FCC CFR47 PART 15 SUBPART C
INDUSTRY CANADA RSS-210 ISSUE 7

CERTIFICATION TEST REPORT

FOR

802.15.4 2.4GHz MODULAR TRANSCEIVER

MODEL NUMBER: RFM2530LX

REPORT NUMBER: 09U12944-1, Revision A

FCC ID: X2R-RFM2530A
IC: 8775A-RFM2530A

ISSUE DATE: JANUARY 22, 2010

Prepared for
CROSBY ENGINEERING SERVICES
19986 ECHO BLUE DRIVE, PENN VALLEY
CALIFORNIA 95646, U.S.A.

Prepared by
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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	12/11/09	Initial Issue	F. Ibrahim
A	01/22/10	Revised section 5.5 “worst-case configuration and mode”	F. Ibrahim

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: CROSBY ENGINEERING SERVICES
19986 ECH BLUE DRIVE
PENN VALLEY, CALIFORNIA 95946

EUT DESCRIPTION: 802.15.4 2.4GHz MODULAR TRANSCEIVER

MODEL: RFM2530LX

SERIAL NUMBER: 002

DATE TESTED: DECEMBER 10, 2009

APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
FCC PART 15 SUBPART C	Pass
INDUSTRY CANADA RSS-210 Issue 7	Pass
INDUSTRY CANADA RSS-GEN Issue 2	Pass

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

FRANK IBRAHIM
EMC SUPERVISOR
COMPLIANCE CERTIFICATION SERVICES

Tested By:

THANH NGUYEN
EMC ENGINEER
COMPLIANCE CERTIFICATION SERVICES

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2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4-2003, FCC CFR 47 Part 2, FCC CFR 47 Part 15, RSS-GEN Issue 2, and RSS-210 Issue 7.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

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%.

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5. EQUIPMENT UNDER TEST

5.1. DESCRIPTION OF EUT

The EUT is an 802.15.4 Zigbee modular transceiver.

The radio module is manufactured by Might Electronic Co LTD.

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)
2405 - 2480	802.15.4 Zigbee	6.38	4.35

5.3. DESCRIPTION OF AVAILABLE ANTENNAS

The radio utilizes a permanently attached chip antenna, with a maximum gain of 0 dBi.

5.4. SOFTWARE AND FIRMWARE

The firmware installed in the EUT during testing was version 1.01.

The EUT driver software installed during testing was TIMAC-CC2530-1.3.0.

The test utility software used during testing was N/A.

5.5. WORST-CASE CONFIGURATION AND MODE

The worst-case channel is determined as the channel with the highest output power; therefore radiated emissions below 1 GHz and power line conducted emissions tests were performed with EUT set to low channel.

Worst case data rate as provided by the client was 250 kBps.

Three orthogonal orientations X, Y and Z were investigated, orientation X was found to be worst-case orientation; therefore, radiated emission testing was performed with EUT setup in X orientation.

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5.6. DESCRIPTION OF TEST SETUP

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
AC/DC Adapter	Tamura	425A12400P	N/A	N/A
RFM2530 Eval Board	Crosby Engineering Svcs	RFM2530 EVAL	1/1/1900	N/A

I/O CABLES

I/O CABLE LIST						
Cable No.	**Port**	**# of Identical Ports**	**Connector Type**	**Cable Type**	**Cable Length**	**Remarks**
1	DC	1	DC Power Jack	Unshielded	2m	N/A

TEST SETUP

The EUT is a stand alone, power by AC/DC Adapter.

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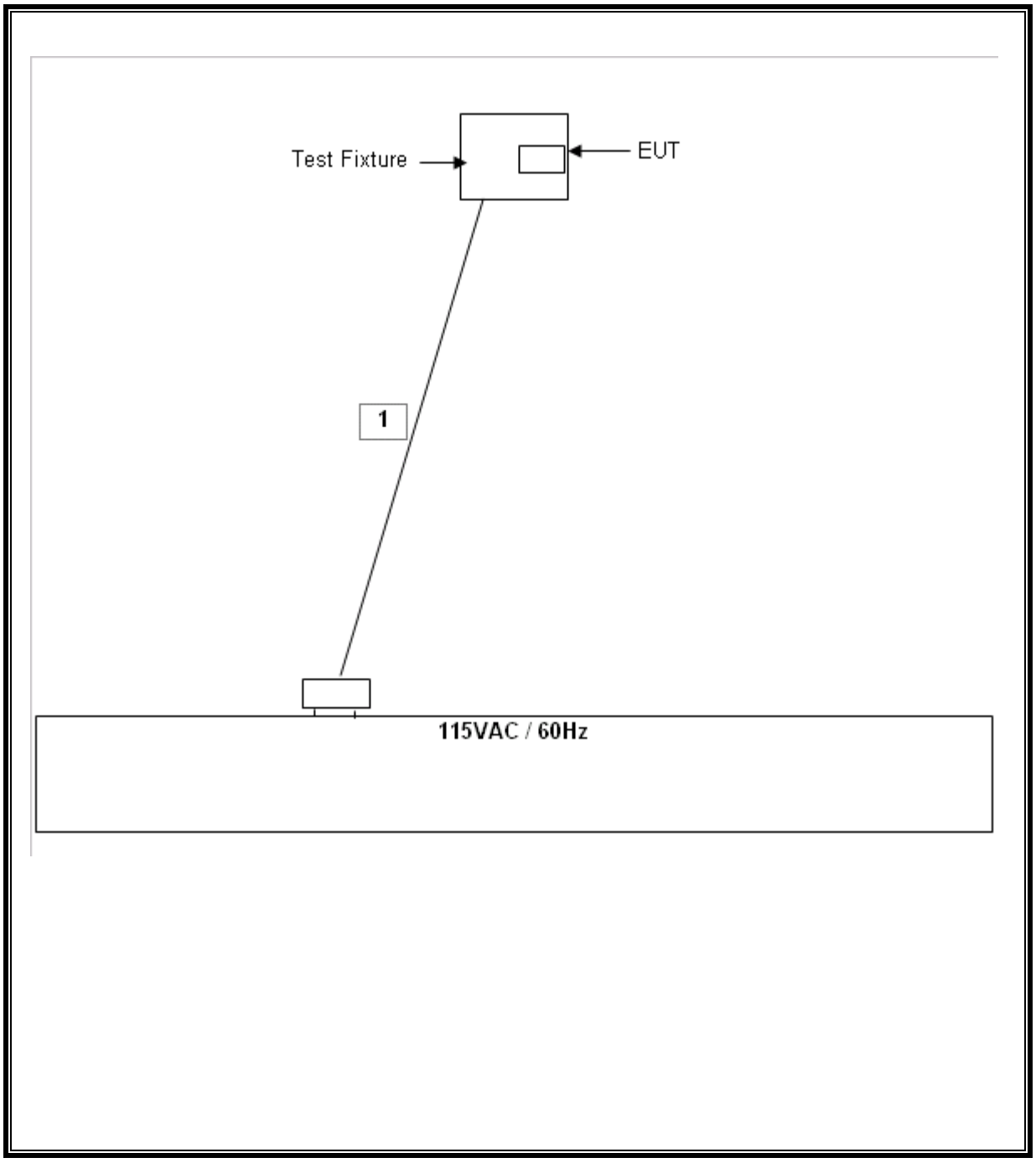
SETUP DIAGRAM FOR TESTS



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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**
Antenna, Bilog, 2 GHz	Sunol Sciences	JB1	C01011	1/14/2009	1/14/2010
Preamplifier, 1300 MHz	Agilent / HP	8447D	C00885	3/31/2009	3/31/2010
0	Agilent / HP	E4446A	C01069	1/5/2009	1/5/2010
Antenna, Horn, 18 GHz	EMCO	3115	C00945	4/22/2009	4/22/2010
Preamplifier, 26.5 GHz	Agilent / HP	8449B	C01052	8/5/2009	8/5/2010
LISN, 30 MHz	FCC	LISN-50/250-25-2	N02625	10/29/2009	10/29/2010
LISN, 10 kHz ~ 30 MHz	Solar	8012-50-R-24-BNC	N02481	10/29/2009	10/29/2010
EMI Test Receiver, 30 MHz	R & S	ESHS 20	N02396	2/6/2009	8/6/2010
Power Meter	Agilent / HP	437B	N02785	6/2/2009	12/2/2010
Power Sensor, 18 GHz	Agilent / HP	8481A	N02781	5/2/2009	11/2/2010

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7. TEST RESULTS

7.1. ANTENNA PORT RESULTS

7.1.1. 6 dB BANDWIDTH

LIMITS

FCC §15.247 (a) (2)

IC RSS-210 A8.2 (a)

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

TEST PROCEDURE

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

RESULTS

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Limit (MHz)
Low	2405	1.6	0.5
Middle	2440	1.617	0.5
High	2480	1.633	0.5

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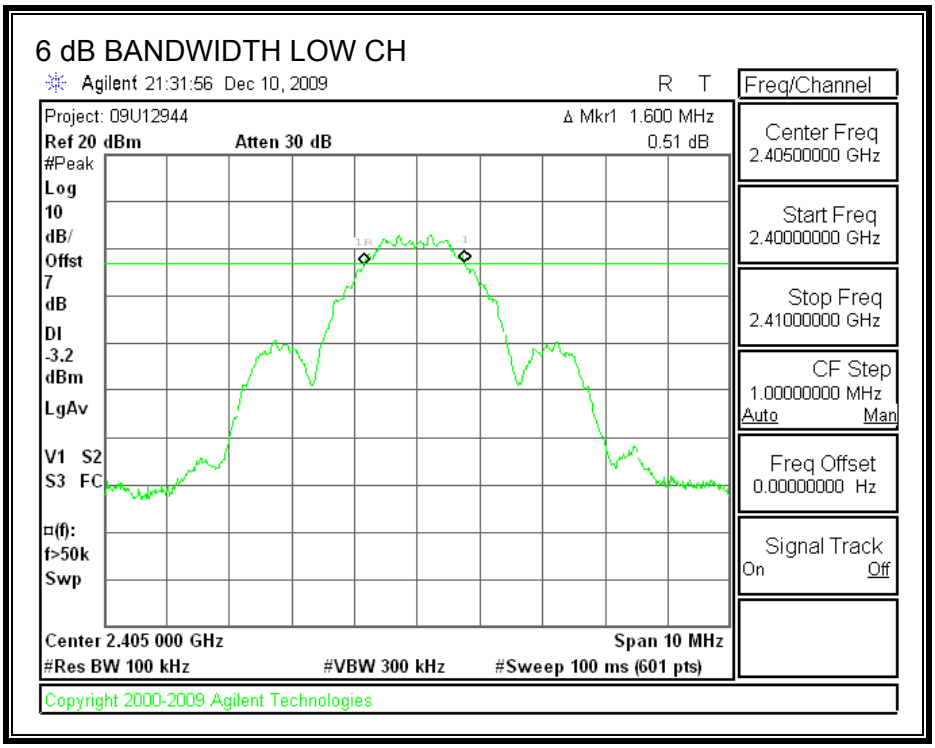
6 dB BANDWIDTH



