TEST REPORT

Report Number: 3144904LEX-001
Project Number: 3144904

Evaluation of the Lexmark 802.11 Wireless Module
Model Number: LEX-M04-001

FCC ID: *IYLLEXM04001*

Industry Canada ID: *2376A-M04001*

Tested to the Criteria in
FCC Part 15 Subpart C (15.247),
FCC Part 15 Subpart B (15.109),
ICES-003 and RSS-210 Issue 6

For

Lexmark International, Inc.

Test Performed by:	Test Authorized by:
Intertek	Lexmark International, Inc.
731 Enterprise Drive	740 West New Circle Road
Lexington, KY 40510	Lexington, KY 40511

Prepared By:_____ **Date:** 4/15/2008

Jason Centers, Senior Project Engineer

Approved By:_____ **Date:** 4/15/2008

Bryan Taylor, EMC Team Leader

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1 JOB DESCRIPTION

1.1 Test Sample Information

The LEX-M04-001 is an 802.11b/g/n wireless print server. It allows the printer, that it is installed in, to be shared on a wireless network without the use of CAT5, USB, or Serial connections. It is sold as an option on some printer models.

Company Information	
Manufacturer:	Lexmark International, Inc.
Address:	740 West New Circle Road Lexington KY 40511
Contact Name:	Paul Ramey
Telephone Number:	(859)-825-4469
Fax Number:	(859)-232-7345
Email Address:	pramey@lexmark.com

Test sample			
Lexmark Model Number:	LEX-M04-001		
Serial Number:	Not Labled		
FCC ID:	IYLLEXM04001		
Industry Canada ID:	2376A-M04001		
Device Category:	Mobile		
RF Exposure Category:	General Population/Uncontrolled Environment		
Transmission Modes:	**802.11b**	**802.11g**	**802.11n**
Frequency Range, MHz:	2412MHz – 2462MHz	2412MHz – 2462MHz	2412MHz – 2462MHz
Type of Transmission:	QPSK, BSK, CCK	BPSK, QPSK, 16QAM, 64QAM	OFDM
Maximum Peak Conducted Output Power:	11.74 dBm	19.27 dBm	18.45 dBm
Antenna Type:	Acon - P/n ADM6P-70004x		
Antenna Location:	External Back Side of the 802.11 Wireless Module		
Antenna Gain:	2.2 dBi		
Sample Receive Date:	2/4/2008		

Test Signal Mode	
Test Commands:	X
Base Station Simulator:	

1.2 System Support Equipment

A Dell Latitude D610 (Service Tag 73RPH71) laptop used to configure the transmit mode of the 802.11 Wireless Module prior to each test. No other support equipment was used.

1.3 Cables associated with EUT

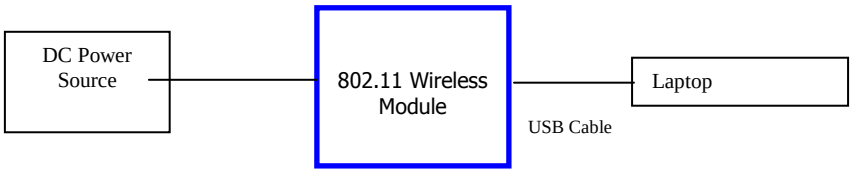
Table 1-1 contains the details of the cables associated with the EUT.

Table 1-1: Interconnecting cables between modules of EUT

Cables					
Description	**Length**	**Shielding**	**Ferrites**	**Connection**	
				From	**To**
DC Cable	6 ft.	None	None	EUT	AC/DC Power Converter
AC Power Cable	6 ft.	None	None	AC/DC Power Converter	120VAC Power Source
USB Cable	3 ft.	Yes	None	EUT	Laptop

1.4 System Block Diagram

The diagram shown below details the interconnection of the EUT and its accessories during the testing.



1.5 Mode(s) of operation

The 802.11 Wireless Module was powered by an external AC/DC power supply and was tested in a stand alone configuration. In order to force the 802.11 Wireless Module to transmit during the evaluation a control program was used to communicate with the module via a USB cable connected to a laptop computer. This software enabled the user to adjust the output power of the transmitter, change the transmission modulation scheme, and to select the transmit channel. During the evaluation the 802.11 Wireless Module was set to transmit at maximum output power as instructed by Lexmark International, Inc..

1.6 Modifications required for compliance

Lexmark International, Inc. added a ferrite absorber (DooSung - P/n IDA-SDS-070-150-210-A1) to the back side of the transmitter module to obtain compliance with radiated spurious emissions requirements.

1.7 Related Submittal(s) Grants

None

2 EXECUTIVE SUMMARY

Testing performed for: Lexmark International, Inc.

Equipment Under Test: Model LEX-M04-001

Test Start Date: 2/5/2008

Test End Date: 2/25/2008

This device meets the requirements for modular approval.

IC RULE	FCC RULE	DESCRIPTION OF TEST	RESULT	PAGE
RSS-210 (A8.2, A8.2, A8.4(4))	§15.247(a)(b)(d)	Conducted RF Power, 6dB Bandwidth, and Power Density	**Compliant**	9
RSS-210 A8.4(4)	§15.247(b)	Radiated RF Power	**Compliant**	12
RSS-102	§15.247(b)(5)	Maximum Permissible Exposure (MPE) Calculations	**Compliant**	13
RSS-210 A8.5	§15.247(c)	Out of Band Emissions at Antenna Terminals	**Compliant**	15
RSS-210 2.2	c15.247(c) and §15.209(f)	Field Strength of Spurious Radiation (General Requirements and Restricted Band Requirements)	**Compliant**	17
ICES-003	§15.109	Receiver Spurious Emissions	**Compliant**	36
ICES-003	§15.107, §15.207	Conducted Voltage Emissions on the Mains Connections	**Compliant**	38

3 TEST FACILITY

The INTERTEK-Lexington is located at 731 Enterprise Drive, Lexington Kentucky, 40510. The radiated emission test site is a 10-meter semi-anechoic chamber. The chamber meets the characteristics of CISPR 16-1: 1993 and ANSI C63.4: 1992. For measurements, a remotely controlled flush-mount metal-top turntable is used to rotate the EUT a full 360 degrees. A remote controlled non-conductive antenna mast is used to scan the antenna height from one to four meters.

The test site is listed with the FCC under registration number 485103. The test site is listed with Industry Canada under site number IC 2055A-1.

3.1 Test Equipment

Description	Manufacturer	Model Number	Serial Number	Calibration due date
RF Power Meter	Boonton	5232	13601	2/28/2007
Signal Generator	Hewlett Packard	83620B	3614A00199	8/20/2008
Environmental Chamber	Thermotron	SE-1000-5-5	29410	7/3/2008
EMI Receiver	Rohde & Schwarz	ESI 26	1088.7490	9/17/2008
Horn Antenna	Antenna Research	DRG-118/A	1086	7/20/2008
Horn Antenna	EMCO	3115	6556	8/2/2008
Horn Antenna	EMCO	3116	9310-2222	4/10/2008
Bilog Antenna	ETS	3142C	00051864	11/14/2008
High Pass Filter	Microwave Circuits	H3G020G2	3986-01 DC0408	Verify at Time of Use
LISN	Fischer Custom Communication	FCC-LISN-50-50-2M	1026	5/11/2008
Pre-Amp	Miteq	AFS44-00102000-30-10P-44	987410	6/19/2008
Pre-Amp	Miteq	JS4-18004000-30-5P-S	965178	8/13/2008

4 CONDUCTED RF POWER, 6DB BANDWIDTH, AND POWER DENSITY

4.1 Test Procedure (FCC Rule: §15.247(b) Conducted RF Power)

The antenna port of the 802.11 Wireless Module was connected to the input of a peak power meter. The power was read directly from the power meter and corrected for cable loss to obtain the power at the antenna terminals. Conducted power was measured on the high, middle and low channels for all data rates and modulation modes.

4.2 Conducted Output Power Criteria

The maximum allowable transmitter power for antennas with gains of 6dBi or less is 1watt (30dBm).

4.3 Test Procedure (FCC Rule: §15.247(a), 6dB Bandwidth)

The antenna port of the 802.11 Wireless Module was connected to the input of a spectrum analyzer. The analyzer amplitude was offset for the associated cable loss. The analyzer resolution and video bandwidths were set to 100kHz and the max hold function was turned on. A marker peak search was performed on the resultant trace to find the peak amplitude. Markers were then positioned on either side of the peak amplitude such that they were 6dB lower than that amplitude. The 6dB bandwidth was the frequency difference between the marker on the lower side and the marker on the higher side of the peak amplitude. The 6dB bandwidth was measured for the highest data rate for each possible modulation mode on the high, middle, and low channels.

4.4 6dB Bandwidth Criteria

The minimum 6dB bandwidth shall be at least 500kHz

4.5 Test Procedure (FCC Rule: §15.247(d) (b) Power Density)

The antenna port of the 802.11 Wireless Module was connected to the input of a spectrum analyzer. The analyzer amplitude was offset for the associated cable loss. The analyzer resolution and video bandwidths were set to 3kHz and the max hold function was turned on. The frequency span was set to 600kHz around the highest amplitude occurring in the peak emission envelope. The total sweep time was calculated as follows:

Sweep time (Sec.) = (Fstop – Fstart)/Resolution Bandwidth

Sweep time (Sec) = 600kHz / 3kHz

Sweep time (Sec) = 200 Seconds

A peak search was then performed on the resultant trace. The amplitude of that peak was recorded as the maximum power density in dBm. Power density was measured for all data rates and modulation modes on the middle channel. For the high and low channels, power density was measured at the data rate and modulation mode that resulted in the highest and lowest conducted power for that channel.

4.6 Power Density Criteria

The peak power spectral density shall not be greater than 8dBm in any 3kHz band during any time interval of continuous transmission.

4.7 Test Results

The LEX-M04-001 802.11 Wireless Module met the RF power output, 6dB bandwidth, and power density requirements of FCC Part 15 Subpart C (15.247). The test results are located in Table 4-1 through Table 4-3.

Table 4-1 RF Output Power, 6dB Bandwidth, Power Density Measurements – Channel 6

Frequency MHz	Mode	Modulation	Data Rate (Mbps)	Conducted Power (dBm)	Conducted Power (mW)	Power Density (dBm)	6dB Bandwidth MHz
2437 Channel 6	802.11b	BPSK	1	11.74	14.93	-14.96	13.12
		QPSK	2	11.68	14.72	-13.36	12.0
		CCK	5.5	11.55	14.29	-10.51	
		CCK	11	11.61	14.49	-9.57	12.32
	802.11g	OFDM	6	18.76	75.16	-12.6	
		OFDM	9	18.82	76.21	-12.15	
		OFDM	12	18.92	77.98	-13.04	
		OFDM	18	18.48	70.47	-12.96	
		OFDM	24	19.27	84.53	-11.86	
		OFDM	36	18.65	73.28	-11.74	
		OFDM	48	14.77	29.99	-14.99	
		OFDM	54	14.94	31.19	-15.79	16.73
	802.11n	OFDM	6.6	17.09	51.17	-14.25	
		OFDM	13	17.24	52.97	-12.27	
		OFDM	19.5	16.99	50.00	-13.49	
		OFDM	26	18.45	69.98	-12.05	
		OFDM	39	18.36	68.55	-12.56	
		OFDM	52	14.68	29.38	-13.68	
		OFDM	58.5	14.92	31.05	-16.39	
		OFDM	65	13.22	20.99	-17.52	17.83

Table 4-2 RF Output Power, 6dB Bandwidth, Power Density Measurements – Channel 1

Frequency MHz	Mode	Modulation	Data Rate (Mbps)	Conducted Power (dBm)	Conducted Power (mW)	Power Density (dBm)	6dB Bandwidth MHz
2412 Channel 1	802.11b	BPSK	1	11.66	14.66	-14.95	13.12
		QPSK	2	11.64	14.59		12.9
		CCK	5.5	11.48	14.06		
		CCK	11	11.54	14.26	-9.59	12.73
	802.11g	OFDM	6	18.2	66.07		
		OFDM	9	18.27	67.14		
		OFDM	12	18.39	69.02		
		OFDM	18	17.96	62.52		
		OFDM	24	18.75	74.99	-12.51	
		OFDM	36	18.14	65.16		
		OFDM	48	14.41	27.61	-14.89	
		OFDM	54	14.55	28.51		16.53
	802.11n	OFDM	6.6	16.87	48.64		
		OFDM	13	17	50.12		
		OFDM	19.5	16.78	47.64		
		OFDM	26	17.98	62.81	-12.29	
		OFDM	39	17.89	61.52		
		OFDM	52	14.36	27.29		
		OFDM	58.5	14.62	28.97		
		OFDM	65	12.91	19.54	-17.69	16.93

Table 4-3 RF Output Power, 6dB Bandwidth, Power Density Measurements – Channel 11

Frequency MHz	Mode	Modulation	Data Rate (Mbps)	Conducted Power (dBm)	Conducted Power (mW)	Power Density (dBm)	6dB Bandwidth MHz
2462 Channel 11	802.11b	BPSK	1	11.59	14.42	-15.13	13.13
		QPSK	2	11.52	14.19		13.0
		CCK	5.5	11.36	13.68	-9.7	
		CCK	11	11.44	13.93		12.42
	802.11g	OFDM	6	18.64	73.11		
		OFDM	9	18.68	73.79		
		OFDM	12	18.77	75.34		
		OFDM	18	18.34	68.23		
		OFDM	24	19.12	81.66	-12.54	
		OFDM	36	18.5	70.79		
		OFDM	48	14.64	29.11	-13.07	
		OFDM	54	14.8	30.20		16.53
	802.11n	OFDM	6.6	17.01	50.23		
		OFDM	13	17.13	51.64		
		OFDM	19.5	16.87	48.64		
		OFDM	26	18.3	67.61	-12.23	
		OFDM	39	18.22	66.37		
		OFDM	52	14.54	28.44		
		OFDM	58.5	14.78	30.06		
		OFDM	65	13.11	20.46	-17.76	17.84

5 RADIATED RF POWER

5.1 Test Procedure (FCC Rule: §15.247(b) Radiated RF Power)

The peak radiated RF output power for the 802.11 Wireless Module was calculated using the measured peak output power at the antenna terminals as follows:

$$EIRP = P_1 + G$$

where,

P_1 is the measured peak output power

G is the gain of the transmitting antenna in dBi.

5.2 Radiated Output Power Criteria

The maximum allowable transmitter power for antennas with gains of 6dBi or less is 1watt (30dBm).

5.3 Test Results

The LEX-M04-001 802.11 Wireless Module met the radiated power requirements of FCC §15.247(b). The test results are located in Table 5-1. All results are less than the 30dBm limit.

Table 5-1 Radiated RF Power

EUT Mode	TX Channel	TX Frequency (MHz)	Measured Conducted Output Power (dBm)	Peak Antenna Gain (dBi)	EIRP (dBm)	EIRP (mW)
802.11b	1	2412	11.66	2.2	13.86	24.3220401
802.11b	6	2437	11.74	2.2	13.94	24.7742206
802.11b	11	2462	11.59	2.2	13.79	23.9331576
802.11g	1	2412	18.75	2.2	20.95	124.451461
802.11g	6	2437	19.27	2.2	**21.47**	**140.28137**
802.11g	11	2462	19.12	2.2	21.32	135.518941
802.11n	1	2412	17.89	2.2	20.09	102.093948
802.11n	6	2437	18.45	2.2	20.65	116.144861
802.11n	11	2462	18.3	2.2	20.5	112.201845

6 MAXIMUM PERMISSIBLE EXPOSURE (MPE) CALCULATIONS

The § 1.1310 Radiofrequency radiation exposure limits are listed in the table below.

	Frequency Range (MHz)	Power Density Limit (mW/cm^2)
Limits for Occupational/Controlled Exposures	0.3-3.0	100
	3.0-30	900/ Frequency2
	30-300	1.0
	300-1500	Frequency/300
	1500-100,000	5.0
Limits for General Population/Uncontrolled Exposure	0.3-1.34	100
	1.34-30	180/Frequency2
	30-300	0.2
	300-1500	Frequency/1500
	1500-100,000	1.0

6.1 Test Procedure (FCC Rule: §15.247(b)(5))

The EIRP was calculated in section 5. The radiated RF power was used to calculate the maximum RF exposure at a 20 cm distance using the formula:

$$\text{Maximum RF Exposure at 20cm} = (\text{EIRP in mW})/(4\text{Pi}(20\text{cm})^2)$$

Once the Maximum RF Exposure calculations were complete the results were compared to the MPE limits above.

