



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

**BLUETOOTH LOW ENERGY
CERTIFICATION TEST REPORT**

FOR

GIMBAL PROXIMITY BEACON

MODEL NUMBER: 10-B7182

**FCC ID: R6CIGB1
IC: 10756A-IGB1**

REPORT NUMBER: 13U15158-6, Revision B

ISSUE DATE: AUGUST 29, 2013

Prepared for
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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	08/23/13	Initial Issue	T. LEE
A	08/27/13	Changed FCC and IC IDs	AAumentado
B	8/28/13	Update KDB 558074 D01 reference from V02 to v03r01	F. de Anda
C	8/29/13	Update – added duty cycle data	F. de Anda

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: Qualcomm Retail Solutions, Inc.
5775 Morehouse Drive
San Diego, CA 92121

EUT DESCRIPTION: Gimbal Proximity Beacon

MODEL: 10-B7182

SERIAL NUMBER: 1, 2, 3, 4, 5 and 6

DATE TESTED: JULY 23 -25, 2013 and AUGUST 14, 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.

Approved & Released For
UL Verification Services Inc. By:

Tested By:



TIMOTHY LEE
EMC SUPERVISOR
UL Verification Services Inc.



THANH NGUYEN
EMC ENGINEER
UL Verification Services Inc.

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.10-2009, 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 47173 Benicia Street, Fremont, California, USA.

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <http://www.ccsenc.com>.

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:

$$\begin{aligned} \text{Field Strength (dBuV/m)} &= \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \\ &\text{Cable Loss (dB)} - \text{Preamplifier Gain (dB)} \\ 36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} &= 28.9 \text{ dBuV/m} \end{aligned}$$

4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Conducted Disturbance, 0.15 to 30 MHz	3.52 dB
Radiated Disturbance, 30 to 1000 MHz	4.94 dB

Uncertainty figures are valid to a confidence level of 95%.

5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is an Bluetooth 4.0 Low Energy Device transceiver.

The radio module is manufactured by Qualcomm Retail Solutions, Inc.

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	BLE	0.66	1.16

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a Dipole or Patch antenna, with maximum gains of 1.3 and 2.5 dBi respectively.

5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was FYX-Beacon v1.0.1.

5.5. WORST-CASE CONFIGURATION AND MODE

The fundamental of the EUT was investigated in three orthogonal orientations X,Y,Z, it was determined that the Y orientation was worst-case orientation; therefore, all final radiated testing was performed with the EUT in the Y orientation.

5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

The EUT is a standalone device no support equipment was used.

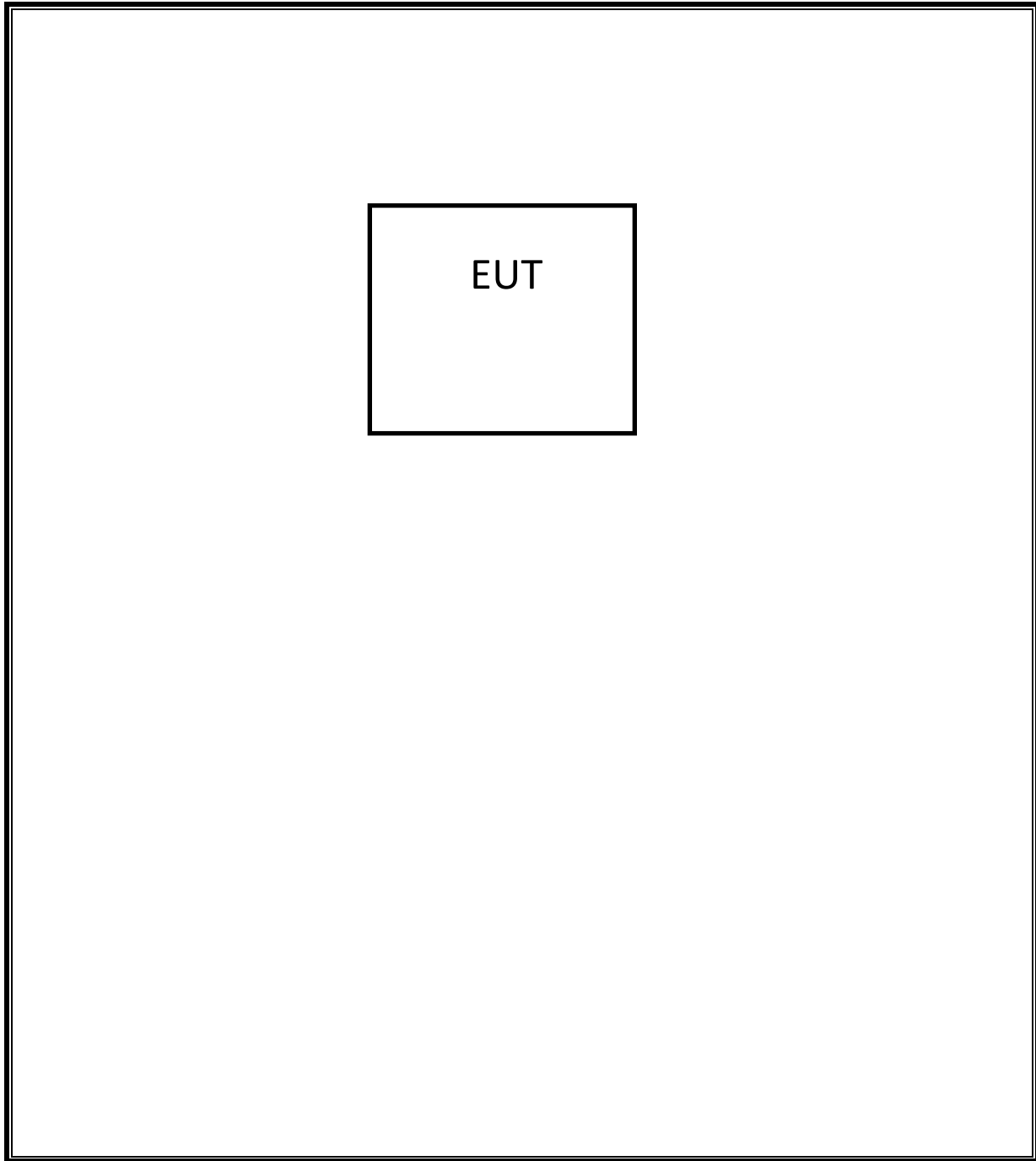
I/O CABLES

The EUT is a standalone device no support equipment was used.

TEST SETUP

The EUT is a standalone, battery operated device.

SETUP DIAGRAM FOR TESTS



6. TEST AND MEASUREMENT EQUIPMENT

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

Test Equipment List					
Description	Manufacturer	Model	Asset	Cal Date	Cal Due
Spectrum Analyzer, 26.5 GHz	Agilent	E4440A	C01179	02/26/13	02/26/14
Spectrum Analyzer, 26.5 GHz	Agilent	E4440A	C01176	12/13/12	12/13/13
Spectrum Analyzer, 40 GHz	Agilent	8564E	C00951	07/29/13	07/29/14
Preamplifier, 1300 MHz	Agilent	8447D	C00580	01/28/13	01/28/14
PreAmplifier, 1-26.5GHz	Agilent	8449B	F00167	03/23/13	03/23/14
Antenna, Bilog, 30MHz-1 GHz	Sunol Sciences	JB1	F00064	03/06/13	03/06/14
Horn Antenna, 1-18GHz	ETS Lindgren	3117	F00132	02/19/13	02/19/14
Antenna, Horn, 26.5 GHz	ARA	MWH-1826/B	C00980	11/14/12	11/14/13
Single Channel PK Power Meter	Agilent	N1911A	F00026	04/02/13	04/02/14
Peak and Average Power Sensor	Agilent	E9323A	F00160	04/03/13	04/03/14

7. ANTENNA PORT TEST RESULTS

7.1. ON TIME AND DUTY CYCLE RESULTS

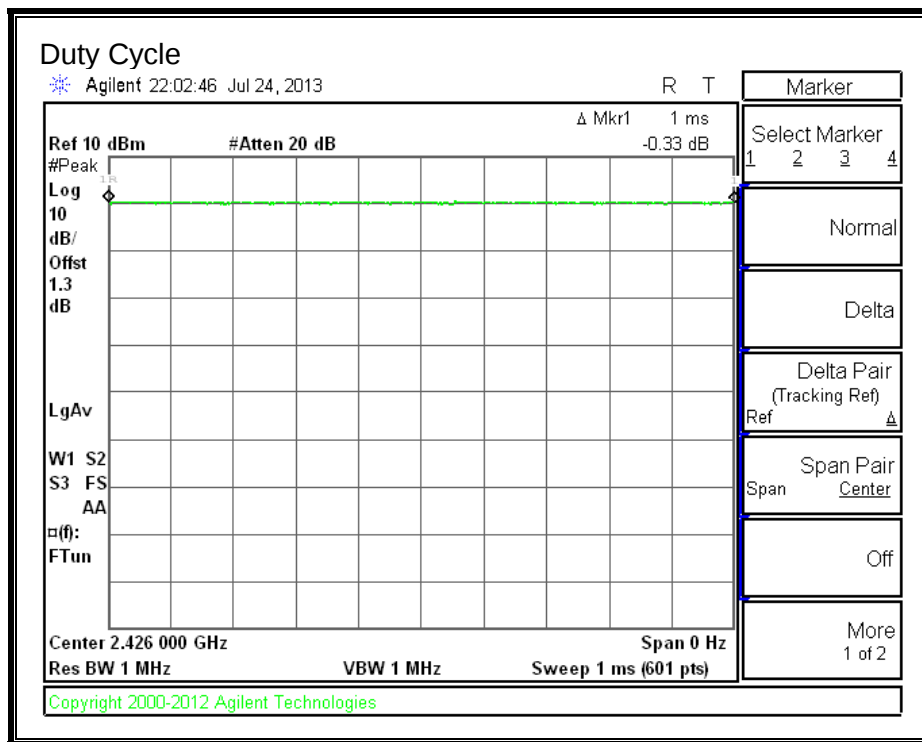
LIMITS

None; for reporting purposes only.

RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/T Minimum VBW (kHz)
BLE	1.00	1.00	1.000	100.0%	0.00	0.010

DUTY CYCLE PLOT



7.2. 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.

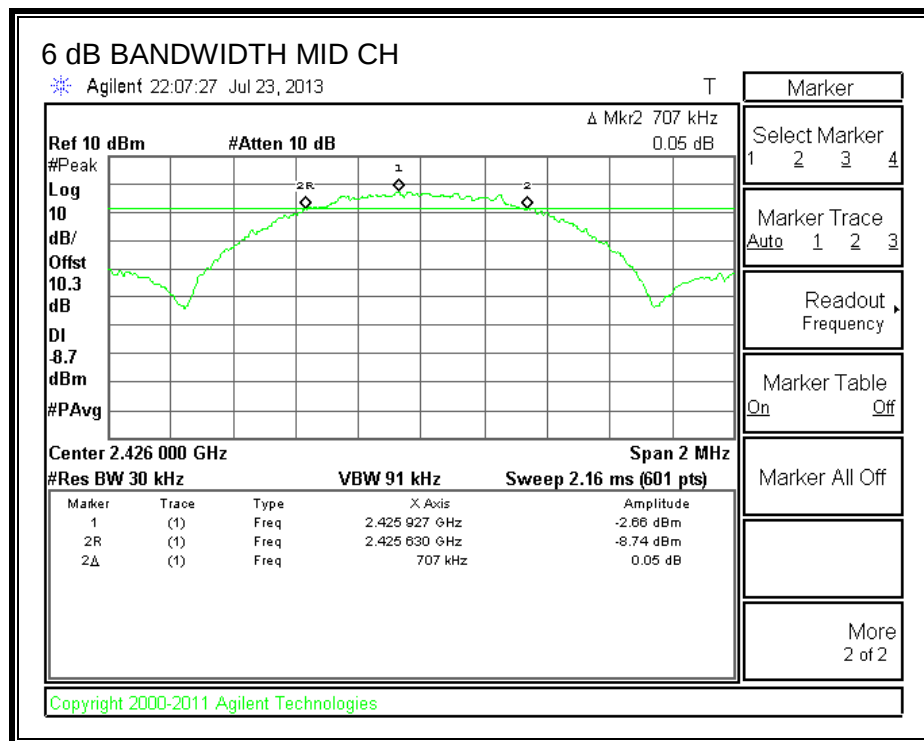
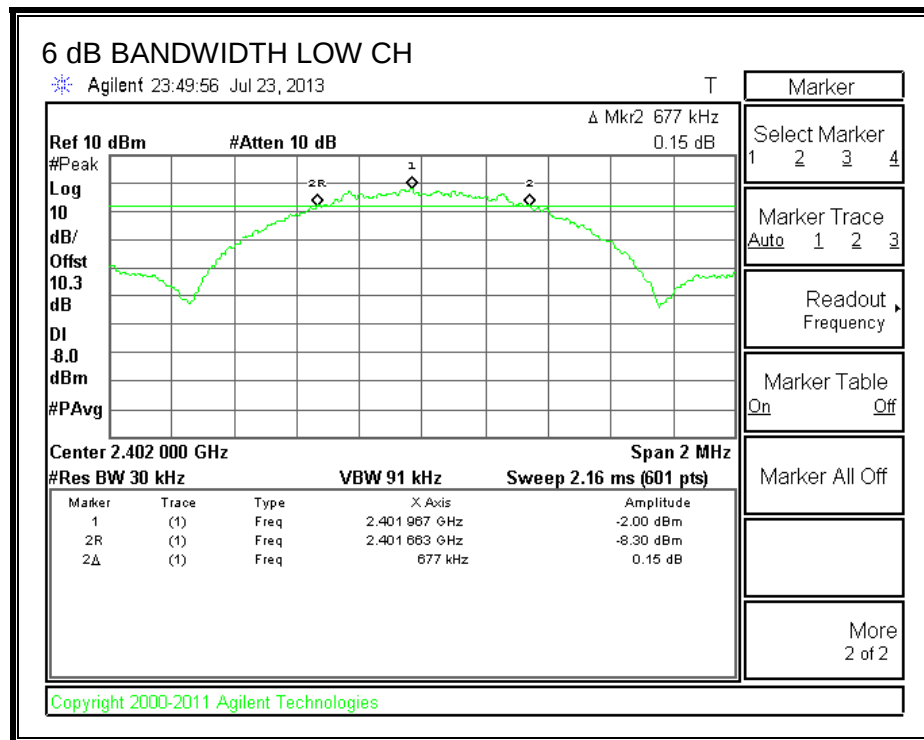
TEST PROCEDURE

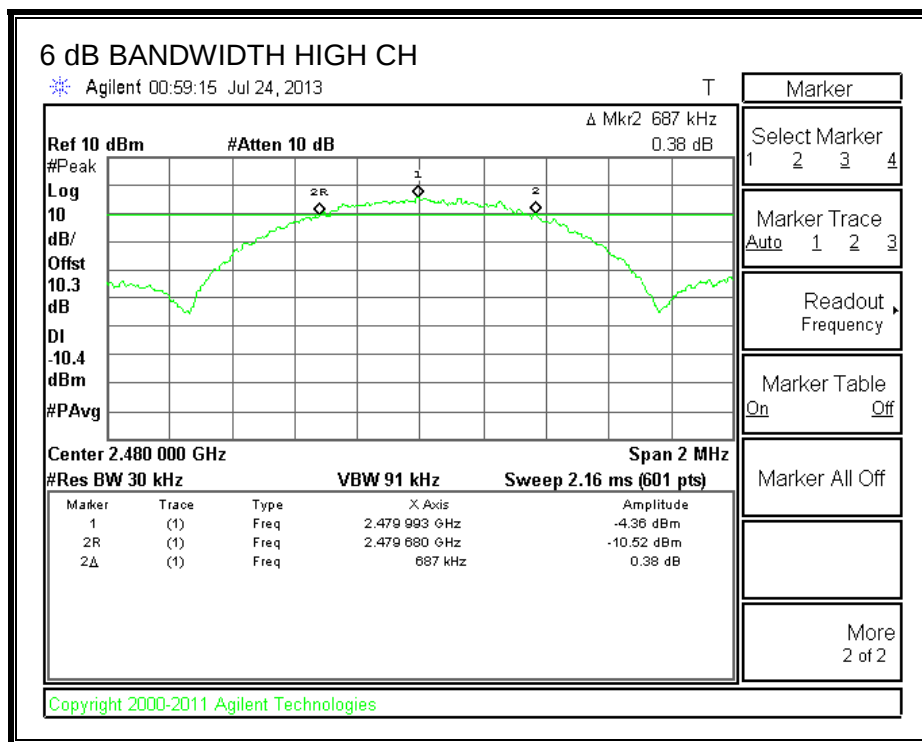
KDB 558074 D01 v03r01 "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under 15.247".

