FCC 47 CFR PART 15 SUBPART C
INDUSTRY CANADA RSS-210 ISSUE 8

BLUETOOTH LOW ENERGY
CERTIFICATION TEST REPORT

FOR

Chamberlain Group Inc.

BT LE Garage Door Sensor

MODEL NUMBER: 041D7924

REPORT NUMBER: 13N15223

ISSUE DATE: July 19, 2013
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Prepared for
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Elmhurst, IL 60126

Prepared by
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Revision History

Rev.	Issue Date	Revisions	Revised By
--	20130719	Initial Issue	B. Mucha
1	20130802	Editorial and some data changes	B.Mucha

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: **Chamberlain Group Inc.**
845 Larch Av
Elmhurst, IL 60126

EUT DESCRIPTION: BT LE Garage Door Sensor

MODEL: 041D7924

SERIAL NUMBER: prototype

DATE TESTED: May 16, 2013 thru June 18, 2013

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
CFR 47 Part 15 Subpart C	Pass
INDUSTRY CANADA RSS-210 Issue 8 Annex 8	Pass
INDUSTRY CANADA RSS-GEN Issue 3	Pass

UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by UL Verification Services Inc. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

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2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4-2003, FCC CFR 47 Part 2, FCC CFR 47 Part 15, RSS-GEN Issue 3, and RSS-210 Issue 8.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 333 Pfingsten Road, Northbrook, IL 60062, USA

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at http://ts.nist.gov/Standards/scopes/1004140.htm

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. SAMPLE CALCULATION

Where relevant, the following sample calculation is provided:

Field Strength (dBuV/m) = Measured Voltage (dBuV) + Antenna Factor (dB/m) + Cable Loss (dB) – Preamp Gain (dB)

36.5 dBuV + 18.7 dB/m + 0.6 dB – 26.9 dB = 28.9 dBuV/m

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is an Low Energy Blue Tooth transceiver.

5.2. MAXIMUM OUTPUT POWER

The transmitter has a maximum peak conducted output power as follows:

Frequency Range (MHz)	Mode	Output Power (dBm)	Output Power (mW)
2402 - 2480	TX Modulated	1.27	1.34

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an internal PCB antenna with gain of less then 6dB. Based on Measured FS of fundamental emission (94.33dBuV/m @ 3m – 95.2dB = -0.97dBm EIRP) and measured output power the antenna gain is -2.27dBi.

5.4. SOFTWARE AND FIRMWARE

Device was programmed to transmit continuously by manufacturer on selected channels with highest duty cycle possible/allowed by the chip.

WORST-CASE CONFIGURATION AND MODE

The EUT is normally installed on garage doors. The two possible orientations of the EUT are referred to as door opened and door closed. For radiated spurious emissions the EUT was tested in both orientations.

5.5. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

No Support Equipment required for testing

I/O CABLES

No I/O calbes

TEST SETUP

Tested as stand-alone in both door open and door closed positions.

6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

Radiated Emissions – 10-Meter Chamber

Description	Manufacturer	Model	Identifier	Cal. Date	Cal. Due Date
EMI Test Receiver	Rohde & Schwarz	ESU	EMC4323	20121227	20131231
Bicon Antenna	Electro-Metrics	EM6912A	EMC4070	20120806	20130830
Log-P Antenna	Chase	UPA6109	EMC4313	20120807	20130831
Spectrum Analyzer	Rhode & Schwarz	FSEK	EMC4182	20121226	20131231
Antenna Array	UL	BOMS Assembly (1GHz-40GHz)	EMC4276	20111227	20131231

Antenna Port Conducted Emissions

Description	Manufacturer	Model	Identifier	Cal Date	Cal Due Date
Spectrum analyzer	Agilent	PXA	EMC4360	20121226	20131226
Cable and Attenuator	-	-	-	*	*
* measured at the time of testing					

7. ANTENNA PORT TEST RESULTS

7.1. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

IC RSS-210 A8.2 (a)

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

TEST PROCEDURE

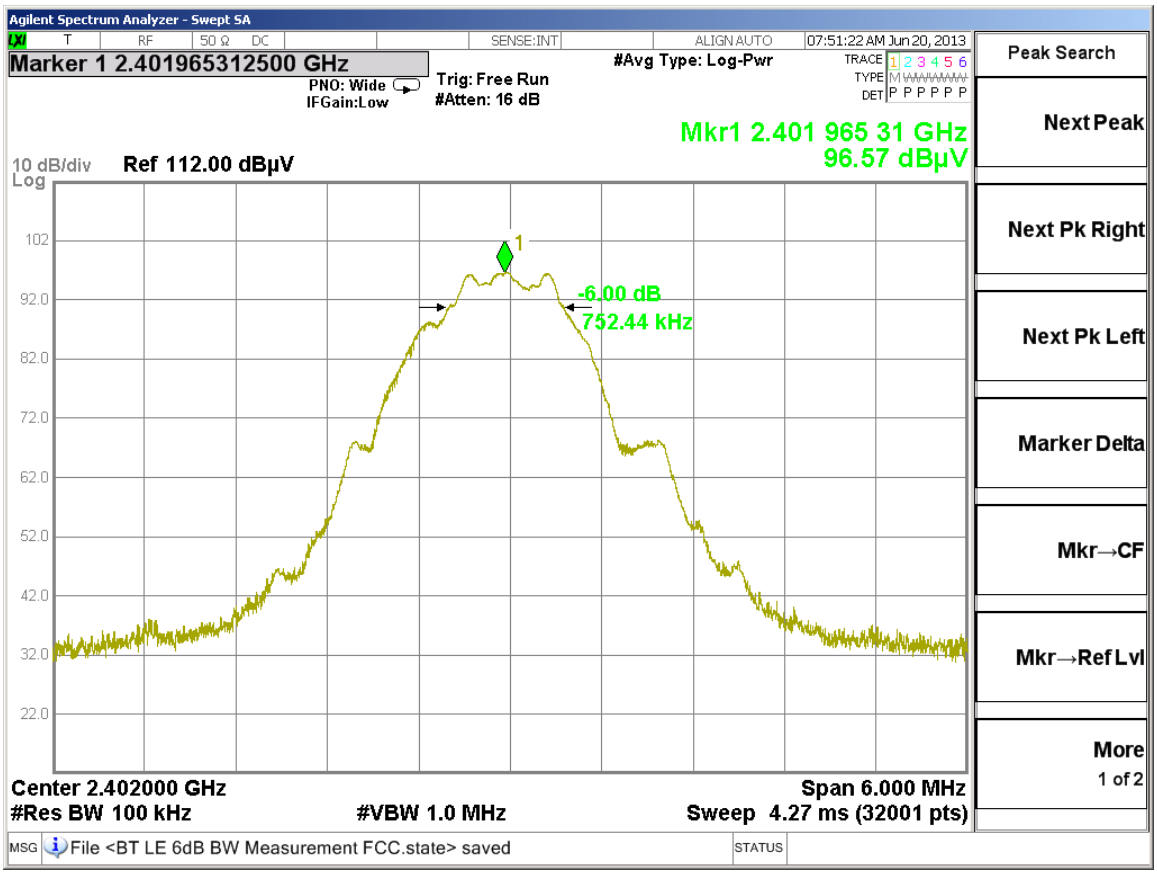
The transmitter output is connected to a spectrum analyzer. The RBW is set to 100 kHz and the VBW is set to 300 kHz or greater. The sweep time is coupled.

RESULTS

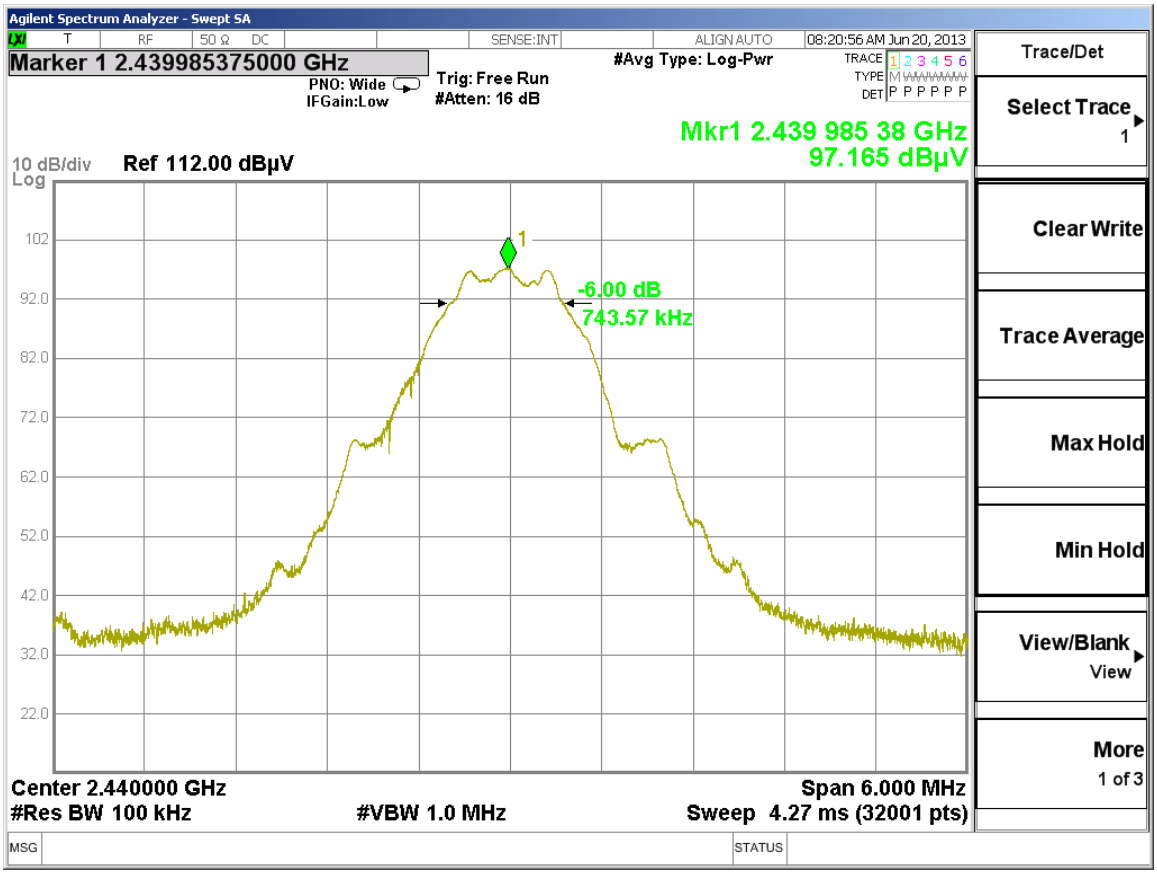
Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	0.7524	0.5
Middle	2440	0.7436	0.5
High	2480	0.7249	0.5

6 dB BANDWIDTH

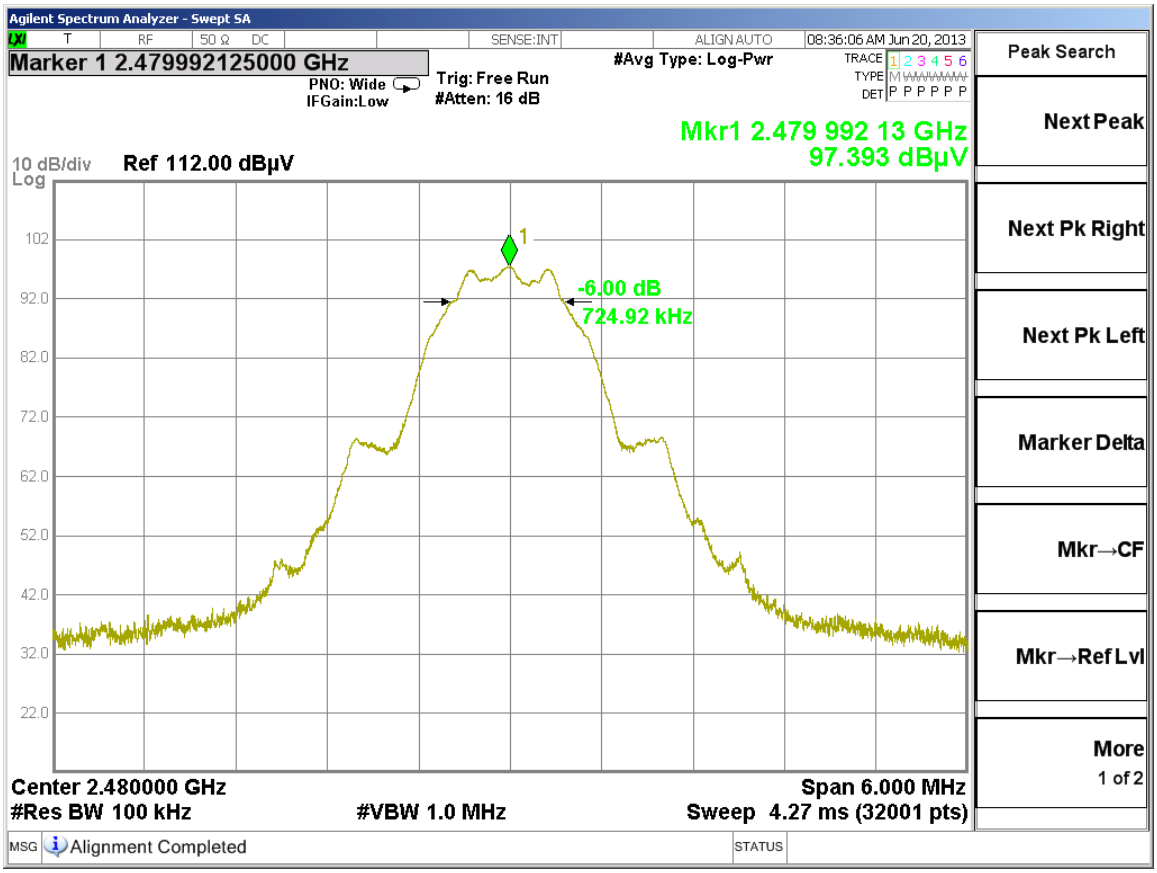
Low Channel



Middle Channel



High Channel



7.2. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

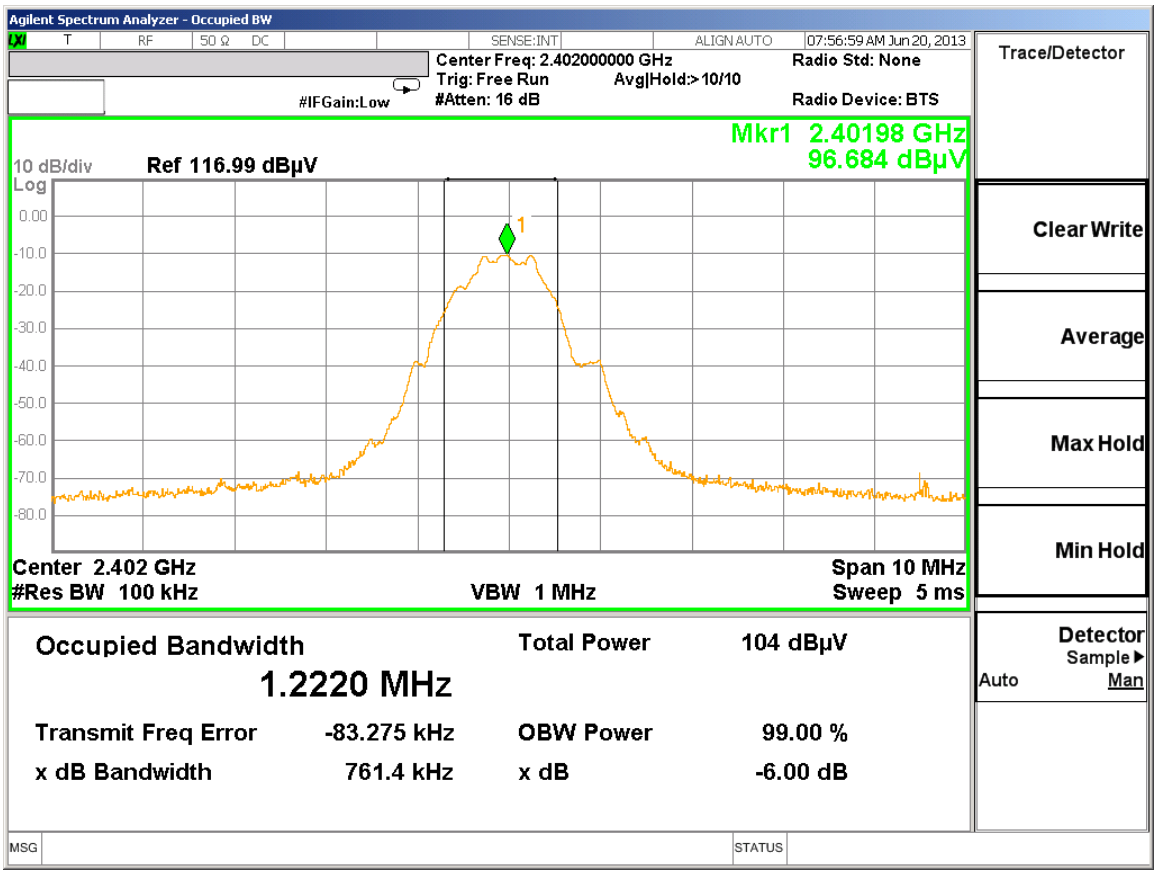
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth and to 1% of the span. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