6.2 Test Results

The following calculations show the Maximum RF Exposure from the 802.11 Wireless Module at 20cm for the worst case calculated EIRP. The MPE level is well below the limits for the general population described in the table above.

$$\text{Maximum Measured EIRP} = 21.47\ \text{dBm} = 140.28\ \text{mW}$$

$$\text{MPE} = 140.28\ \text{mW} / (4\text{Pi}(20\text{cm})^2) = 0.0279\ \text{mW/cm}^2$$

7 OUT OF BAND EMISSIONS AT ANTENNA TERMINALS

7.1 Test Procedure (FCC Rule §15.247(c))

The antenna port of the 802.11 Wireless Module was connected to the input of a spectrum analyzer. The analyzer resolution and video bandwidths were set to 1MHz. The 802.11 Wireless Module was set to transmit at its highest output power level and with the modulation scheme that produced the highest conducted output power level. The spectrum analyzer was scanned from 30MHz to 26GHz using the max hold function to detect any out of band spurious emissions. The resulting trace was corrected for the cable loss between the test sample and the spectrum analyzer.

7.2 Out of Band Emissions at Antenna Terminals Criteria

In any 100kHz bandwidth outside the frequency band in which the transmitter is operating, the RF power shall be at least 20dB below that of the carrier.

7.3 Test Results

The 802.11 Wireless Module met the out of band emission at antenna terminal requirements. The following plots illustrate the output power of channels 1, 6, and 11and also show that there are no spurious emissions within 20dB of the peak carrier power.

Figure 7-1: Out of band emissions at antenna terminals – Channel 1, 6, and 11 (802.11b Mode)

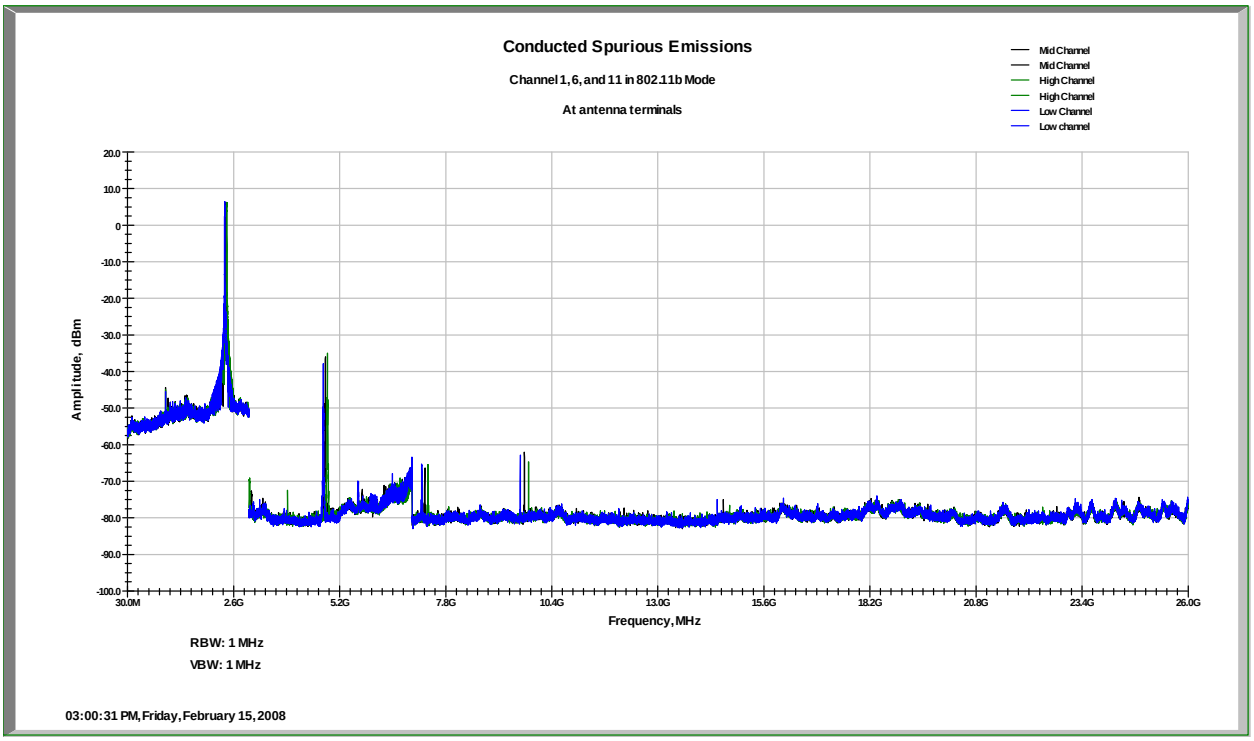


Figure 7-2: Out of band emissions at antenna terminals – Channel 1, 6, and 11 (802.11g mode)

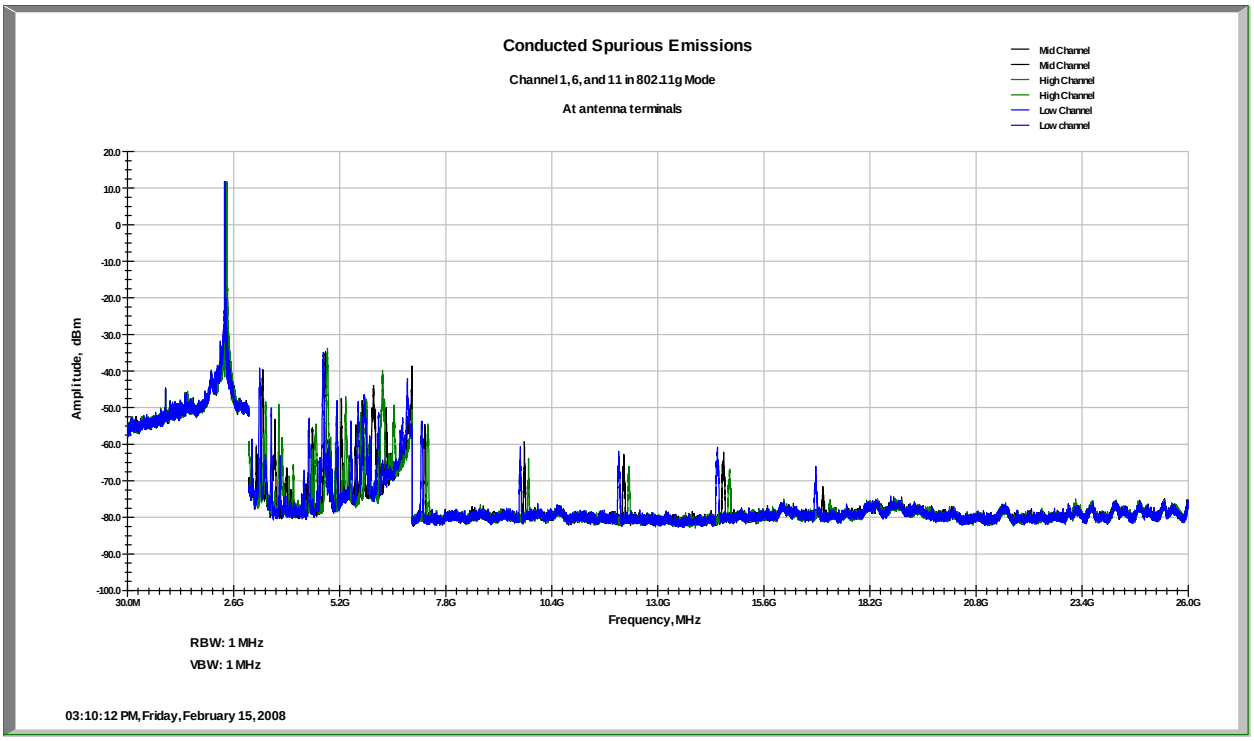
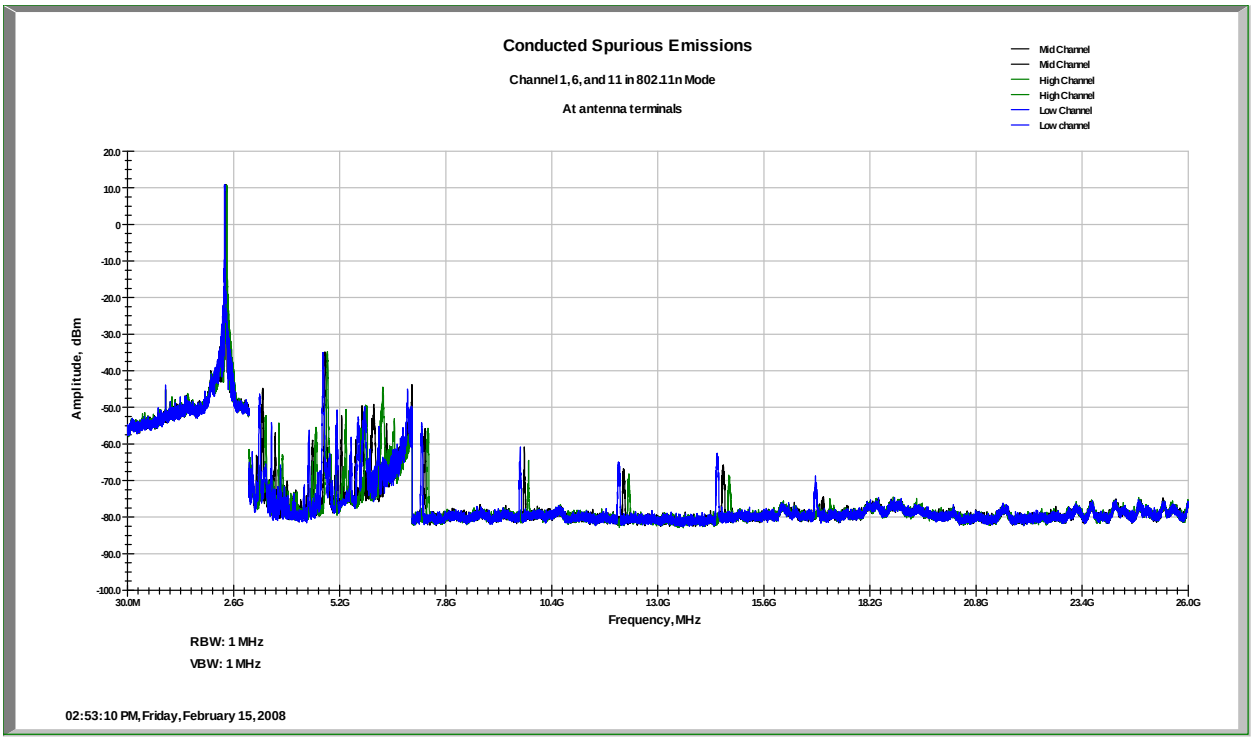


Figure 7-3: Out of band emissions at antenna terminals – Channel 1, 6, and 11 (802.11n mode)



8 FIELD STRENGTH OF SPURIOUS RADIATION (GENERAL REQUIREMENTS AND RESTRICTED BAND REQUIREMENTS)

8.1 Test Procedure (FCC Rule §15.247(c) for Radiated Measurements)

The 802.11 Wireless Module was placed on a non-conductive table. It was then set to transmit at its highest output power level and with the modulation scheme that produced the highest conducted output power level. The 30MHz – 3GHz range was measured with a bilog antenna, no external preamplifier, and no external filtering in the measurement path. The 3GHz-26GHz range was measured with an in line preamplifier and high pass filter with a pass band above 3GHz in order to keep the fundamental transmission from overloading the receiver. All measurements were performed with the receiving antenna 3 meters from the EUT with the exception of the 18-26GHz range which was performed at a distance of 1m. During the tests, the antenna height and EUT azimuth were varied in order to identify the maximum level of emissions from the EUT.

The frequency range up to tenth harmonic was investigated for each of three fundamental frequencies (low, middle, and high channels) in each operating band. The field strength of each spurious emission within 20dB of the limit was measured using the procedure outlined in ANSI C63.4.

Also, a scan was performed looking specifically at the band edge of channels 1 and 11 in order to show that the restricted bands ranging from 2310MHz to 2390MHz and 2483.5MHz to 2500 MHz were not intruded upon. To perform this measurement, the spectrum analyzer was manually set to show the band edge of channels 1 and 11 and the entire restricted band. The amplitude was offset to account for cable loss, antenna factor, and preamplifier gain. The turntable and tower were maximized with the analyzer set to max hold. These scans were performed in peak and average detection mode.

8.2 Field Strength of Spurious Radiation Criteria

In any 100kHz bandwidth outside the frequency band in which the transmitter is operating, the RF power shall be at least 20dB below that of the carrier. In addition, emissions within the restricted bands as specified in §15.205(a), must also comply with the limits specified in §15.209(a). Those limits are in the table below.

Table 8-1 Radiated Emission Limit for FCC §15.209(a)

Radiated Emission Limits at 3 meters	
Frequency (MHz)	**Quasi-Peak limits, dB (µV/m)**
30 to 88	40.0
88 to 216	43.5
216 to 960	46.0
960 and up	54.0

8.3 Test Results

The LEX-M04-001 802.11 Wireless Module met the field strength of spurious radiation requirements of FCC §15.209 and §15.247(c). The following graphs in Figure 8-1 through Figure 8-21 show that all harmonics and spurious emissions are at least 20dB below the carrier and that there are no emissions within the restricted bands exceeding the limits specified in §15.209(a).

