FCC CFR47 PART 15 SUBPART C
INDUSTRY CANADA RSS-210 ISSUE 8

CERTIFICATION TEST REPORT

FOR

802.11a/b/g/n WLAN + Bluetooth PCI-E Custom Combination Card

MODEL NUMBER: BCM94331CD

FCC ID: QDS-BRCM1064
IC: 4324A-BRCM1064

REPORT NUMBER: 12U14227-5, Revision A

ISSUE DATE: JUNE 04, 2012

Prepared for
BROADCOM CORPORATION
190 MATHILDA PLACE
SUNNYVALE, CA 94086, U.S.A.

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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	05/30/12	Initial Issue	F. Ibrahim
A	06/04/12	Revised sections 5.2, 7.1 and 7.6	F. Ibrahim

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: BROADCOM CORPORATION
190 MATHILDA PLACE
SUNNYVALE, CA 94086, USA

EUT DESCRIPTION: 802.11a/b/g/n WLAN + Bluetooth PCI-E Custom Combination Card

MODEL: BCM94331CD

SERIAL NUMBER: C8Y2104004NDRJVE4 (P508)

DATE TESTED: MAY 01 - MAY 9, 2012

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

Compliance Certification Services (UL CCS) 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 CCS 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 CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL CCS 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 CCS By:

FRANK IBRAHIM
EMC SUPERVISOR
UL CCS

Tested By:

DAVID GARCIA
EMC ENGINEER
UL CCS

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 47173 Benicia Street, Fremont, California, USA.

UL CCS is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at http://www.ccsemc.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:

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 an 802.11a/b/g/n WLAN + Bluetooth PCI-E Custom Combination Card.

The radio module is manufactured by Broadcom.

5.1. 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	Low Energy BLE	7.78	6.00

5.2. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes an 802.11bgn WLAN and Bluetooth antenna with a maximum gain of 4.8dBi.

Note: This antenna was connected during radiated emissions testing. Part number is (604-3215).

5.3. SOFTWARE AND FIRMWARE

The EUT driver software installed during testing was Broadcom Bluetooth Version 1.5.2

The test utility software used during testing was Bluetool, ver. 1.5.2.8.

5.4. WORST-CASE CONFIGURATION AND MODE

The EUT was tested as an external module installed in a test jig board connected to a host Laptop PC.

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

5.5. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

Description	Manufacturer	Model	Serial Number	FCC ID
Laptop	Lenovo	G560	CBU4495773	DoC
AC Adapter	Lenovo	ADP-65KH B	11S36001646ZZ10011FKEZ	DoC
Adapter Board	Catalyst	MINI2EXP	JUAN 02	N/A
Adapter Board	Broadcom	BCM94331CSMFG	1458923	N/A

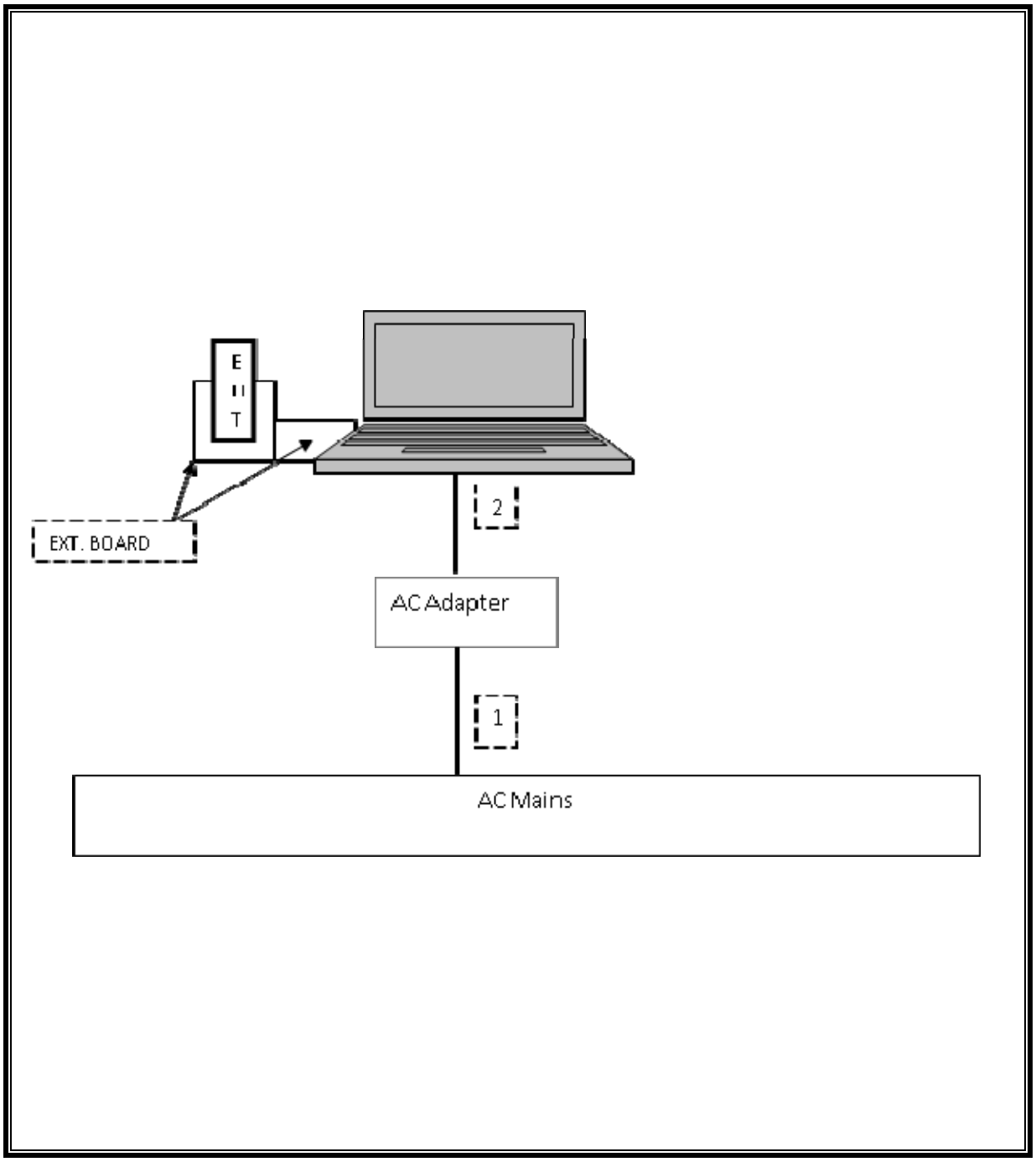
I/O CABLES

I/O Cable List						
Cable No	Port	# of identical ports	Connector Type	Cable Type	Cable Length (m)	Remarks
1	AC	1	US 115V	Un-Shielded	1m	NA
2	DC	1	DC	Un-Shielded	1.8m	Ferrite at laptop's end

TEST SETUP

The EUT is attached to a jig board which is installed in the PCMCI slot of a host laptop computer during the tests. Test software exercised the radio card.

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, 44 GHz	Agilent / HP	E4446A	C01012	09/02/11	09/02/12
Spectrum Analyzer, 26.5 GHz	Agilent / HP	E4440A	C01176	08/04/11	08/04/12
EMI Test Receiver, 9 kHz-7 GHz	R & S	ESCI 7	1000741	07/06/11	07/06/12
EMI Test Receiver, 30 MHz	R & S	ESHS 20	N02396	08/19/11	08/19/13
Antenna, Horn, 18 GHz	EMCO	3115	C00872	09/20/11	09/20/12
Antenna, Bilog, 30MHz-1 GHz	Sunol Sciences	JB1	C01171	01/26/12	01/26/13
Antenna, Horn, 26.5 GHz	ARA	MWH-1826/B	C00589	07/28/11	07/28/12
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C00749	07/18/11	07/18/12
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00558	11/11/11	11/11/12
LISN, 30 MHz	FCC	50/250-25-2	C00626	12/13/11	12/13/12

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.

