



**FCC 47 CFR PART 15 SUBPART C  
INDUSTRY CANADA RSS-210 ISSUE 8  
CLASS II PERMISSIVE CHANGE  
CERTIFICATION TEST REPORT**

**FOR**

**3G/UNLICENSED WIRELESS HUB**

**MODEL NUMBER: QWH-HUB-V1.0A**

**FCC ID: J9C2NET  
IC: 2723A-2NET**

**REPORT NUMBER: 14U17164-1, REVISION A**

**ISSUE DATE: MARCH 4, 2014**

*Prepared for*

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**NVLAP LAB CODE 200065-0**

Revision History

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--	02/26/2014	Initial Issue	G. QUIZON
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# 1. ATTESTATION OF TEST RESULTS

**COMPANY NAME:** QUALCOMM TECHNOLOGIES INC.  
5775 MOREHOUSE DR  
SAN DIEGO, CA 92121-1714

**EUT DESCRIPTION:** 3G/UNLICENSED WIRELESS HUB

**MODEL:** QWH-HUB-V1.0A

**SERIAL NUMBER:** QUALC00100014806, (CONDUCTED)  
QUALC00100014735, (RADIATED)  
QUALC00100014807, (RADIATED)

**DATE TESTED:** February 21 - 26, 2014

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:



George Quizon  
PROJECT LEAD  
UL Verification Services Inc.

Danny Vu  
LAB TECHNICIAN  
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.

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

47173 Benicia Street	47266 Benicia Street
<input checked="" type="checkbox"/> Chamber A	<input type="checkbox"/> Chamber D
<input type="checkbox"/> Chamber B	<input type="checkbox"/> Chamber E
<input type="checkbox"/> Chamber C	<input type="checkbox"/> Chamber F

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/2000650.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:

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

### 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 a 3G/unlicensed Wireless Hub with WLAN/ Bluetooth/BLE

The radio module is manufactured by Qualcomm.

### 5.2. DESCRIPTION OF CLASS II PERMISSIVE CHANGE

This scope of the Class II permissive change is to add Bluetooth BLE mode.

### 5.3. 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	1.97	1.57

### 5.4. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an internal PIFA antenna, with a maximum gain of 3.8 dBi.

### 5.5. SOFTWARE AND FIRMWARE

The test utility software used during testing was 2net low level command.

## **5.6. WORST-CASE CONFIGURATION AND MODE**

Radiated emission and power line conducted emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

For Radiated Emission below 1 GHz, do the testing for EUT with each antenna.  
One data sheet is enough for all modes; pick the channel among all modes that has the highest conducted output power.

For Fundamental investigation, Since the EUT is portable device that have three orientation, X, Y, and Z orientations have been investigated, and the worst case found to be at Y orientation.

## 5.7. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

Support Equipment List				
Description	Manufacturer	Model	Serial Number	FCC ID
Laptop w/ Power Supply	HP Compaq	EliteBook 8460P	PPD-WCN3660	-

### I/O CABLES

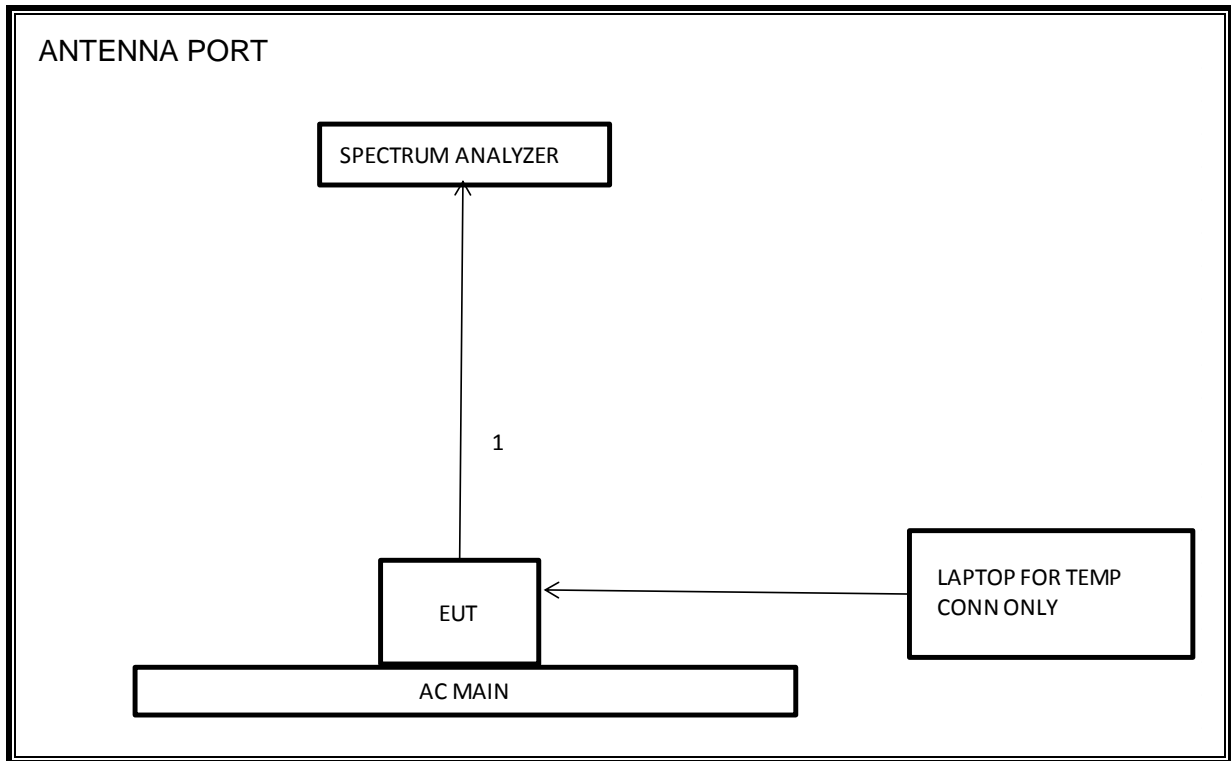
I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	BT RF Out	1	SMA	Shielded	60 Cm	For testing only/ Not part of final product
2	USB	1	USB	Unshielded	1.8m	For testing only/ Not part of final product
3	AC	1	US 115V	Shielded	1.5m	

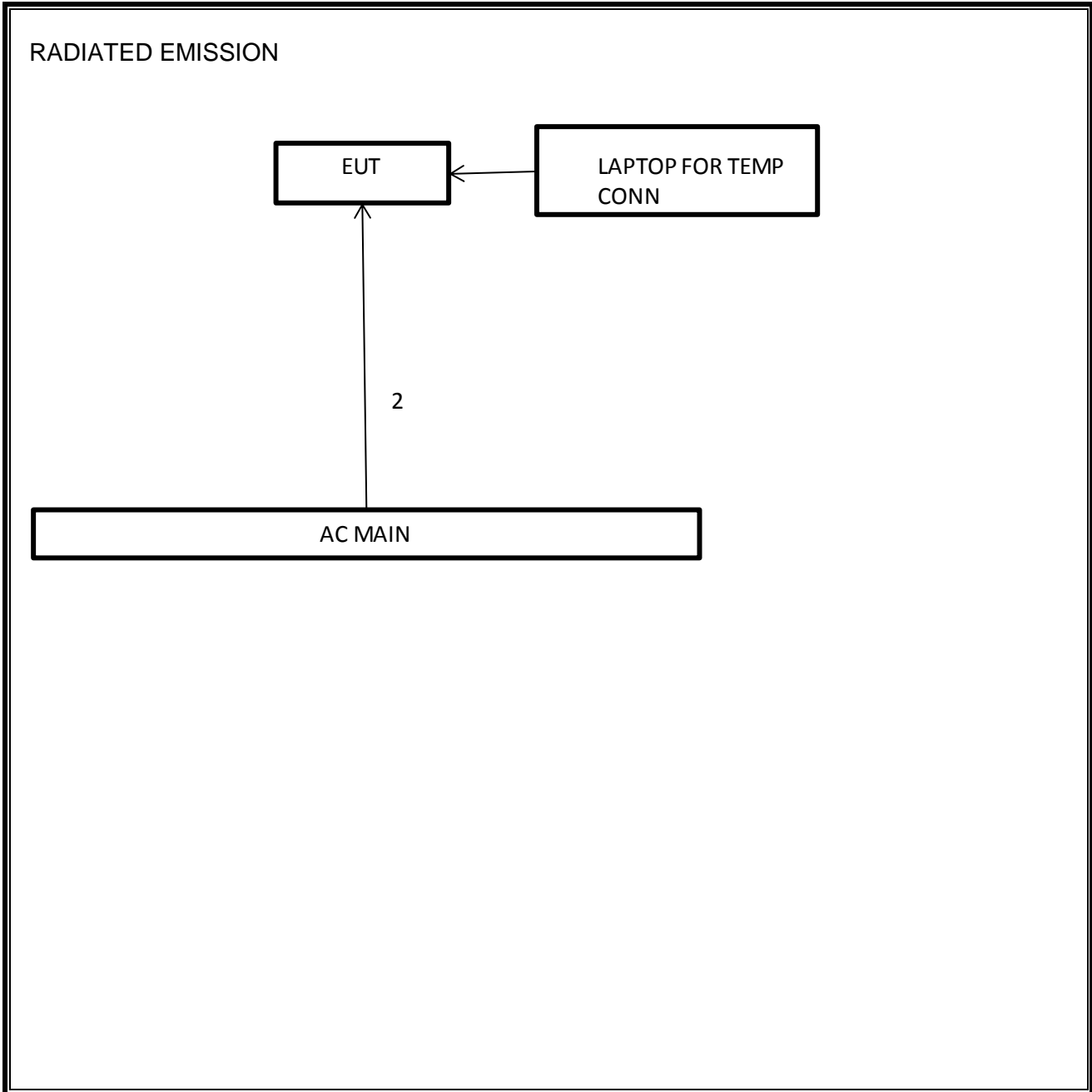
### TEST SETUP

The EUT is set to transmit in BLE mode by connecting to a laptop via a USB cable and entering the appropriate script commands in the DOS CMD window.