RESULTS

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	0.677	0.5
Middle	2426	0.707	0.5
High	2480	0.687	0.5

6 dB BANDWIDTH





7.3. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

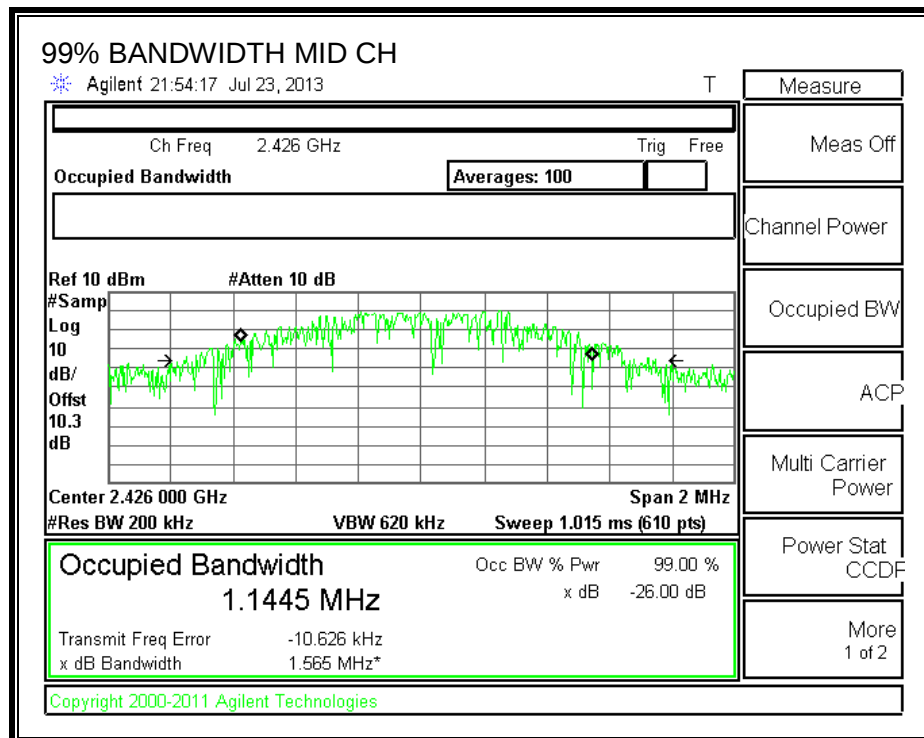
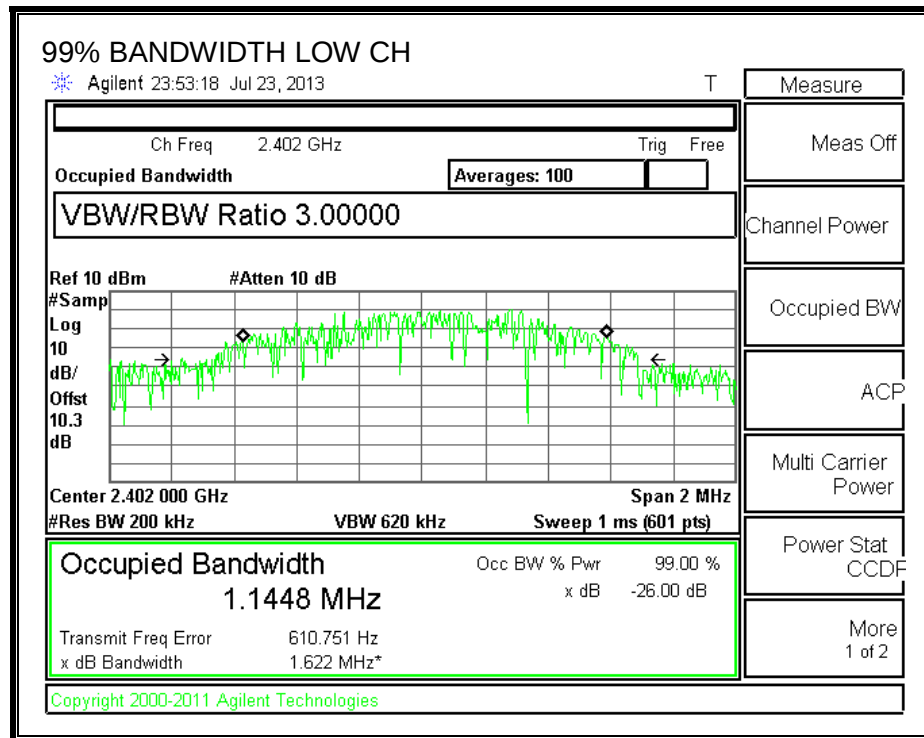
TEST PROCEDURE

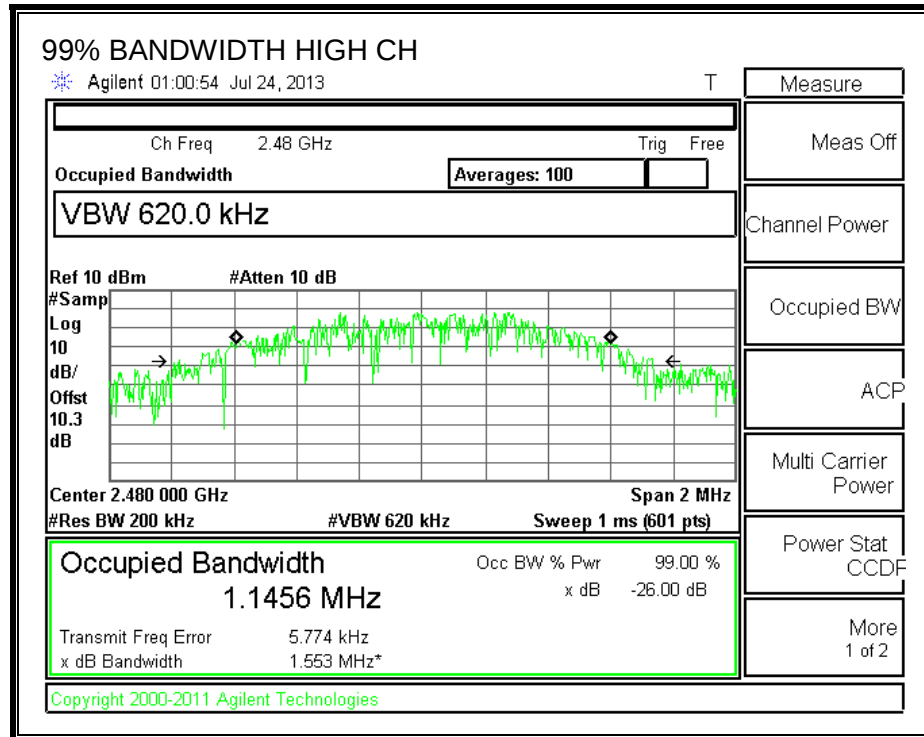
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth and to 1% of the span. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.1448
Middle	2426	1.1445
High	2480	1.1456

99% BANDWIDTH





7.4. 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.

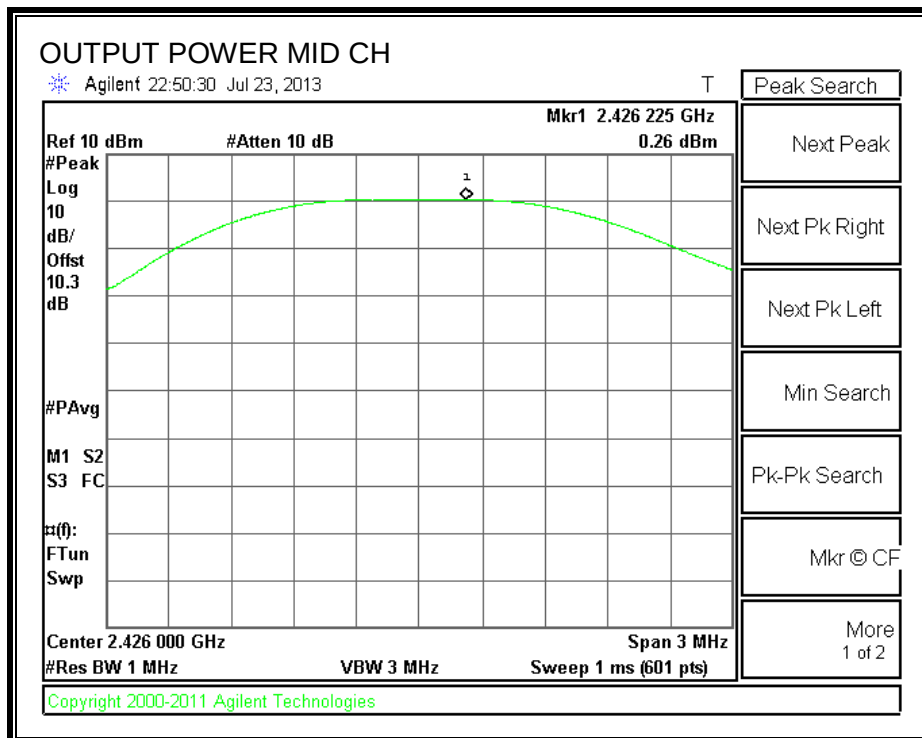
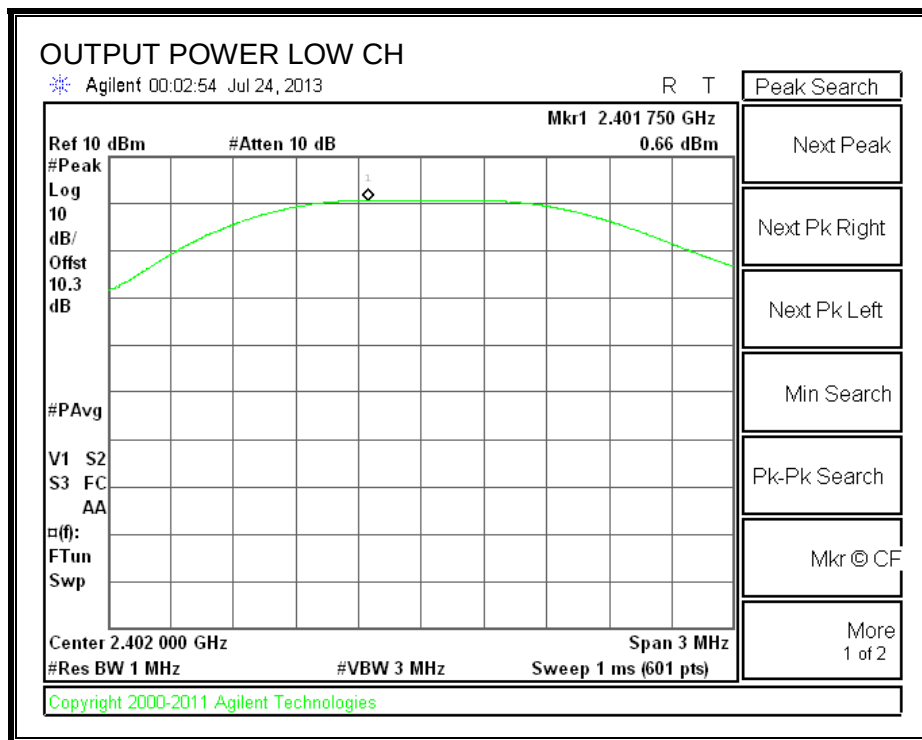
TEST PROCEDURE

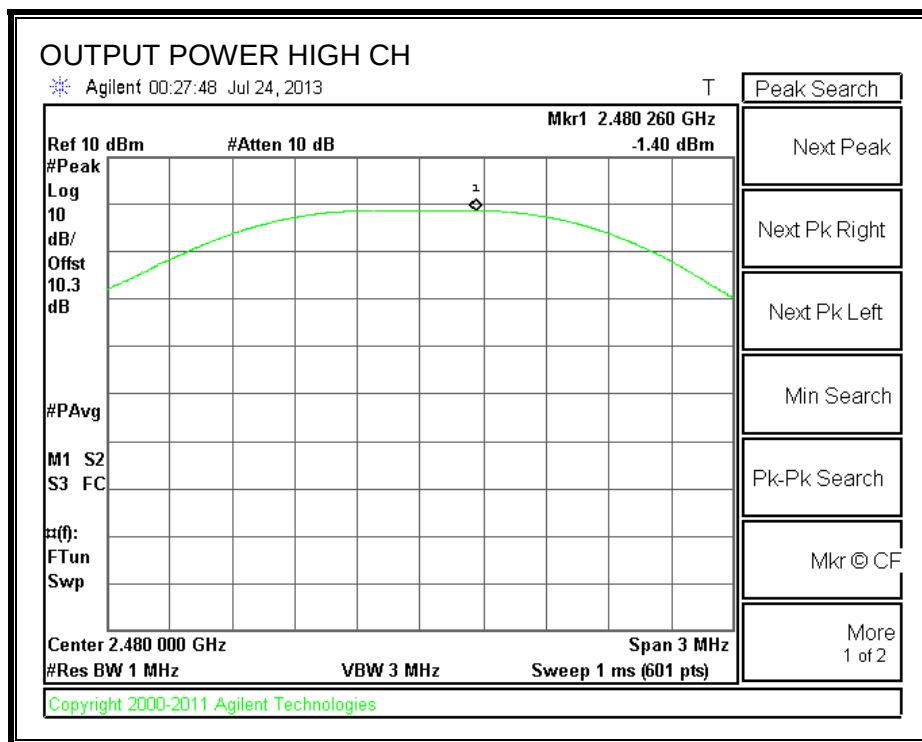
KDB 558074 D01 v03r01 "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under 15.247".

RESULTS

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	0.660	30	-29.340
Middle	2426	0.260	30	-29.740
High	2480	-1.400	30	-31.400

OUTPUT POWER





7.5. 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.

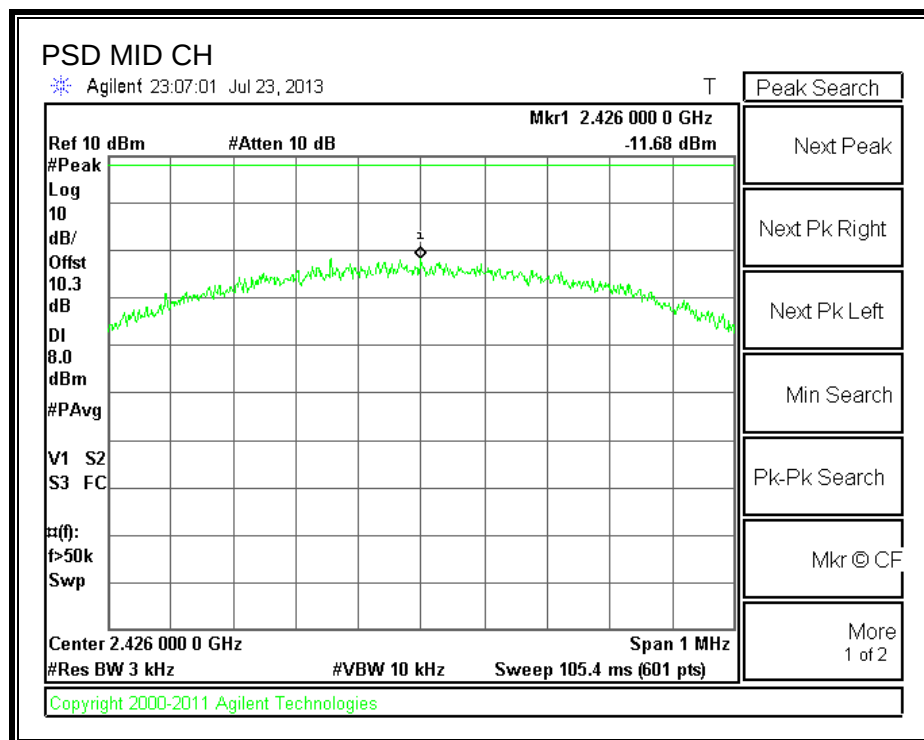
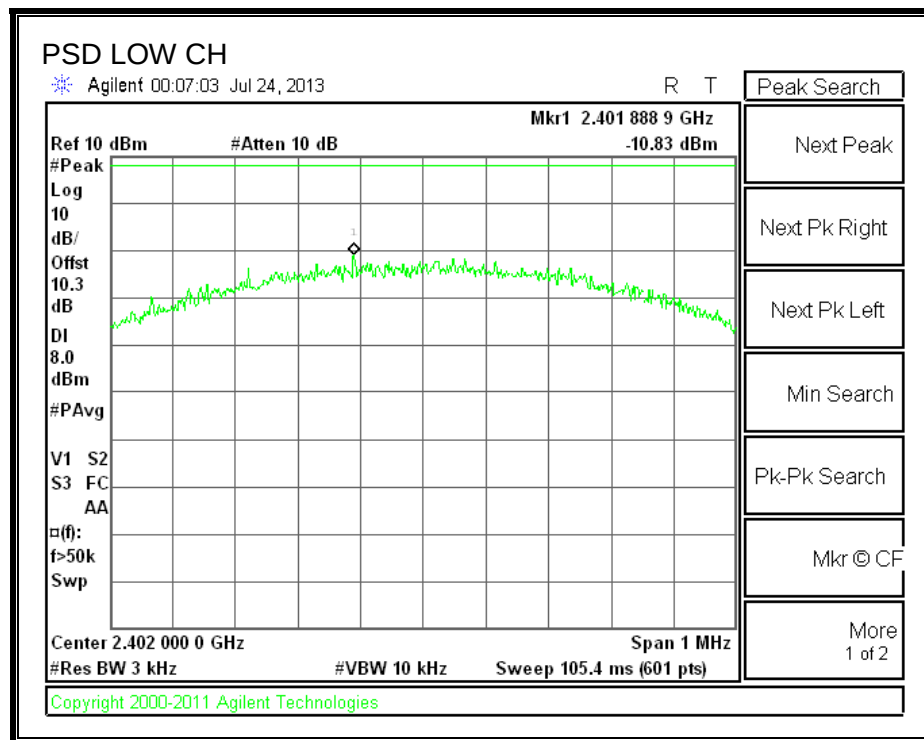
TEST PROCEDURE