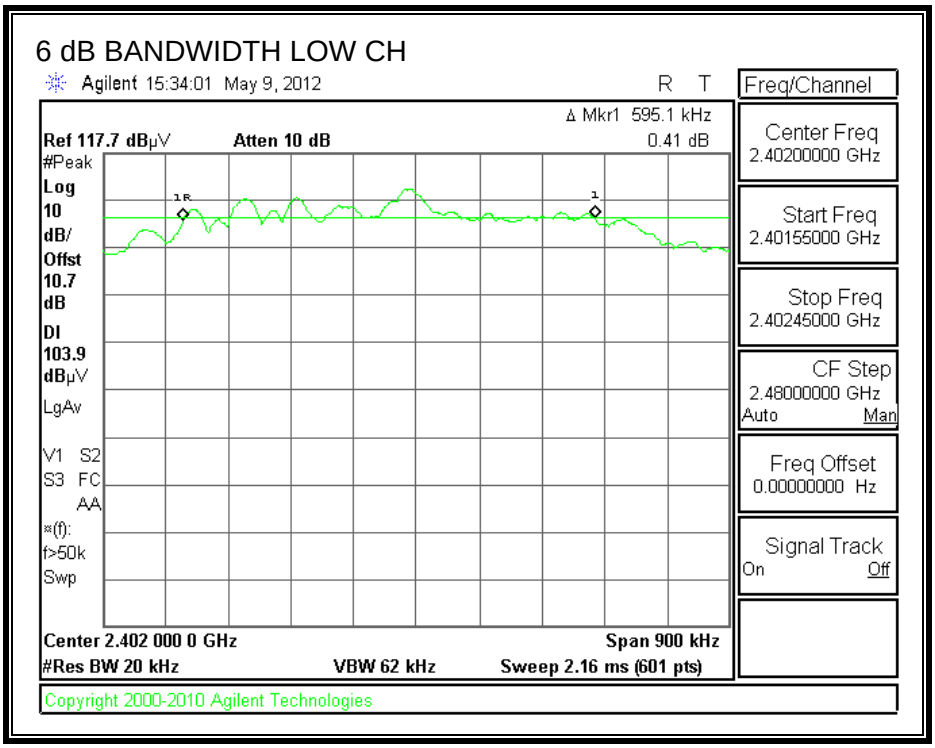
TEST PROCEDURE

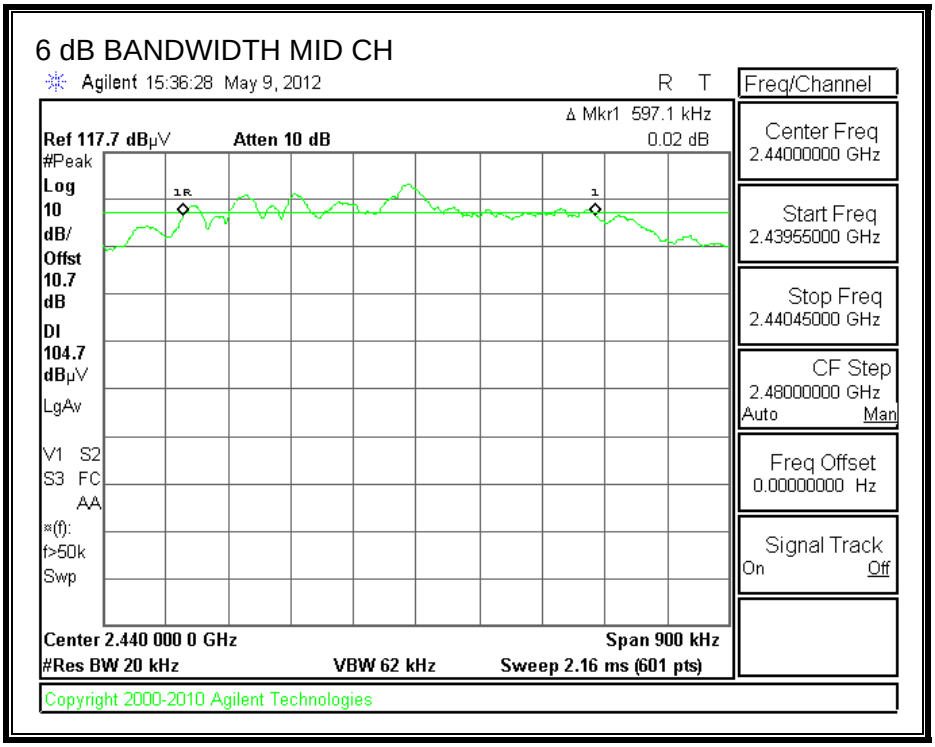
KDB 558074 D01 DTS Measurement Guidance V01 dated 01-18-12.

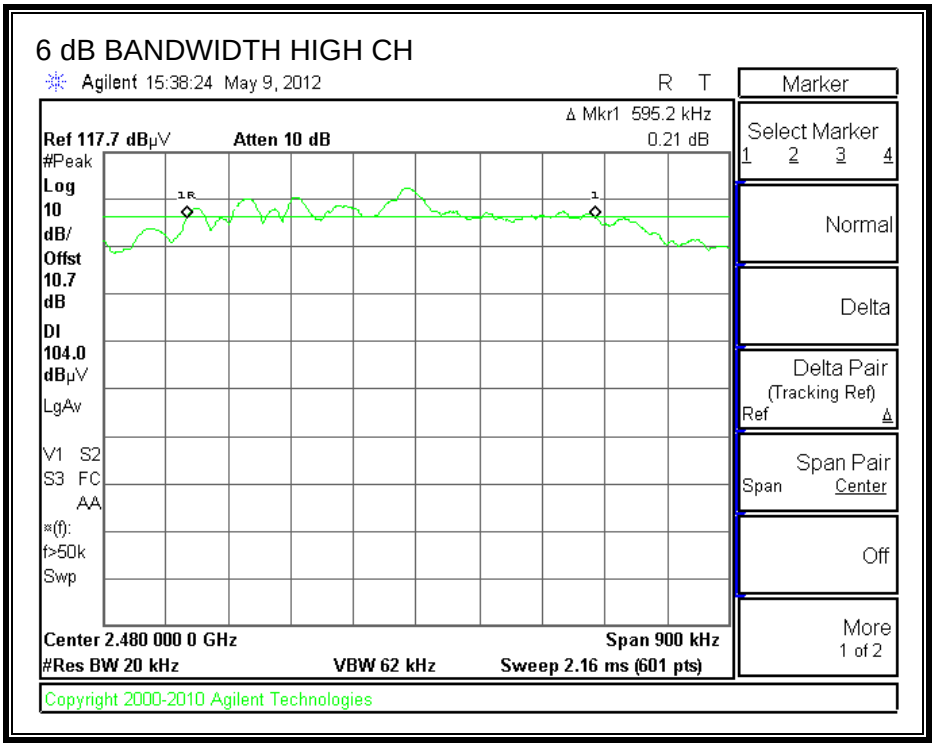
RESULTS

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2402	0.5951	0.5
Middle	2440	0.5971	0.5
High	2480	0.5952	0.5

6 dB BANDWIDTH







7.2. 99% BANDWIDTH

LIMITS

None; for reporting purposes only.

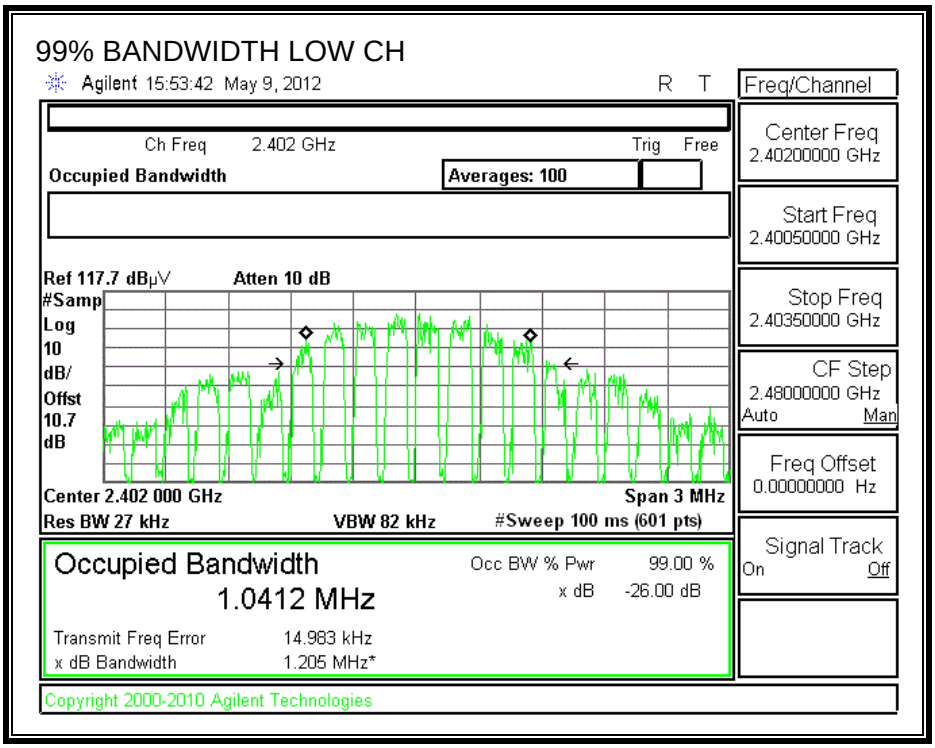
TEST PROCEDURE

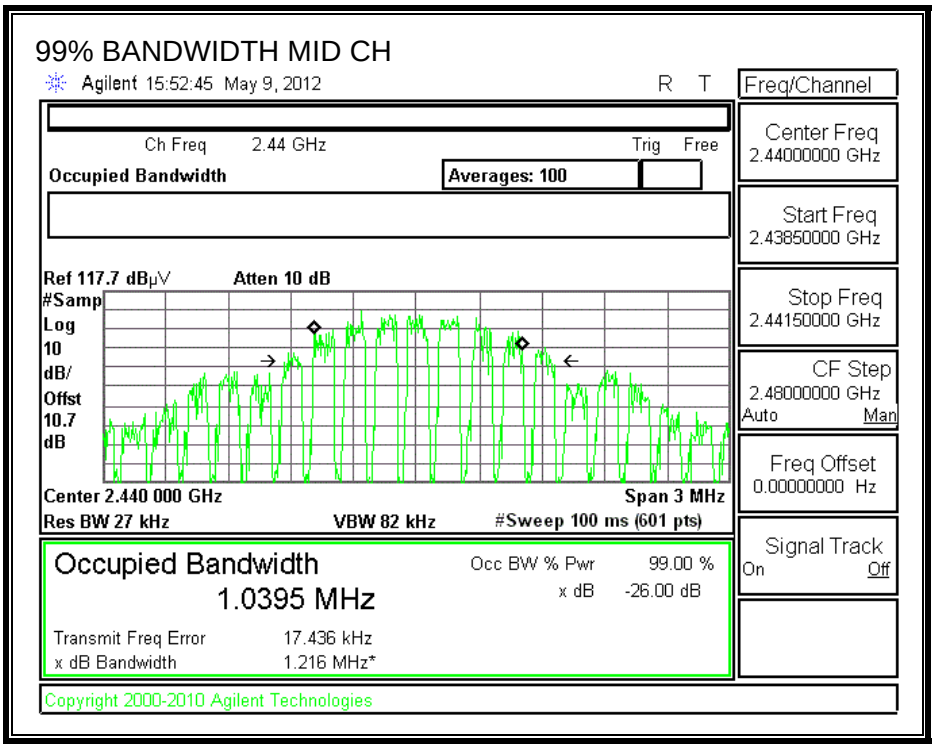
The transmitter output is connected to the spectrum analyzer. The RBW is set to 1% to 3% of the 99 % bandwidth. The VBW is set to 3 times the RBW. The sweep time is coupled. The spectrum analyzer internal 99% bandwidth function is utilized.

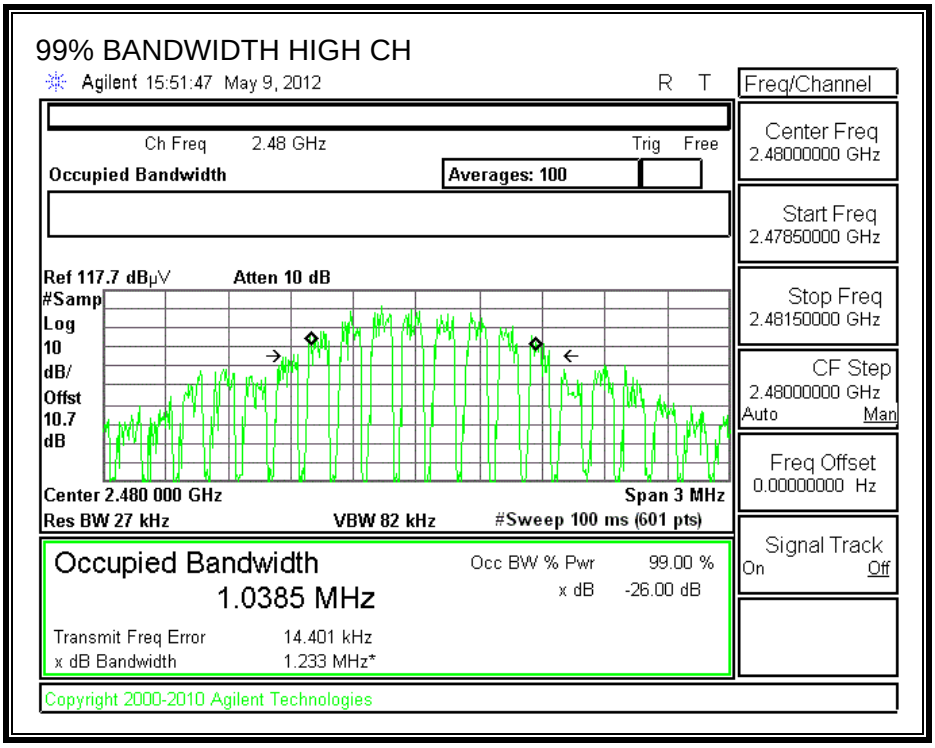
RESULTS

Channel	Frequency (MHz)	99% Bandwidth (MHz)
Low	2402	1.0412
Middle	2440	1.0395
High	2480	1.0385

99% BANDWIDTH







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.