**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, 44GHz	Agilent	E446A	C00986	04/01/13	04/01/14
Spectrum Analyzer, 26.5GHz	Agilent	E440A	C001176	12/13/12	12/13/14
Attenuator/Switch Driver	Agilent	11713A	F00203	CNR	CNR
Attenuator/Switch Driver	Agilent	11713A	F00202	CNR	CNR
Peak Power Meter	Agilent	N1911A	F00021	04/03/13	04/03/14
Peak and Average Power Sensor	Agilent	E9323A	F00163	04/03/13	04/03/14
Antenna, Bilog, 30MHz-1GHz	Sunol	JB1	C01016	08/22/13	08/22/14
Antenna, Horn, 18GHz	ETS	3117	C01005	03/20/13	03/20/14
Antenna, Horn, 18GHz	ETS	3117	C01022	2/21/2013	2/21/2014
Antenna, Horn, 18- 26 GHz	ARA	MWH-1826/B	C00946	11/12/12	11/12/13
PreAmplifer 1300MHz	Agilent	8447D	C00885	01/16/13	01/16/14
PreAmplifer 1-18GHz	Miteq	T742	F00354	08/24/13	08/24/14
RF Preamplifier, 1GHz - 18GHz	Miteq	T739	F00351	06/27/13	06/27/14
High Pass Filter	Mictro-Tronics	HPM17543	F00182	04/13/13	04/13/14
Low Pass Filter	Mictro-Tronics	LPS17541	F00175	08/24/13	08/24/14
LISN, 10kHz-30MHz	Solar	8012-50-R-24-BNC	N02481	05/09/13	05/09/14

## 7. ANTENNA PORT TEST RESULTS

## 8. ON TIME, DUTY CYCLE AND MEASUREMENT METHODS

### LIMITS

None; for reporting purposes only.

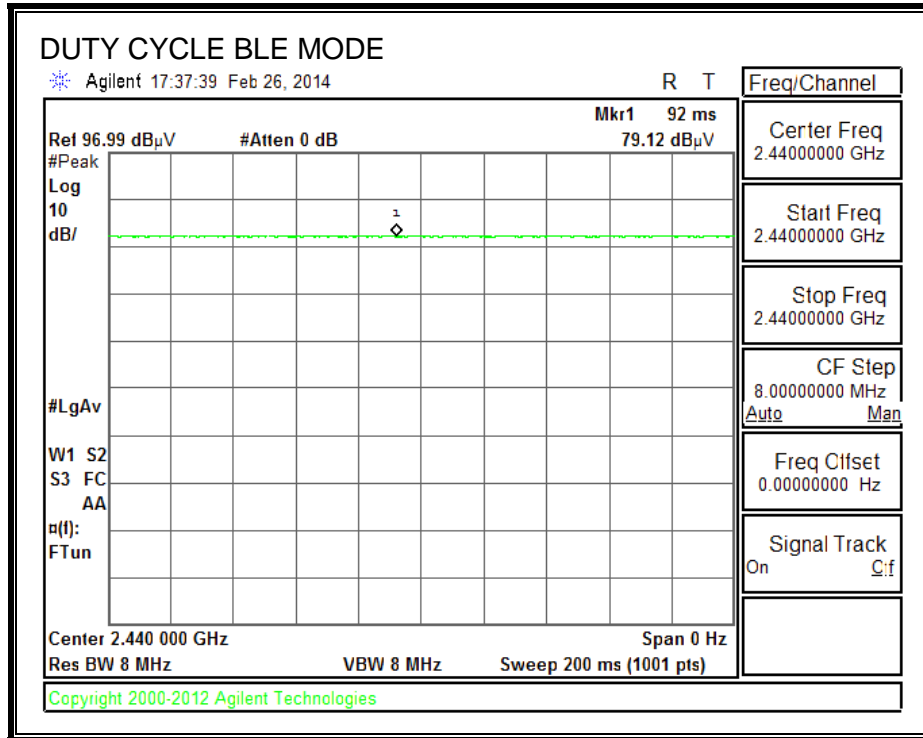
### PROCEDURE

KDB 558074 Zero-Span Spectrum Analyzer Method.

### 8.1. ON TIME AND DUTY CYCLE RESULTS

Mode	ON Time B (msec)	Period (msec)	Duty Cycle x (linear)	Duty Cycle (%)	Duty Cycle Correction Factor (dB)	1/B Minimum VBW (kHz)
BLE	92.000	92.000	1.000	100.00%	0.00	0.010

DUTY CYCLE PLOTS



## 8.2. 6 dB BANDWIDTH

### LIMITS

FCC §15.247 (a) (2)

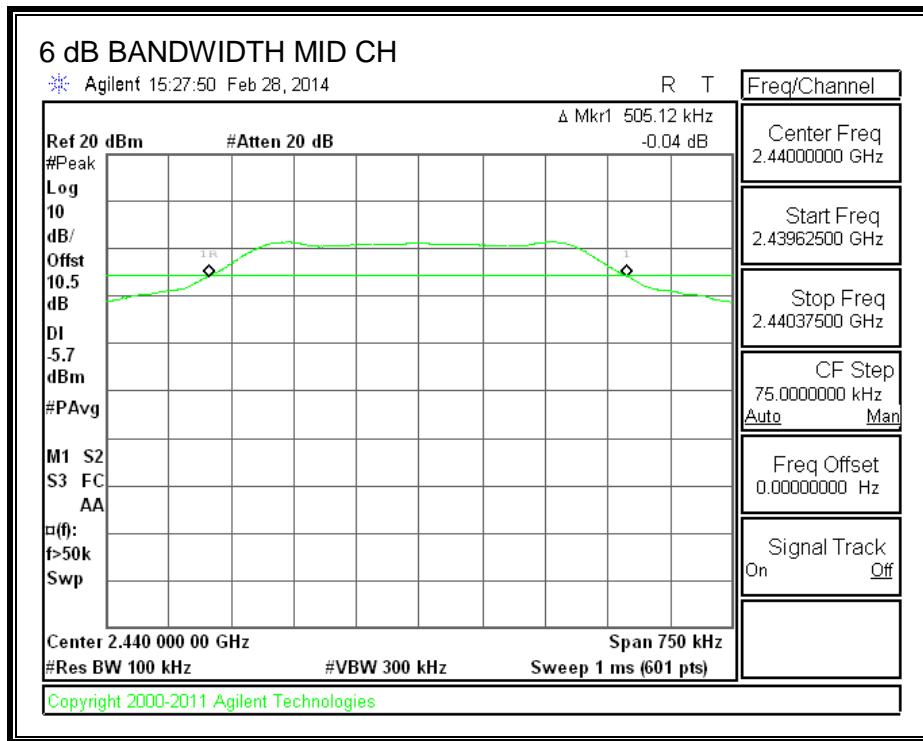
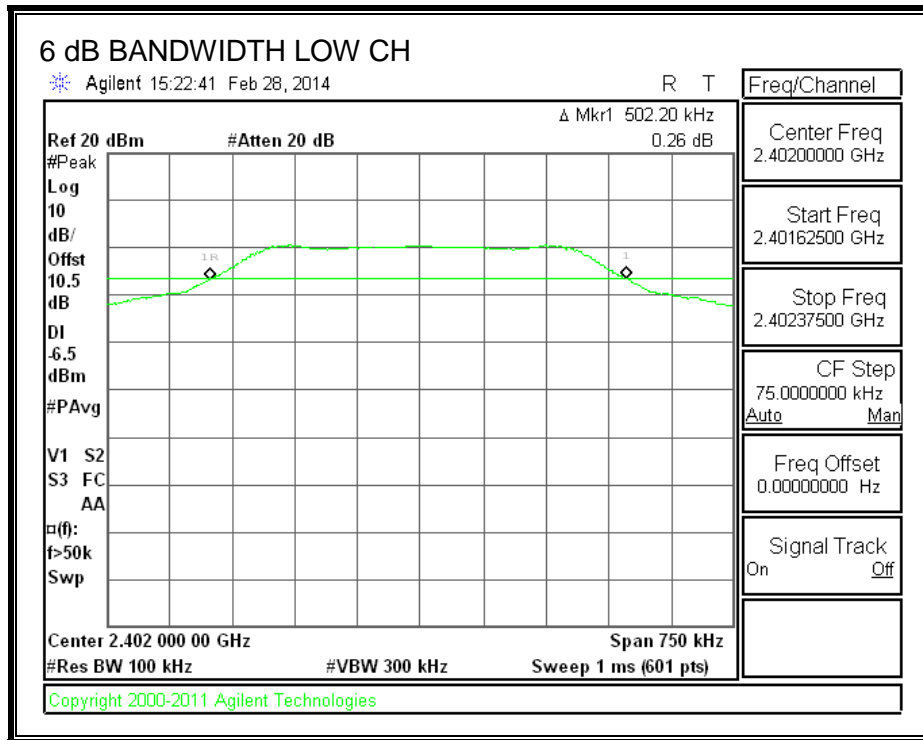
IC RSS-210 A8.2 (a)

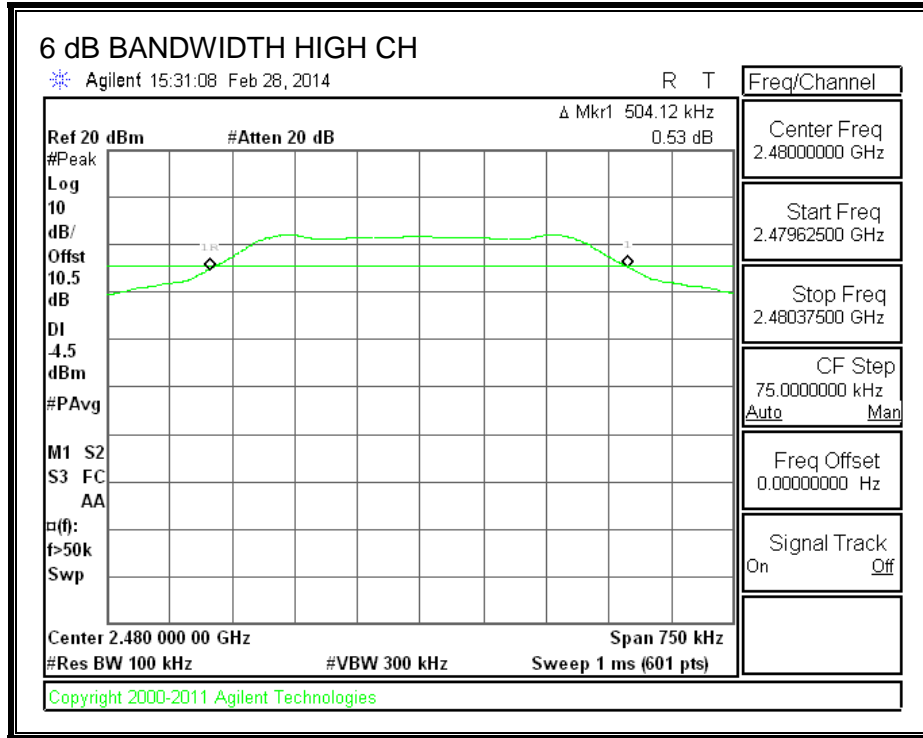
The minimum 6 dB bandwidth shall be at least 500 kHz.

