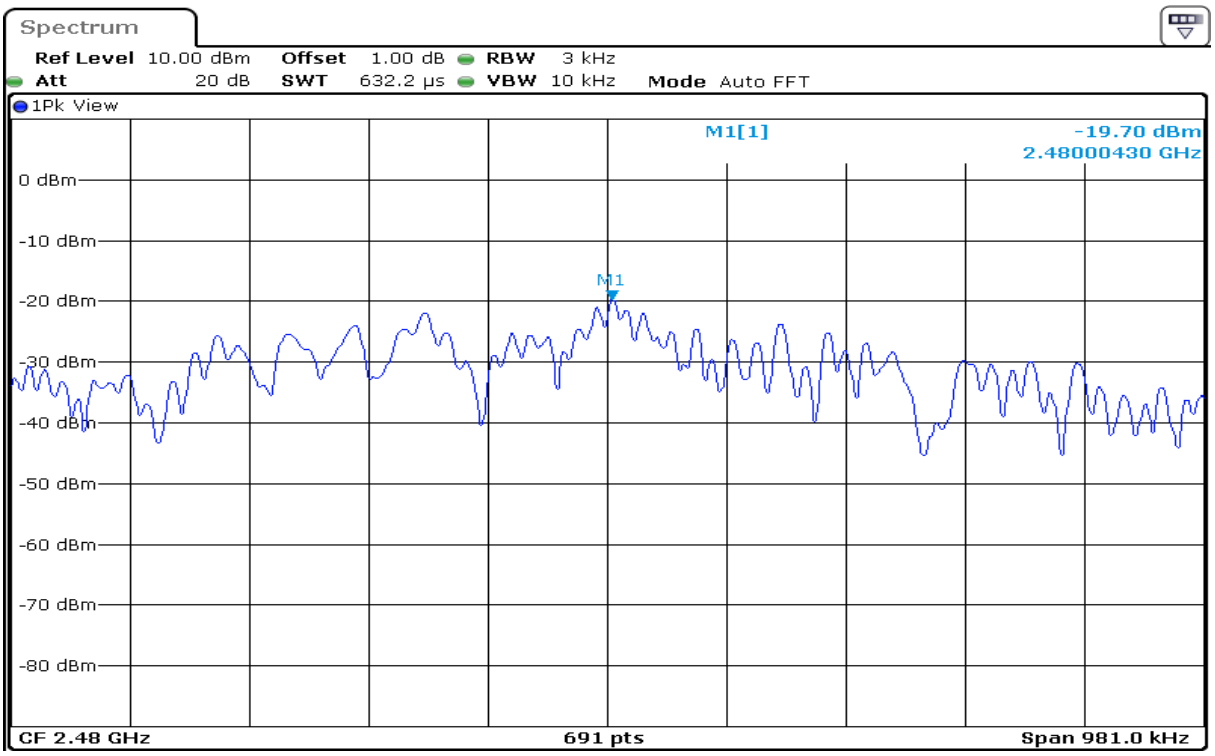
Channel 00



Channel 19



Channel 39



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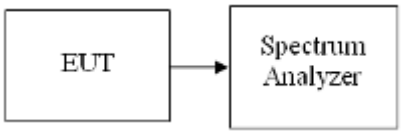
7.3 6dB Bandwidth Measurement

Limit of 6dB Bandwidth

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

Test Configuration



Test Procedure

1. The testing follows Sub-clause 11.8 of ANSI C63.10.
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.

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Test Results of Bandwidth

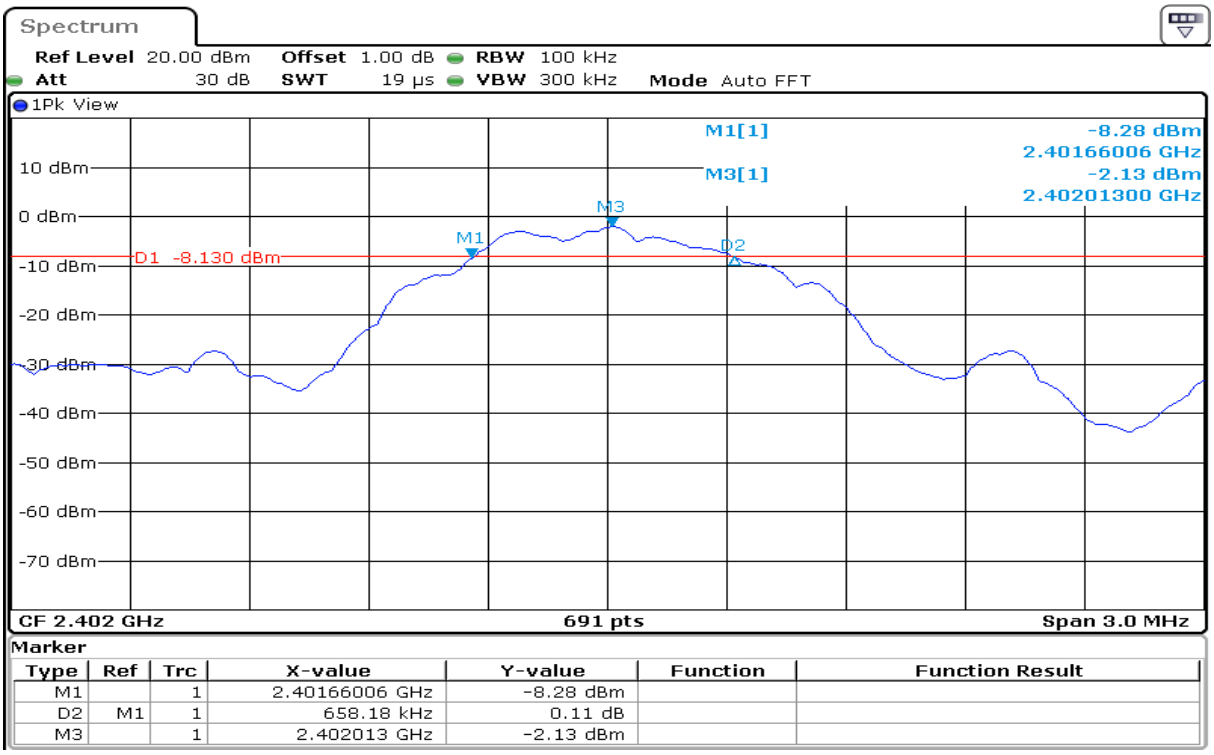
No non-compliance noted

Test mode:	Bluetooth LE4.0	**Temperature:**	23℃
Test By:	Matt.yao	**Test Date:**	2018-11-15

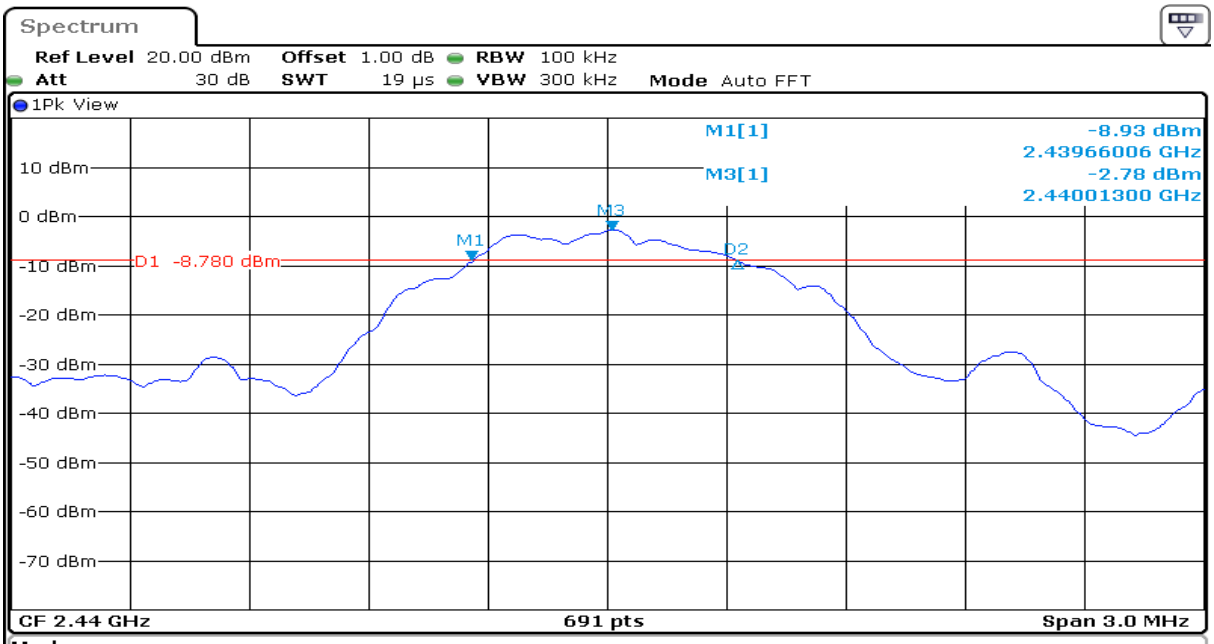
Channel	Frequency (MHz)	6dB Bandwidth (MHz)	6dB Bandwidth Limit (MHz)	Result
00	2402	0.658	0.5	Pass
19	2440	0.667	0.5	Pass
39	2480	0.654	0.5	Pass

Test Plot

Channel 00



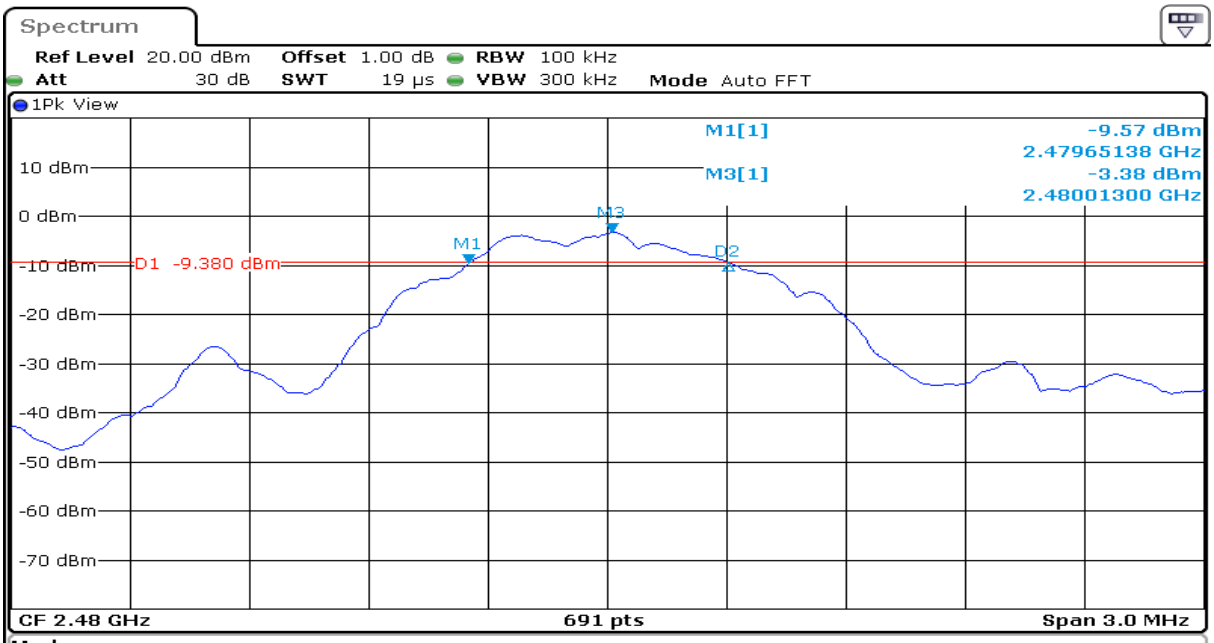
Channel 19



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.43966006 GHz	-8.93 dBm		
D2	M1	1	666.86 kHz	-0.00 dB		
M3		1	2.440013 GHz	-2.78 dBm		

Channel 39



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.47965137 GHz	-9.57 dBm		
D2	M1	1	653.84 kHz	0.16 dB		
M3		1	2.480013 GHz	-3.38 dBm		

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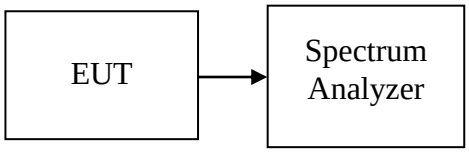
7.4 Conducted Band Edges and Spurious Emission Measurement

LIMIT

According to §15.247(d), in any 100 kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator in 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 RESULTSD