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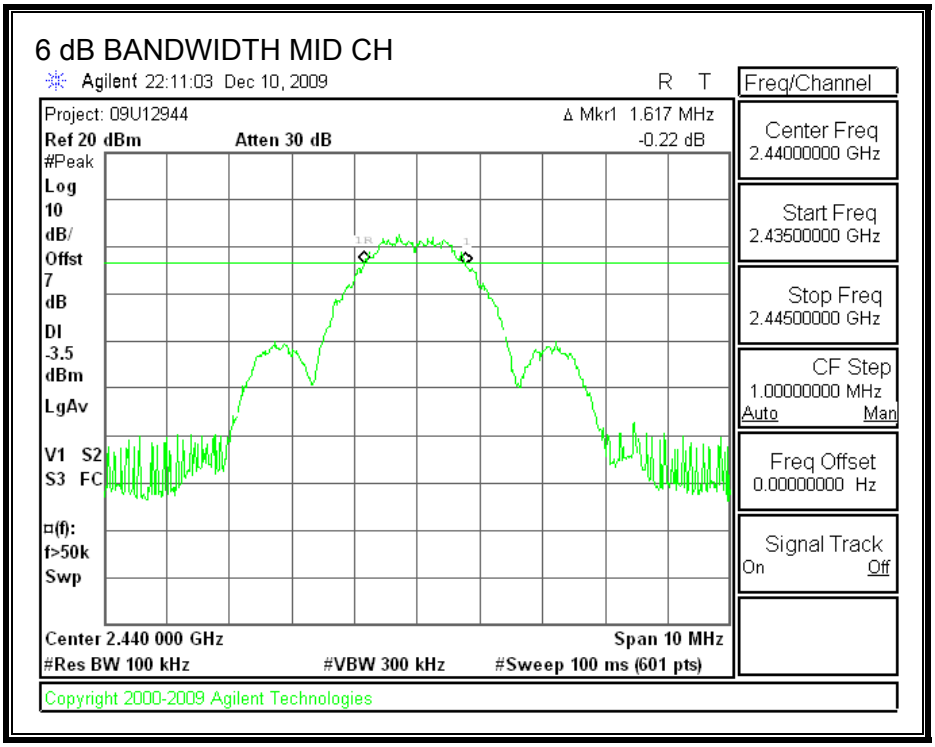

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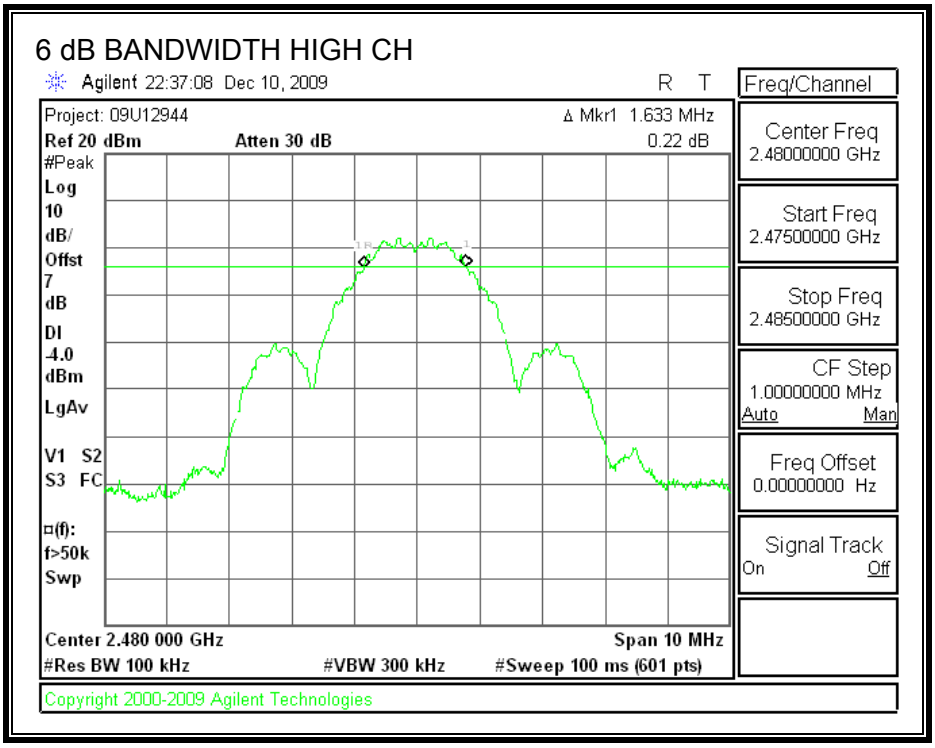

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7.1.2. 99% BANDWIDTH

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	2405	2.5312
Middle	2440	2.6048
High	2480	2.5956

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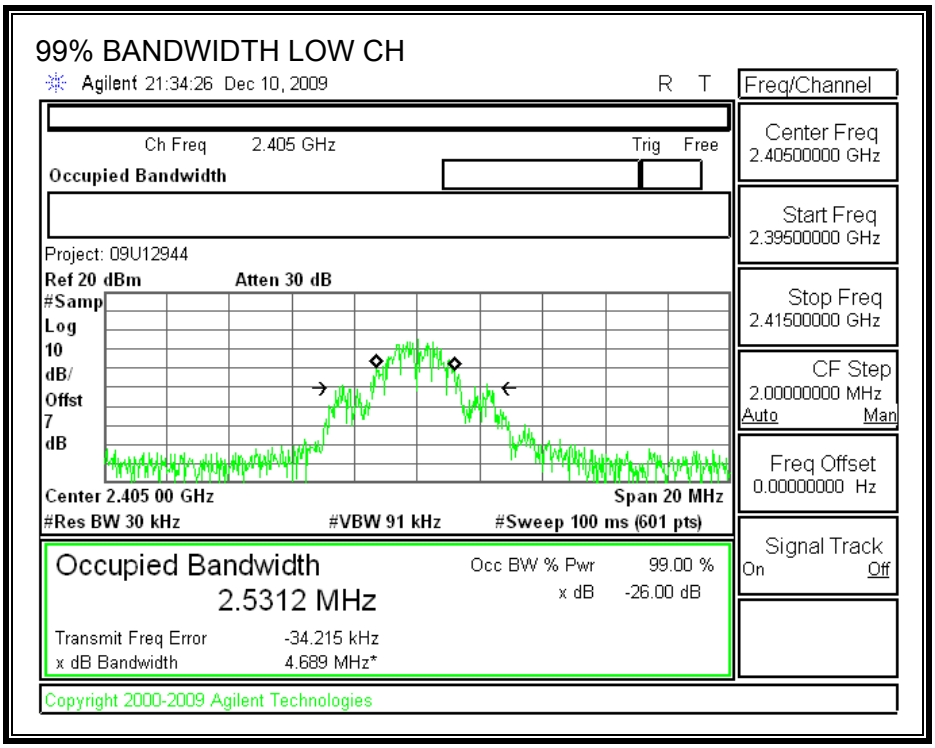
99% BANDWIDTH



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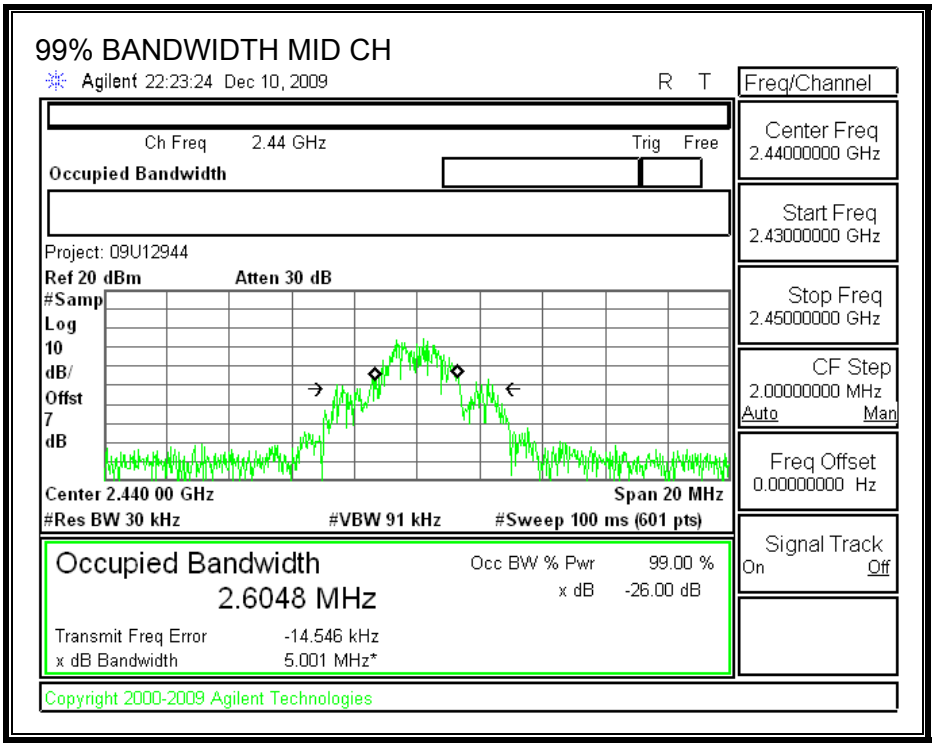

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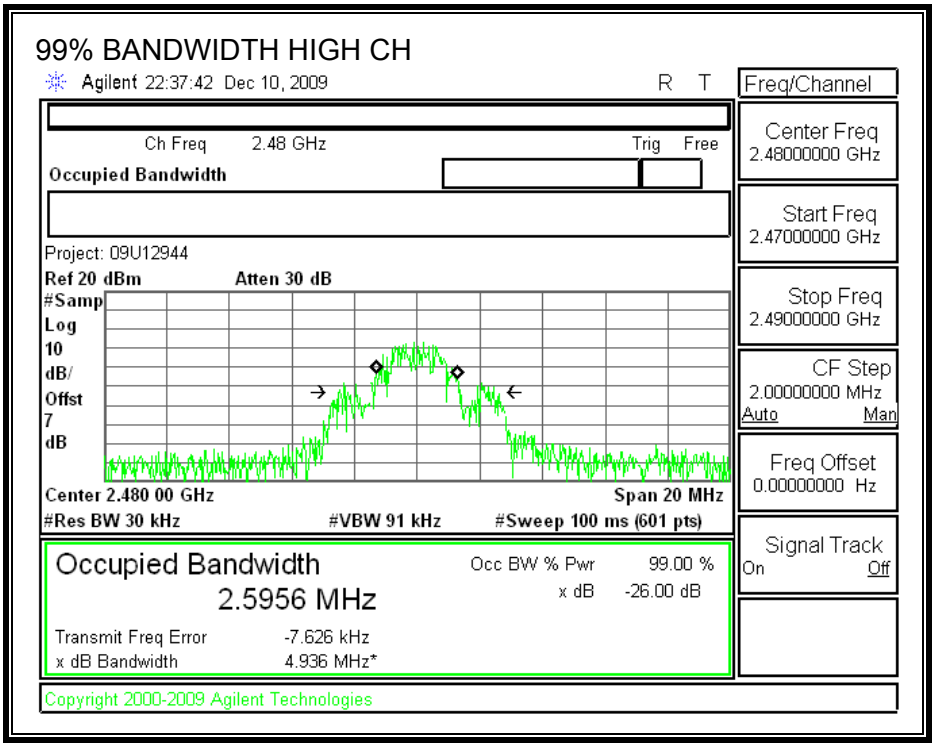

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7.1.3. OUTPUT POWER

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

The transmitter output is connected to a spectrum analyzer the analyzer bandwidth is set to a value greater than the 99% bandwidth of the EUT.

