TEST REPORT

Report Number: 3127731LEX-002
Project Number: 3127731

Evaluation of the Lexmark MarkNet N8052
Model Number: 4032-852
FCCID: IYLN8052

Tested to the Criteria in FCC Part 15, Subpart C Section 407
For

Lexmark International

Test Performed by:	Test Authorized by:
Intertek	Lexmark International
731 Enterprise Drive	740 West New Circle Road
Lexington, KY 40510	Lexington, KY 40550

Prepared By:_____**Date:**____9/13/2007_____

Bryan C. Taylor, EMC Team Leader

Approved By:_____**Date:**____9/13/2007_____

Jason Centers, Senior Project Engineer

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1 JOB DESCRIPTION

1.1 Test Sample Information

The Lexmark MarkNet N8052, model 4032-852 is an 802.11a, b, and g wireless print server. It allows the printer 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
Address:	740 West New Circle Road Lexington KY 40550
Contact Name:	Thomas Bugbee
Telephone Number:	(859)-825-4432
Fax Number:	(859)-232-3014
Email Address:	bugbee@lexmark.com

Test sample				
Trade Name:	Lexmark MarkNet N8052			
Lexmark Model Number:	4032-852			
Serial Number:	Not Labled			
FCC ID:	IYLN8052			
Device Category:	Mobile			
RF Exposure Category:	General Population/Uncontrolled Environment			
Transmission Modes:	**802.11a (UNII)**	**802.11a**	**802.11b**	**802.11g**
Frequency Range, MHz:	5180MHz – 5240MHz	5745MHz – 5825MHz	2412MHz – 2462MHz	2412MHz – 2462MHz
Maximum Peak Conducted Output Power:	15.72 dBm	13.25 dBm	17.94 dBm	16.44 dBm
Antenna Type:	Nearson 90 Degree with Swivel Joint			
Antenna Location:	External Back Side of the Test Sample			
Antenna Gain:	2dBi			
Antenna Connector	Reverse Polarity SMA Plug			
Sample Receive Date:	7/9/2007			

Test Signal Mode	
Test Commands:	X
Base Station Simulator:	

1.2 System Support Equipment

Manufacturer	Model Number	Description	Comments
Dell	Latitude D610	Laptop Computer	Computer used to initiate test commands
Lexmark	T640	Laser Printer	Host laser printer that the Lexmark MarkNet N8052 was installed in

1.3 Cables associated with EUT

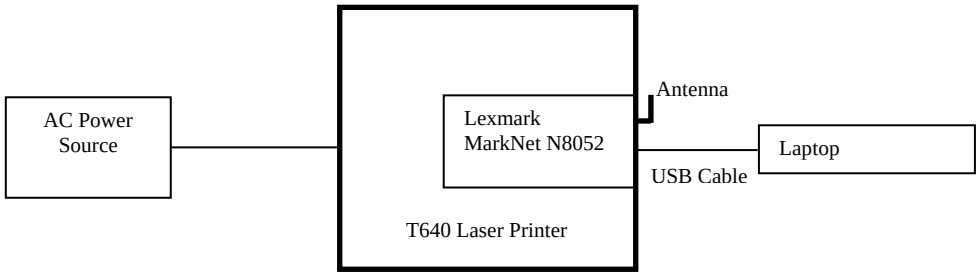
Table 1-1 contains the details of the cables used during the testing.

Table 1-1: Interconnecting Cables Used During Testing

Cables					
Description	**Length**	**Shielding**	**Ferrites**	**Connection**	
				From	**To**
AC Cable for Printer	6 ft	None	None	AC Power Source	Power Port on the Printer
USB Cable for Printer	6 ft	Yes	Yes	USB Port on Laptop	USB Port on the Printer
AC Cable for Laptop	8 ft	None	Yes	AC Power Source	Power Port on the 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 Lexmark MarkNet N8052 was installed in a T640 laser printer manufactured by Lexmark International. The printer was powered by 120VAC / 60Hz. In order to force the Lexmark MarkNet N8052 to transmit during the evaluation, a control program was used to communicate with the printer via a USB cable connected between a laptop computer and the printer. 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 Lexmark MarkNet N8052 was set to transmit at maximum output power. The laptop computer was left connected to the printer during the tesing.

1.6 Modifications required for compliance

No modifications were implemented by Intertek. All results in this report pertain to the un-modified sample provided to Intertek.

1.7 Related Submittal(s) Grants

There is also an accompanying submittal for the part 15.247 radio (802.11a, b, and g) which is covered in a separate report.

2 EXECUTIVE SUMMARY AND STATEMENT OF COMPLIANCE

Testing was performed for Lexmark International on the Lexmark MarkNet N8052 model 4032-852 starting on 7/9/2007 and ending on 7/18/2007. All testing was performed by Bryan Taylor and Jason Centers at the Intertek laboratory located at 731 Enterprise Drive, Lexington Kentucky, 40510

The Lexmark International model 4032-852 was tested to and meets the requirements of FCC Part 15 Subpart E (15.407).

FCC RULE	DESCRIPTION OF TEST	RESULT	PAGE
§15.407(a)(1)	26dB Bandwidth	**Compliant**	8
§15.407(a)(1)	Conducted RF Power	**Compliant**	12
§15.407(a)(1)	Peak Power Spectral Density	**Compliant**	13
§15.407(a)(6)	Peak Excursion	**Compliant**	17
§15.407(b)(1)	Out of Band Emissions at Antenna Terminals	**Compliant**	21
§15.407(b)(1)(6)	Field Strength of Spurious Radiation	**Compliant**	23
§15.109	Receiver Spurious Emissions	**Compliant**	30
§15.207, §15.407(b)(6)	Power Line Conducted Emissions	**Compliant**	32

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
EMI Receiver	Rohde & Schwarz	ESI 26	1088.7490	9/6/2007
Spectrum Analyzer	Rohde & Schwarz	FSEK 30	1088.3494.35	3/12/2008
Spectrum Analyzer	Rohde & Schwarz	FSP 7	1164.4391.07	8/2/2007
Horn Antenna	Antenna Research	DRG-118/A	1086	7/20/2007
Horn Antenna	EMCO	3115	6556	7/28/2007
Horn Antenna	EMCO	3116	9310-2222	4/10/2008
Bilog Antenna	ETS	3142C	00051864	11/14/2007
High Pass Filter	Microwave Circuits	H3G020G2	3986-01 DC0408	Verify at Time of Use
LISN	Fischer Custom Communication	FCC-LISN-50-50-2M	1025	5/11/2008
Signal Generator	Hewlett Packard	83620B	3614A00199	8/15/2007
Preamplifier	Miteq	JS418004000	818197	2/6/2008
Preamplifier	Miteq	JS418004000	965178	8/7/2007

4 26DB BANDWIDTH

4.1 Test Procedure (FCC Rule: §15.407(a), 26dB Bandwidth)

The antenna port of the Lexmark MarkNet N8052 was connected to the input of a spectrum analyzer. The analyzer amplitude was offset for the associated cable loss. The analyzer resolution bandwidth was set to 300kHz, the video bandwidth was set to 1MHz, 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 26dB lower than that amplitude. The 26dB bandwidth was the frequency difference between the marker on the lower side and the marker on the higher side of the peak amplitude. The 26dB bandwidth was measured for the on the high, middle, and low channels.

4.2 26dB Bandwidth Criteria

The 26dB bandwidth was used in calculation of the output power limit in the following report section.

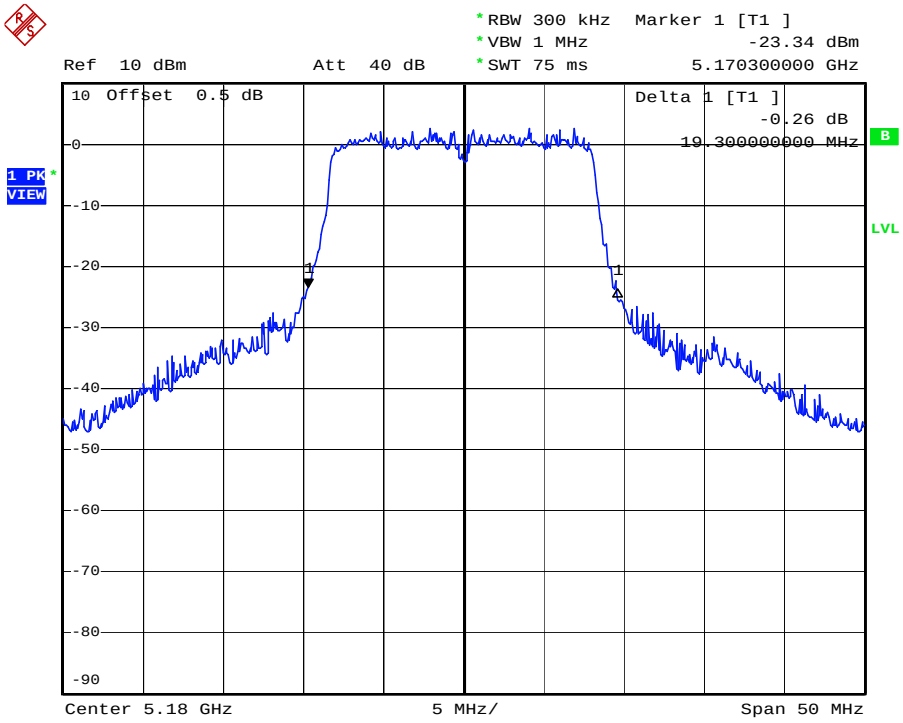
4.3 Test Results

The 26dB bandwidth measurements are shown Table 4-1 and in the subsequent plots.