Table 8-2 Spurious Radiated Emissions

TX Mode	Freqency	Pol.	Reading (dBuV)	Cable (dB)	Antenna (dB/m)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Detector
802.11b Ch 1	4.8239 GHz	H	47.4	-32	33.25	48.65	54	-5.35	Avg
802.11b Ch 1	4.8239 GHz	H	41.72	-32	33.25	42.97	74	-31.03	PK
802.11b Ch 1	4.8241 GHz	V	47.34	-32	32.98	48.32	54	-5.68	Avg
802.11b Ch 1	4.8241 GHz	V	49.91	-32	32.98	50.89	74	-23.11	PK
802.11b Ch 6	4.8739 GHz	H	50.83	-31.31	33.32	52.84	54	**-1.16**	Avg
802.11b Ch 6	4.8739 GHz	H	52.97	-31.31	33.32	54.98	74	-19.02	PK
802.11b Ch 6	4.874 GHz	V	48.98	-31.31	33.07	50.74	54	-3.26	Avg
802.11b Ch 6	4.874 GHz	V	51.49	-31.31	33.07	53.25	74	-20.75	PK
802.11b Ch 11	4.924 GHz	H	50.18	-31.53	33.39	52.04	54	-1.96	Avg
802.11b Ch 11	4.924 GHz	H	42.75	-31.53	33.39	44.61	74	-29.39	PK
802.11b Ch 11	4.9239 GHz	V	49.97	-31.54	33.16	51.59	54	-2.41	Avg
802.11b Ch 11	4.9239 GHz	V	51.61	-31.54	33.16	53.23	74	-20.77	PK
802.11g Ch 11	4.9258 GHz	H	41.36	-31.45	33.4	43.31	54	-10.69	Avg
802.11g Ch 11	4.9258 GHz	H	44.63	-31.45	33.4	46.58	74	-27.42	PK
802.11g Ch 11	4.9239 GHz	V	39.27	-31.54	33.16	40.89	54	-13.11	Avg
802.11g Ch 11	4.9239 GHz	V	51.36	-31.54	33.16	52.98	74	-21.02	PK
802.11n Ch 6	4.8738 GHz	H	38.82	-31.31	33.32	40.83	54	-13.17	Avg
802.11n Ch 6	4.8738 GHz	H	51.23	-31.31	33.32	53.24	74	-20.76	PK
802.11n Ch 6	4.873 GHz	V	37.96	-31.3	33.07	39.73	54	-14.27	Avg
802.11n Ch 6	4.873 GHz	V	39.85	-31.3	33.07	41.62	74	-32.38	PK

Figure 8-1: Field Strength of Spurious Radiation Channel 1 (30MHz – 26GHz) – 802.11b

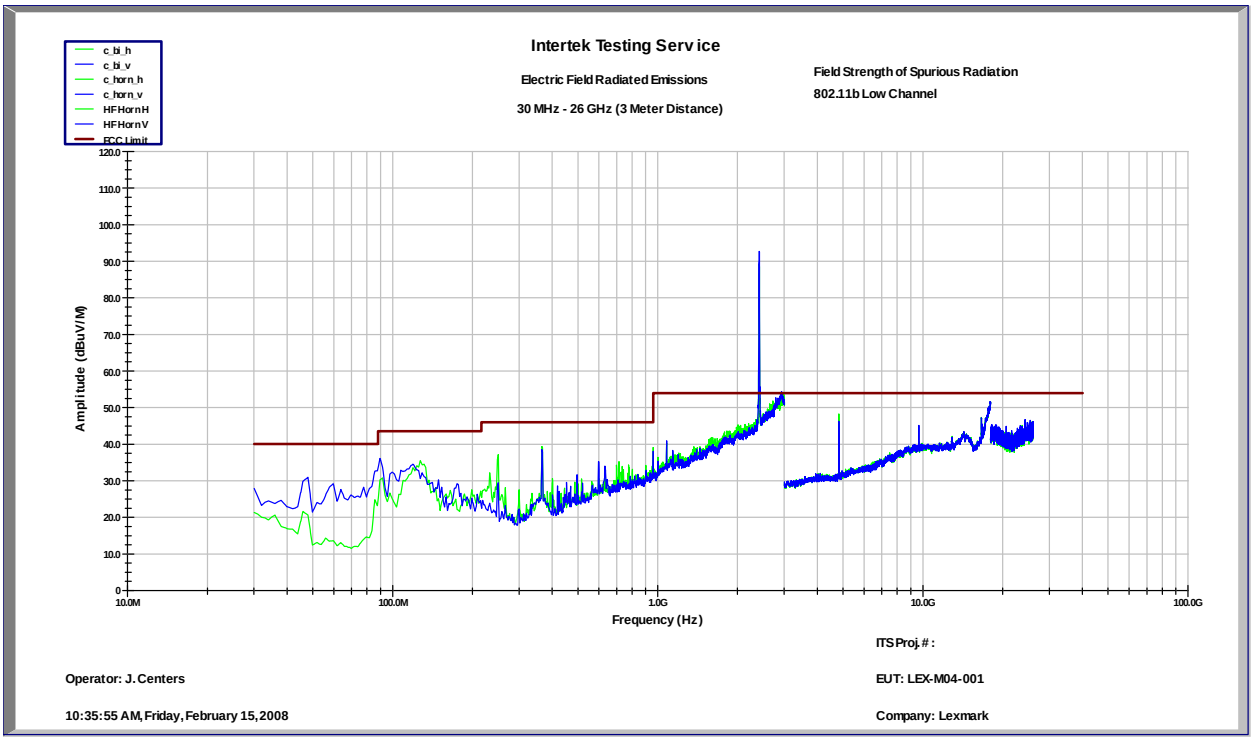


Figure 8-2: Field Strength of Spurious Radiation Channel 6 (30MHz – 26GHz) – 802.11b

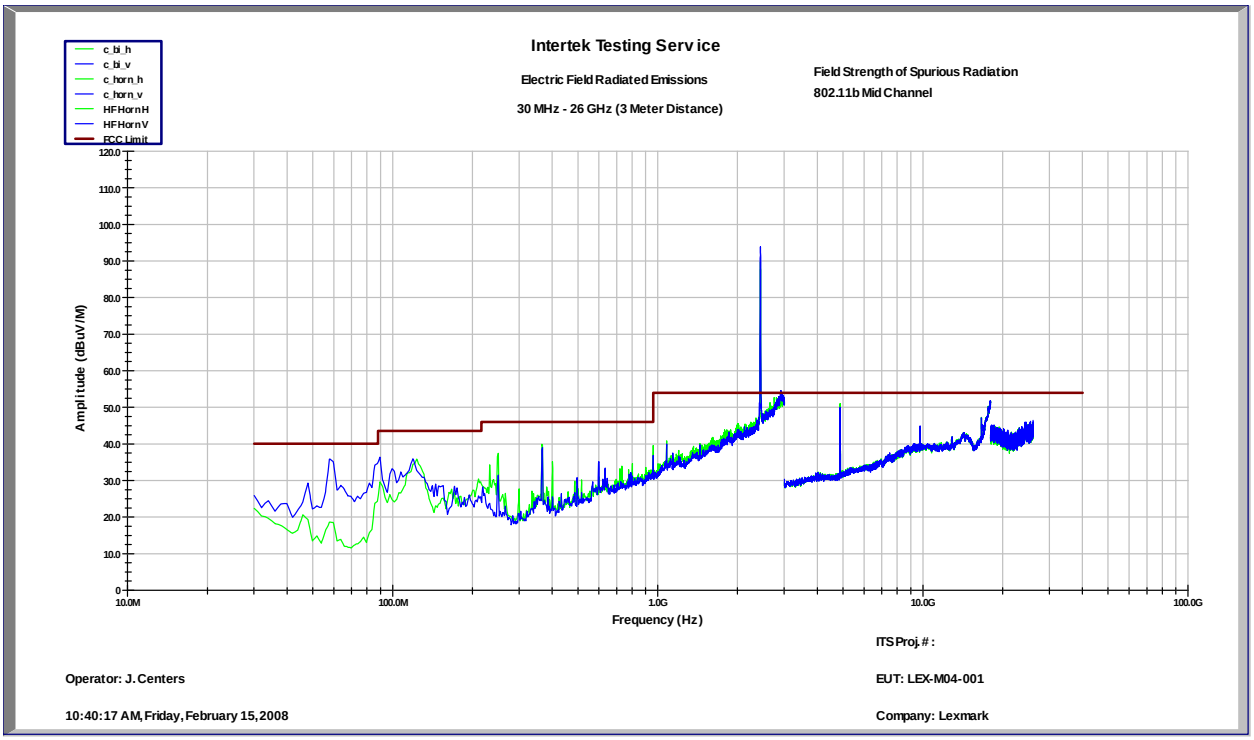


Figure 8-3: Field Strength of Spurious Radiation Channel 11 (30MHz – 26GHz) – 802.11b

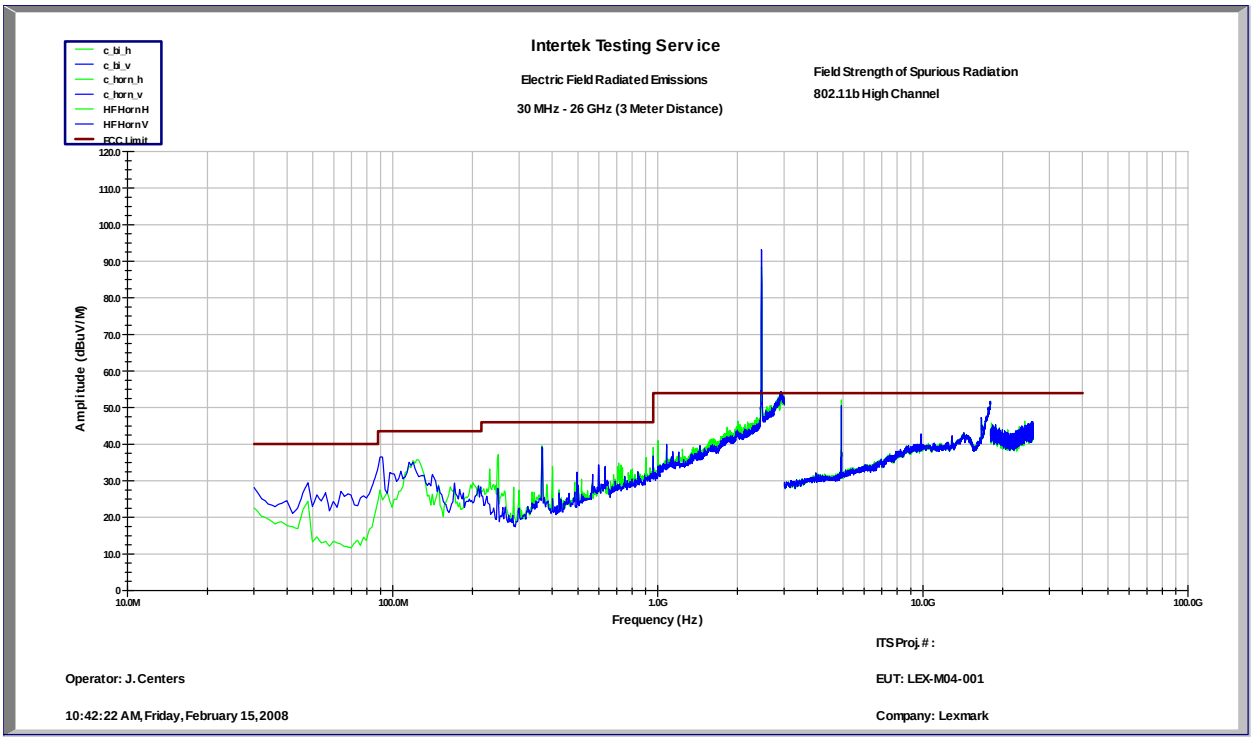


Figure 8-4: Field Strength of Spurious Radiation Channel 1 (30MHz – 26GHz) – 802.11g

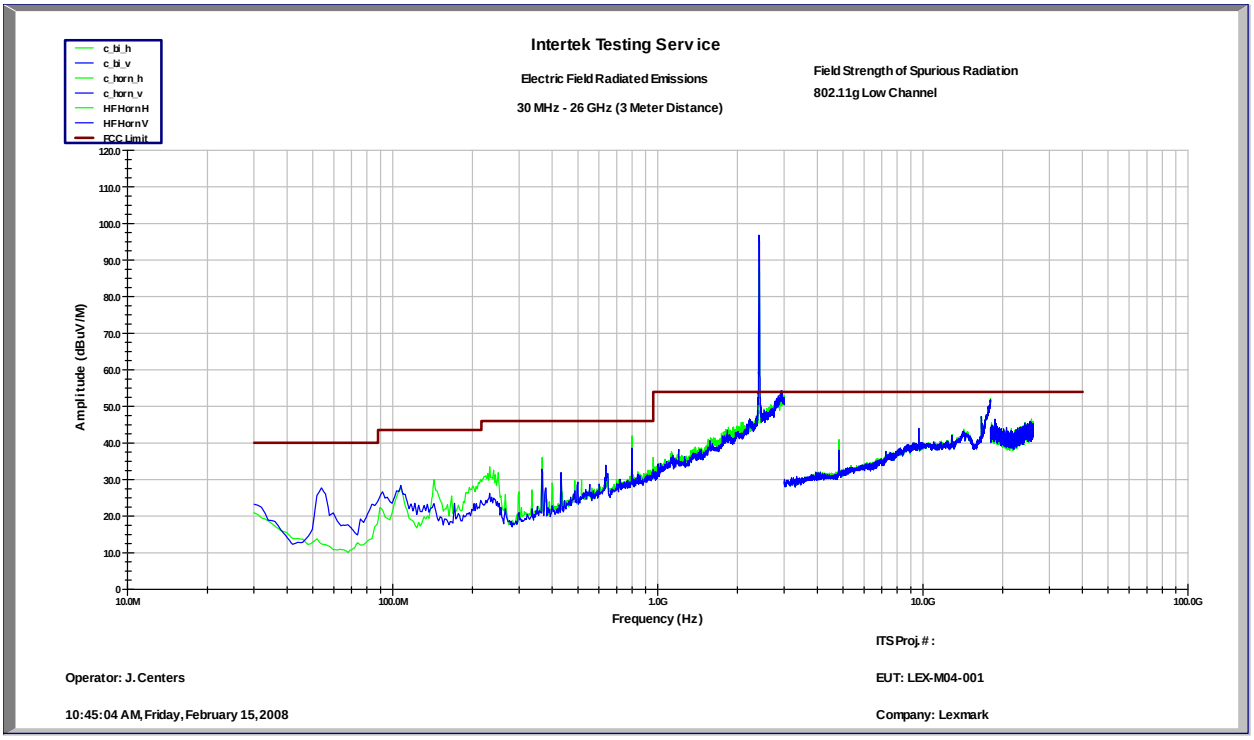


Figure 8-5: Field Strength of Spurious Radiation Channel 6 (30MHz – 26GHz) – 802.11g

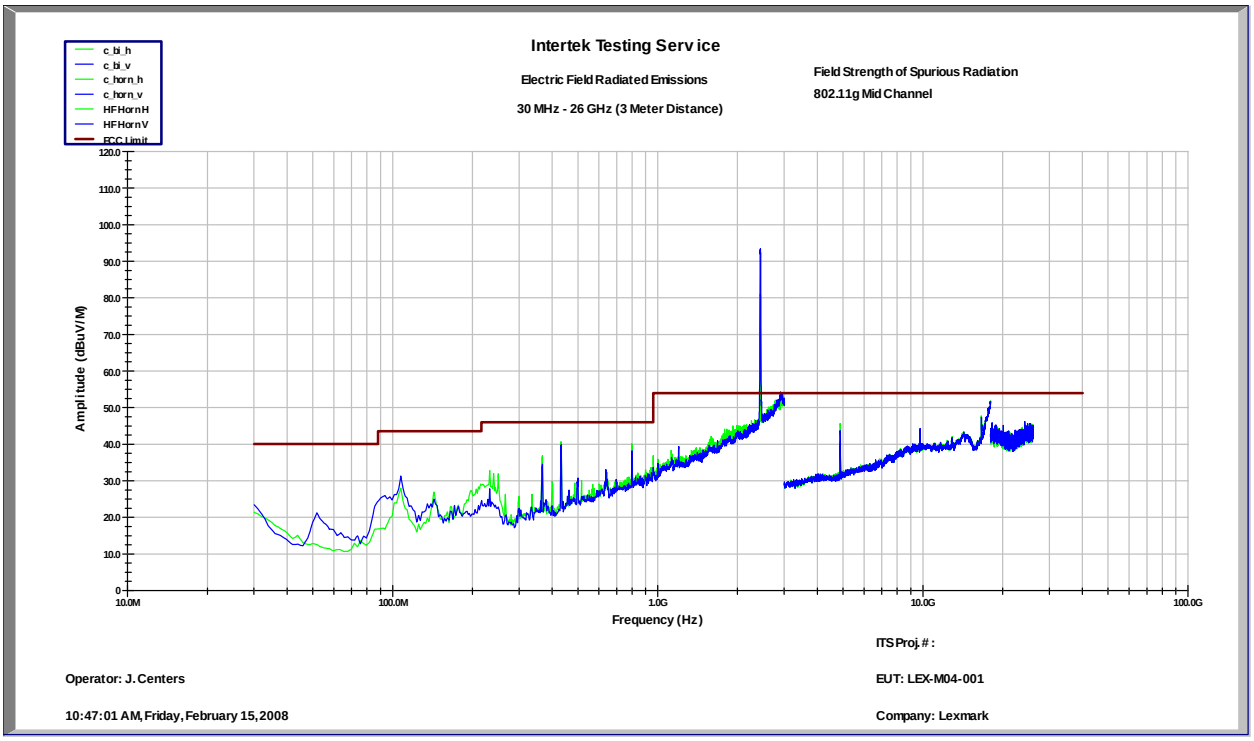


Figure 8-6: Field Strength of Spurious Radiation Channel 11 (30MHz – 26GHz) – 802.11g