### RESULTS

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	0.5022	0.5
Middle	2440	0.5051	0.5
High	2480	0.5041	0.5

**6 dB BANDWIDTH**







### 8.3. 99% BANDWIDTH

#### LIMITS

None; for reporting purposes only.

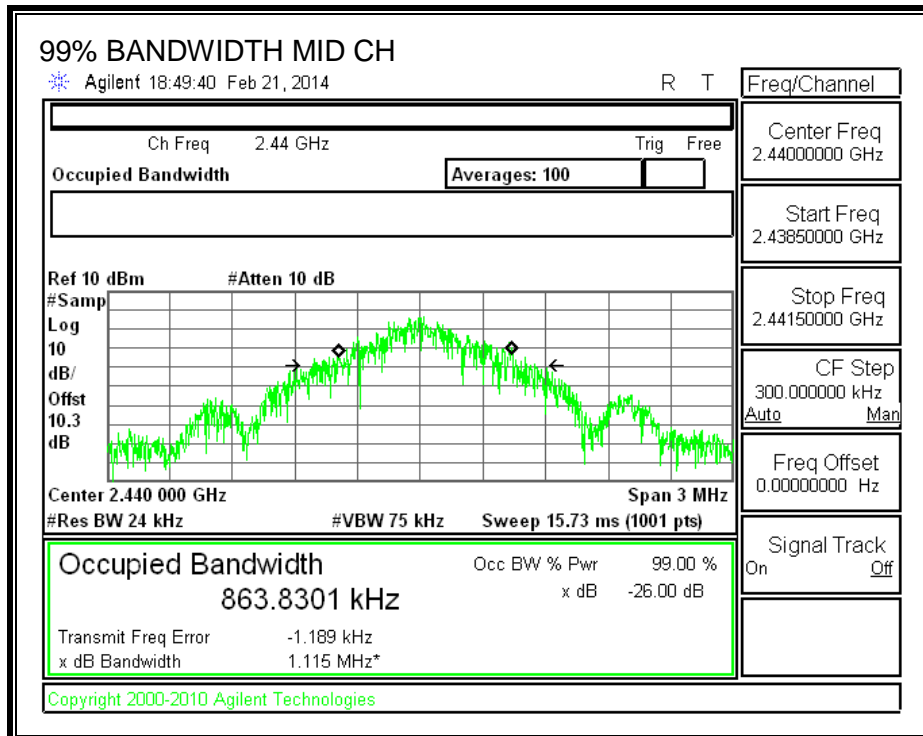
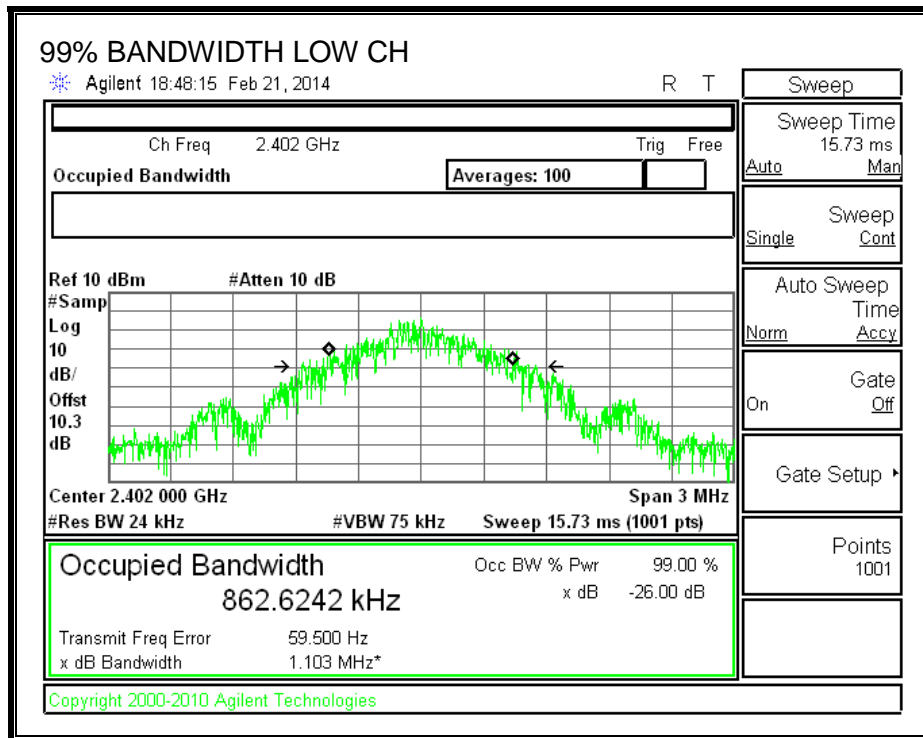
#### TEST PROCEDURE

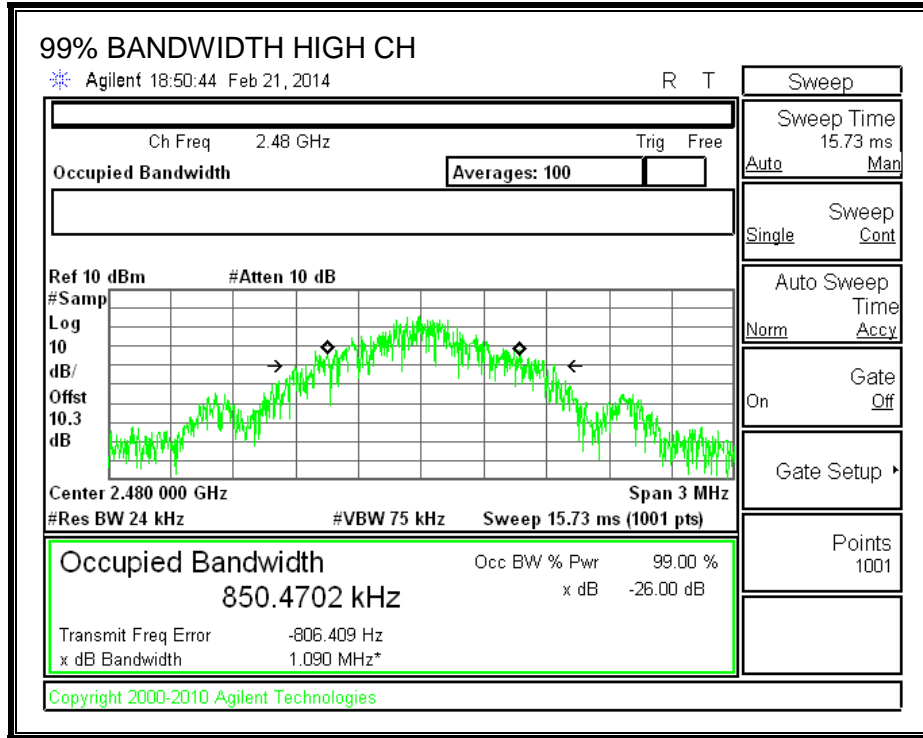
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth and to 1% of the span. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

#### RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	0.8626
Middle	2440	0.8638
High	2480	0.8505

**99% BANDWIDTH**





## 8.4. OUTPUT POWER

### LIMITS

FCC §15.247 (b)

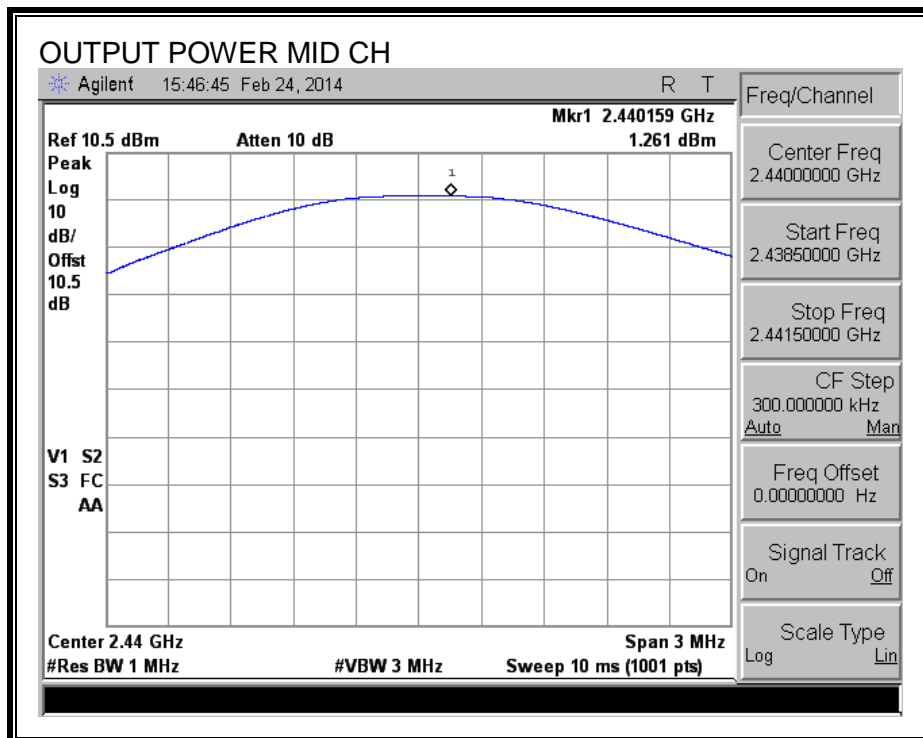
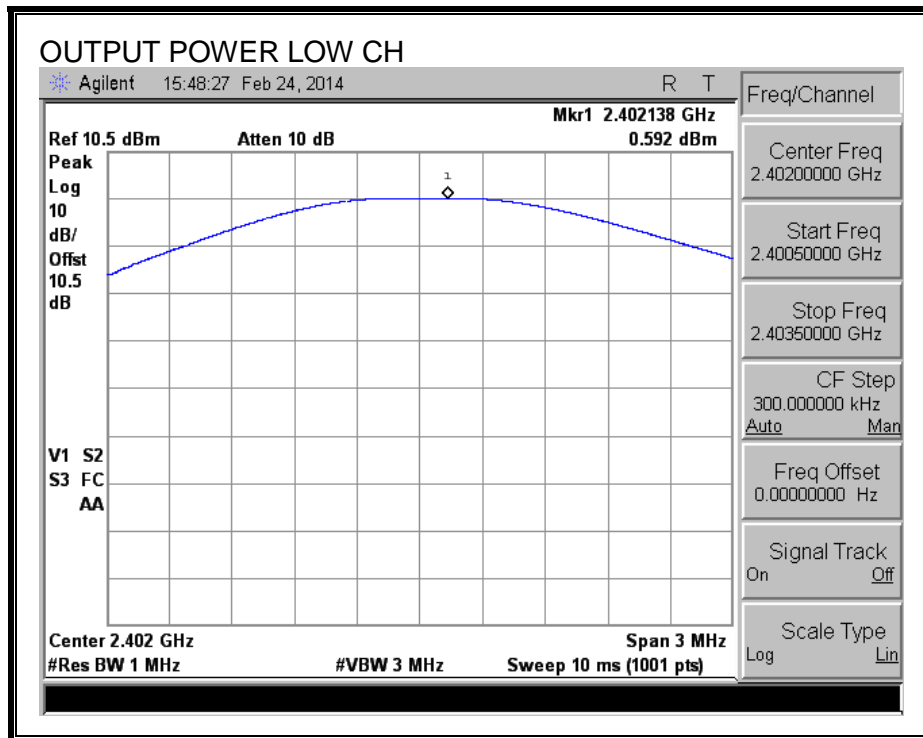
IC RSS-210 A8.4