Table 4-1 26dB Bandwidth Measurements

Mode	Channel	Frequency (MHz)	26dB Bandwidth (MHz)
802.11a	36	5180	19.3
802.11a	40	5200	19.4
802.11a	48	5240	19.5

Figure 4-1: 26dB Bandwidth Plot

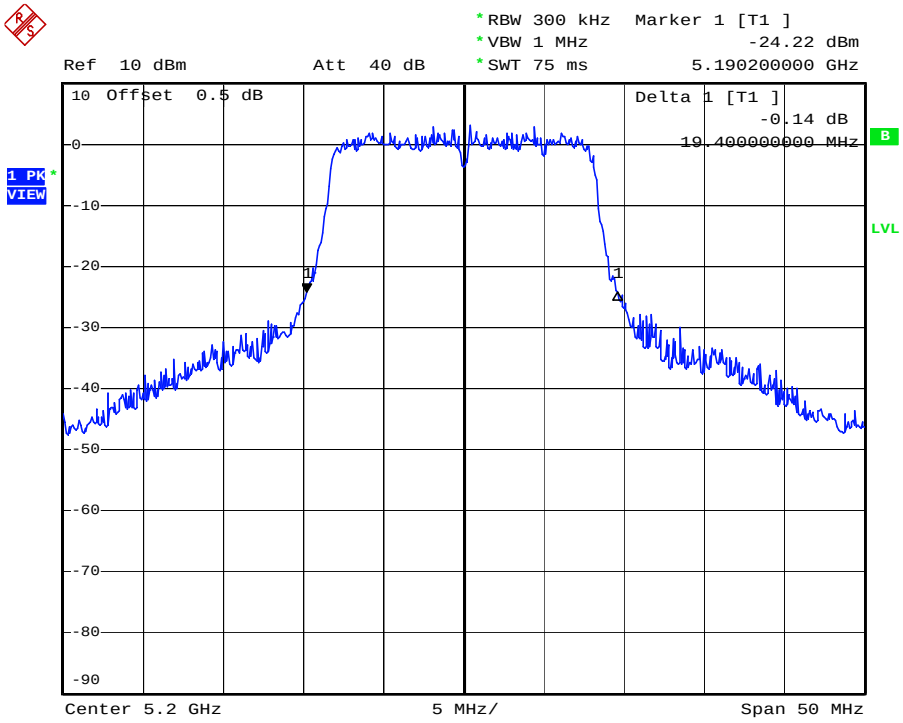


Channel: 36

Mode: 802.11a

26dB Bandwidth: 19.3MHz

Figure 4-2: 26dB Bandwidth Plot



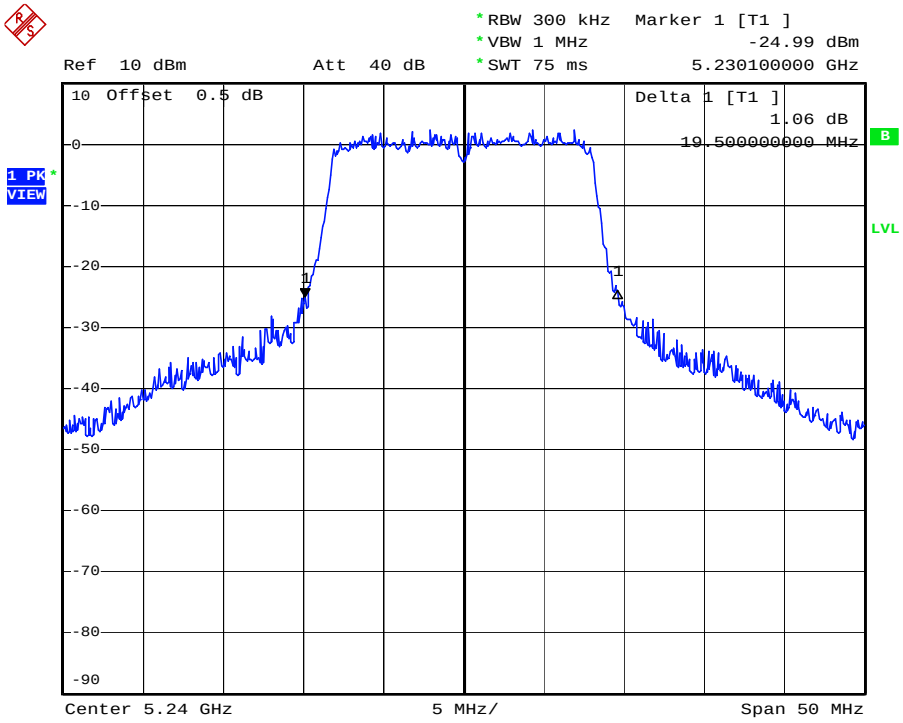
Date: 10.JUL.2007 11:33:11

Channel: 40

Mode: 802.11a

26dB Bandwidth: 19.4MHz

Figure 4-3: 26dB Bandwidth Plot



Date: 10.JUL.2007 11:36:12

Channel: 48

Mode: 802.11a

26dB Bandwidth: 19.5MHz

5 CONDUCTED RF POWER

5.1 Test Procedure (FCC Rule: §15.407(a) Conducted RF Power)

The conducted output power was measured using method 1 from the recommended test procedures. The antenna port of the Lexmark MarkNet N8052 was connected to the input of a spectrum analyzer. The analyzer amplitude was offset for the associated cable loss. The analyzer resolution bandwidth was set to 1MHz, the video bandwidth was set to 3MHz, and the analyzer was set to power average over 100sweeps. The spectrum analyzers band power function was used to integrate the spectrum across the emission bandwidth of the signal. The band power reading was then recorded as the peak output power. The peak output power measurement was performed on the high, mid and low channels and with a voltage input of 85%, 100%, and 115% of the nominal.

5.2 Conducted Output Power Criteria

For the band 5.15–5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 50 mW (17dBm) or 4 dBm + 10 log B, where B is the 26dB emission bandwidth in MHz. From the previous report section, the 26dB emission bandwidth was measured as 19.5MHz. Therefore the limit for the maximum conducted output power is:

$$\text{Limit (dBm)} = 4\ \text{dBm} + 10 \log 19.5$$

$$\text{Limit(dBm)} = 16.9\text{dBm}$$

5.3 Test Results

The Lexmark MarkNet N8052 met the RF power output of FCC Part 15 Subpart E (15.407). The test results are located in Table 5-1. None of the conducted power measurements exceeded the 50 mW or 4 dBm + 10 log B limit.

Table 5-1 RF Output Power Measurements

Mode	Channel	Frequency (MHz)	Output Power (dBm)
802.11a	36	5180	15.28
802.11a	40	5200	15.29
802.11a	48	5240	**15.72**

6 PEAK POWER SPECTRAL DENSITY

6.1 Test Procedure (FCC Rule: §15.407(a))

The peak power spectral density was performed using method 2 from the recommended test procedures. The antenna port of the Lexmark MarkNet N8052 was connected to the input of a spectrum analyzer. The analyzer amplitude was offset for the associated cable loss. The analyzer resolution bandwidth was set to 1MHz, the video bandwidth was set to 3MHz, and the analyzer was set to power average over 100sweeps using sample detection with a frequency span of 30MHz. A peak search was then performed on the resultant trace. The amplitude of that peak was recorded as the maximum power spectral density in dBm. Power spectral density was measured on the high, mid and low channels.

6.2 Power Density Criteria

The peak power spectral density shall not exceed 4 dBm in any 1–MHz band.