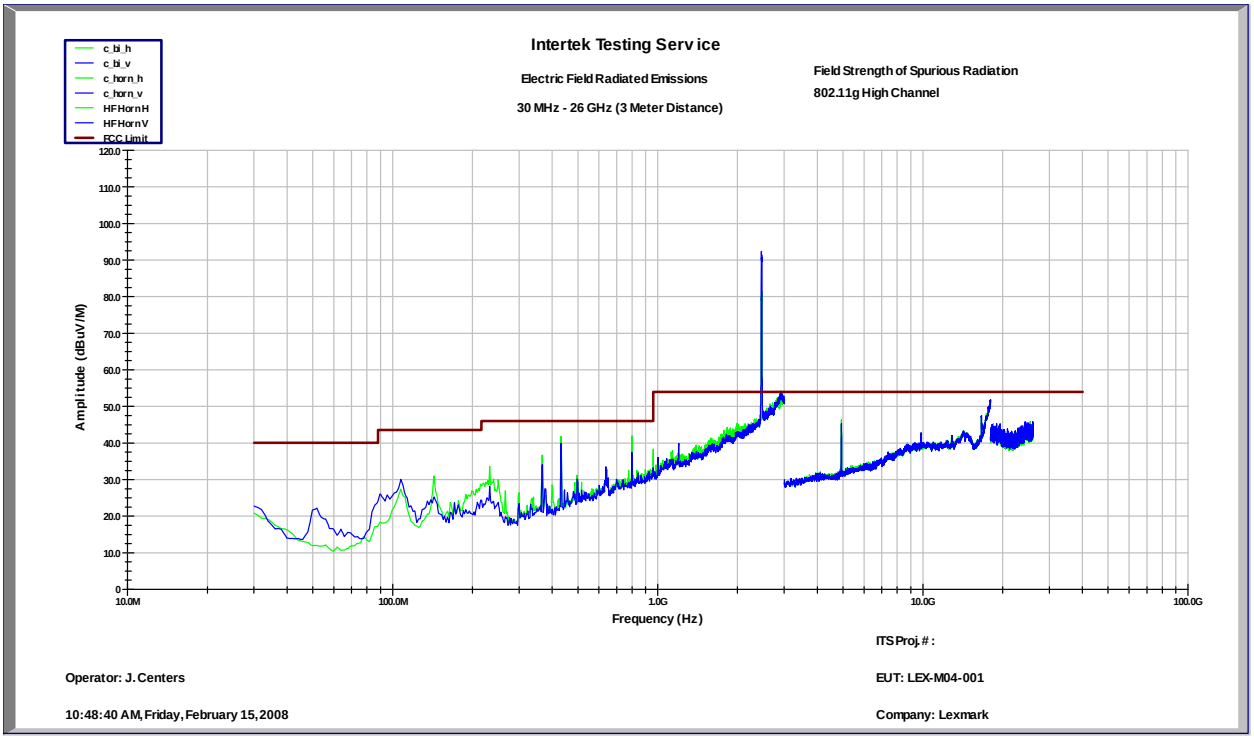


Figure 8-7: Field Strength of Spurious Radiation Channel 1 (30MHz – 26GHz) – 802.11n

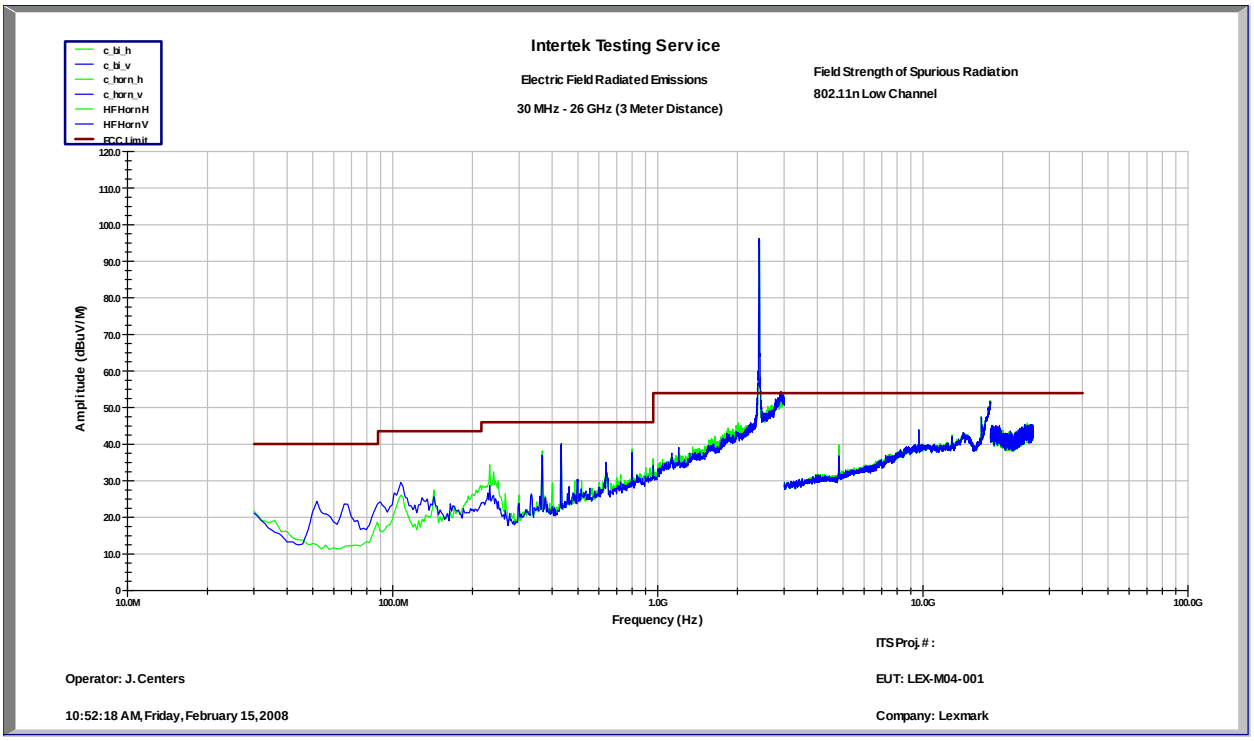


Figure 8-8: Field Strength of Spurious Radiation Channel 6 (30MHz – 26GHz) – 802.11n

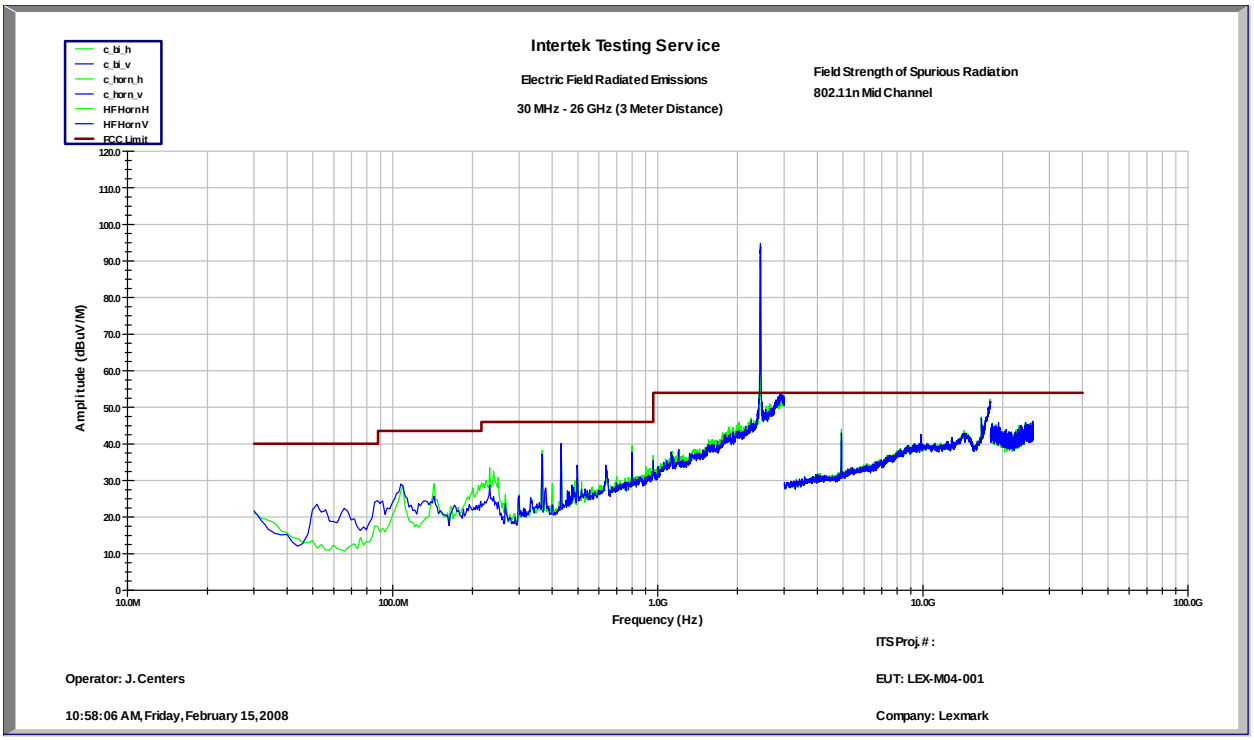
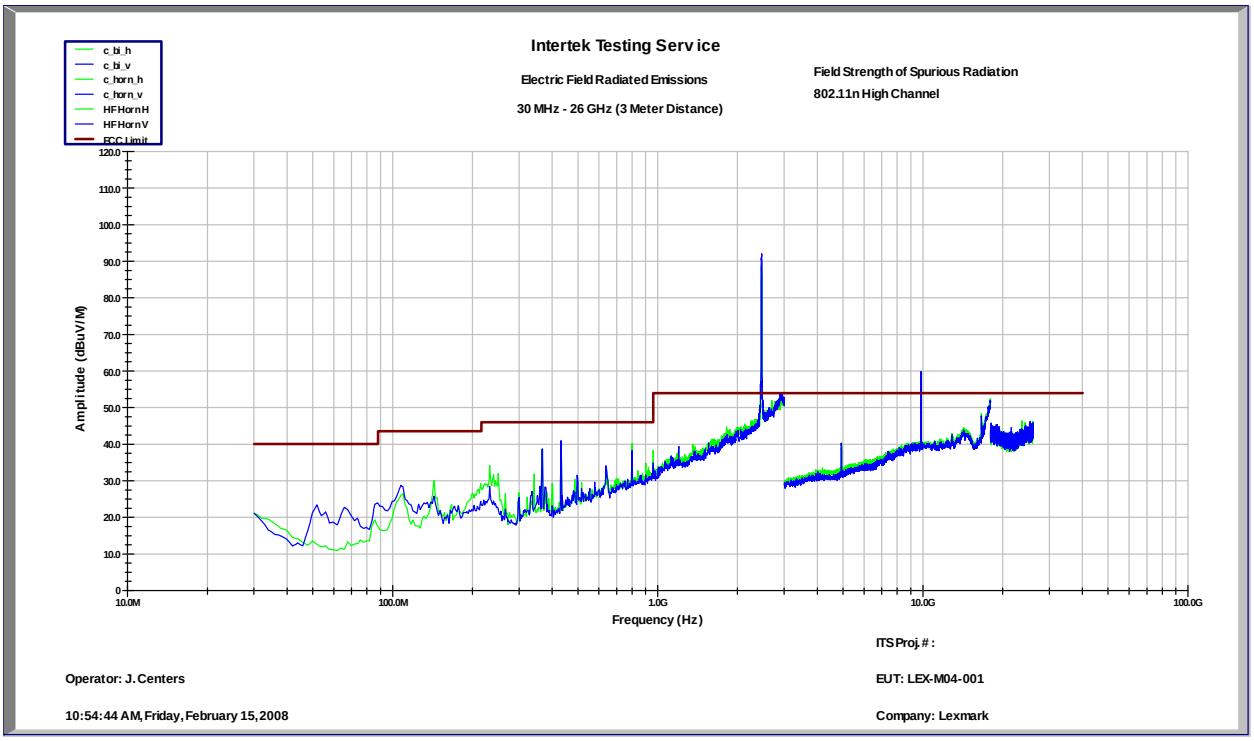


Figure 8-9: Field Strength of Spurious Radiation Channel 11 (30MHz – 26GHz) – 802.11n[1]



[1] The peak at 9.848 GHz was not in a restricted band and is only required to be attenuated to 20dBc.

Figure 8-10: Channel 1 Band Edge Showing the Restricted Band from 2310 to 2390 MHz (802.11b) – Peak Detector

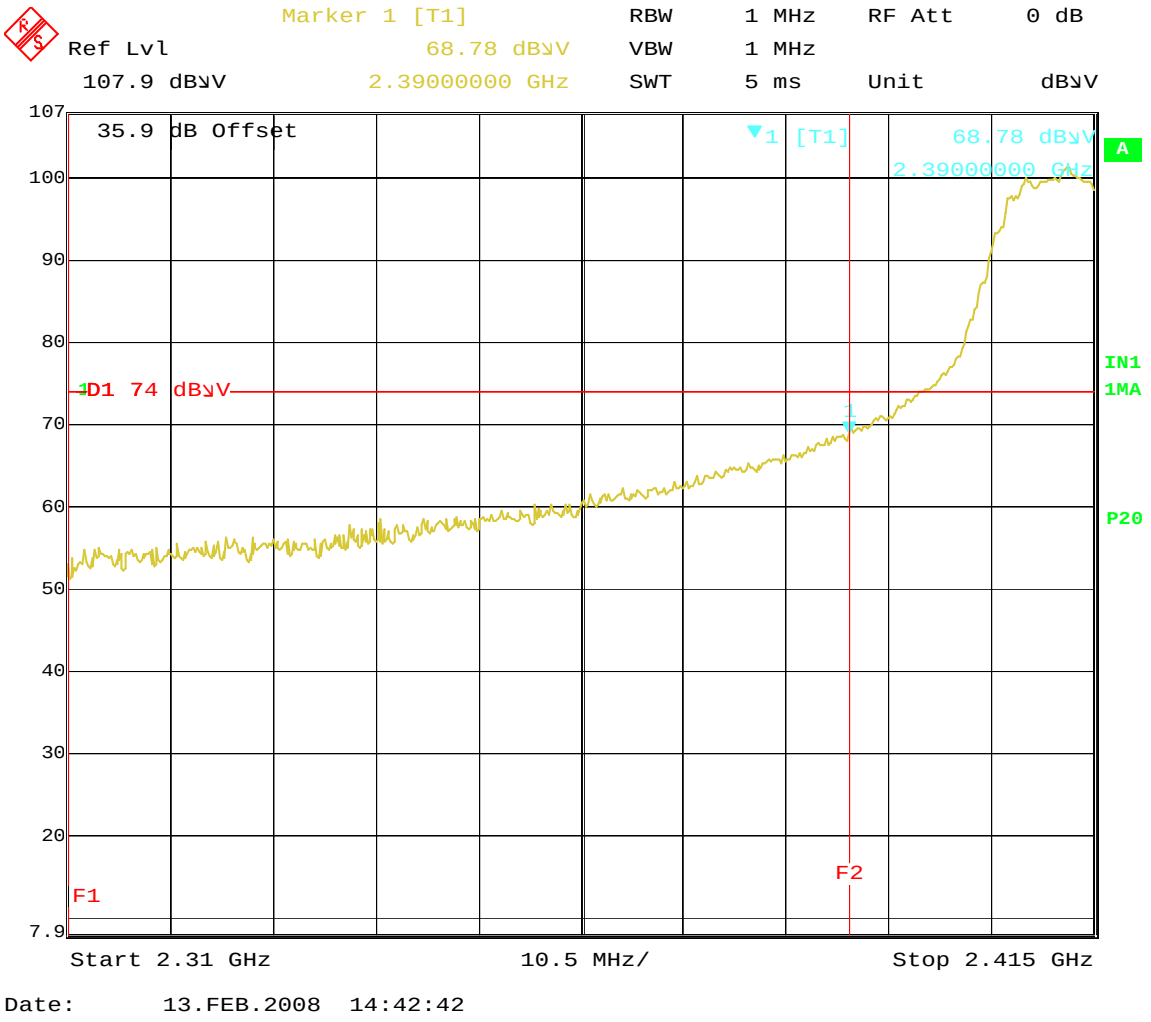


Figure 8-11: Channel 1 Band Edge Showing the Restricted Band from 2310 to 2390 MHz (802.11b) – Average Detector