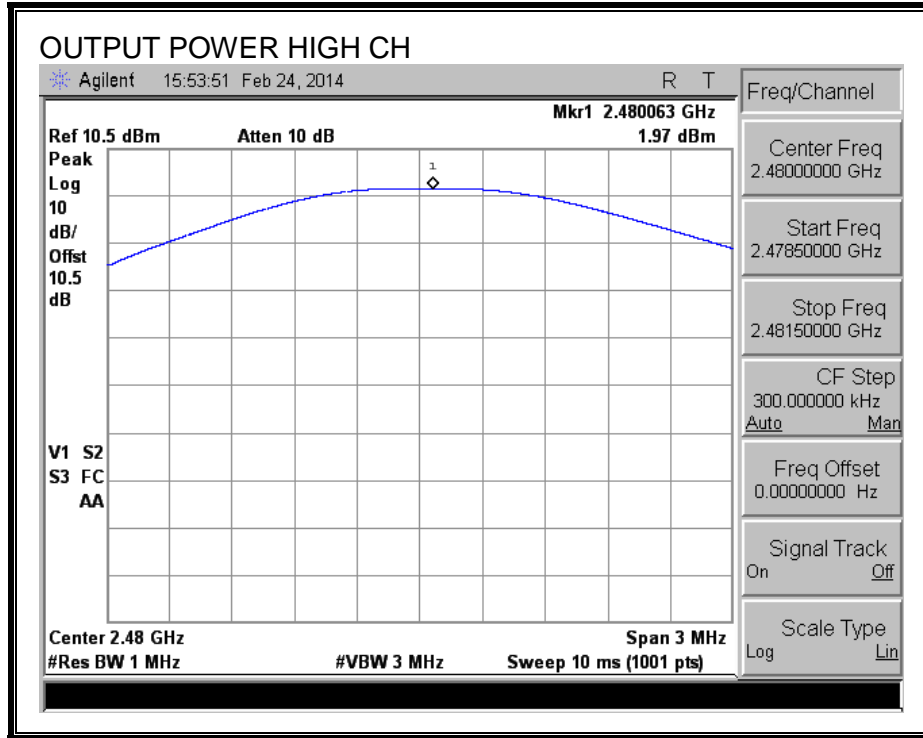
The maximum antenna gain is less than or equal to 6 dBi, therefore the limit is 30 dBm.

### RESULTS

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	0.592	30	-29.408
Middle	2440	1.261	30	-28.739
High	2480	1.970	30	-28.030

**OUTPUT POWER**





## 8.5. AVERAGE POWER

### LIMITS

None; for reporting purposes only.

### RESULTS

The cable assembly insertion loss of 10.5 dB (including 10 dB pad and .5 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	AV power (dBm)
Low	2402	0.52
Middle	2440	1.25
High	2480	1.82

## 8.6. POWER SPECTRAL DENSITY

### LIMITS

FCC §15.247 (e)

IC RSS-210 A8.2 (b)

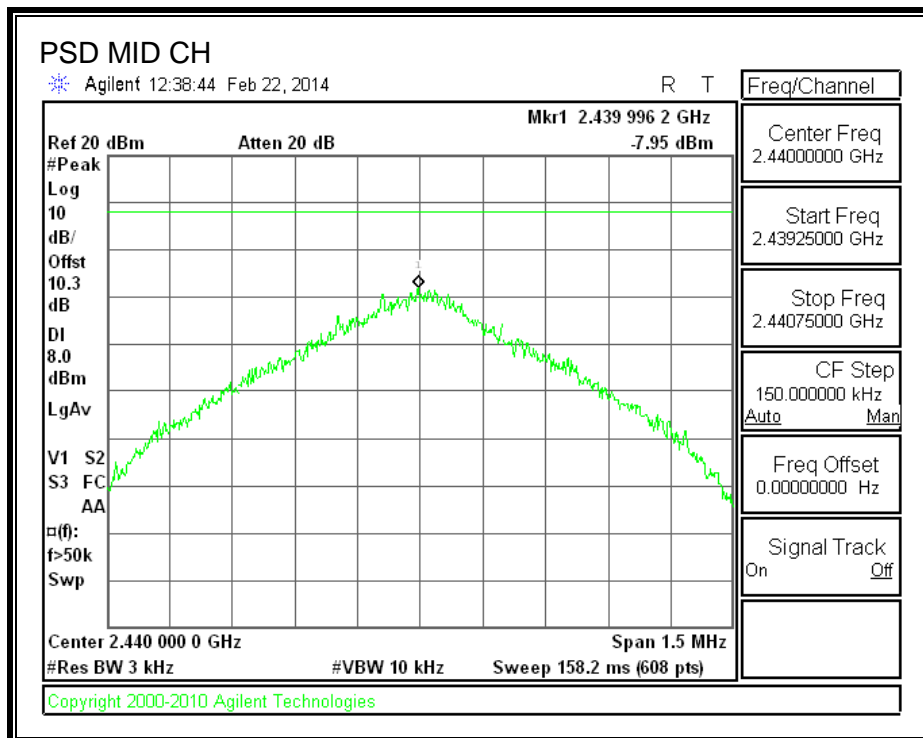
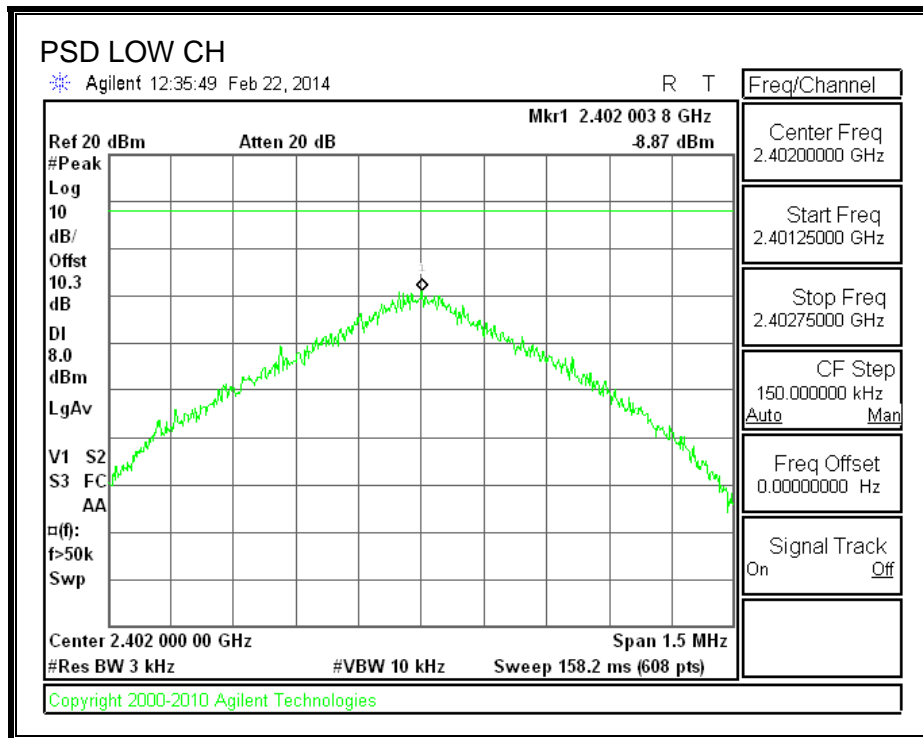
The power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

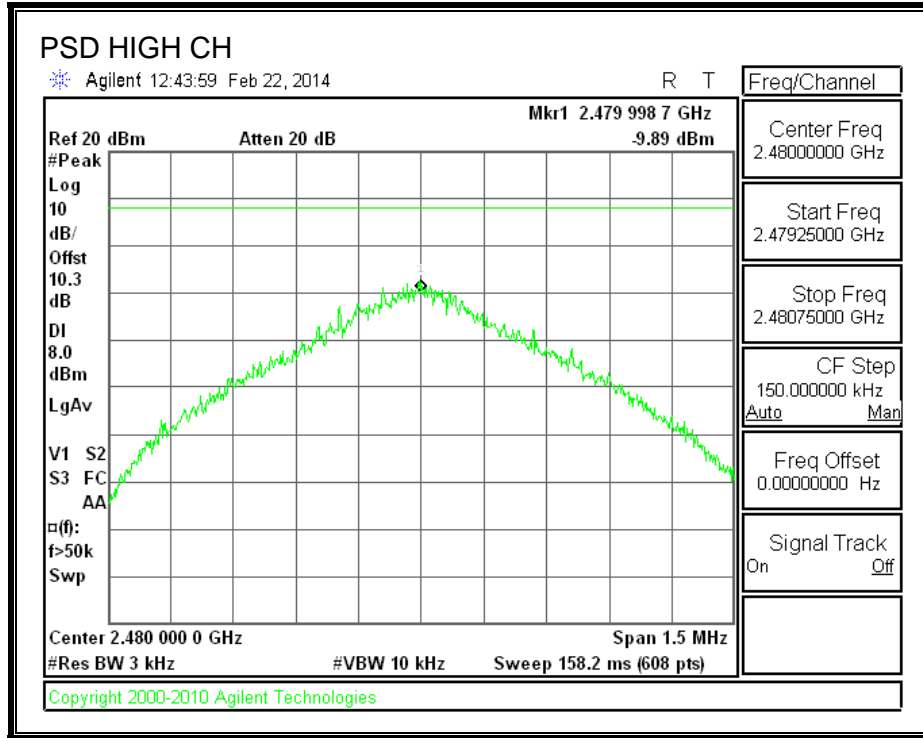
### RESULTS

Channel	Frequency (MHz)	PSD (dBm)	Limit (dBm)	Margin (dB)
Low	2402	-8.87	8	-16.87
Middle	2440	-7.95	8	-15.95
High	2480	-9.89	8	-17.89