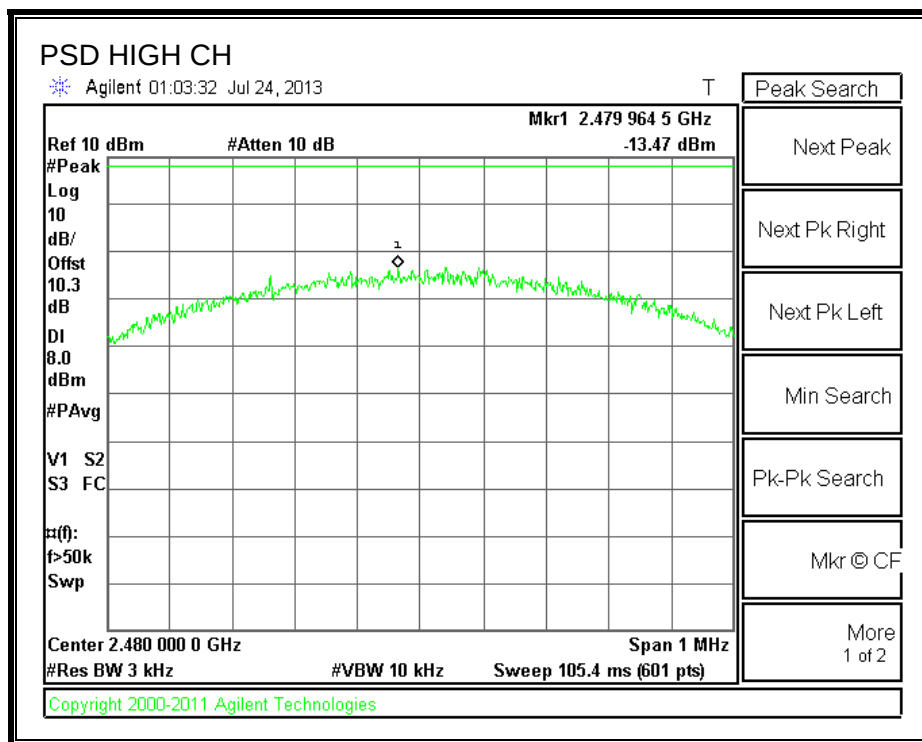
KDB 558074 D01 v03r01 "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under 15.247".

RESULTS

Channel	Frequency (MHz)	PSD (dBm)	Limit (dBm)	Margin (dB)
Low	2402	-10.83	8	-18.83
Middle	2426	-11.68	8	-19.68
High	2480	-13.47	8	-21.47

POWER SPECTRAL DENSITY





7.6. CONDUCTED SPURIOUS EMISSIONS

LIMITS

FCC §15.247 (d)

IC RSS-210 A8.5

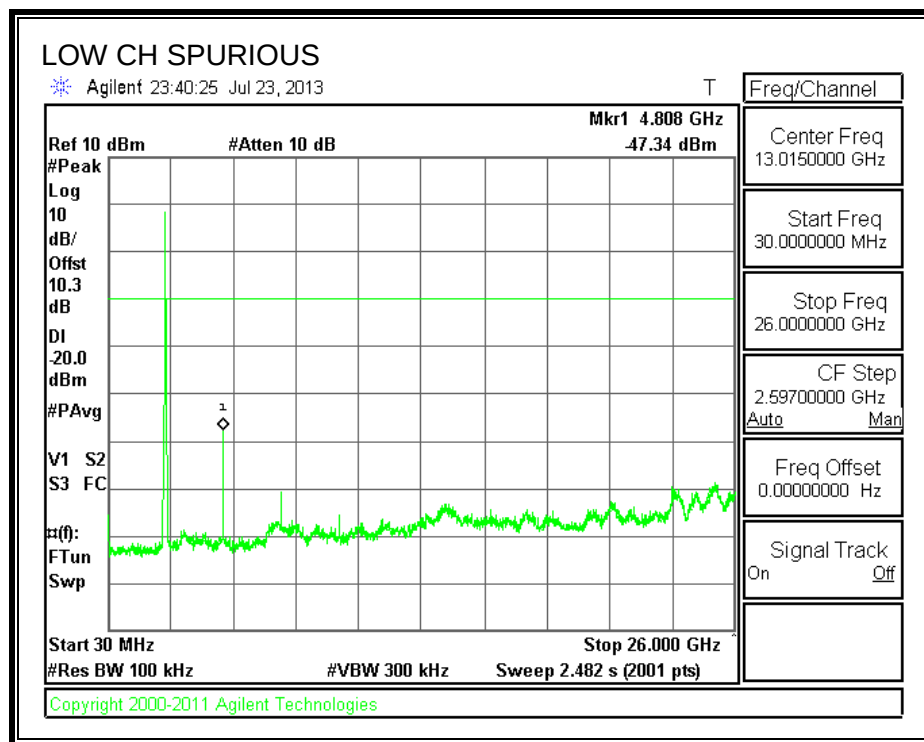
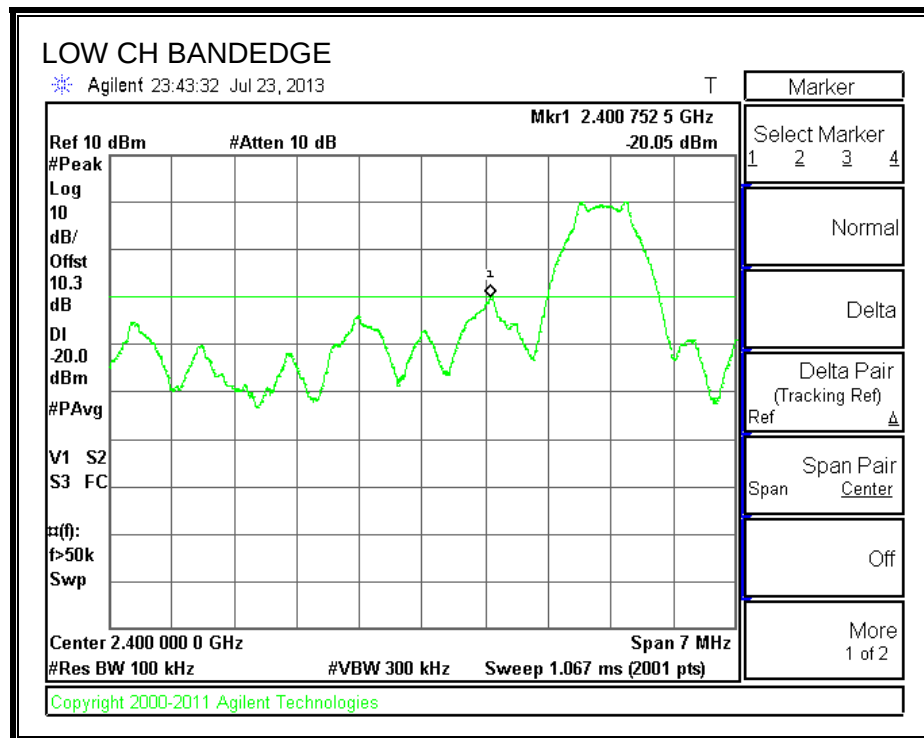
Output power was measured based on the use of a peak measurement, therefore the required attenuation is 20 dB.

TEST PROCEDURE

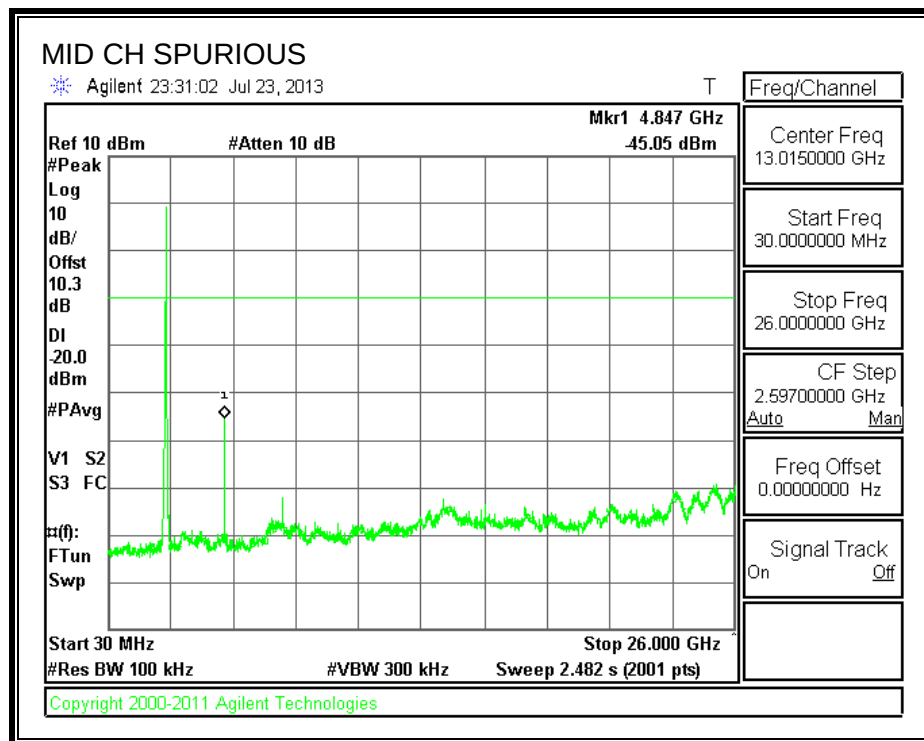
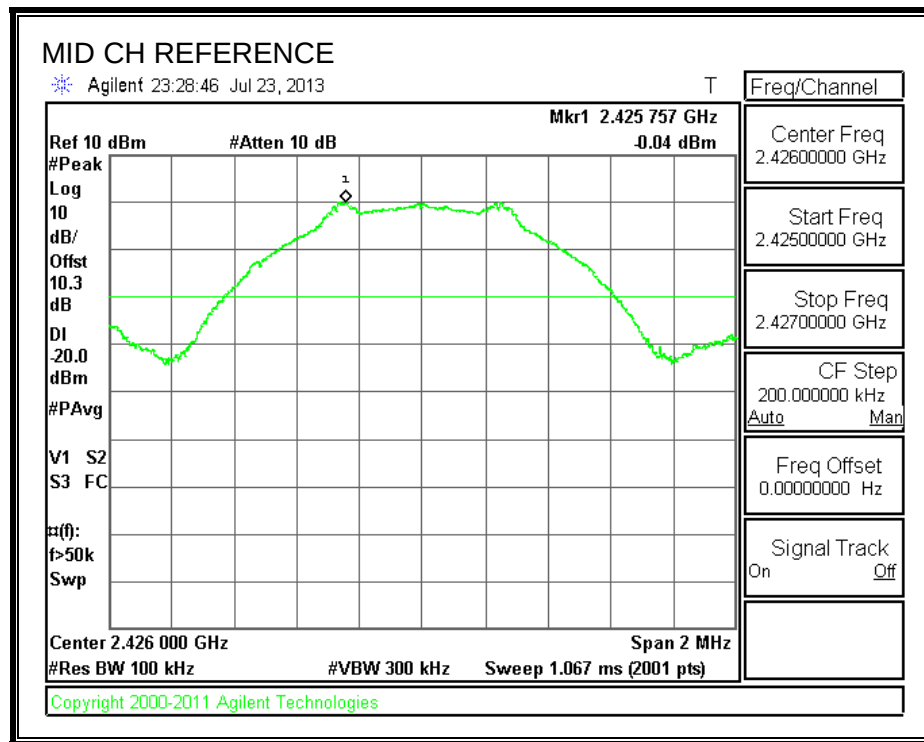
KDB 558074 D01 v03r01 "Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under 15.247".

RESULTS

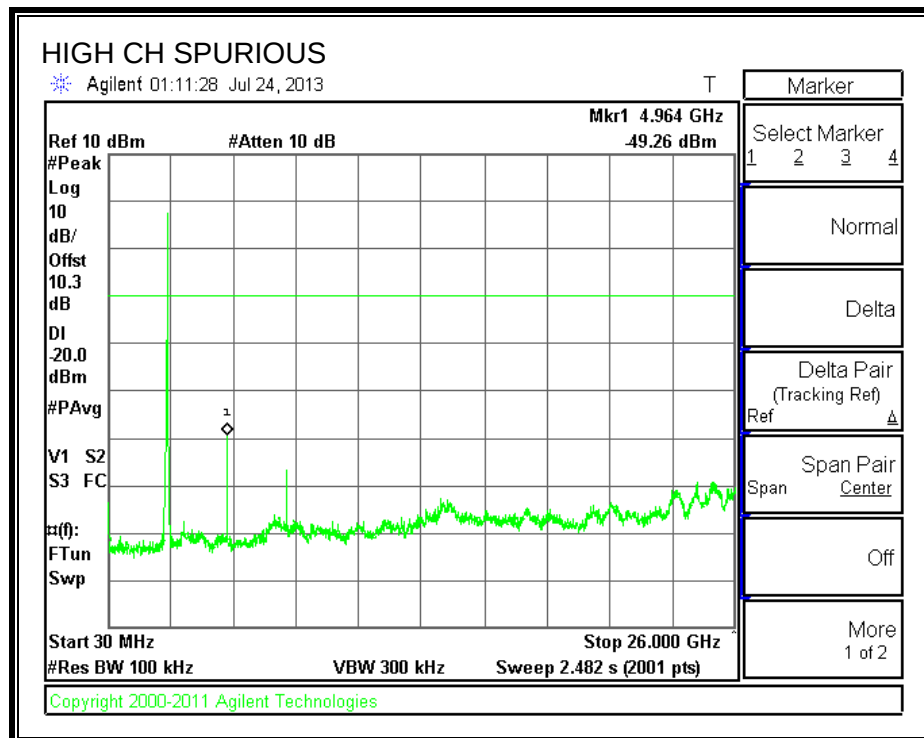
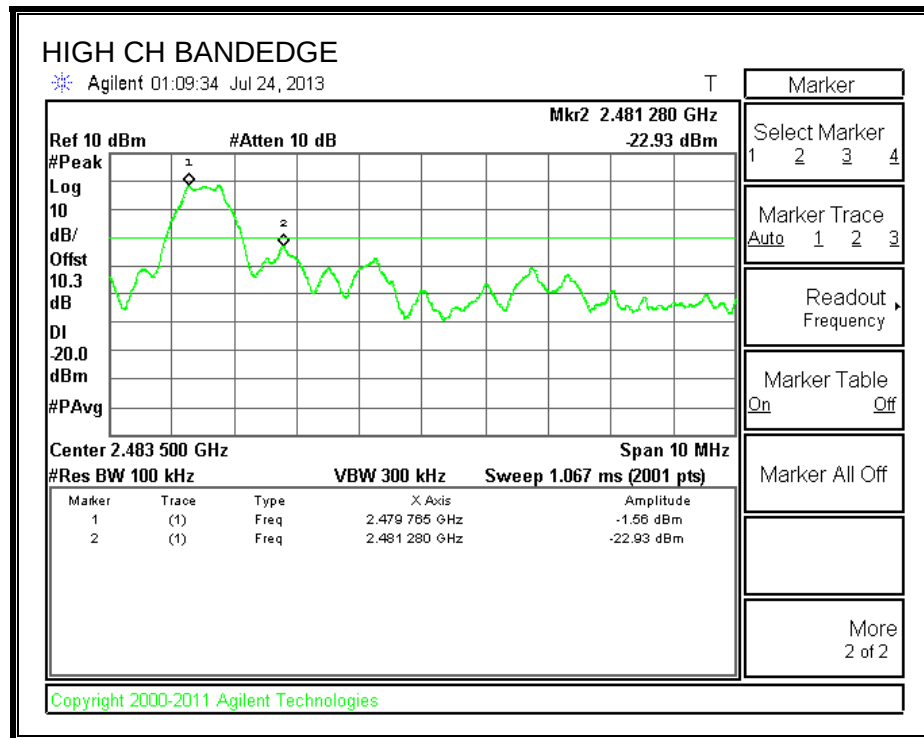
SPURIOUS EMISSIONS, LOW CHANNEL



SPURIOUS EMISSIONS, MID CHANNEL



SPURIOUS EMISSIONS, HIGH CHANNEL



8. RADIATED TEST RESULTS

8.1. LIMITS AND PROCEDURE

LIMITS

FCC §15.205 and §15.209

IC RSS-210 Clause 2.6 (Transmitter)

IC RSS-GEN Clause 6 (Receiver)

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. 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 the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 1 MHz for peak measurements and 10 Hz for average measurements.