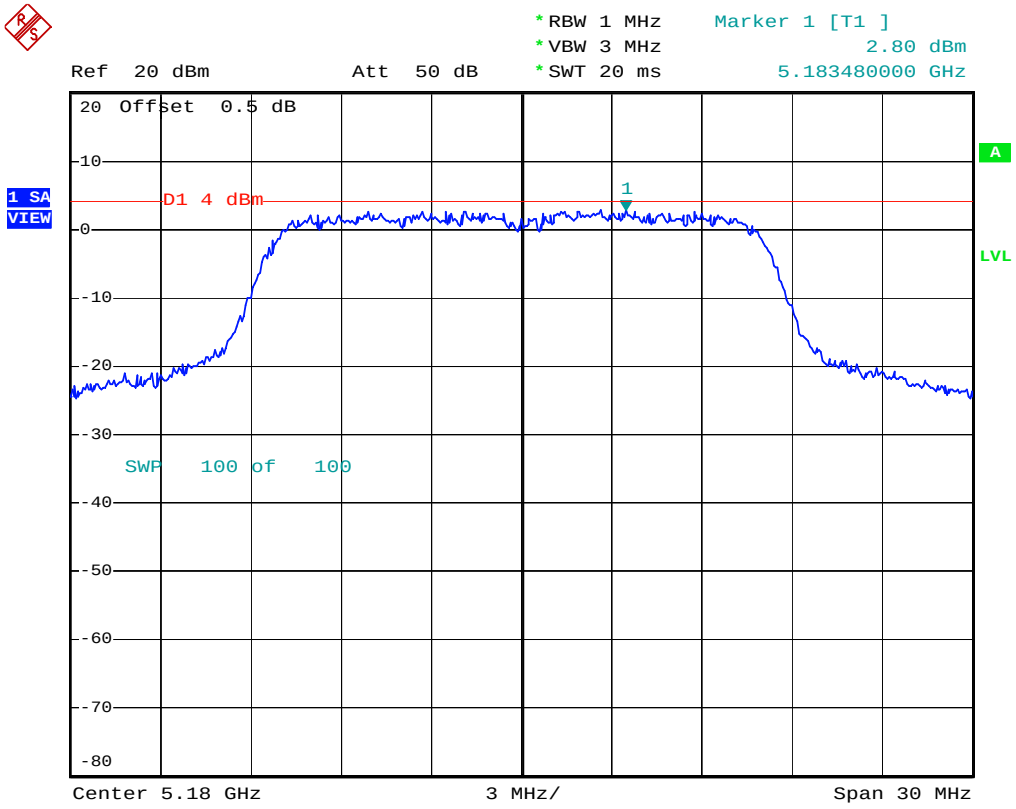
6.3 Test Results

The Lexmark MarkNet N8052 met the peak power spectral density requirements of FCC Part 15 Subpart E (15.407). The test results are located in Table 6-1. None of the measurements exceeded the 4dBm / MHz limit.

Table 6-1 Peak Power Spectral Density Measurements

Mode	Channel	Frequency (MHz)	Peak Power Spectral Density (dBm)
802.11a	36	5180	**2.8**
802.11a	40	5200	1.5
802.11a	48	5240	2.48

Figure 6-1: Peak Power Spectral Density Plot

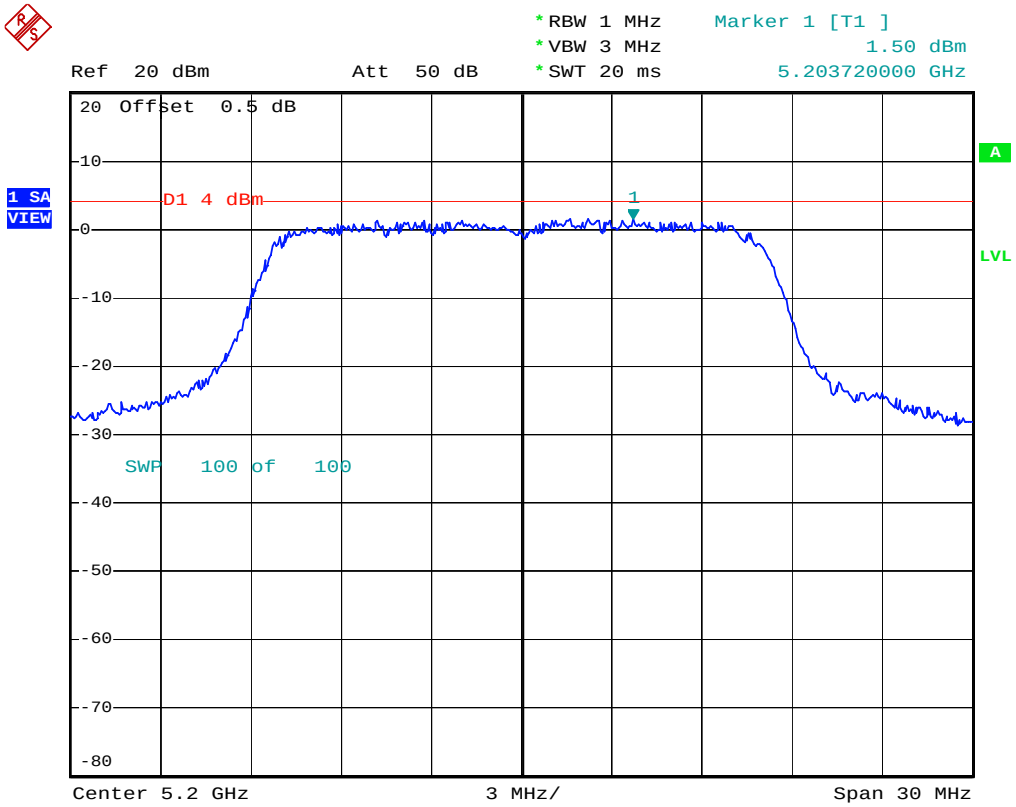


Channel: 36

Mode: 802.11a

PSD: 2.8dBm (Using method 2; the recommended method)

Figure 6-2: Peak Power Spectral Density Plot

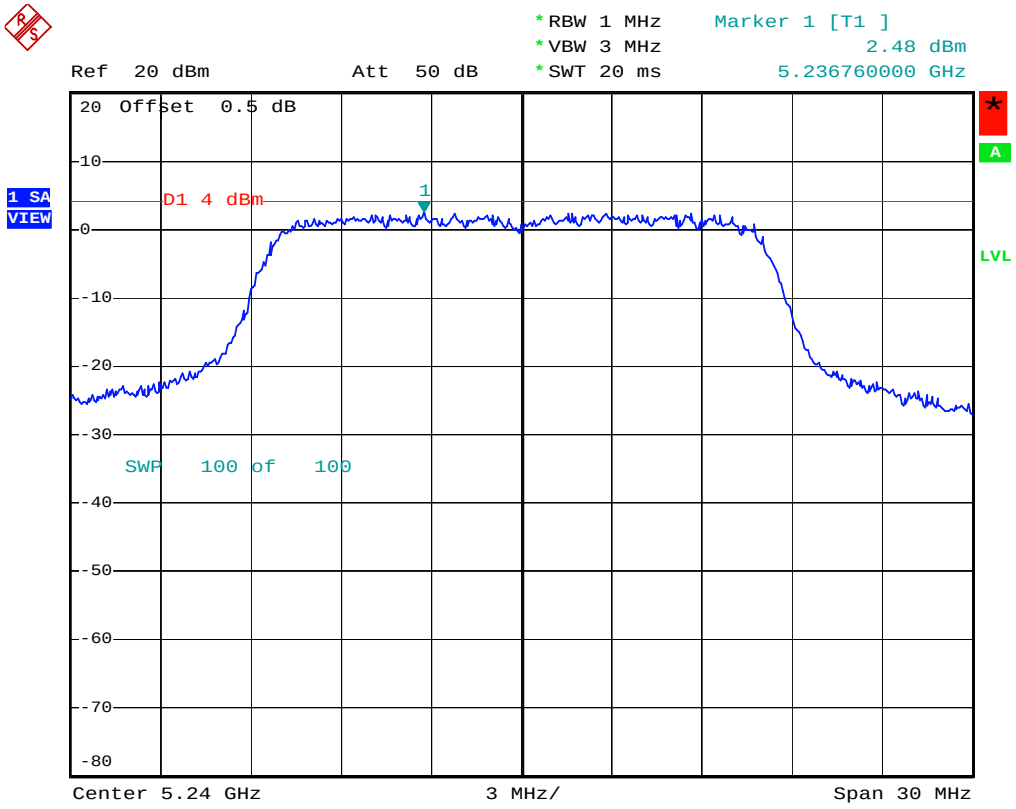


Channel: 40

Mode: 802.11a

PSD: 1.5dBm (Using method 2; the recommended method)

Figure 6-3: Peak Power Spectral Density Plot



Date: 17.JUL.2007 12:37:38

Channel: 48

Mode: 802.11a

PSD: 2.48dBm (Using method 2; the recommended method)

7 PEAK EXCURSION

7.1 Test Procedure (FCC Rule: §15.407(a)(6))

The antenna port of the Lexmark MarkNet N8052 was connected to the input of a spectrum analyzer. The analyzer amplitude was offset for the associated cable loss. On trace one, the analyzer resolution bandwidth was set to 1MHz, the video bandwidth was set to 3MHz, and the analyzer was set use peak detection with max hold. On trace two, the resolution and video bandwidths were left the same but sample detection was turned on and trace was power averaged over 100 sweeps.

7.2 Power Density Criteria

The ratio of the peak excursion of the modulation envelope (measured using a peak hold function) to the maximum conducted output power shall not exceed 13 dB across any 1 MHz bandwidth or the emission bandwidth whichever is less.