RESULTS

Channel	Frequency (MHz)	Output Power (dBm)	Limit (dBm)	Margin (dB)
Low	2405	6.38	30	-23.62
Middle	2440	6.14	30	-23.86
High	2480	5.80	30	-24.20

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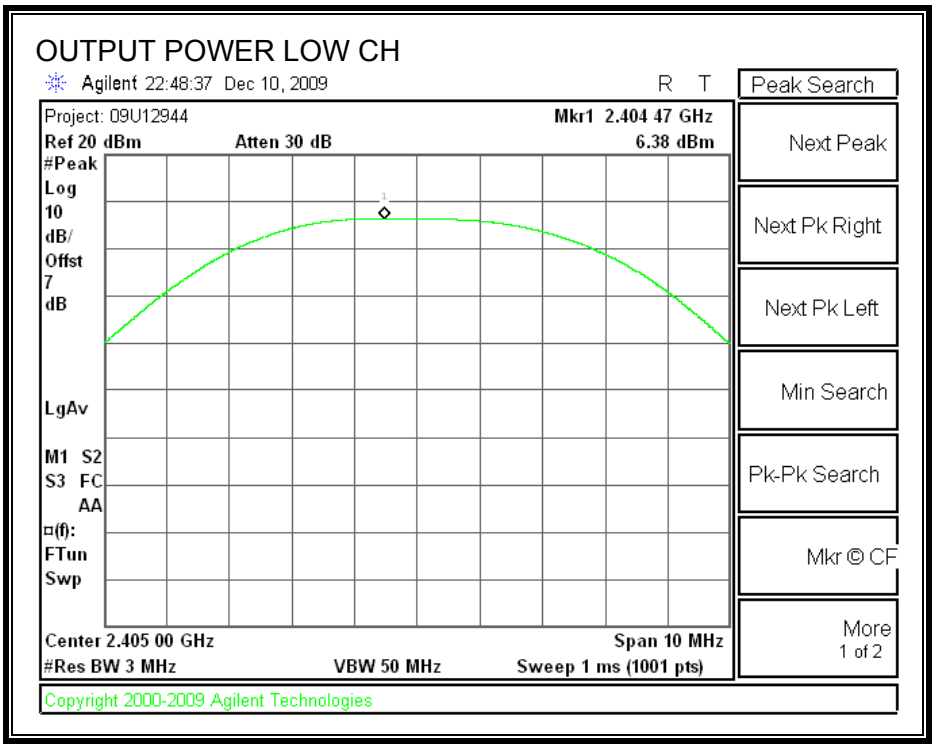
OUTPUT POWER



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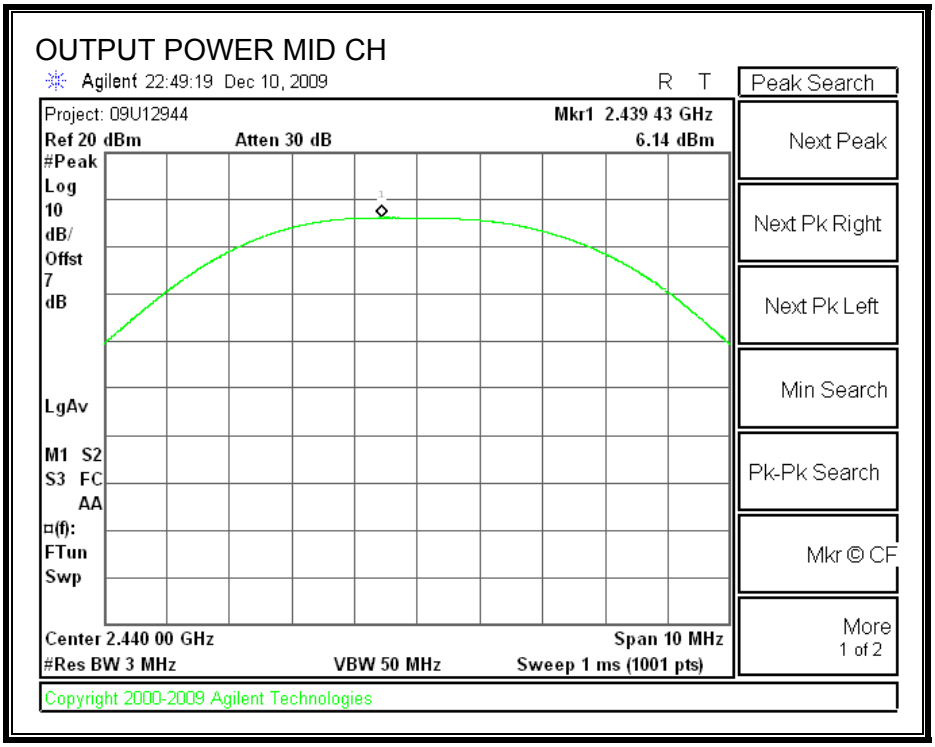

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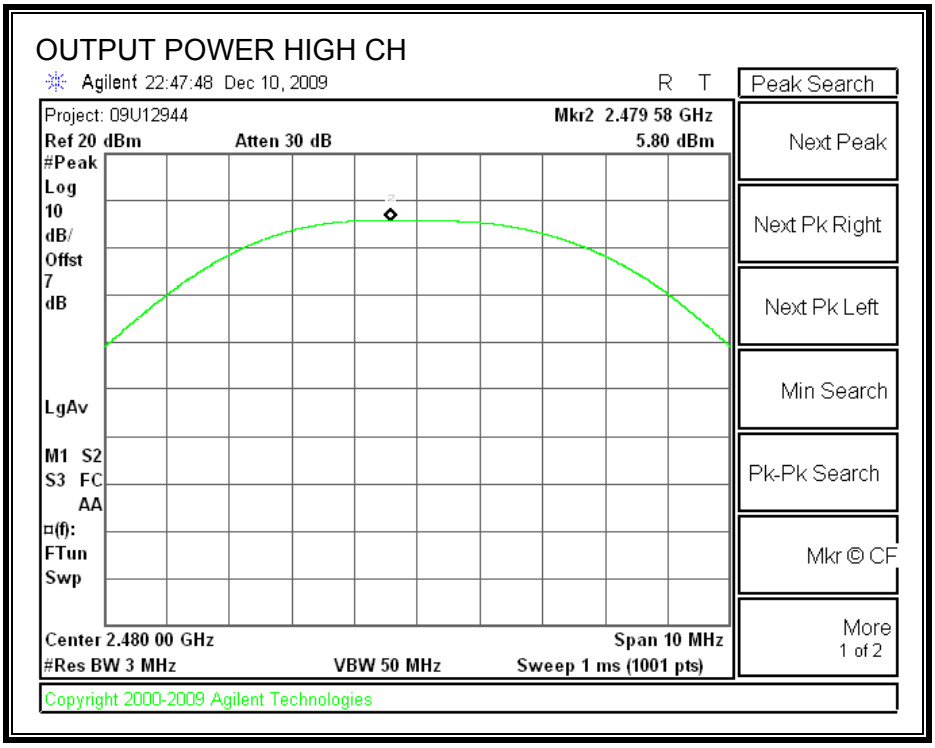

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7.1.4. AVERAGE POWER

LIMITS

None; for reporting purposes only.

TEST PROCEDURE

The transmitter output is connected to a power meter.

RESULTS

The cable assembly insertion loss of 6.67 dB (including 6.4 dB pad and .27 dB cable) was entered as an offset in the power meter to allow for direct reading of power.

Channel	Frequency (MHz)	Power (dBm)
Low	2405	4.25
Middle	2440	4.31
High	2480	4.01

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7.1.5. 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

Output power was measured based on the use of a peak measurement, therefore the power spectral density was measured using PSD Option 1 in accordance with FCC document "Measurement of Digital Transmission Systems Operating under Section 15.247", March 23, 2005.

RESULTS

Channel	Frequency (MHz)	PPSD (dBm)	Limit (dBm)	Margin (dB)
Low	2405	-8.00	8	-16.00
Middle	2440	-8.41	8	-16.41
High	2480	-9.06	8	-17.06

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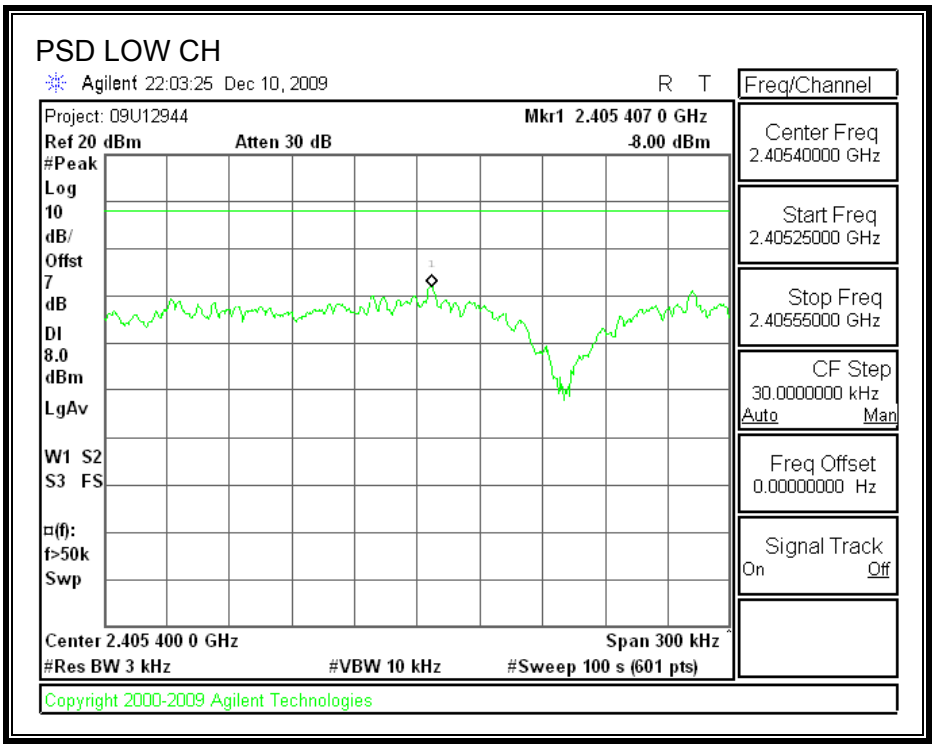
POWER SPECTRAL DENSITY



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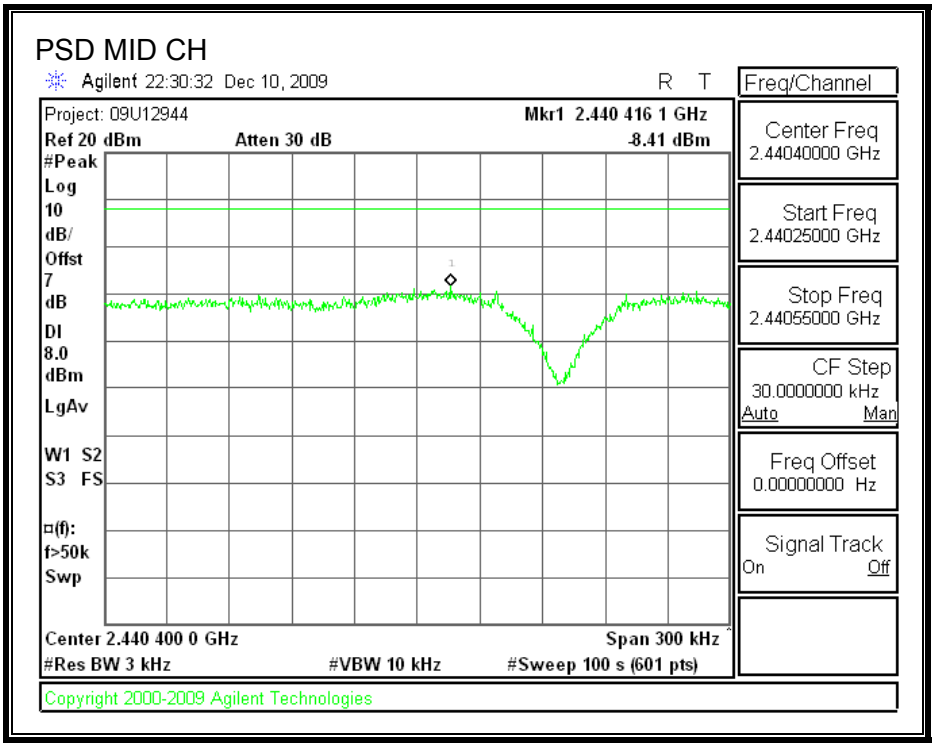