**POWER SPECTRAL DENSITY**





## 8.7. CONDUCTED SPURIOUS EMISSIONS

### LIMITS

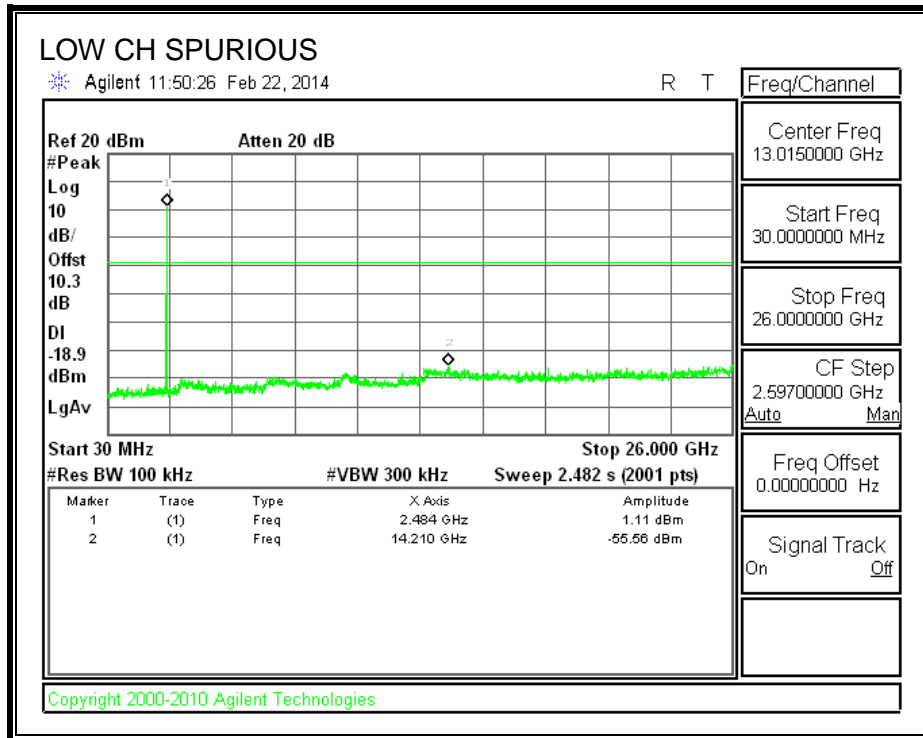
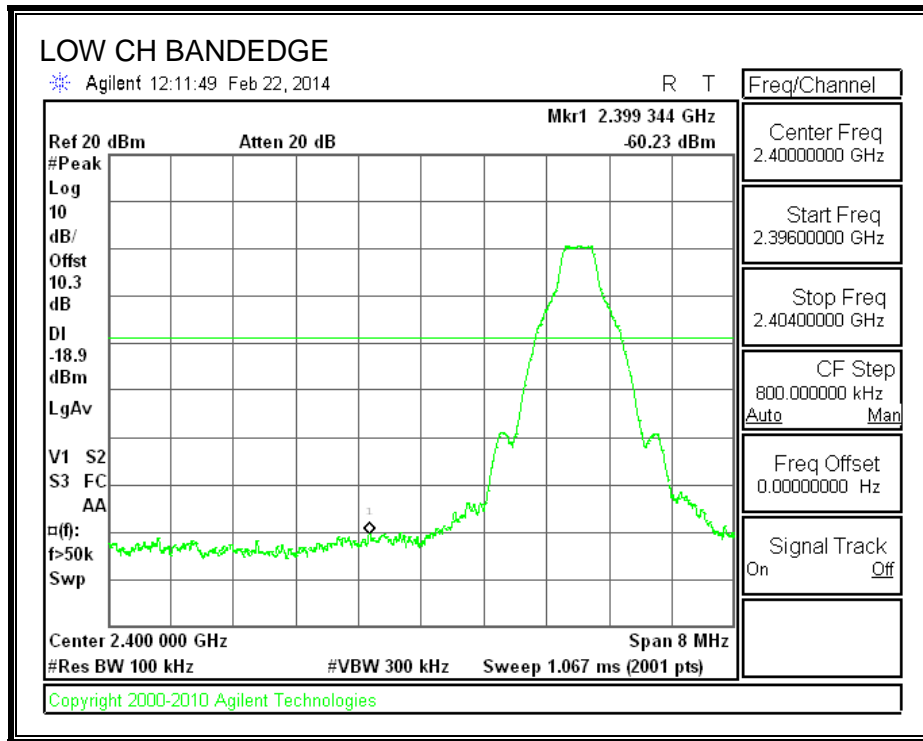
FCC §15.247 (d)

IC RSS-210 A8.5

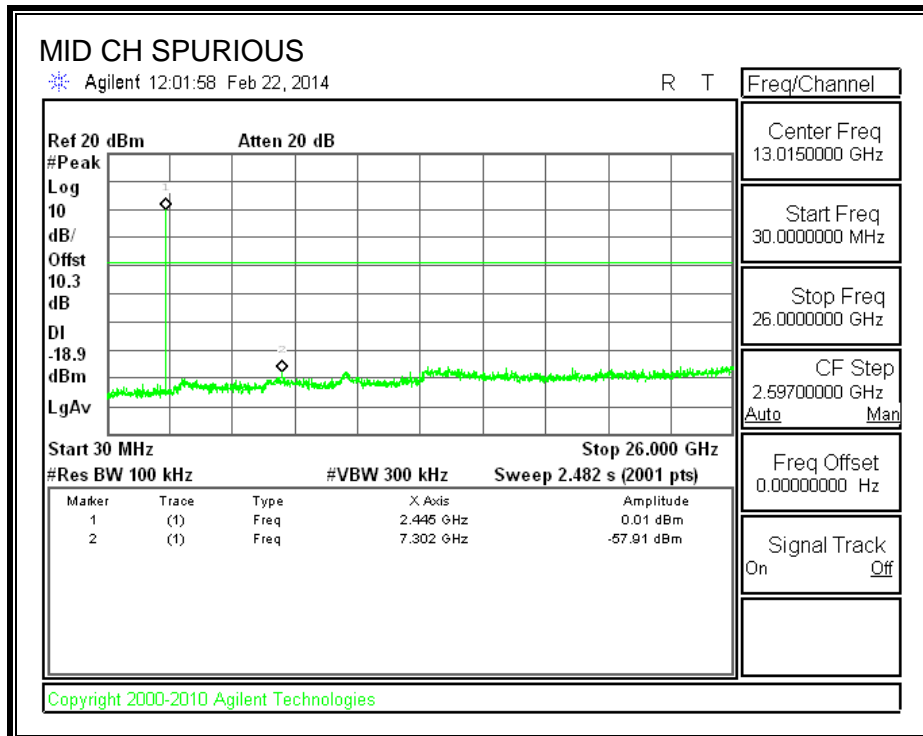
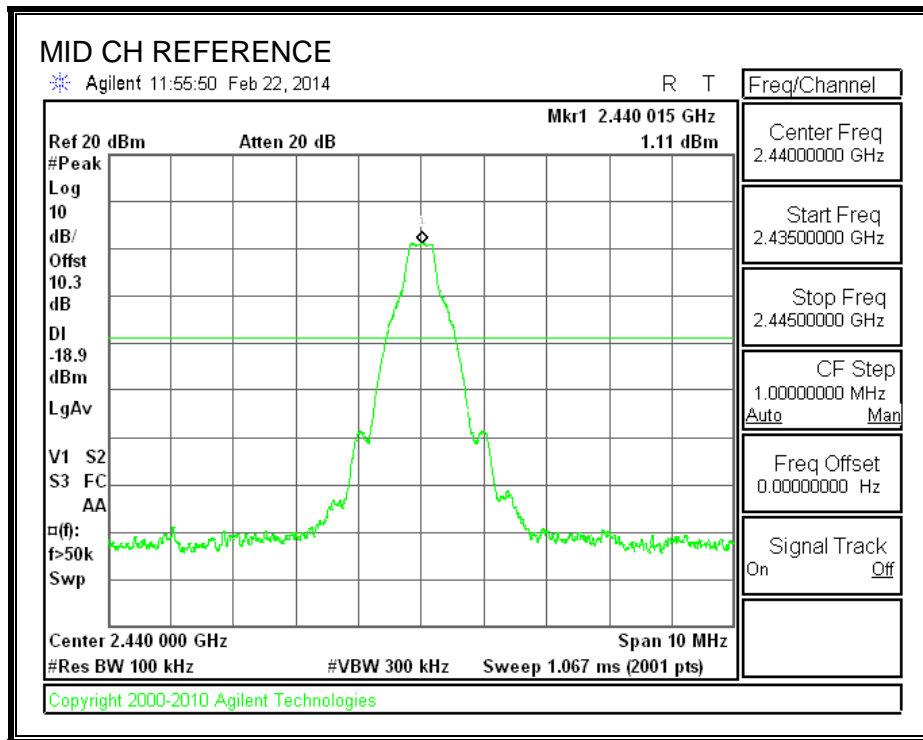
Output power was measured based on the use of a peak measurement, therefore the required attenuation is 20 dB.