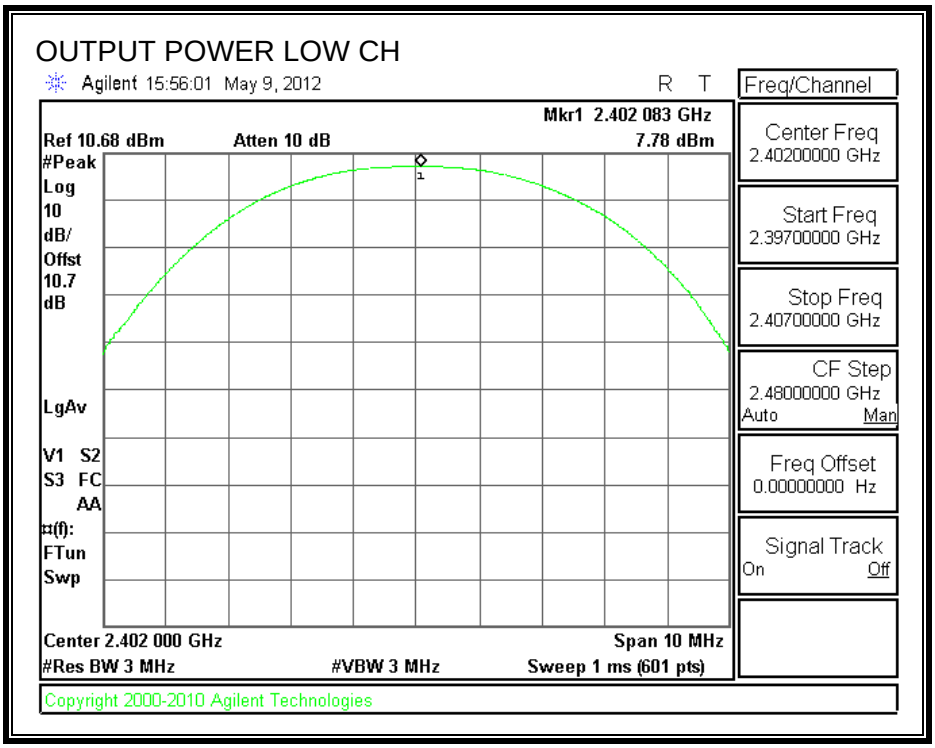
TEST PROCEDURE

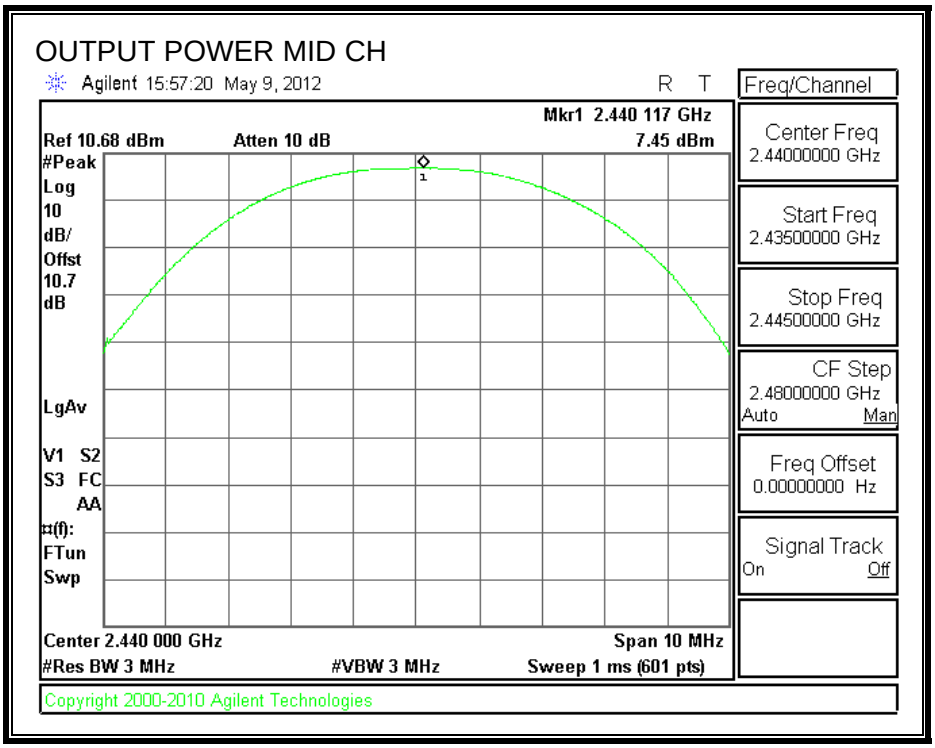
KDB 558074 D01 DTS Measurement Guidance V01 dated 01-18-12.

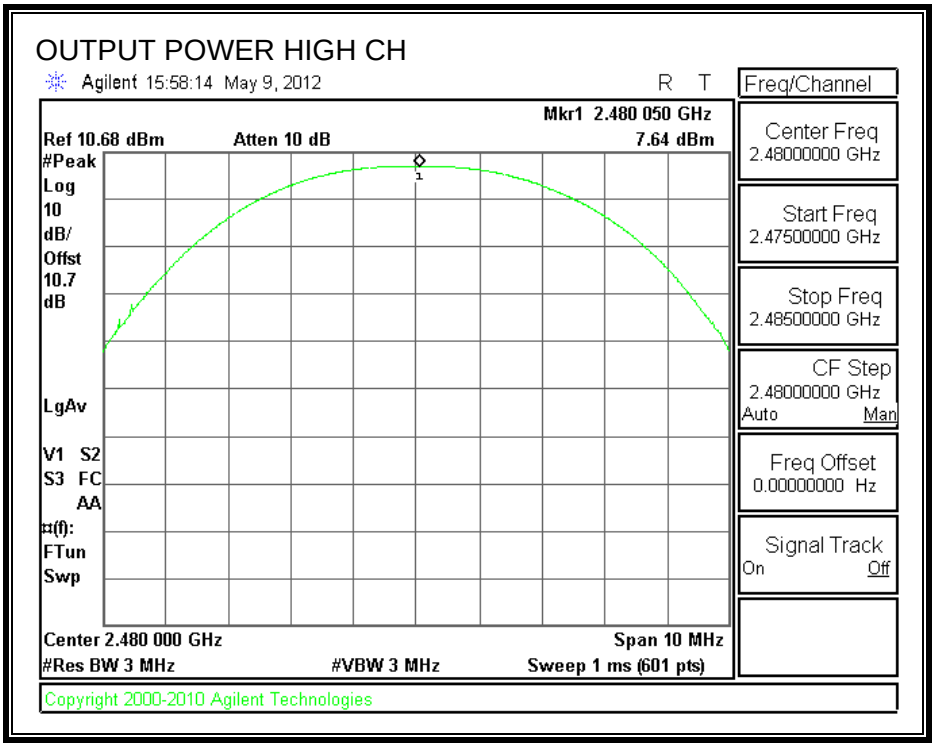
RESULTS

Channel	Frequency (MHz)	Peak Power Reading (dBm)	Attenuator and Cable Offset (dB)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2402	7.78	0	7.78	30	-22.22
Middle	2440	7.45	0	7.45	30	-22.55
High	2480	7.64	0	7.64	30	-22.36

OUTPUT POWER







7.4. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 10.68 dB (including 10 dB pad and 0.68 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Power (dBm)
Low	2402	6.11
Middle	2440	6.83
High	2480	6.94

7.5. POWER SPECTRAL DENSITY

LIMITS

FCC §15.247 (e)

IC RSS-210 A8.2 (b)