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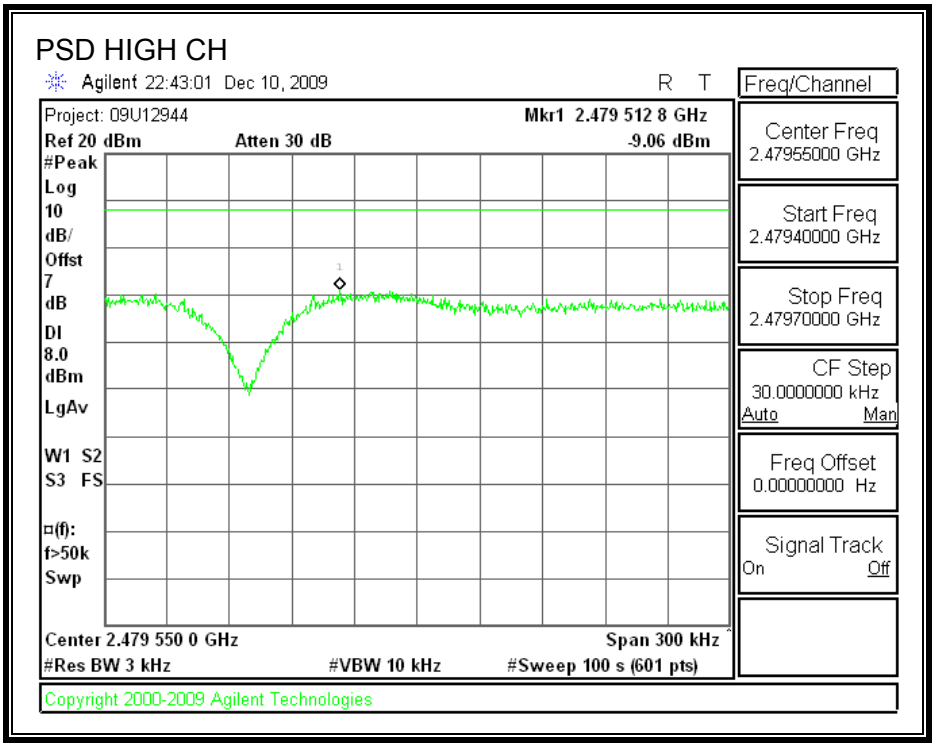

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7.1.6. CONDUCTED SPURIOUS EMISSIONS

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

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

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

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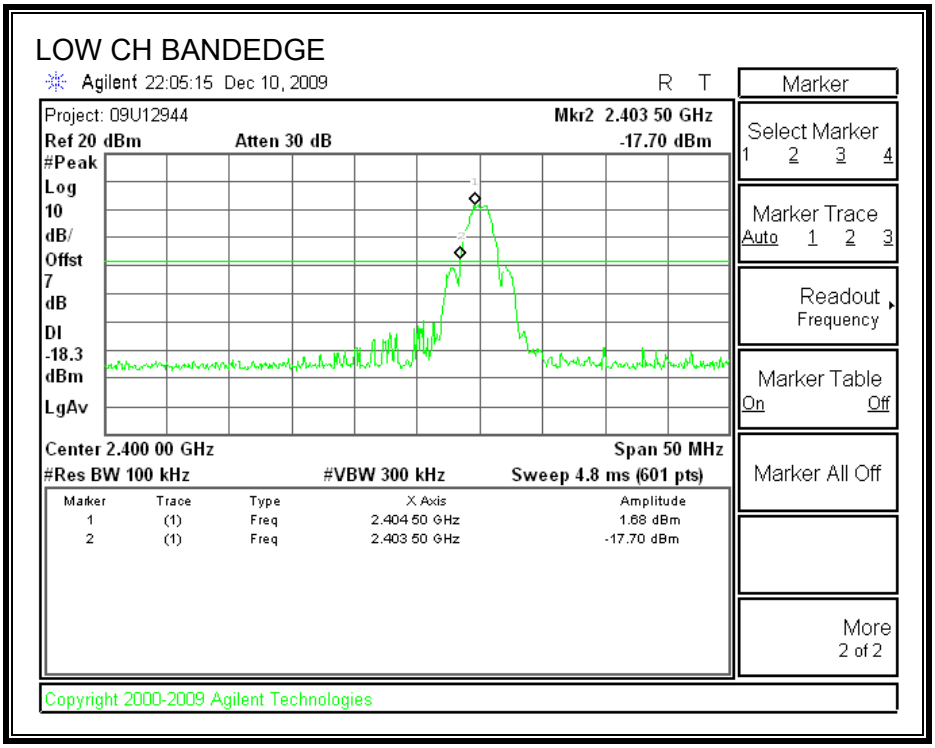
RESULTS

SPURIOUS EMISSIONS, LOW CHANNEL



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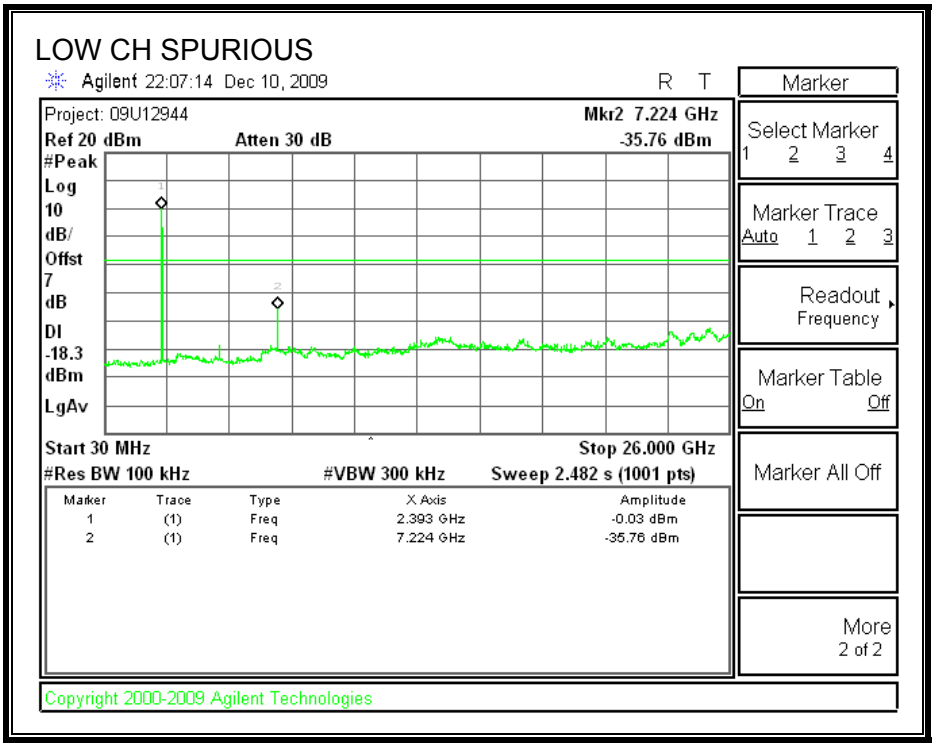

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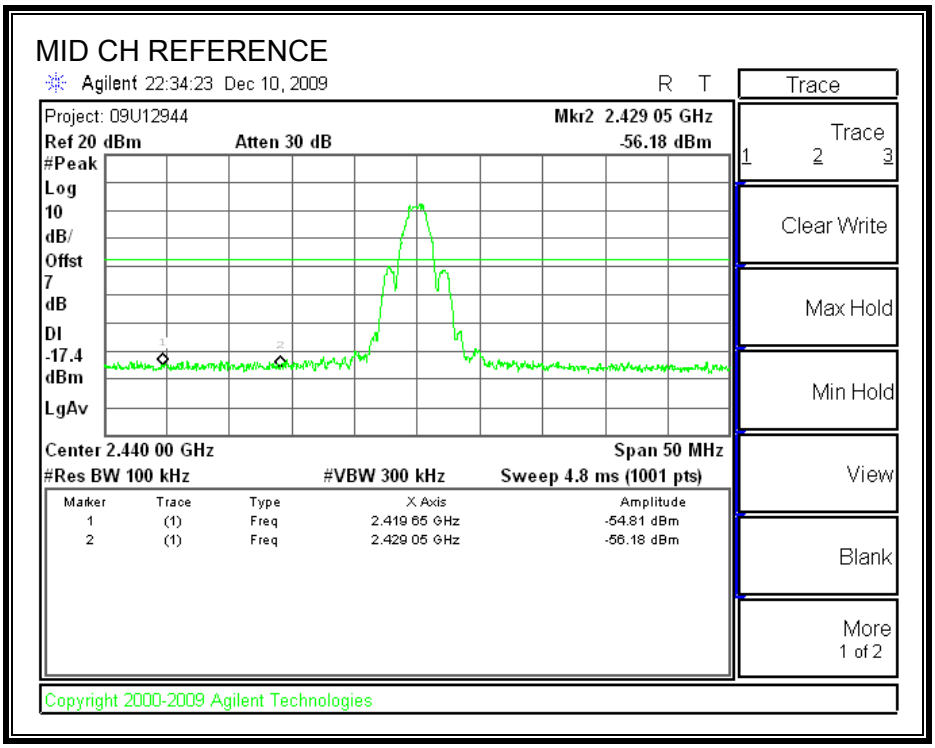
SPURIOUS EMISSIONS, MID CHANNEL



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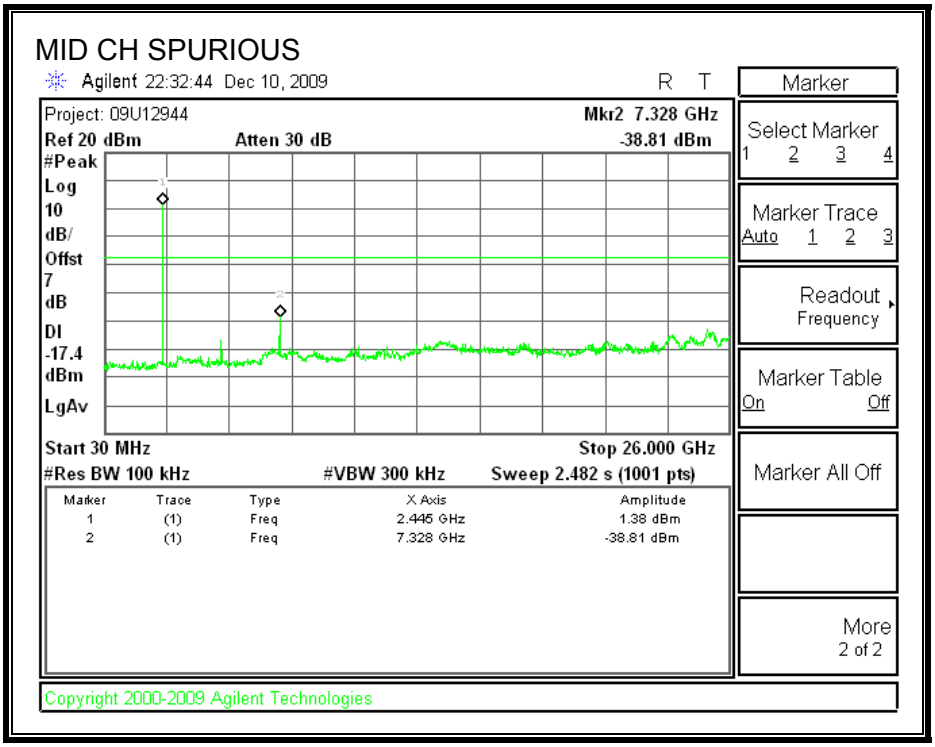