No non-compliance noted

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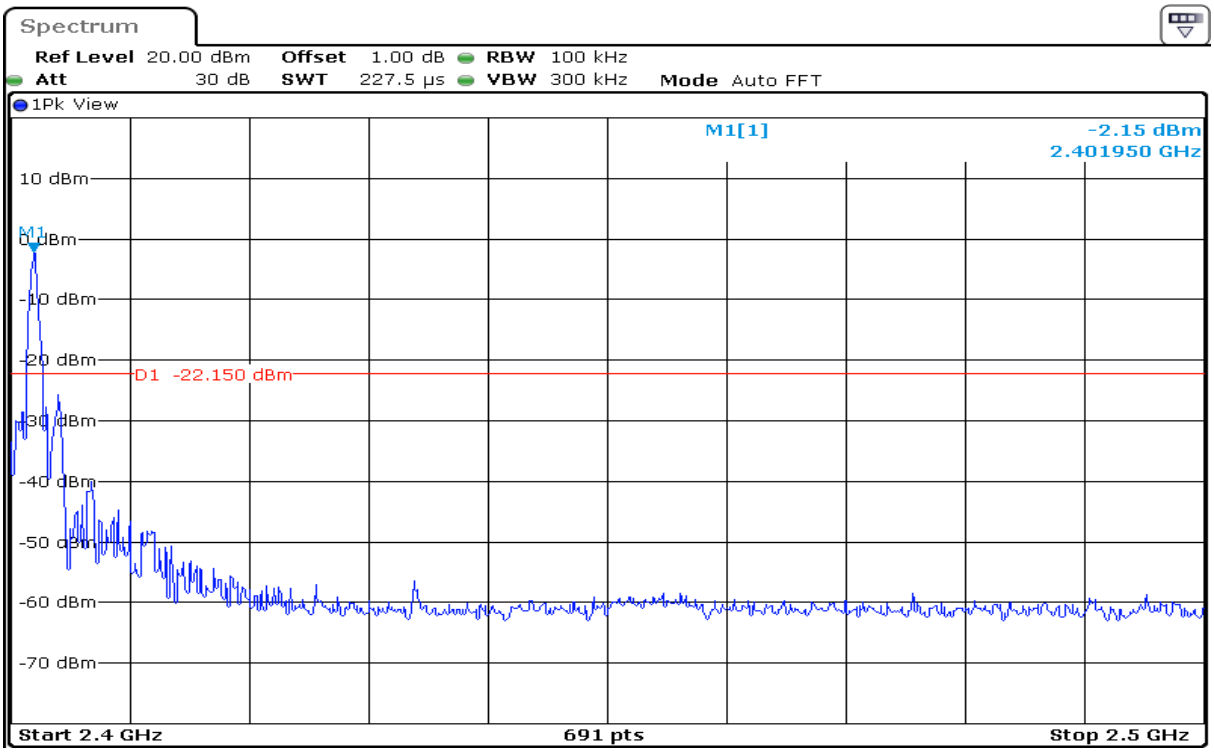
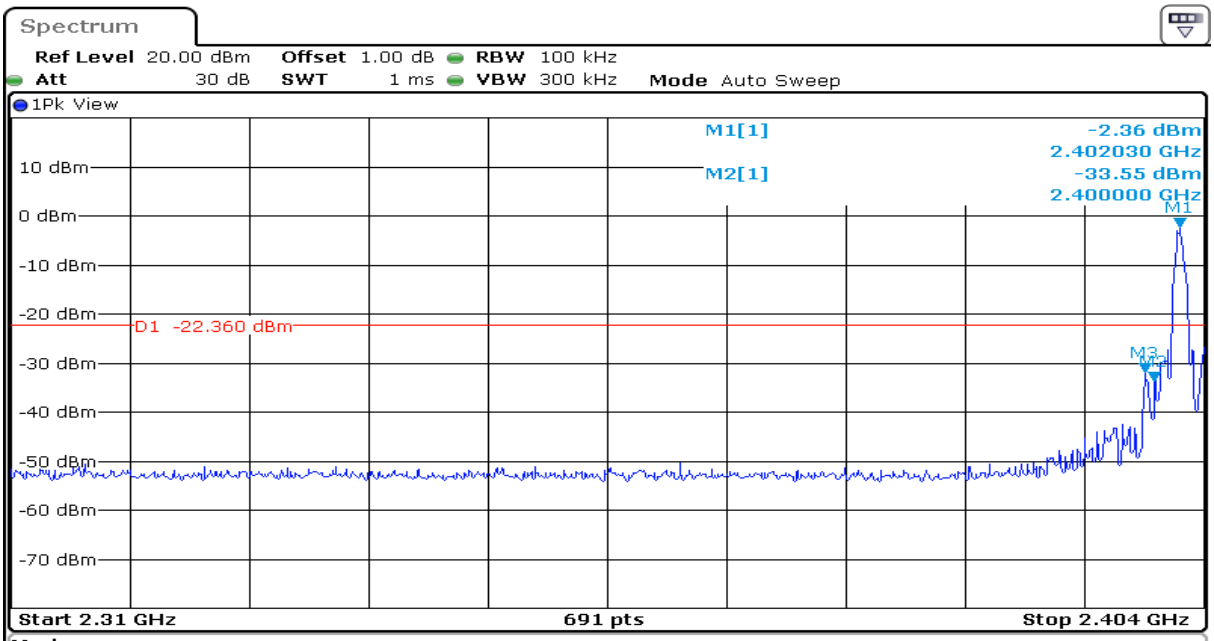
Test Plot
OUT-OF-BAND SPURIOUS EMISSIONS-CONDUCTED MEASUREMENT

CH Low





Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.40203 GHz	-2.36 dBm		
M2		1	2.4 GHz	-33.55 dBm		
M3		1	2.39931 GHz	-32.00 dBm		

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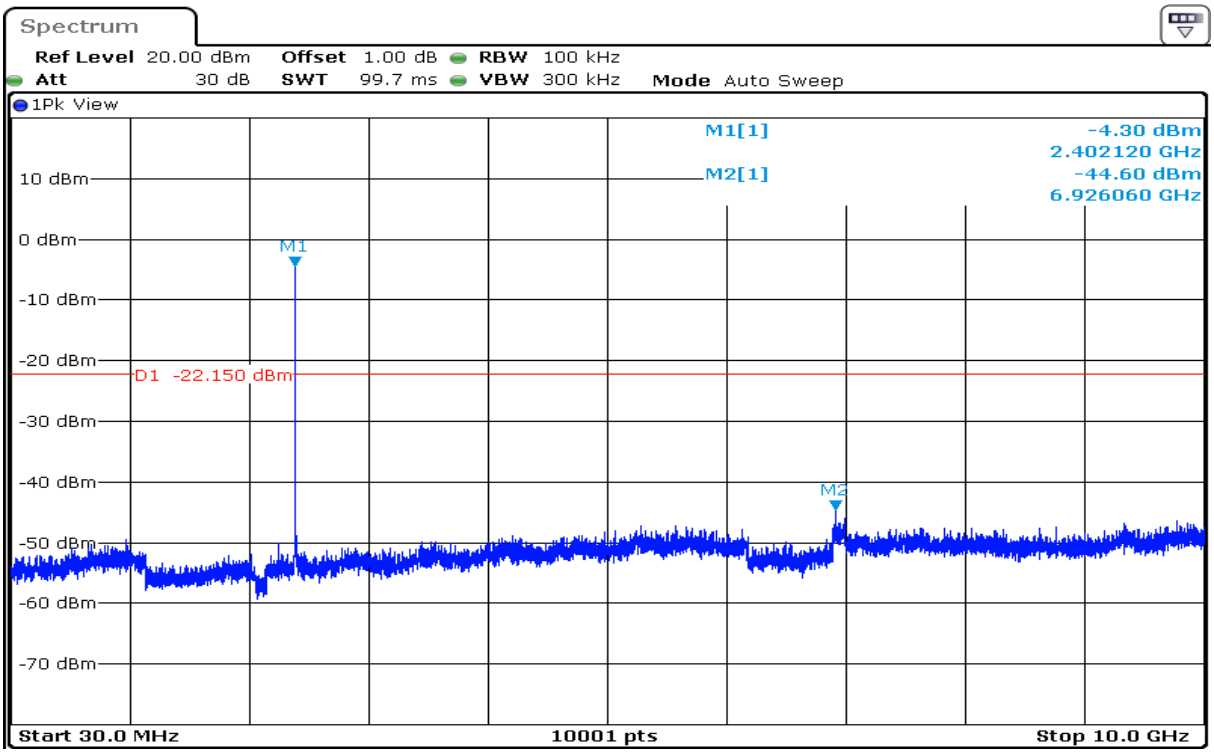
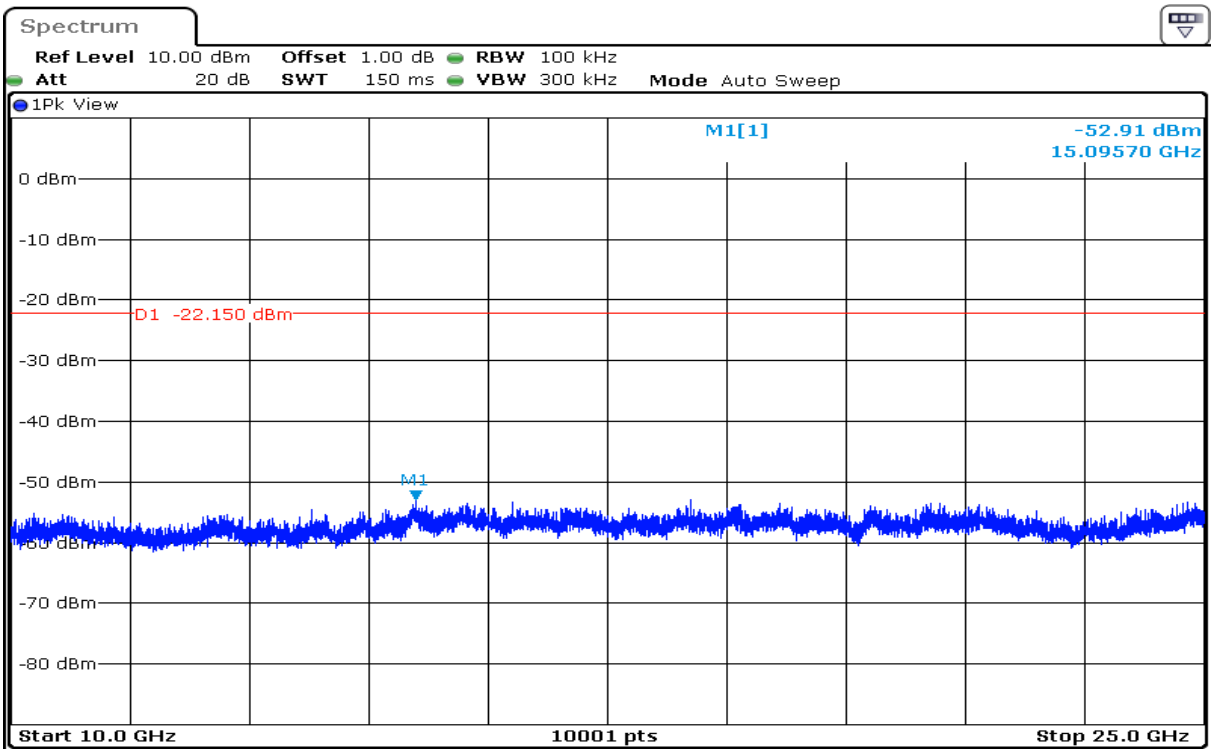
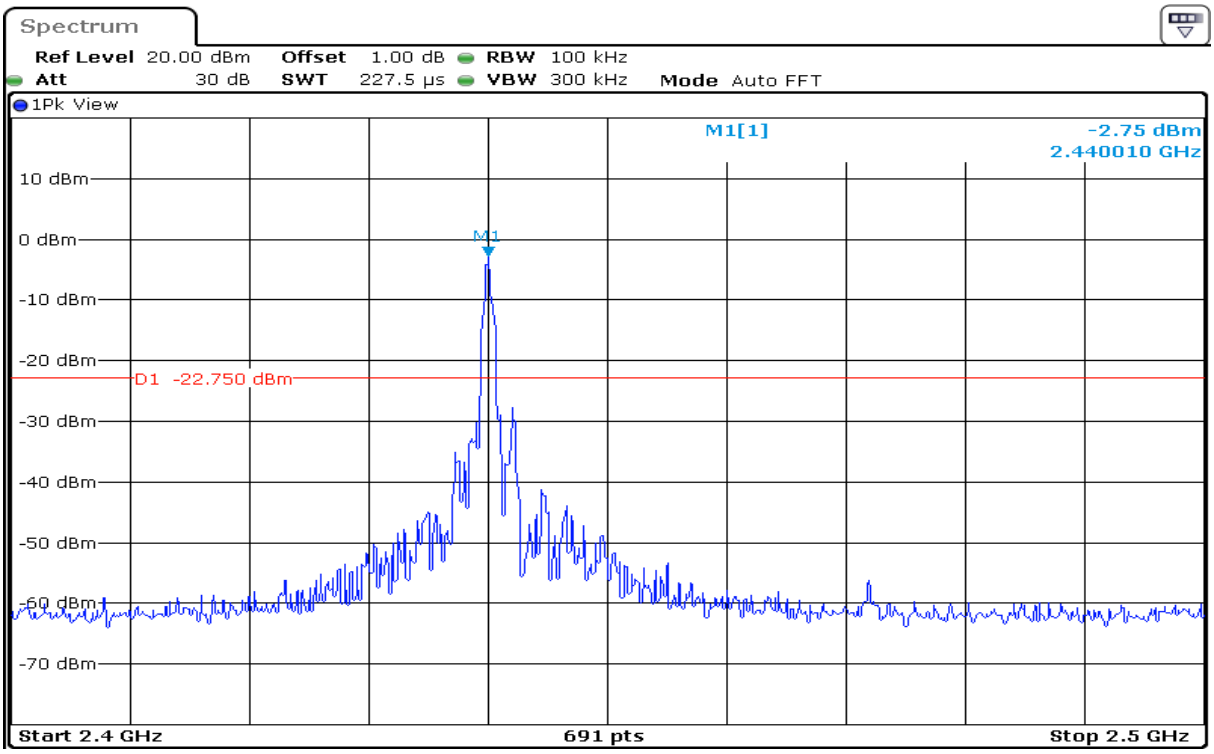
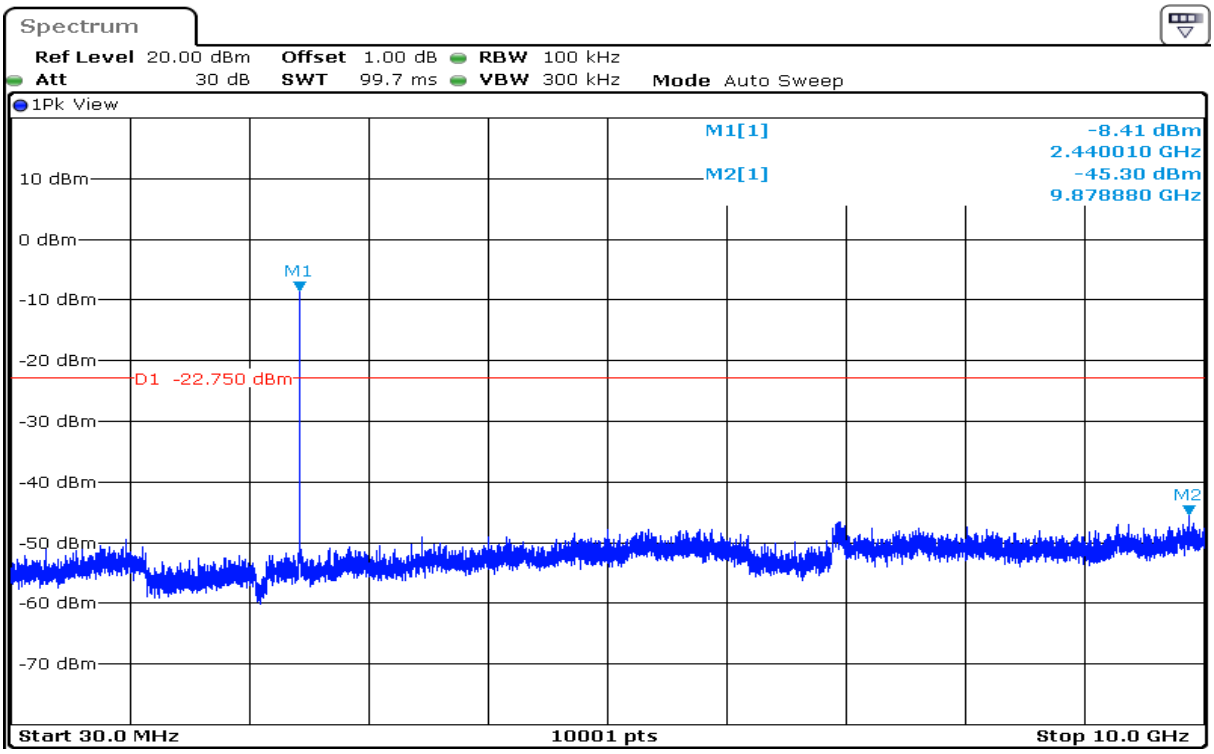
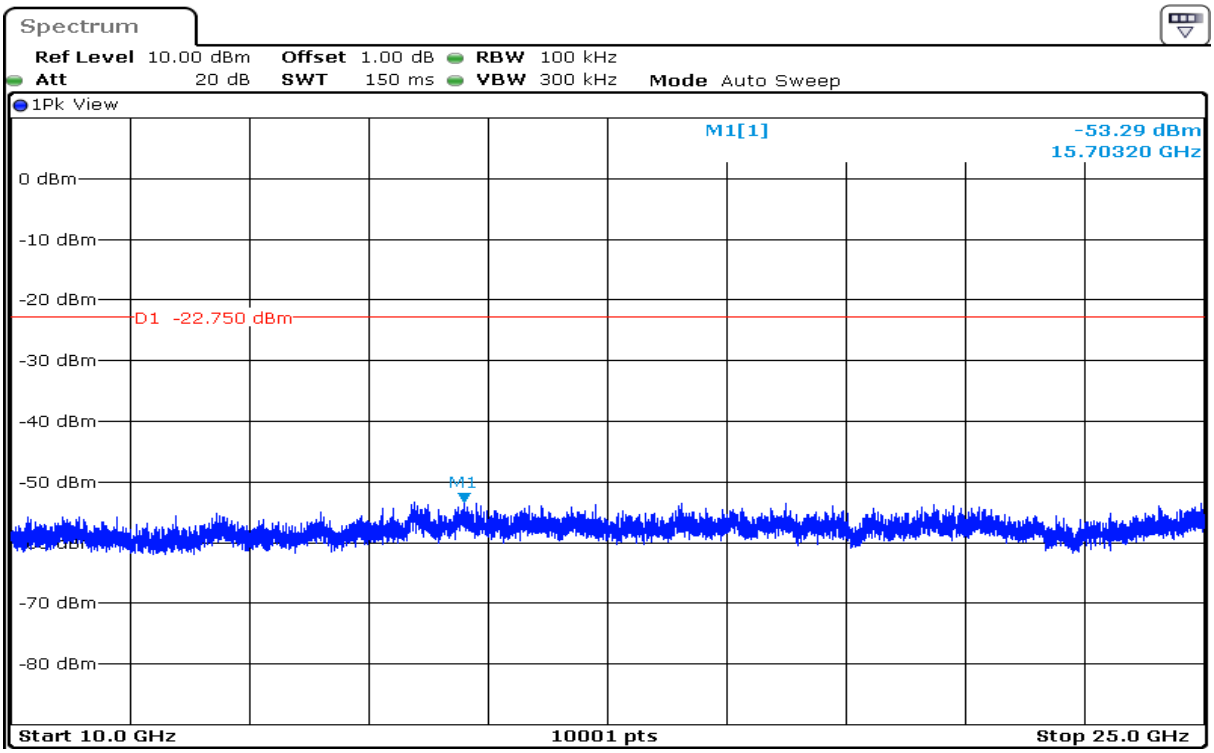