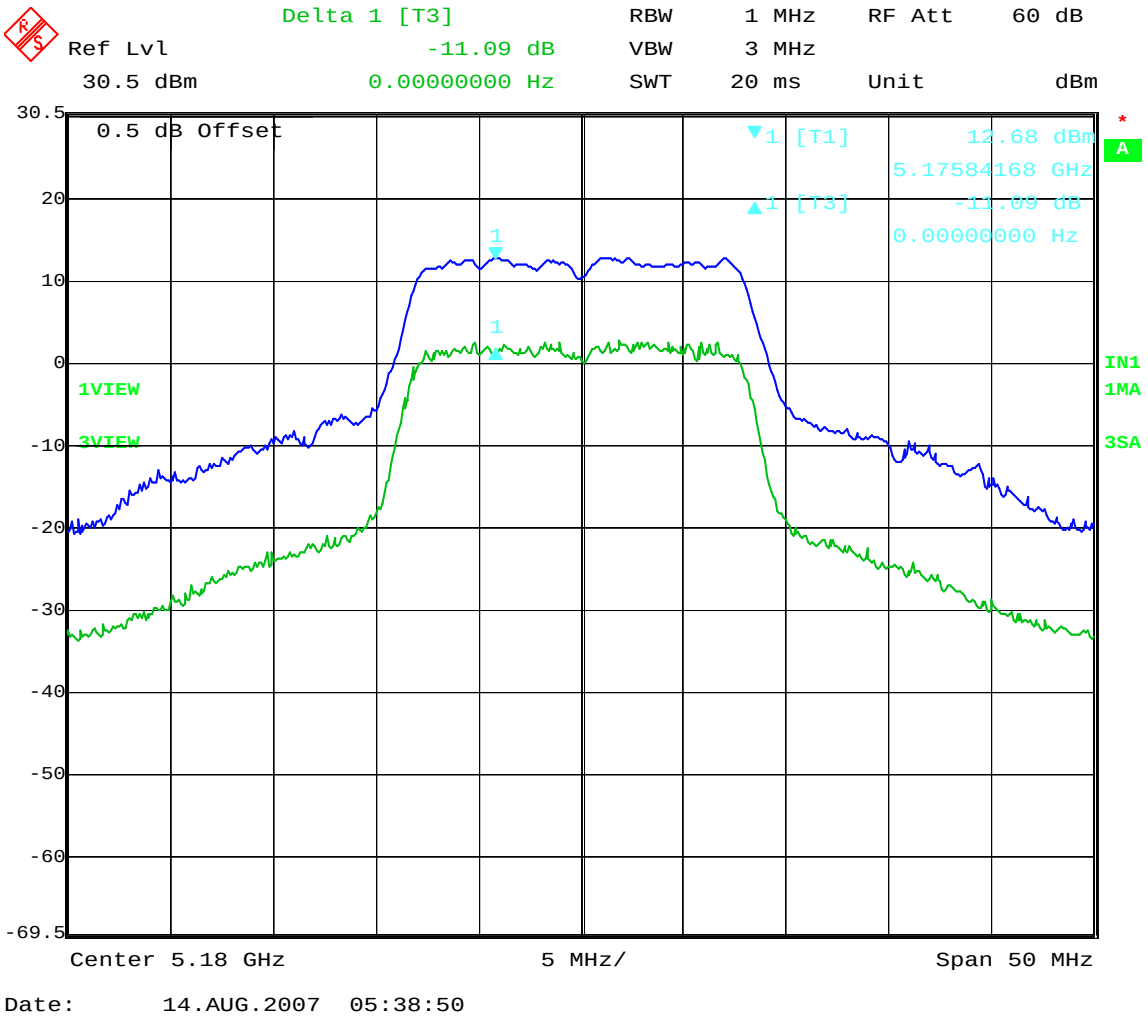
7.3 Test Results

The Lexmark MarkNet N8052 met the peak power spectral density requirements of FCC Part 15 Subpart E (15.407). The test results are located in Table 6-1. None of the measurements exceeded the 4dBm / MHz limit.

Table 7-1 Peak Excursion Measurements

Mode	Channel	Frequency (MHz)	Peak Excursion (dBm)
802.11a	36	5180	**11.09**
802.11a	40	5200	10.9
802.11a	48	5240	10.6