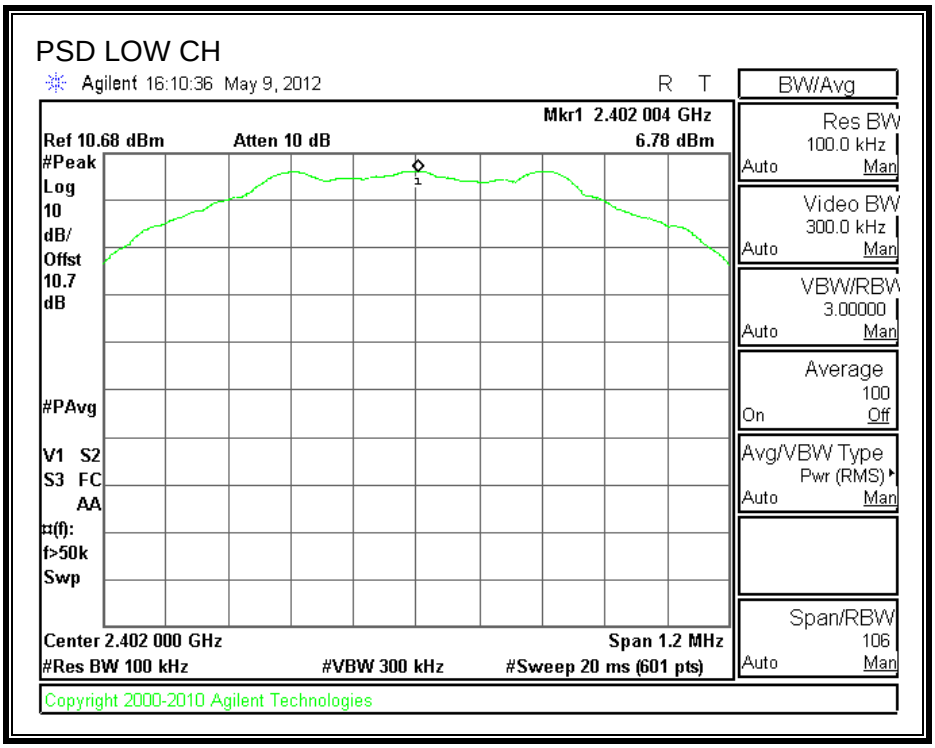
TEST PROCEDURE

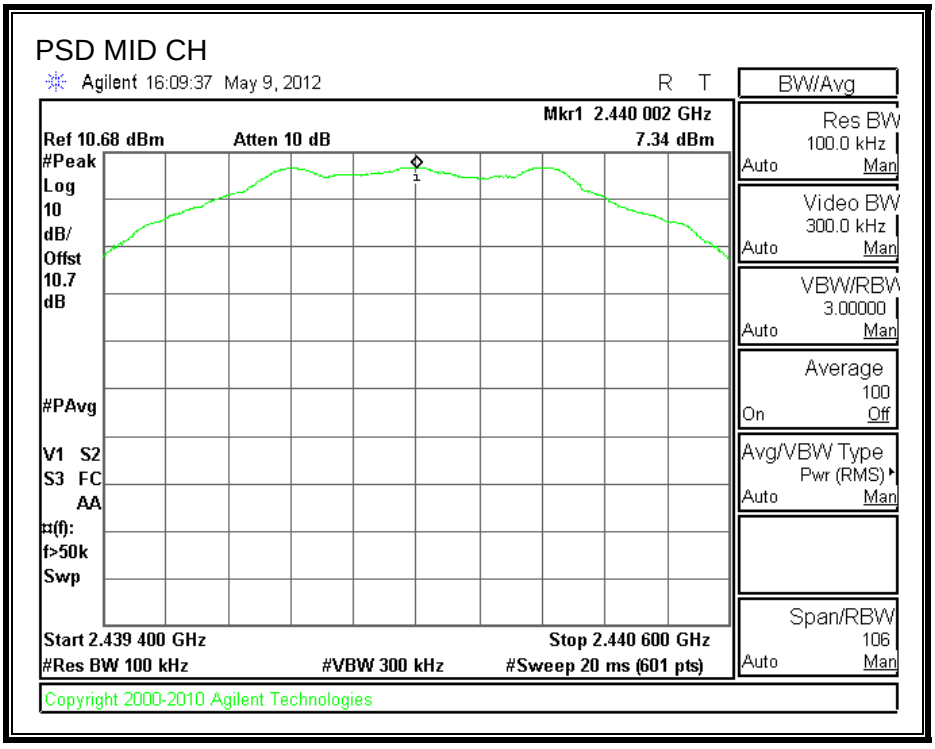
KDB 558074 D01 DTS Measurement Guidance V01 dated 01-18-12.

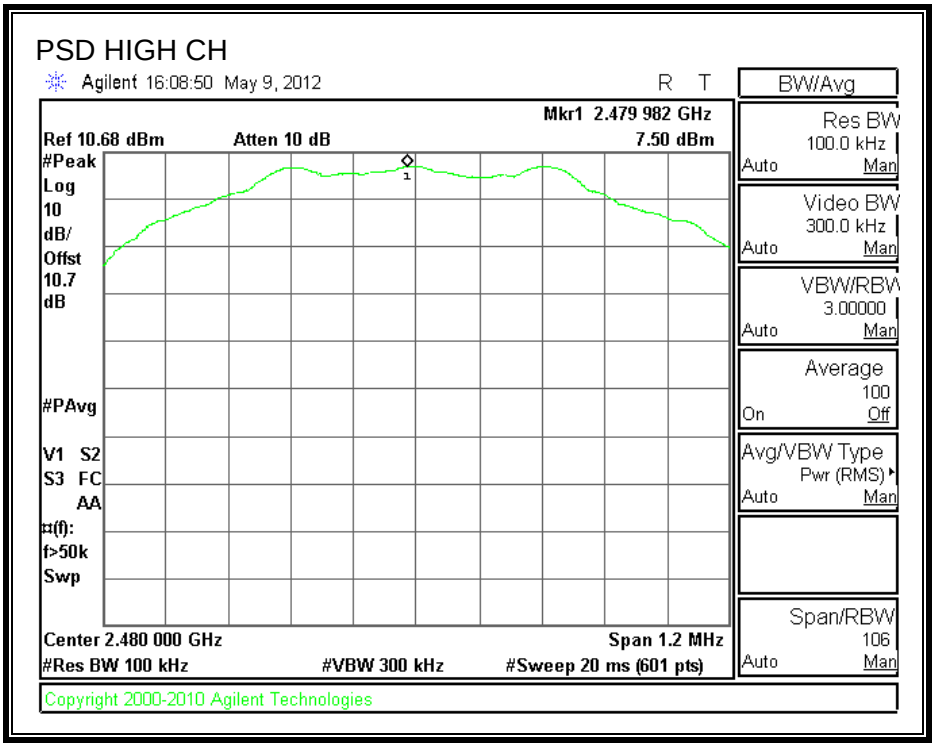
RESULTS

Channel	Frequency (MHz)	PPSD (dBm)	10 log (3/100 kHz)	Limit (dBm)	Margin (dB)
Low	2402	6.78	-15.2	8	-16.42
Middle	2440	7.34	-15.2	8	-15.86
High	2480	7.50	-15.2	8	-15.70

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.

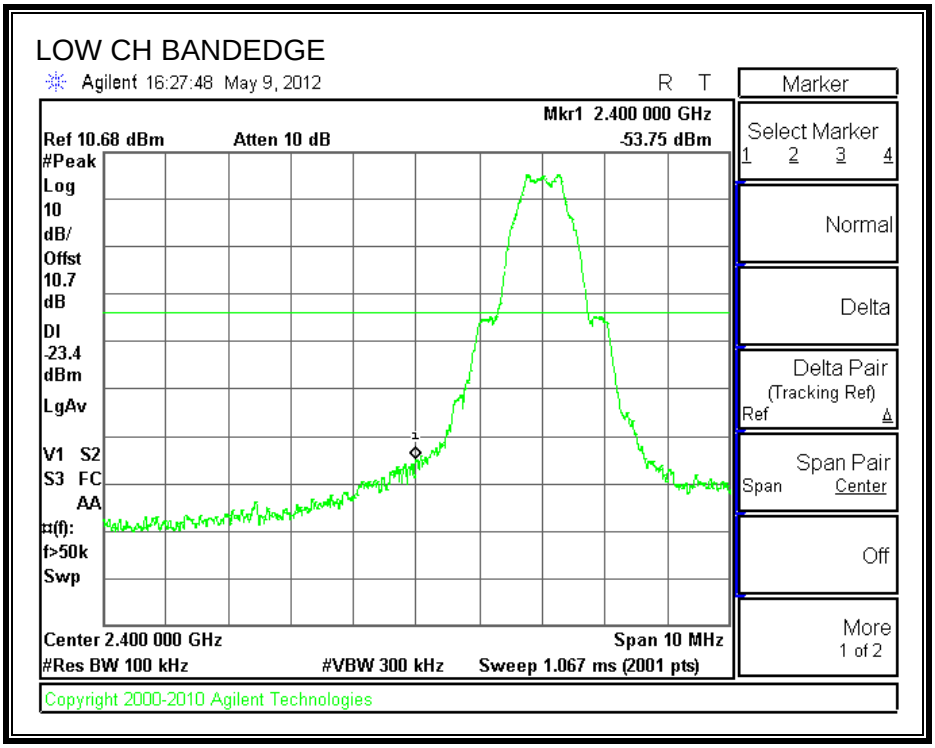
TEST PROCEDURE

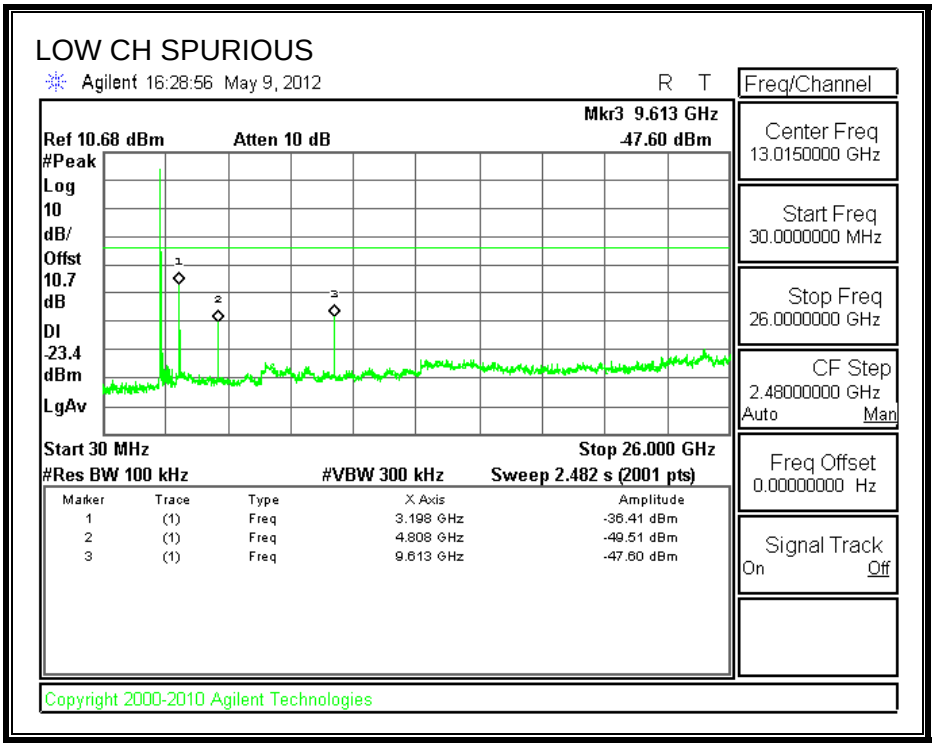
KDB 558074 D01 DTS Measurement Guidance V01 dated 01-18-12.

Note: Radiated measurements were made with the device connected to the highest gain antenna of each antenna type, and so conducted measurements were only used to verify compliance with the -20dBc limits for spurious not in restricted bands.