Spectrum
Ref Level 20.00 dBm Offset 1.00 dB RBW 100 kHz
Att 30 dB SWT 99.7 ms VBW 300 kHz Mode Auto Sweep
1Pk View
M1[1] -4.30 dBm
2.402120 GHz
M2[1] -44.60 dBm
6.926060 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
M2
D1 -22.150 dBm
Start 30.0 MHz
10001 pts
Stop 10.0 GHz


Spectrum
Ref Level 10.00 dBm Offset 1.00 dB RBW 100 kHz
Att 20 dB SWT 150 ms VBW 300 kHz Mode Auto Sweep
1Pk View
M1[1] -52.91 dBm
15.09570 GHz
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
-80 dBm
M1
D1 -22.150 dBm
Start 10.0 GHz
10001 pts
Stop 25.0 GHz

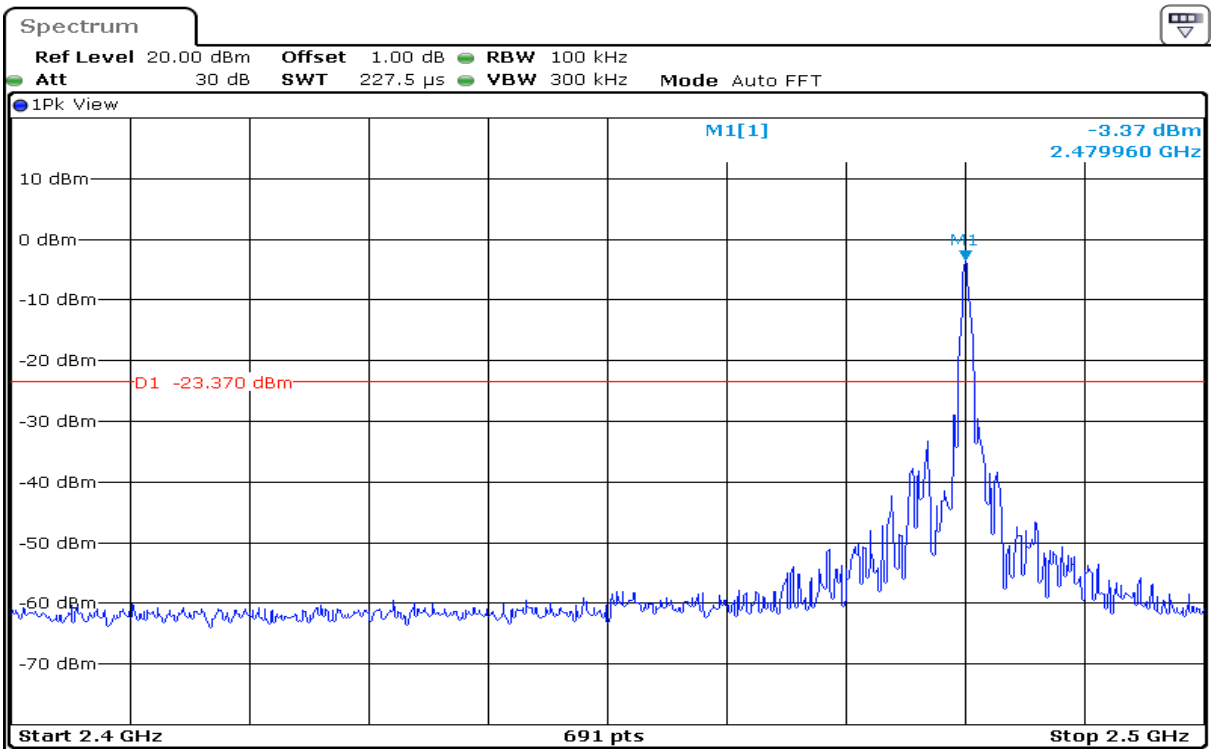
CH Mid

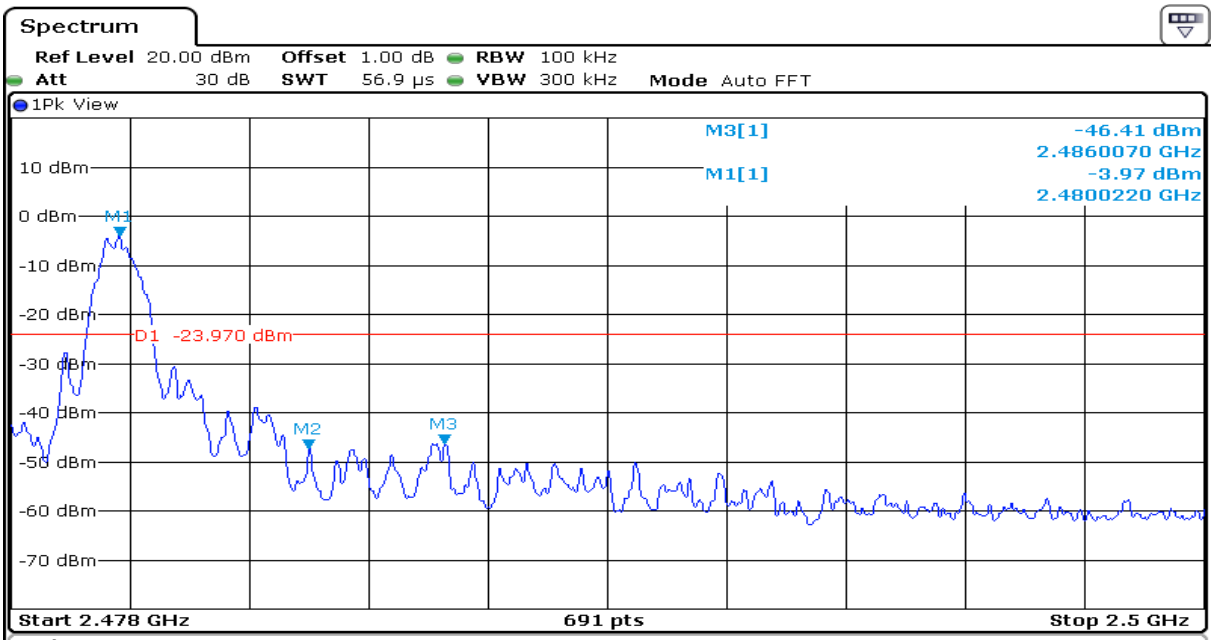

Spectrum
Ref Level 20.00 dBm Offset 1.00 dB RBW 100 kHz
Att 30 dB SWT 227.5 µs VBW 300 kHz Mode Auto FFT
1Pk View
M1[1] -2.75 dBm
2.440010 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
D1 -22.750 dBm
Start 2.4 GHz
691 pts
Stop 2.5 GHz