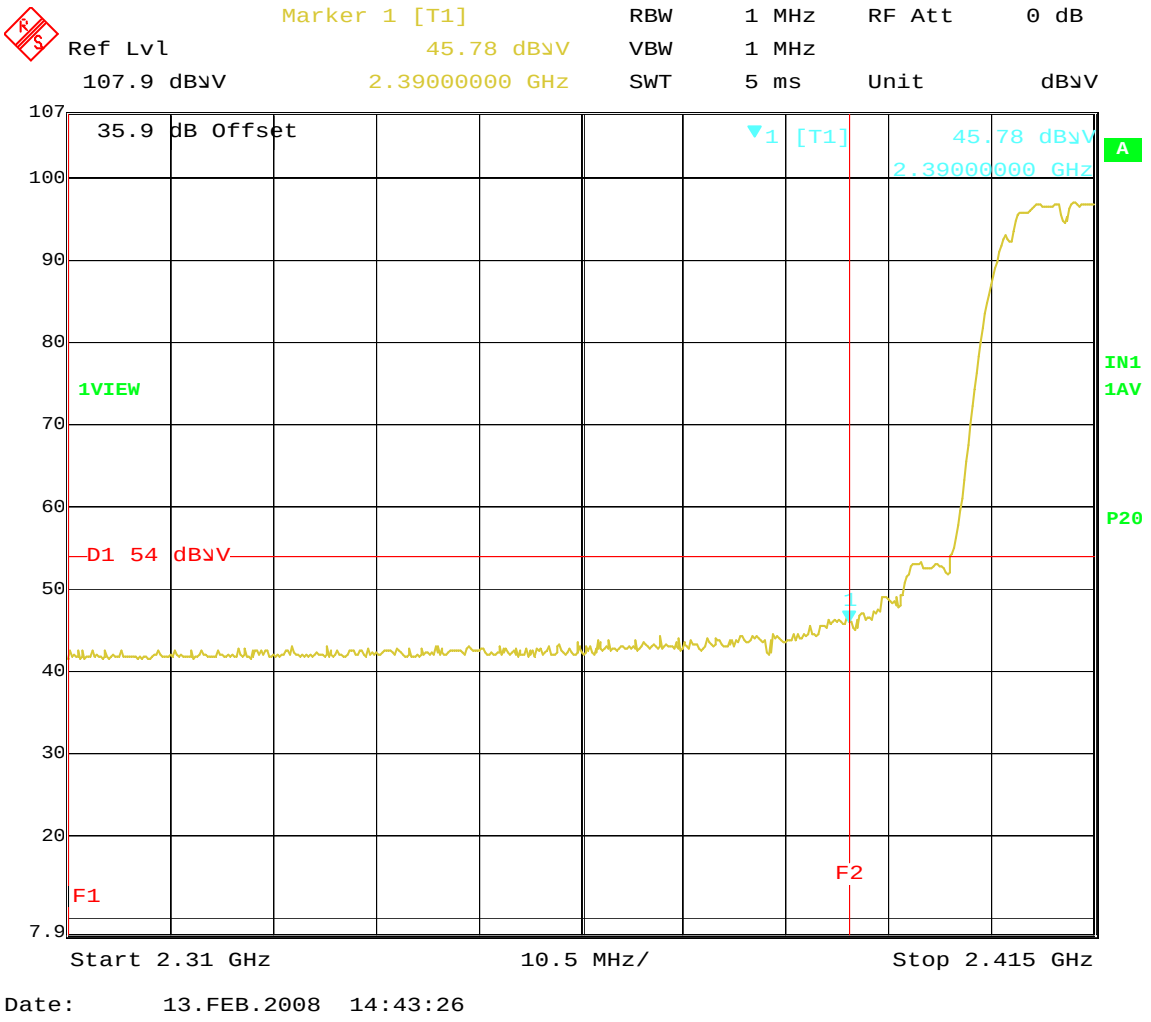


Figure 8-12: Channel 1 Band Edge Showing the Restricted Band from 2310 to 2390 MHz (802.11g) – Peak Detector

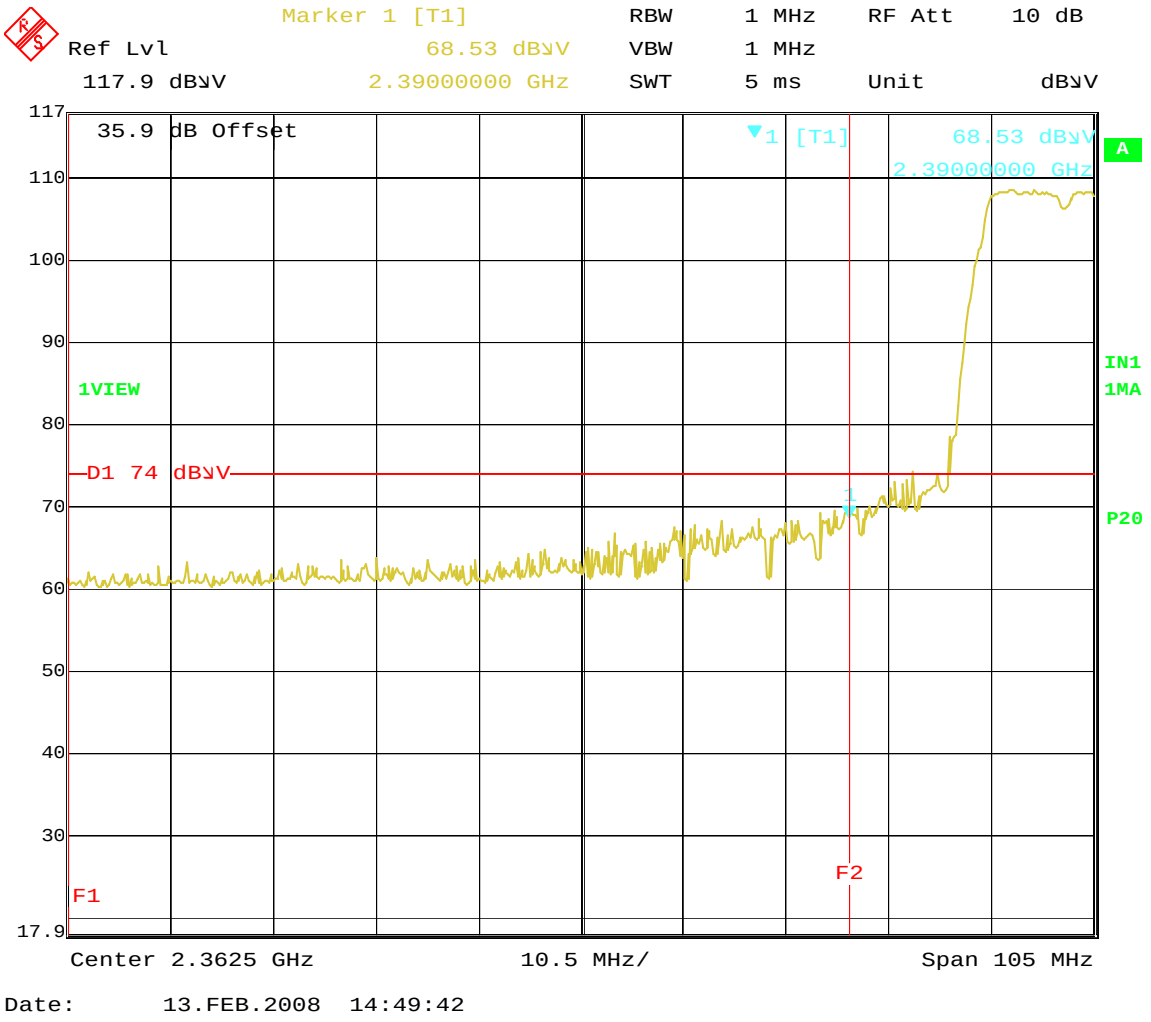


Figure 8-13: Channel 1 Band Edge Showing the Restricted Band from 2310 to 2390 MHz (802.11g) – Average Detector

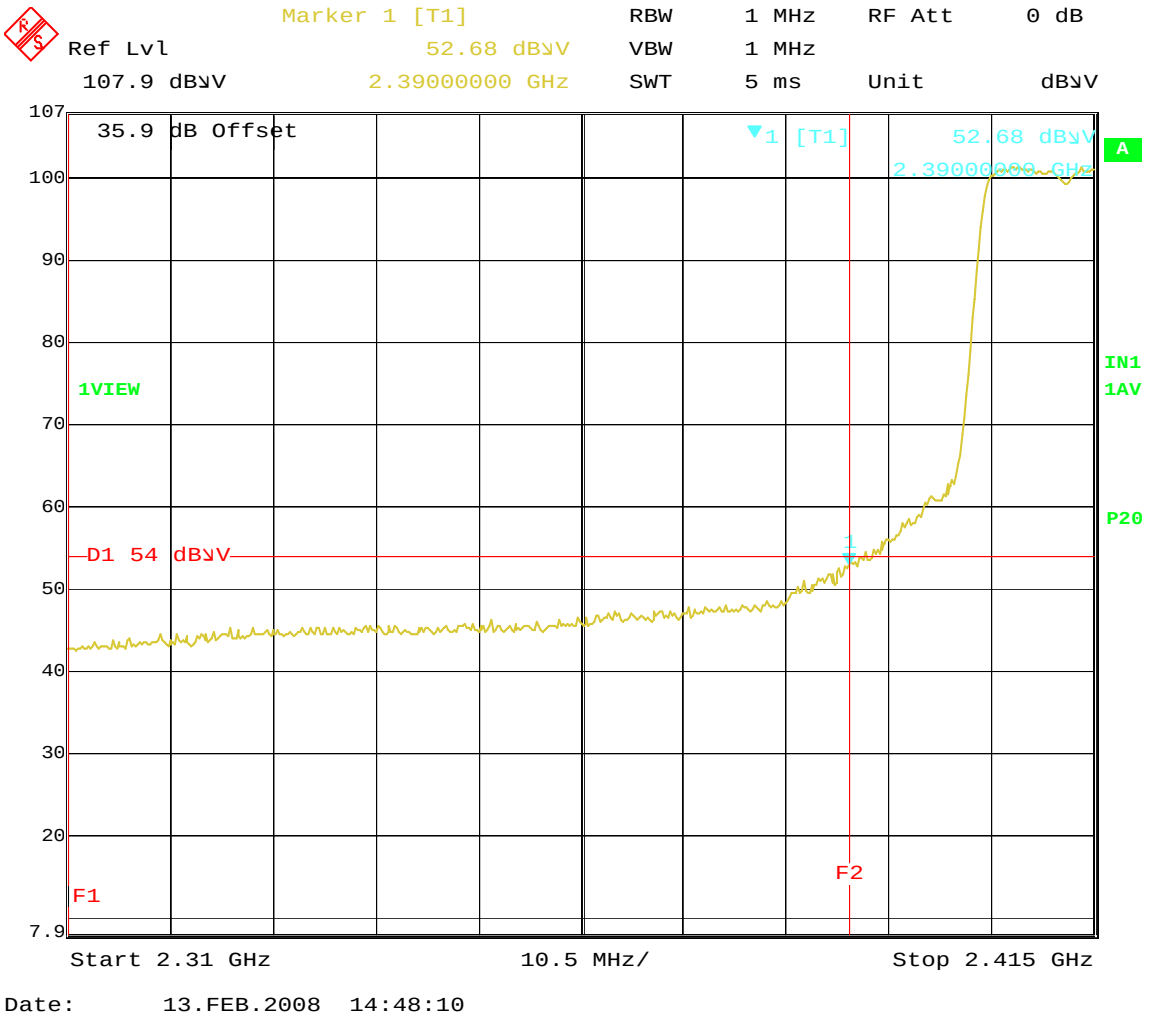


Figure 8-14: Channel 1 Band Edge Showing the Restricted Band from 2310 to 2390 MHz (802.11n) – Peak Detector

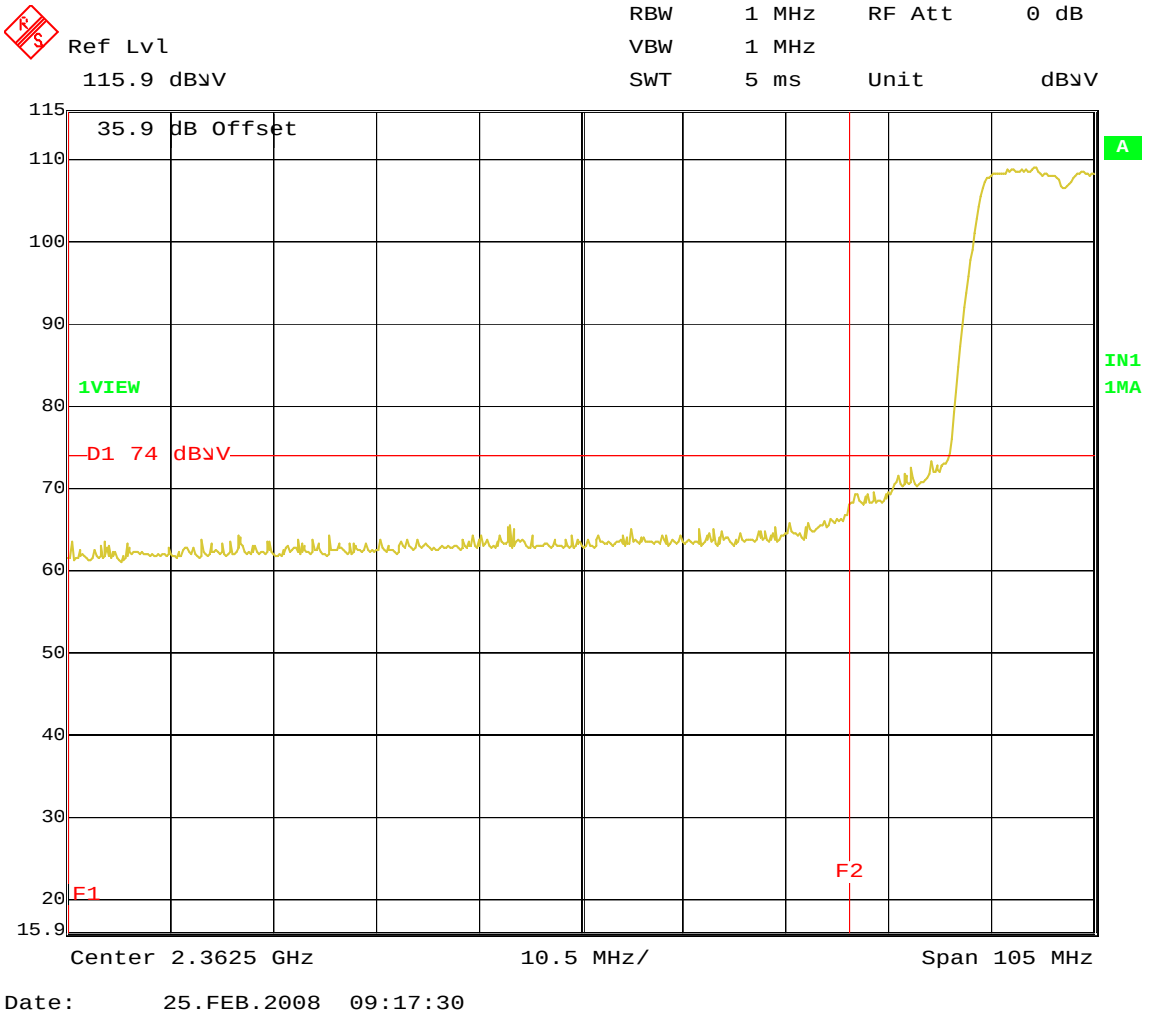


Figure 8-15: Channel 1 Band Edge Showing the Restricted Band from 2310 to 2390 MHz (802.11n) – Average Detector