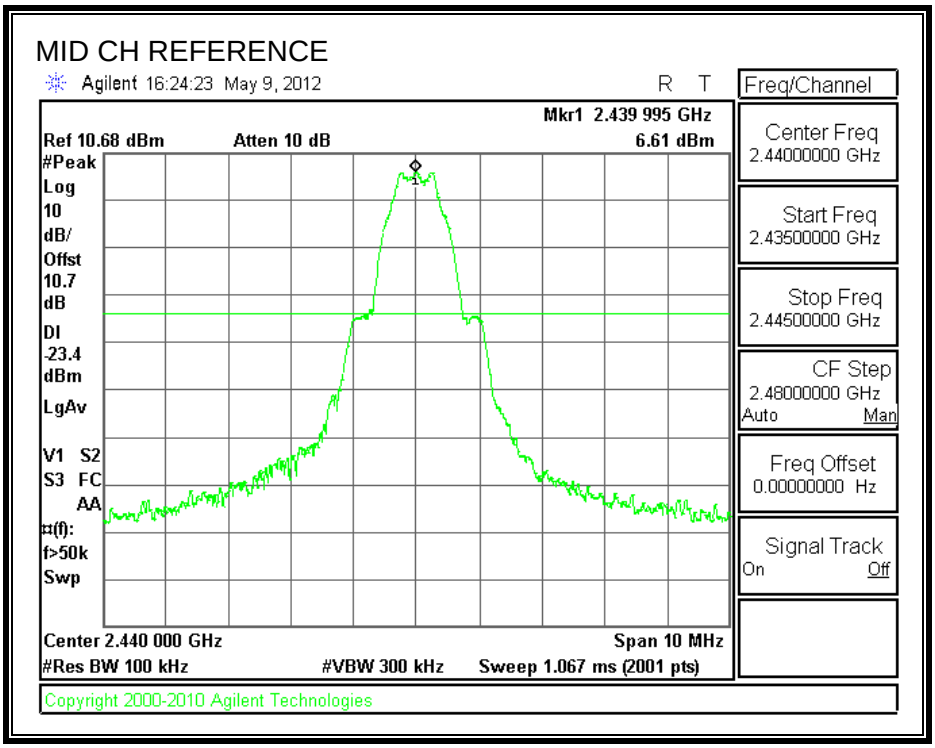
RESULTS

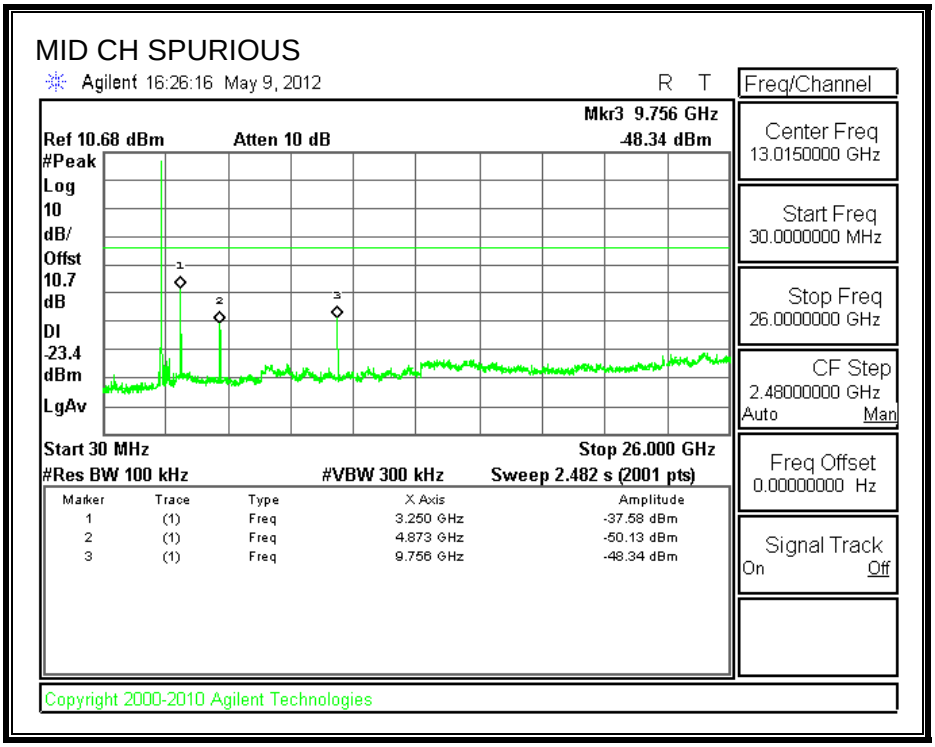
SPURIOUS EMISSIONS, LOW CHANNEL



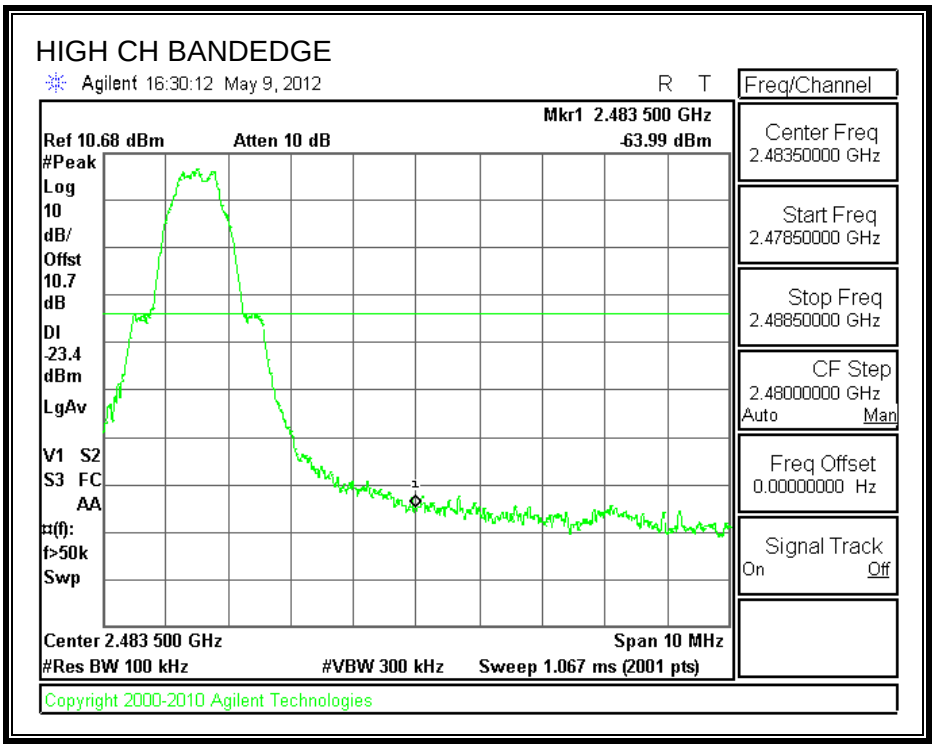


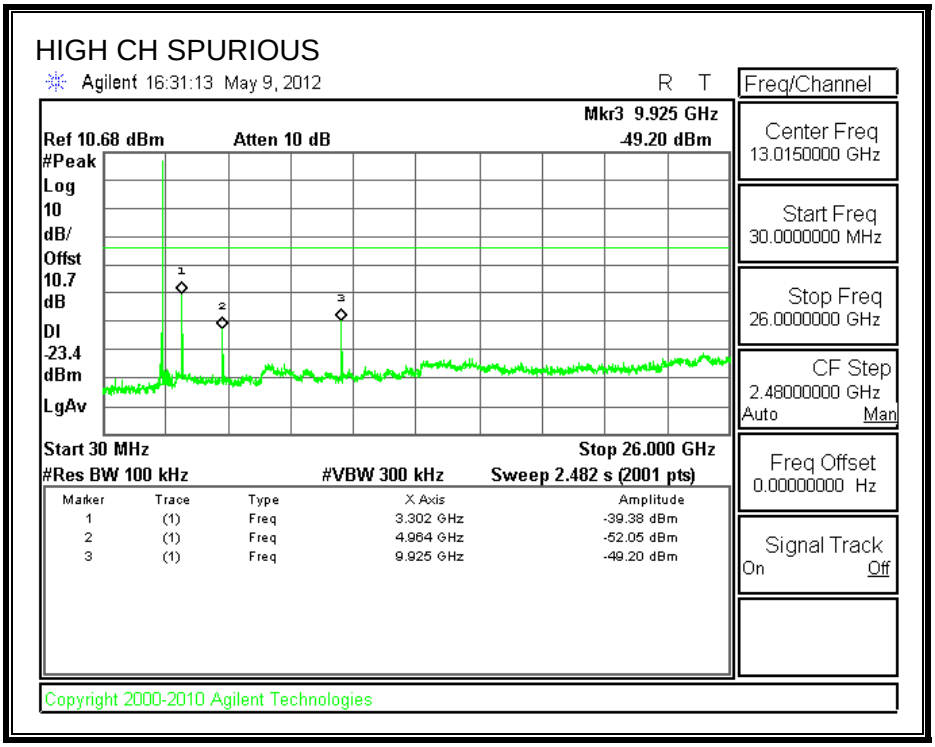
SPURIOUS EMISSIONS, MID CHANNEL





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.

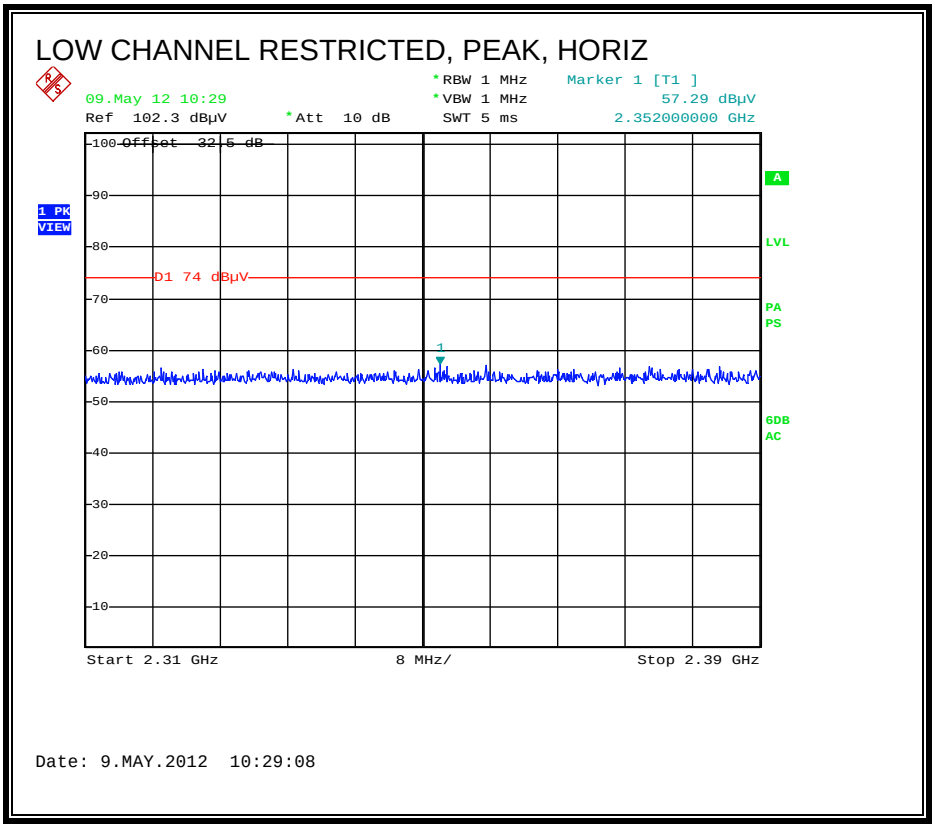
The spectrum from 30 MHz to 26 GHz is investigated with the transmitter set to the lowest, middle, and highest channels in the 2.4 GHz band.

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.