Spectrum
Ref Level 20.00 dBm Offset 1.00 dB RBW 100 kHz
Att 30 dB SWT 99.7 ms VBW 300 kHz Mode Auto Sweep
1Pk View
M1[1] -8.41 dBm
2.440010 GHz
M2[1] -45.30 dBm
9.878880 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
M2
D1 -22.750 dBm
Start 30.0 MHz
10001 pts
Stop 10.0 GHz


Spectrum
Ref Level 10.00 dBm Offset 1.00 dB RBW 100 kHz
Att 20 dB SWT 150 ms VBW 300 kHz Mode Auto Sweep
1Pk View
M1[1] -53.29 dBm
15.70320 GHz
0 dBm
-10 dBm
-20 dBm
D1 -22.750 dBm
-30 dBm
-40 dBm
-50 dBm
M1
-70 dBm
-80 dBm
Start 10.0 GHz
10001 pts
Stop 25.0 GHz

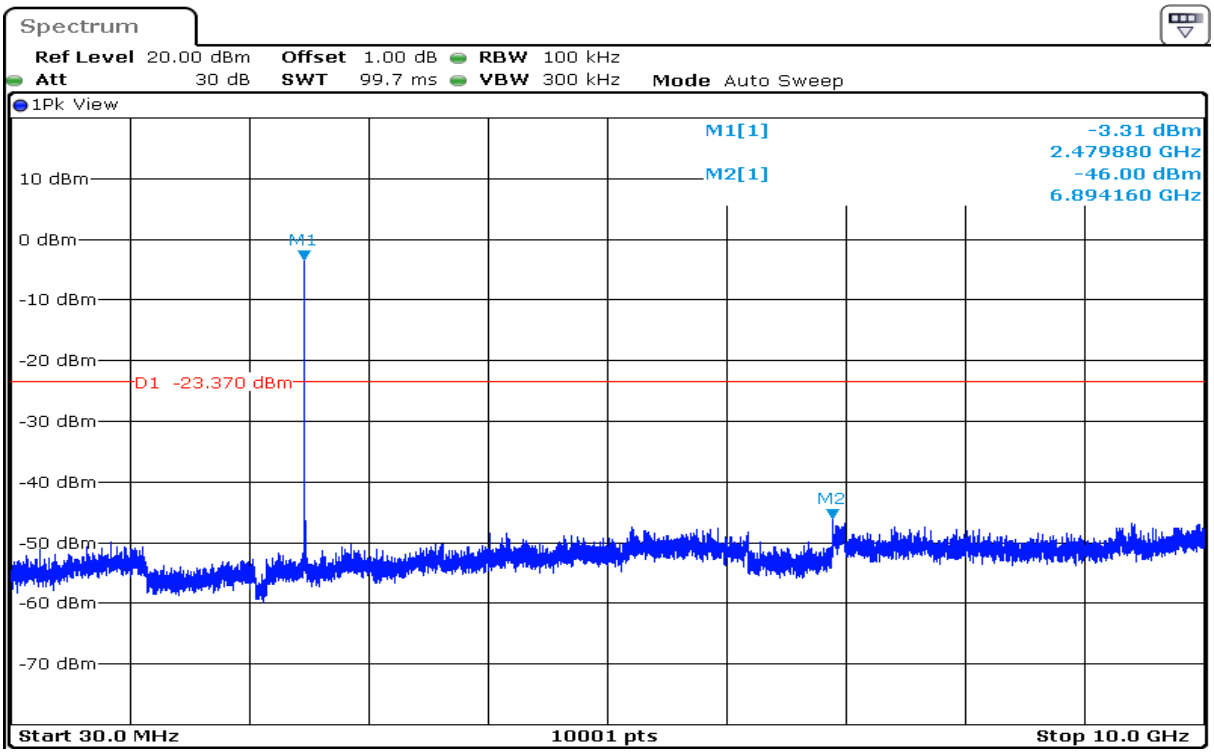
CH High

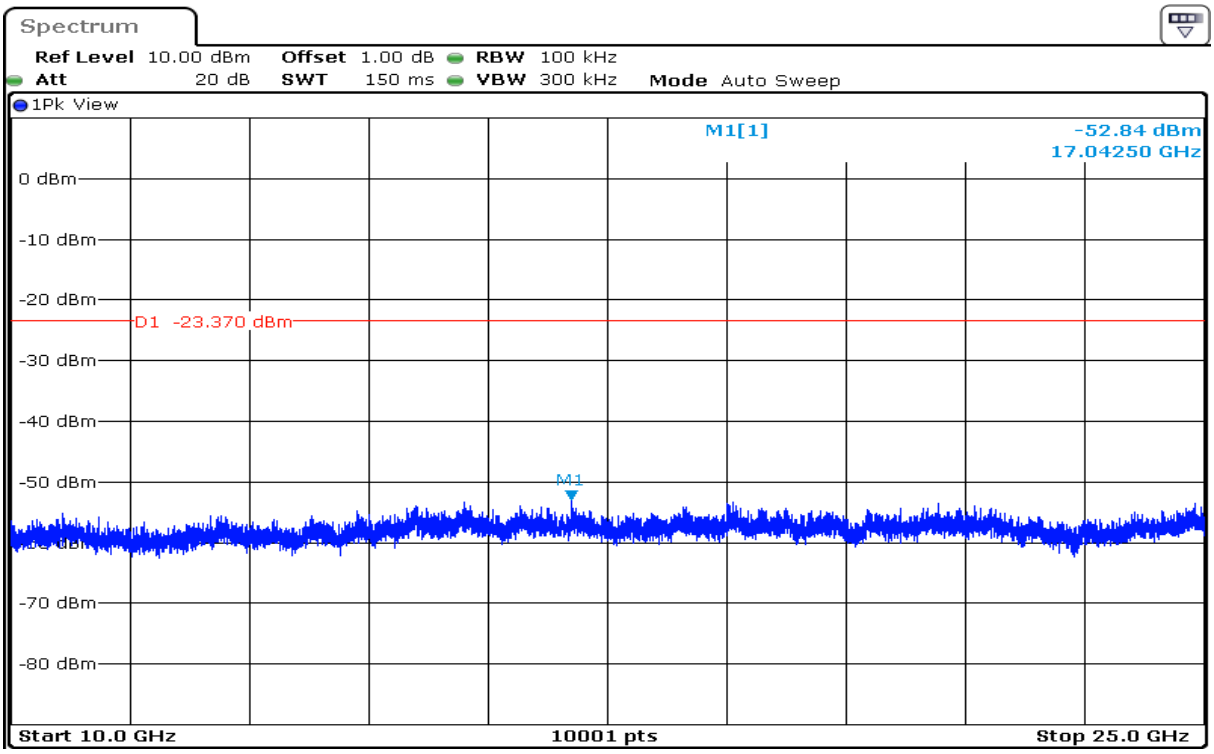

Spectrum
Ref Level 20.00 dBm Offset 1.00 dB RBW 100 kHz
Att 30 dB SWT 227.5 µs VBW 300 kHz Mode Auto FFT
1Pk View
M1[1] -3.37 dBm
2.479960 GHz
10 dBm
0 dBm
M1
-10 dBm
-20 dBm
D1 -23.370 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
Start 2.4 GHz
691 pts
Stop 2.5 GHz



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	2.480022 GHz	-3.97 dBm		
M2		1	2.4835 GHz	-47.23 dBm		
M3		1	2.486007 GHz	-46.41 dBm		




Spectrum
Ref Level 10.00 dBm Offset 1.00 dB RBW 100 kHz
Att 20 dB SWT 150 ms VBW 300 kHz Mode Auto Sweep
1Pk View
M1[1] -52.84 dBm
17.04250 GHz
0 dBm
-10 dBm
-20 dBm
D1 -23.370 dBm
-30 dBm
-40 dBm
-50 dBm
M1
-70 dBm
-80 dBm
Start 10.0 GHz
10001 pts
Stop 25.0 GHz

7.5 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 (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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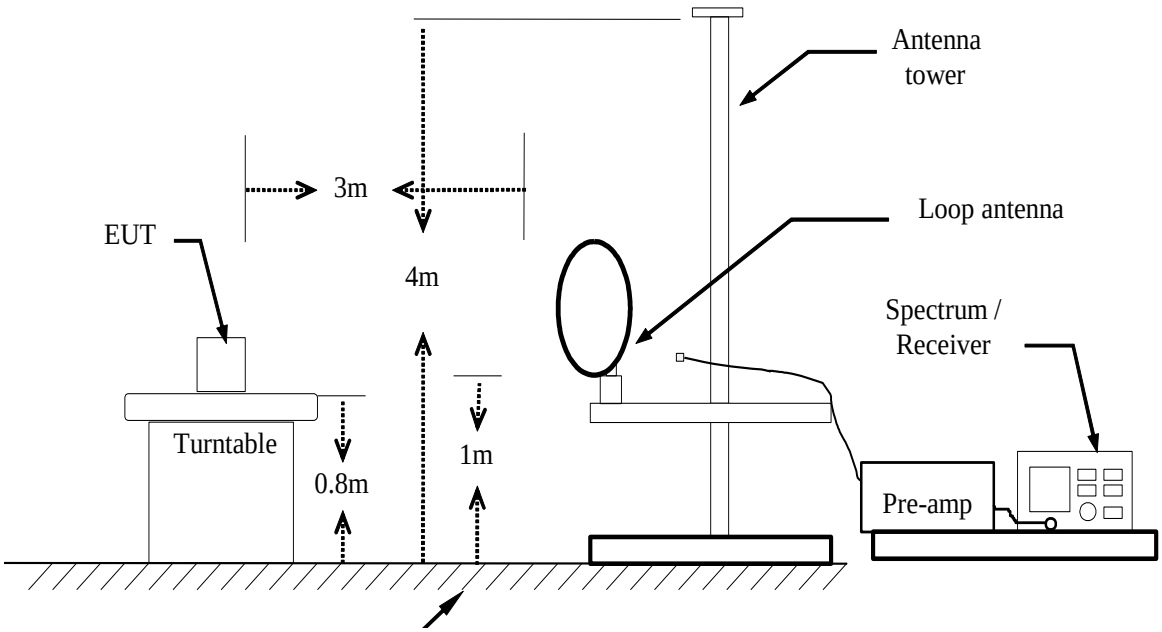
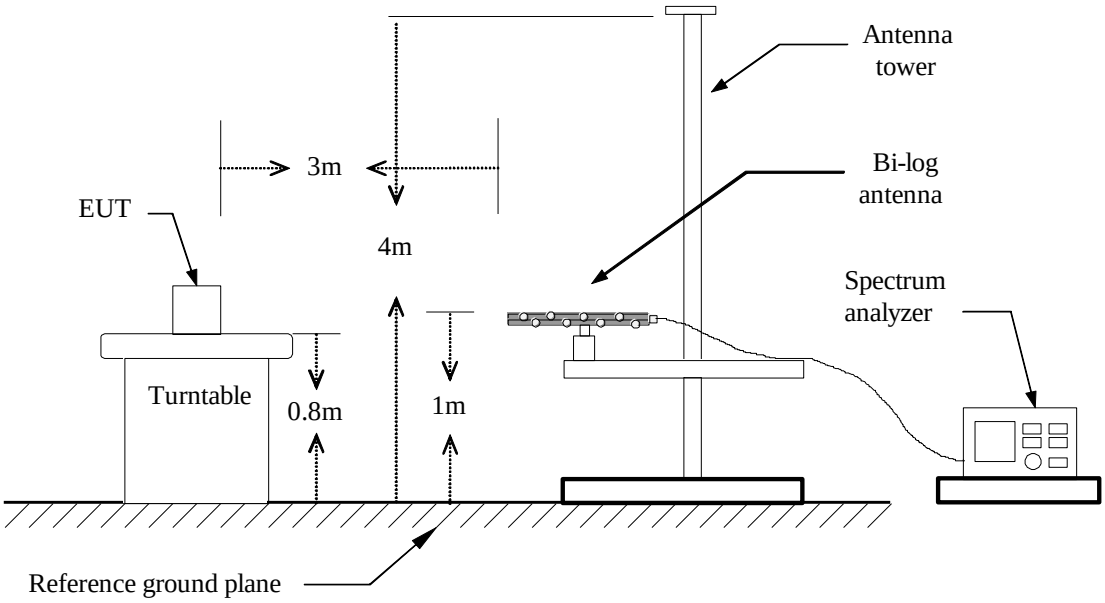
Test Configuration

Below 30MHz



Below 1 GHz



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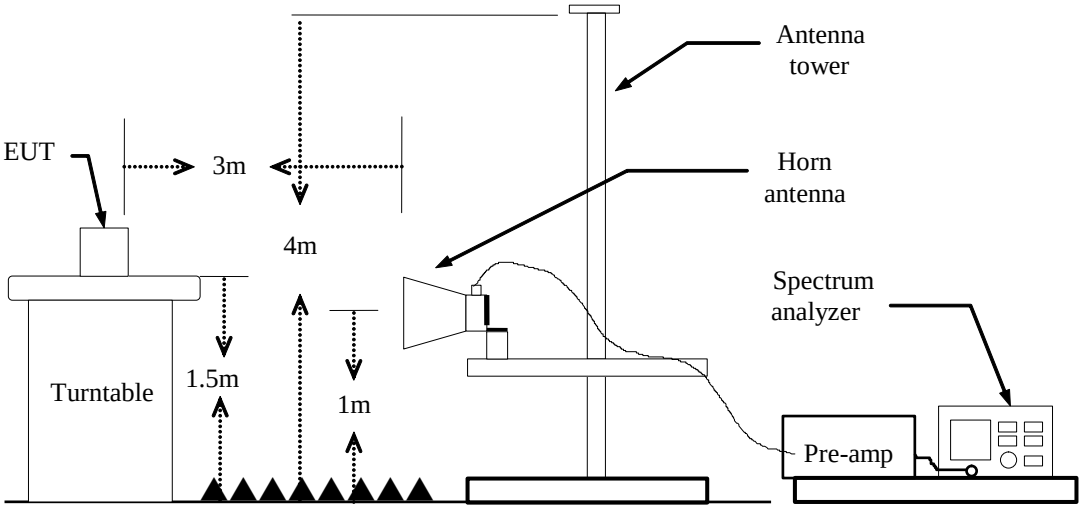
Above 1 GHz



TEST PROCEDURE

1. The testing follows Sub-clause 11.12 and 11.13 of ANSI C63.10.
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 ≥ 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.