The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

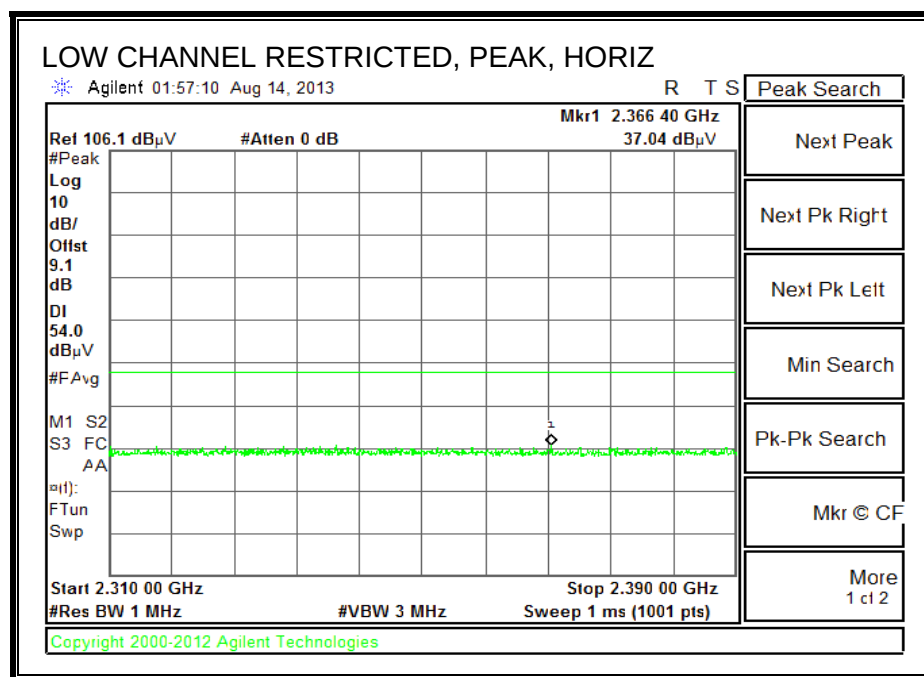
The spectrum from 30 MHz to 40 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in each applicable band.

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.

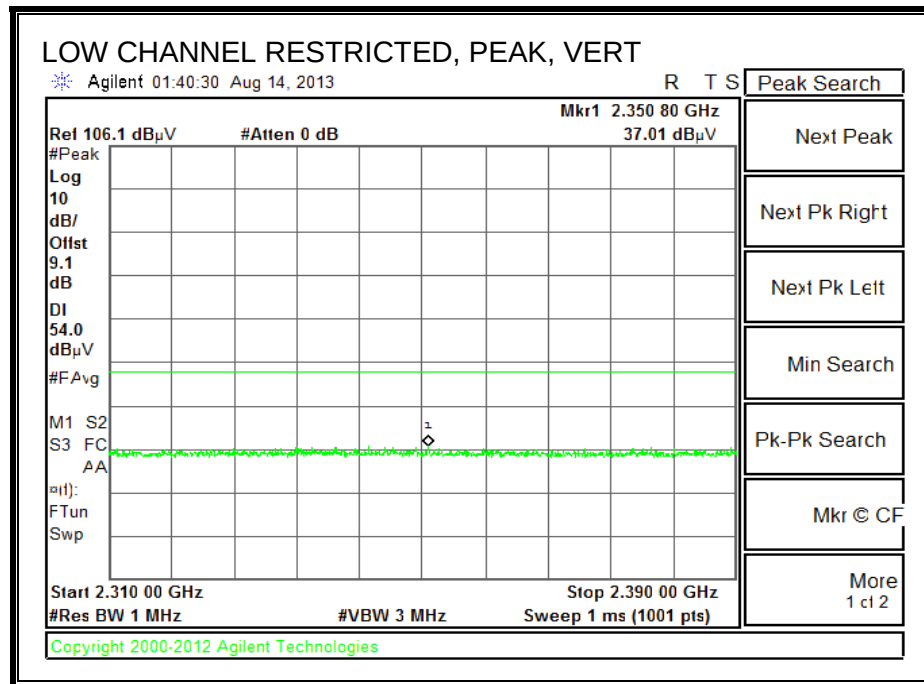
8.2. TRANSMITTER ABOVE 1 GHz

8.2.1. TX ABOVE 1 GHz FOR BLUETOOTH LOW ENERGY MODE IN THE 2.4 GHz BAND WITH DIPOLE ANTENNA

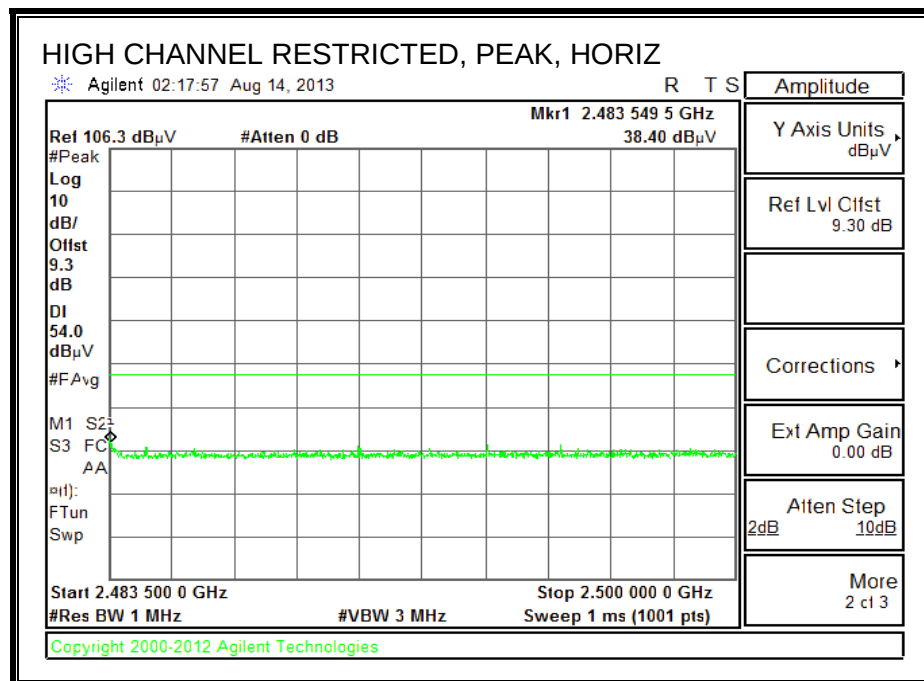
RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



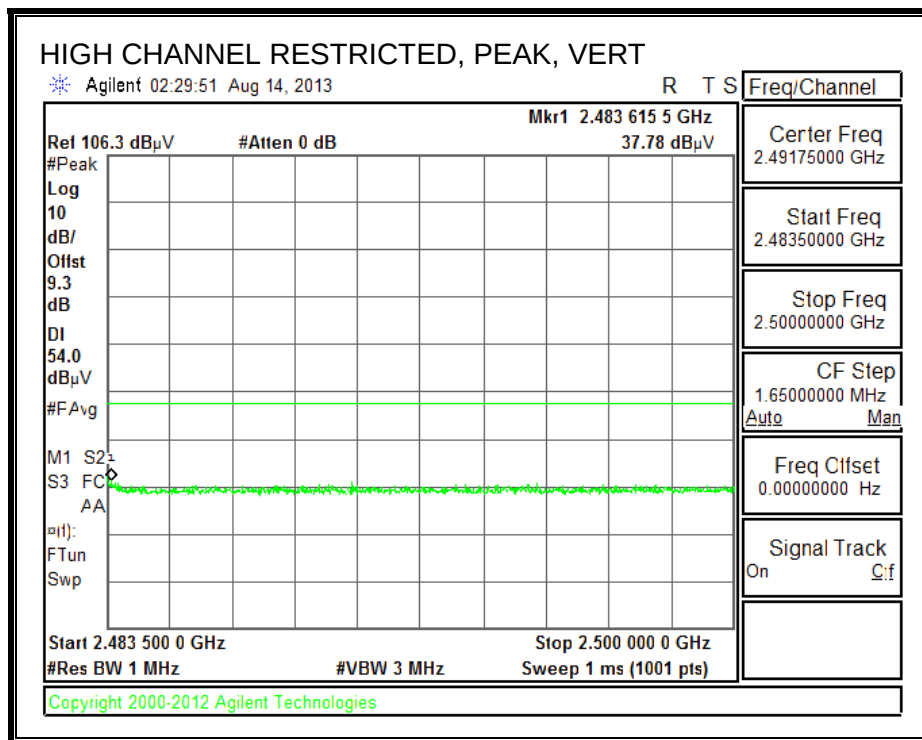
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)

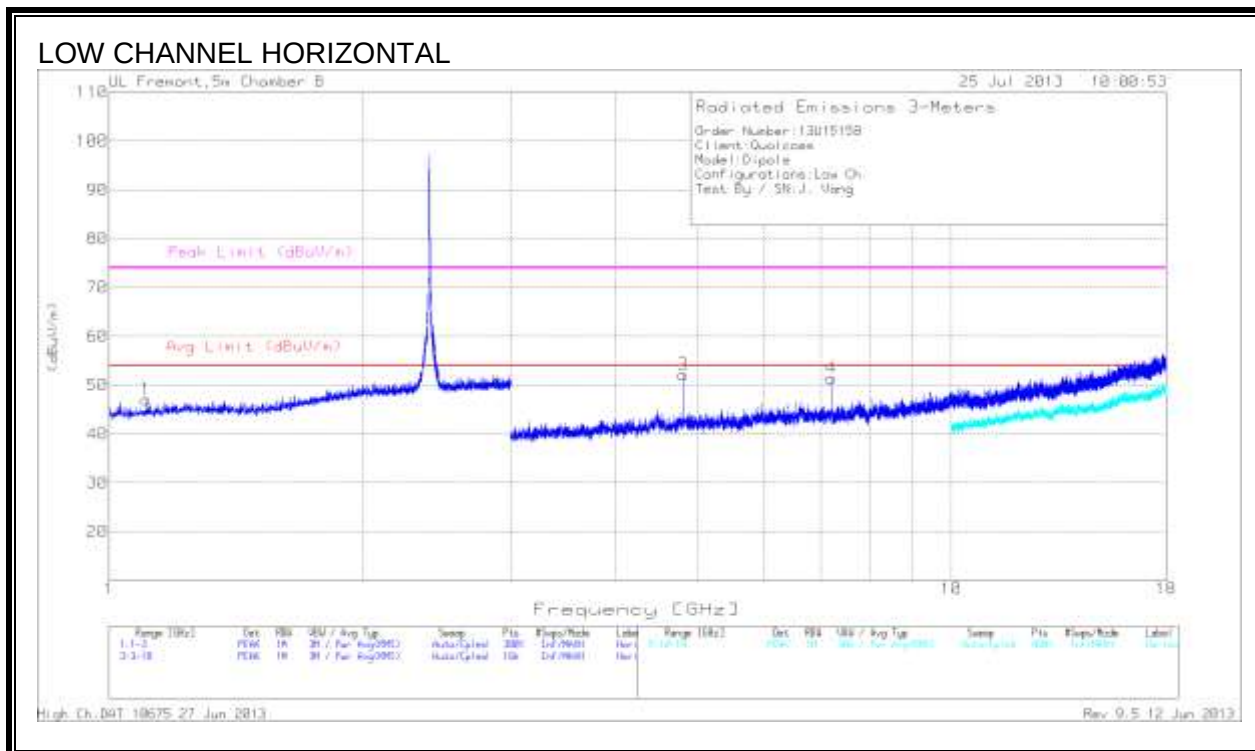


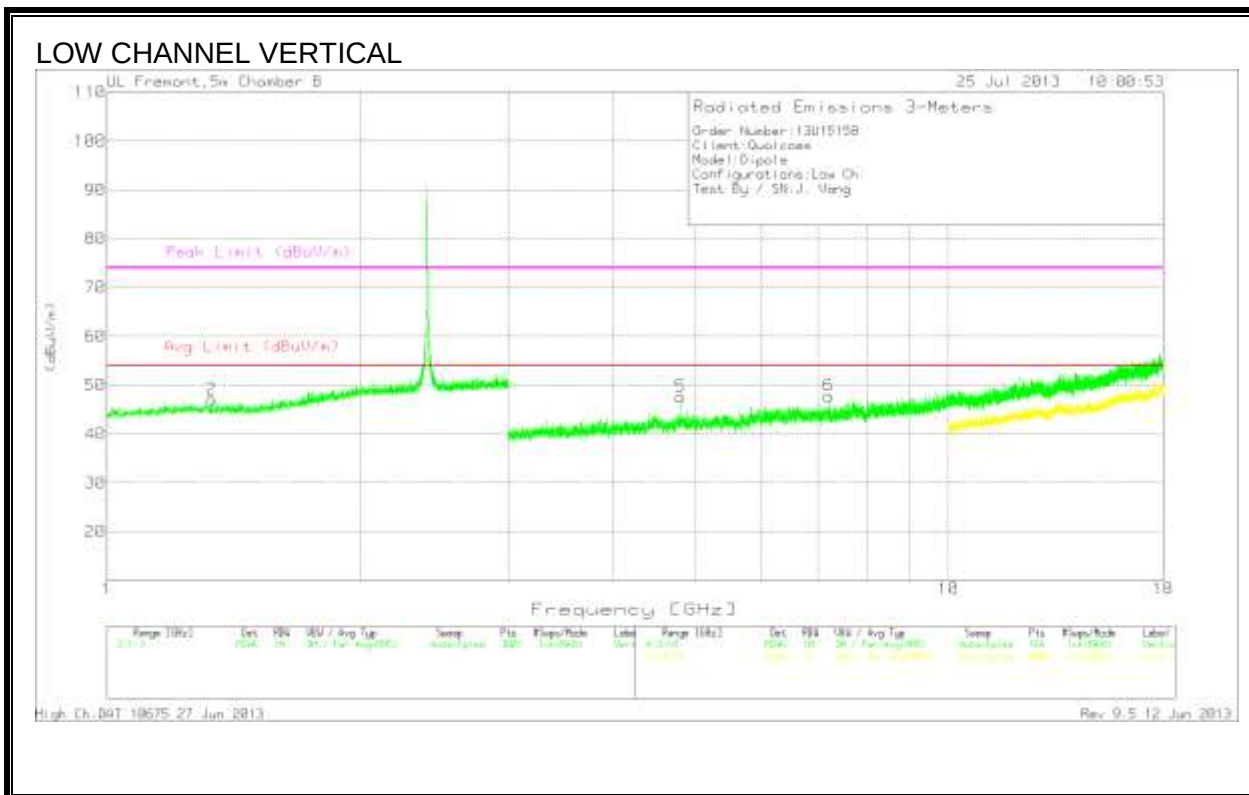
RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)



The peak emission is lower than the average limit. Therefore, average measurements were not taken.