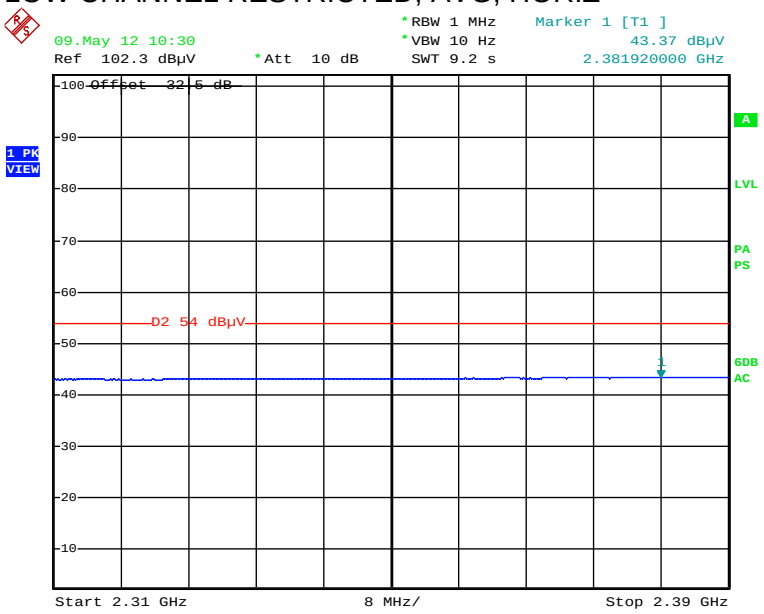
The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the emission. Measurements are made with the antenna polarized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

8.2. TRANSMITTER ABOVE 1 GHz

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



LOW CHANNEL RESTRICTED, AVG, HORIZ



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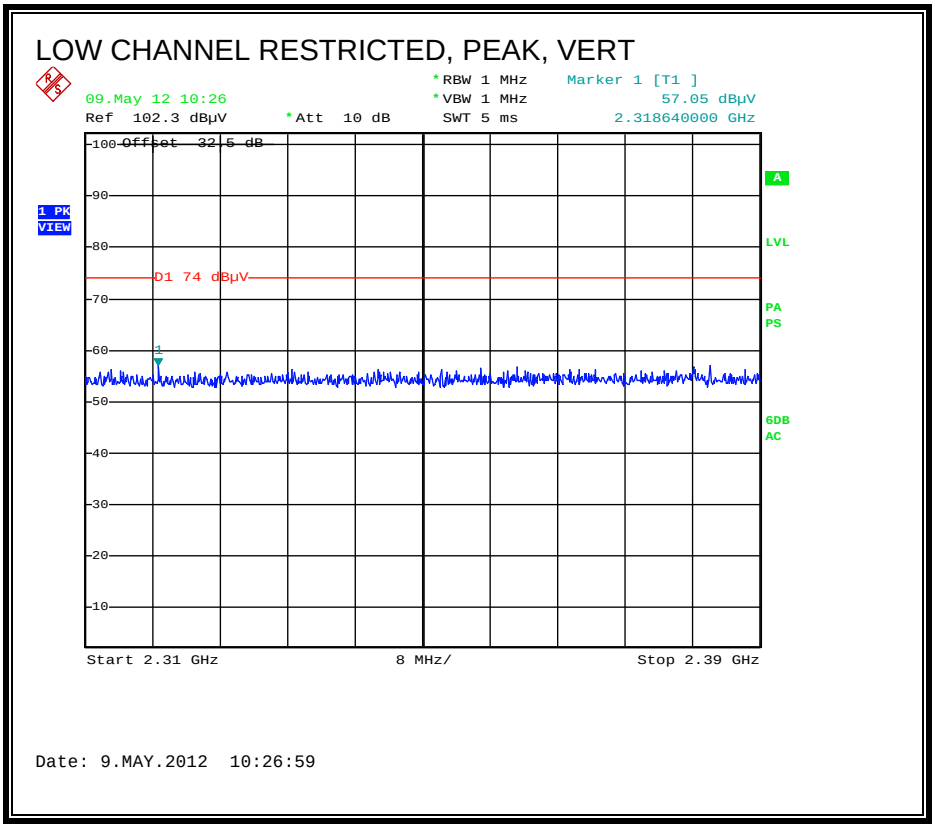
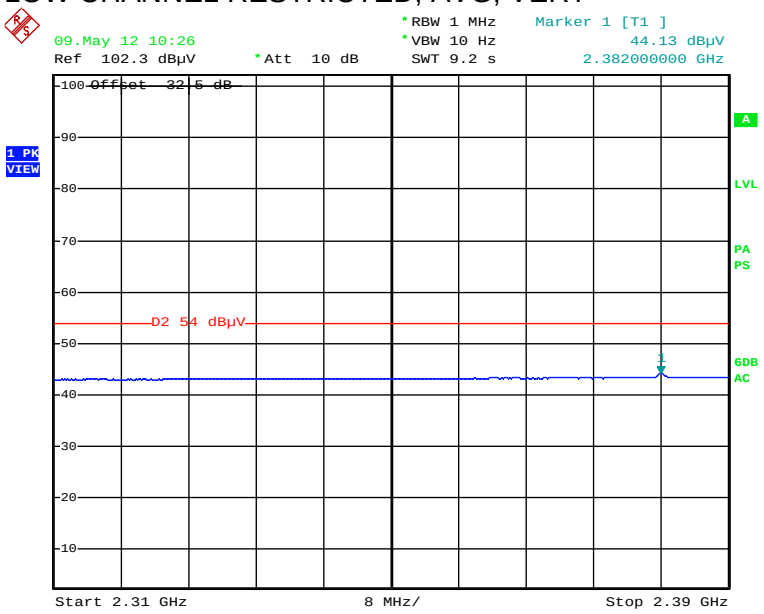
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



LOW CHANNEL RESTRICTED, AVG, VERT



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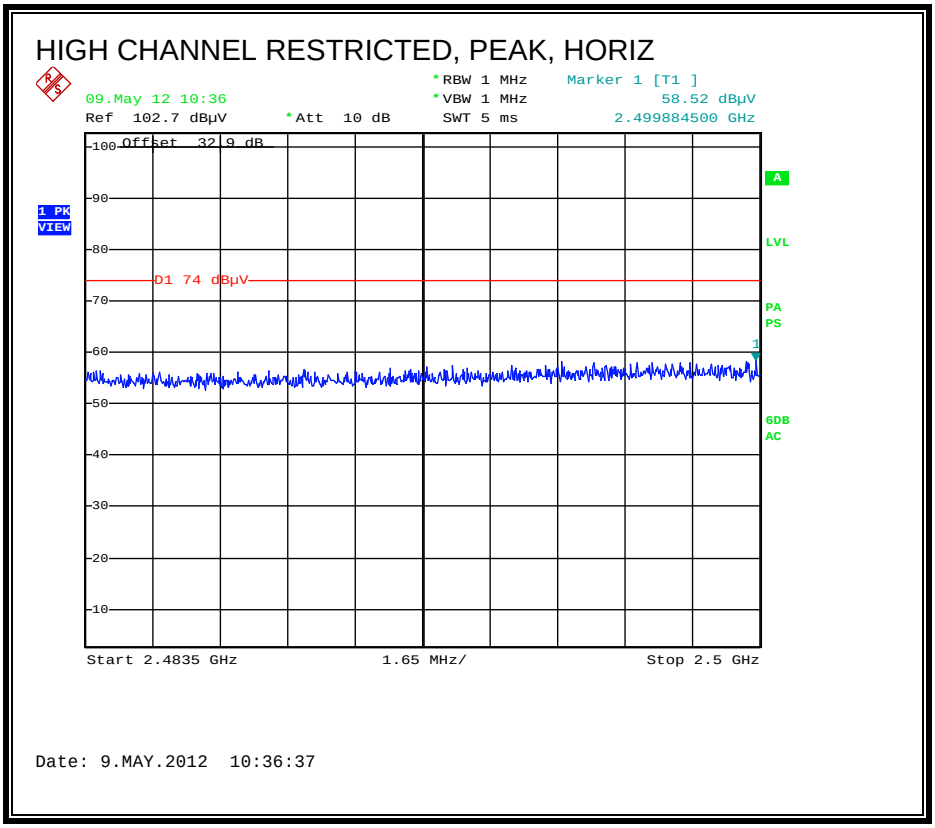
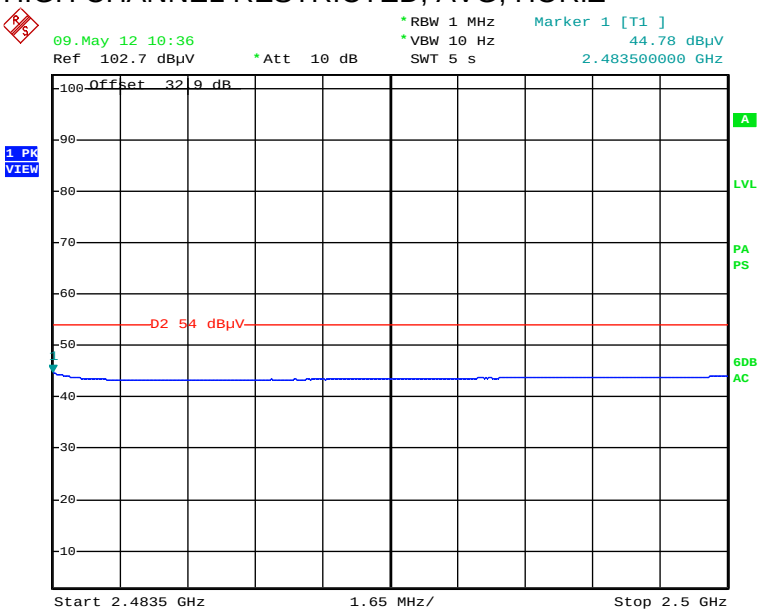
RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)