**RESULTS**

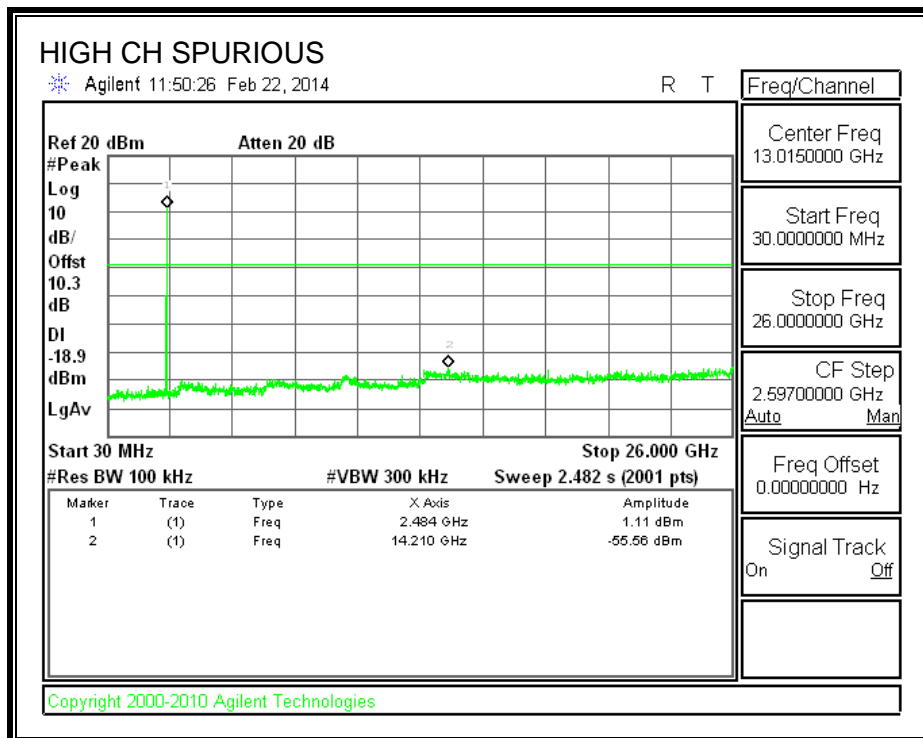
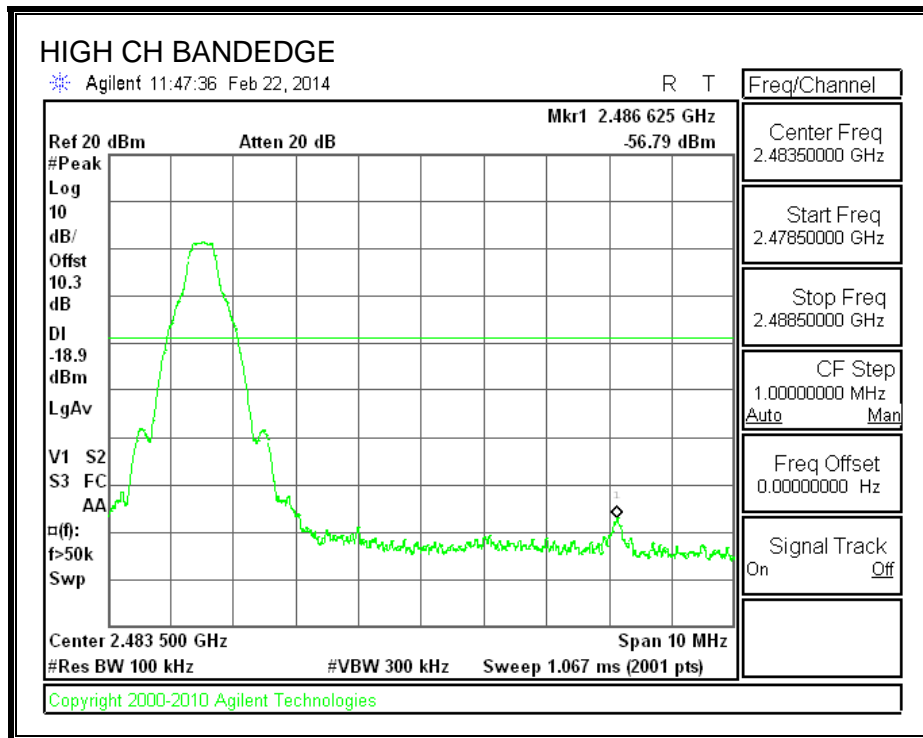
**SPURIOUS EMISSIONS, LOW CHANNEL**



**SPURIOUS EMISSIONS, MID CHANNEL**

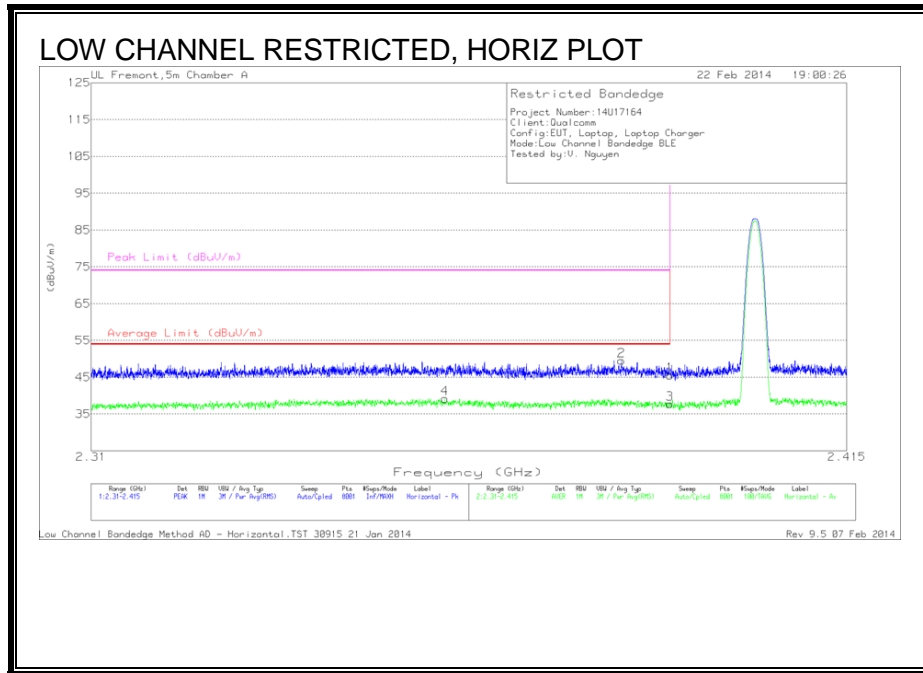


**SPURIOUS EMISSIONS, HIGH CHANNEL**



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

#### RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



LOW CHANNEL RESTRICTED, HORIZ, DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Ampl/Chl/Filt / Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
4	2.359	31.01	RMS	32	-23.8	39.21	54	-14.79	-	-	279	374	H
2	2.363	41.14	PK	32.1	-23.7	49.54	-	-	74	-24.46	279	374	H
1	2.39	37.84	PK	32.1	-24.4	45.54	-	-	74	-28.46	279	374	H
3	2.39	30.05	RMS	32.1	-24.4	37.75	54	-16.25	-	-	279	374	H

PK - Peak detector

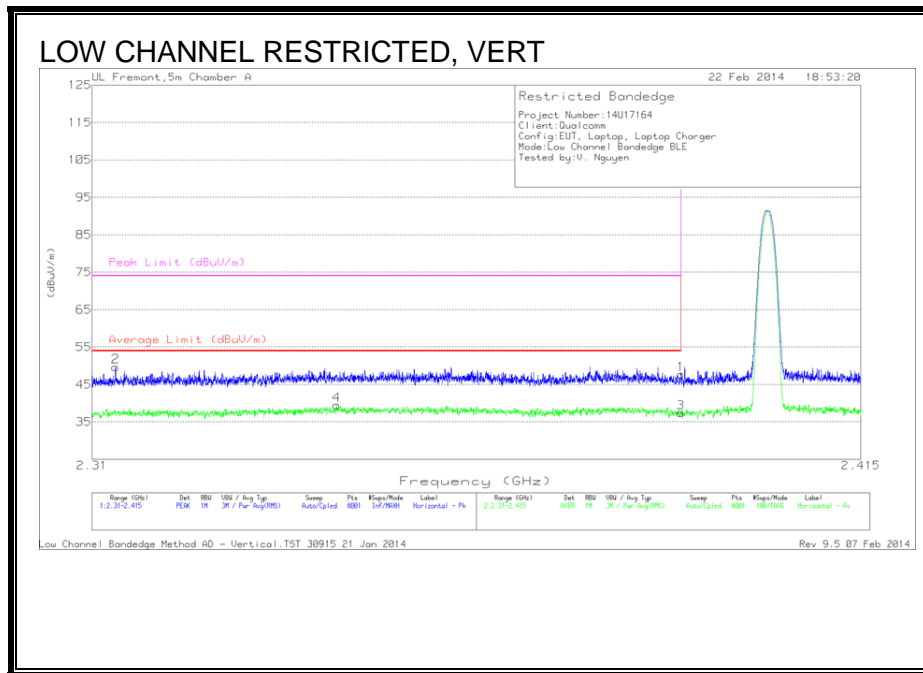
RMS - RMS detection

Low Channel Bandedge Method AD - Horizontal.TST 30915 21 Jan 2014

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**RESTRICTED BANDEGE (LOW CHANNEL, VERTICAL)**



