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

QUALCOMM TECHNOLOGIES INC.
5775 MOREHOUSE DR
SAN DIEGO, CA 92121-1714

Prepared by

UL VERIFICATION SERVICES INC.
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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	02/26/2014	Initial Issue	G. QUIZON
A	03/04/2014	Revise correct applicant name	A.Kanamatsu

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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:

George Quizon
PROJECT LEAD
UL Verification Services Inc.

Tested By:

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
☒ Chamber A	☐ Chamber D
☐ Chamber B	☐ Chamber E
☐ Chamber C	☐ 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:

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

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	-

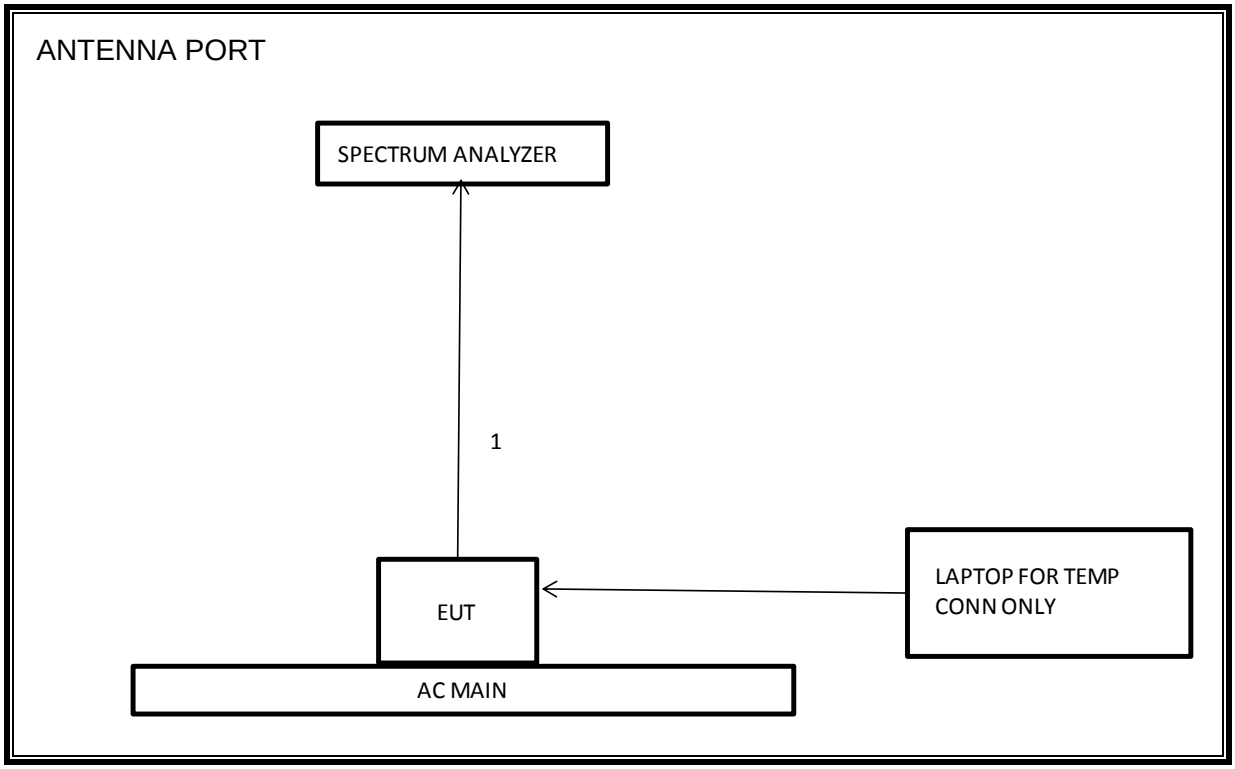
I/O CABLES

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	

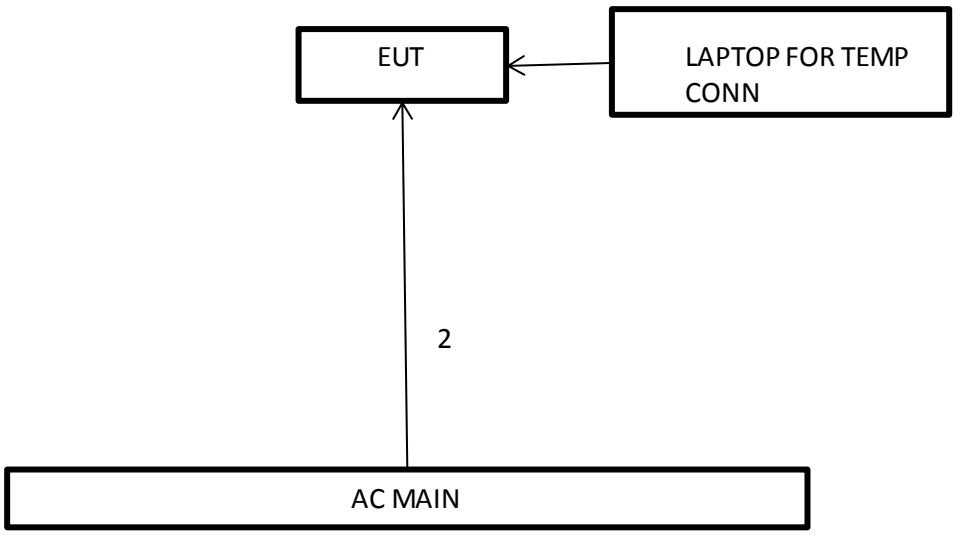
TEST SETUP

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



RADIATED EMISSION



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.

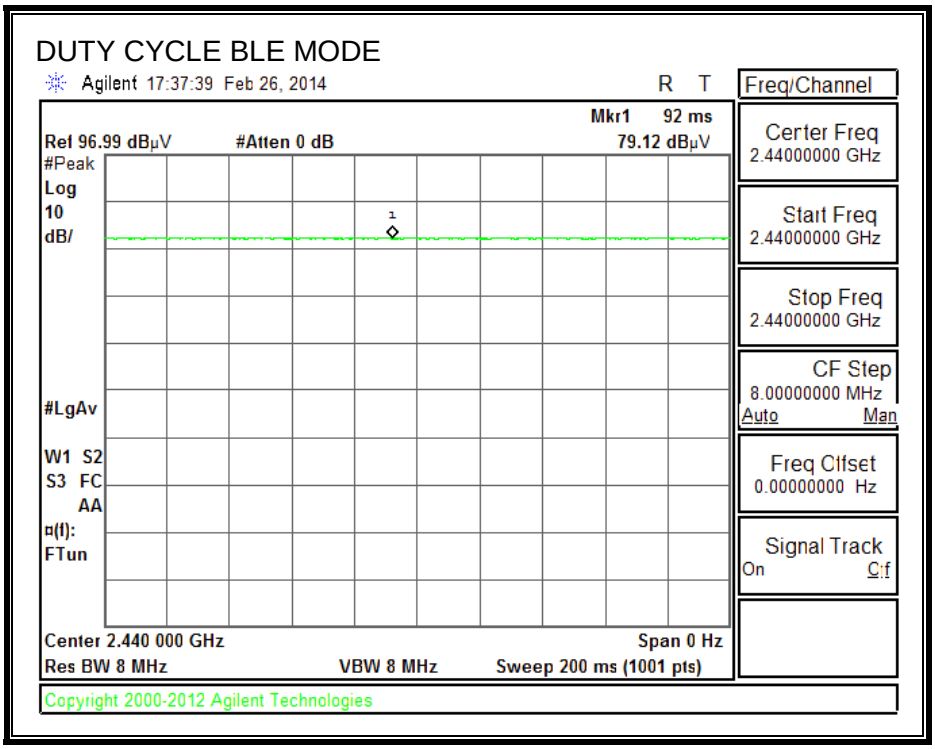
PROCEDURE

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)