HIGH CHANNEL RESTRICTED, AVG, HORIZ



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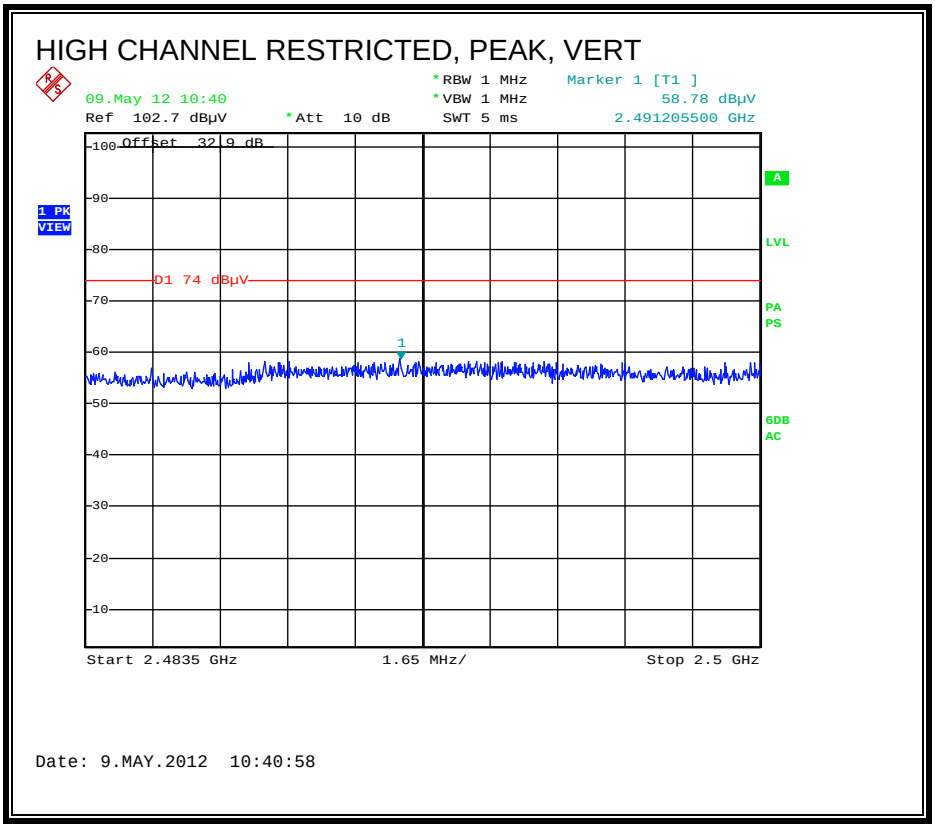
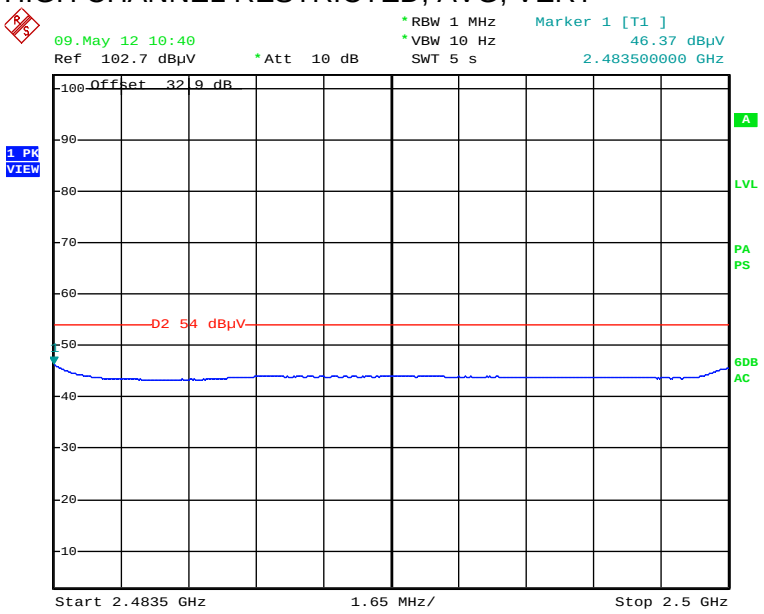
RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)



HIGH CHANNEL RESTRICTED, AVG, VERT



HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Test Engr: David Garcia
Date: 05/09/12
Project #: 12U14227
Company: Broadcom
Test Target: 15.205
Mode Oper: Bluetooth LE

f	Measurement Frequency	Amp	Preamp Gain		Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters		Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m		Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength		Margin vs. Peak Limit
CL	Cable Loss	HPF	High Pass Filter		

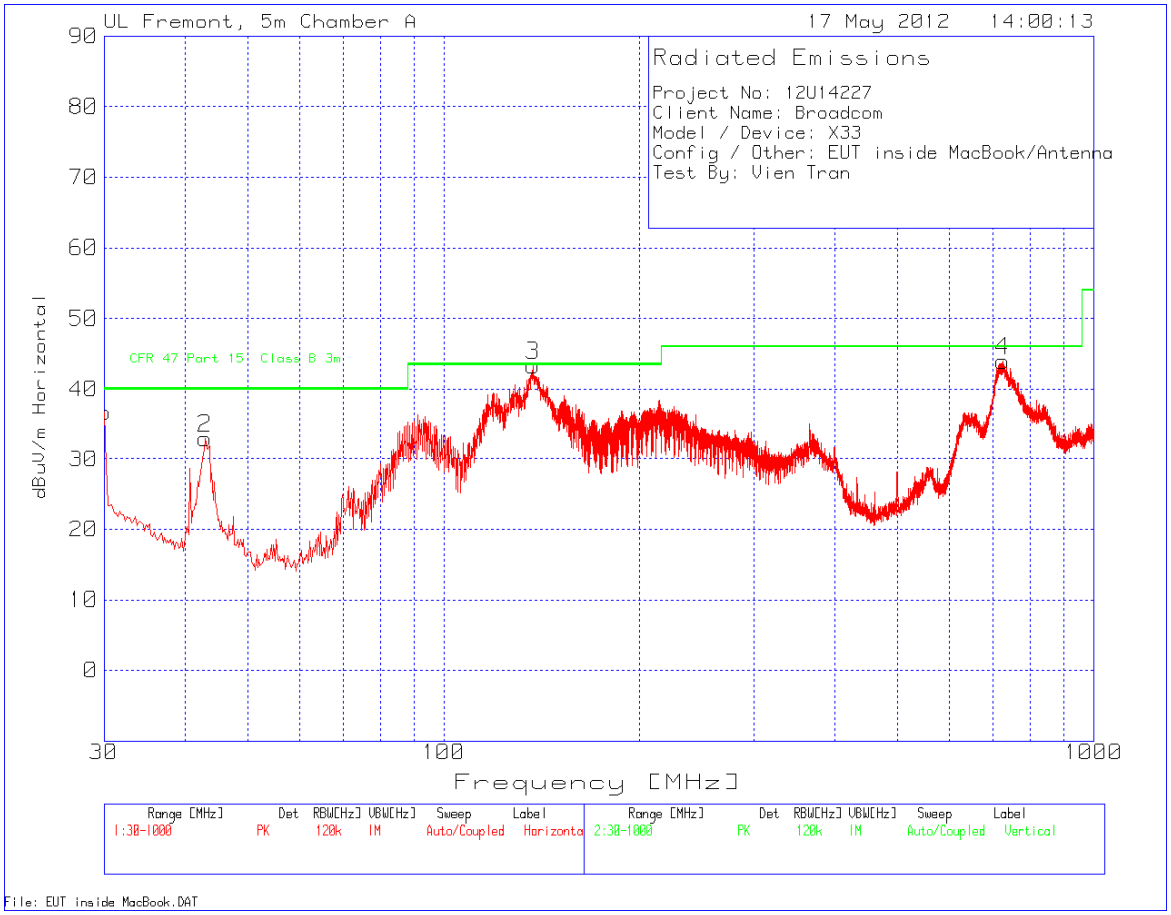
f GHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Notes
Low Channel: 2402 MHz													
4.804	3.0	38.7	33.1	6.8	-34.1	0.0	0.0	44.5	74.0	-29.5	H	P	
4.804	3.0	28.1	33.1	6.8	-34.1	0.0	0.0	33.9	54.0	-20.1	H	A	
12.010	3.0	34.0	39.4	11.9	-32.5	0.0	0.0	52.8	74.0	-21.2	H	P	
12.010	3.0	21.8	39.4	11.9	-32.5	0.0	0.0	40.5	54.0	-13.5	H	A	
4.804	3.0	40.7	33.1	6.8	-34.1	0.0	0.0	46.5	74.0	-27.5	V	P	
4.804	3.0	30.2	33.1	6.8	-34.1	0.0	0.0	36.0	54.0	-18.0	V	A	
12.010	3.0	33.7	39.4	11.9	-32.5	0.0	0.0	52.5	74.0	-21.5	V	P	
12.010	3.0	21.7	39.4	11.9	-32.5	0.0	0.0	40.5	54.0	-13.5	V	A	
Mid Channel: 2440 MHz													
4.880	3.0	38.2	33.2	6.8	-34.0	0.0	0.0	44.2	74.0	-29.8	H	P	
4.880	3.0	26.7	33.2	6.8	-34.0	0.0	0.0	32.7	54.0	-21.3	H	A	
7.320	3.0	35.6	36.3	9.1	-33.1	0.0	0.0	47.9	74.0	-26.1	H	P	
7.320	3.0	23.3	36.3	9.1	-33.1	0.0	0.0	35.6	54.0	-18.4	H	A	
12.200	3.0	33.7	39.4	12.0	-32.5	0.0	0.0	52.6	74.0	-21.4	H	P	
12.200	3.0	21.3	39.4	12.0	-32.5	0.0	0.0	40.2	54.0	-13.8	H	A	
4.880	3.0	39.9	33.2	6.8	-34.0	0.0	0.0	45.9	74.0	-28.1	V	P	
4.880	3.0	28.9	33.2	6.8	-34.0	0.0	0.0	34.9	54.0	-19.1	V	A	
7.320	3.0	35.2	36.3	9.1	-33.1	0.0	0.0	47.5	74.0	-26.5	V	P	
7.320	3.0	23.3	36.3	9.1	-33.1	0.0	0.0	35.6	54.0	-18.4	V	A	
High Channel: 2480 MHz													
4.960	3.0	36.8	33.2	6.9	-34.0	0.0	0.0	42.9	74.0	-31.1	H	P	
4.960	3.0	24.8	33.2	6.9	-34.0	0.0	0.0	30.9	54.0	-23.1	H	A	
7.440	3.0	35.7	36.5	9.1	-33.0	0.0	0.0	48.2	74.0	-25.8	H	P	
7.440	3.0	23.6	36.5	9.1	-33.0	0.0	0.0	36.2	54.0	-17.8	H	A	
4.960	3.0	38.9	33.2	6.9	-34.0	0.0	0.0	45.0	74.0	-29.0	V	P	
4.960	3.0	27.7	33.2	6.9	-34.0	0.0	0.0	33.8	54.0	-20.2	V	A	
7.440	3.0	36.5	36.5	9.1	-33.0	0.0	0.0	49.0	74.0	-25.0	V	P	
7.440	3.0	23.3	36.5	9.1	-33.0	0.0	0.0	35.8	54.0	-18.2	V	A	

Rev. 4.1.2.7
Note: No other emissions were detected above the system noise floor.