RESULTS

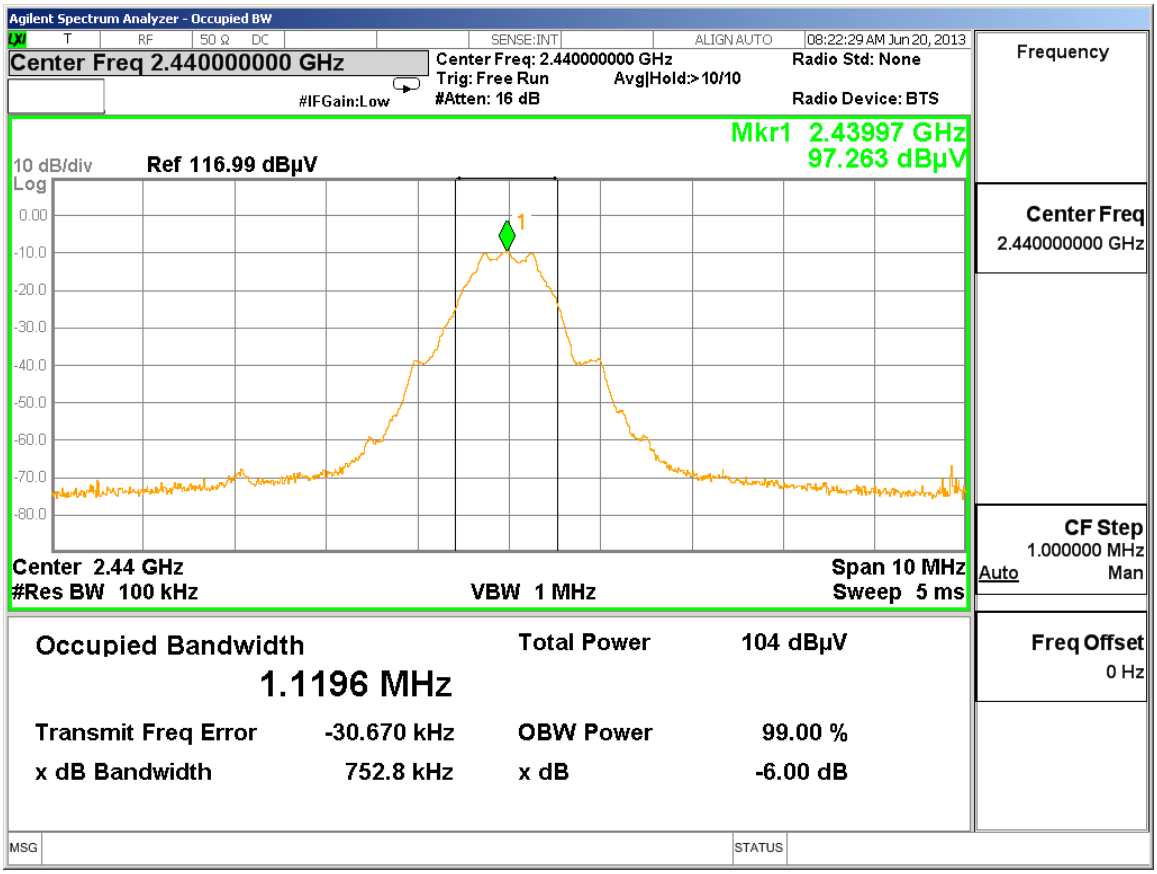
Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.2220
Middle	2440	1.1196
High	2480	1.0798

99% BANDWIDTH

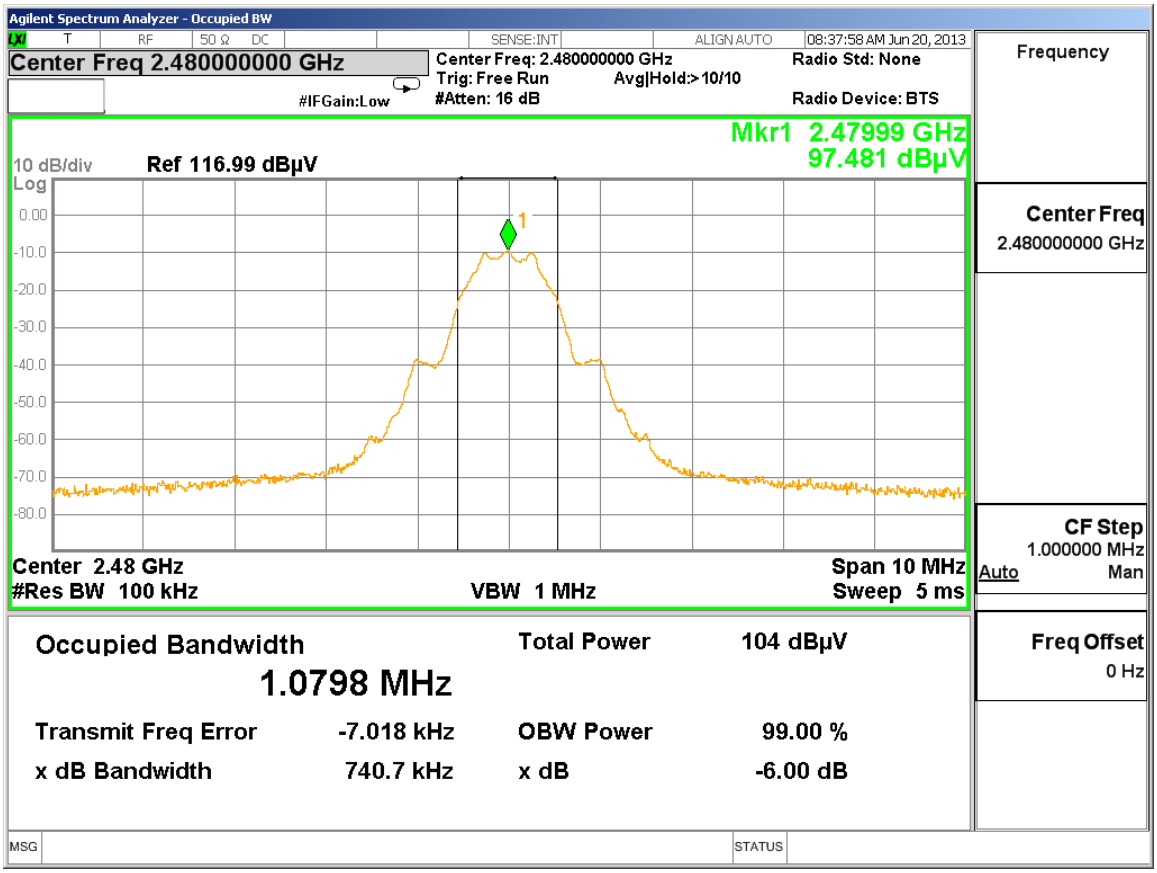
Low
Channel



Middle channel



High Channel



7.3. OUTPUT POWER

LIMITS

FCC §15.247 (b)

IC RSS-210 A8.4

The maximum antenna gain is less than or equal to 6 dBi, therefore the limit is 30 dBm.

TEST PROCEDURE

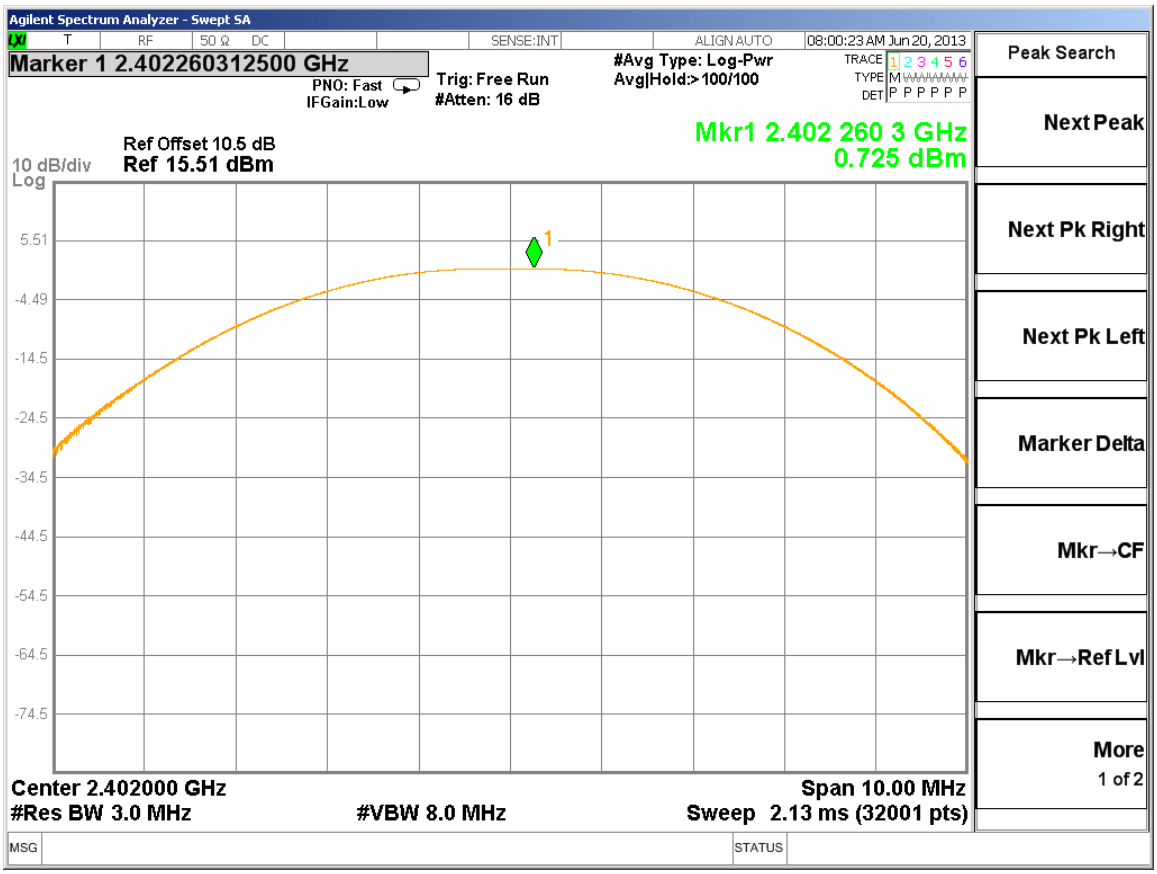
FCC KDB Publication "558074 D01 DTS Meas Gudance v03r01", using option 9.1.1 RBW greater or equal to DTS bandwidth.

RESULTS

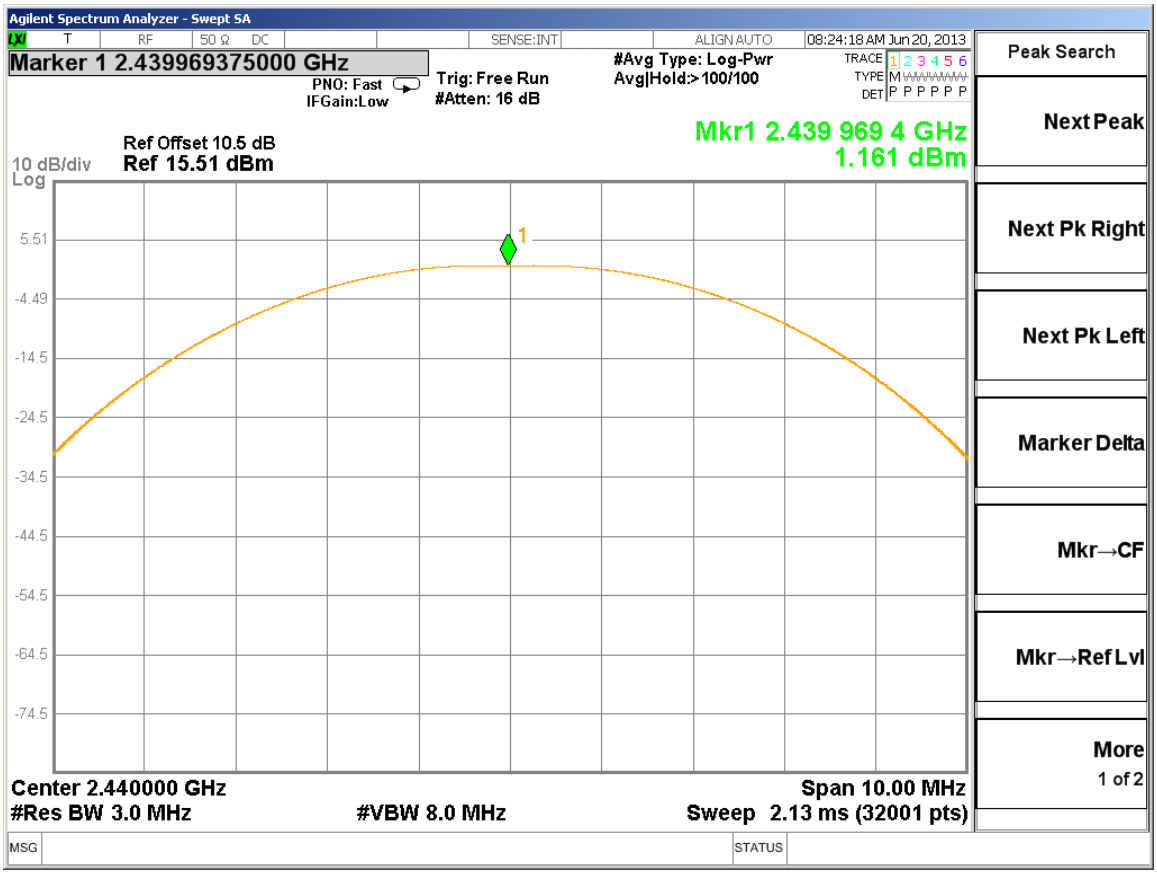
Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	0.725	30	-29.275
Middle	2440	1.161	30	-28.839
High	2480	1.266	30	-28.734