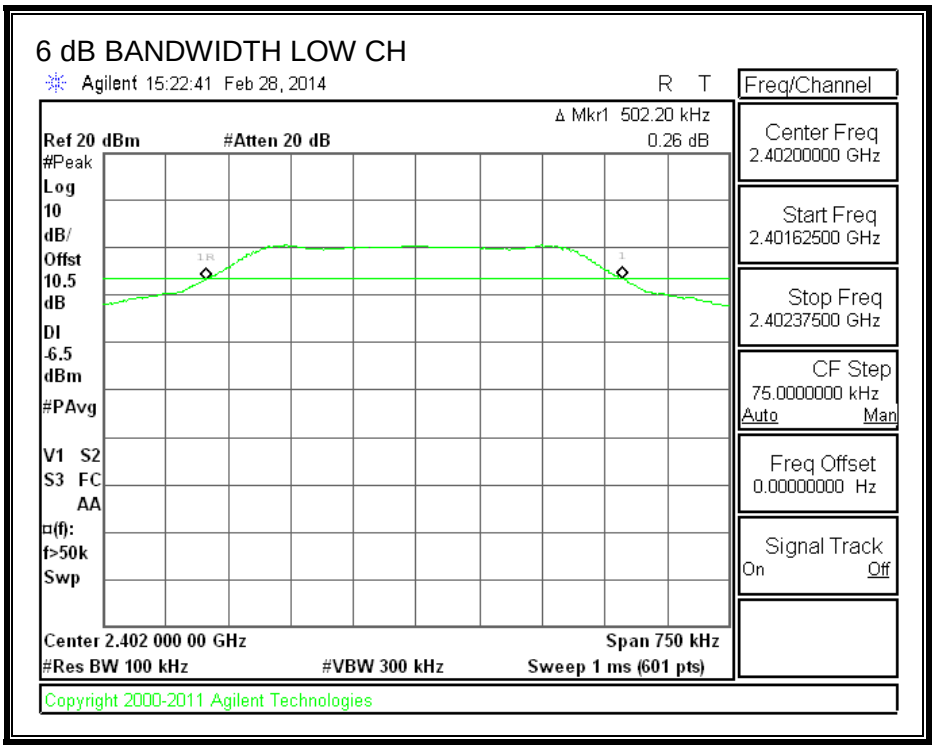
IC RSS-210 A8.2 (a)

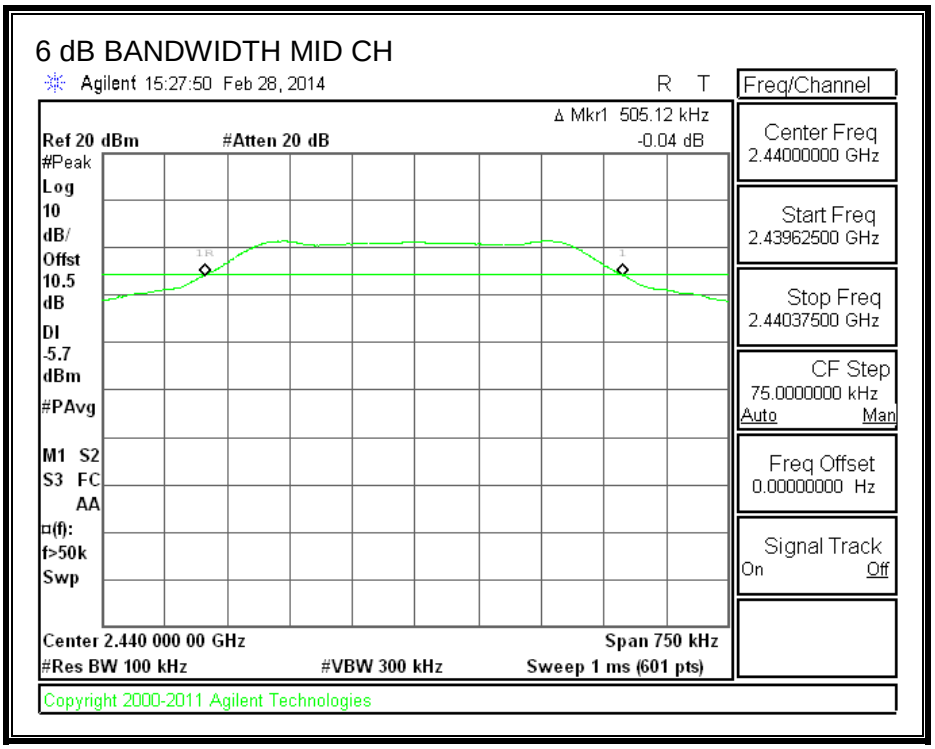
The minimum 6 dB bandwidth shall be at least 500 kHz.

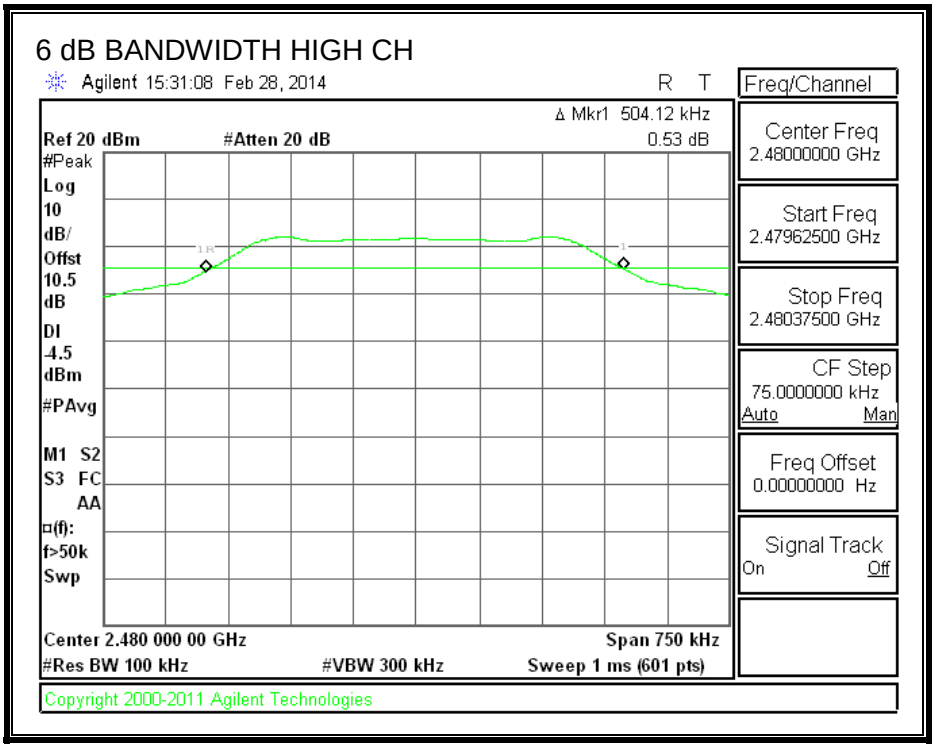
RESULTS

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.