Figure 7-1: Peak Excursion Plot

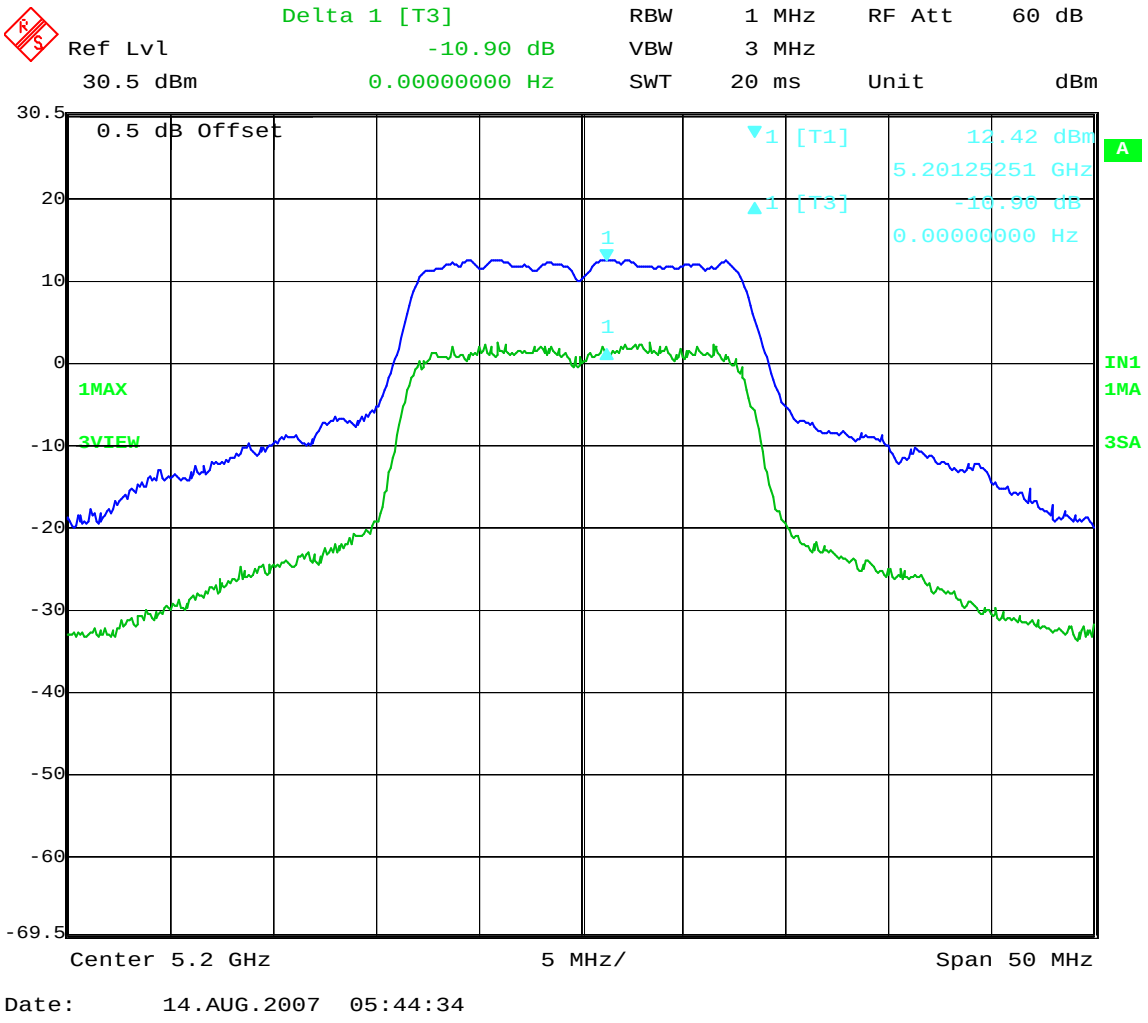


Channel: 36

Mode: 802.11a

Peak Excursion: 11.09 dB

Figure 7-2: Peak Excursion Plot

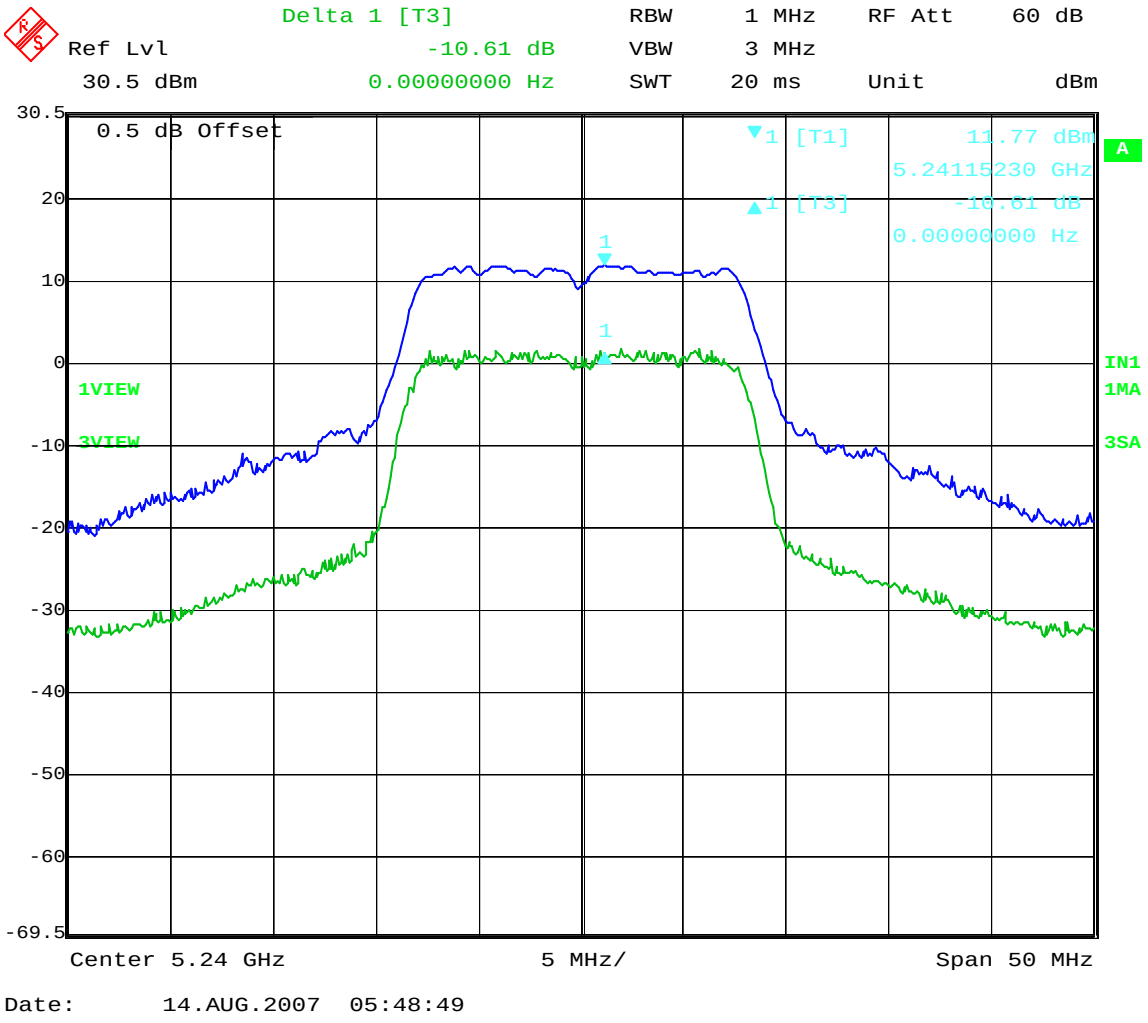


Channel: 40

Mode: 802.11a

Peak Excursion: 10.9 dB

Figure 7-3: Peak Excursion Plot



Channel: 48

Mode: 802.11a

Peak Excursion: 10.61 dB

8 OUT OF BAND EMISSIONS AT ANTENNA TERMINALS

8.1 Test Procedure (FCC Rule §15.407(b))

The antenna port of the Lexmark MarkNet N8052 was connected to the input of a spectrum analyzer. The analyzer resolution and video bandwidths were set to 1MHz. The Lexmark MarkNet N8052 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 40GHz 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.

8.2 Out of Band Emissions at Antenna Terminals Criteria

All emissions outside of the 5.15–5.35 GHz band shall not exceed an EIRP of –27 dBm/MHz.

8.3 Test Results

The Lexmark MarkNet N8052 met the out of band emission at antenna terminal requirements. The following plots illustrate show that there are no spurious emissions above the -27 dBm/MHz limit.

Figure 8-1: Out of band emissions at antenna terminals – Channel 36, 40, and 48 (802.11a Mode)

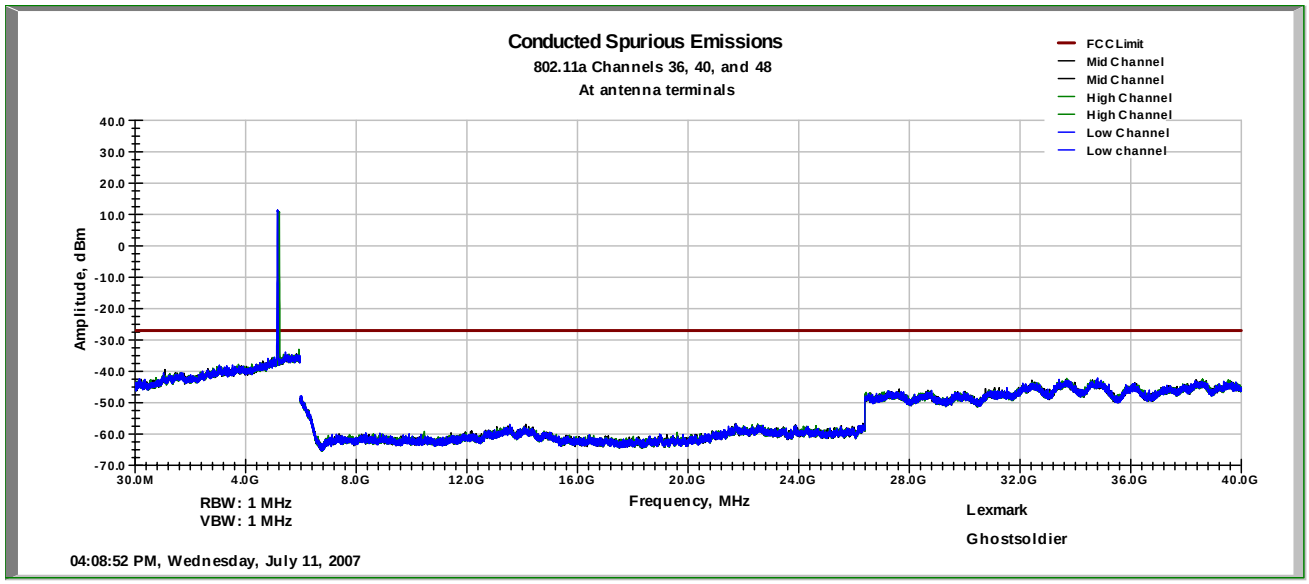
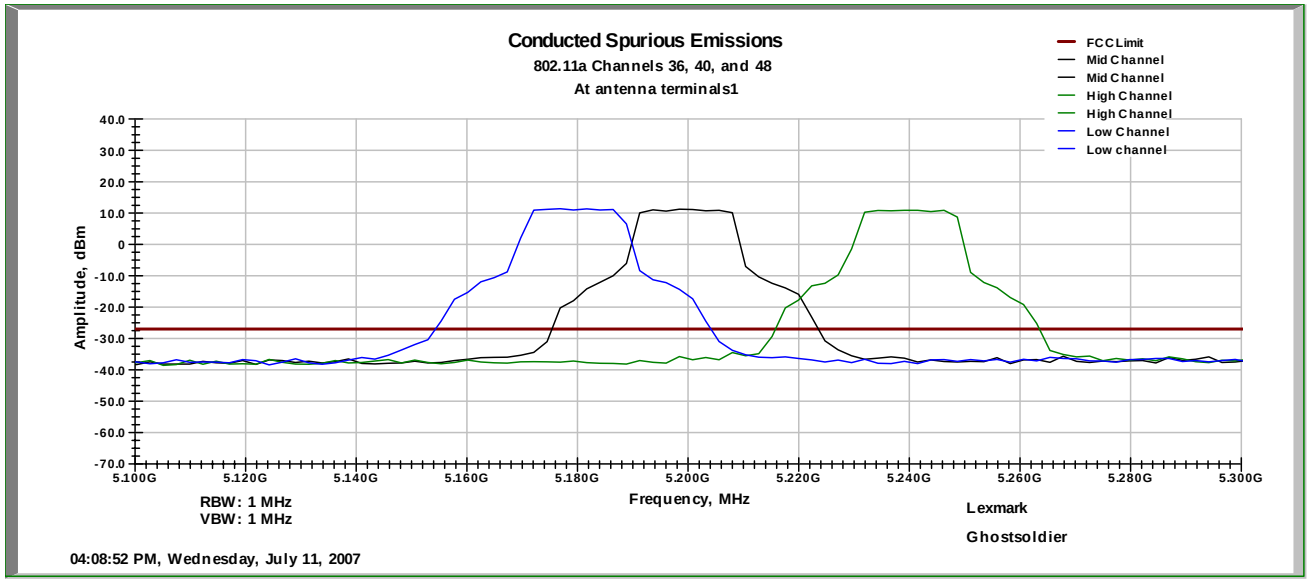


Figure 8-2: Out of band emissions at antenna terminals – Channel 36, 40, and 48 (802.11a Mode)

Zoomed In Around Fundamentals



9 FIELD STRENGTH OF SPURIOUS RADIATION

9.1 Test Procedure (FCC Rule §15.407(b) for Radiated Measurements)

The Lexmark MarkNet N8052 was placed on a non-conductive turntable. It was then set to transmit at its highest output power level. When necessary, a high pass filter was inserted in line with the measurement path in order to keep the fundamental emission from overloading the preamplifier. All measurements were performed with the receiving antenna 3 meters from the EUT with the exception of the 20-40GHz 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 investigated was 30MHz up to the tenth harmonic or 40GHz (whichever was lower) for each of three fundamental frequencies (low, middle, and high channels) in each operating band.

The plots were generated with multiple scans using three types of antennas (a bilog and two horns). Each plot is comprised of 37 individual scans which are pieced together within the measurement software and plotted on one set of axis. In this way it is easy to compare the field strength of the fundamental with the field strength of any spur (rather than having to search through 37 different individual scans). For each frequency scan, the turntable was rotated and the antenna scanned from 1 – 4 meters (in vertical and horizontal polarity). Each spur which was within a restricted band and close to the 15.209 limit was optimized (over the tower and turntable) and reported in a tabular format. There were no spurs within 20dB of the fundamental

9.2 Field Strength of Spurious Radiation Criteria

All emissions outside of the 5.15–5.35 GHz band shall not exceed an EIRP of –27 dBm/MHz. In addition, unwanted emissions below 1 GHz must comply with the general field strength limits set forth in §15.209. Those Limits are in the table below.