OUTPUT POWER

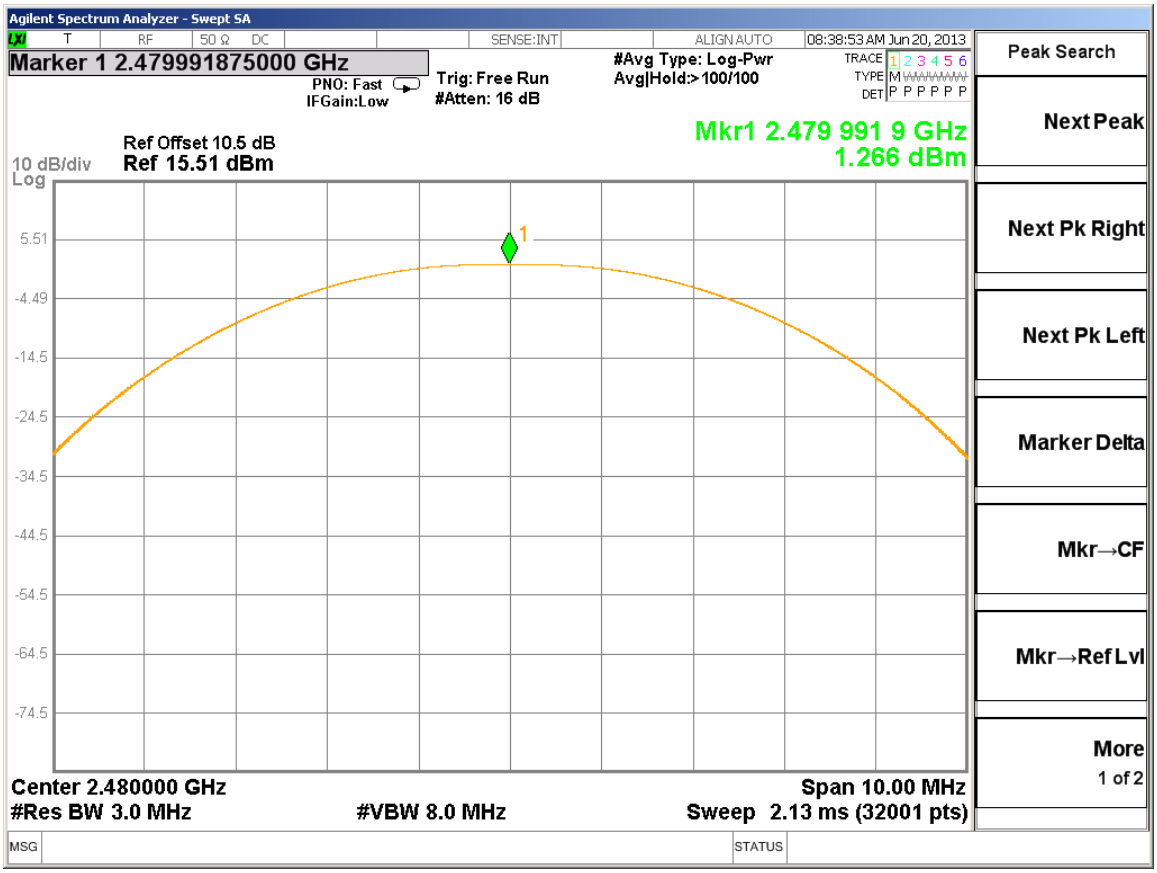
Low Channel



Middle Channel



High Channel



7.4. POWER SPECTRAL DENSITY

LIMITS

FCC §15.247 (e)

IC RSS-210 A8.2 (b)

The power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

TEST PROCEDURE

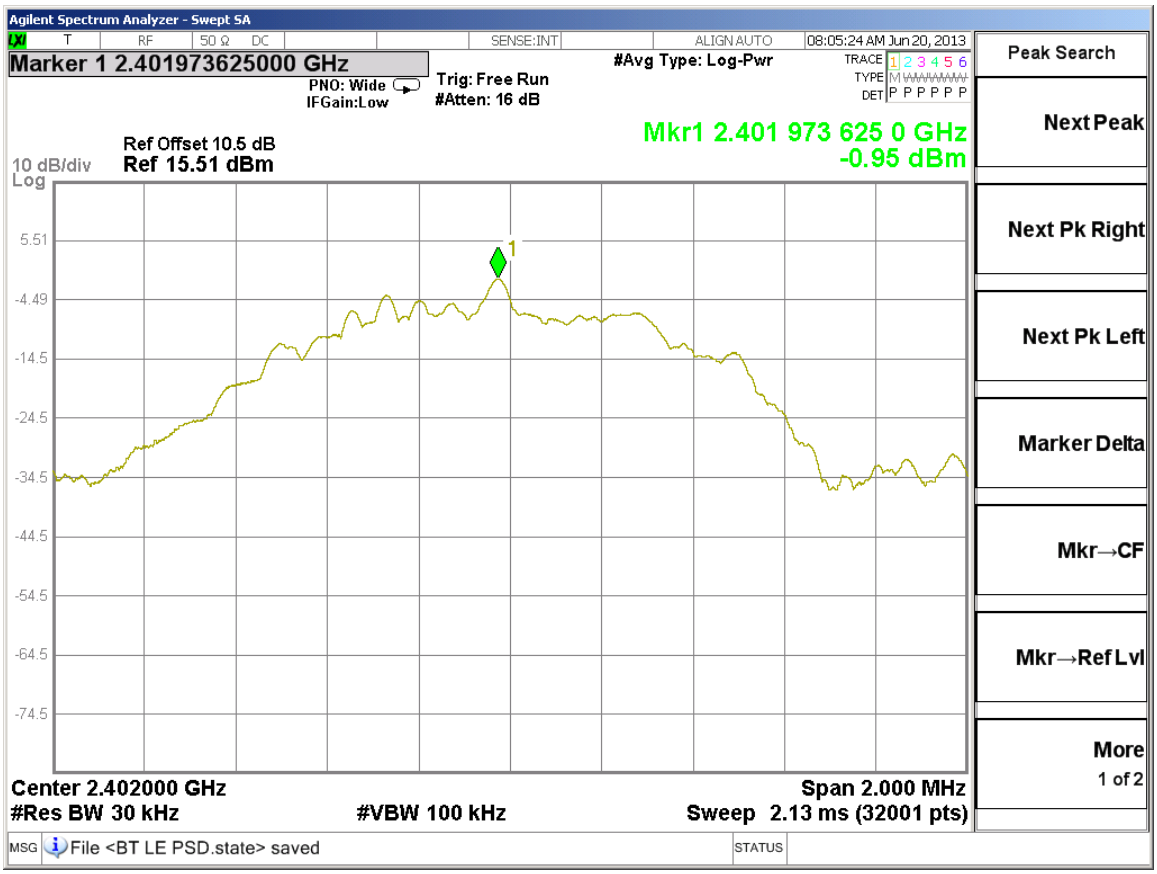
Measurements were conducted per FCC KDB publication "558074 D01 DTS Meas Gudence v03r01", using option 10.2 Method PKPSD (peak PSD)

RESULTS

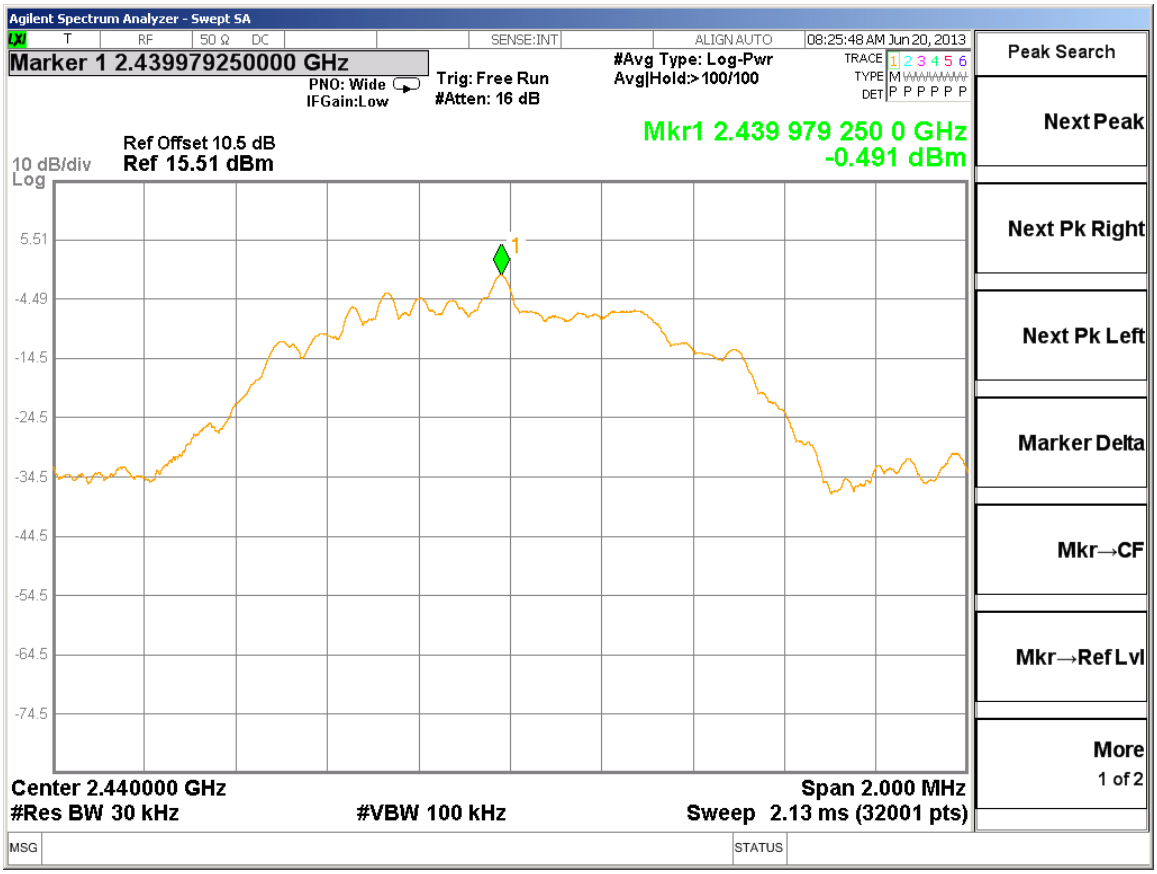
Channel	Frequency (MHz)	PSD (dBm)	Limit (dBm)	Margin (dB)
Low	2402	-0.95	8	-8.95
Middle	2440	-0.49	8	-8.49
High	2480	-0.20	8	-8.20

POWER SPECTRAL DENSITY

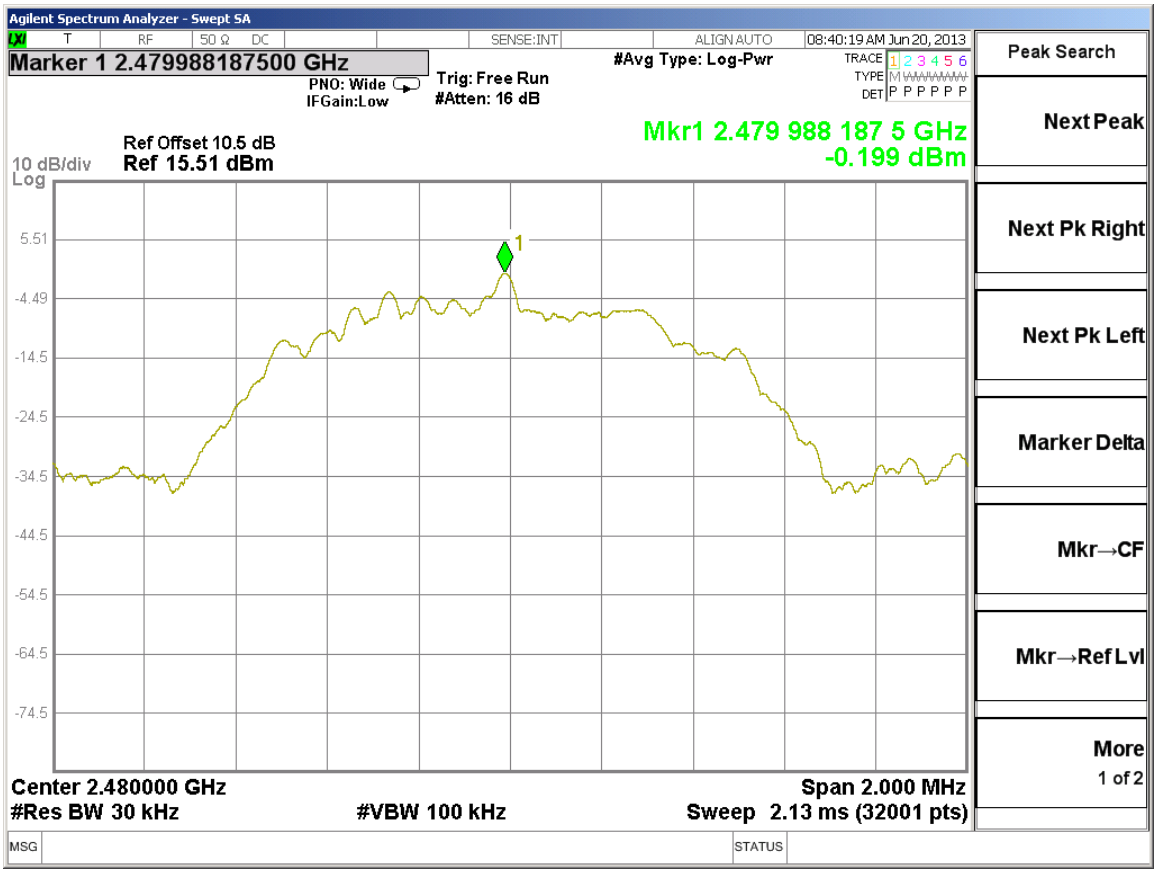
PSD Low Channel



PSD Middle Channel



PSD High Channel



7.5. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-210 A8.5

Output power was measured based on the use of a peak measurement, therefore the required attenuation is 20 dB.

TEST PROCEDURE

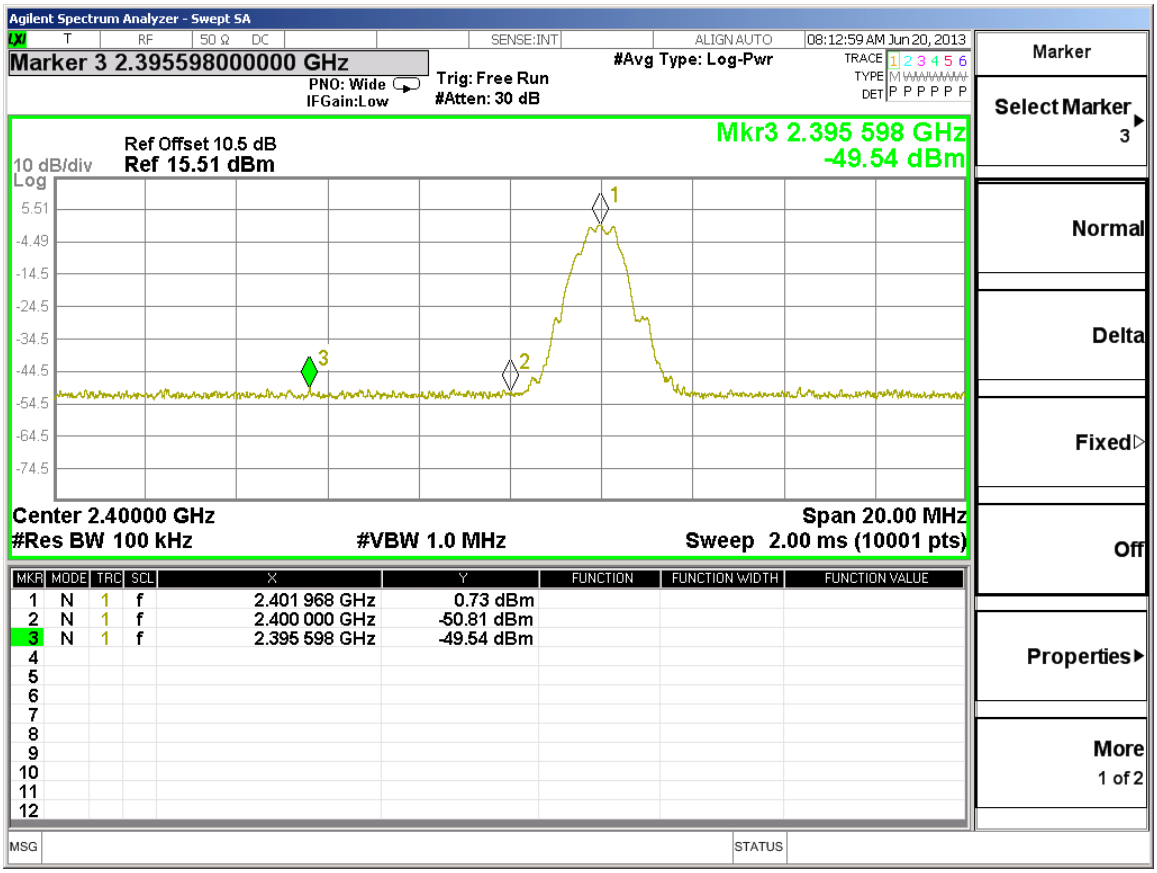
The transmitter output is connected to a spectrum analyzer. The resolution bandwidth is set to 100 kHz. The video bandwidth is set to 300 kHz or greater.