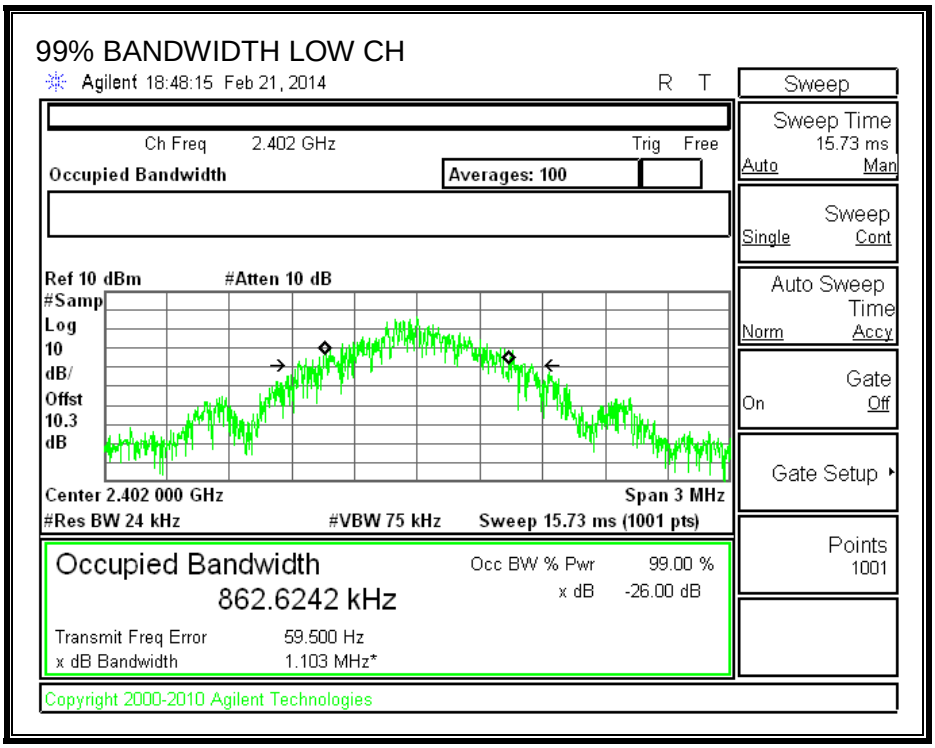
TEST PROCEDURE

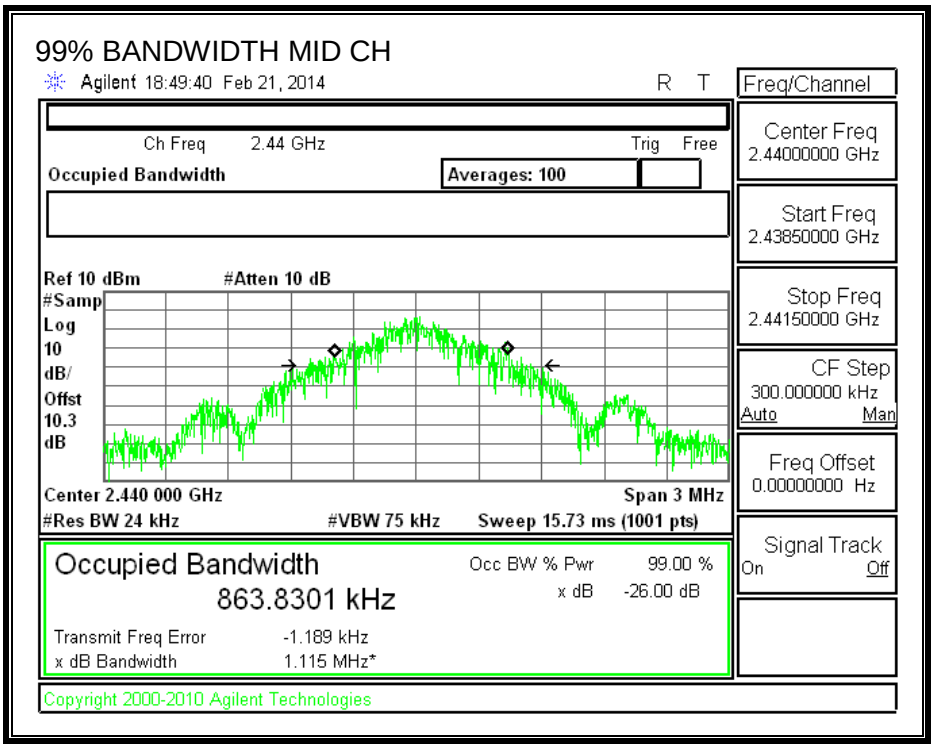
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth and to 1% of the span. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

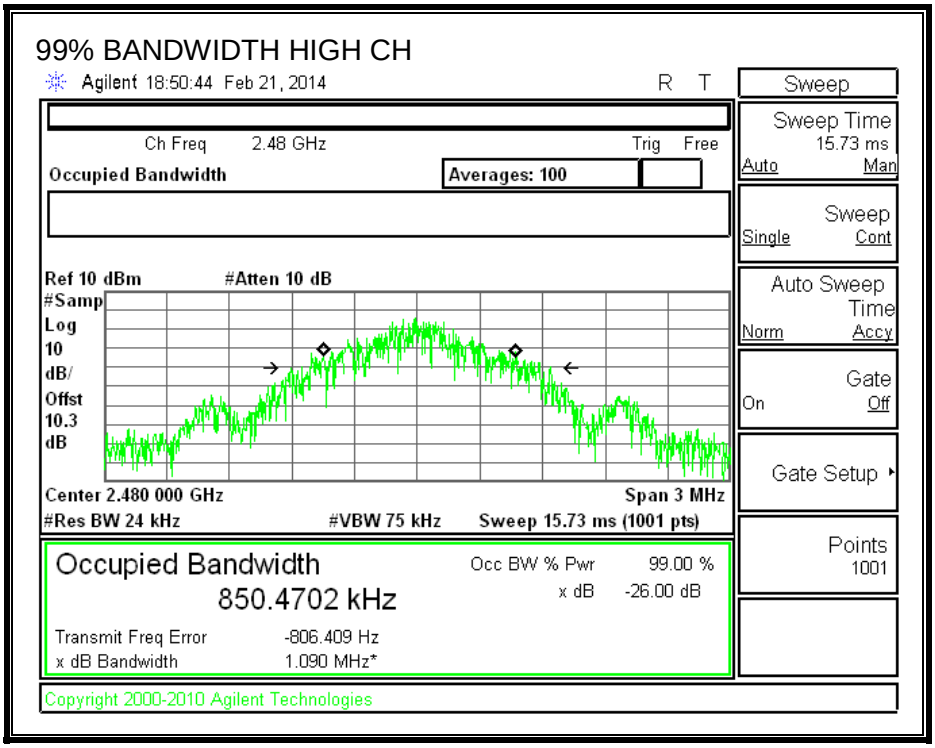
RESULTS

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

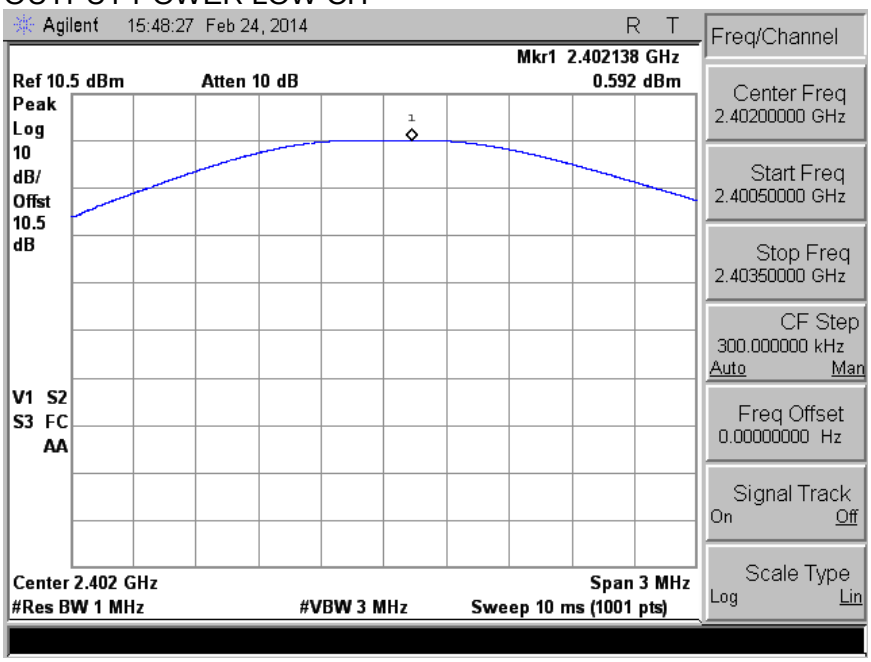
The maximum antenna gain is less than or equal to 6 dBi, therefore the limit is 30 dBm.

RESULTS

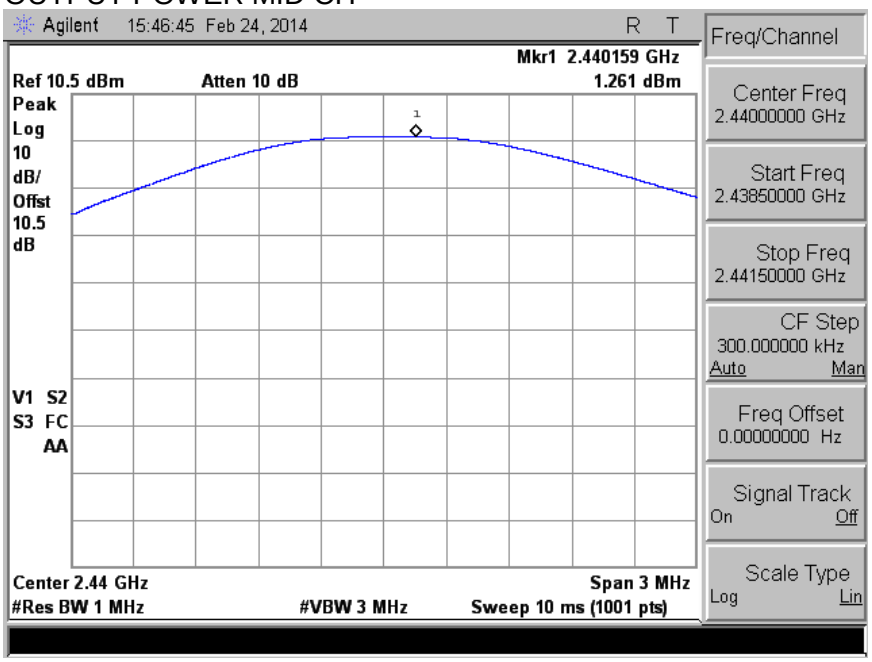
Channel	Frequency (MHz)	Peak Power Reading (dBm)	Limit (dBm)	Margin (dB)
Low	2402	0.592	30	-29.408
Middle	2440	1.261	30	-28.739
High	2480	1.970	30	-28.030