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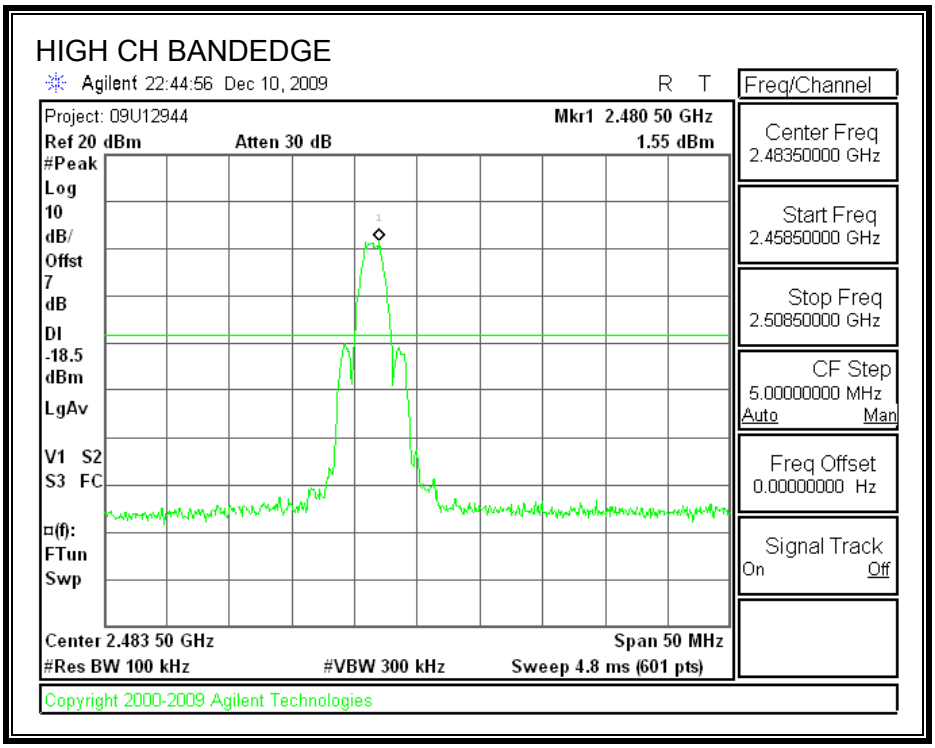
SPURIOUS EMISSIONS, HIGH CHANNEL



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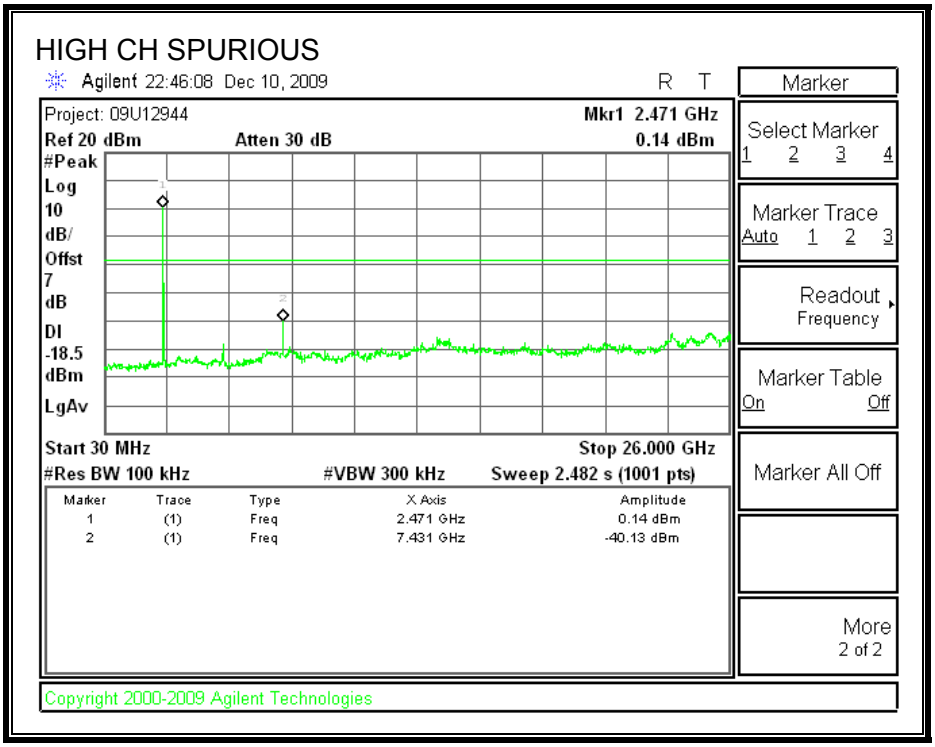

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7.2. RADIATED EMISSIONS RESULTS

7.2.1. 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 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.

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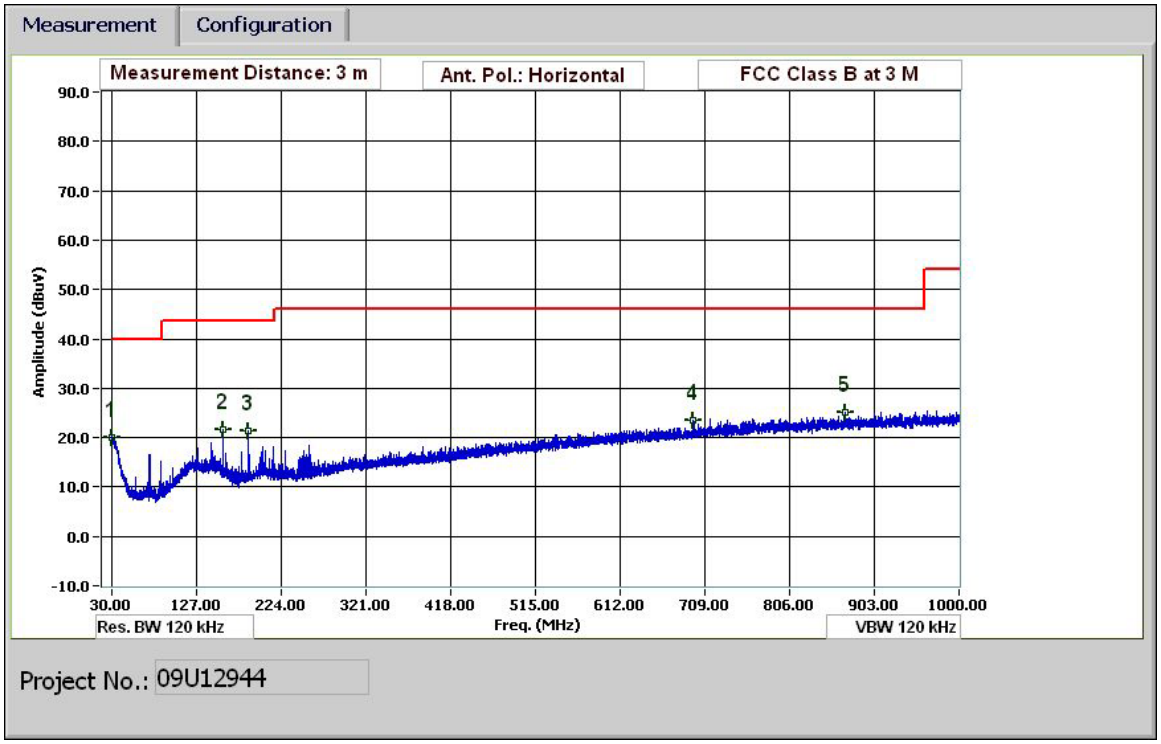
7.2.2. TX SPURIOUS EMISSION 30 TO 1000 MHz (HORIZONTAL)

HORIZONTAL PLOT



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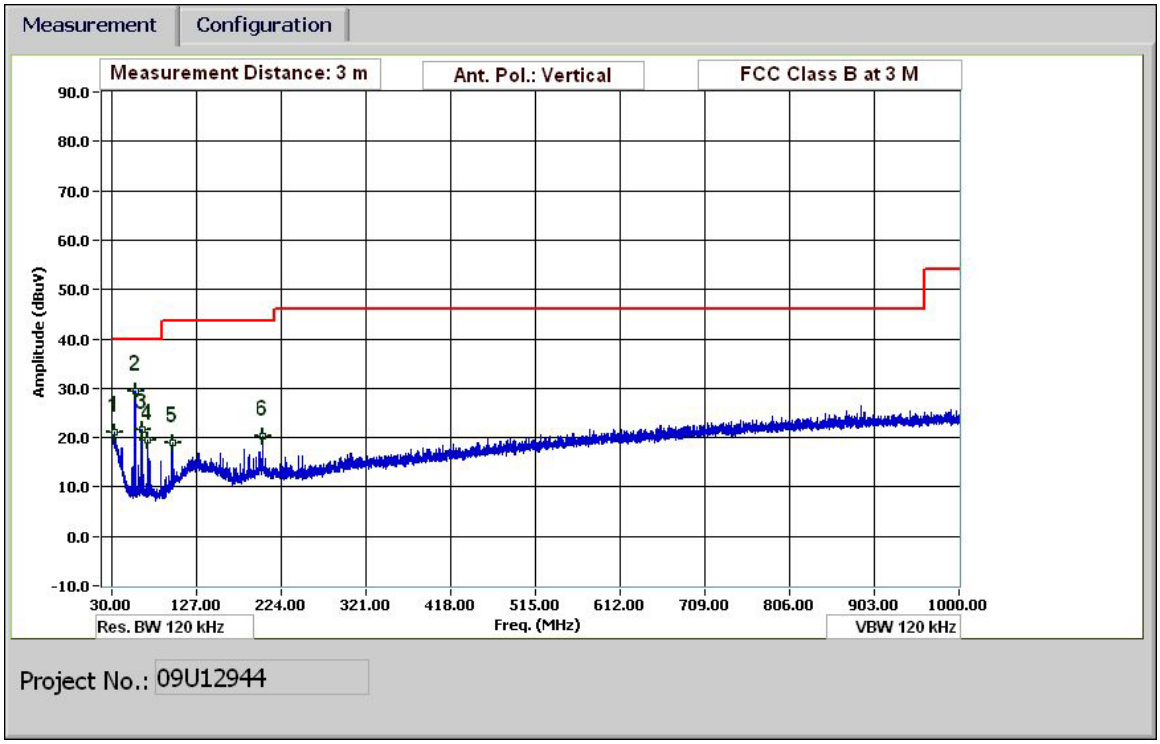
7.2.3. TX SPURIOUS EMISSION 30 TO 1000 MHz (VERTICAL)