The spectrum from 30 MHz to 25 GHz is investigated with the transmitter set to the lowest, middle, and highest channels.

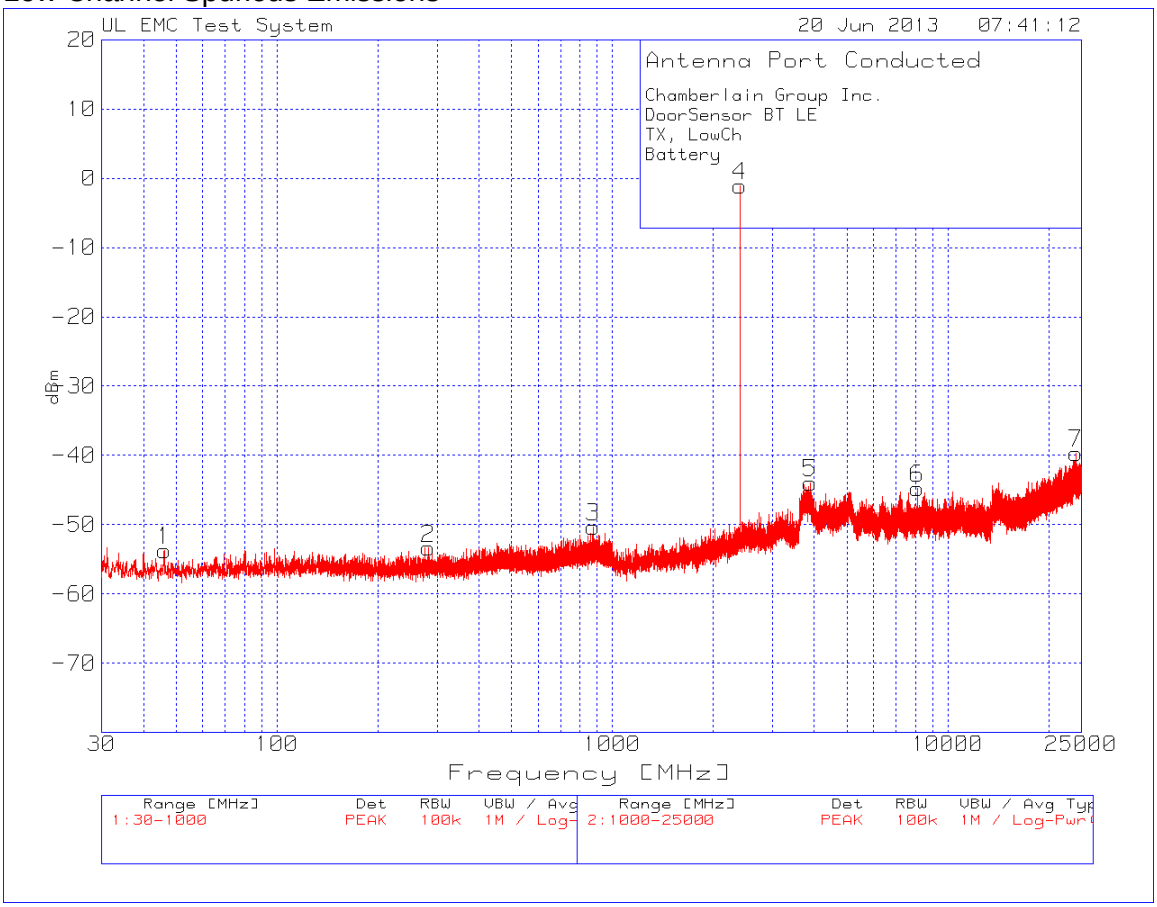
RESULTS

SPURIOUS EMISSIONS, LOW CHANNEL

Low Channel Band Edge



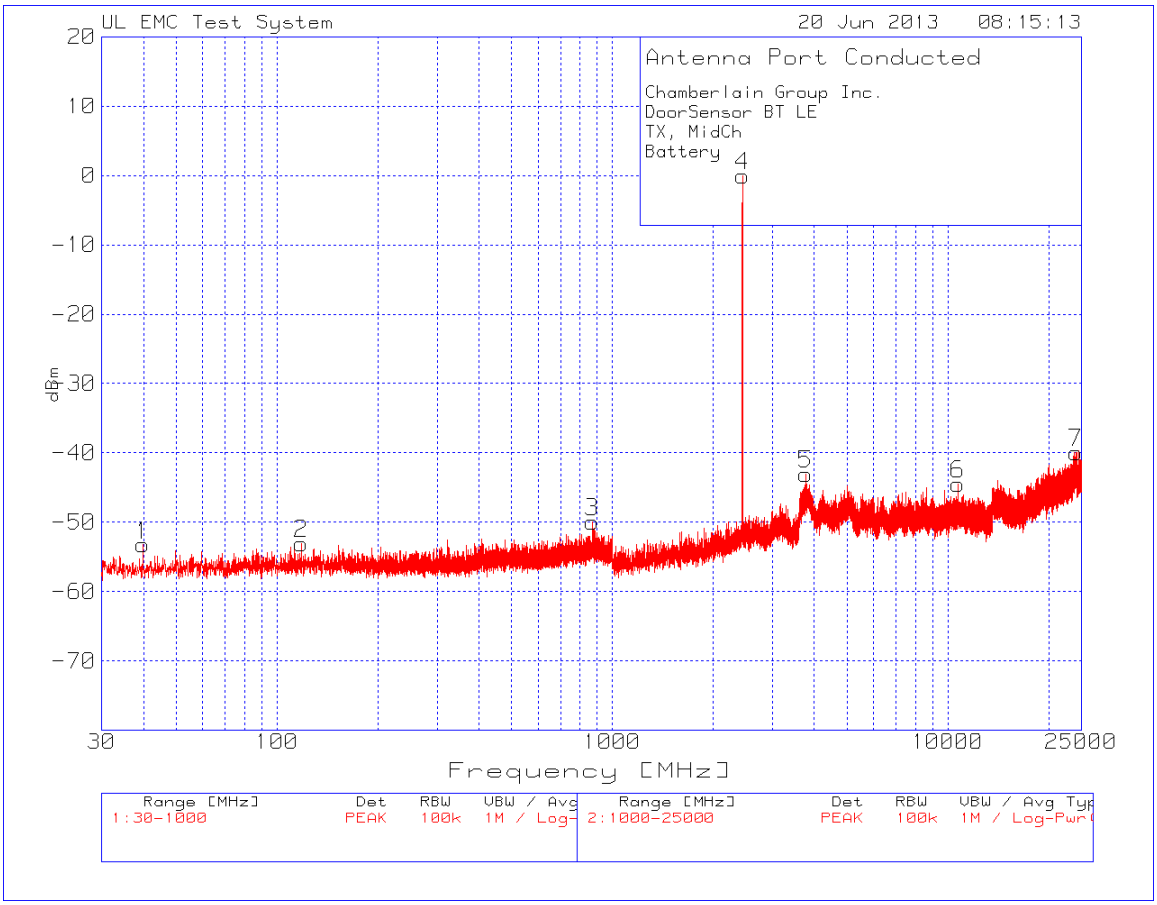
Low Channel Spurious Emissions



Marker No.	Test Frequency	Meter Reading dBuV	Detector	dBuV to dBm	CF dB	Corrected Reading dBm
1	46.102	43.26	PK	-107	10	-53.74
2	283.461	43.41	PK	-107	10.2	-53.39
3	875.646	46.32	PK	-107	10.3	-50.38
4	2401.75	95.41	PK	-107	10.5	-1.09
5	3892	52.34	PK	-107	10.7	-43.96
6	8107.75	51.28	PK	-107	11	-44.72
7	24085	54.81	PK	-107	12.5	-39.69
PK - Peak detector						

SPURIOUS EMISSIONS, MID CHANNEL

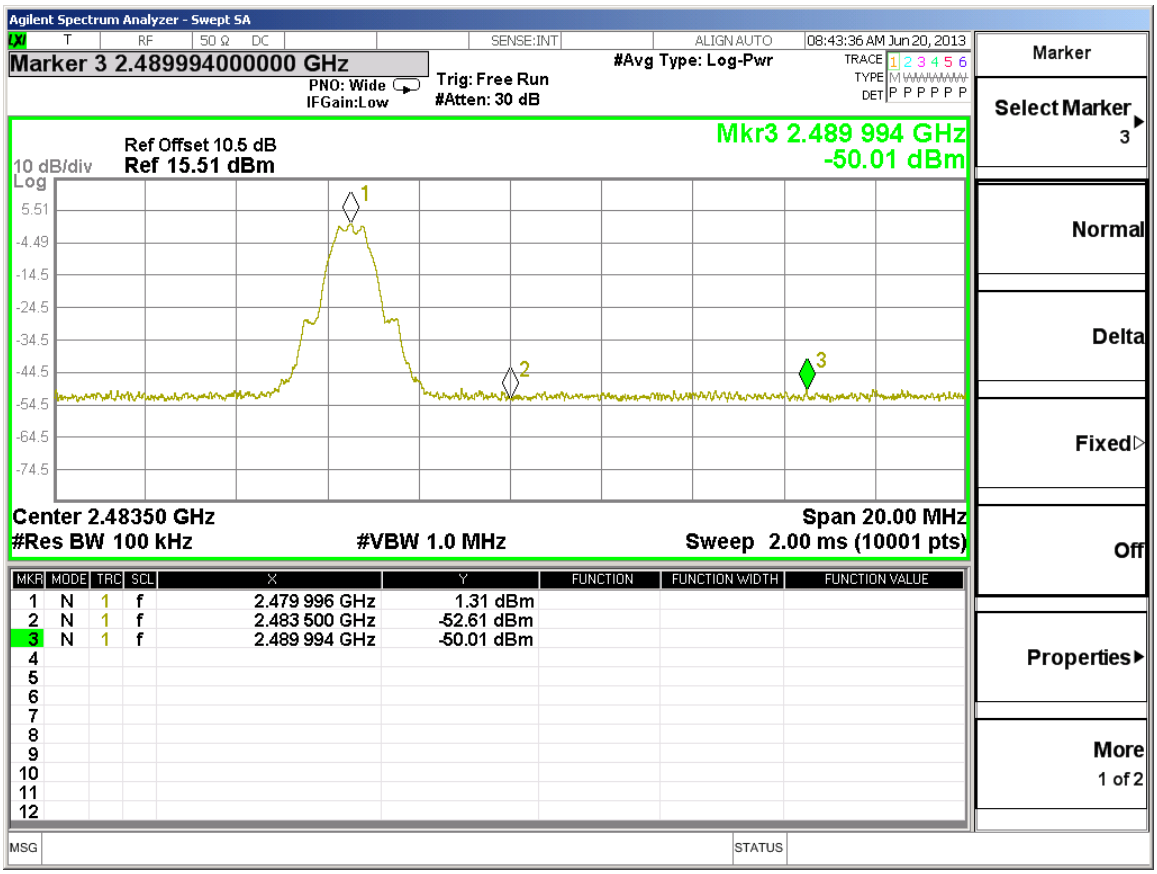
Middle Channel Spurious Emissions



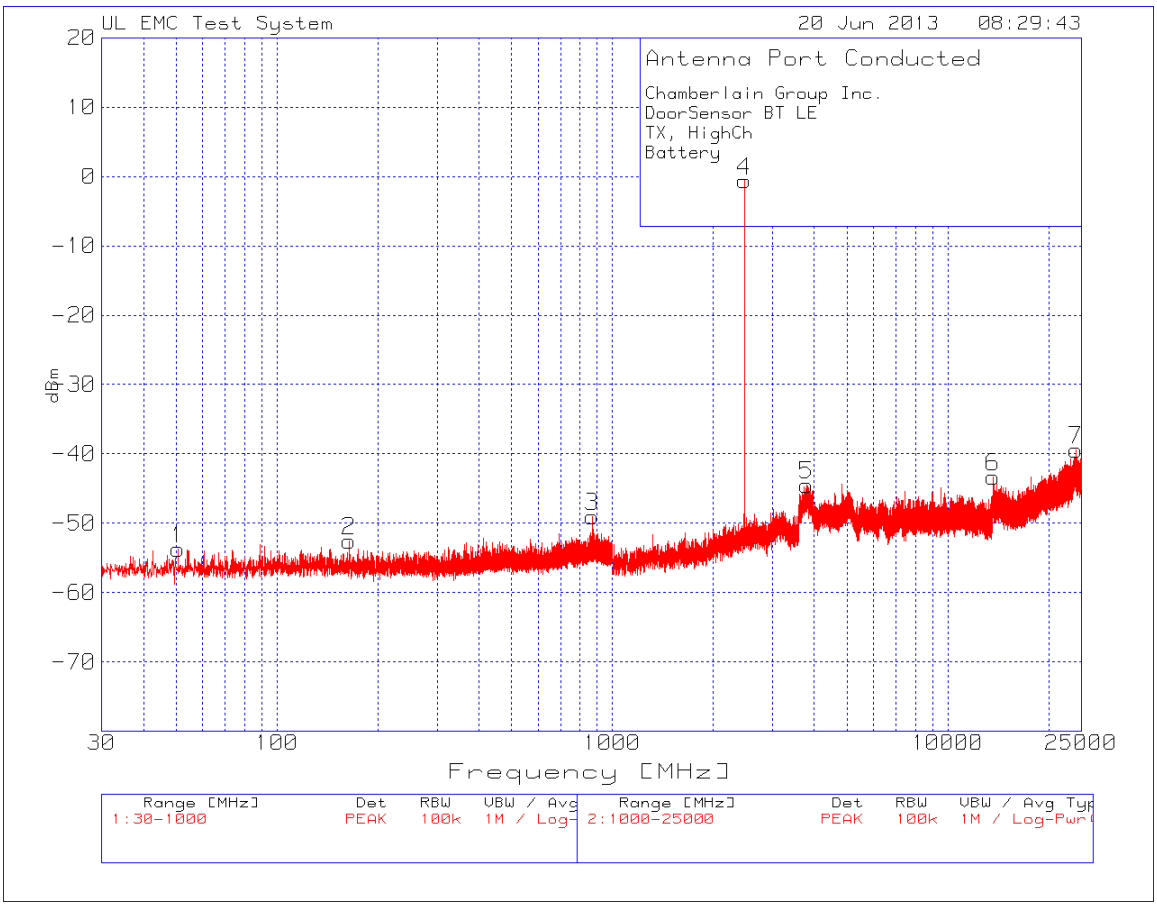
Marker No.	Test Frequency	Meter Reading dBuV	Detector	dBuV to dBm	CF dB	Corrected Reading dBm
1	39.797	43.64	PK	-107	10.1	-53.26
2	117.979	43.82	PK	-107	10.1	-53.08
3	872.251	46.72	PK	-107	10.3	-49.98
4	2440	96.42	PK	-107	10.5	-0.08
5	3778.75	53.3	PK	-107	10.6	-43.1
6	10733.5	51.2	PK	-107	11.3	-44.5
7	24063.25	54.25	PK	-107	12.8	-39.95
PK - Peak detector						