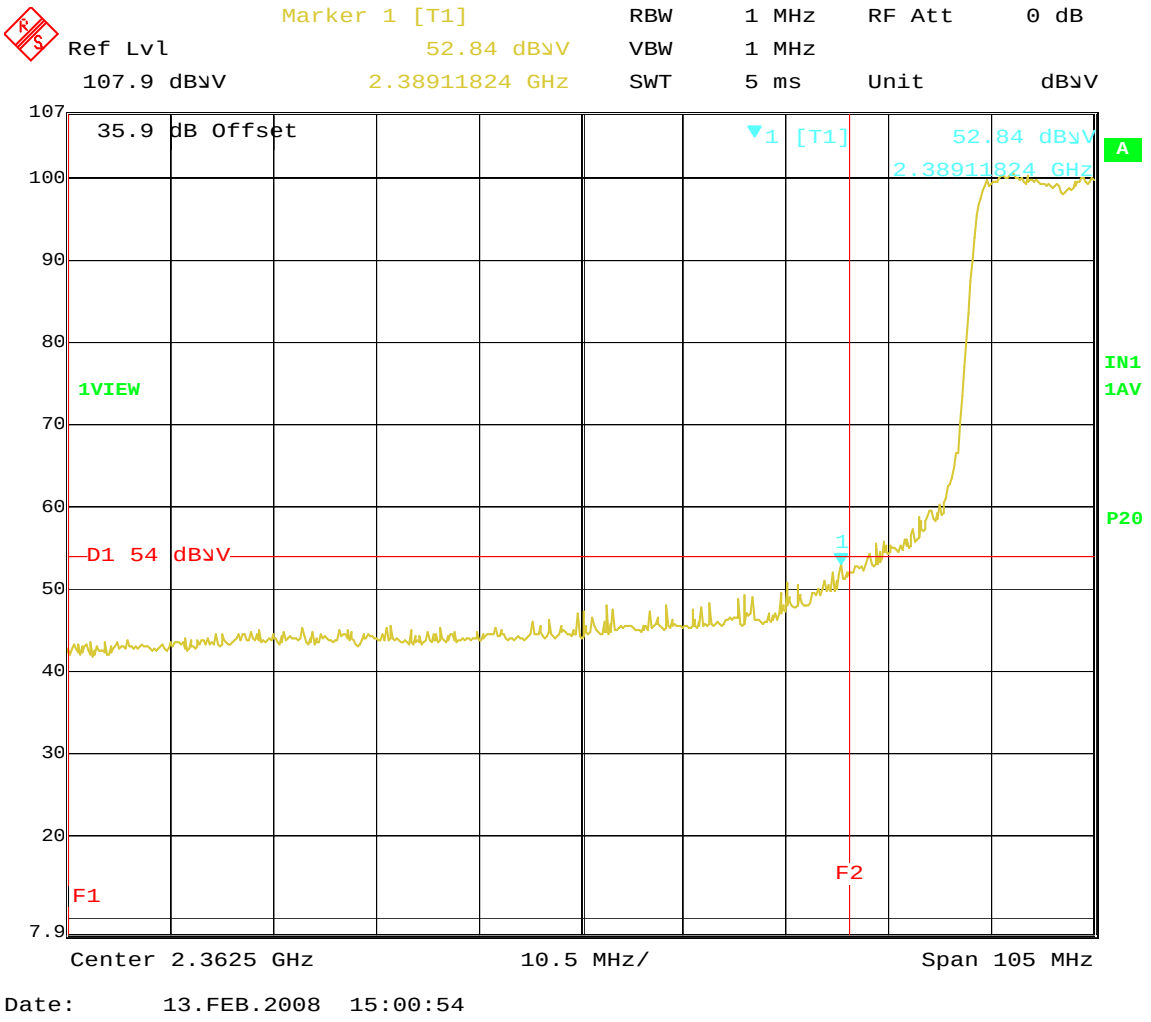


Figure 8-16: Channel 11 Band Edge Showing the Restricted Band from 2483.5 to 2500 MHz (802.11b) - Peak Detector

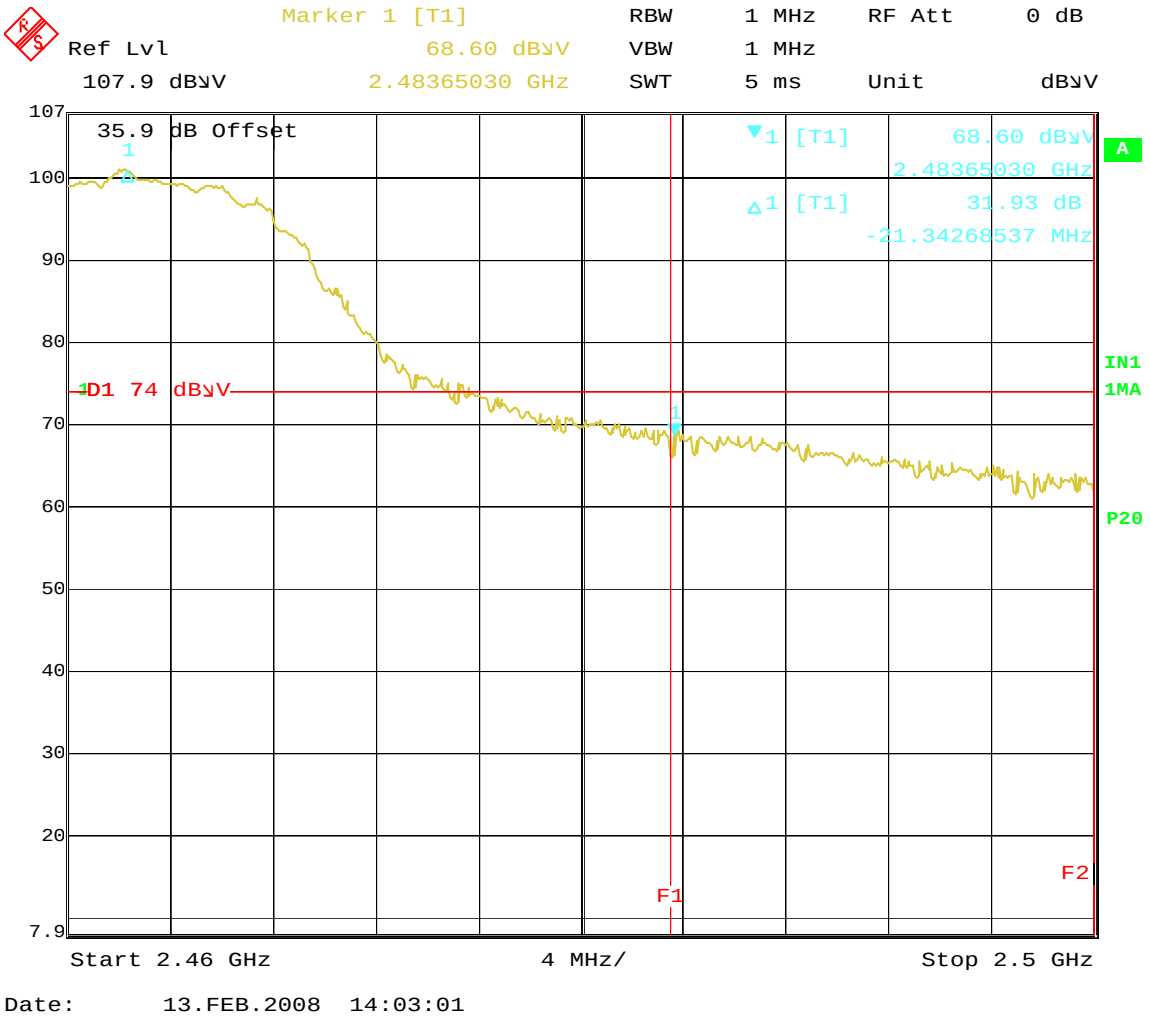


Figure 8-17: Channel 11 Band Edge Showing the Restricted Band from 2483.5 to 2500 MHz (802.11b) – Average Detector

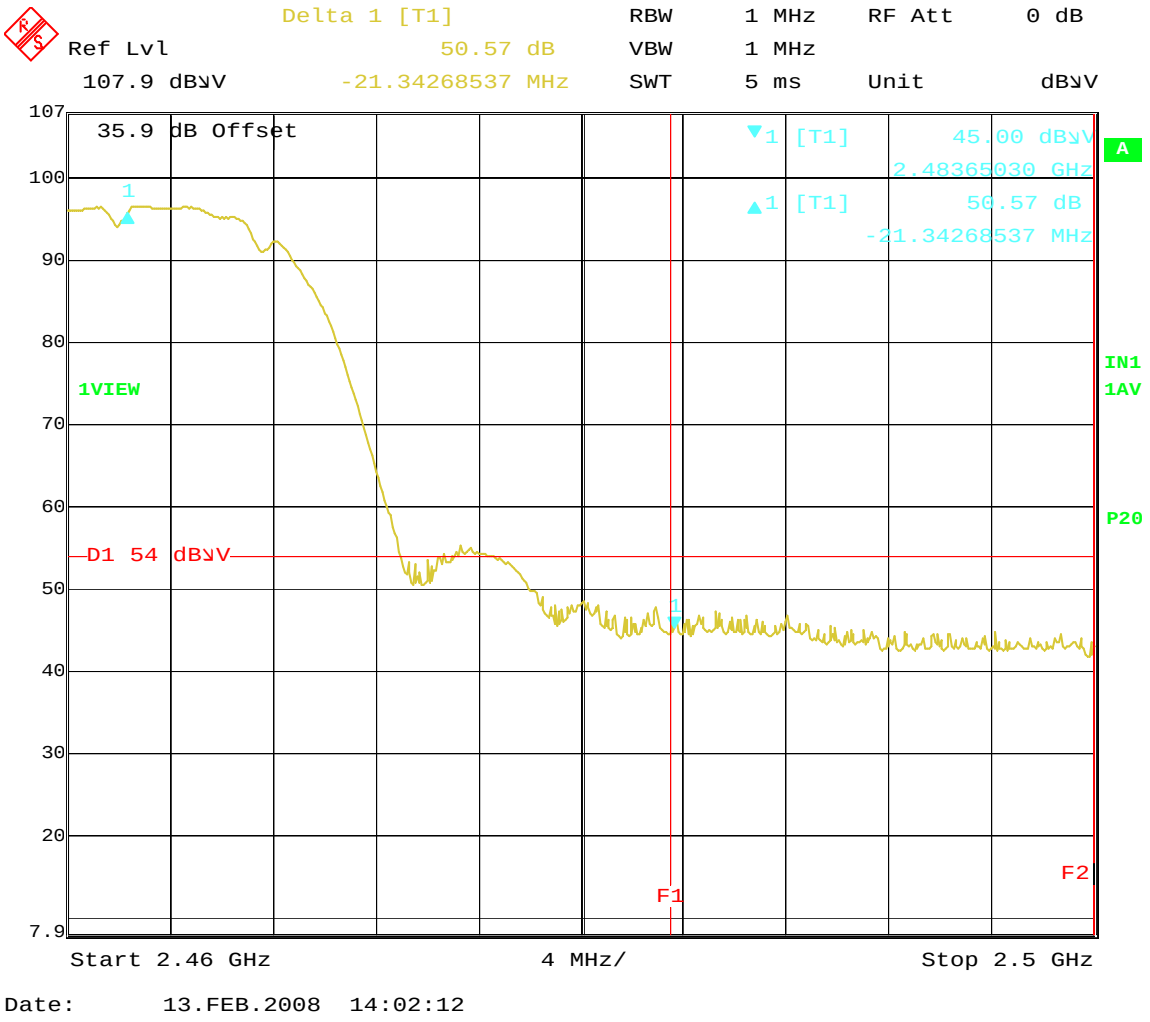


Figure 8-18: Channel 11 Band Edge Showing the Restricted Band from 2483.5 to 2500 MHz (802.11g) - Peak Detector

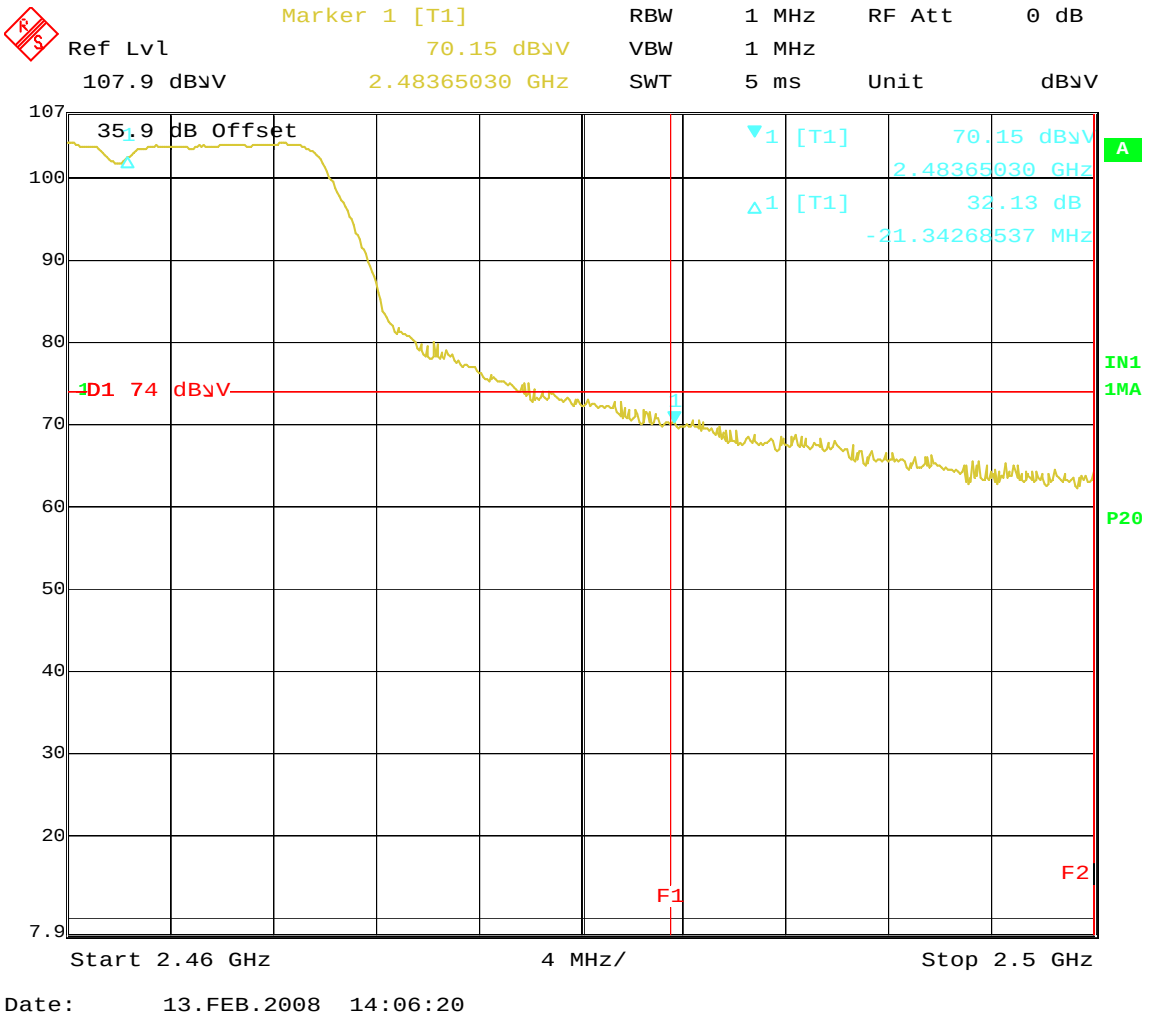


Figure 8-19: Channel 11 Band Edge Showing the Restricted Band from 2483.5 to 2500 MHz (802.11g) – Average Detector