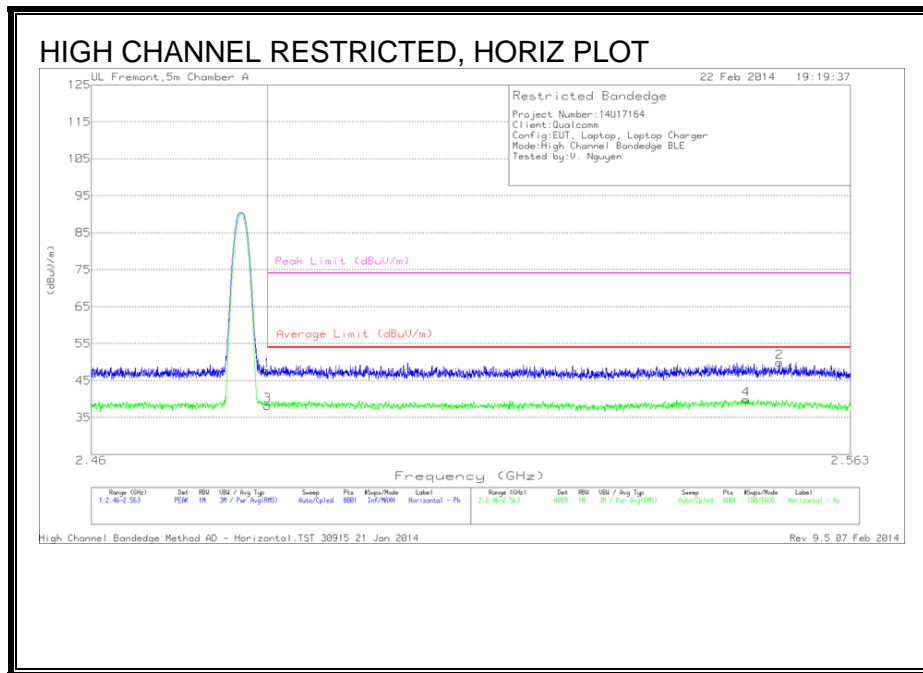
LOW CHANNEL RESTRICTED, VERT DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Ampl/Chl/Filt / Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	2.315	42.49	PK	31.9	-24.7	49.69	-	-	74	-24.31	245	354	V
4	2.343	31.27	RMS	32	-23.9	39.47	54	-16.53	-	-	245	354	V
1	2.39	39.99	PK	32.1	-24.4	47.69	-	-	74	-26.31	245	354	V
3	2.39	29.7	RMS	32.1	-24.4	37.4	54	-16.6	-	-	245	354	V

PK - Peak detector  
 RMS - RMS detection  
 Low Channel Bandedge Method AD - Vertical.TST 30915 21 Jan 2014  
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**RESTRICTED BANDEGE (HIGH CHANNEL, HORIZONTAL)**



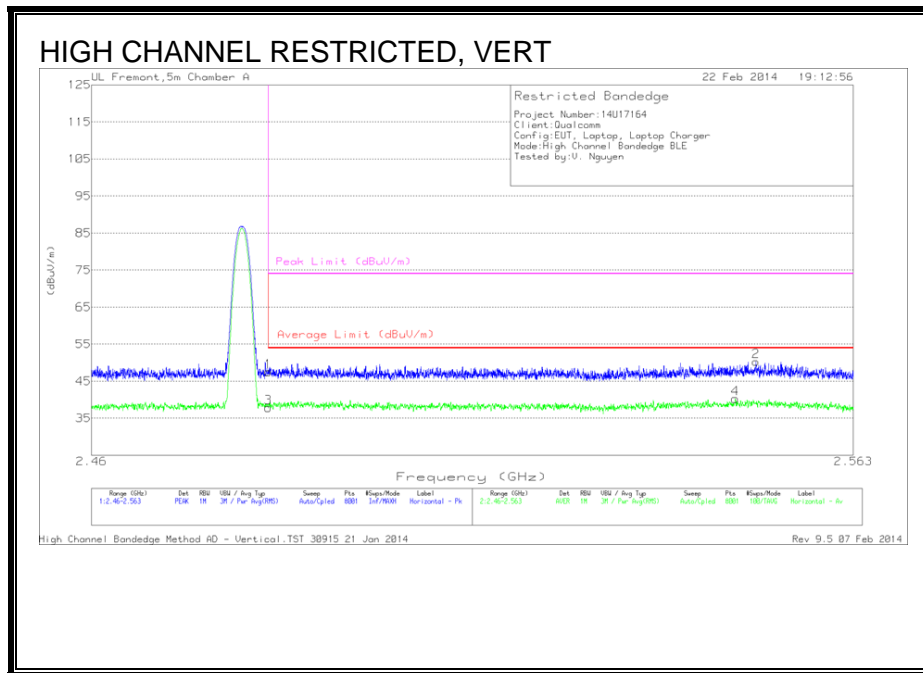
### HIGH CHANNEL RESTRICTED, HORIZ DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Ampl/Chl/Filt / Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	2.484	38.86	PK	32.3	-23.5	47.68	-	-	74	-26.34	167	198	H
3	2.484	29.4	RMS	32.3	-23.5	38.2	-	-	-	-	167	198	H
4	2.649	30.66	RMS	32.4	-23.2	39.86	-	-	-	-	167	198	H
2	2.653	40.71	PK	32.4	-23.2	49.91	-	-	74	-24.09	167	198	H

PK - Peak detector  
 RMS - RMS detection  
 High Channel Bandedge Method AD - Horizontal.TST 30915 21 Jan 2014  
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**RESTRICTED BANDEGE (HIGH CHANNEL, VERTICAL)**



### HIGH CHANNEL RESTRICTED, AVG, VERT

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Ampl/Chl/Filt / Pad (dB)	Corrected Reading (dBuV/m)	Average Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Altitude (Degs)	Height (cm)	Polarity
1	2.484	38.75	PK	32.3	-23.5	47.55	-	-	74	-26.45	228	295	V
3	2.484	29.06	RMS	32.3	-23.5	37.96	-	-	-	-	228	295	V
4	2.547	31.07	RMS	32.4	-23.2	40.27	-	-	-	-	228	295	V
2	2.55	41	PK	32.4	-23.1	50.3	-	-	74	-23.7	228	295	V

PK - Peak detector

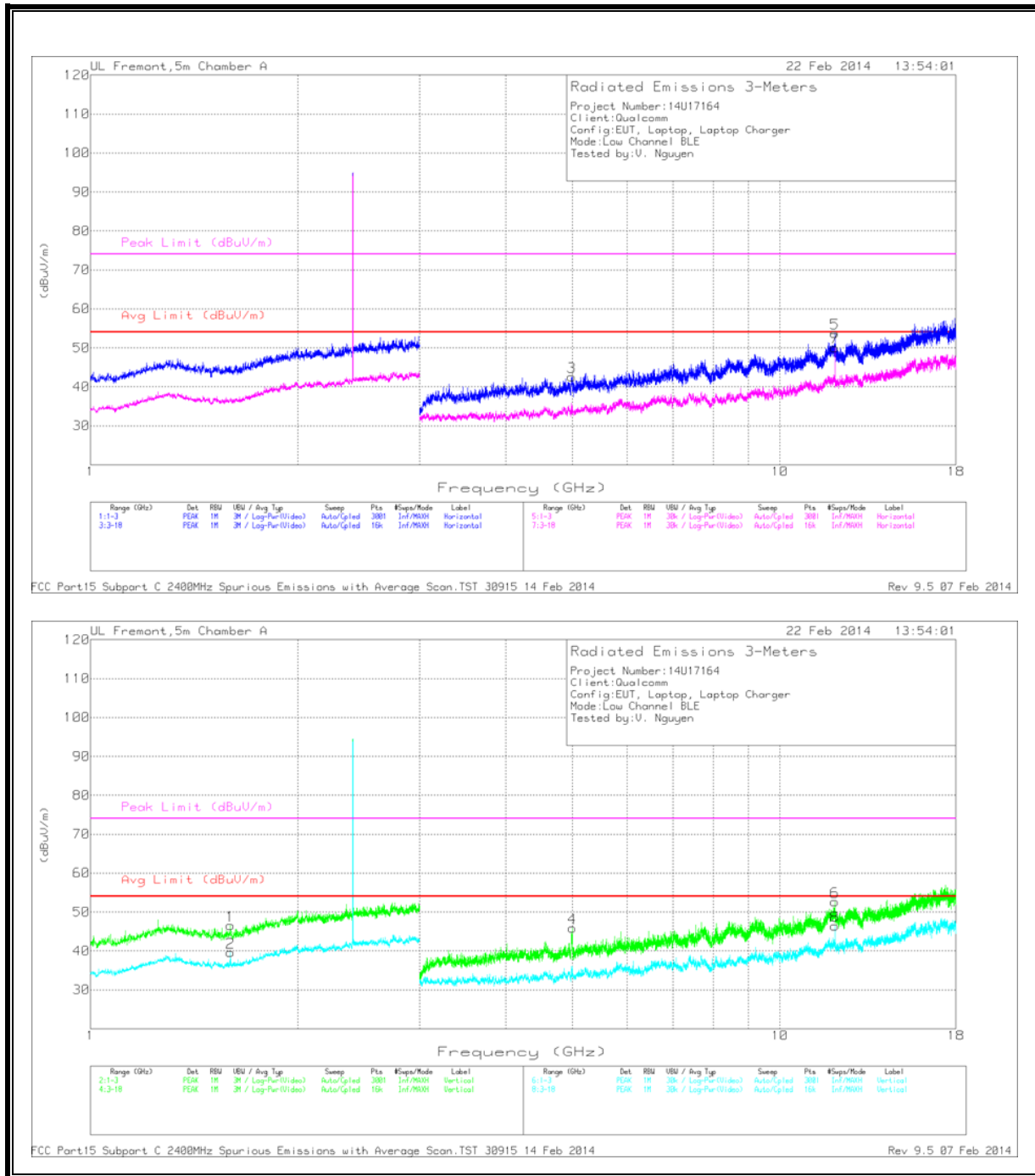
RMS - RMS detection

High Channel Bandedge Method AD - Vertical.TST 30915 21 Jan 2014

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**HARMONICS AND SPURIOUS EMISSIONS**

LOW CHANNEL



Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Ampl/Cb/Filter/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	*1.996	44.16	PK	28.1	-25.7	46.58	54	-7.44	74	-27.44	0-360	201	V
3	*4.988	39.79	PK	34	-30.2	42.59	54	-11.41	74	-31.41	0-360	100	H
5	*12.011	37.64	PK	39.1	-23	53.74	54	-0.26	74	-20.26	0-360	100	H
4	*4.999	41.91	PK	34	-30	45.91	54	-8.09	74	-28.09	0-360	101	V
6	*12.011	36.56	PK	39.1	-23	52.66	54	-1.34	74	-21.34	0-360	201	V
2	*1.996	37.22	Avg	28.1	-25.7	39.62	54	-14.38	-	-	0-360	200	V
7	*12.011	33.95	Avg	39.1	-23	50.05	54	-3.95	-	-	0-360	101	H
8	*12.01	30.27	Avg	39.1	-22.9	46.47	54	-7.53	-	-	0-360	201	V

\* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK - Peak detector

Avg - Video bandwidth < Resolution bandwidth

Radiated Emissions

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Ampl/Cb/Filter/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
*12.01	38.93	PK2	39.1	-22.9	55.13	-	-	74	-19.87	205	128	H
*12.009	31.65	MAV1	39.1	-22.9	47.75	54	-6.25	-	-	205	128	H

\* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK2 - KDB558074 Method: Maximum Peak