SPURIOUS EMISSIONS, HIGH CHANNEL

High Channel Band Edge



High Channel Spurious Emissions



Marker No.	Test Frequency	Meter Reading dBuV	Detector	dBuV to dBm	CF dB	Corrected Reading dBm
1	50.661	43.13	PK	-107	10.1	-53.77
2	164.151	44.35	PK	-107	10.1	-52.55
3	873.512	47.66	PK	-107	10.3	-49.04
4	2479.75	95.87	PK	-107	10.5	-0.63
5	3799	51.83	PK	-107	10.7	-44.47
6	13637.5	52.28	PK	-107	11.4	-43.32
7	24062.5	54.77	PK	-107	12.8	-39.43
PK - Peak detector						

8. RADIATED TEST RESULTS

8.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209

IC RSS-210 Clause 2.6 (Transmitter)

Frequency Range (MHz)	Field Strength Limit (uV/m) at 3 m	Field Strength Limit (dBuV/m) at 3 m
30 - 88	100	40
88 - 216	150	43.5
216 - 960	200	46
Above 960	500	54

TEST PROCEDURE

The EUT is placed on a non-conducting table 80 cm above the ground plane. The antenna to EUT distance is 3 meters. The EUT is configured in accordance with ANSI C63.4:2003. The EUT is set to transmit in a continuous mode.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

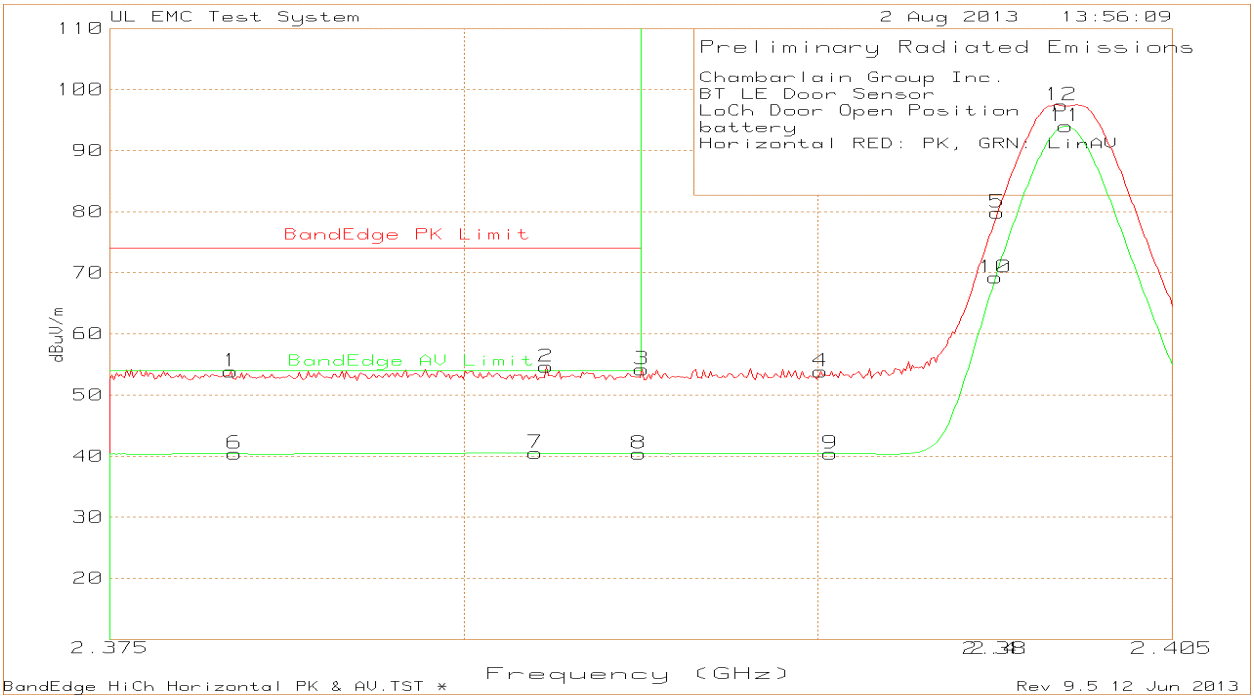
For measurements above 1 GHz (band-edge only) the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 1 MHz for peak measurements and 3 kHz (pulse on-time is 400uS) for average measurements. There were no harmonics measured above 1GHz and compliance is based on peak pre-scan data.

The spectrum from 30 MHz to 25 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

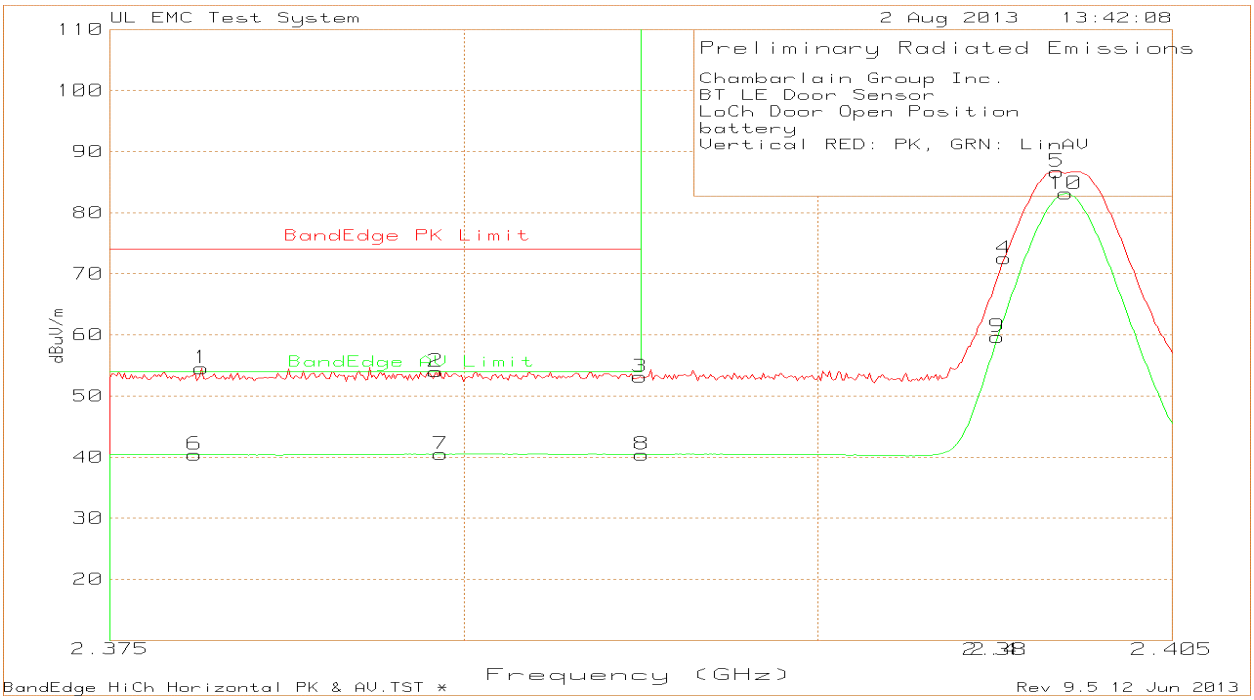
8.2. TX ABOVE 1 GHz FOR BLUETOOTH LOW ENERGY MODE IN THE 2.4 GHz BAND

RESTRICTED BANDEDGE (DOOR OPEN, LOW CHANNEL, HORIZONTAL)



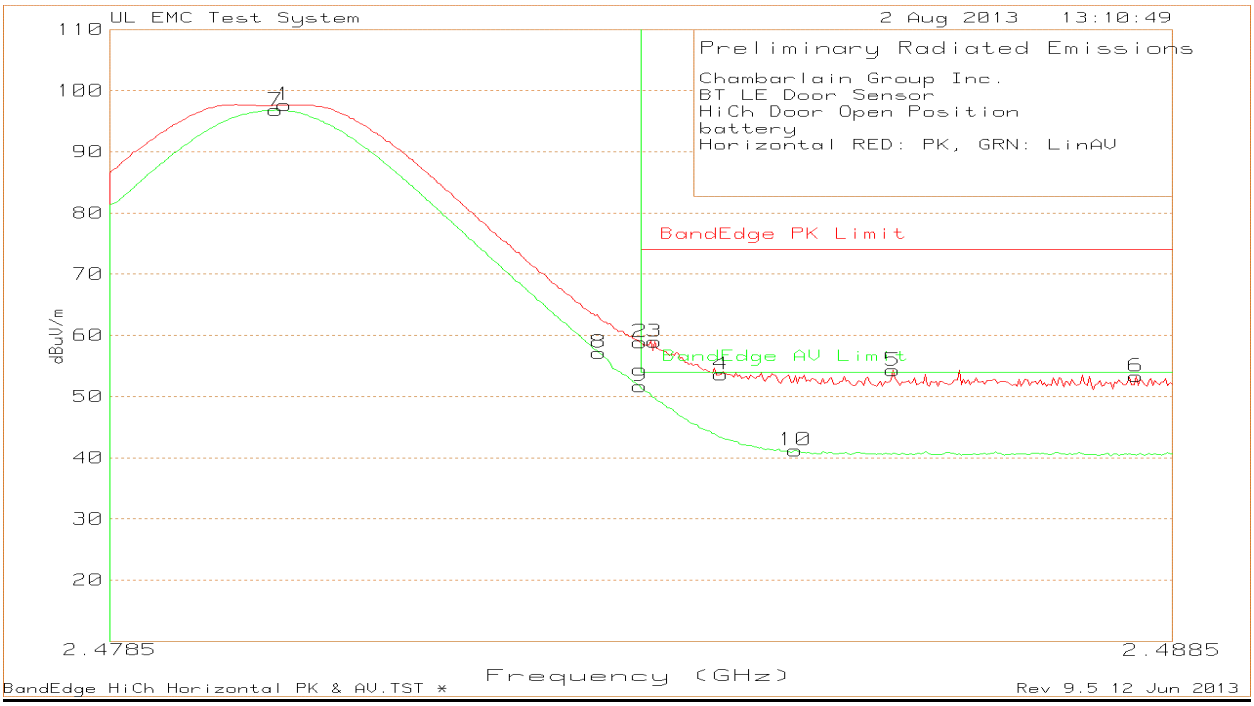
Peak 2.375 - 2.405MHz								
Marker No.	Test Frequency (GHz)	Meter Reading dBuV	Detector	AF dB/m	Path Factor dB	FS Level dBuV/m	BandEdge PK Limit	Margin (dB)
1	2.3784	27.85	PK	21.8	4.24	53.89	74	-20.11
2	2.3873	28.4	PK	21.8	4.43	54.63	74	-19.37
3	2.39	27.91	PK	21.8	4.48	54.19	74	-19.81
4	2.3951	27.66	PK	21.8	4.43	53.89	n/a	n/a
5	2.4001	53.78	PK	21.8	4.31	79.89	n/a	n/a
12	2.4019	71.37	PK	21.8	4.26	97.43	n/a	n/a
Averge 2.375 - 2.405MHz								
Marker No.	Test Frequency (GHz)	Meter Reading dBuV	Detector	AF dB/m	Path Factor dB	FS Level dBuV/m	BandEdge AV Limit	Margin (dB)
6	2.3785	14.37	LinAv	21.8	4.24	40.41	54	-13.59
7	2.387	14.27	LinAv	21.8	4.43	40.5	54	-13.5
8	2.3899	14.15	LinAv	21.8	4.48	40.43	54	-13.57
9	2.3954	14.16	LinAv	21.8	4.43	40.39	n/a	n/a
10	2.4	43.11	LinAv	21.8	4.31	69.22	n/a	n/a
11	2.402	67.93	LinAv	21.8	4.26	93.99	n/a	n/a

RESTRICTED BANDEDGE (DOOR OPEN, LOW CHANNEL, VERTICAL)



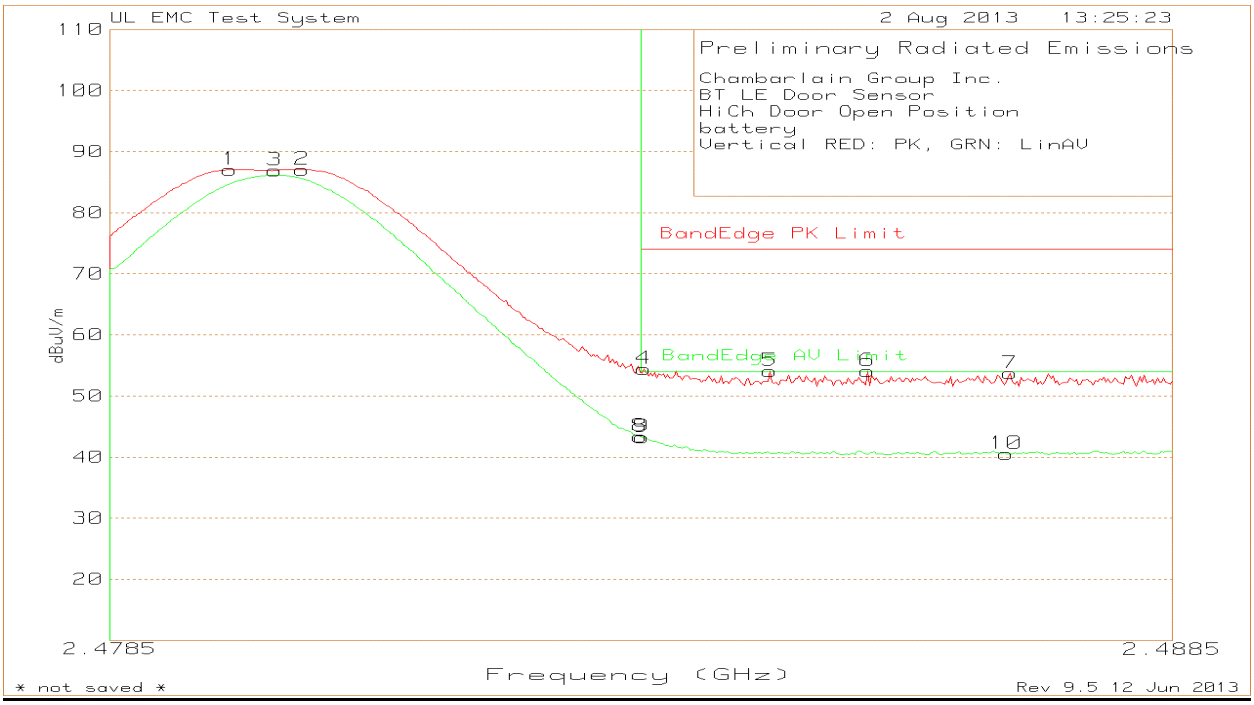
Peak 2.375 - 2.405MHz								
Marker No.	Test Frequency (GHz)	Meter Reading dBuV	Detector	AF dB/m	Path Factor dB	FS Level dBuV/m	BandEdge PK Limit	Margin (dB)
1	2.3776	28.57	PK	21.8	4.21	54.58	74	-19.42
2	2.3842	27.85	PK	21.8	4.38	54.03	74	-19.97
3	2.39	26.86	PK	21.8	4.48	53.14	74	-20.86
4	2.4003	46.42	PK	21.8	4.3	72.52	n/a	n/a
5	2.4018	60.63	PK	21.8	4.27	86.7	n/a	n/a
Avearge 2.375 - 2.405MHz								
Marker No.	Test Frequency (GHz)	Meter Reading dBuV	Detector	AF dB/m	Path Factor dB	FS Level dBuV/m	BandEdge AV Limit	Margin (dB)
6	2.3774	14.41	PK	21.8	4.21	40.42	54	-13.58
7	2.3843	14.3	PK	21.8	4.38	40.48	54	-13.52
8	2.39	14.17	PK	21.8	4.48	40.45	54	-13.55
9	2.4001	33.57	PK	21.8	4.31	59.68	n/a	n/a
10	2.402	57.06	PK	21.8	4.26	83.12	n/a	n/a