8.3. WORST-CASE BELOW 1 GHz

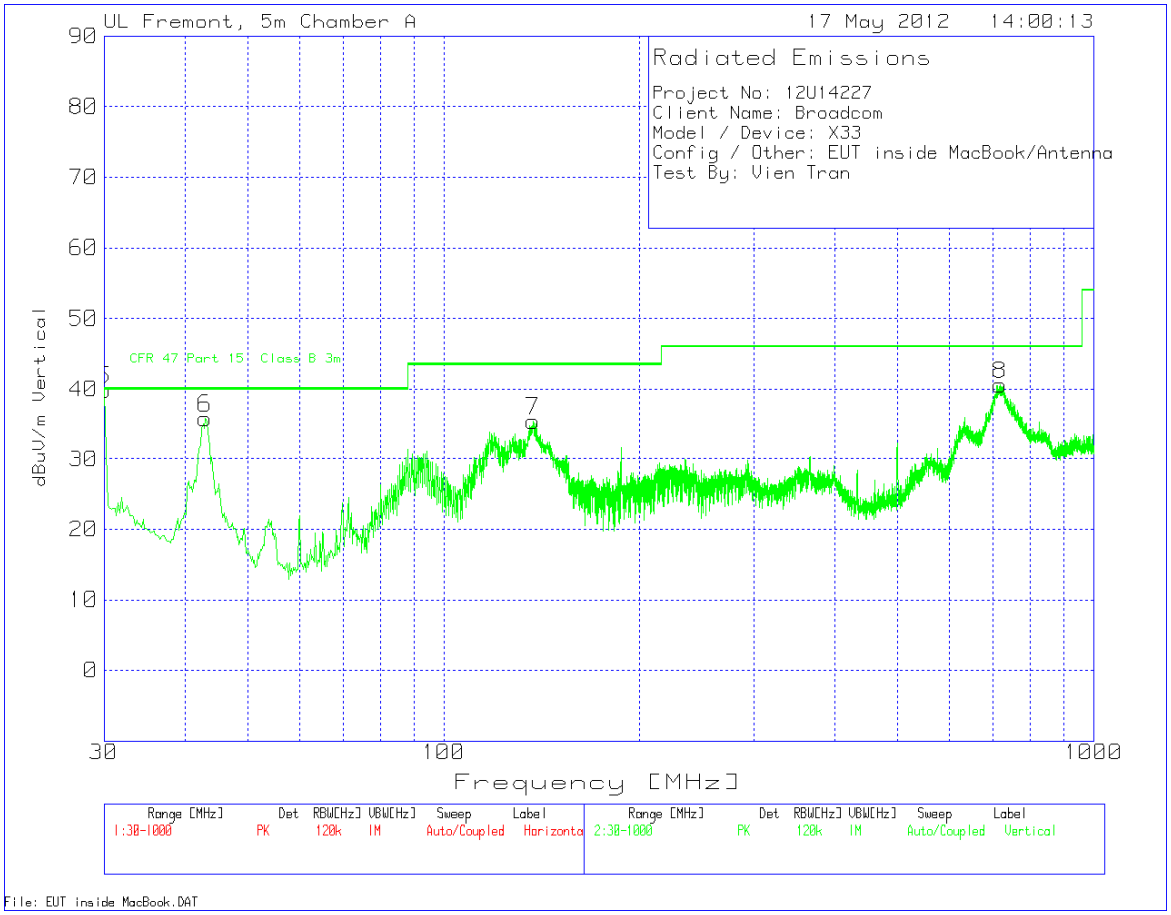
SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, HORIZONTAL)

HORIZONTAL PLOT



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

VERTICAL PLOT



HORIZONTAL AND VERTICAL DATA

Project No: 12U14227
Client Name: Broadcom
Model / Device: X33
Config / Other: EUT inside MacBook/Antenna
Test By: Vien Tran

Horizontal 30 - 1000MHz

Test Frequency	Meter Reading	Detector	1GHz ChmbrA Amplified. TX [dB]	T243 Sunol Bilog.TXT [dB]	dBuV/m	CFR 47 Part 15 Class B 3m	Margin	Height [cm]	Polarity
30	42.99	PK	-27.5	21.3	36.79	40.0	-3.21	200	Horz
42.9876	48.53	PK	-27.4	11.9	33.03	40.0	-6.97	400	Horz
137.3901	57.02	PK	-26.7	13.0	43.32	43.5	-0.18	200	Horz
137.3901	53.81	QK	-26.7	13.0	40.11	43.5	-3.39	200	Horz
725.9033	47.02	PK	-23.3	20.2	43.92	46.0	-2.08	100	Horz
725.9033	45.14	PK	-23.3	20.2	42.04	46.0	-3.96	100	Horz

Vertical 30 - 1000MHz

Test Frequency	Meter Reading	Detector	1GHz ChmbrA Amplified. TX [dB]	T243 Sunol Bilog.TXT [dB]	dBuV/m	CFR 47 Part 15 Class B 3m	Margin	Height [cm]	Polarity
30	46.01	PK	-27.5	21.3	39.81	40.0	-0.19	400	Vert
30	40.72	PK	-27.5	21.3	34.52	40.0	-5.48	400	Vert
42.9876	51.35	PK	-27.4	11.9	35.85	40.0	-4.15	100	Vert
137.3901	49.18	PK	-26.7	13.0	35.48	43.5	-8.02	200	Vert
717.3741	43.66	PK	-23.2	20.1	40.56	46.0	-5.44	100	Vert

PK - Peak detector
QP - Quasi-Peak detector
Av - Average detector

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

The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.4.

The receiver is set to a resolution bandwidth of 9 kHz. Peak detection is used unless otherwise noted as quasi-peak or average.

Line conducted data is recorded for both NEUTRAL and HOT lines.

RESULTS

6 WORST EMISSIONS

Project No:12U14227
Client Name:Broadcom
Model/Device:802.11a/g/n 3x3 MIMO WLAN + BT
Test Volt/Freq:120 Vac / 60Hz
Test By:Vien Tran

Line-L1 .15 - 30MHz

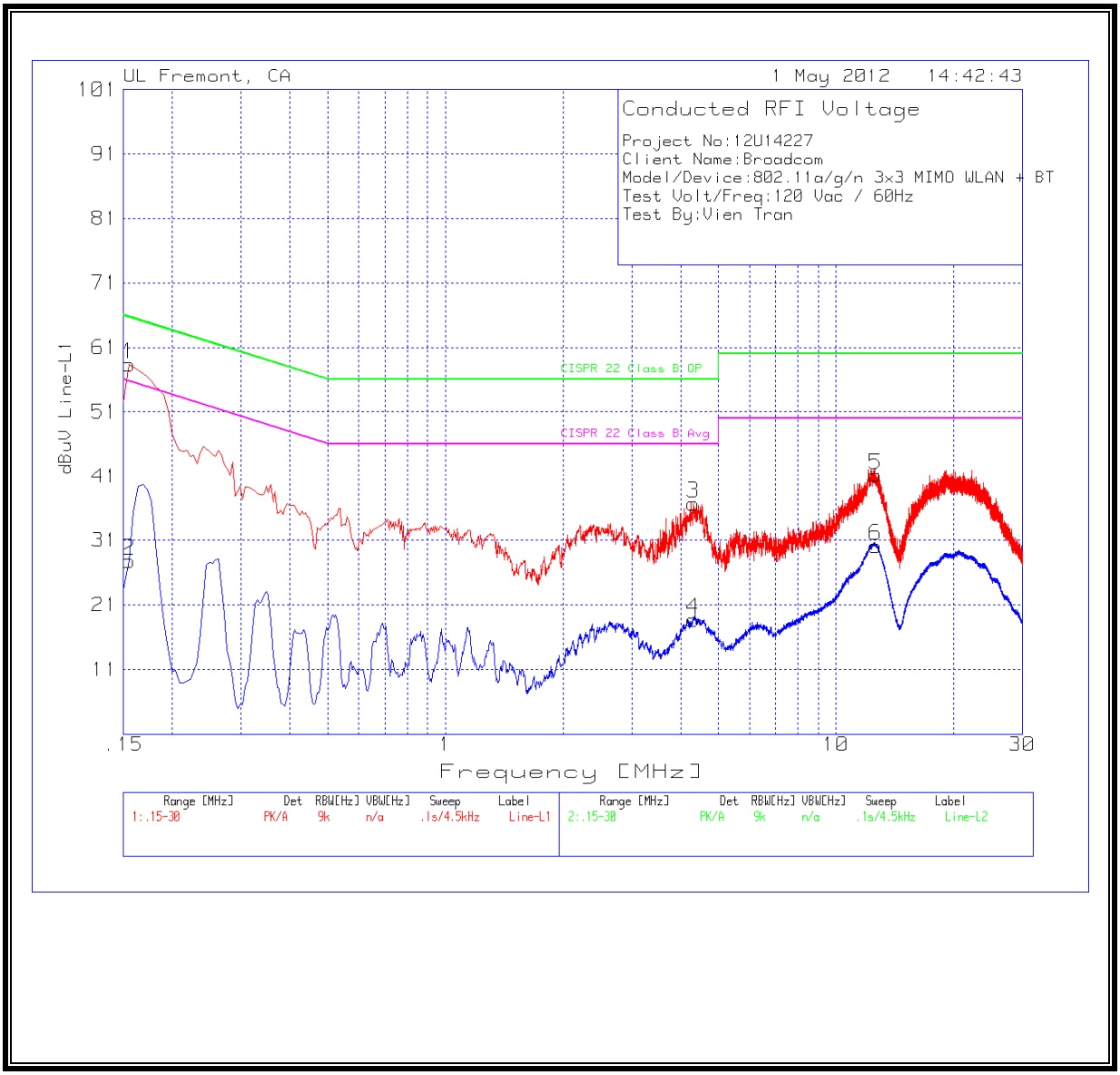
Test Frequency	Meter Reading	Detector	T24 IL L1.TXT [dB]	LC Cables 1&3.TXT [dB]	dBuV	CISPR 22 Class B QP	Margin	CISPR 22 Class B Avg	Margin
0.155	58.27	PK	0.1	0.00	58.37	65.8	-7.43	-	-
0.155	27.73	Av	0.1	0.00	27.83	-	-	55.80	-27.97
4.308	36.5	PK	0.1	0.10	36.70	56	-19.30	-	-
4.308	18.47	Av	0.1	0.10	18.67	-	-	46.00	-27.33
12.615	40.75	PK	0.2	0.20	41.15	60	-18.85	-	-
12.615	29.67	Av	0.2	0.20	30.07	-	-	50.00	-19.93

Line-L2 .15 - 30MHz

Test Frequency	Meter Reading	Detector	T24 IL L1.TXT [dB]	LC Cables 1&3.TXT [dB]	dBuV	CISPR 22 Class B QP	Margin	CISPR 22 Class B Avg	Margin
0.164	54.87	PK	0.1	0	54.97	65.3	-10.33	-	-
0.164	35.78	Av	0.1	0	35.88	-	-	55.3	-19.42
4.232	36.83	PK	0.1	0.1	37.03	56	-18.97	-	-
4.232	19.17	Av	0.1	0.1	19.37	-	-	46	-26.63
12.539	41.39	PK	0.2	0.2	41.79	60	-18.21	-	-
12.539	29.68	Av	0.2	0.2	30.08	-	-	50	-19.92

PK - Peak detector
QP - Quasi-Peak detector
Av - Average detector

LINE 1 RESULTS



LINE 2 RESULTS