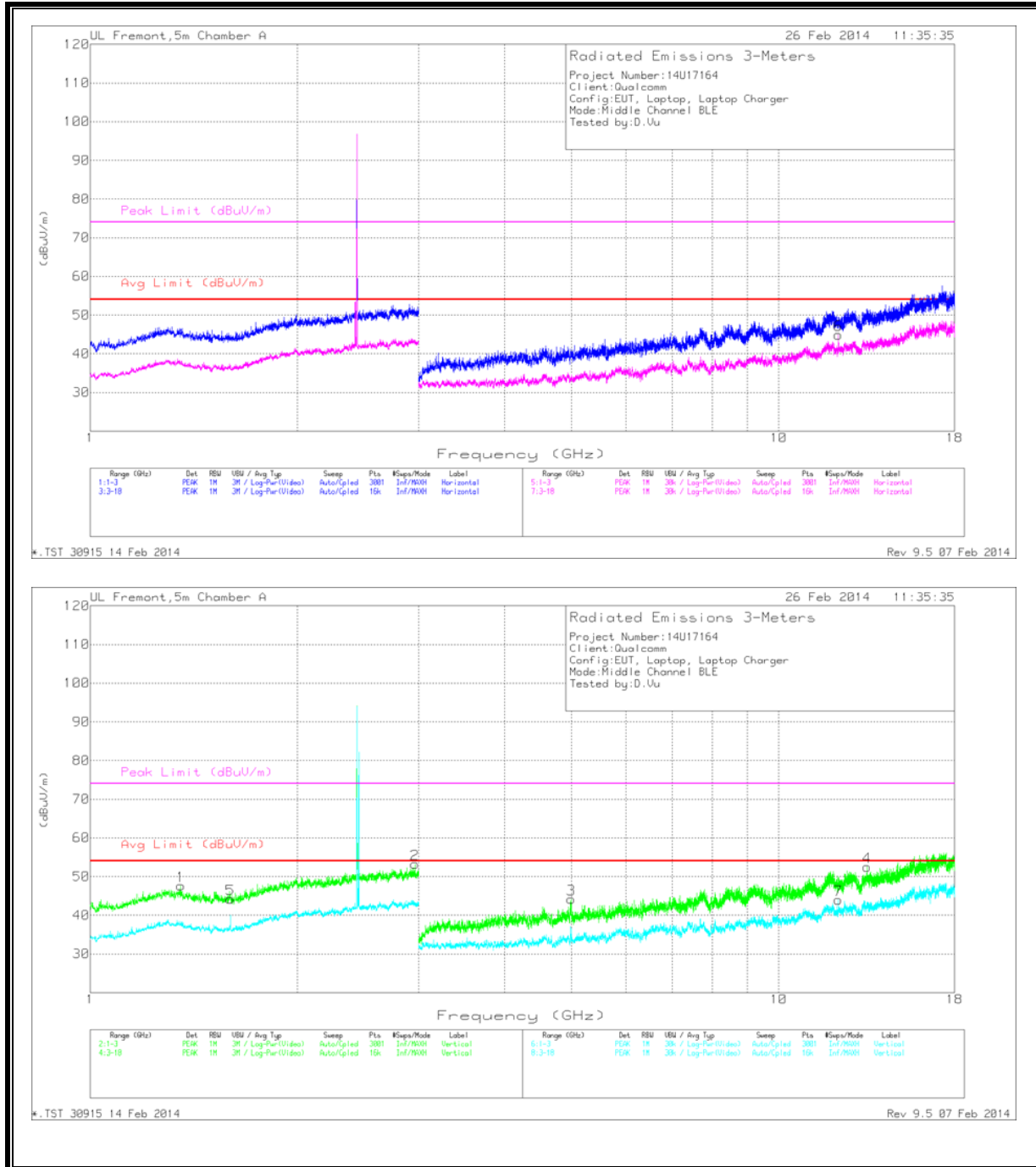
MAV1 - KDB558074 Option 1 Maximum RMS Average

FCC Part15 Subpart C 2400MHz Spurious Emissions with Average Scan.TST 30915 14 Feb 2014

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MID CHANNEL



Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/CbI/Fit r/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
1	*1364	44.53	PK	29.6	-26.5	47.63	54	-6.37	74	-26.37	0-360	101	V
5	*1597	49.82	PK	28.1	-25.7	44.22	54	-9.78	74	-28.78	0-360	101	V
3	*4.998	40.26	PK	34	-30.1	44.76	54	-9.84	74	-29.84	0-360	200	V
6	*12.201	28.2	Avg	39.1	-22.4	44.9	54	-9.1	-	-	0-360	200	H
7	*12.201	27.3	Avg	39.1	-22.4	44	54	-10	-	-	0-360	200	V
2	2.963	49.26	PK	32.9	-22.9	53.26	-	-	-	-	0-360	201	V
4	13.438	35.9	PK	39.1	-22.5	52.5	-	-	-	-	0-360	200	V

\* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

PK - Peak detector

Avg - Video bandwidth < Resolution bandwidth

Radiated Emissions

Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/CbI/Fit r/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
*12.99	35.49	PK2	39.1	-22.5	52.09	54	-19.1	74	-219.1	46	149	H
*12.99	27.69	MAv1	39.1	-22.5	44.29	54	-9.71	-	-	46	149	H
*12.201	35.9	PK2	39.1	-22.4	51.86	54	-2.14	74	-22.14	29	201	V
*12.201	26.87	MAv1	39.1	-22.4	43.67	54	-10.43	-	-	29	201	V

\* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band

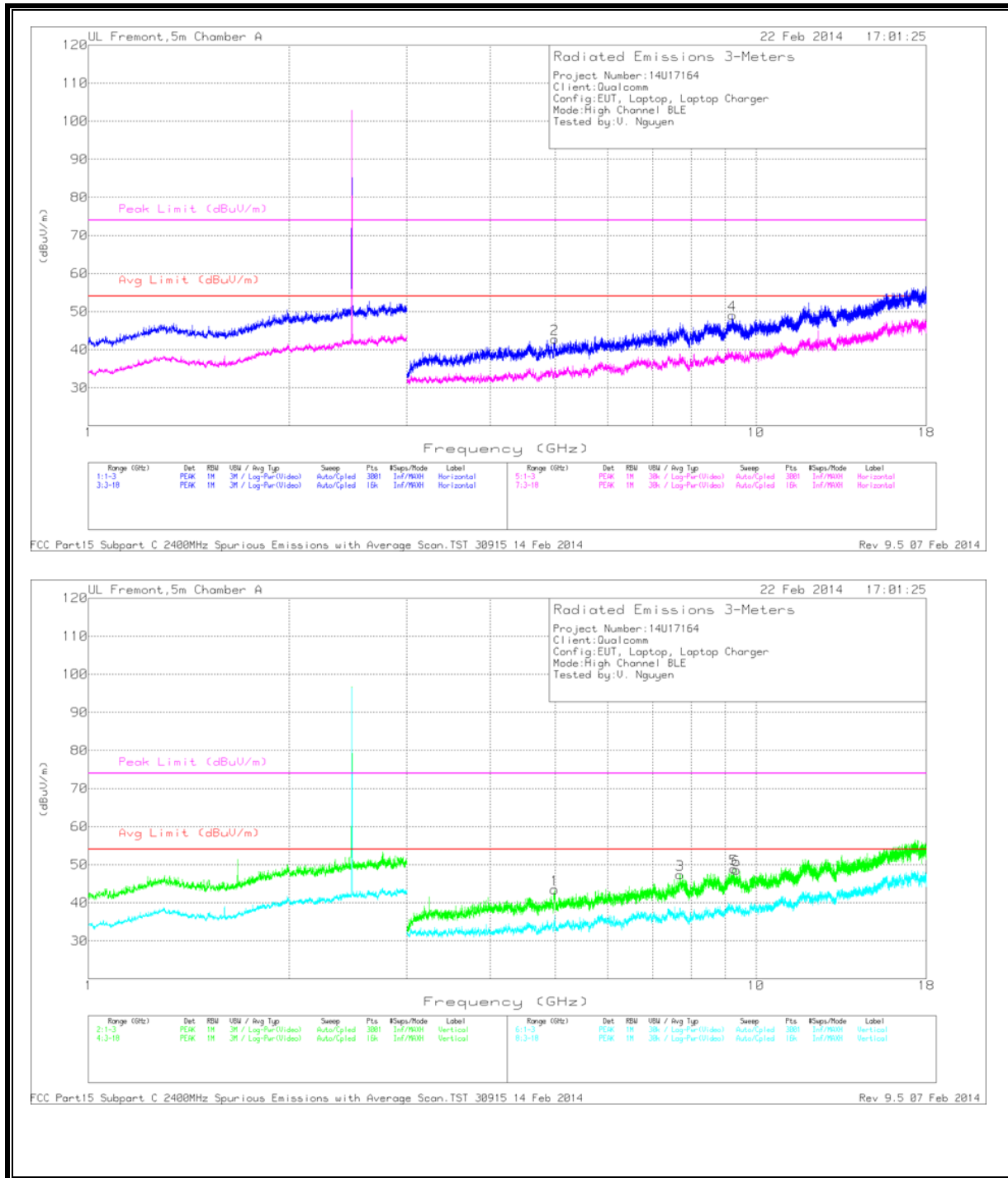
PK2 - KDB558074 Method: Maximum Peak

MAv1 - KDB558074 Option 1 Maximum RMS Average

\*.TST 30915 14 Feb 2014

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HIGH CHANNEL



Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/CM/Filt/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
2	*4.994	38.92	PK	34	-30.1	42.82	54	-11.8	74	-31.8	0-360	200	H
1	*4.992	39.59	PK	34	-30.1	43.49	54	-10.51	74	-30.51	0-360	200	V
3	*7.892	36.21	PK	35.8	-24.6	47.41	54	-6.59	74	-26.59	0-360	100	V
6	*9.347	37.63	PK	36.4	-25.4	48.63	54	-5.37	74	-25.37	0-360	200	V
4	9.218	38.81	PK	36.3	-24	49.11	-	-	-	-	0-360	101	H
5	9.264	37.36	PK	36.3	-24.7	48.96	-	-	-	-	0-360	100	V

\* - indicates frequency in CFR15.205/IC7.2.2 Restricted Band  
 PK - Peak detector  
 FCC Part15 Subpart C 2400MHz Spurious Emissions with Average Scan.TST 30915 14 Feb 2014  
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