RESTRICTED BANDEDGE (DOOR OPEN (worst case), HIGH CHANNEL, HORIZONTAL)



Peak 2.4785 - 2.4885MHz								
Marker No.	Test Frequency (GHz)	Meter Reading dBuV	Detector	AF dB/m	Path Factor dB	FS Level dBuV/m	BandEdge PK Limit dB	Margin (dB)
1	2.4801	71.88	PK	22	3.77	97.65	n/a	n/a
2	2.4835	32.99	PK	22.1	3.77	58.86	74	-15.14
3	2.4836	33.09	PK	22.1	3.77	58.96	74	-15.04
4	2.4843	27.73	PK	22.1	3.77	53.6	74	-20.4
5	2.4859	28.4	PK	22.1	3.77	54.27	74	-19.73
6	2.4882	27.47	PK	22.1	3.78	53.35	74	-20.65
Avearge 2.4785 - 2.4885MHz								
Marker No.	Test Frequency (GHz)	Meter Reading dBuV	Detector	AF dB/m	Path Factor dB	FS Level dBuV/m	BandEdge AV Limit dB	Margin (dB)
7	2.4801	71.03	LinAV	22	3.77	96.8	n/a	n/a
8	2.4831	31.38	LinAV	22	3.77	57.15	n/a	n/a
9	2.4835	25.82	LinAV	22.1	3.77	51.69	54	-2.31
10	2.485	15.34	LinAV	22.1	3.77	41.21	54	-12.79

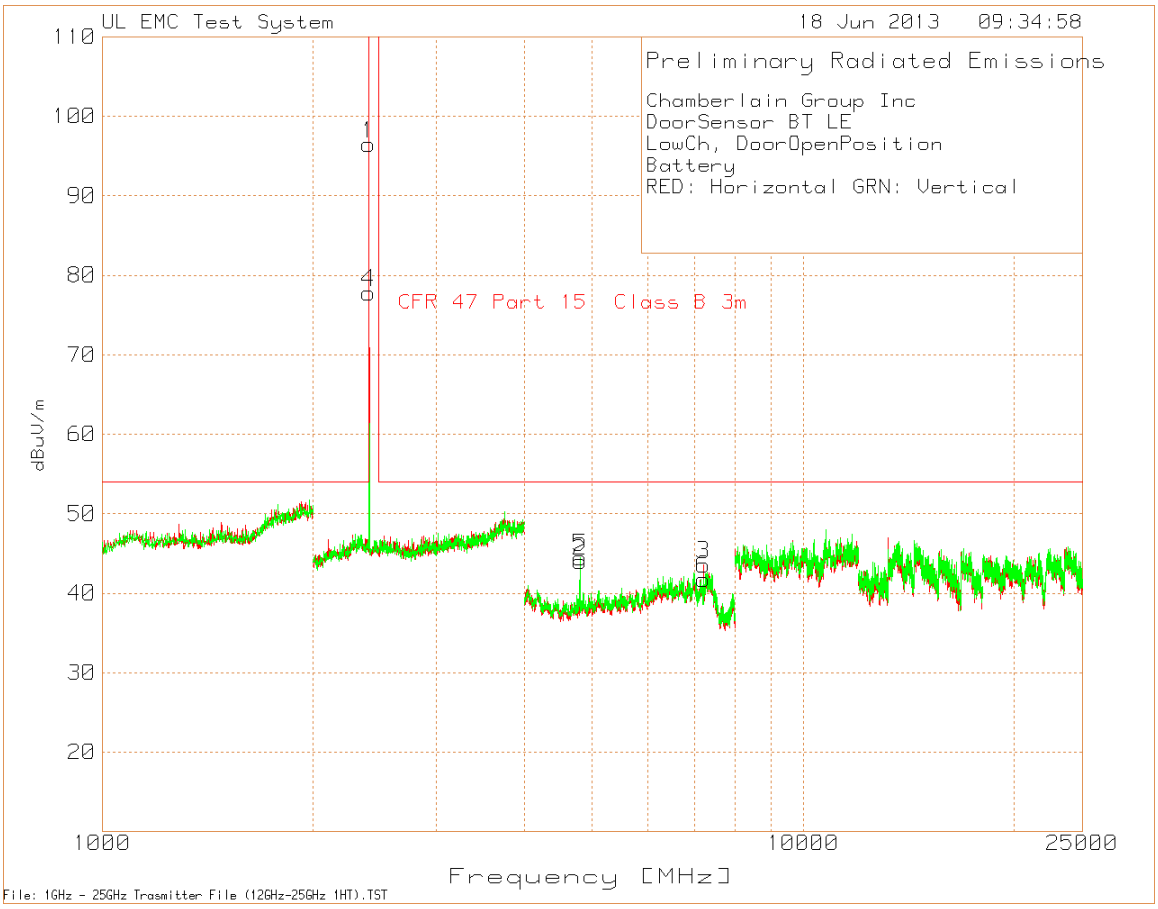
RESTRICTED BANDEDGE (DOOR OPEN (worst case), HIGH CHANNEL, VERTICAL)



Peak 2.4785 - 2.4885MHz								
Marker No.	Test Frequency (GHz)	Meter Reading dBuV	Detector	AF dB/m	Path Factor dB	FS Level dBuV/m	BandEdge PK Limit	Margin (dB)
1	2.4796	61.32	PK	22	3.77	87.09	n/a	n/a
2	2.4803	61.32	PK	22	3.77	87.09	n/a	n/a
3	2.4801	61.2	PK	22	3.77	86.97	n/a	n/a
4	2.4835	28.57	PK	22.1	3.77	54.44	74	-19.56
5	2.4847	28.26	PK	22.1	3.77	54.13	74	-19.87
6	2.4856	28.24	PK	22.1	3.77	54.11	74	-19.89
7	2.487	27.84	PK	22.1	3.77	53.71	74	-20.29
Averge 2.4785 - 2.4885MHz								
Marker No.	Test Frequency (GHz)	Meter Reading dBuV	Detector	AF dB/m	Path Factor dB	FS Level dBuV/m	BandEdge AV Limit	Margin (dB)
8	2.4835	17.53	LinAv	22.1	3.77	43.4	54	-10.6
9	2.4835	17.39	LinAv	22.1	3.77	43.26	54	-10.74
10	2.4869	14.69	LinAv	22.1	3.77	40.56	54	-13.44

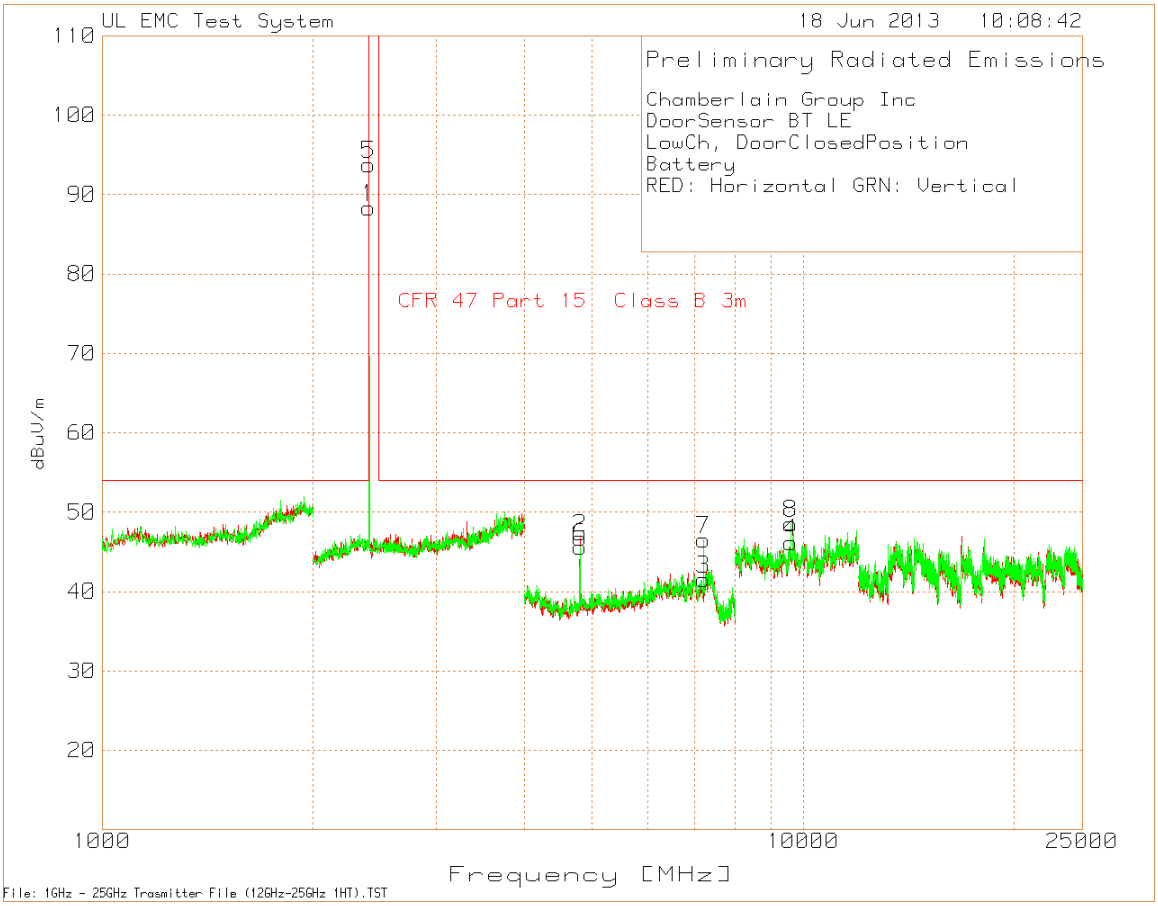
HARMONICS AND SPURIOUS EMISSIONS

Door Opened, Low Channel



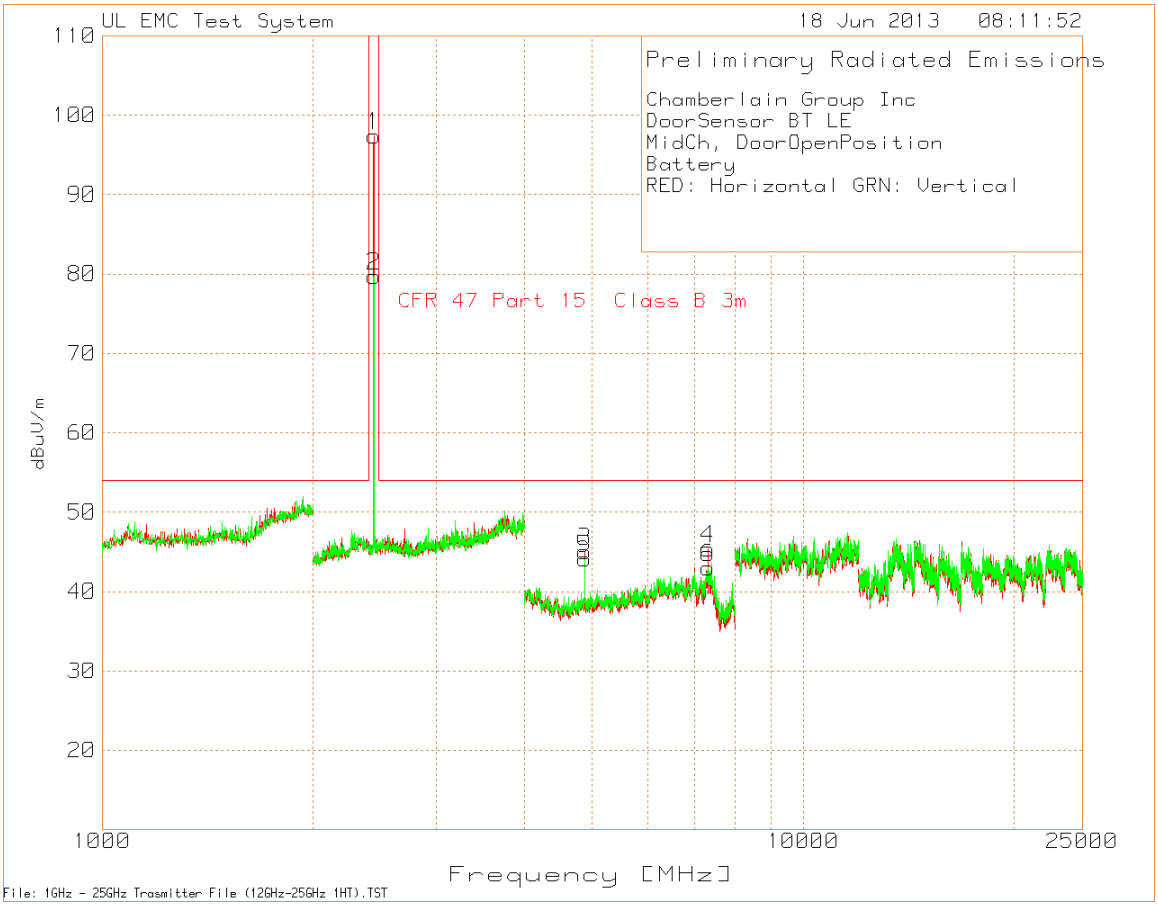
Based on peak pre-scan data all emissions are attenuated at least 6dB under the limit. Further measurements were considered not required.

Door Closed, Low Channel



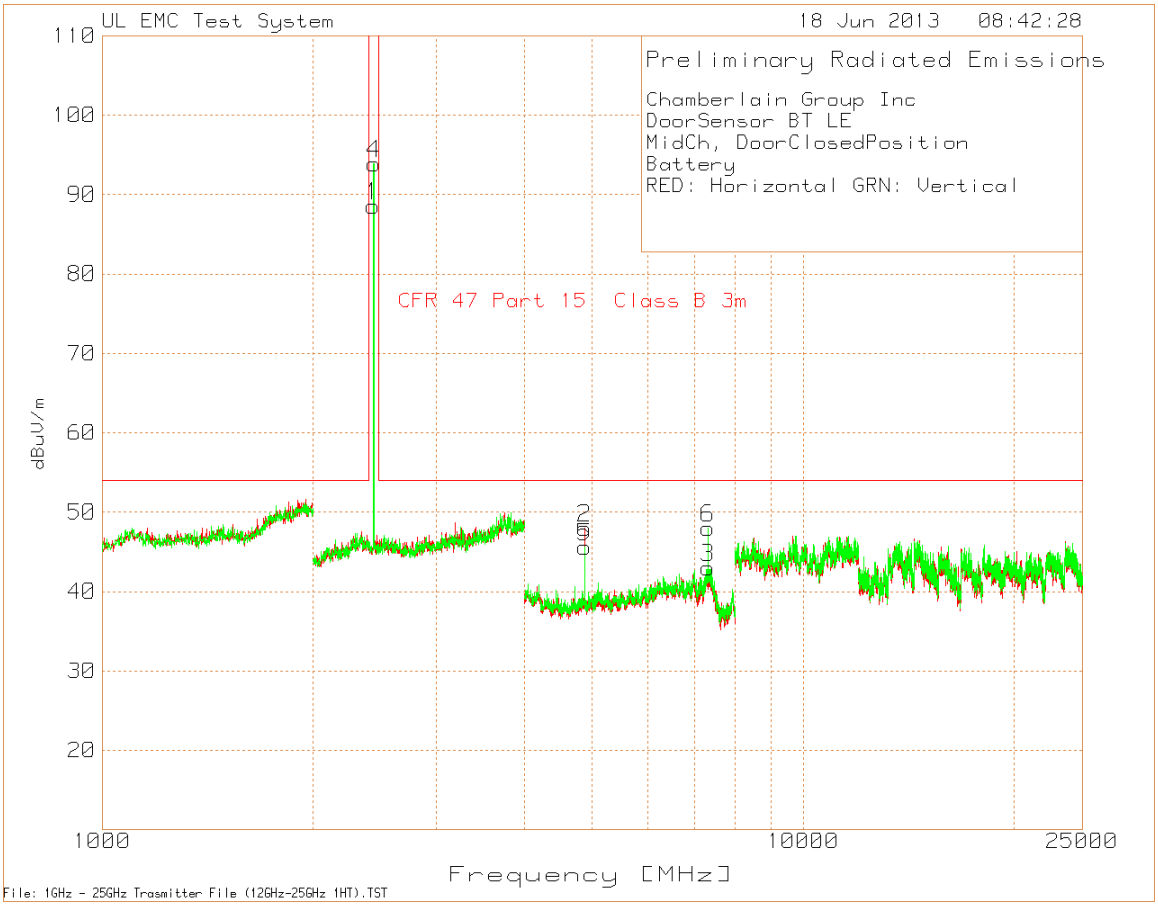
Based on peak pre-scan data all emissions are attenuated at least 6dB under the limit. Further measurements were considered not required.