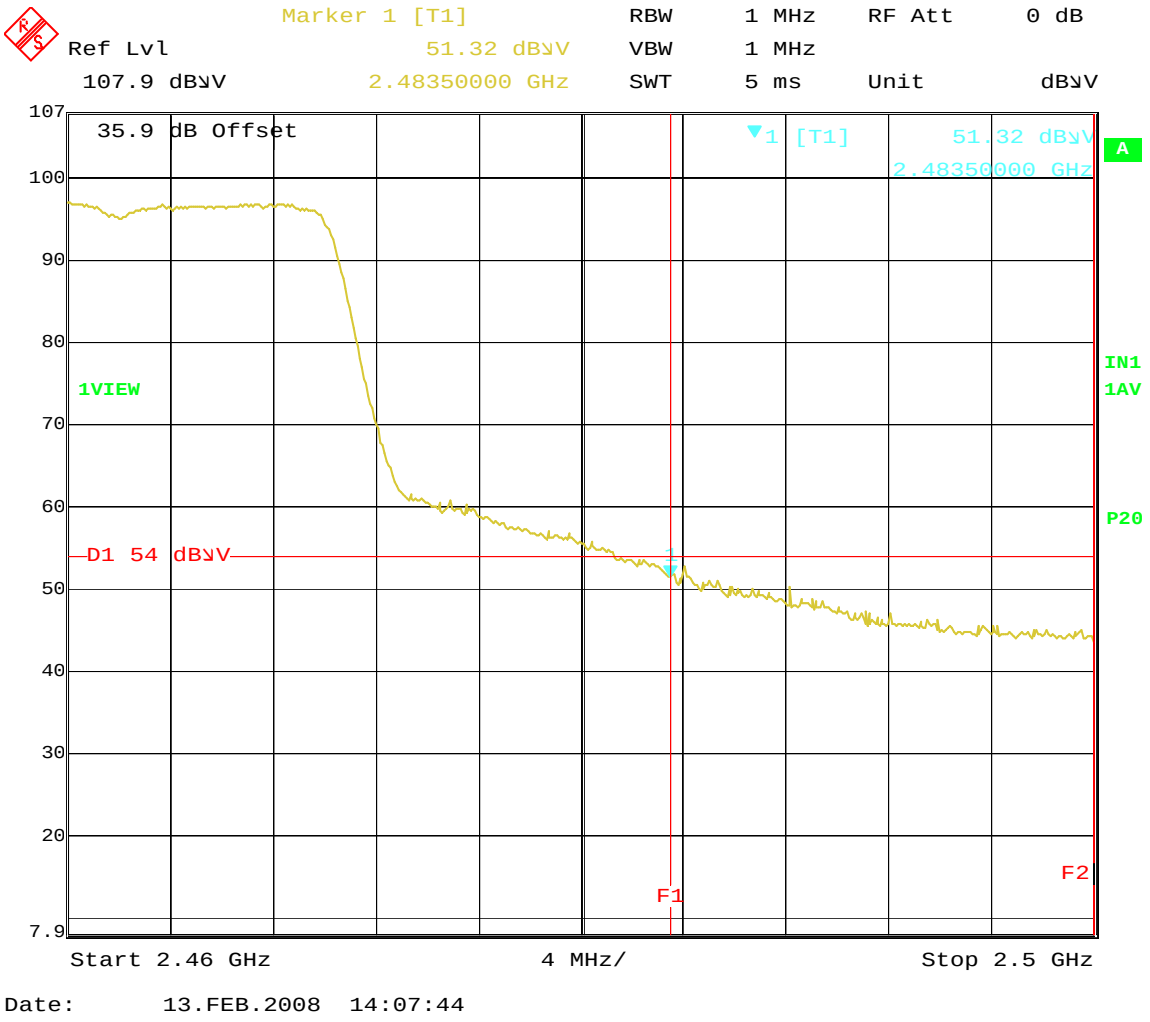


Figure 8-20: Channel 11 Band Edge Showing the Restricted Band from 2483.5 to 2500 MHz (802.11n) - Peak Detector

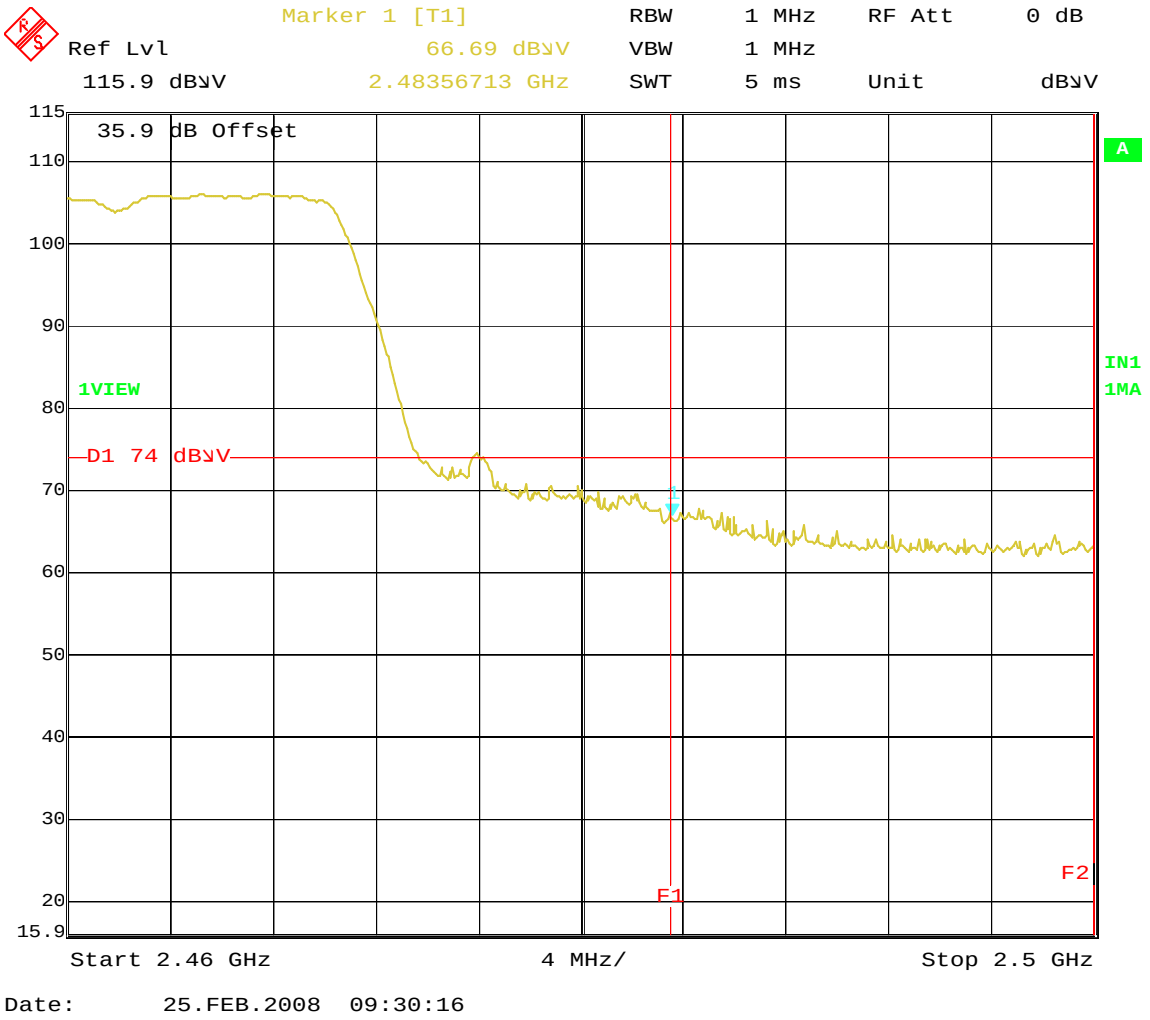
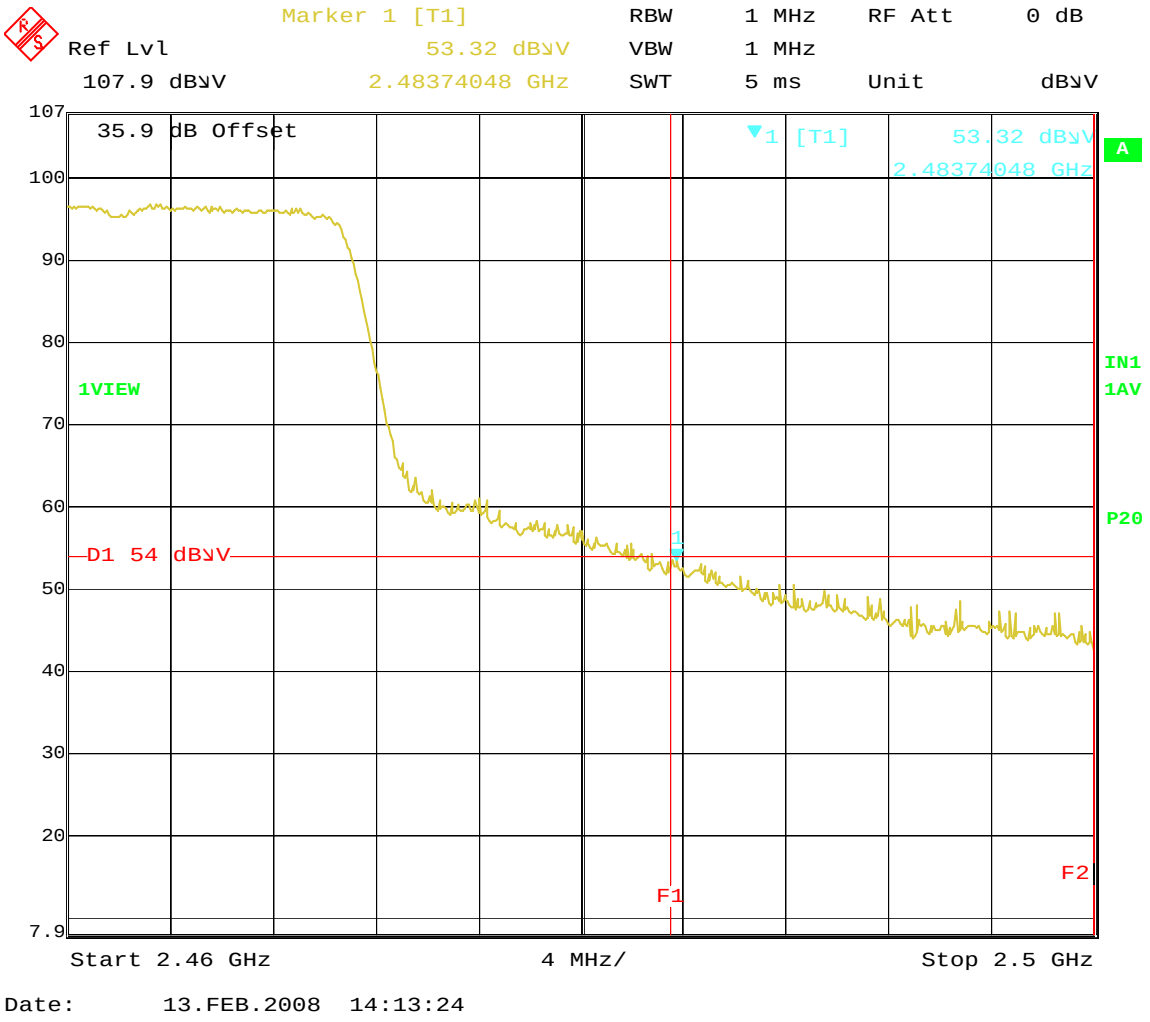


Figure 8-21: Channel 11 Band Edge Showing the Restricted Band from 2483.5 to 2500 MHz (802.11n) – Average Detector



9 RECEIVER SPURIOUS EMISSIONS

9.1 Test Procedure (FCC §15.109, ICES-003 §5.6)

Measurements are made over the frequency range of 30 MHz to five times the highest frequency operating within the device. The measuring receiver meets the requirements of Section One of CISPR 16 and the measuring antenna correlates to a balanced dipole. From 30 to 1000 MHz, a quasi-peak detector was used for measurement. Above 1000 MHz, average measurements were performed.

Measurements of the radiated field are made with the antenna located at a distance of 3 meters from the EUT. If the field-strength measurements at 3m cannot be made because of high ambient noise level or for other reasons, measurements may be made at a closer distance, for example 1m. An inverse proportionality factor of 20 dB per decade should be used to normalize the measured data to the specified distance for determining compliance.

The antenna is adjusted between 1m and 4m in height above the ground plane for maximum meter reading at each test frequency.

The antenna-to-EUT azimuth is varied during the measurement to find the maximum field-strength readings.

The antenna-to-EUT polarization (horizontal and vertical) is varied during the measurements to find the maximum field-strength readings.

The EUT, where intended for tabletop use, is placed on a table whose top is 0.8m above the ground plane. The table is constructed of non-conductive materials. Its dimensions are 1m by 1.5m, but may be extended for larger EUT.

Equipment setup for radiated disturbance tests followed the guidelines of ANSI C63.4.

9.2 Receiver Spurious Emissions Criteria

Table 9-1 Radiated Emission Limit for FCC §15.109

Radiated Emission Limits at 3 meters	
Frequency (MHz)	**Quasi-Peak limits, dB (µV/m)**
30 to 88	40.0
88 to 216	43.5
216 to 960	46.0
960 and up	54.0

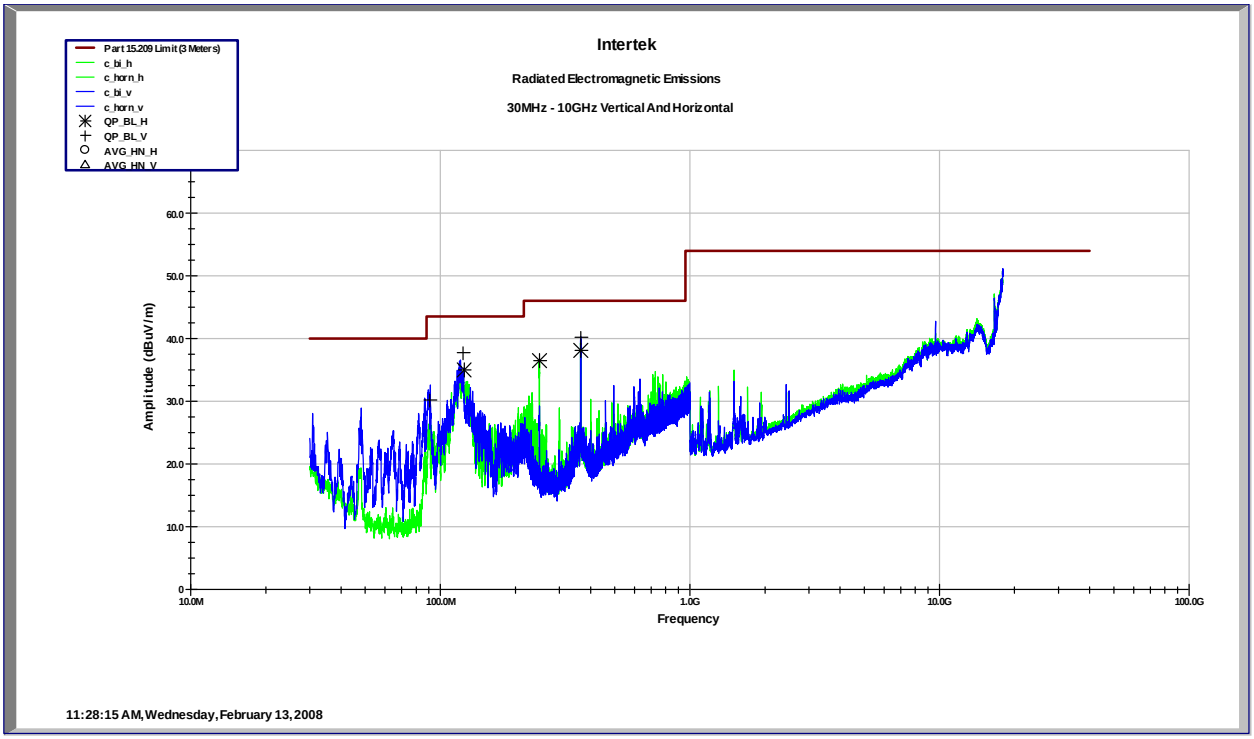
9.3 Test Results

The LEX-M04-001 802.11 Wireless Module is **compliant** with the radiated disturbance requirements of FCC §15.109 for a class B device. The table in Figure 9-1 and the graph in Figure 9-2 show that there are no emissions above the limits specified in §15.109.