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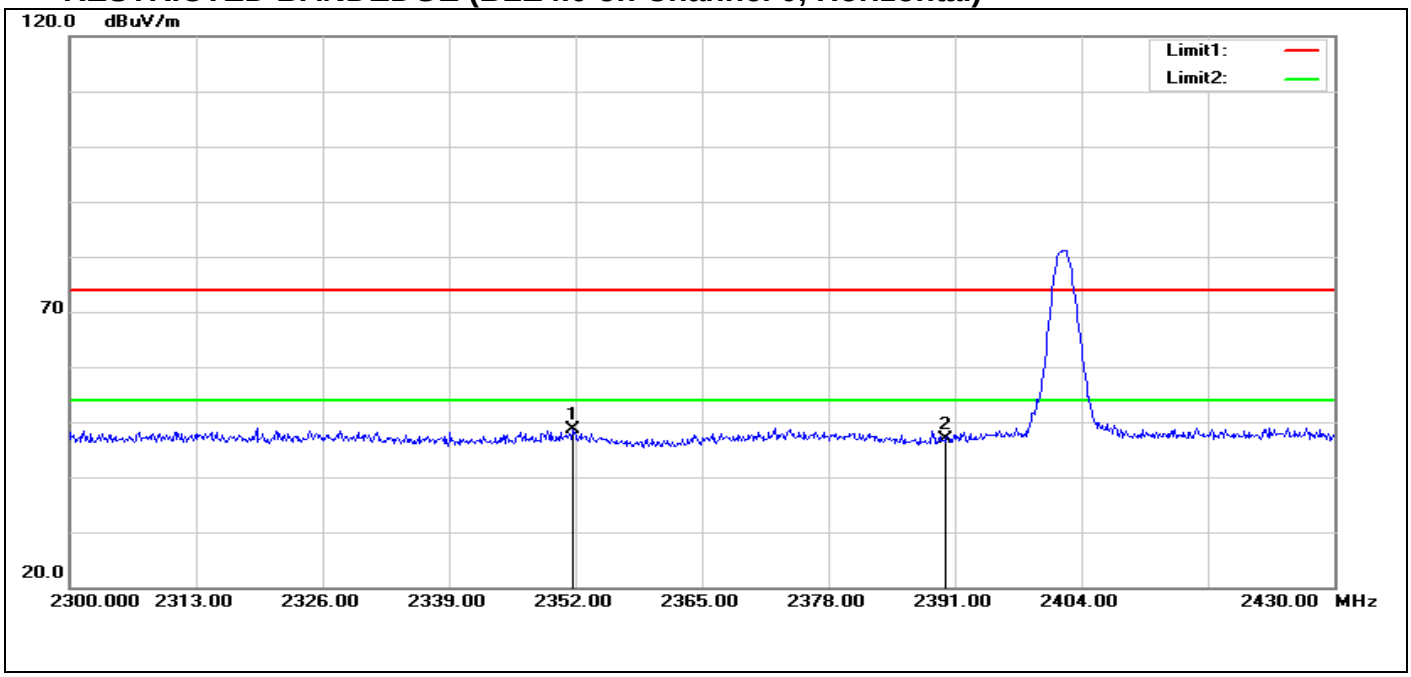
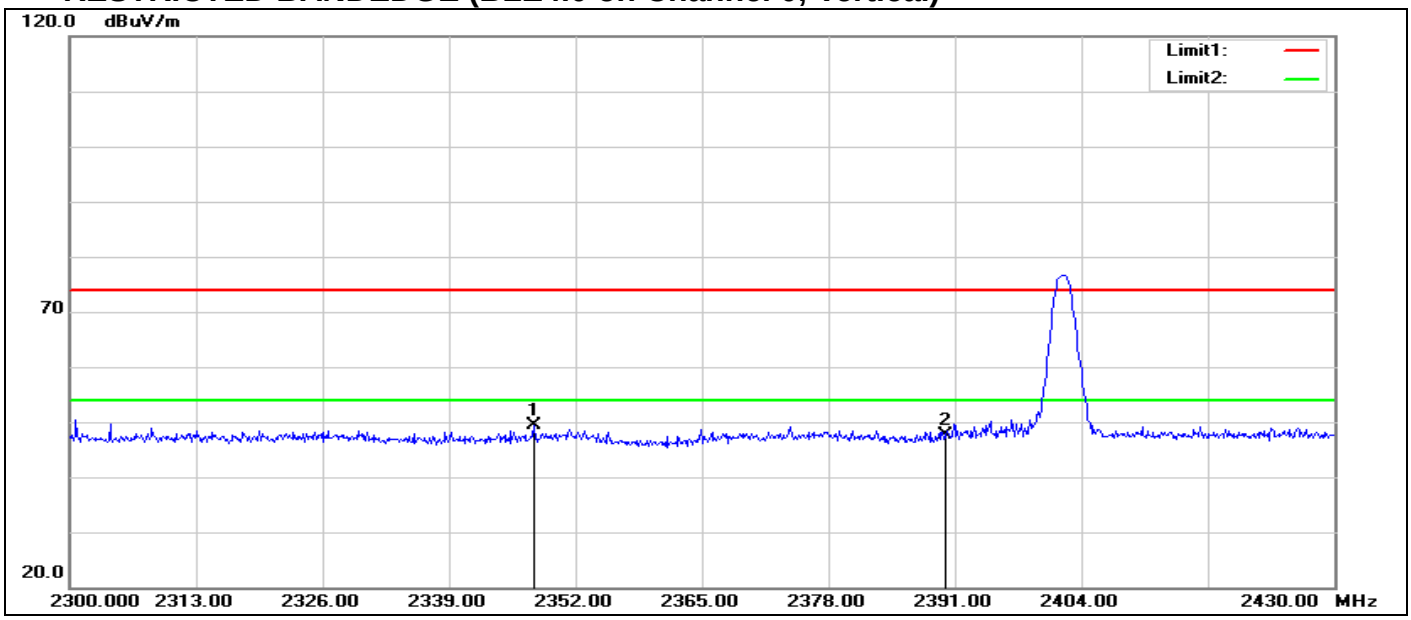
RESTRICTED BANDEDGE (BLE4.0 on Channel 0, Horizontal)



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	2351.740	57.71	-9.19	48.52	74.00	-25.48	100	357	peak
2	2390.000	55.80	-8.95	46.85	74.00	-27.15	100	360	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	2347.710	58.54	-9.22	49.32	74.00	-24.68	100	360	peak
2	2390.000	56.51	-8.95	47.56	74.00	-26.44	100	0	peak

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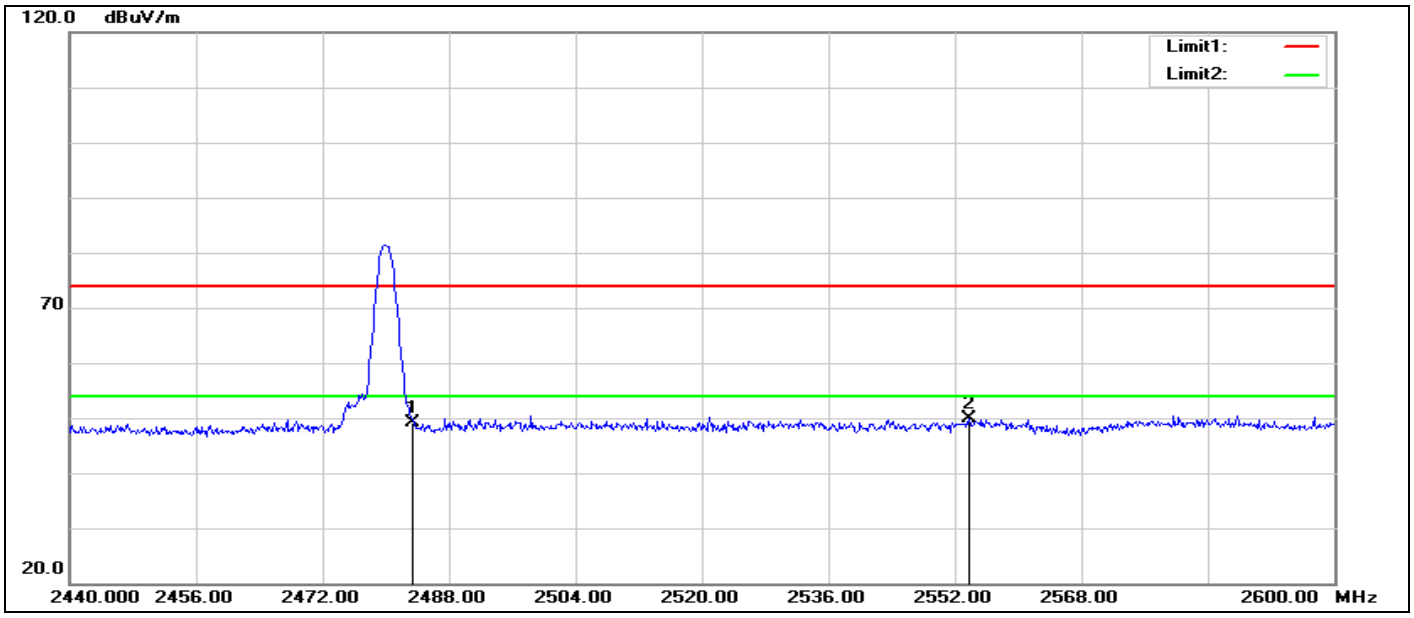
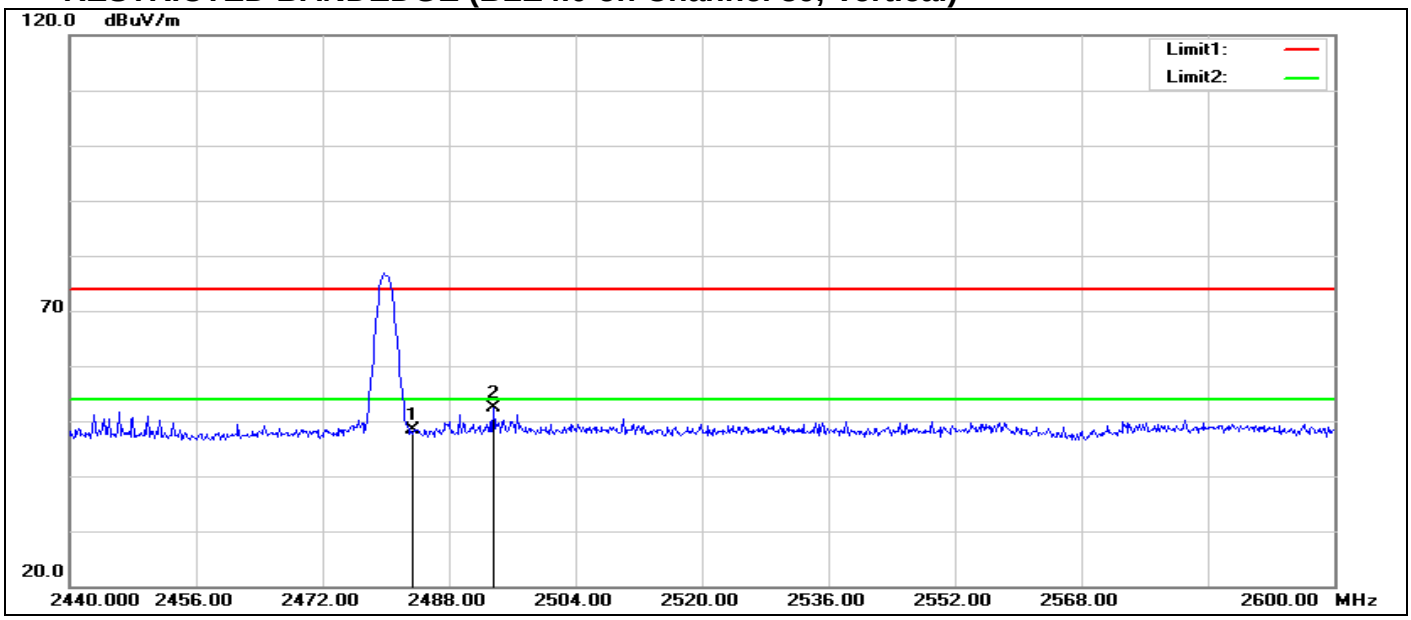
RESTRICTED BANDEDGE (BLE4.0 on Channel 39, Horizontal)