OUTPUT POWER

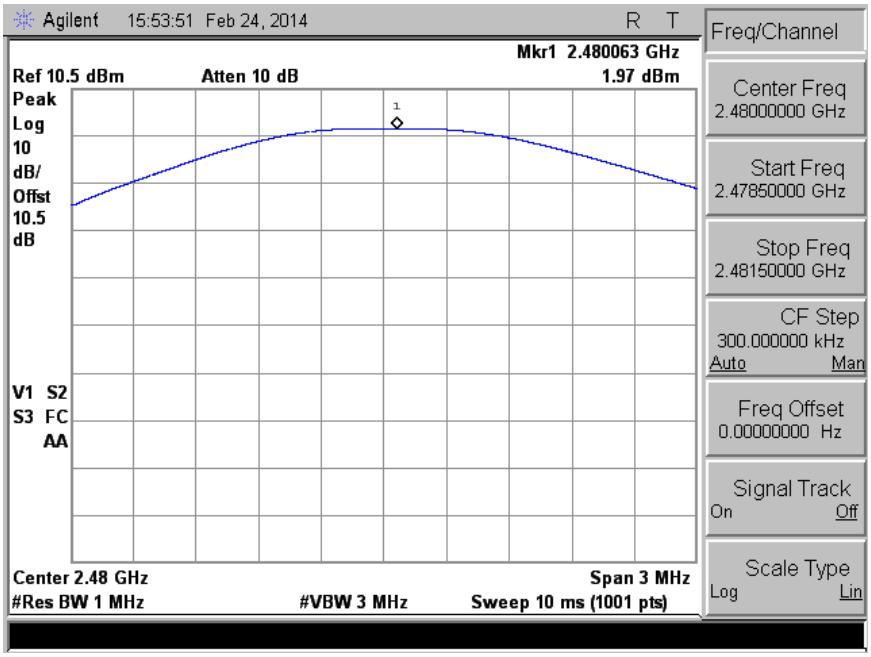
OUTPUT POWER LOW CH



OUTPUT POWER MID CH



OUTPUT POWER HIGH CH



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)

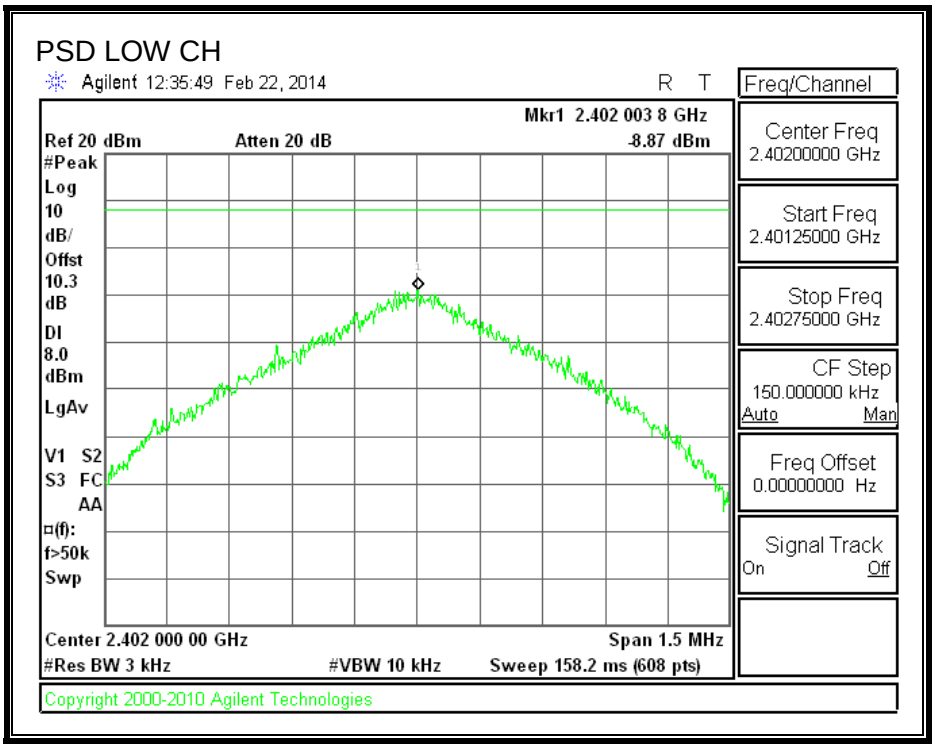
IC RSS-210 A8.2 (b)

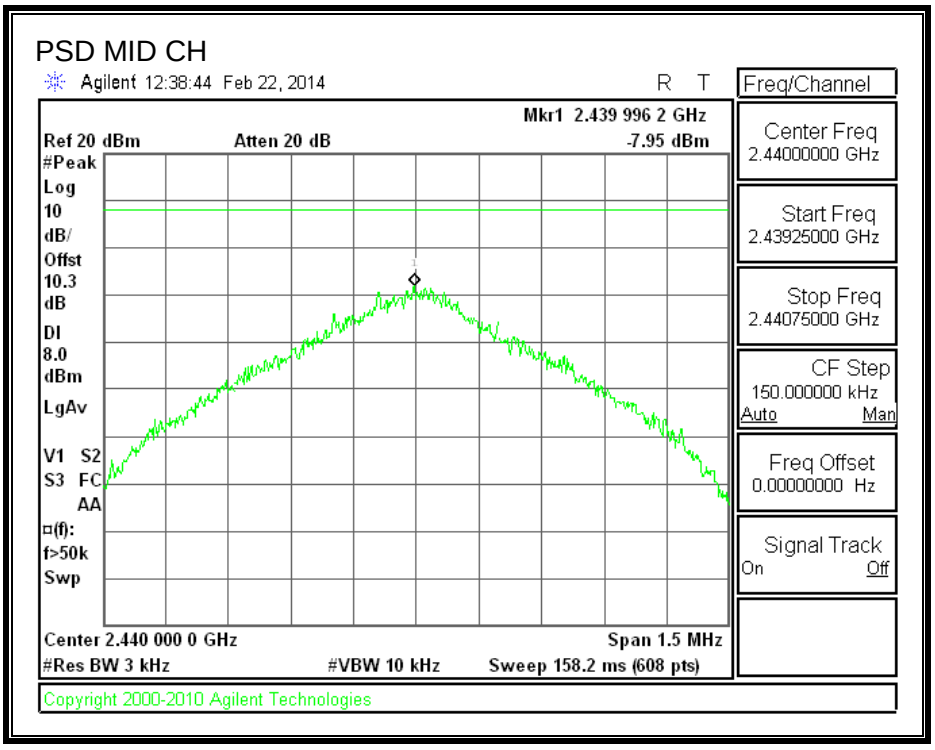
The power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

RESULTS

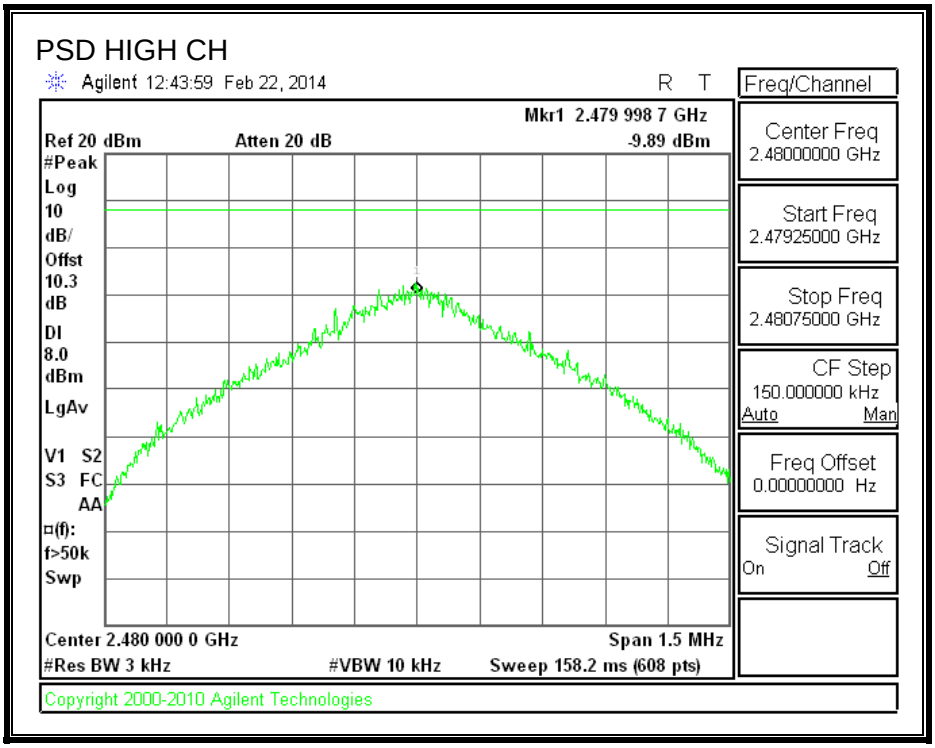
Channel	Frequency (MHz)	PSD (dBm)	Limit (dBm)	Margin (dB)
Low	2402	-8.87	8	-16.87
Middle	2440	-7.95	8	-15.95
High	2480	-9.89	8	-17.89