Door Opened, Middle Channel



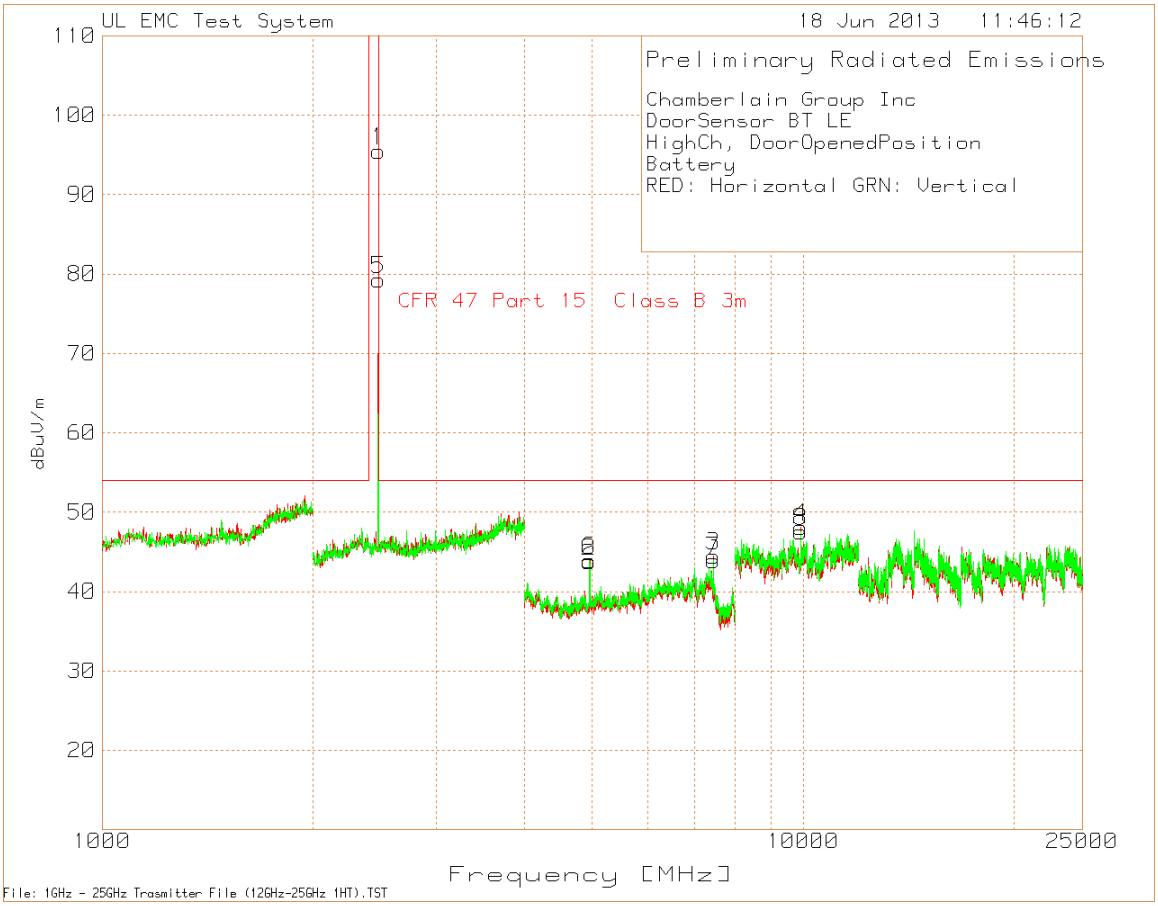
Based on peak pre-scan data all emissions are attenuated at least 6dB under the limit. Further measurements were considered not required.

Door Closed, Middle Channel



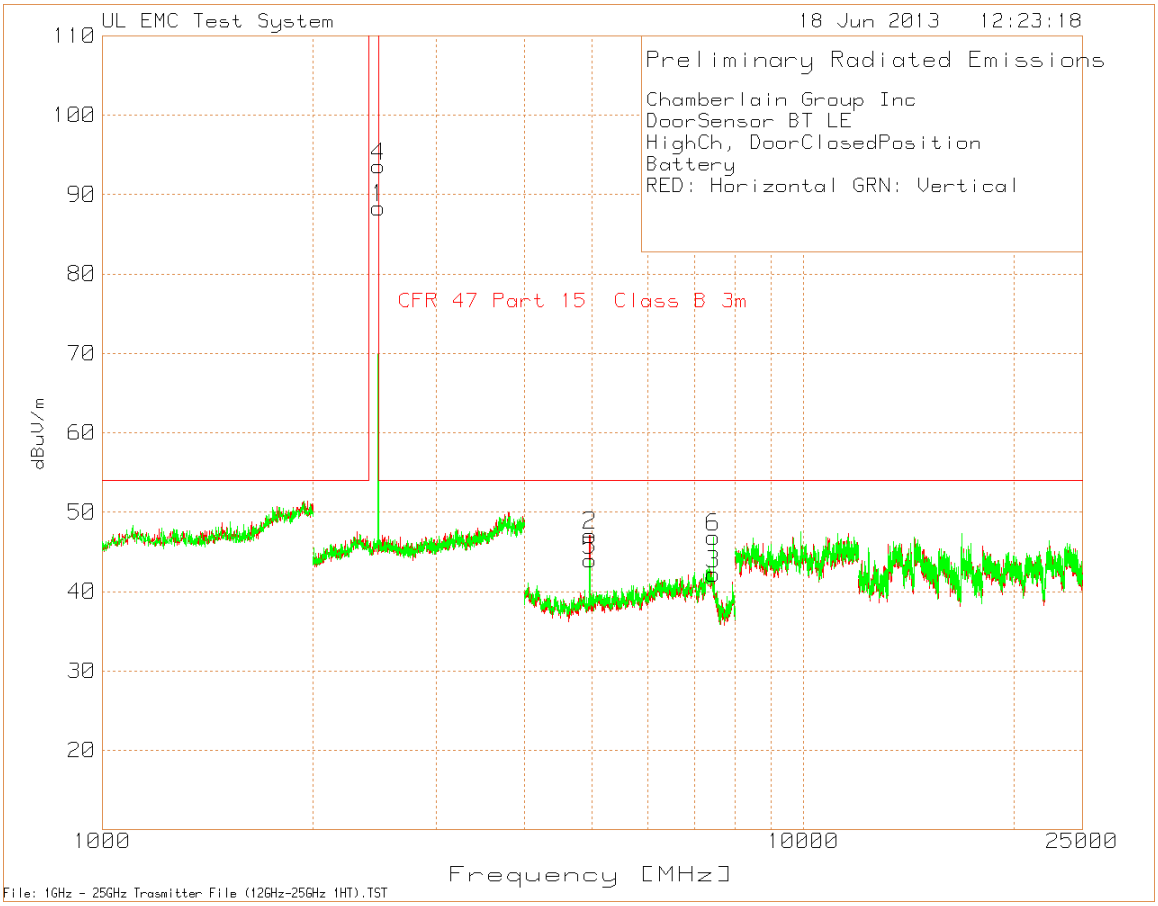
Based on peak pre-scan data all emissions are attenuated at least 6dB under the limit. Further measurements were considered not required.

Door Opened, High Channel



Based on peak pre-scan data all emissions are attenuated at least 6dB under the limit. Further measurements were considered not required.

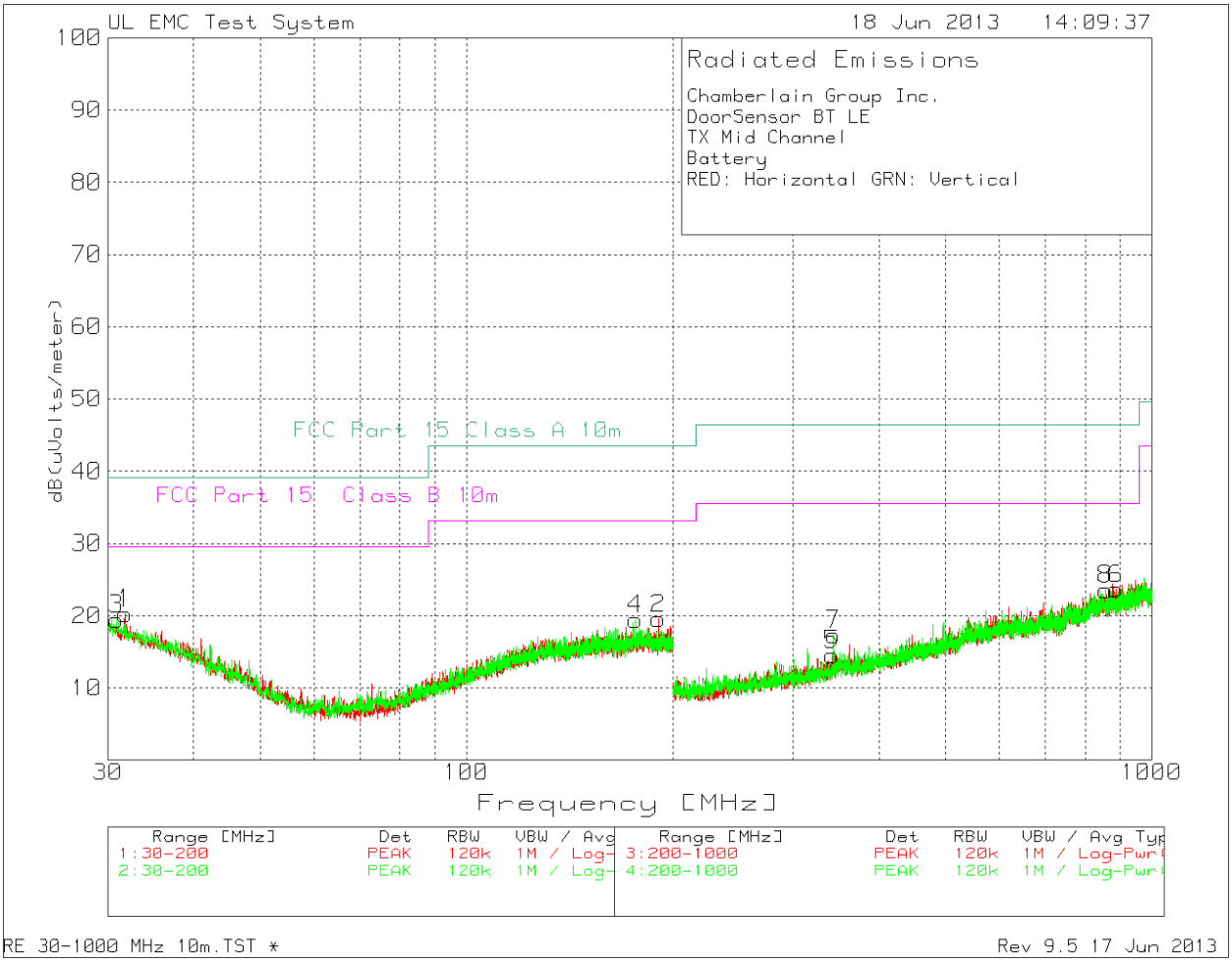
Door Closed, High Channel



Based on peak pre-scan data all emissions are attenuated at least 6dB under the limit. Further measurements were considered not required.

8.3. WORST-CASE BELOW 1 GHz

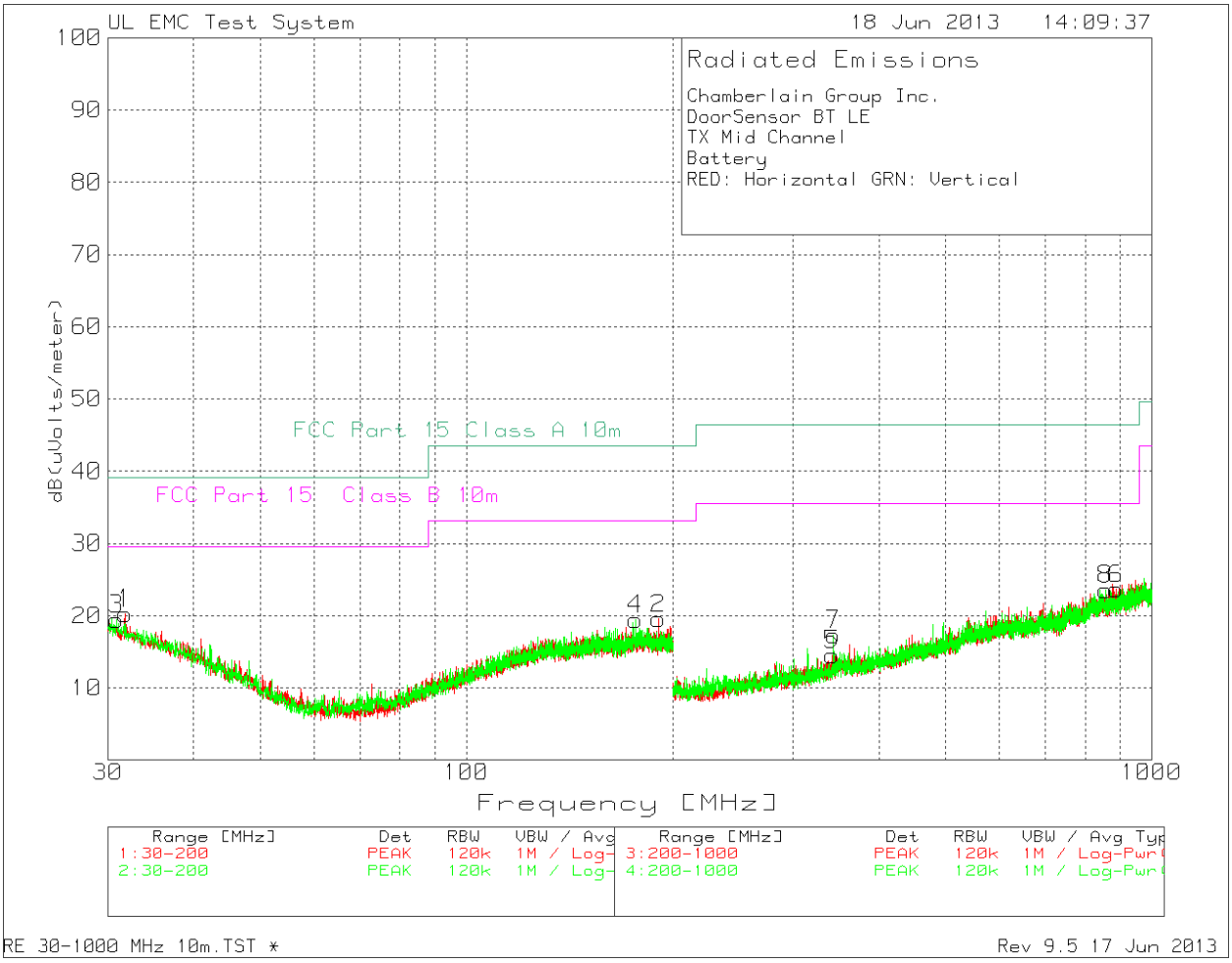
TX SPURIOUS EMISSIONS 30 TO 1000 MHz



No emissions recorded.