HARMONICS AND SPURIOUS EMISSIONS





LOW CHANNEL DATA

Trace Markers

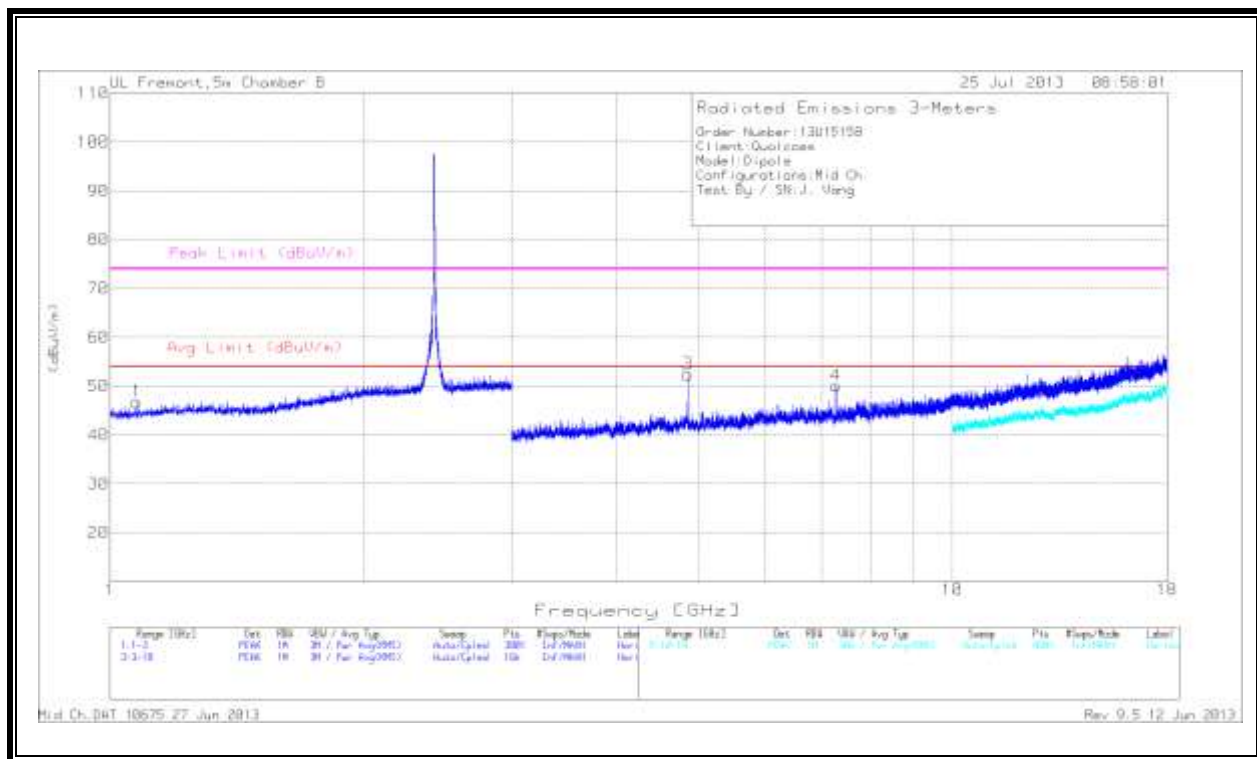
Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl /Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1.107	44.33	PK	27.9	-25.2	47.03	53.97	-6.94	74	-26.97	0-360	200	H
1.333	43.63	PK	28.5	-25.1	47.03	53.97	-6.94	74	-26.97	0-360	100	V
4.804	46.84	PK	34.7	-29.4	52.14	53.97	-1.83	74	-21.86	0-360	100	H
**7.206	42.77	PK	35.8	-27.1	51.47	-	-	68.2	-16.73	0-360	100	H
4.804	42.27	PK	34.7	-29.4	47.57	53.97	-6.4	74	-26.43	0-360	100	V
**7.205	39.27	PK	35.8	-27.2	47.87	-	-	68.2	-20.33	0-360	100	V

**Nonrestricted Band

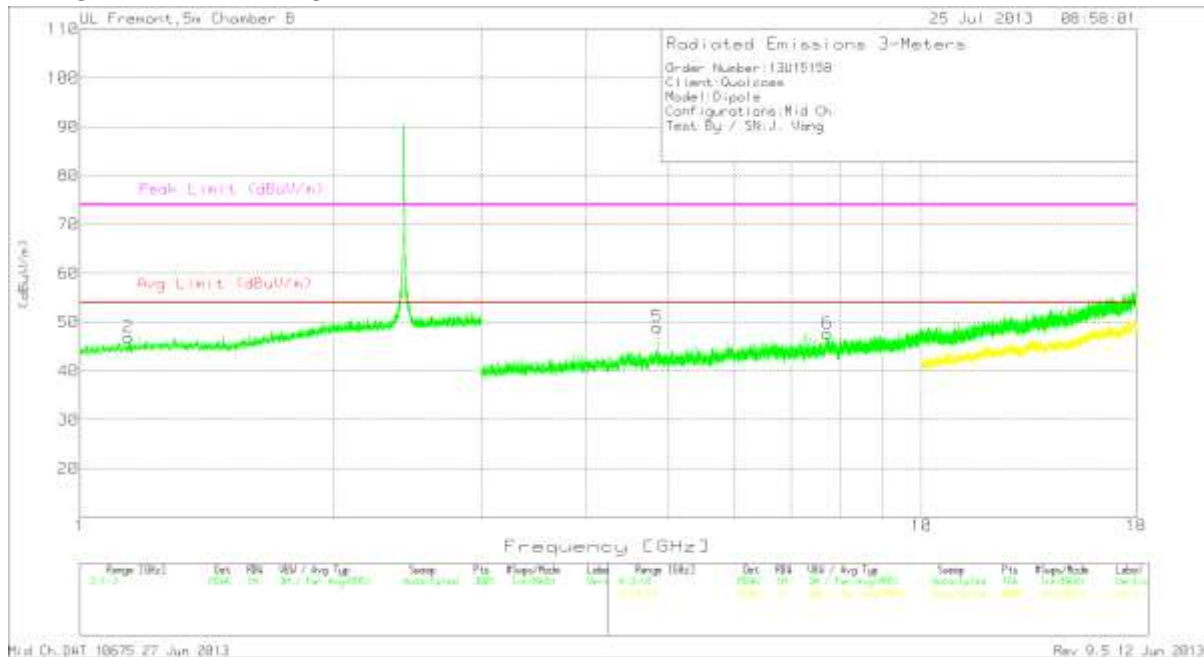
PK - Peak detector

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl /Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
4.803	39.4	Av	34.7	-29.4	44.7	53.97	-9.27	-	-	231	115	H

Av - Average detection

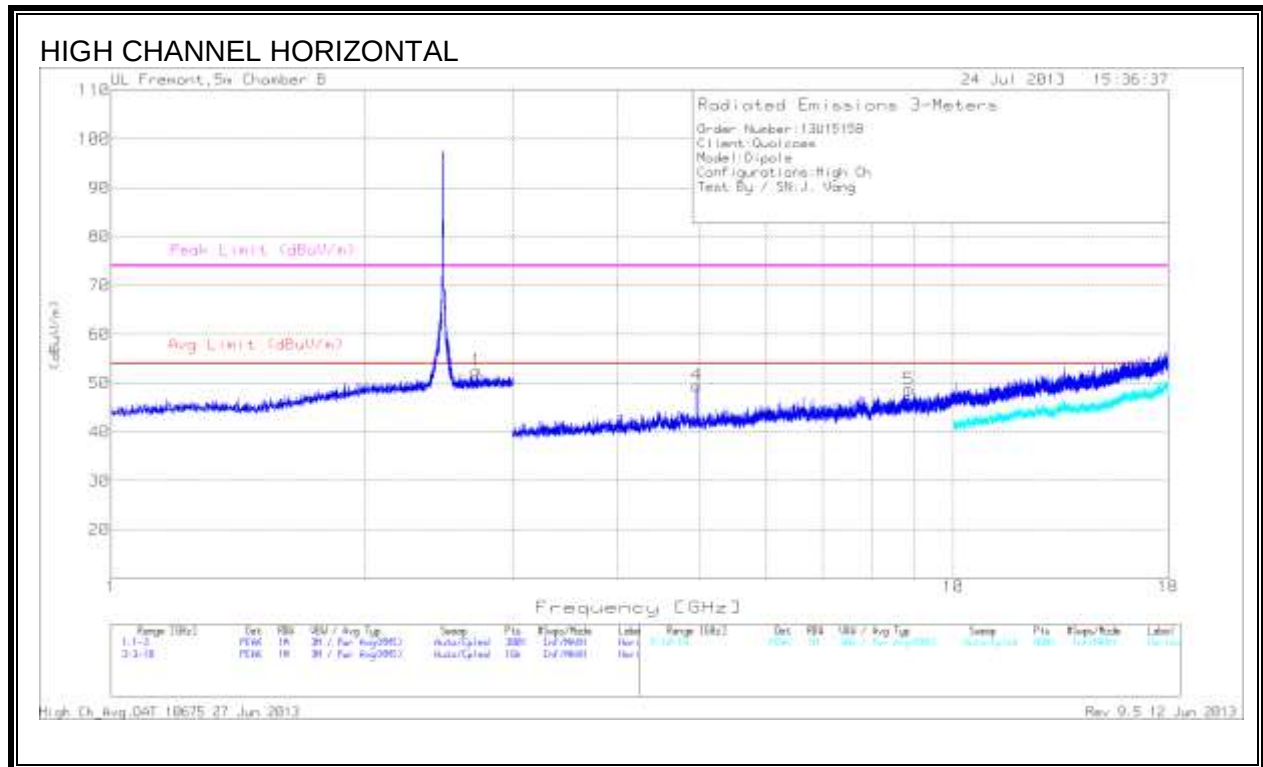


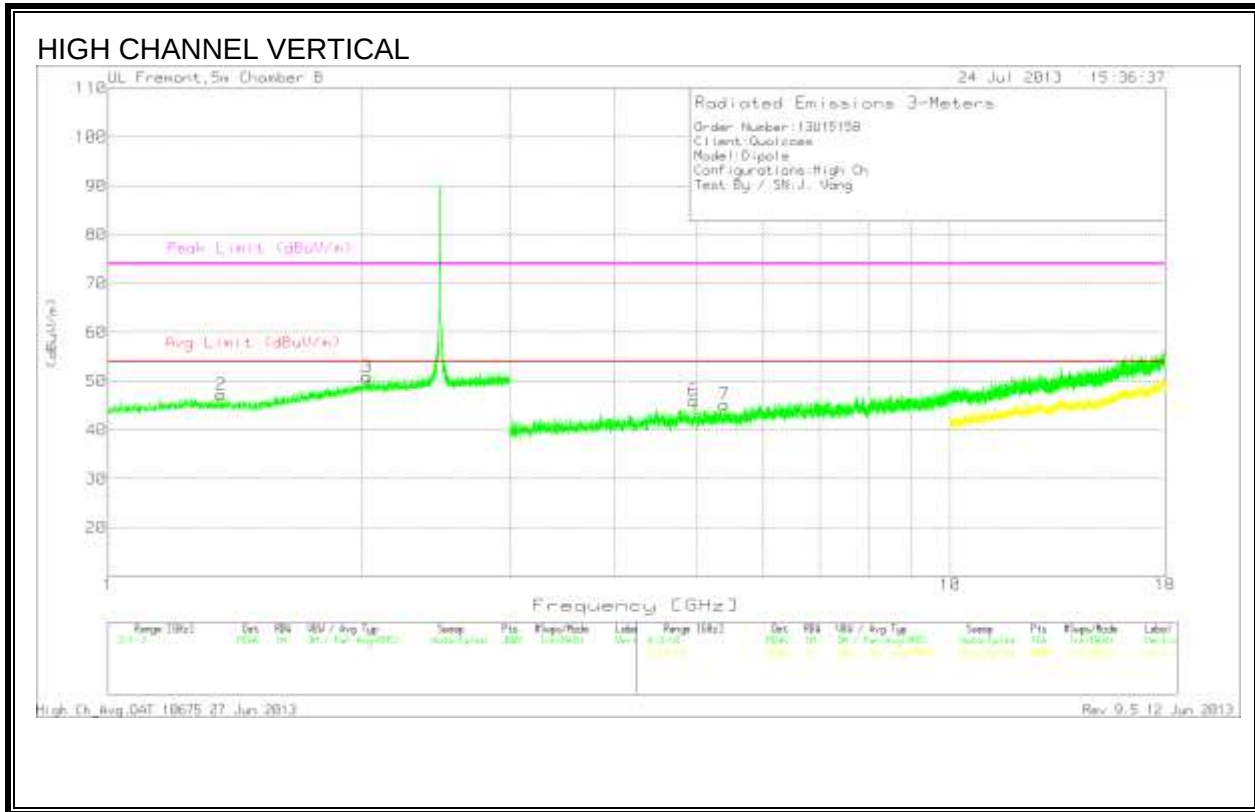
MID CHANNEL VERTICAL



MID CHANNEL DATA

Trace Markers												
Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl /Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1.076	44.25	PK	27.8	-25.3	46.75	53.97	-7.22	74	-27.25	0-360	200	H
1.141	44.17	PK	28.1	-25.3	46.97	53.97	-7	74	-27.03	0-360	100	V
4.851	48.21	PK	34.7	-30.5	52.41	53.97	-1.56	74	-21.59	0-360	100	H
7.278	41.96	PK	35.8	-27.7	50.06	53.97	-3.91	74	-23.94	0-360	100	H
4.852	44.93	PK	34.7	-30.6	49.03	53.97	-4.94	74	-24.97	0-360	100	V
7.728	37.03	PK	36.2	-25.5	47.73	53.97	-6.24	74	-26.27	0-360	200	V
PK - Peak detector												
Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl /Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
4.852	40.3	Av	34.7	-30.5	44.5	53.97	-9.47	-	-	212	132	H
7.278	26.19	Av	35.8	-27.7	34.29	53.97	-19.68	-	-	57	113	H
Av - Average detection												



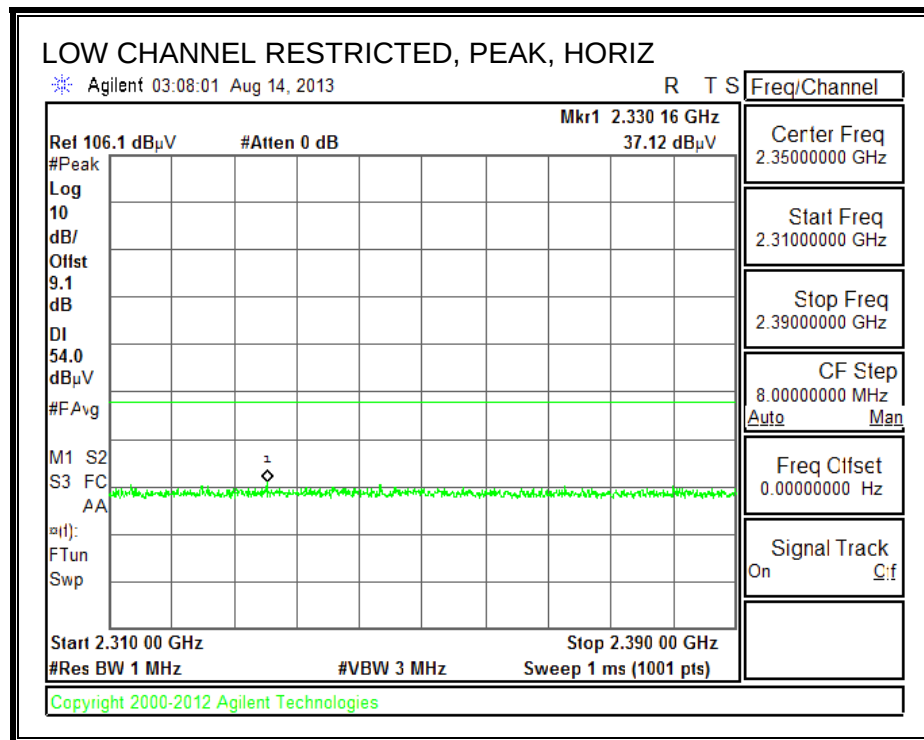


HIGH CHANNEL DATA

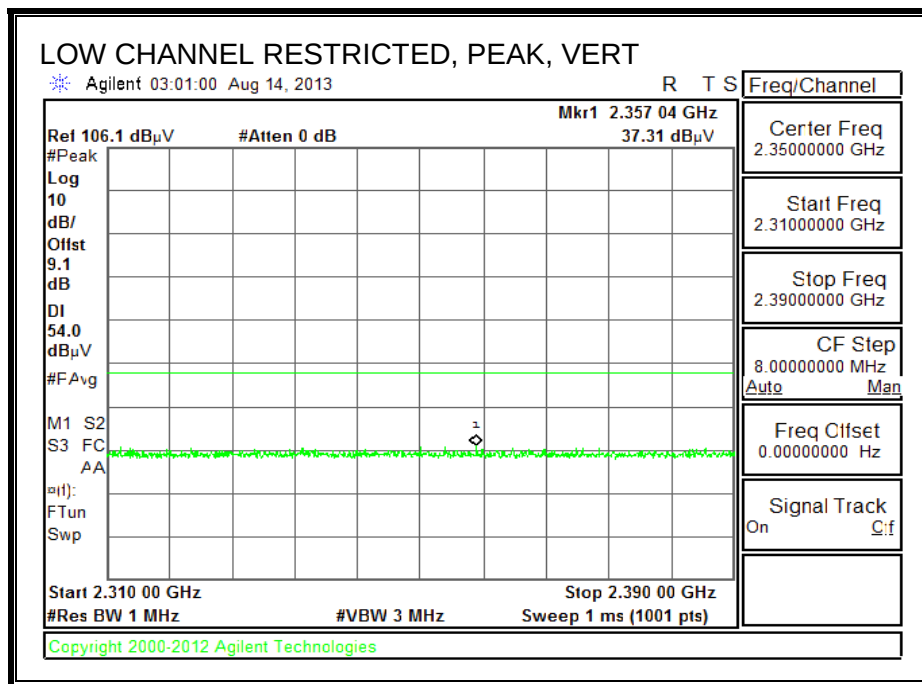
Trace Markers												
Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl /Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2.717	42.43	PK	32.8	-22.7	52.53	53.97	-1.44	74	-21.47	0-360	200	H
1.363	43.95	PK	28.4	-25.1	47.25	53.97	-6.72	74	-26.75	0-360	200	V
**2.032	42.94	PK	31.8	-23.9	50.84	-	-	68.2	-17.36	0-360	100	V
4.96	45.2	PK	34.6	-30.3	49.5	53.97	-4.47	74	-24.5	0-360	200	H
**8.853	38.29	PK	36.6	-26.2	48.69	-	-	68.2	-19.51	0-360	100	H
4.959	41.67	PK	34.6	-30.3	45.97	53.97	-8	74	-28.03	0-360	100	V
**Nonrestricted Band												
PK - Peak detector												
Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl /Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2.713	17.23	Av	32.8	-22.7	27.33	53.97	-26.64	-	-	337	151	H
4.96	37.9	Av	34.6	-30.3	42.2	53.97	-11.77	-	-	231	150	H
Av - Average detection												