POWER SPECTRAL DENSITY





PSD HIGH CH



8.7. CONDUCTED SPURIOUS EMISSIONS

LIMITS

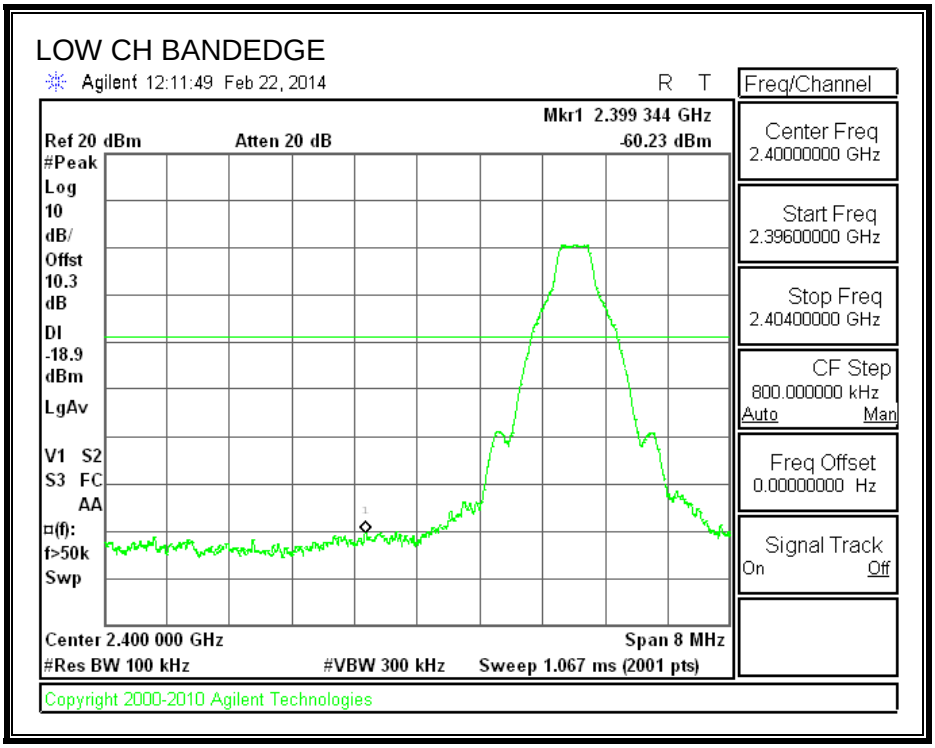
FCC §15.247 (d)