Figure 9-1 FCC §15.109 Receiver Spurious Emission (Quasi-Peak Readings)

Frequency (MHz)	Polarity (H/V)	Cab. (dB)	Ant. (dB)	Corr. Reading. (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Azimuth (deg)	Tower (cm)	Results
123.27 MHz	V	1.51	8.03	37.73	43.52	-5.79	134	100	**Compliant**
365.04 MHz	V	2.66	15.5	40.18	46.02	-5.84	108	108	**Compliant**
365.04 MHz	H	2.66	15.9	38.09	46.02	-7.93	275	100	**Compliant**
124.67 MHz	H	1.52	7.42	34.98	43.52	-8.54	15	242	**Compliant**
249.86 MHz	H	2.2	12.4	36.47	46.02	-9.55	250	131	**Compliant**
9.8479 GHz	V	-23.11	38.14	43.08	53.98	-10.9	140	100	**Compliant**
90.812 MHz	V	1.29	9.25	30.19	43.52	-13.33	276	100	**Compliant**

Figure 9-2 FCC §15.109 Receiver Spurious Emission (Vertical and Horizontal)



10 POWER LINE CONDUCTED EMISSIONS

10.1 Test Procedure (FCC §15.207, ICES-003 §5.3)

Measurements are carried out using quasi-peak and average detector receivers in accordance with CISPR 16. An AMN is required to provide a defined impedance at high frequencies across the power feed at the point of measurement of terminal voltage and also to provide isolation of the circuit under test from the ambient noise on the power lines. An AMN as defined in CISPR 16 shall be used.

The EUT is located so that the distance between the boundary of the EUT and the closest surface of the AMN is 0.8m.

Where a flexible mains cord is provided by the manufacturer, this shall be 1m long or if in excess of 1m, the excess cable is folded back and forth as far as possible so as to form a bundle not exceeding 0.4m in length.

The EUT is arranged and connected with cables terminated in accordance with the product specification.

Conducted disturbance is measured between the phase lead and the reference ground, and between the neutral lead and the reference ground. Both measured values are reported.

The EUT, where intended for tabletop use, is placed on a table whose top is 0.8m above the ground plane. A vertical, metal reference plane is placed 0.4m from the EUT. The vertical metal reference-plane is at least 2m by 2m. The EUT shall be kept at least 0.8m from any other metal surface or other ground plane not being part of the EUT. The table is constructed of non-conductive materials. Its dimensions are 1m by 1.5m, but may be extended for larger EUT.

Floor standing EUTs are placed on a horizontal metal ground plane and isolated from the ground plane by 3 to 12 mm of insulating material. The metal ground plane extends at least 0.5m beyond the boundaries of the EUT and has minimum dimensions of 2m by 2m.

Equipment setup for conducted disturbance tests followed the guidelines of ANSI C63.4.

10.2 Power Line Conducted Emissions Criteria

The RF energy radiated back onto the public utility (AC Power Lines) shall not exceed the values in the following table when measured with the corresponding detector function.

Table 10-1 Conducted Emission Limit for FCC §15.207(a)

Frequency Range (MHz)	FCC Part 15.207(a) Quasi Peak Limit (dBuV)	FCC Part 15.207(a) Average Limit (dBuV)
0.15 – 0.5 MHz	66 to 56	56 to 46
0.5 – 5.0 MHz	56	46
5.0 - 30 MHz	60	50

10.3 Test Results

The LEX-M04-001 802.11 Wireless Module met the power line conducted emission requirements of §15.207. See Figure 10-1 for tabular data with the device in transmit and receive modes. See Figure 10-2 through Figure 10-5 for graphical results of the device in transmit and receive modes. The test was performed on the AC input to the power supply providing the DC voltage to the LEX-M04-001 802.11 Wireless Module.

Figure 10-1: FCC §15 Power Line Conducted Emissions

Mode	Line	Frequency (MHz)	Quasi-Peak (dBuV)	Quasi-Peak Limit (dBuV)	Quasi-Peak Delta (dB)	Average (dBuV)	Average Limit (dBuV)	Average Delta (dB)	Results
802.11b	L1	150.0 KHz	50.79	66	-15.21	27.52	56	-28.48	**Compliant**
802.11b	L1	169.4 KHz	49.47	64.99	-15.52	42.61	54.99	-12.38	**Compliant**
802.11b	L1	1.6743MHz	40.91	56	-15.09	27.61	46	-18.39	**Compliant**
802.11b	L1	1.844 MHz	40.88	56	-15.12	27.45	46	-18.55	**Compliant**
802.11b	L2	150.0 KHz	48.01	66	-17.99	25.91	56	-30.09	**Compliant**
802.11b	L2	169.4 KHz	49.85	64.99	-15.14	38.99	54.99	-16	**Compliant**
802.11b	L2	1.675 MHz	39.07	56	-16.93	26.72	46	-19.28	**Compliant**
802.11b	L2	1.844 MHz	39.51	56	-16.49	25.77	46	-20.23	**Compliant**
802.11g	L1	150.0 KHz	44.62	66	-21.38	27.61	56	-28.39	**Compliant**
802.11g	L1	165.7 KHz	50.6	65.17	-14.57	43.05	55.17	-12.12	**Compliant**
802.11g	L1	177.0 KHz	43.93	64.63	-20.69	30.37	54.63	-24.25	**Compliant**
802.11g	L2	150.0 KHz	44.01	66	-21.99	26.12	56	-29.88	**Compliant**
802.11g	L2	165.7 KHz	51.69	65.17	-13.48	39.3	55.17	-15.87	**Compliant**
802.11g	L2	177.0 KHz	43.47	64.63	-21.15	28.14	54.63	-26.48	**Compliant**
802.11n	L1	150.0 KHz	43.73	66	-22.27	27.04	56	-28.96	**Compliant**
802.11n	L1	165.9 KHz	49.46	65.16	-15.7	43.34	55.16	-11.82	**Compliant**
802.11n	L1	177.0 KHz	42.03	64.63	-22.59	28.77	54.63	-25.85	**Compliant**
802.11n	L2	150.0 KHz	43.62	66	-22.38	25.58	56	-30.42	**Compliant**
802.11n	L2	165.9 KHz	51.3	65.16	-13.86	39.92	55.16	-15.24	**Compliant**
802.11n	L2	177.0 KHz	41	64.63	-23.62	26.37	54.63	-28.25	**Compliant**
Receive	L1	150.0 KHz	45.31	66	-20.69	24.3	56	-31.7	**Compliant**
Receive	L1	159.0 KHz	43.64	65.52	-21.87	23.64	55.52	-31.87	**Compliant**
Receive	L1	207.4 KHz	45.3	63.31	-18.01	43.4	53.31	-9.91	**Compliant**
Receive	L2	150.0 KHz	44.19	66	-21.81	23.89	56	-32.11	**Compliant**
Receive	L2	158.8 KHz	41.25	65.53	-24.27	23.01	55.53	-32.52	**Compliant**
Receive	L2	207.4 KHz	46.28	63.31	-17.03	39.35	53.31	-13.96	**Compliant**
Receive	L2	1.65 MHz	39.24	56	-16.76	29.29	46	-16.71	**Compliant**

Figure 10-2: FCC §15. Power Line Conducted Emissions 802.11b Mode (Lines 1 and 2)

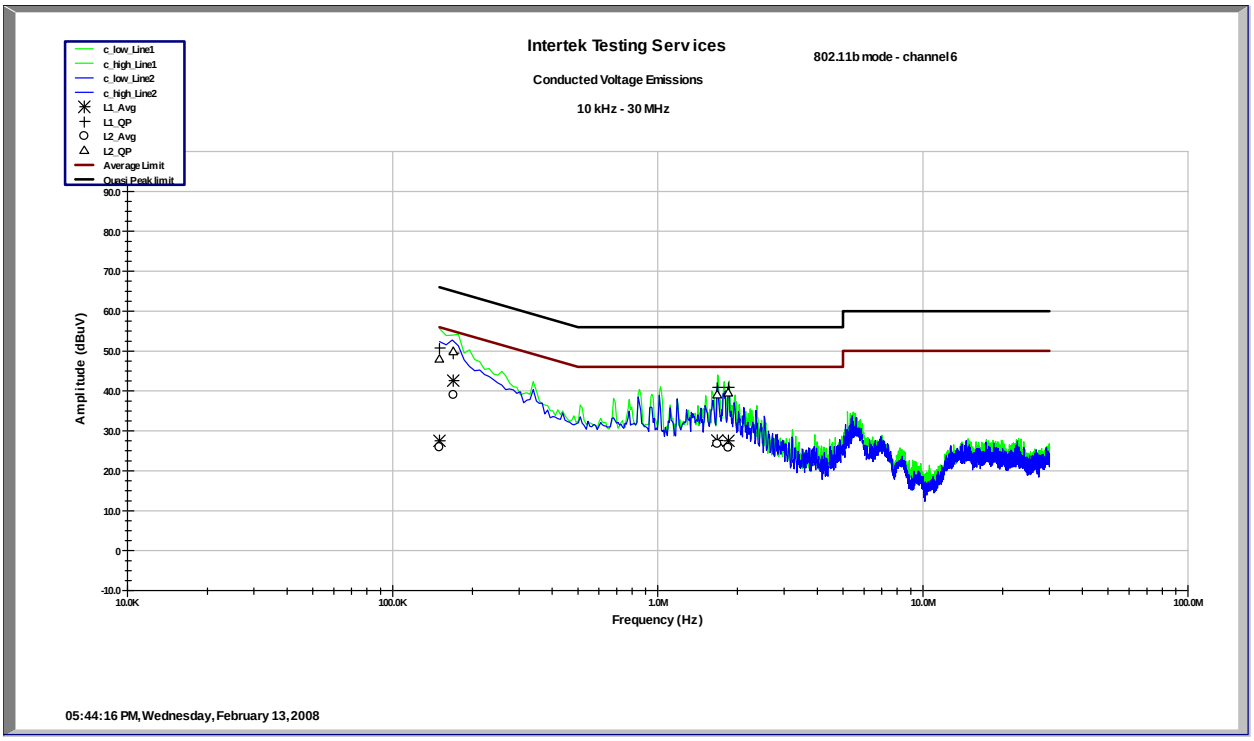


Figure 10-3: FCC §15. Power Line Conducted Emissions 802.11g Mode (Lines 1 and 2)

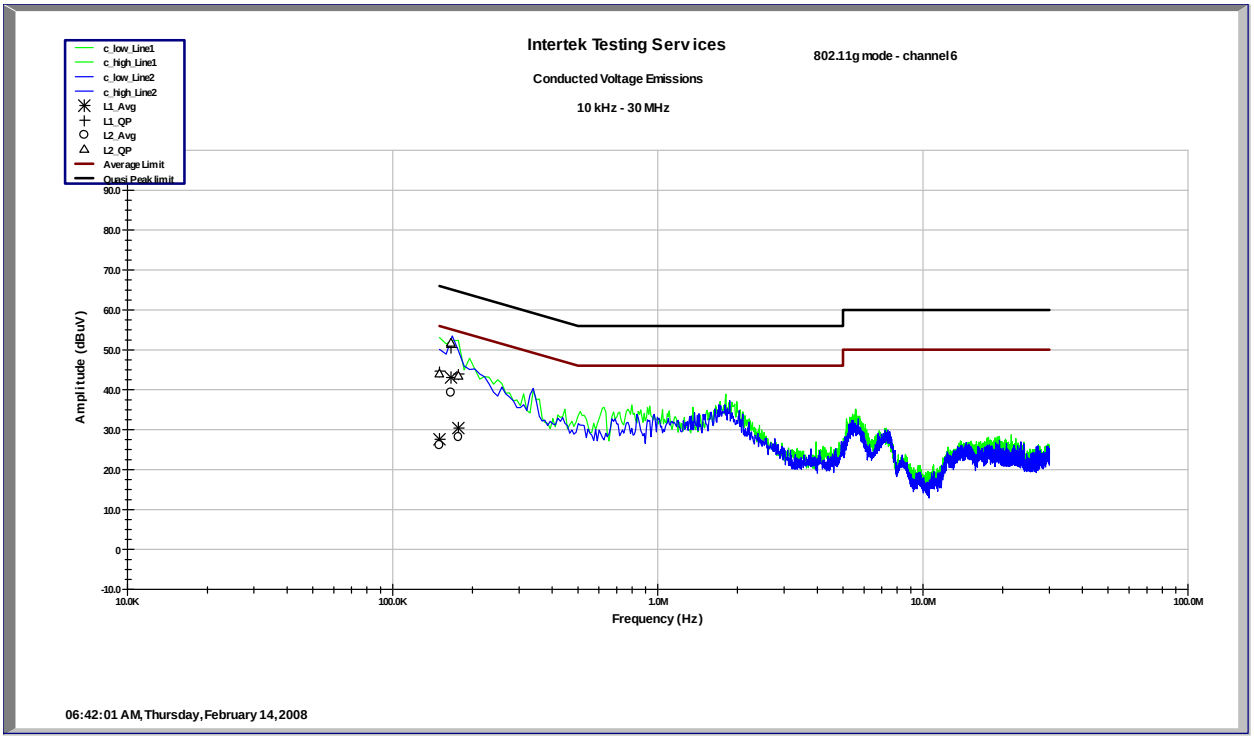


Figure 10-4: FCC §15. Power Line Conducted Emissions 802.11g Mode (Lines 1 and 2)

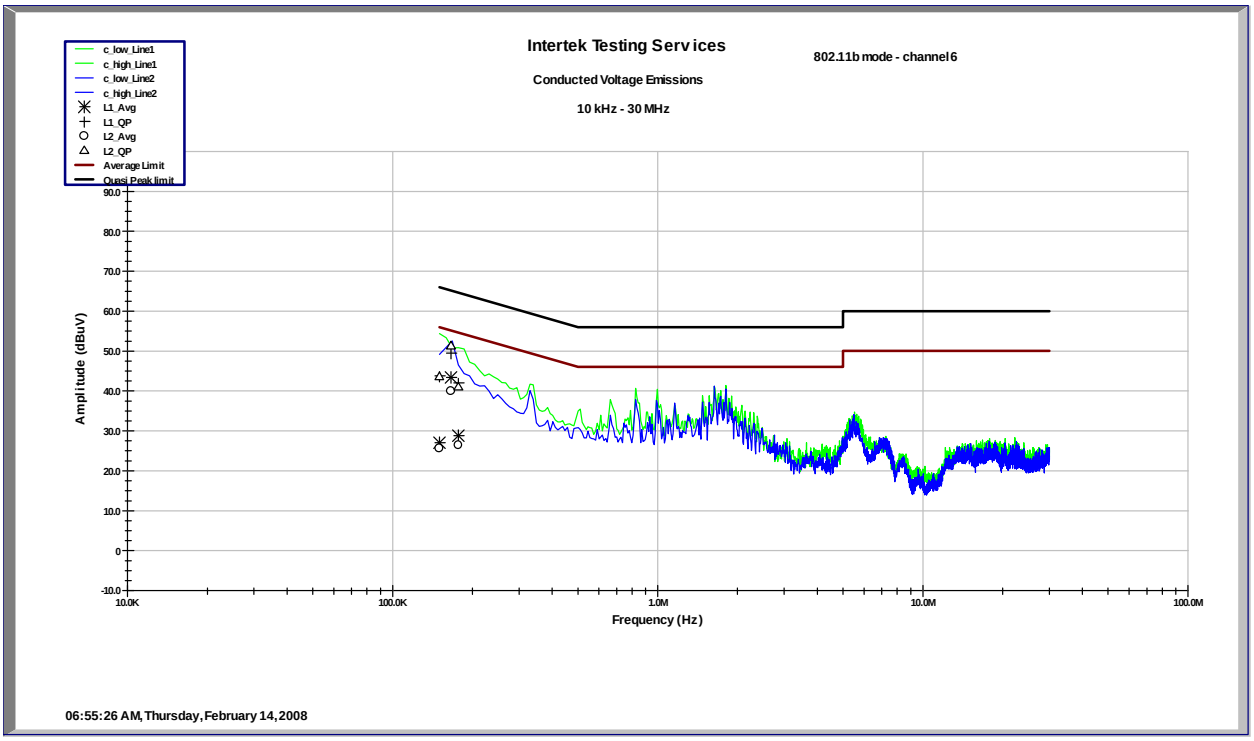


Figure 10-5: FCC §15. Power Line Conducted Emissions Receive Mode (Lines 1 and 2)