Table 9-1 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

9.3 Test Results

The Lexmark MarkNet N8052 met the field strength of spurious radiation requirements of FCC §15.209 and §15.407(b). The following graphs in Figure 9-1 through Figure 9-7 show that all harmonics and spurious emissions below the -27dBm/MHz limit and that there are no emissions above the general limits specified in §15.209(a).

In the following plots, the §15.209 limit above 1GHz is 54dBuV/m. This corresponds to 75nW or -41dBm. Since there were no spurious emissions above this limit which is much lower than the -27dBm/MHz limit, it is obvious that the Lexmark MarkNet N8052 complied with the §15.407(b) limit.

Figure 9-1: Field Strength of Spurious Radiation Channel 36 (30MHz – 40GHz) – 802.11a

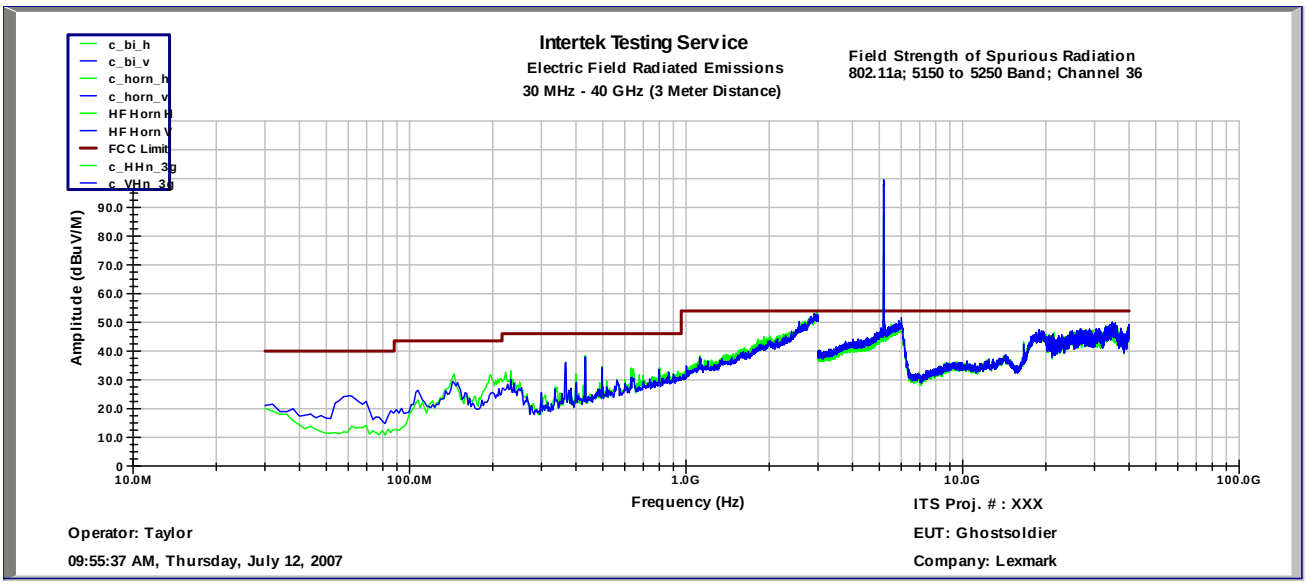


Figure 9-2: Field Strength of Spurious Radiation Channel 40 (30MHz – 40GHz) – 802.11a

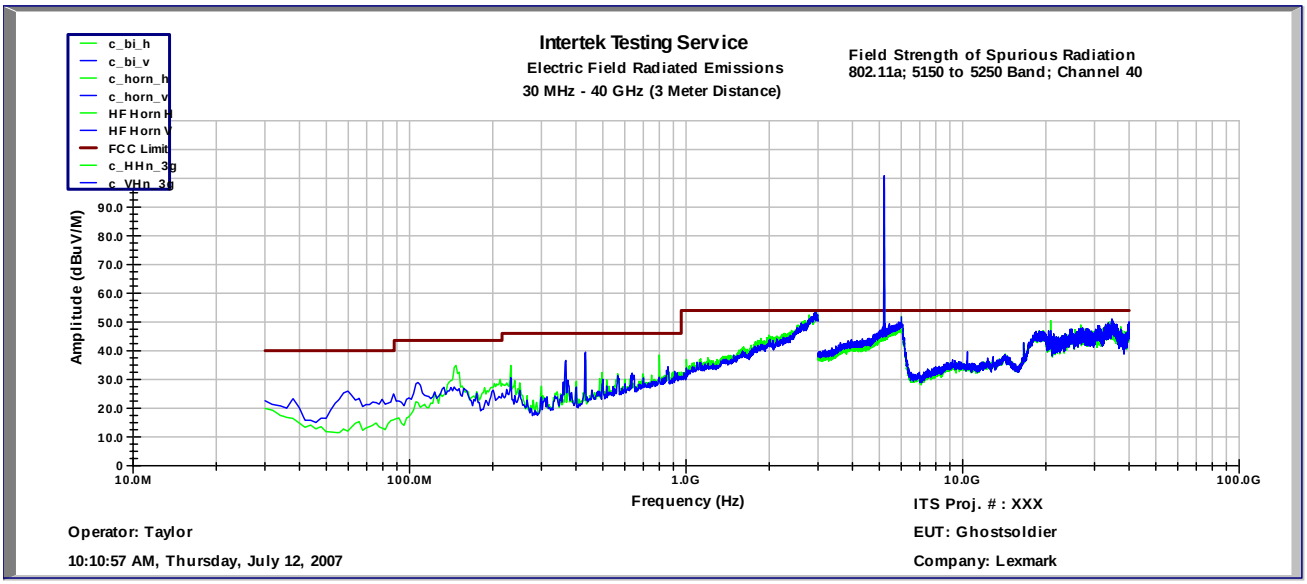


Figure 9-3: Field Strength of Spurious Radiation Channel 48 (30MHz – 40GHz) – 802.11a

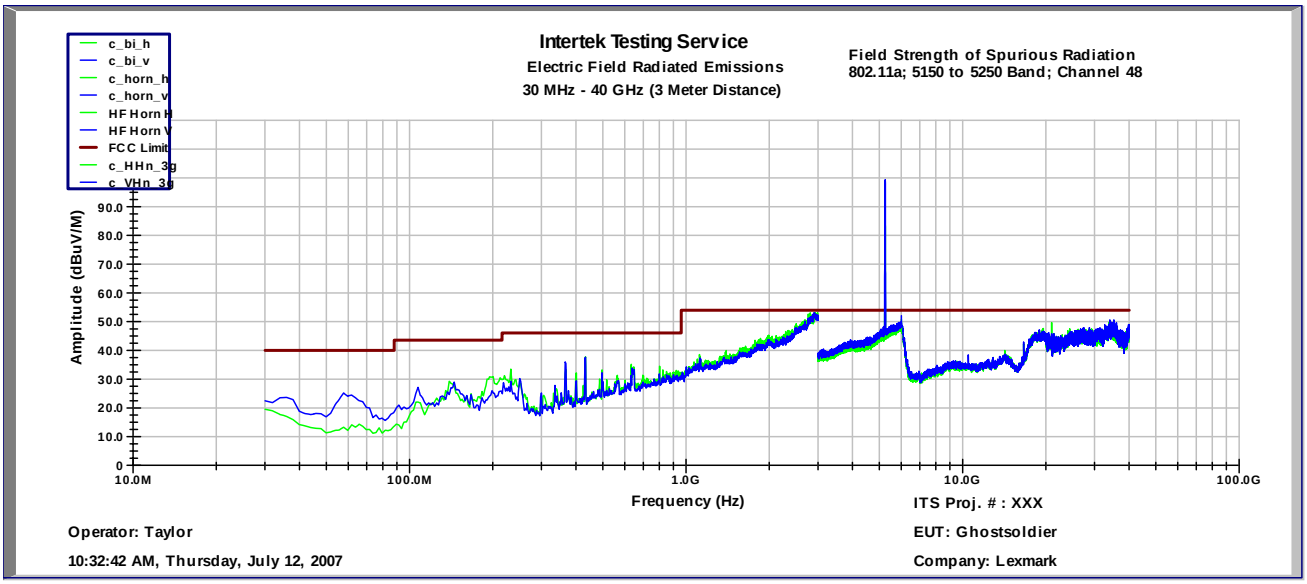


Figure 9-4: Upper Bandedge with Peak Detection (802.11a)