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	57.50	-8.35	49.15	74.00	-24.85	100	360	peak
2	2553.760	57.78	-7.97	49.81	74.00	-24.19	100	360	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	56.70	-8.35	48.35	74.00	-25.65	100	228	peak
2	2493.600	60.59	-8.28	52.31	74.00	-21.69	100	88	peak

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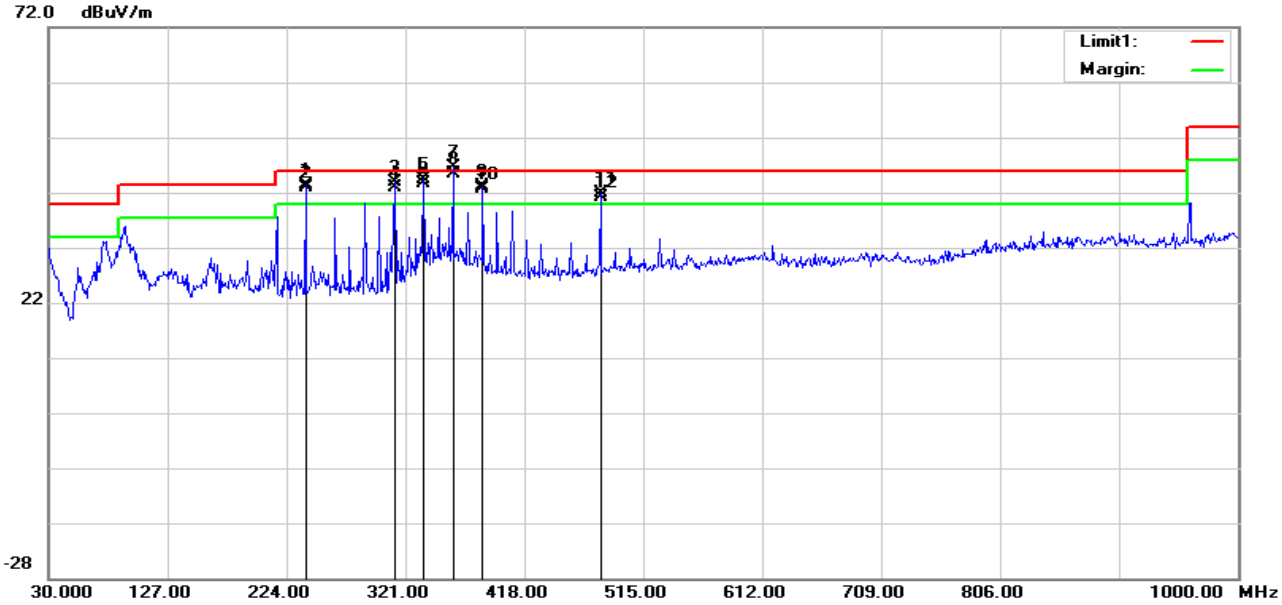
Test Result of Radiated Emission

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:**	2018-11-22
Temperature:	25°C	**Tested by:**	Matt.yao
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	239.5200	24.46	18.32	42.78	46.00	-3.22	100	258	QP
2	312.2700	21.22	21.69	42.91	46.00	-3.09	100	245	QP
3	335.5500	19.22	24.53	43.75	46.00	-2.25	100	194	QP
4	360.0250	19.61	25.82	45.43	46.00	-0.57	100	169	QP
5	384.0500	17.91	24.69	42.60	46.00	-3.40	100	234	QP
6	480.0800	17.03	24.10	41.13	46.00	-4.87	200	208	QP

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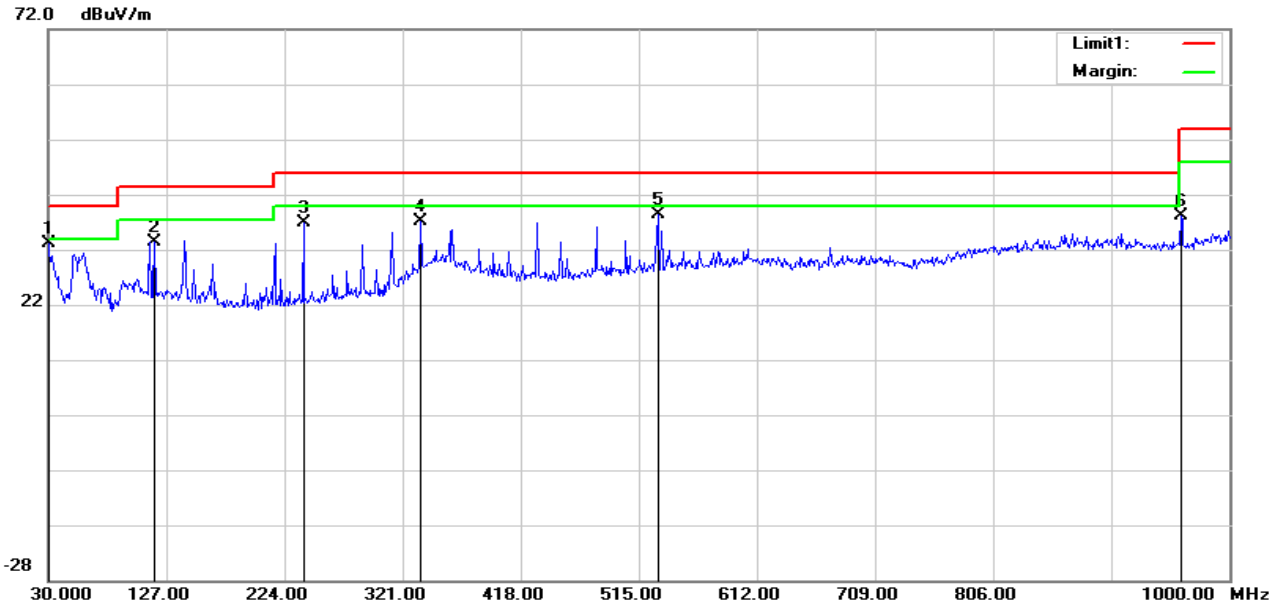
Operation Mode:	Normal Link	**Test Date:**	2018-11-22
Temperature:	25°C	**Tested by:**	Matt.yao
Humidity:	48% RH	**Polarity:**	Ver.



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	30.0000	33.19	0.00	33.19	40.00	-6.81	108	0	peak
2	117.3000	33.48	0.00	33.48	43.50	-10.02	300	50	peak
3	239.5200	36.97	0.00	36.97	46.00	-9.03	100	36	peak
4	335.5500	37.23	0.00	37.23	46.00	-8.77	200	70	peak
5	530.5200	38.26	0.00	38.26	46.00	-7.74	200	326	peak
6	960.2300	38.18	0.00	38.18	54.00	-15.82	100	38	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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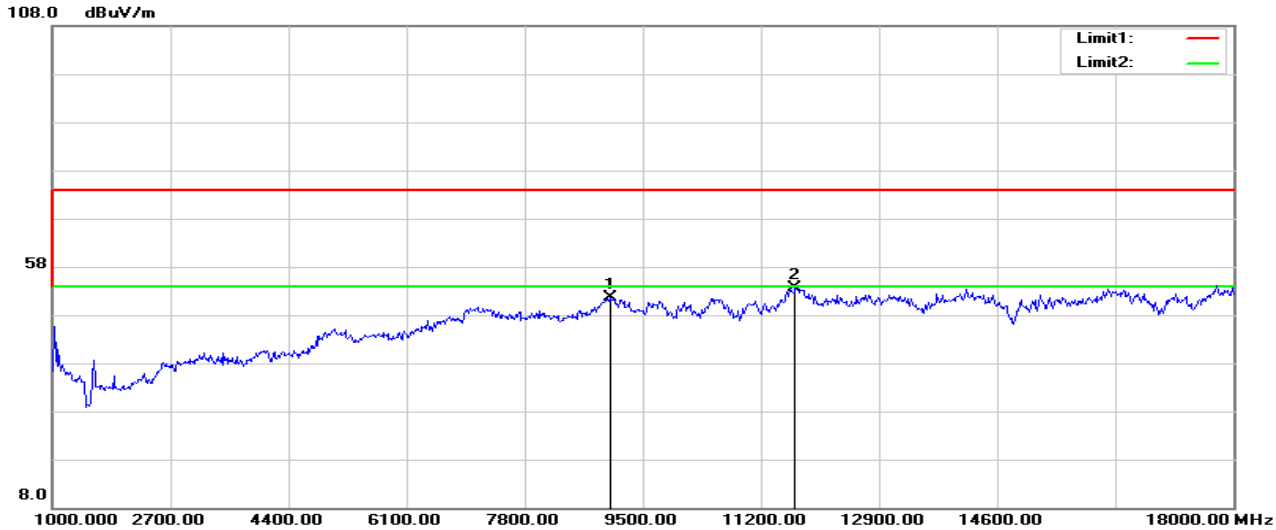
Above 1 GHz

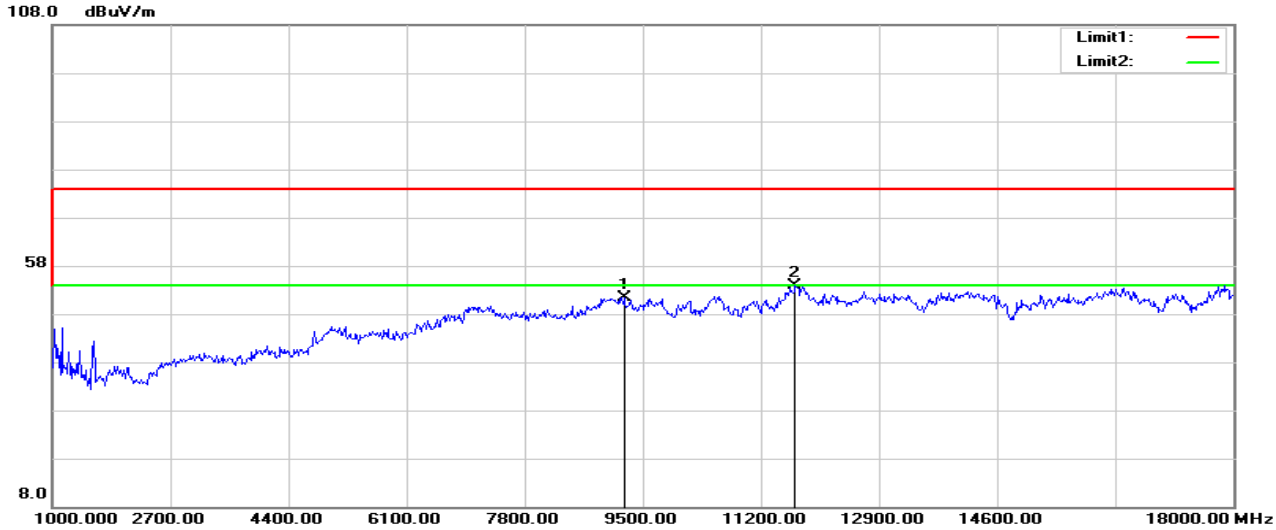
Operation Mode:	Bluetooth LE4.0	**Test Date:**	2018-11-22
Test Channel:	CH00	**Tested by:**	Matt.yao
Temperature:	25°C	**Polarity:**	Ver. / Hor.

Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	9024.000	42.56	9.02	51.58	74.00	-22.42	138	361	peak
2	11693.000	41.95	11.62	53.57	74.00	-20.43	200	31	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	9228.000	42.26	9.04	51.30	74.00	-22.70	100	111	peak
2	11693.000	42.20	11.62	53.82	74.00	-20.18	200	39	peak

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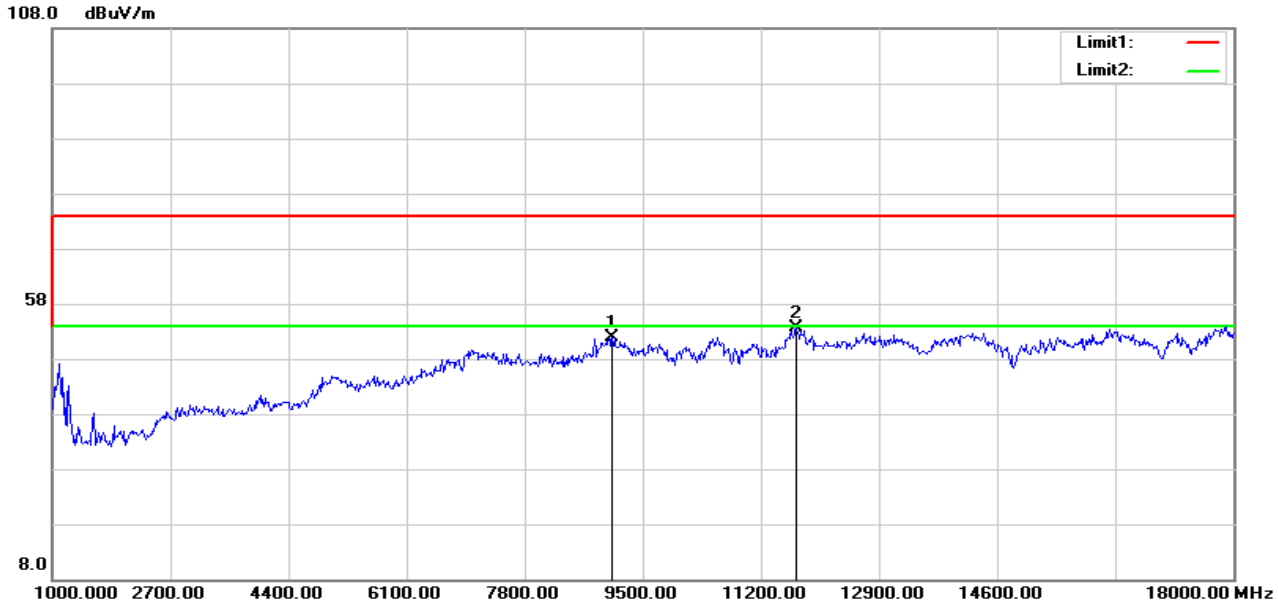
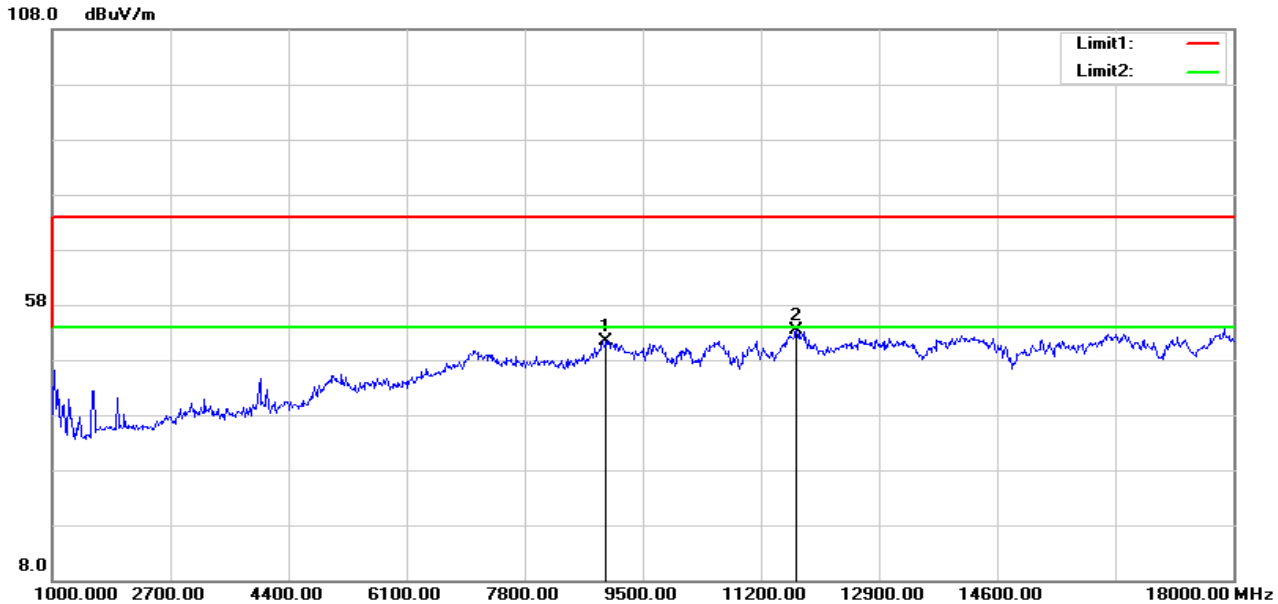
Operation Mode:	Bluetooth LE4.0	**Test Date:**	2018-11-22
Test Channel:	CH19	**Tested by:**	Matt.yao
Temperature:	25°C	**Polarity:**	Ver. / Hor.

Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	9058.000	42.89	9.02	51.91	74.00	-22.09	200	263	peak
2	11710.000	41.94	11.65	53.59	74.00	-20.41	100	134	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	8973.000	42.58	8.87	51.45	74.00	-22.55	119	361	peak
2	11710.000	41.65	11.65	53.30	74.00	-20.70	200	26	peak

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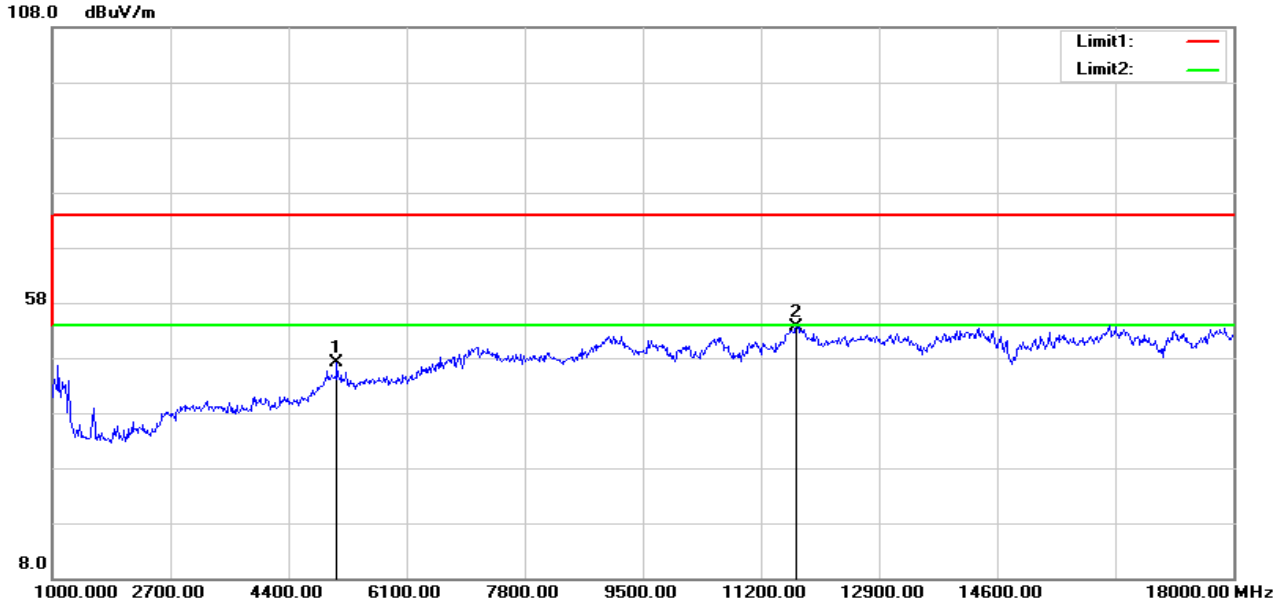
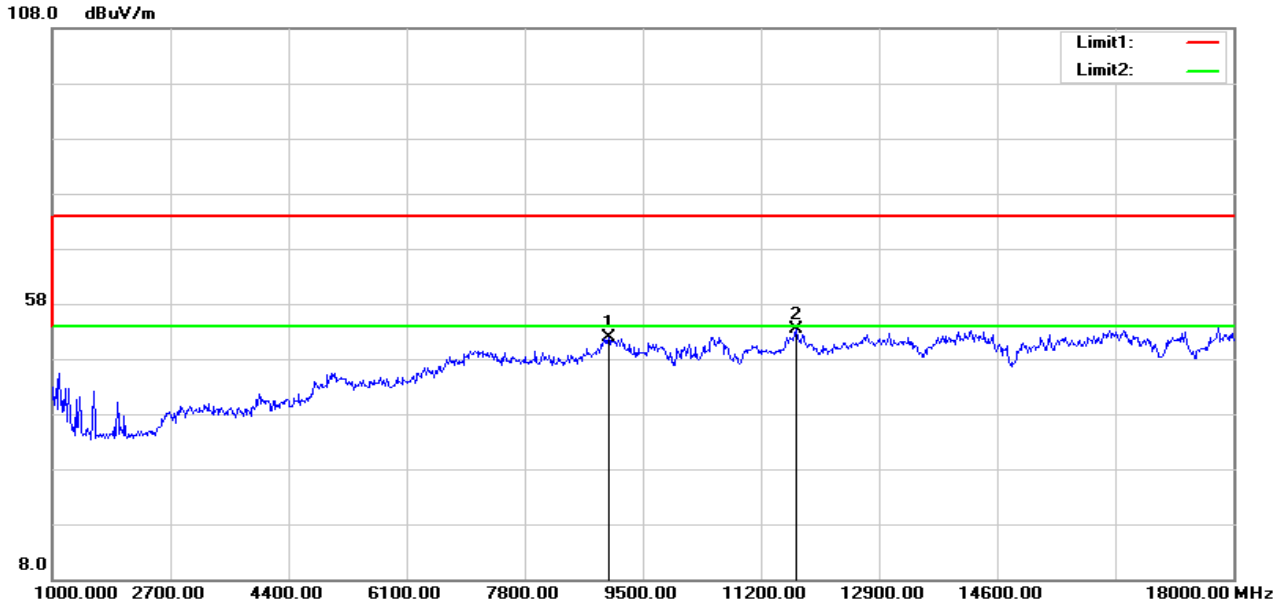
Operation Mode:	Bluetooth LE4.0	**Test Date:**	2018-11-22
Test Channel:	CH39	**Tested by:**	Matt.yao
Temperature:	25°C	**Polarity:**	Ver. / Hor.

Horizontal



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor(dB/m)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Height (cm)	Degree (deg.)	Remark
1	5097.000	46.35	0.73	47.08	74.00	-26.92	100	2	peak
2	11710.000	41.90	11.65	53.55	74.00	-20.45	200	2	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	9007.000	42.74	9.02	51.76	74.00	-22.24	100	290	peak
2	11710.000	41.62	11.65	53.27	74.00	-20.73	300	1	peak

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7.6 POWERLINE CONDUCTED EMISSIONS

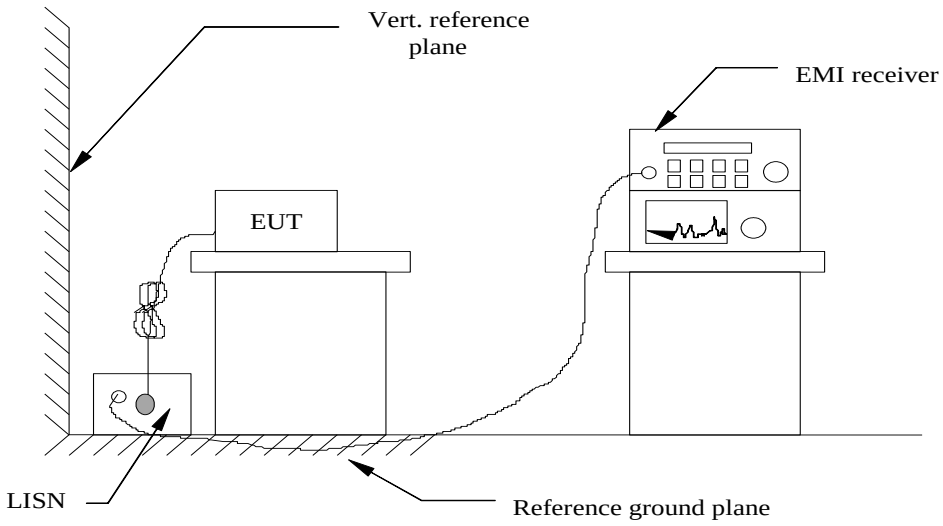
LIMIT

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 (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

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.