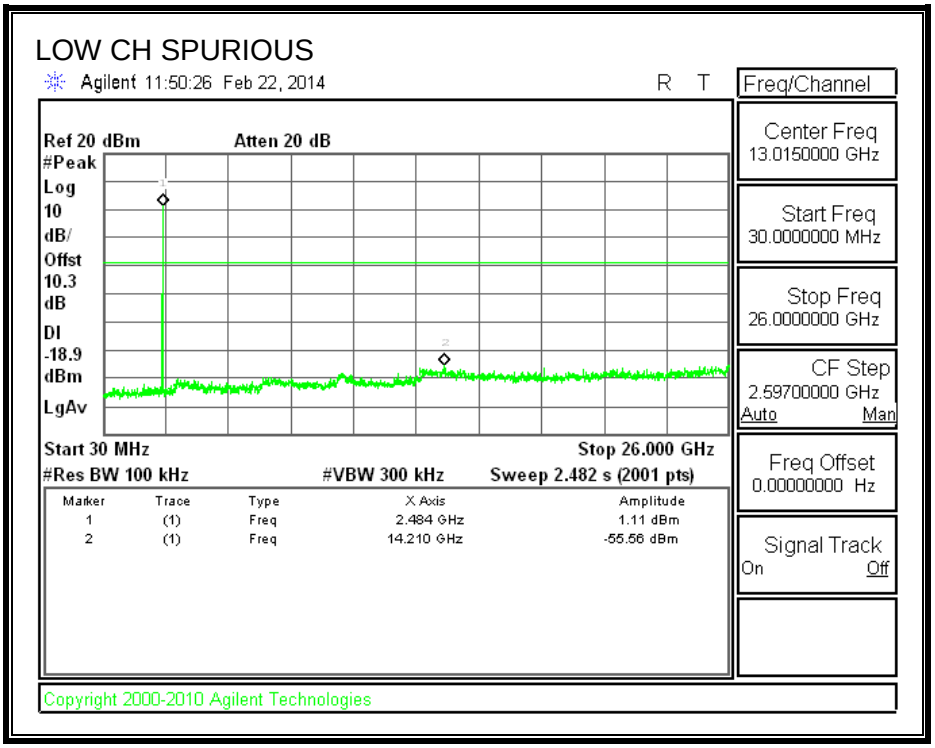
IC RSS-210 A8.5

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

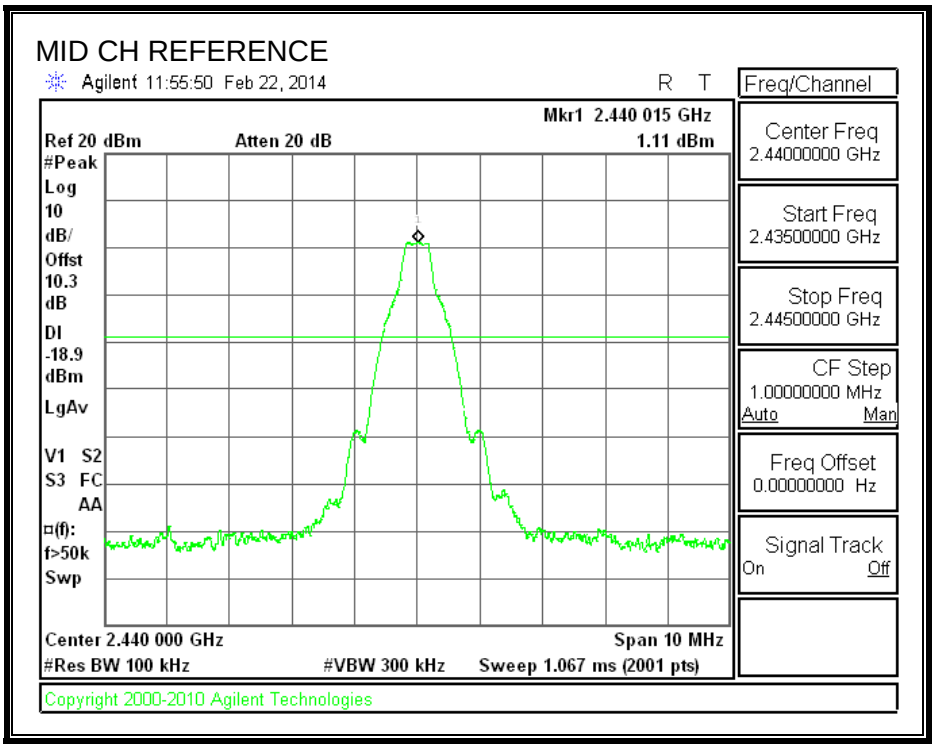
RESULTS

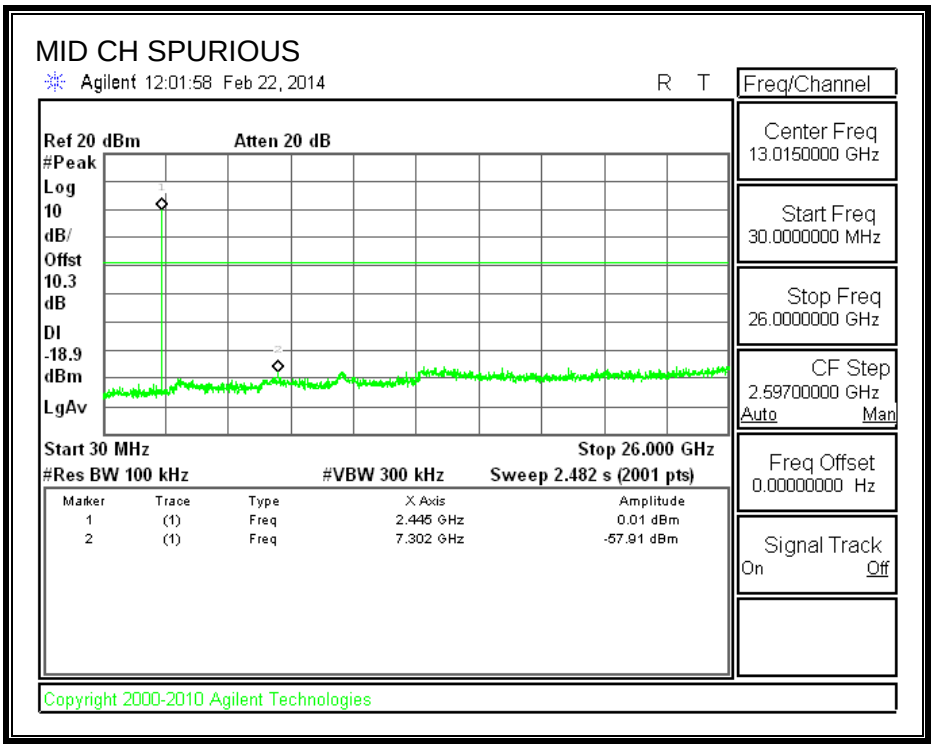
SPURIOUS EMISSIONS, LOW CHANNEL



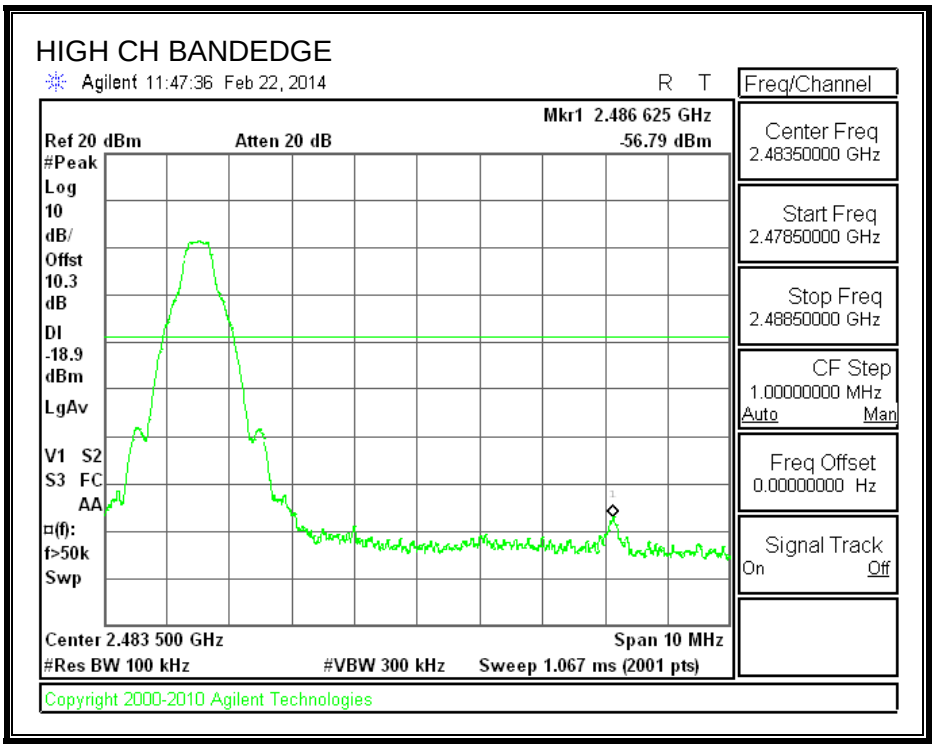


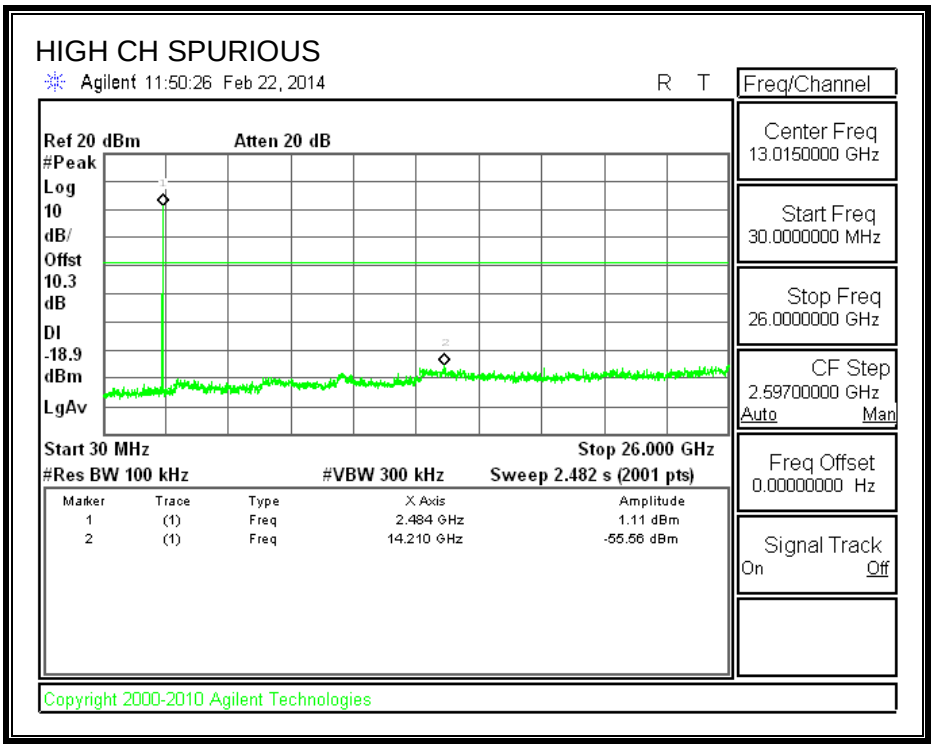
SPURIOUS EMISSIONS, MID CHANNEL





SPURIOUS EMISSIONS, HIGH CHANNEL

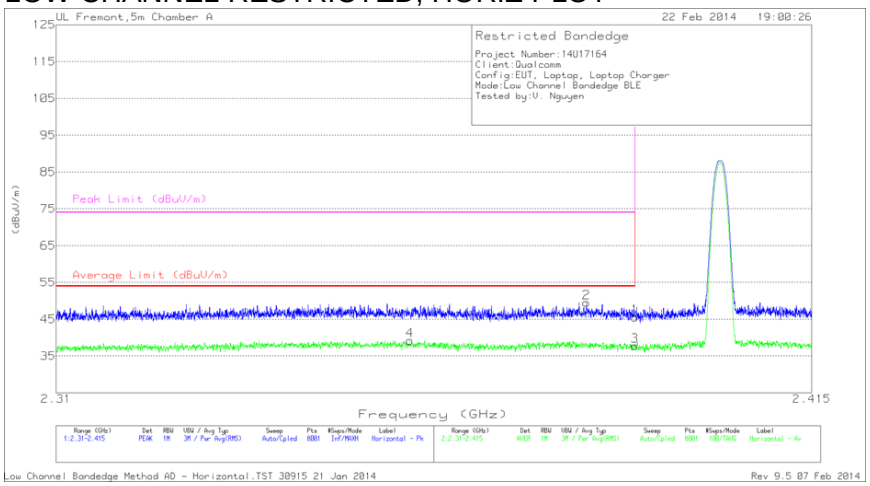




8.8. TX ABOVE 1 GHz FOR BLUETOOTH LOW ENERGY MODE IN THE 2.4 GHz BAND

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)

LOW CHANNEL RESTRICTED, HORIZ PLOT



LOW CHANNEL RESTRICTED, HORIZ, DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Fltr / 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	2.383	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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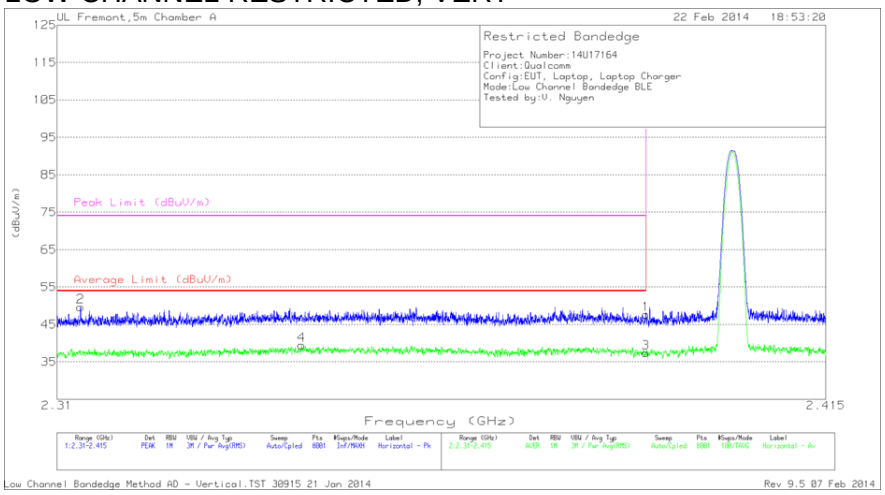
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)