VERTICAL PLOT



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HORIZONT AND VERTICAL DATA

30-1000MHz Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Test Engr: Thanh Nguyen
Date: 12/10/2009
Project #: 09U12944
Company: Crosby Engineering Services
EUT Description: 802.15.4 2.4GHz Modular TransCeiver
EUT M/N: RFM2530LX
Test Target: FCC 15.247 Class B
Mode Oper: Normal

f	Measurement Frequency	Amp	Preamp Gain	Margin	Margin vs. Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters		
Read	Analyzer Reading	Filter	Filter Insert Loss		
AF	Antenna Factor	Corr.	Calculated Field Strength		
CL	Cable Loss	Limit	Field Strength Limit		

f MHz	Dist (m)	Read dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Filter dB	Corr. dBuV/m	Limit dBuV/m	Margin dB	Ant. Pol. V/H	Det. P/A/QP	Ant. High cm	Table Angle Degree	Notes
32.520	3.0	29.9	19.0	0.5	28.4	0.0	0.0	21.0	40.0	-19.0	V	P	100.0	0 - 360	Full scan
56.641	3.0	49.0	8.1	0.7	28.4	0.0	0.0	29.4	40.0	-10.6	V	P	100.0	0 - 360	
64.201	3.0	41.4	8.0	0.7	28.4	0.0	0.0	21.7	40.0	-18.3	V	P	100.0	0 - 360	
71.282	3.0	39.0	8.0	0.7	28.3	0.0	0.0	19.4	40.0	-20.6	V	P	100.0	0 - 360	
99.603	3.0	36.5	9.8	0.9	28.3	0.0	0.0	18.9	43.5	-24.6	V	P	100.0	0 - 360	
202.807	3.0	35.3	12.0	1.3	28.2	0.0	0.0	20.3	43.5	-23.2	V	P	100.0	0 - 360	
30.000	3.0	27.8	20.1	0.5	28.4	0.0	0.0	20.0	40.0	-20.0	H	P	100.0	0 - 360	
157.565	3.0	36.8	11.9	1.1	28.3	0.0	0.0	21.5	43.5	-22.0	H	P	100.0	0 - 360	
186.126	3.0	37.1	11.3	1.2	28.2	0.0	0.0	21.3	43.5	-22.2	H	P	100.0	0 - 360	
696.027	3.0	28.8	19.5	2.4	27.2	0.0	0.0	23.6	46.0	-22.4	H	P	100.0	0 - 360	
869.075	3.0	28.3	21.6	2.8	27.7	0.0	0.0	25.0	46.0	-21.0	H	P	100.0	0 - 360	

Rev. 1.27.09
Note: No other emissions were detected above the system noise floor.

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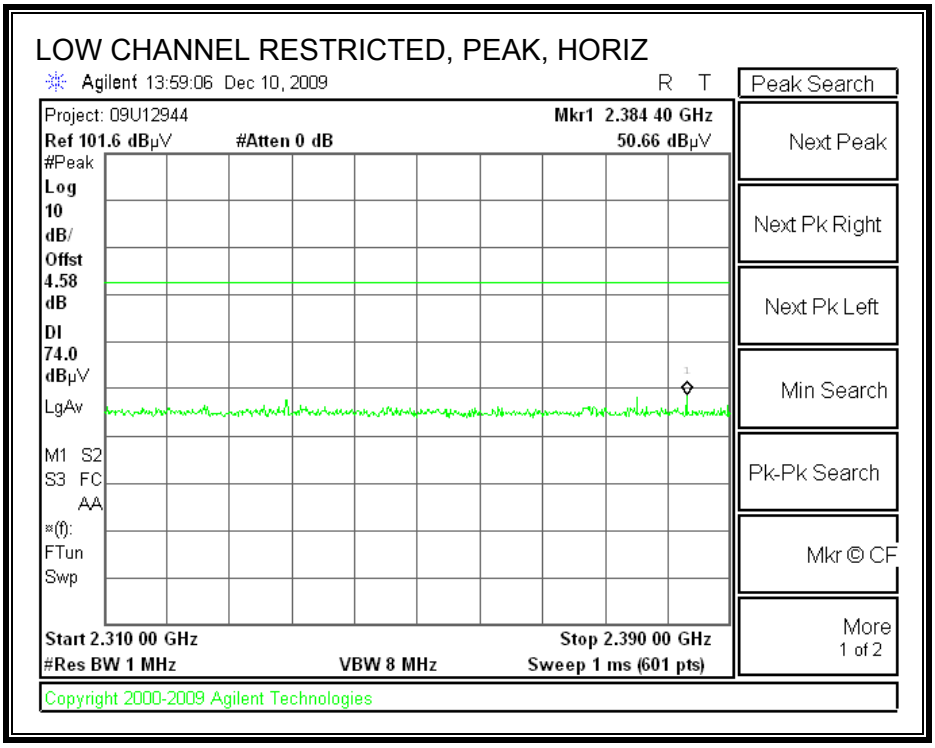
7.2.4. TX ABOVE 1 GHz

RESTRICTED BANDEDGE (LOW CHANNEL, HORIZONTAL)



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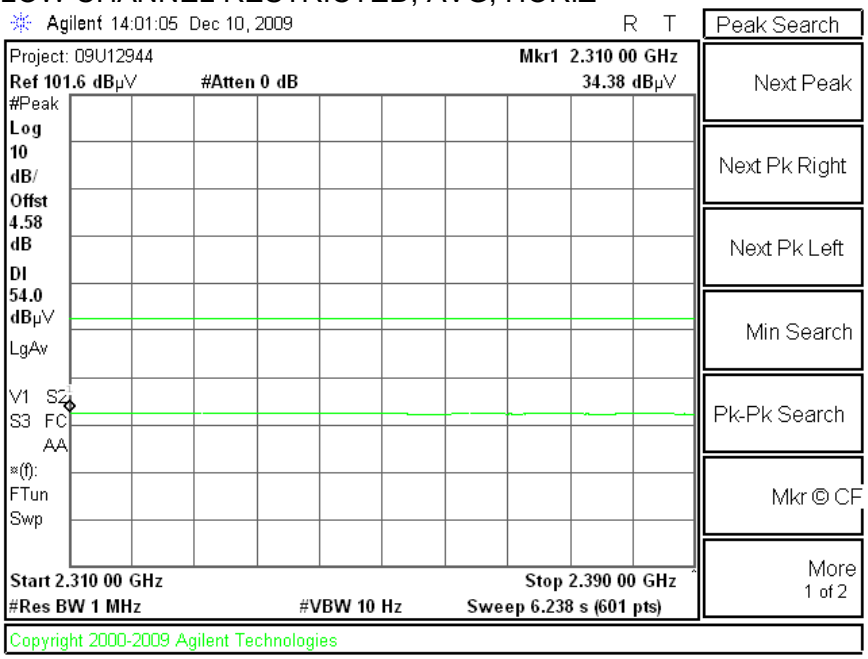
LOW CHANNEL RESTRICTED, AVG, HORIZ



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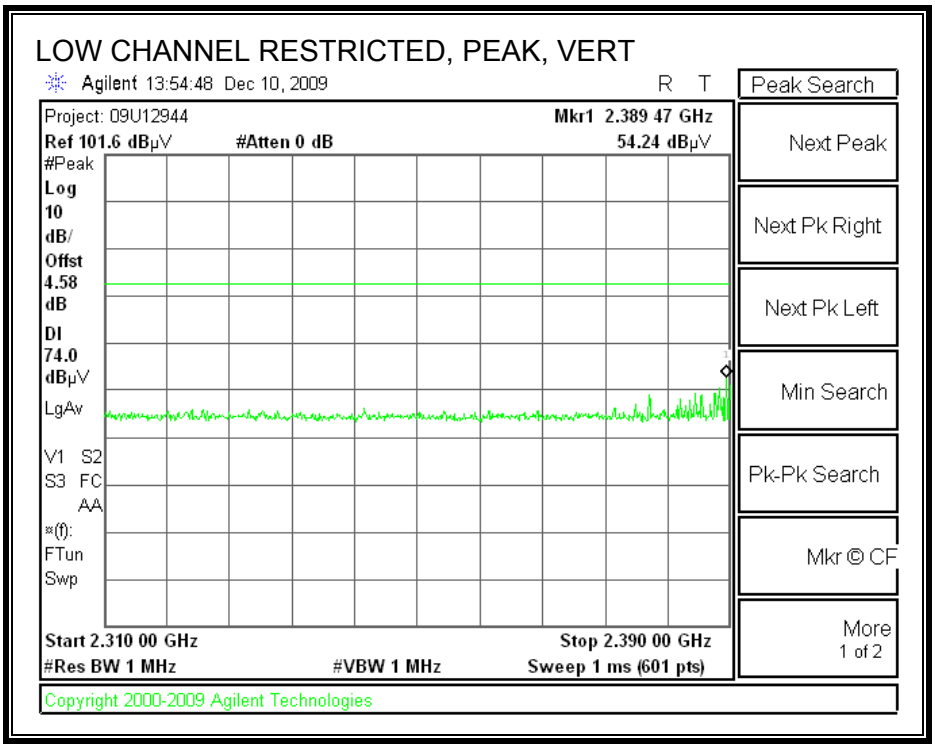
RESTRICTED BANDEDGE (LOW CHANNEL, VERTICAL)



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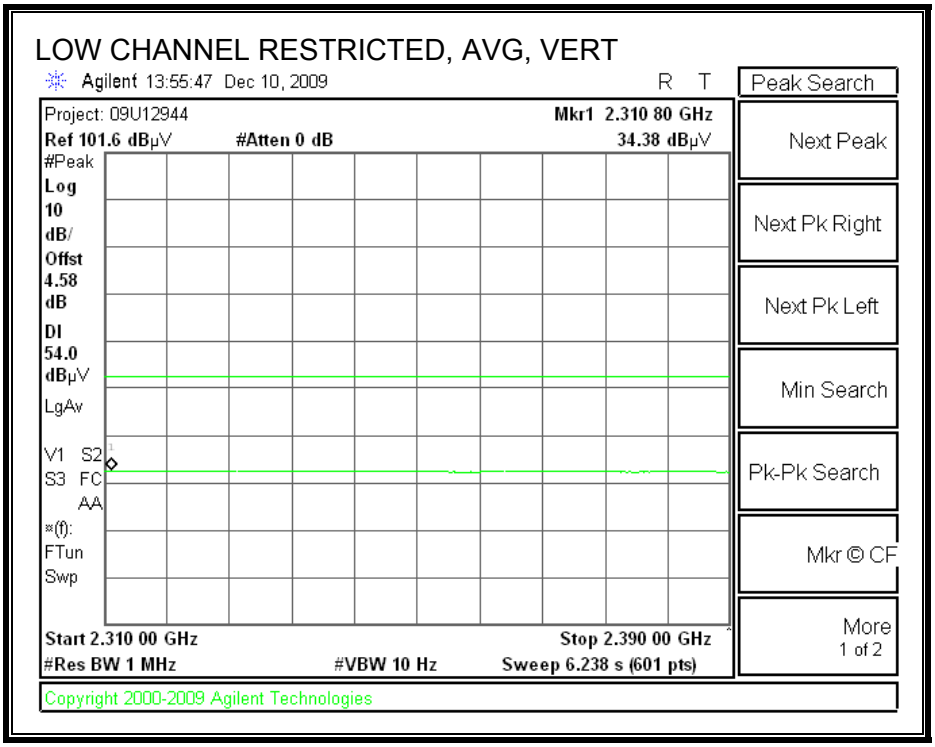