8.2.2. TX ABOVE 1 GHz FOR BLUETOOTH LOW ENERGY MODE IN THE 2.4 GHz BAND WITH PATCH ANTENNA

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



RESTRICTED BANEDGE (LOW CHANNEL, VERTICAL)



HIGH CHANNEL RESTRICTED, PEAK, HORIZ

Agilent 03:24:08 Aug 14, 2013

R T S

Peak Search

Ref 106.3 dB μ V
 #Peak
 Log
 10
 dB/
 Offset
 9.3
 dB
 DI
 54.0
 dB μ V
 #FAvg

#Atten 0 dB

Mkr1 2.484 193 0 GHz
 37.63 dB μ V

M1 S2
 S3 FC
 AA

Min Search

(H):
 FTun
 Swp

Pk-Pk Search

Mkr © CF

Start 2.483 500 0 GHz
 #Res BW 1 MHz

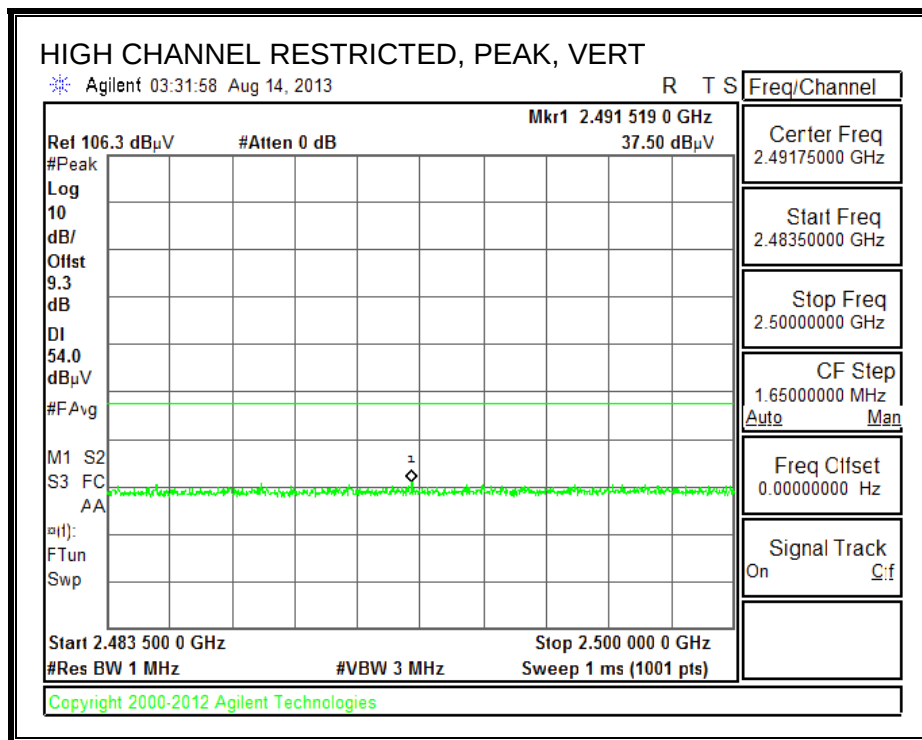
#VBW 3 MHz

Stop 2.500 000 0 GHz
 Sweep 1 ms (1001 pts)

More
 1 of 2

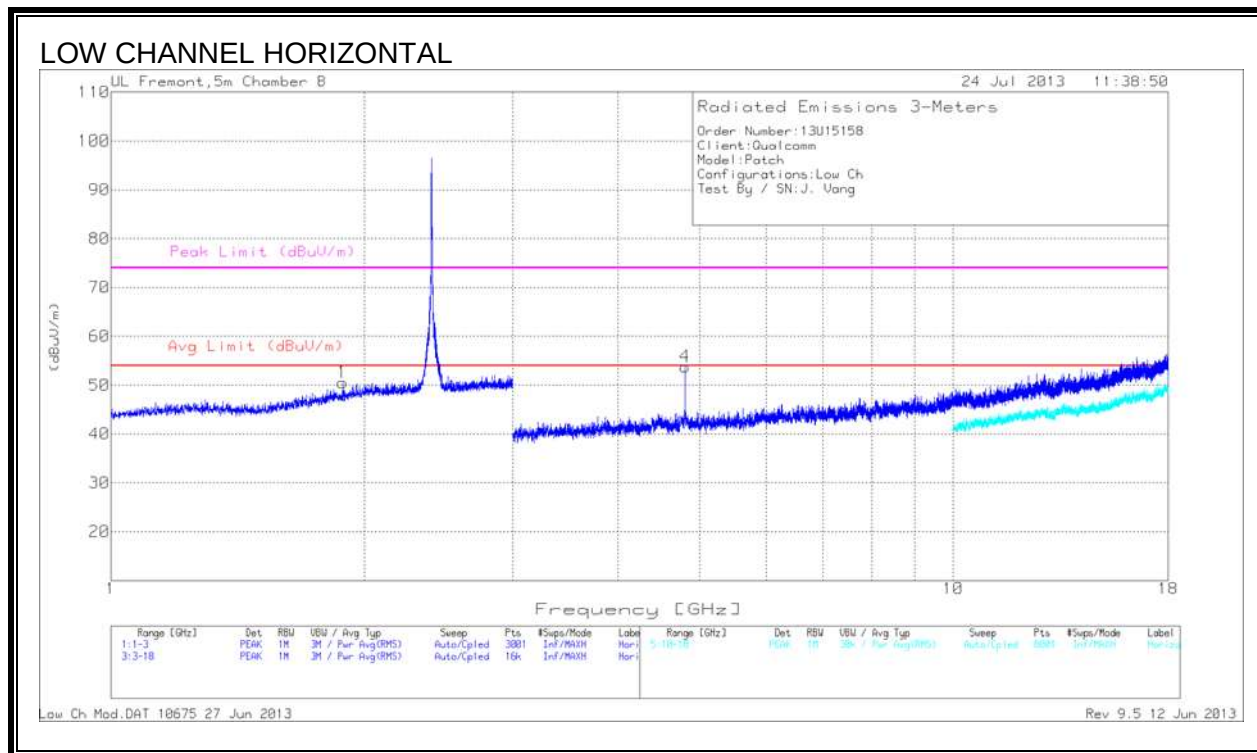
Copyright 2000-2012 Agilent Technologies

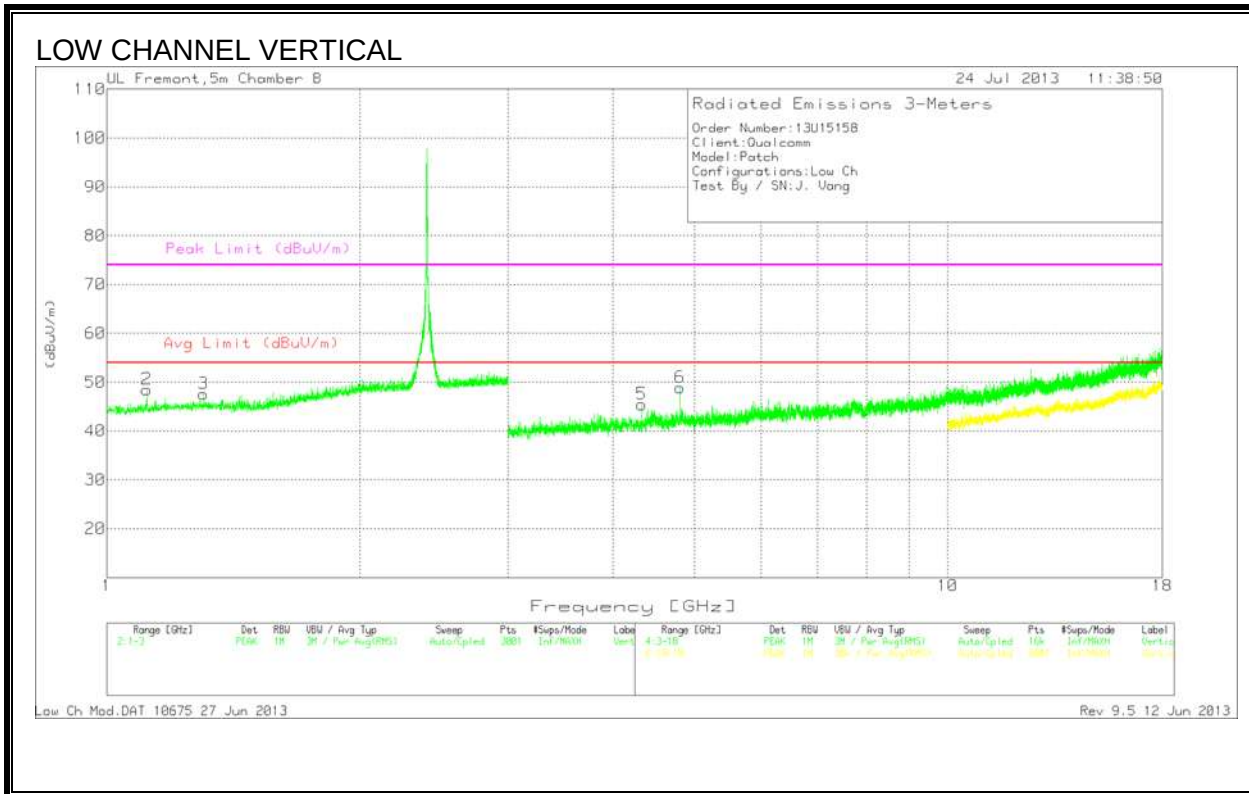
RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)



The peak emission is lower than the average limit. Therefore, average measurements were not taken.

HARMONICS AND SPURIOUS EMISSIONS





LOW CHANNEL DATA

Trace Markers

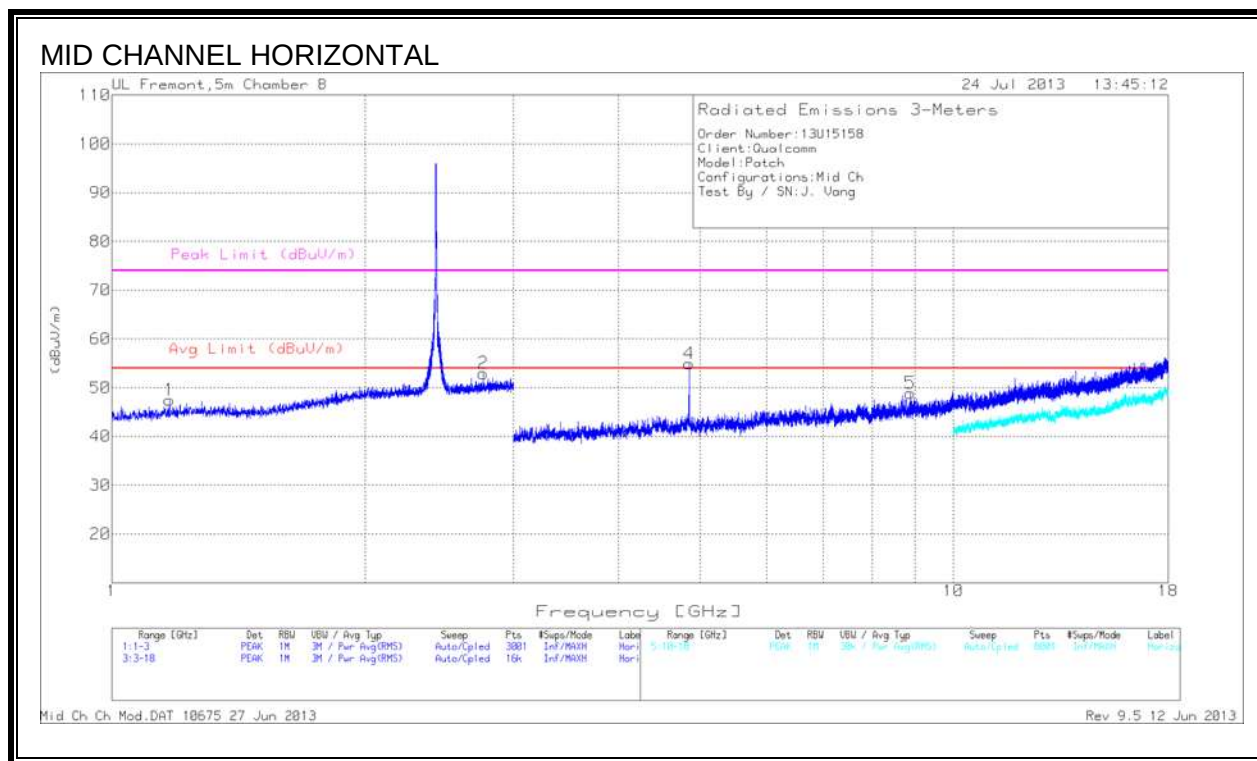
Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl /Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
**1.884	43.71	PK	31	-24.2	50.51	-	-	68.2	-17.69	0-360	200	H
1.115	45.79	PK	28	-25.3	48.49	53.97	-5.48	74	-25.51	0-360	100	V
1.303	44.2	PK	28.5	-25.1	47.6	53.97	-6.37	74	-26.4	0-360	100	V
4.804	48.46	PK	34.7	-29.4	53.76	53.97	-0.21	74	-20.24	0-360	100	H
4.328	42.76	PK	34.2	-31.5	45.46	53.97	-8.51	74	-28.54	0-360	100	V
4.804	43.6	PK	34.7	-29.4	48.9	53.97	-5.07	74	-25.1	0-360	100	V