LOW CHANNEL RESTRICTED, VERT



LOW CHANNEL RESTRICTED, VERT DATA

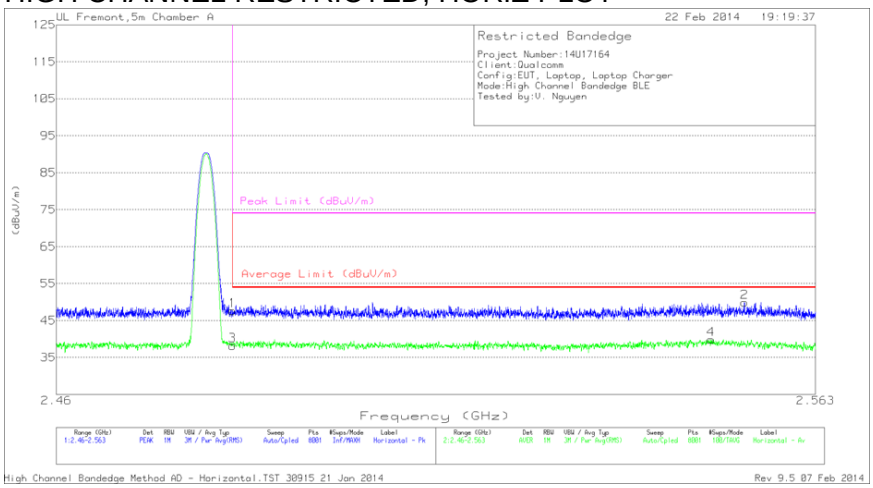
Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AFT119 (dB/m)	Amp/Cbl/Fltr/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	2.313	42.49	PK	31.9	-24.7	49.69	-	-	74	-24.31	245	314	V
4	2.343	31.27	RMS	32	-23.8	39.47	54	-14.53	-	-	245	314	V
1	2.39	39.99	PK	32.1	-24.4	47.69	-	-	74	-26.31	245	314	V
3	2.39	29.7	RMS	32.1	-24.4	37.4	54	-16.6	-	-	245	314	V

PK - Peak detector
RMS - RMS detection
Low Channel Bandedge Method AD - Vertical.TST 30915 21 Jan 2014
Rev 9.5 07 Feb 2014

RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)

HIGH CHANNEL RESTRICTED, HORIZ PLOT



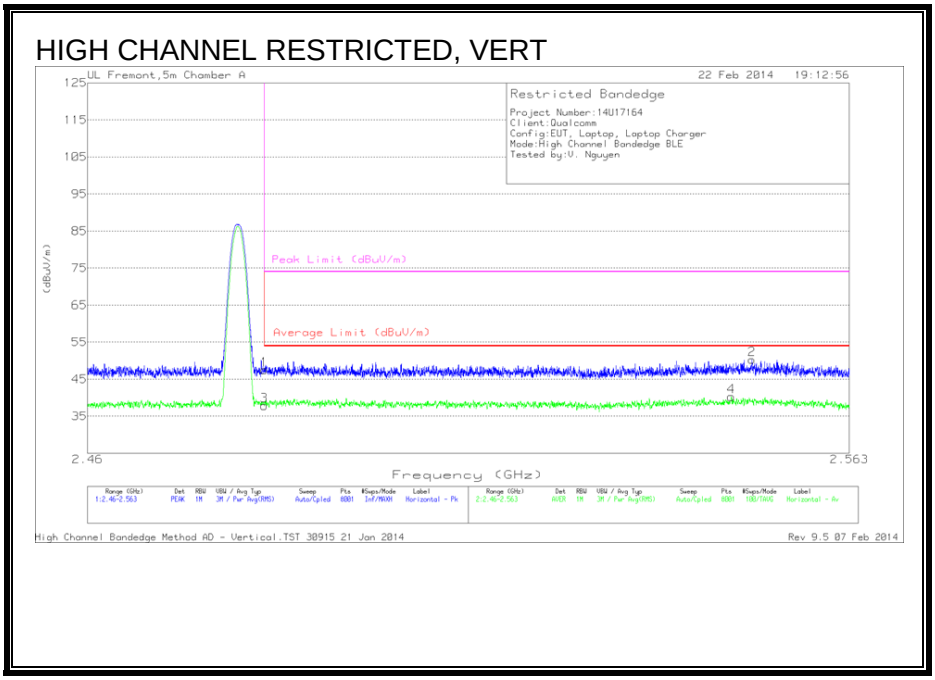
HIGH CHANNEL RESTRICTED, HORIZ DATA

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Fltr / 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	47.66	-	-	74	-26.34	167	198	H
3	2.484	29.4	RMS	32.3	-23.5	38.2	-	-	-	-	167	198	H
4	2.549	30.66	RMS	32.4	-23.2	39.86	-	-	-	-	167	198	H
2	2.553	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
Rev 9.5 07 Feb 2014

RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)



HIGH CHANNEL RESTRICTED, AVG, VERT

Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Fltr / 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	38.75	PK	32.3	-23.5	47.55	-	-	74	-26.45	228	295	V
3	2.484	29.06	RMS	32.3	-23.5	37.86	-	-	-	-	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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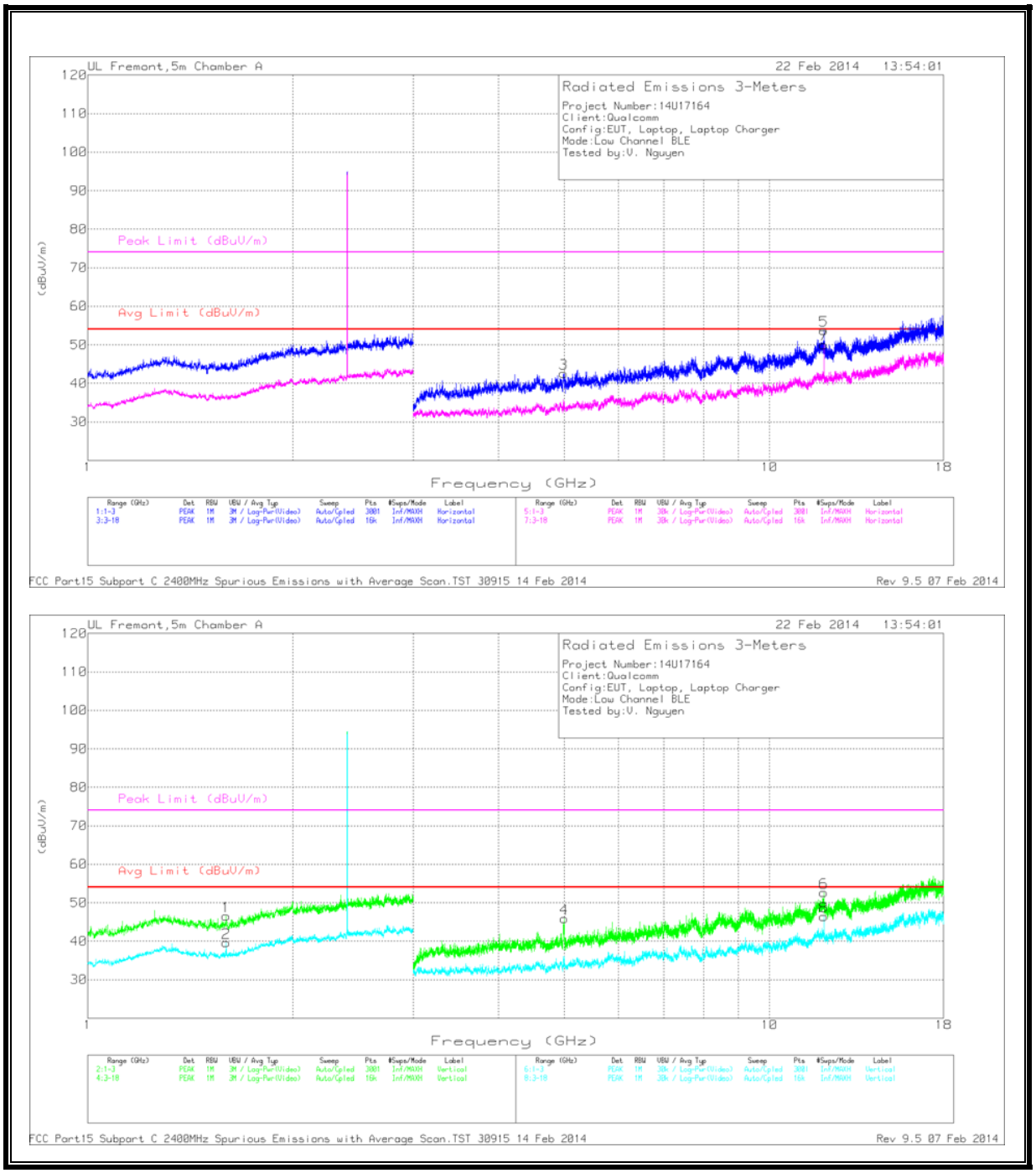
HARMONICS AND SPURIOUS EMISSIONS