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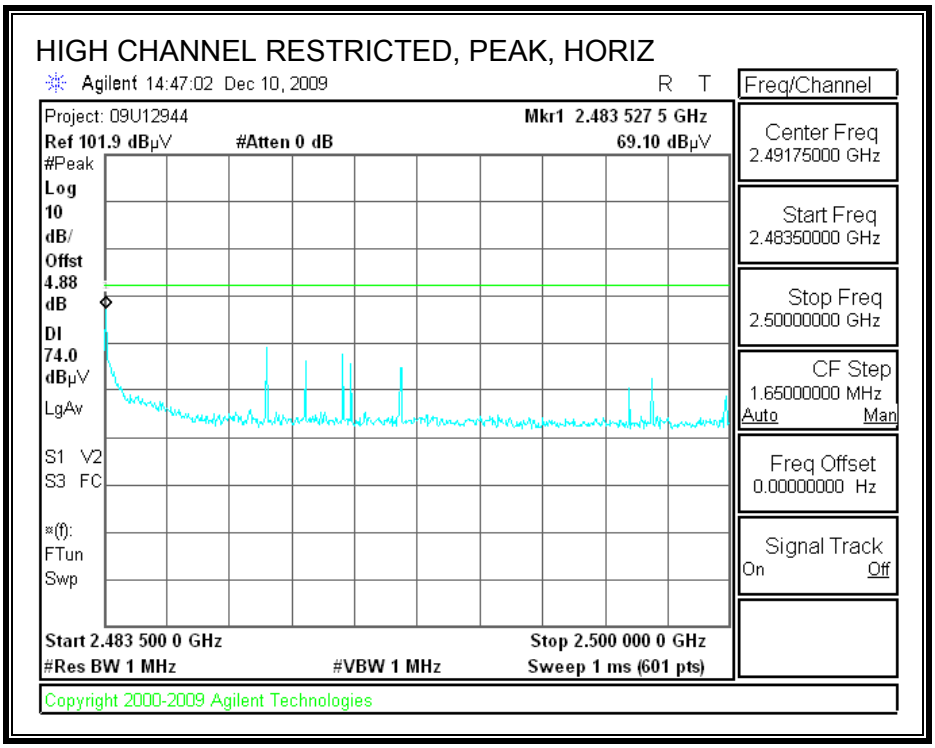
RESTRICTED BANDEDGE (HIGH CHANNEL, HORIZONTAL)



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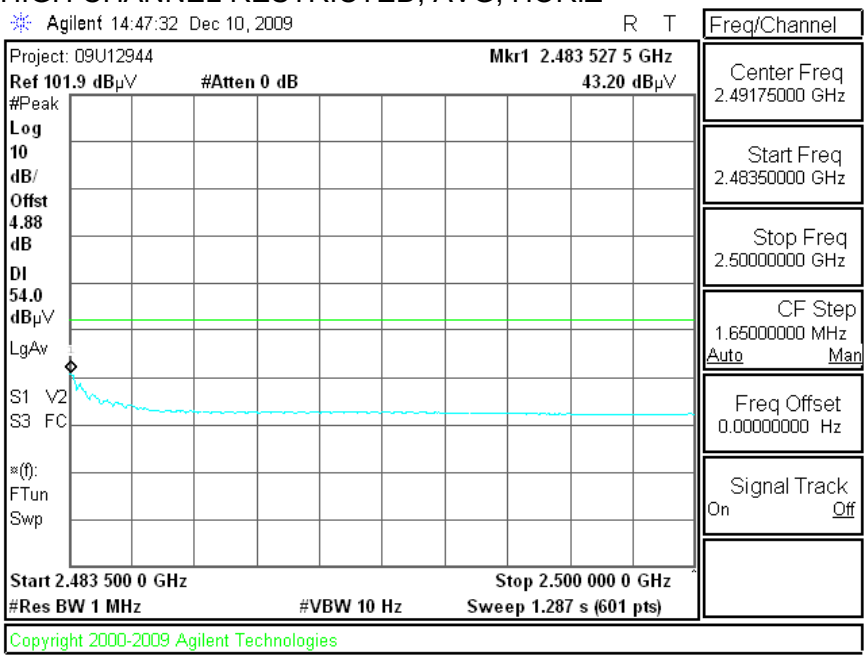
HIGH CHANNEL RESTRICTED, AVG, HORIZ



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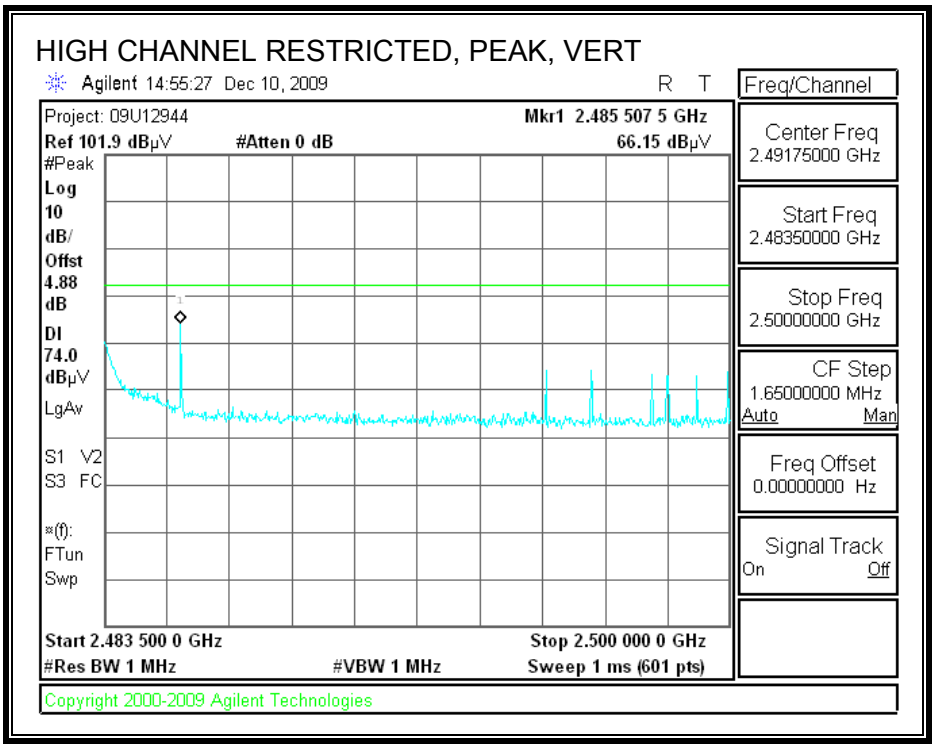
RESTRICTED BANDEDGE (HIGH CHANNEL, VERTICAL)



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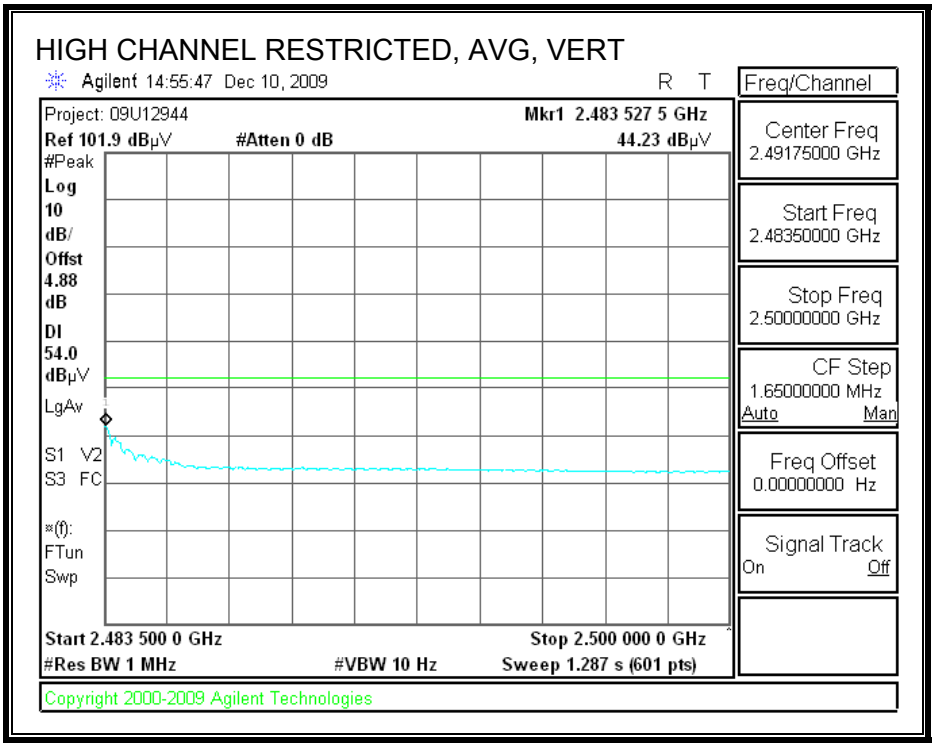

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HARMONICS AND SPURIOUS EMISSIONS

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Company: Crosby Engineering Services
Project #: 09U12944
Date: 12/10/2009
Test Engineer: Thanh Nguyen
Configuration: EUT with AC/DC Adapter
Mode: Normal

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T73; S/N: 6717 @3m	T144 Miteq 3008A00931			FCC 15.209

Hi Frequency Cables

3' cable 22807700	12' cable 22807600	20' cable 22807500	HPF	Reject Filter
3' cable 22807700	12' cable 22807600	20' cable 22807500		R_001

Peak Measurements
RBW=VBW=1MHz
Average Measurements
RBW=1MHz ; VBW=10Hz

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
Harmonics Emissions															
Low Ch 2405MHz															
4.810	3.0	41.3	28.2	33.0	5.8	-36.5	0.0	0.0	43.6	30.6	74	54	-30.4	-23.4	V
7.215	3.0	40.6	28.3	35.2	7.2	-36.2	0.0	0.0	46.7	34.4	74	54	-27.3	-19.6	V
9.620	3.0	39.6	25.9	37.4	8.5	-36.9	0.0	0.0	48.5	34.9	74	54	-25.5	-19.1	V
12.025	3.0	38.4	26.5	39.0	9.7	-35.4	0.0	0.0	51.7	39.8	74	54	-22.3	-14.2	V
4.810	3.0	40.3	28.6	33.0	5.8	-36.5	0.0	0.0	42.6	30.9	74	54	-31.4	-23.1	H
7.215	3.0	44.3	30.6	35.2	7.2	-36.2	0.0	0.0	50.4	36.7	74	54	-23.6	-17.3	H
9.620	3.0	38.6	25.3	37.4	8.5	-36.9	0.0	0.0	47.5	34.3	74	54	-26.5	-19.7	H
12.025	3.0	37.5	25.9	39.0	9.7	-35.4	0.0	0.0	50.8	39.2	74	54	-23.2	-14.8	H
Mid Ch 2440MHz															
4.880	3.0	42.4	28.6	33.1	5.8	-36.5	0.0	0.0	44.9	31.1	74	54	-29.1	-22.9	V
7.320	3.0	44.1	30.3	35.3	7.3	-36.2	0.0	0.0	50.5	36.6	74	54	-23.5	-17.4	V
9.760	3.0	39.3	27.4	37.4	8.6	-37.0	0.0	0.0	48.3	36.4	74	54	-25.7	-17.6	V
12.200	3.0	39.4	27.2	39.0	9.8	-35.4	0.0	0.0	52.8	40.6	74	54	-21.2	-13.4	V
4.880	3.0	40.3	27.6	33.1	5.8	-36.5	0.0	0.0	42.7	30.0	74	54	-31.3	-24.0	H
7.320	3.0	43.7	30.3	35.3	7.3	-36.2	0.0	0.0	50.1	36.6	74	54	-23.9	-17.4	H
9.760	3.0	37.6	26.2	37.4	8.6	-37.0	0.0	0.0	46.6	35.3	74	54	-27.4	-18.7	H
12.200	3.0	38.4	26.9	39.0	9.8	-35.4	0.0	0.0	51.8	40.3	74	54	-22.2	-13.7	H
High Ch 2480MHz															
4.960	3.0	40.7	31.1	33.2	5.9	-36.5	0.0	0.0	43.3	33.8	74	54	-30.7	-20.2	V
7.440	3.0	44.6	30.3	35.5	7.3	-36.2	0.0	0.0	51.2	36.9	74	54	-22.8	-17.1	V
9.920	3.0	38.4	26.4	37.5	8.7	-37.1	0.0	0.0	47.5	35.5	74	54	-26.5	-18.5	V
12.400	3.0	39.7	26.8	39.0	9.9	-35.4	0.0	0.0	53.2	40.3	74	54	-20.8	-13.7	V
4.960	3.0	40.4	28.3	33.2	5.9	-36.5	0.0	0.0	43.1	31.0	74	54	-30.9	-23.0	H
7.440	3.0	43.2	29.2	35.5	7.3	-36.2	0.0	0.0	49.8	35.8	74	54	-24.2	-18.2	H
9.920	3.0	38.9	25.9	37.5	8.7	-37.1	0.0	0.0	48.0	35.0	74	54	-26.0	-19.0	H
12.400	3.0	41.9	27.2	39.0	9.9	-35.4	0.0	0.0	55.4	40.7	74	54	-18.6	-13.3	H
Sprious Emissions															
1.032	3.0	55.5	40.3	24.0	2.4	-39.4	0.0	0.0	42.5	27.2	74	54	-31.5	-26.8	V
1.046	3.0	47.7	36.3	24.0	2.4	-39.4	0.0	0.0	34.7	23.3	74	54	-39.3	-30.7	H
															H