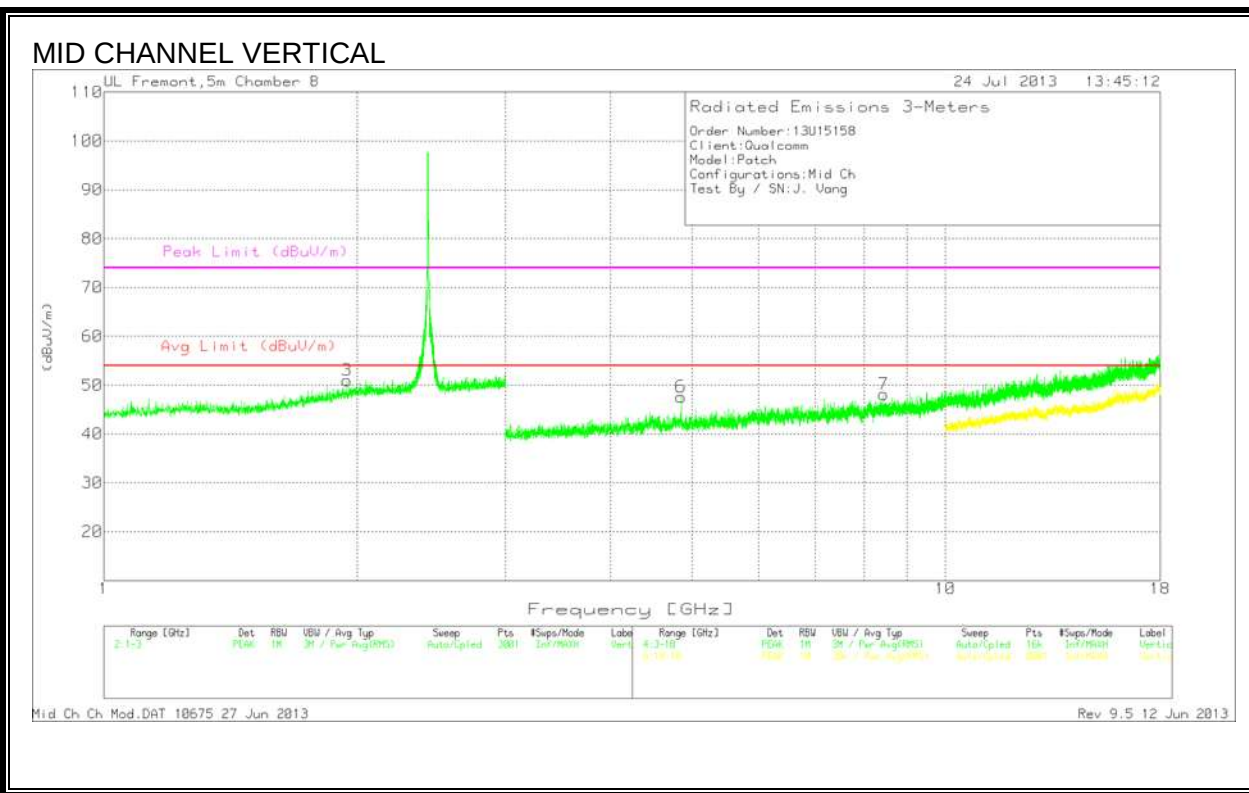
**Nonrestricted Band

PK - Peak detector

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl /Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1.117	30.11	Av	28	-25.3	32.81	53.97	-21.16	-	-	321	136	V
4.804	46.05	Av	34.7	-29.5	51.25	53.97	-2.72	-	-	350	132	H
4.804	37.17	Av	34.7	-29.4	42.47	53.97	-11.5	-	-	41	141	V

Av - Average detection





MID CHANNEL DATA

Trace Markers

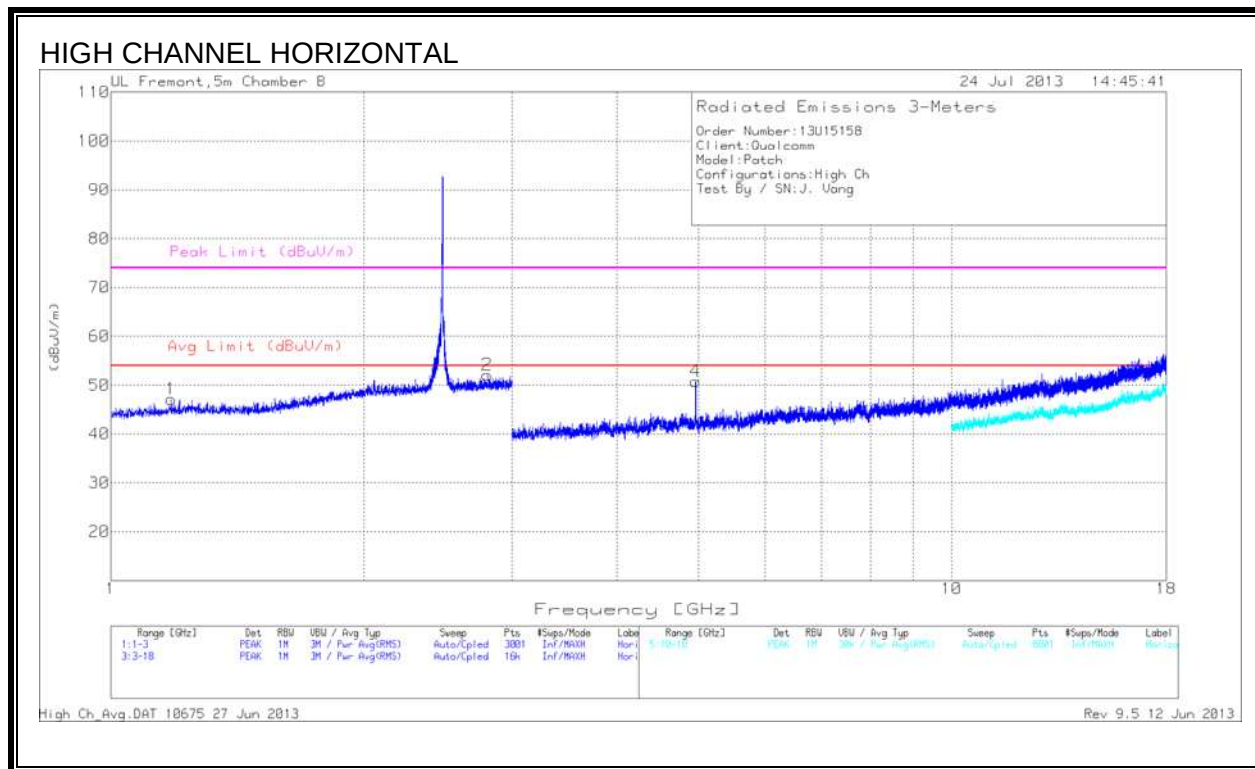
Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl /Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1.171	44.33	PK	28.2	-25.1	47.43	53.97	-6.54	74	-26.57	0-360	200	H
2.761	42.92	PK	32.8	-22.8	52.92	53.97	-1.05	74	-21.08	0-360	100	H
**1.945	43.57	PK	31.4	-24	50.97	-	-	68.2	-17.23	0-360	200	V
4.851	50.68	PK	34.7	-30.5	54.88	53.97	0.91	74	-19.12	0-360	100	H
**8.884	37.83	PK	36.6	-25.6	48.83	-	-	68.2	-19.37	0-360	200	H
4.851	43.38	PK	34.7	-30.5	47.58	53.97	-6.39	74	-26.42	0-360	200	V
8.449	37.64	PK	36.2	-25.7	48.14	53.97	-5.83	74	-25.86	0-360	100	V

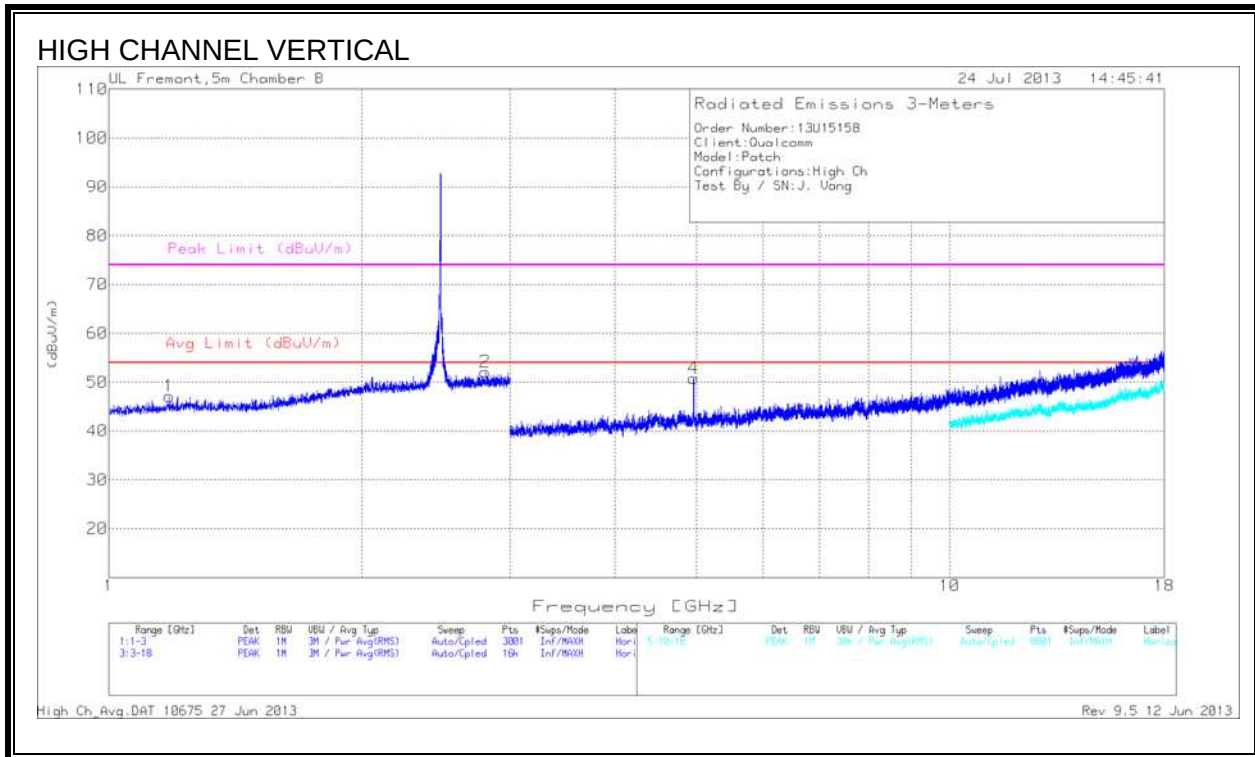
**Nonrestricted Band

PK - Peak detector

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl /Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2.762	17.52	Av	32.8	-22.8	27.52	53.97	-26.45	-	-	154	135	H
4.852	43.44	Av	34.7	-30.6	47.54	53.97	-6.43	-	-	79	160	H

Av - Average detection





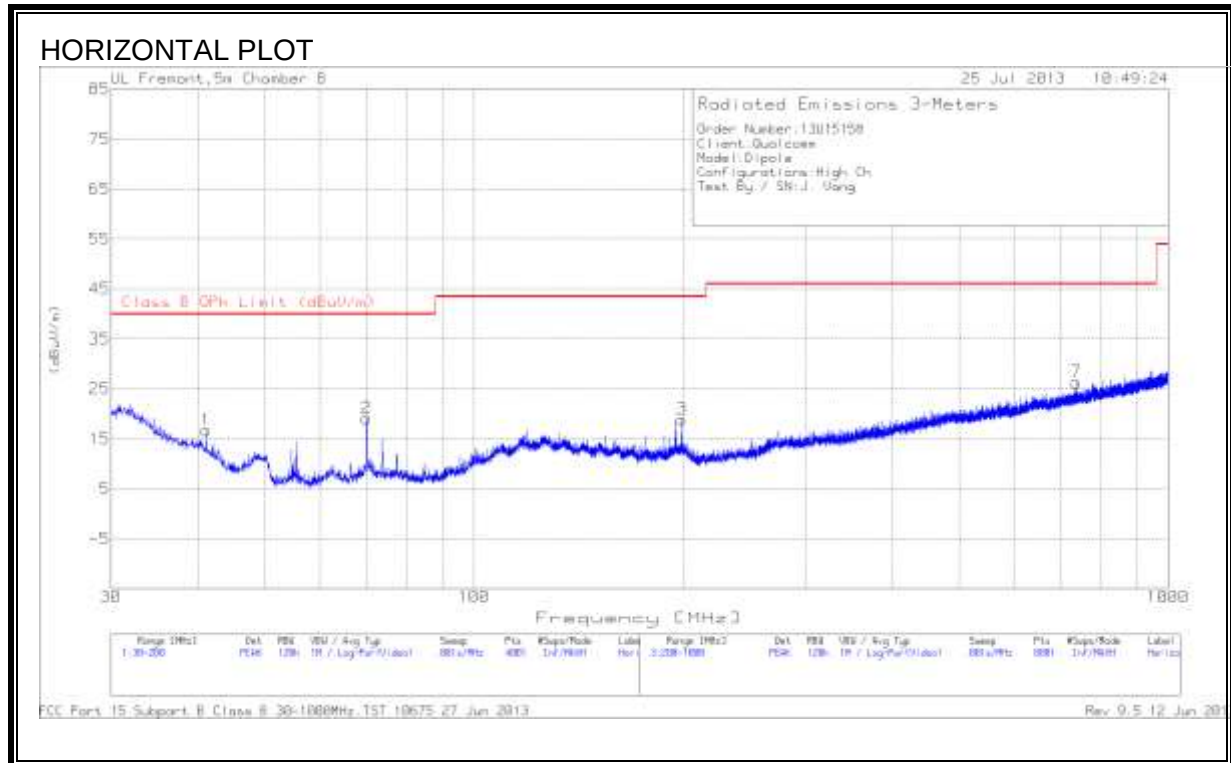
HIGH CHANNEL DATA

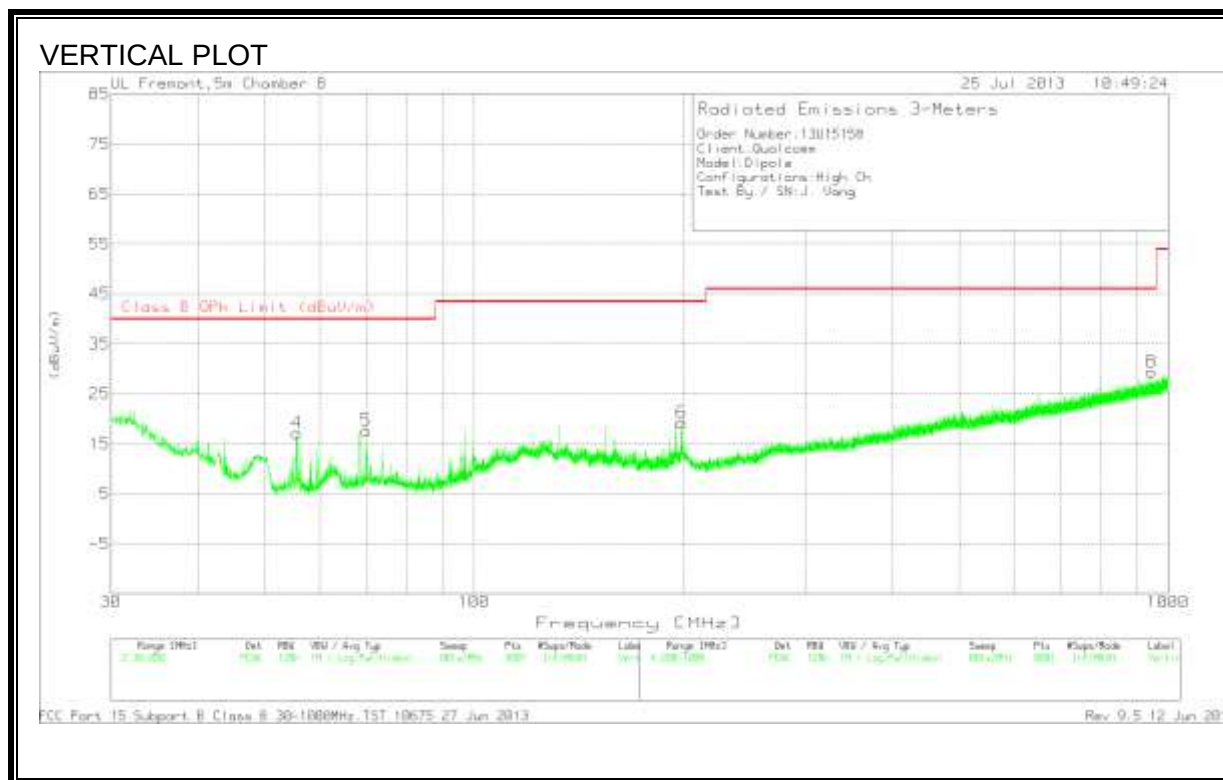
Trace Markers												
Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl /Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1.18	44.01	PK	28.3	-25.2	47.11	53.97	-6.86	74	-26.89	0-360	200	H
2.804	41.55	PK	32.9	-22.4	52.05	-	-	68.2	-16.15	0-360	200	H
**1.853	43.25	PK	30.8	-24.1	49.95	53.97	-4.02	74	-24.05	0-360	200	V
4.959	46.47	PK	34.6	-30.3	50.77	53.97	-3.2	74	-23.23	0-360	100	H
**4.405	40.88	PK	34.3	-30.5	44.68	-	-	68.2	-23.52	0-360	200	V
8.483	38.03	PK	36.2	-25.9	48.33	53.97	-5.64	74	-25.67	0-360	100	V
**Nonrestricted Band												
PK - Peak detector												
Frequency (GHz)	Meter Reading (dBuV)	Det	AF T345 (dB/m)	Amp/Cbl /Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2.795	17.26	Av	32.9	-22.8	27.36	53.97	-26.61	-	-	306	106	H
4.961	38.97	Av	34.6	-30.3	43.27	53.97	-10.7	-	-	89	100	H
8.486	14.37	Av	36.2	-26	24.57	53.97	-29.4	-	-	214	297	V
Av - Average detection												