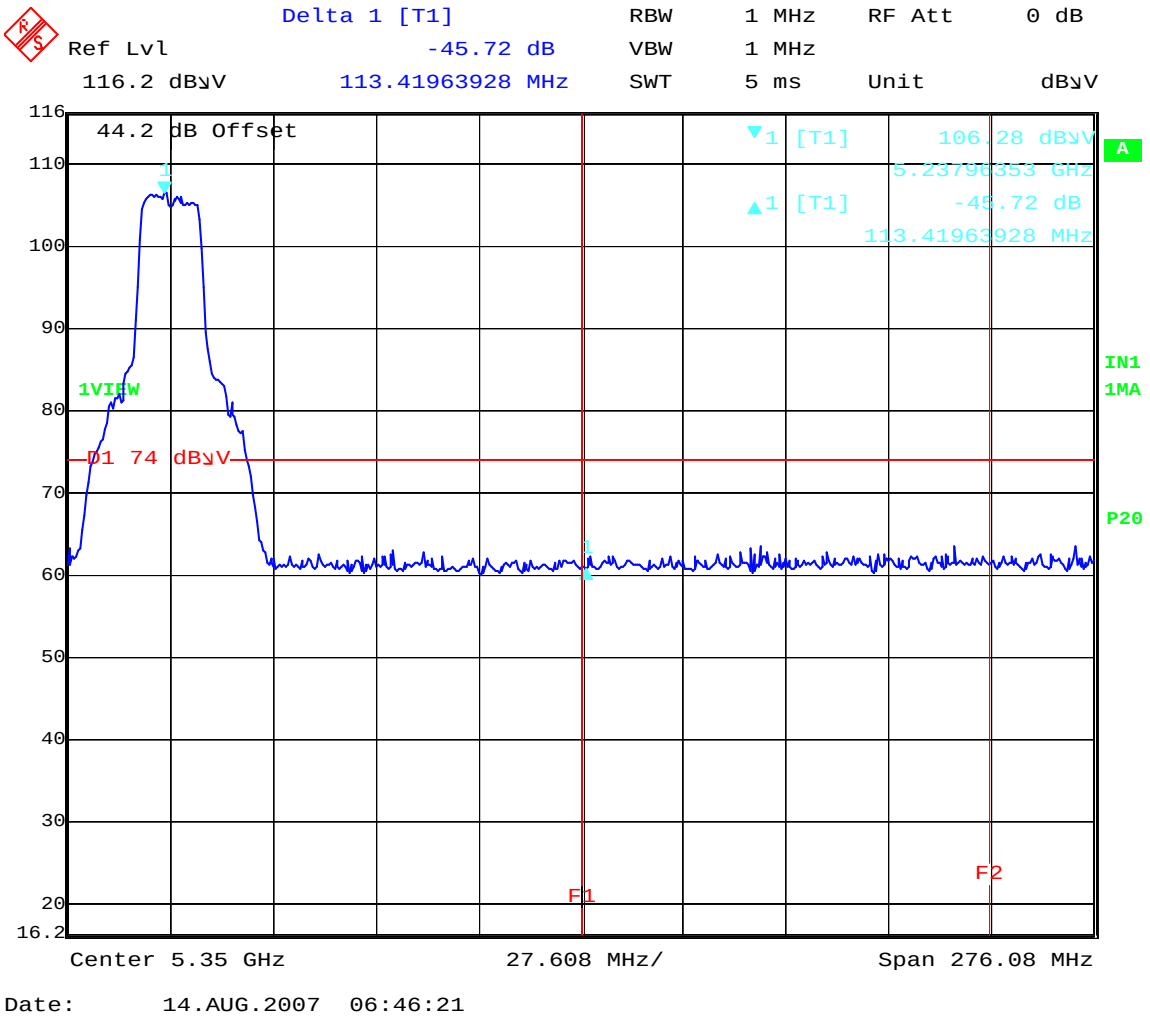


Figure 9-5: Upper Bandedge with Average Detection (802.11a)

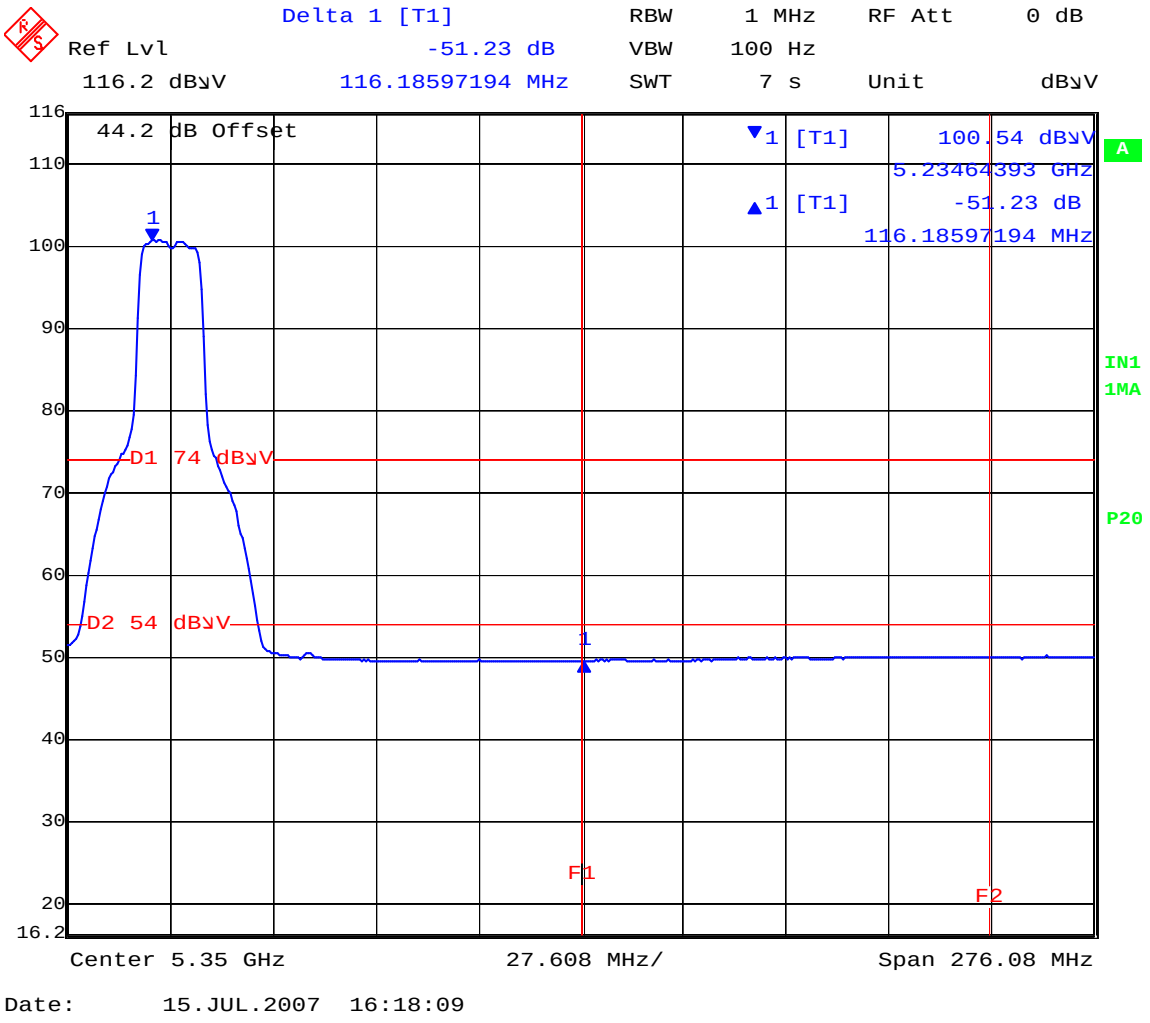


Figure 9-6: Lower Bandedge with Peak Detection (802.11a)