Rev. 11.10.08

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

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RX SPURIOUS EMISSIONS ABOVE 1 GHz (WORST-CASE CONFIGURATION)

High Frequency Measurement
Compliance Certification Services, Fremont 5m Chamber

Company:	Crosby Engineering Services
Project #:	09U12944
Date:	12/10/2009
Test Engineer:	Thanh Nguyen
Configuration:	EUT with AC/DC Adapter
Mode:	Receive Mode

Test Equipment:

Horn 1-18GHz	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz	Limit
T73; S/N: 6717 @3m	T144 Miteq 3008A00931			RX RSS 210

Hi Frequency Cables

3' cable 22807700	12' cable 22807600	20' cable 22807500	HPF	Reject Filter
3' cable 22807700	12' cable 22807600	20' cable 22807500		R_001

Peak Measurements
RBW=VBW=1MHz
Average Measurements
RBW=1MHz ; VBW=10Hz

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
1.027	3.0	46.6	34.6	23.9	2.4	-39.5	0.0	0.0	33.5	21.5	74	54	-40.5	-32.5	V
2.359	3.0	44.2	33.3	28.1	3.8	-37.5	0.0	0.0	38.6	27.6	74	54	-35.4	-26.4	V
3.376	3.0	42.5	28.8	30.9	4.7	-37.1	0.0	0.0	40.9	27.3	74	54	-33.1	-26.7	V
1.234	3.0	46.7	35.3	24.6	2.6	-39.2	0.0	0.0	34.8	23.4	74	54	-39.2	-30.6	H
1.945	3.0	44.0	33.3	27.0	3.4	-38.1	0.0	0.0	36.3	25.5	74	54	-37.7	-28.5	H
3.349	3.0	41.7	29.4	30.8	4.6	-37.1	0.0	0.0	40.1	27.7	74	54	-33.9	-26.3	H
															H

Rev. 11.10.08

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

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7.3. AC MAINS LINE CONDUCTED EMISSIONS RESULTS

LIMITS

§15.207 (a)
IC RSS-GEN, Section 7.2.2

Frequency of emission (MHz)	Conducted Limit (dBµV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56*	56 to 46*
0.50 to 5	56	46
5 to 30	60	50
* Decreases with the logarithm of the frequency.		

TEST PROCEDURE

ANSI C63.4

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RESULTS

6 WORST EMISSIONS

CONDUCTED EMISSIONS DATA (115VAC 60Hz)									
Freq.	Reading			Closs	Limit	EN_B	Margin		Remark
(MHz)	PK (dBuV)	QP (dBuV)	AV (dBuV)	(dB)	QP	AV	QP (dB)	AV (dB)	L1 / L2
0.15	67.54	58.00	22.16	0.00	66.00	56.00	-8.00	-33.84	L1
0.72	45.75	35.80	2.42	0.00	56.00	46.00	-20.20	-43.58	L1
21.04	25.10	--	9.24	0.00	60.00	50.00	-34.90	-40.76	L1
0.15	67.34	57.80	21.83	0.00	66.00	56.00	-8.20	-34.17	L2
0.71	45.94	36.00	2.79	0.00	56.00	46.00	-20.00	-43.21	L2
20.81	27.36	--	10.24	0.00	60.00	50.00	-32.64	-39.76	L2
6 Worst Data									

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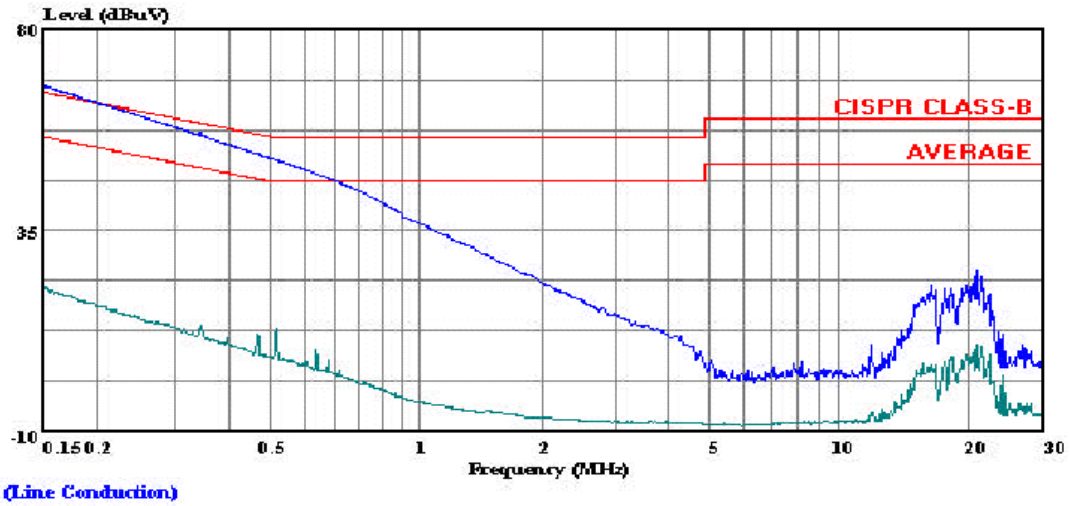
LINE 1 RESULTS

Compliance Certification Services
47173 Benicia Street
Fremont, CA 94538
Tel: (510) 771-1000
Fax: (510) 661-0888

Data#: 7 File#: Line Conduction.EMI
Date: 12-10-2009 Time: 17:13:29



Trace: 5 Ref Trace:

Condition: CISPR CLASS-B
Test Operator: : Thanh Nguyen
Project #: : 09U12944
Company: : Crosby Engineering Services
EUT Description:: 802.15.4 2.4GHz Modular TransCeiver
Configuration: : EUT with AC DC Adapter
Mode: : Normal
Target: : FCC Class B
Voltage: : 115VAC/60Hz
: L1: Peak (Blue), Average (Green)

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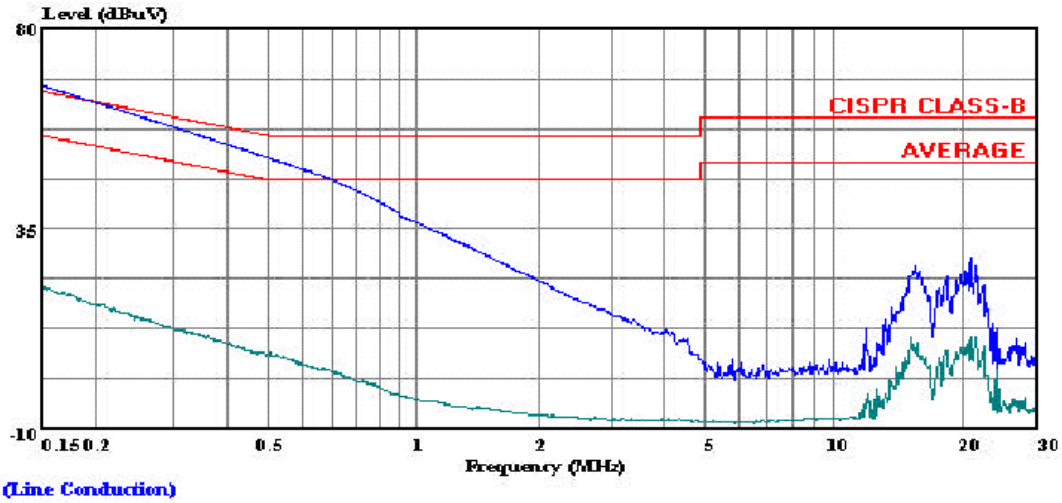
LINE 2 RESULTS

Compliance Certification Services
47173 Benicia Street
Fremont, CA 94538
Tel: (510) 771-1000
Fax: (510) 661-0888

Data#: 14 File#: Line Conduction.EMI
Date: 12-10-2009 Time: 17:31:33



Trace: 12 Ref Trace:

Condition: CISPR CLASS-B
Test Operator: : Thanh Nguyen
Project #: : 09U12944
Company: : Crosby Engineering Services
EUT Description:: 802.15.4 2.4GHz Modular TransCeiver
Configuration: : EUT with AC DC Adapter
Mode: : Normal
Target: : FCC Class B
Voltage: : 115VAC/60Hz
: L2: Peak (Blue), Average (Green)

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8. MAXIMUM PERMISSIBLE EXPOSURE

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.

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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 Classed 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/m^2 is equivalent to 1 mW/cm^2.
3. A magnetic field strength of 1 A/m corresponds to 1.257 microtesla (μT) or 12.57 milligauss (mG).

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EQUATIONS

Power density is given by:

S = EIRP / (4 * Pi * D^2)

where

S = Power density in W/m^2
EIRP = Equivalent Isotropic Radiated Power in W
D = Separation distance in m

Power density in units of W/m^2 is converted to units of mWc/m^2 by dividing by 10.

Distance is given by:

D = SQRT (EIRP / (4 * Pi * S))

where

D = Separation distance in m
EIRP = Equivalent Isotropic Radiated Power in W
S = Power density in W/m^2

For multiple colocated transmitters operating simultaneously in frequency bands where the limit is identical, the total power density is calculated using the total EIRP obtained by summing the Power * Gain product (in linear units) of each transmitter.

Total EIRP = (P1 * G1) + (P2 * G2) + ... + (Pn * Pn)

where

Px = Power of transmitter x
Gx = Numeric gain of antenna x

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.

LIMITS

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

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

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RESULTS

Band	Mode	Separation Distance (m)	Output Power (dBm)	Antenna Gain (dBi)	IC Power Density (W/m^2)	FCC Power Density (mW/cm^2)
2.4 GHz	Zigbee	0.20	6.38	0.00	0.01	0.001

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