8.4. DIGITAL DEVICE BELOW 1 GHz and ABOVE 1GHz

SPURIOUS EMISSIONS 30 TO 1000 MHz



No emissions recorded below and above 1GHz.

9. AC POWER LINE CONDUCTED EMISSIONS

LIMITS

FCC §15.207 (a)

RSS-Gen 7.2.2

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

TEST PROCEDURE

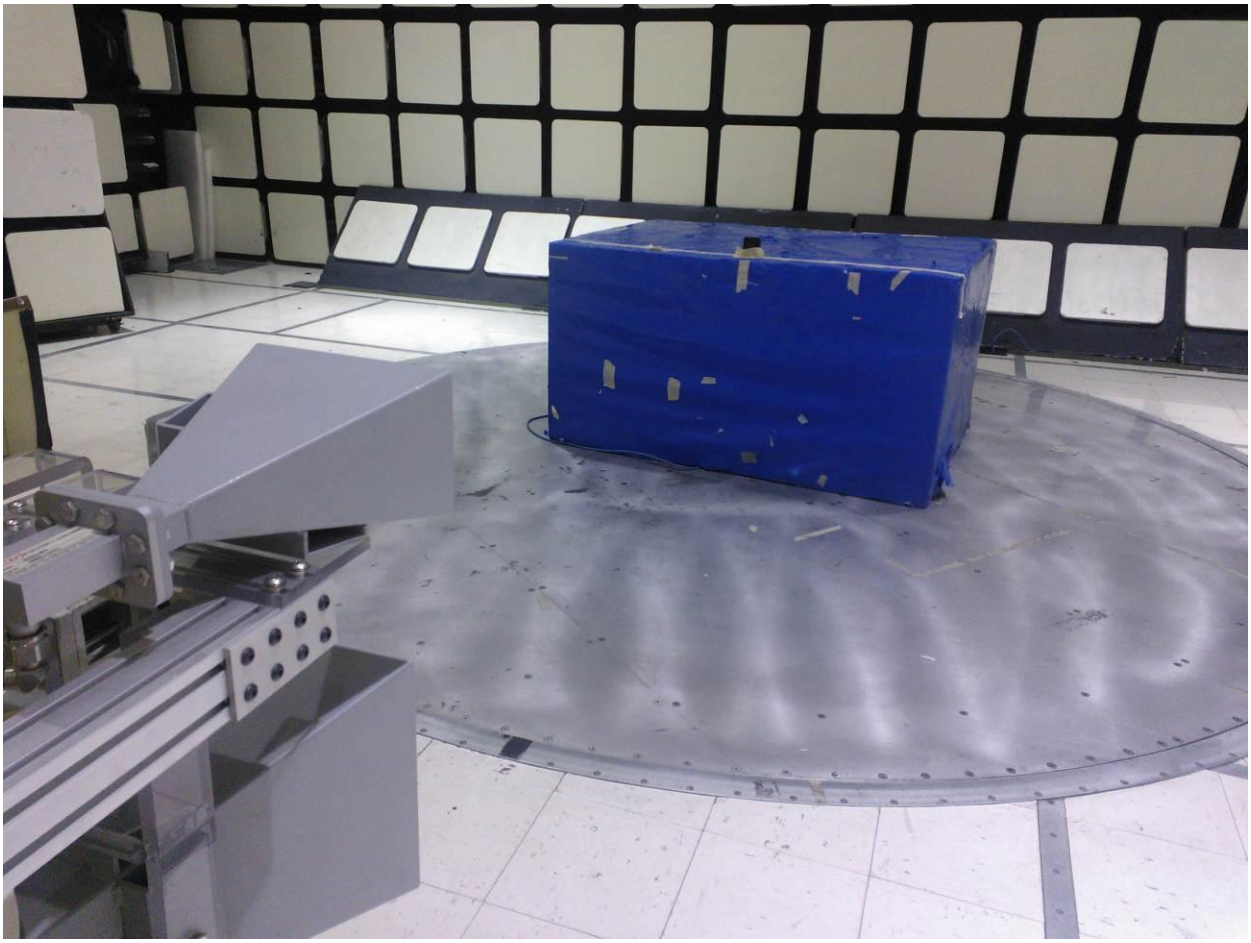
ANSI C63.4

RESULTS

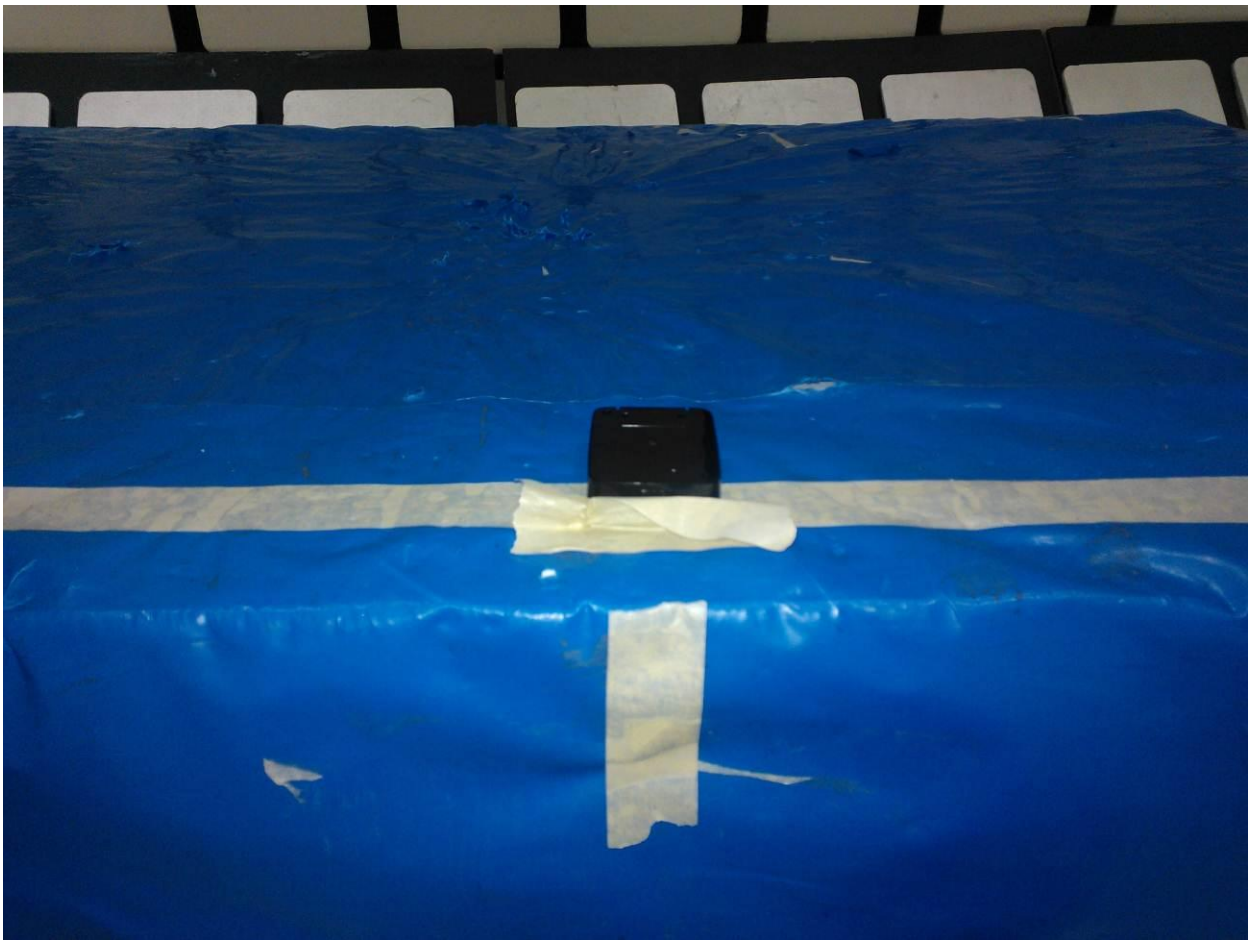
The device does not have provisions to connect to AC mains therefore this test is not required.

10. SETUP PHOTOS

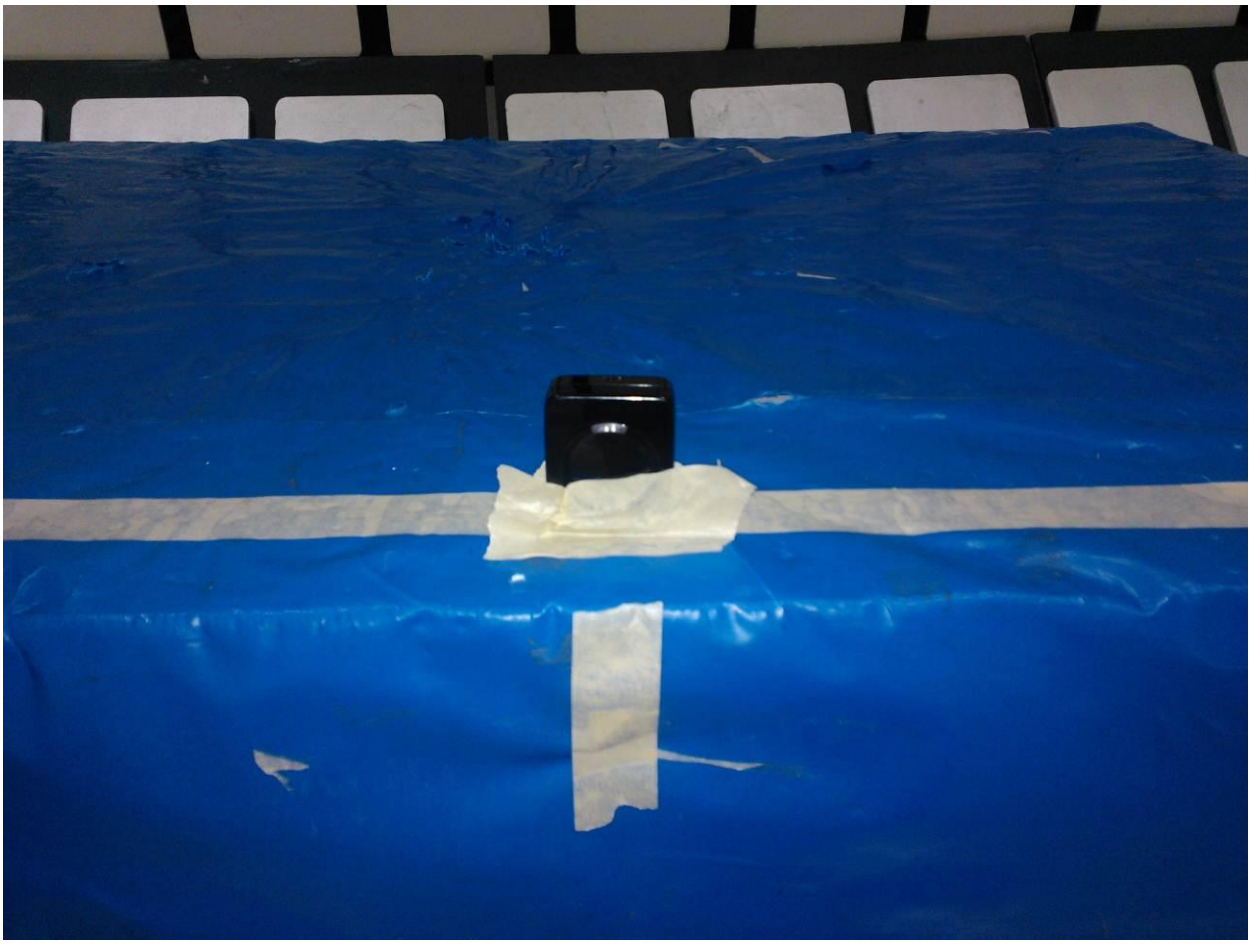
Radiated Spurious Emissions above 1GHz



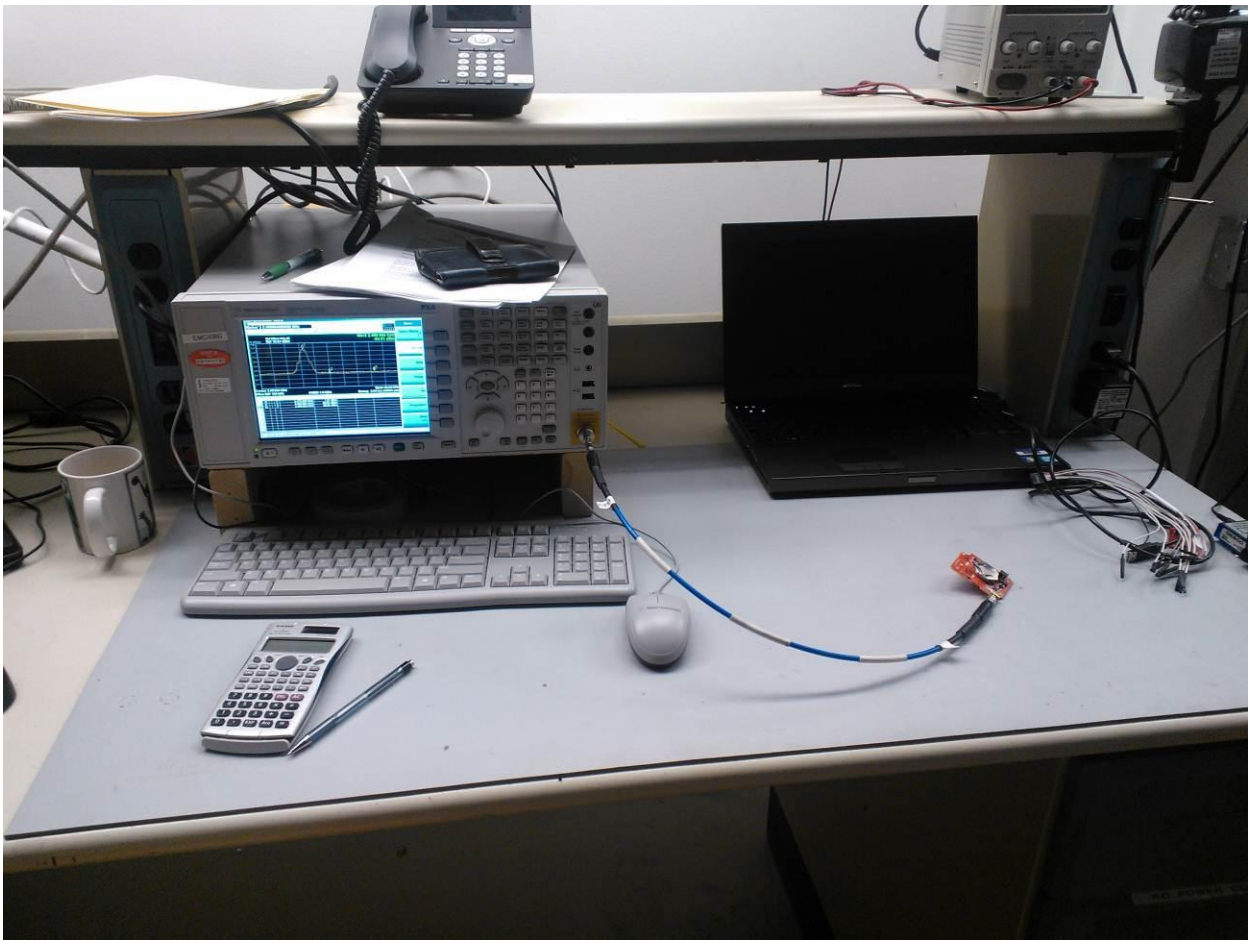
Radiated Emissions Door Open Position



Radiated Emissions Door Closed Position



Antenna Port Measurements



END OF REPORT

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