LOW CHANNEL



Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Fltr/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	*1.596	44.16	PK	28.1	-25.7	46.56	54	-7.44	74	-27.44	0-360	201	V
3	*4.988	38.79	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	*1.596	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)	Amp/Cbl/Fltr/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	-18.87	205	128	H
*12.009	31.55	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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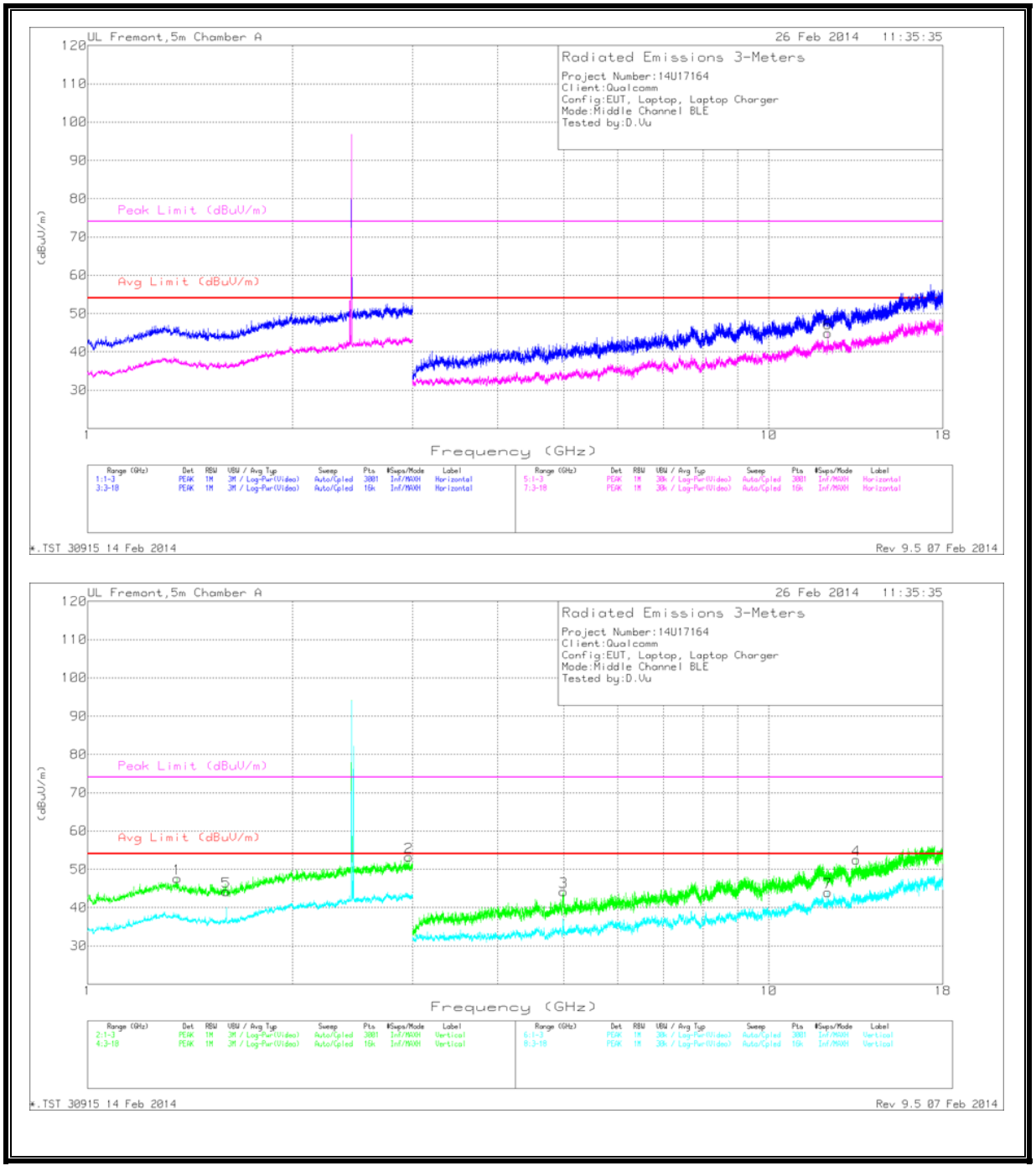
MID CHANNEL



Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AFT119 (dB/m)	Amp/Cbl/Fltr/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	*1.354	44.53	PK	29.6	-26.5	47.63	54	-6.37	74	-26.37	0-360	101	V
5	*1.597	41.82	PK	28.1	-25.7	44.22	54	-9.78	74	-29.78	0-360	101	V
3	*4.996	40.26	PK	34	-30.1	44.16	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	43.26	PK	32.9	-22.9	53.26	-	-	-	-	0-360	201	V
4	13.436	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	AFT119 (dB/m)	Amp/Cbl/Fltr/Pad (dB)	Corrected Reading (dBuV/m)	Avg Limit (dBuV/m)	Margin (dB)	Peak Limit (dBuV/m)	PK Margin (dB)	Azimuth (Degs)	Height (cm)	Polarity
*12.199	35.49	PK2	39.1	-22.5	52.09	54	-1.91	74	-21.91	46	149	H
*12.199	27.69	MAv1	39.1	-22.5	44.29	54	-9.71	-	-	46	149	H
*12.201	35.16	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	43.57	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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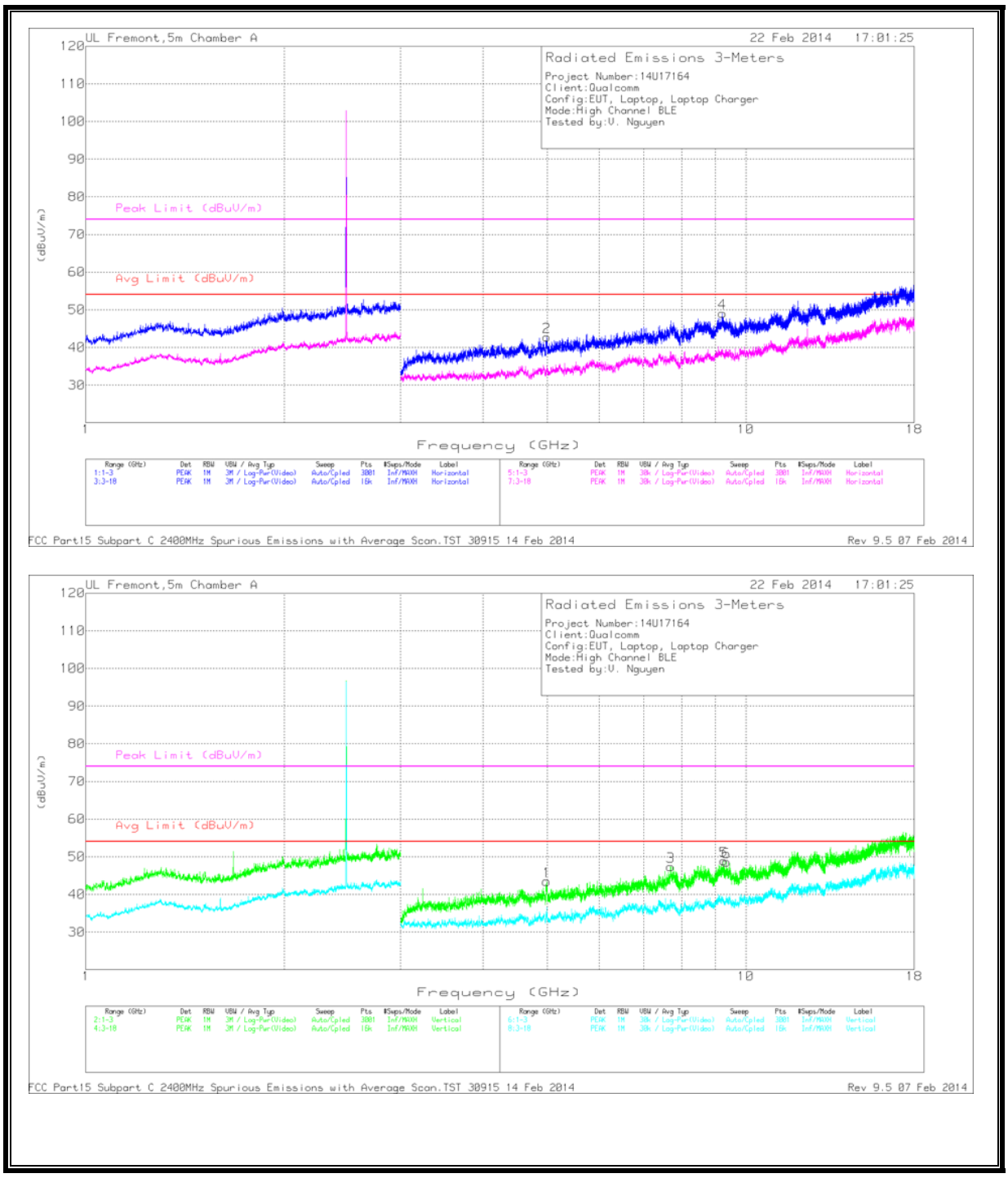
HIGH CHANNEL



Trace Markers

Marker	Frequency (GHz)	Meter Reading (dBuV)	Det	AF T119 (dB/m)	Amp/Cbl/Fltr /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	-11.18	74	-31.18	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	*7.692	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	9.238	36.81	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
Rev 9.5 07 Feb 2014