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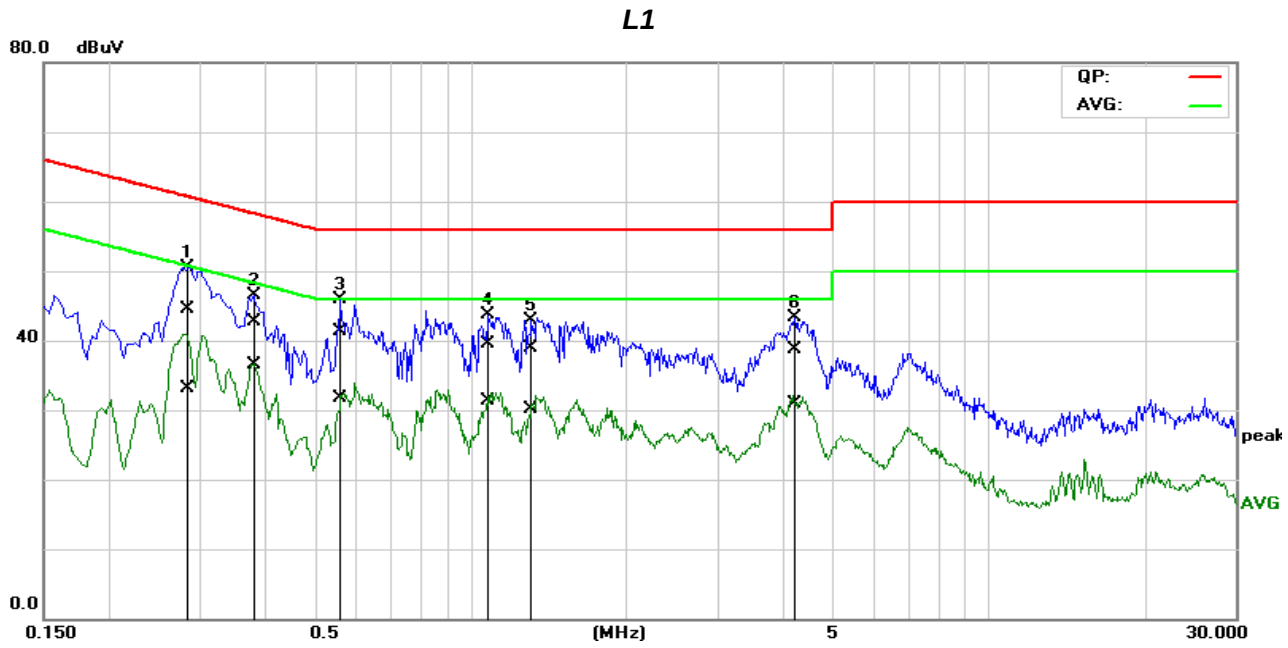
Test Data

Job No.:	C181109R01	Date:	2018/11/20
Model No.:	ALLEGRO III	Time:	10:40:02
Standard:	FCC Class B	Temp.(C)/Hum.(%):	22(C)/41%
Test item:	Conduction test	Test By:	Matt.yao
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	0.2819	25.11	13.70	19.47	44.58	33.17	60.76	50.76	-16.18	-17.59	Pass
2*	0.3818	23.13	16.96	19.49	42.62	36.45	58.24	48.24	-15.62	-11.79	Pass
3	0.5596	21.81	12.28	19.50	41.31	31.78	56.00	46.00	-14.69	-14.22	Pass
4	1.0821	19.89	11.70	19.56	39.45	31.26	56.00	46.00	-16.55	-14.74	Pass
5	1.3059	19.42	10.54	19.57	38.99	30.11	56.00	46.00	-17.01	-15.89	Pass
6	4.2128	19.01	11.31	19.67	38.68	30.98	56.00	46.00	-17.32	-15.02	Pass

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

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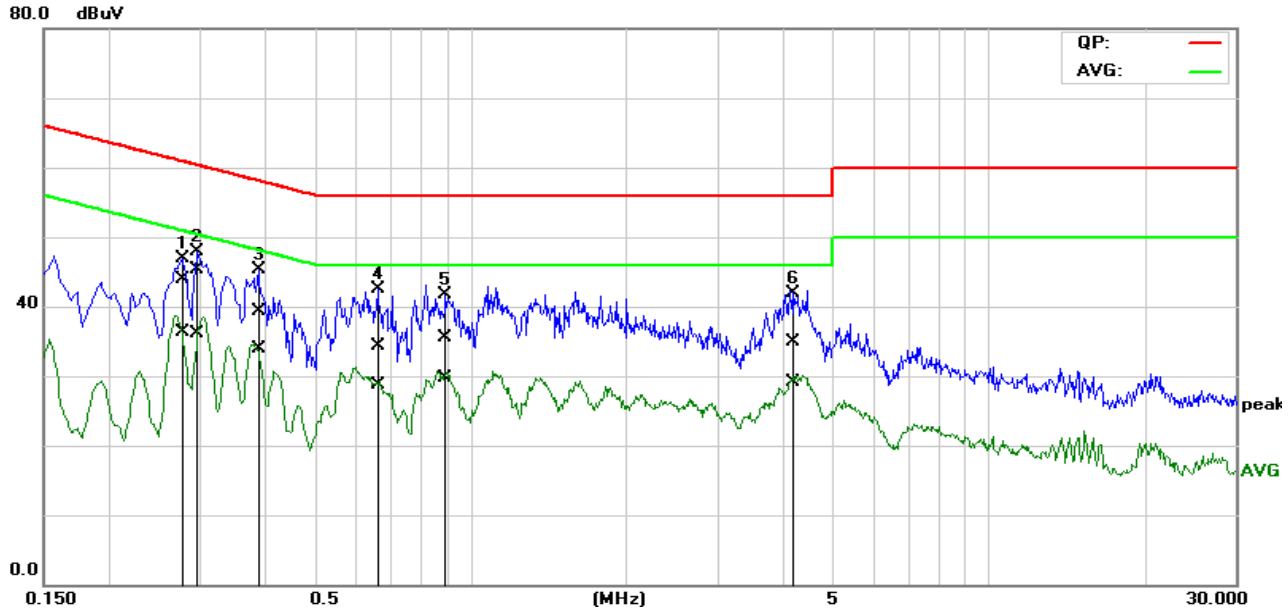
Job No.:	C181109R01	Date:	2018/11/20
Model No.:	ALLEGRO III	Time:	10:44:57
Standard:	FCC Class B	Temp.(C)/Hum.(%):	22(C)/41%
Test item:	Conduction test	Test By:	Matt.yao
Line:	L2	Test Voltage:	AC 120V/60Hz
Model:		Description:	

L2



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	0.2763	24.53	16.92	19.46	43.99	36.38	60.92	50.93	-16.93	-14.55	Pass
2	0.2970	25.92	16.60	19.47	45.39	36.07	60.32	50.33	-14.93	-14.26	Pass
3*	0.3867	19.91	14.47	19.47	39.38	33.94	58.13	48.13	-18.75	-14.19	Pass
4	0.6651	14.87	9.21	19.51	34.38	28.72	56.00	46.00	-21.62	-17.28	Pass
5	0.8863	16.04	10.10	19.54	35.58	29.64	56.00	46.00	-20.42	-16.36	Pass
6	4.1943	15.29	9.44	19.65	34.94	29.09	56.00	46.00	-21.06	-16.91	Pass

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

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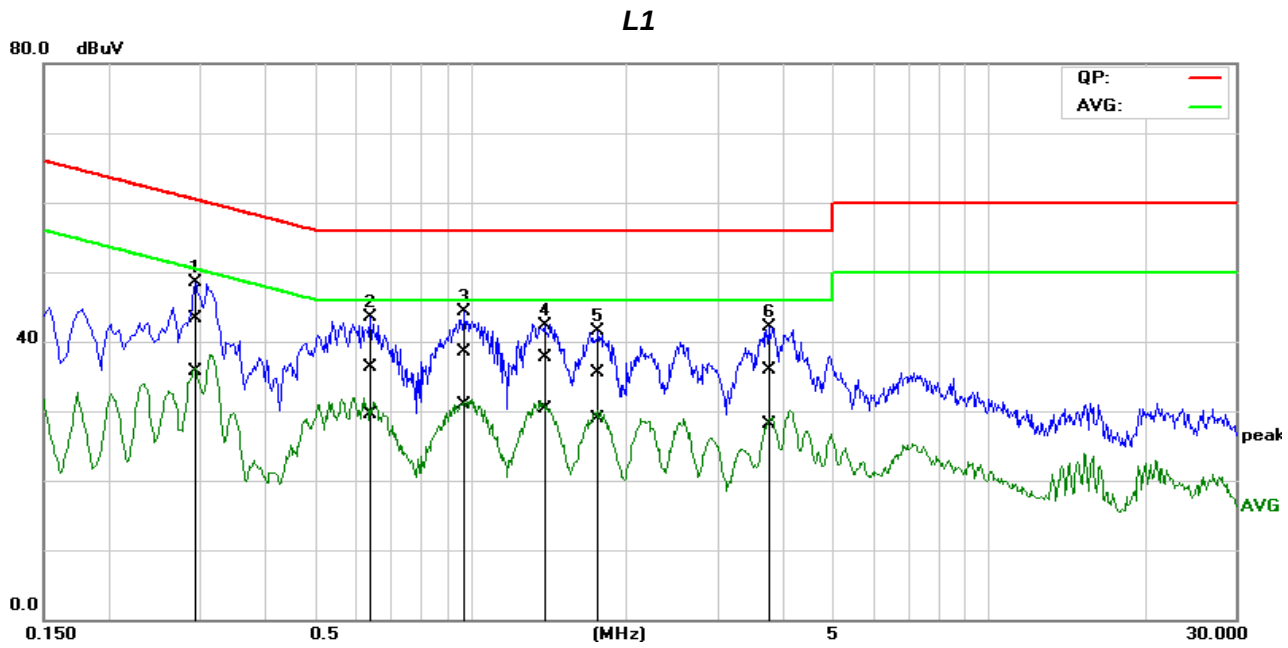
Job No.:	C181109R01	Date:	2018/11/20
Model No.:	ALLEGRO III	Time:	10:33:14
Standard:	FCC Class B	Temp.(C)/Hum.(%):	22(C)/41%
Test item:	Conduction test	Test By:	Matt.yao
Line:	L1	Test Voltage:	AC 240V/60Hz
Model:		Description:	



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*	0.2955	23.77	16.29	19.48	43.25	35.77	60.37	50.37	-17.12	-14.60	Pass
2	0.6410	16.80	10.04	19.51	36.31	29.55	56.00	46.00	-19.69	-16.45	Pass
3	0.9785	18.98	11.29	19.56	38.54	30.85	56.00	46.00	-17.46	-15.15	Pass
4	1.3834	18.16	10.68	19.57	37.73	30.25	56.00	46.00	-18.27	-15.75	Pass
5	1.7588	16.02	9.37	19.58	35.60	28.95	56.00	46.00	-20.40	-17.05	Pass
6	3.7512	16.18	8.44	19.65	35.83	28.09	56.00	46.00	-20.17	-17.91	Pass

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

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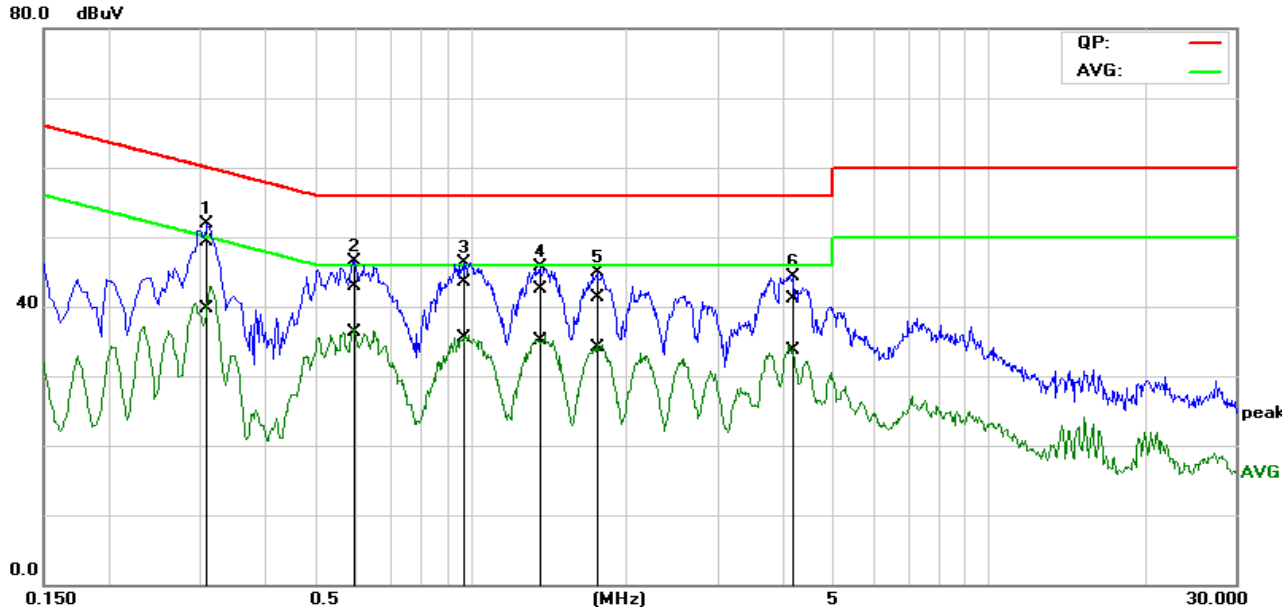
Job No.:	C181109R01	Date:	2018/11/20
Model No.:	ALLEGRO III	Time:	10:28:24
Standard:	FCC Class B	Temp.(C)/Hum.(%):	22(C)/41%
Test item:	Conduction test	Test By:	Matt.yao
Line:	L2	Test Voltage:	AC 240V/60Hz
Model:		Description:	

L2



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	0.3094	29.75	20.19	19.47	49.22	39.66	59.98	49.99	-10.76	-10.33	Pass
2*	0.5973	23.40	16.90	19.49	42.89	36.39	56.00	46.00	-13.11	-9.61	Pass
3	0.9640	23.99	15.88	19.54	43.53	35.42	56.00	46.00	-12.47	-10.58	Pass
4	1.3662	22.86	15.52	19.55	42.41	35.07	56.00	46.00	-13.59	-10.93	Pass
5	1.7617	21.78	14.51	19.56	41.34	34.07	56.00	46.00	-14.66	-11.93	Pass
6	4.1811	21.43	14.03	19.65	41.08	33.68	56.00	46.00	-14.92	-12.32	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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