8.3. WORST-CASE BELOW 1 GHz WITH DIPOLE ANTENNA

8.3.1. BELOW 1 GHz WITH DIPOLE ANTENNA

SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION)





WORST CASE BELOW 1GHz DATA

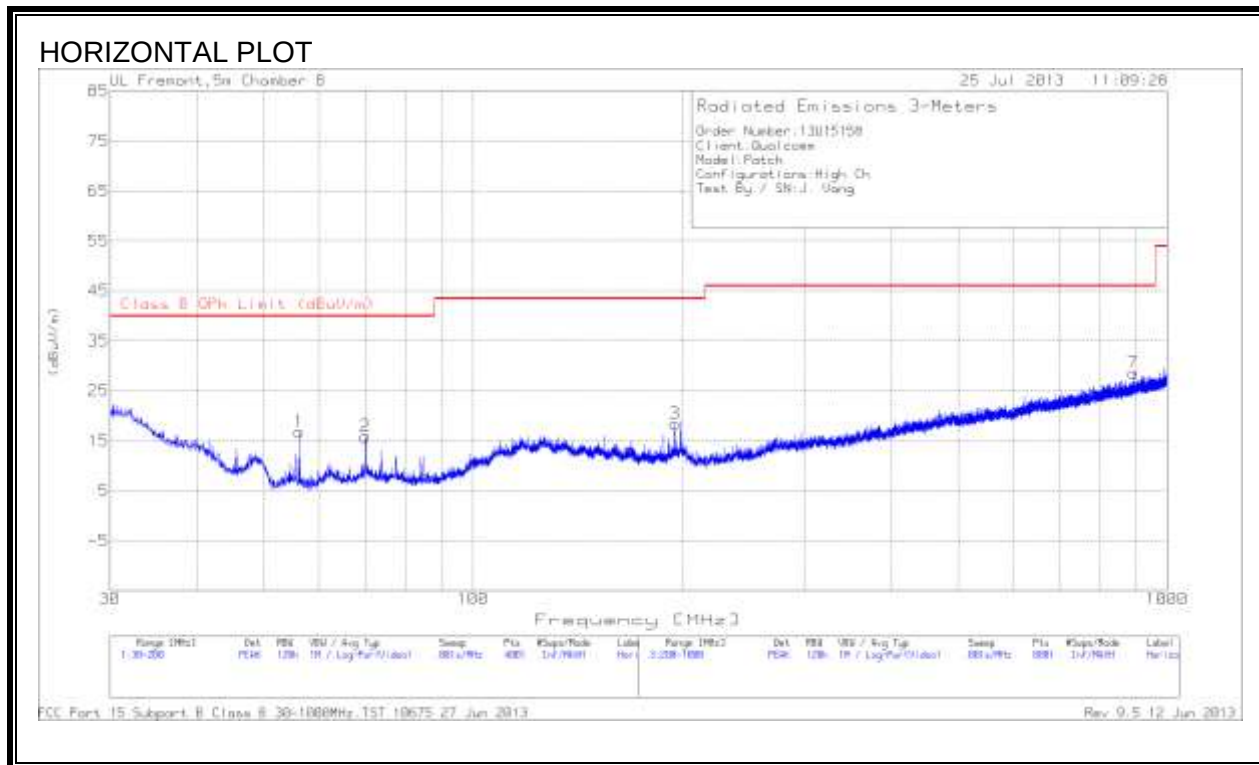
Trace Markers

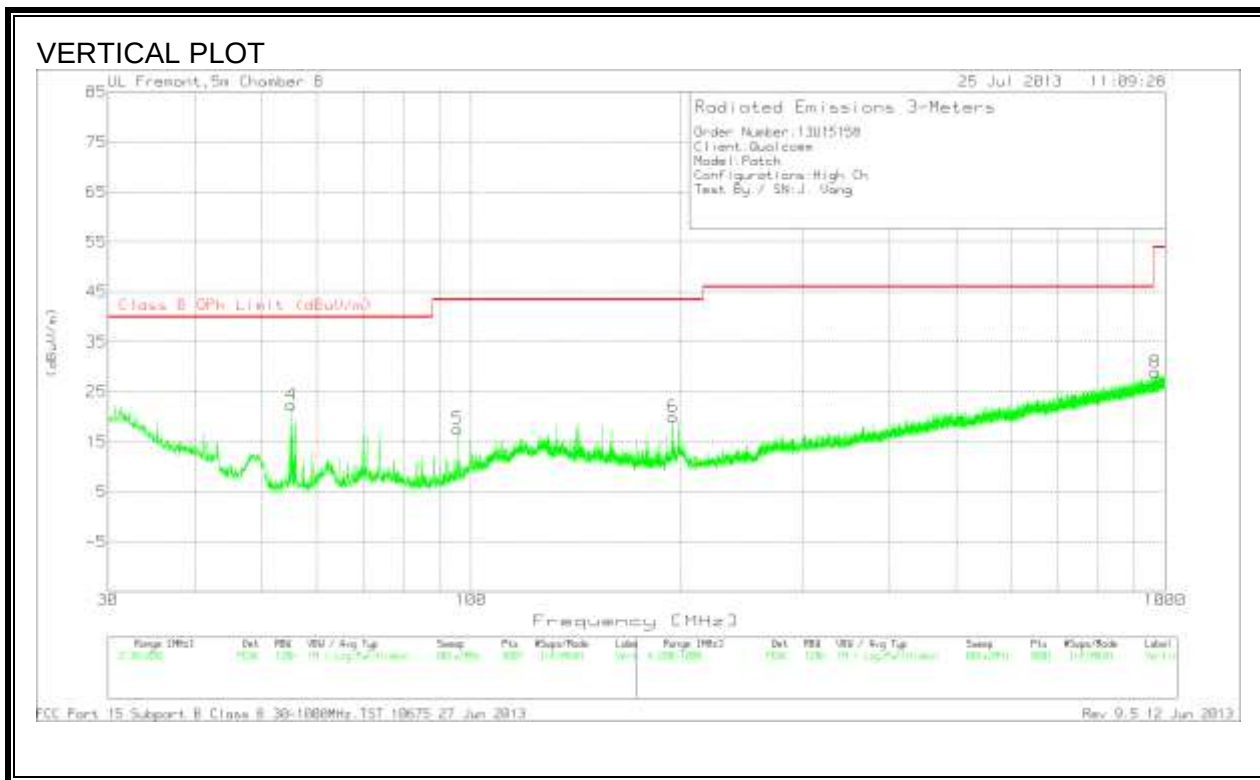
Frequency (MHz)	Meter Reading (dBuV)	Det	AF T243 (dB/m)	Amp/Cbl /Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Class B QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
41.135	32.8	PK	12.6	-28.7	16.7	40	-23.3	0-360	200	H
70.035	39.59	PK	7.9	-28.4	19.09	40	-20.91	0-360	100	H
199.065	33.63	PK	12.3	-27	18.93	43.52	-24.59	0-360	100	H
55.585	38.82	PK	6.9	-28.6	17.12	40	-22.88	0-360	100	V
69.9925	38.11	PK	7.9	-28.4	17.61	40	-22.39	0-360	100	V
199.065	33.93	PK	12.3	-27	19.23	43.52	-24.29	0-360	100	V
737.5	30.2	PK	20.5	-24.4	26.3	46.02	-19.72	0-360	100	H
945.6	29.46	PK	22.7	-22.8	29.36	46.02	-16.66	0-360	200	V

PK - Peak detector

8.3.2. BELOW 1 GHz WITH PATCH ANTENNA

SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION)





WORST CASE BELOW 1GHz DATA

Trace Markers

Frequency (MHz)	Meter Reading (dBuV)	Det	AF T243 (dB/m)	Amp/Cbl /Filtr/Pad (dB)	Corrected Reading (dBuV/m)	Class B QPk Limit (dBuV/m)	Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
56.2225	38.47	PK	6.9	-28.6	16.77	40	-23.23	0-360	200	H
70.035	36.36	PK	7.9	-28.4	15.86	40	-24.14	0-360	100	H
195.3675	33.7	PK	11.7	-27	18.4	43.52	-25.12	0-360	100	H
55.1175	44.11	PK	6.8	-28.6	22.31	40	-17.69	0-360	100	V
95.62	36.84	PK	8.8	-28.1	17.54	43.52	-25.98	0-360	100	V
195.3675	35.25	PK	11.7	-27	19.95	43.52	-23.57	0-360	100	V
894.1	29.74	PK	22.1	-23.2	28.64	46.02	-17.38	0-360	400	H
967.8	28.73	PK	22.8	-22.6	28.93	53.97	-25.04	0-360	400	V

PK - Peak detector

9. MOBILE CONFIGURATION RF EXPOSURE

9.1. FCC RULES

§1.1310 The criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*(900/f ²)	6
30–300	61.4	0.163	1.0	6
300–1500			f/300	6
1500–100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f ²)	30

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)—Continued

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
30–300	27.5	0.073	0.2	30
300–1500			f/1500	30
1500–100,000			1.0	30

f = frequency in MHz

* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

9.2. IC RULES

IC Safety Code 6, Section 2.2.1 (a) A person other than an RF and microwave exposed worker shall not be exposed to electromagnetic radiation in a frequency band listed in Column 1 of Table 5, if the field strength exceeds the value given in Column 2 or 3 of Table 5, when averaged spatially and over time, or if the power density exceeds the value given in Column 4 of Table 5, when averaged spatially and over time.

Table 5
Exposure Limits for Persons Not Classified As RF and Microwave Exposed Workers (Including the General Public)

1 Frequency (MHz)	2 Electric Field Strength; rms (V/m)	3 Magnetic Field Strength; rms (A/m)	4 Power Density (W/m ²)	5 Averaging Time (min)
0.003–1	280	2.19		6
1–10	$280/f$	$2.19/f$		6
10–30	28	$2.19/f$		6
30–300	28	0.073	2*	6
300–1 500	$1.585f^{0.5}$	$0.0042f^{0.5}$	$f/150$	6
1 500–15 000	61.4	0.163	10	6
15 000–150 000	61.4	0.163	10	$616\,000/f^{1.2}$
150 000–300 000	$0.158f^{0.5}$	$4.21 \times 10^{-4}f^{0.5}$	$6.67 \times 10^{-5}f$	$616\,000/f^{1.2}$

* Power density limit is applicable at frequencies greater than 100 MHz.

Notes: 1. Frequency, f , is in MHz.
2. A power density of 10 W/m² is equivalent to 1 mW/cm².
3. A magnetic field strength of 1 A/m corresponds to 1.257 microtesla (μT) or 12.57 milligauss (mG).

9.3. EQUATIONS

POWER DENSITY

Power density is given by:

$$S = \text{EIRP} / (4 * \text{Pi} * D^2)$$

Where

S = Power density in mW/cm²

EIRP = Equivalent Isotropic Radiated Power in mW

D = Separation distance in cm

Power density in units of mW/cm² is converted to units of W/m² by multiplying by 10.

DISTANCE

Distance is given by:

$$D = \text{SQRT} (\text{EIRP} / (4 * \text{Pi} * S))$$

Where

D = Separation distance in cm

EIRP = Equivalent Isotropic Radiated Power in mW

S = Power density in mW/cm²

SOURCE-BASED DUTY CYCLE

Where applicable (for example, multi-slot cell phone applications) a duty cycle factor may be applied.

$$\text{Source-based time-averaged EIRP} = (\text{DC} / 100) * \text{EIRP}$$

Where

DC = Duty Cycle in %, as applicable

EIRP = Equivalent Isotropic Radiated Power in W

9.4. LIMITS

VARIABLE LIMITS

For mobile radio equipment operating in the cellular phone band, the lowest power density limit is calculated using the lowest frequency:

$$824 \text{ MHz} / 1500 = 0.55 \text{ mW/cm}^2 \text{ (FCC)}$$

$$824 \text{ MHz} / 150 = 5.5 \text{ W/m}^2 \text{ (IC)}.$$

FIXED LIMITS

For operation in the PCS band, the 2.4 GHz band and the 5 GHz bands:

From FCC §1.1310 Table 1 (B), the maximum value of $S = 1.0 \text{ mW/cm}^2$

From IC Safety Code 6, Section 2.2 Table 5 Column 4, $S = 10 \text{ W/m}^2$

INDUSTRY CANADA EXEMPTION LIMITS

RSS-102 Clause 2.5.2: RF exposure evaluation is required if the separation distance between the user and the device's radiating element is greater than 20 cm, except when the device operates as follows:

- below 1.5 GHz and the maximum e.i.r.p. of the device is equal to or less than 2.5 W;
- at or above 1.5 GHz and the maximum e.i.r.p. of the device is equal to or less than 5 W.

9.5. RESULTS

In the table(s) below, Power and Gain are entered in units of dBm and dBi respectively and conversions to linear forms are used for the calculations.

Single Chain and non-colocated transmitters								
Band	Mode	Separation Distance (cm)	Output Power (dBm)	Antenna Gain (dBi)	Duty Cycle (%)	EIRP (mW)	FCC Power Density (mW/cm ²)	IC Power Density (W/m ²)
2.4 GHz	BLE	20	0.66	1.00	100.0	1.5	0.0003	0.003

The device operates above 1.5 GHz and the maximum e.i.r.p. is less than 5 W therefore the device is exempt from Industry Canada RF exposure evaluation.

10. PORTABLE CONFIGURATION RF EXPOSURE

10.1. FCC SAR TEST EXCLUSION THRESHOLD LIMITS

Section 4.3.1 of KDB 447498 D01 General RF Exposure Guidance v05: the 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by::

$$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test sep. distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$$

Where:

max. power of channel is rounded to the nearest mW

min. test separation distance is the greater of 5 mm and the actual minimum separation distance (rounded to the nearest mm)

10.2. FCC RESULTS

An assessment was made using the above-stated formula to determine Bluetooth's eligibility for SAR test exclusion, and this process is illustrated in the table below:

1. Determining values for the variables				
	Max. Power of Channel		Min. Test Separation Distance (mm)	Frequency (GHz)
	(dBm)	(mW)		
Measured or Actual Value	0.66	1.16	0.0	2.441
Value used for Computation	N/A	1	5	2.441
2. Assigning the determined values to the formula, arriving at:				
Expression			Result	
[(1mW)/(5 mm)] [$\sqrt{2.441(\text{GHz})}$]			0.3	

The computed value is < 3 ; therefore the device qualifies for FCC Standalone SAR test exclusion.

10.3. IC SAR EXEMPTION LIMITS

RSS-102 Clause 2.5.1 SAR evaluation is required if the separation distance between the user and the radiating element of the device is less than or equal to 20 cm, except when the device operates as follows:

- from 3 kHz up to 1 GHz inclusively, and with output power (i.e. the higher of the conducted or equivalent isotropically radiated power (e.i.r.p.) source-based, time-averaged output power) that is less than or equal to 200 mW for general public use and 1000 mW for controlled use;
- above 1 GHz and up to 2.2 GHz inclusively, and with output power (i.e. the higher of the conducted or radiated (e.i.r.p.) source-based, time-averaged output power) that is less than or equal to 100 mW for general public use and 500 mW for controlled use;
- above 2.2 GHz and up to 3 GHz inclusively, and with output power (i.e. the higher of the conducted or radiated (e.i.r.p.) source-based, time-averaged output power) that is less than or equal to 20 mW for general public use and 100 mW for controlled use;
- above 3 GHz and up to 6 GHz inclusively, and with output power (i.e. the higher of the conducted or radiated (e.i.r.p.) source-based, time-averaged output power) that is less than or equal to 10 mW for general public use and 50 mW for controlled use.

10.4. IC RESULTS

The device operates between 2.2 and 3 GHz and the higher of the conducted and radiated (e.i.r.p.) source-based, time-averaged output power is less than 100 mW therefore the device is exempt from Industry Canada SAR evaluation.