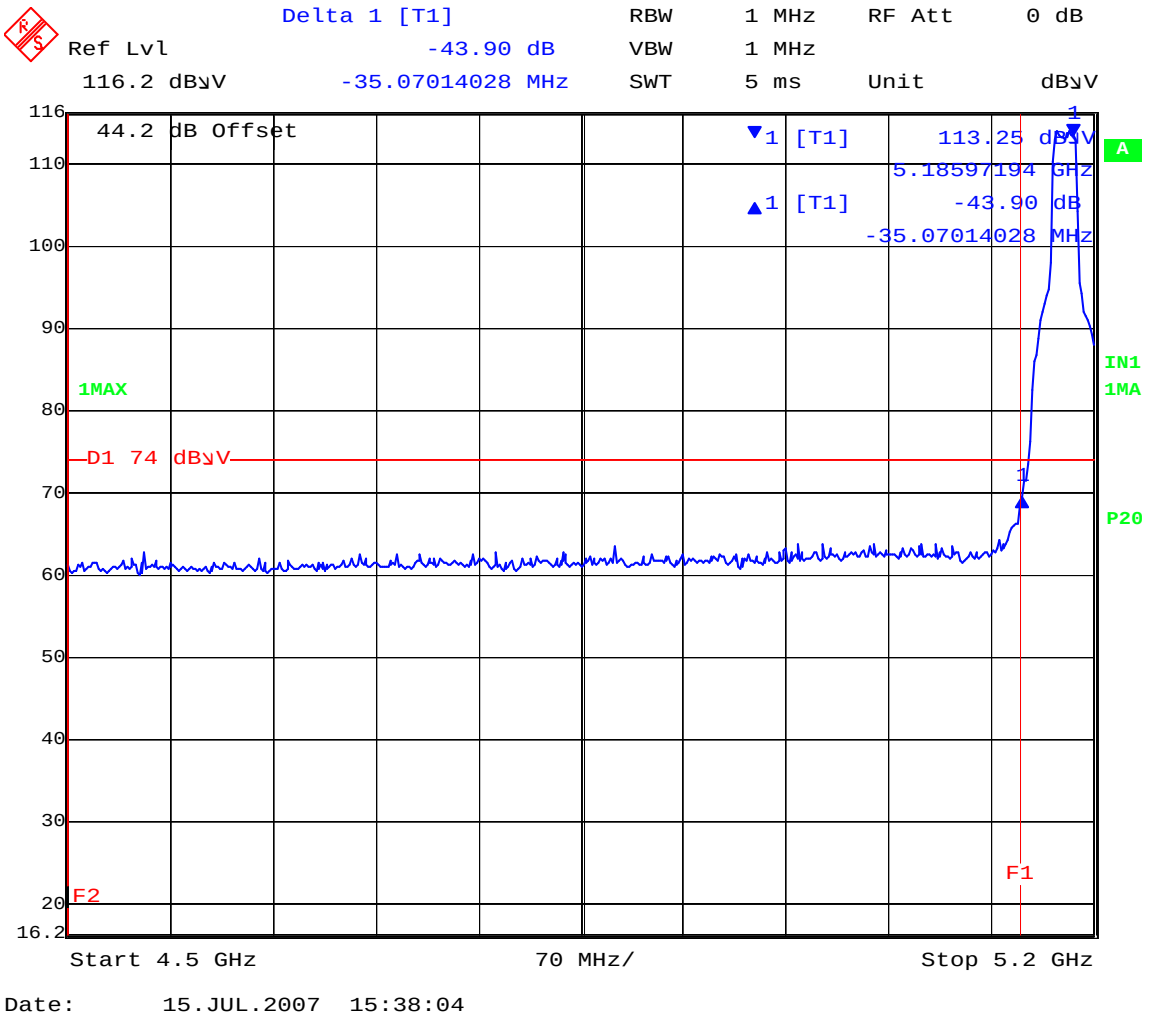
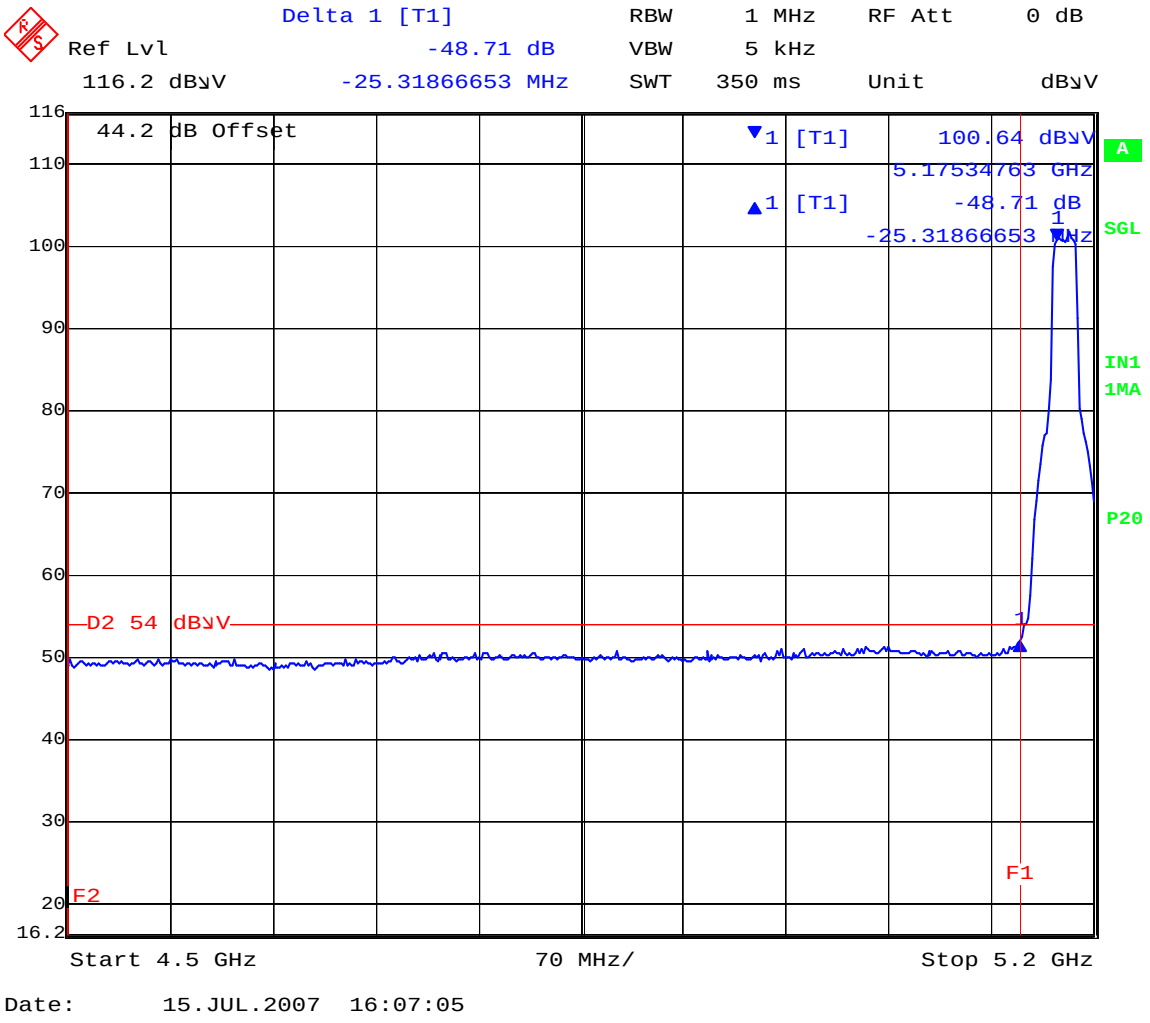


Figure 9-7: Lower Bandedge with Average Detection (802.11a)



10 RECEIVER SPURIOUS EMISSIONS

10.1 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.

10.2 Receiver Spurious Emissions Criteria

Table 10-1 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

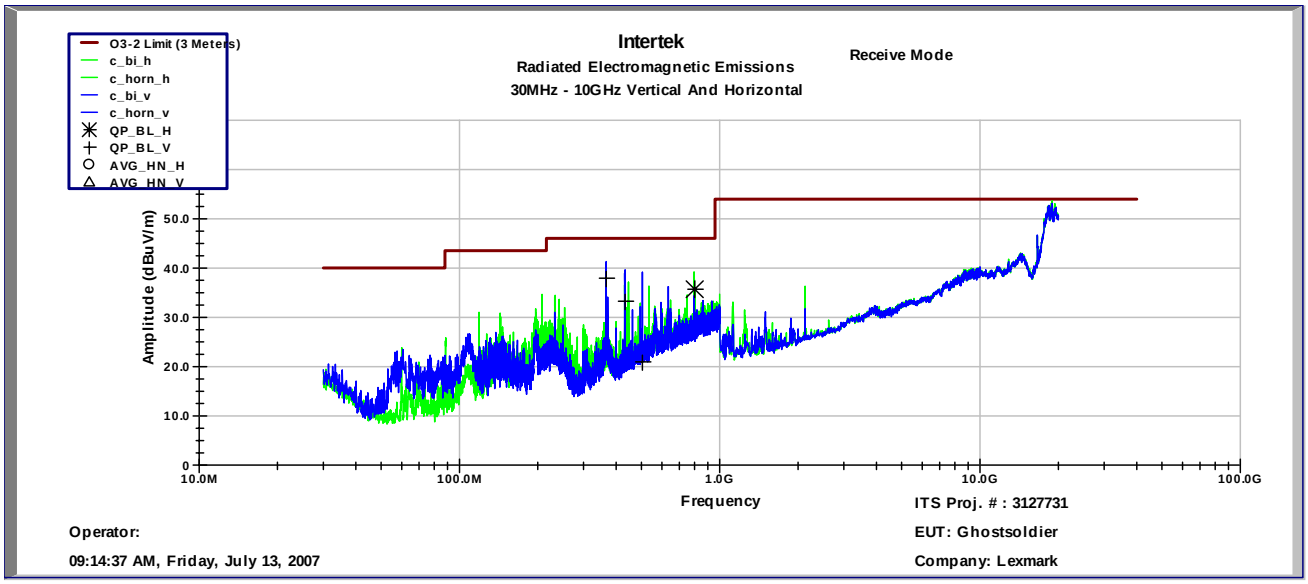
10.3 Test Results

The Lexmark MarkNet N8052 is **compliant** with the radiated disturbance requirements of FCC §15.109 and §15.209 for a class B device. The table in Figure 10-1 and the graph in Figure 10-2 show that there are no emissions above the limit.

Figure 10-1 FCC §15.109 Receiver Spurious Emission (Receive Mode)

Frequency (MHz)	Polarity (H/V)	Cab. (dB)	Ant. (dB)	Corr. Reading. (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Azimuth (deg)	Tower (m)	Results
801.82 MHz	H	4.1	22.04	35.68	46.02	-10.34	309	2	**Compliant**
366.4 MHz	V	2.67	15.56	37.92	46.02	-8.1	200	1	**Compliant**
433.1 MHz	V	2.94	15.79	33.25	46.02	-12.77	309	1	**Compliant**
504.9 MHz	V	3.19	17.7	20.95	46.02	-25.07	199	1	**Compliant**

Figure 10-2 FCC §15.109 Receiver Spurious Emission (Receive Mode)



11 POWER LINE CONDUCTED EMISSIONS

11.1 Test Procedure (FCC §15.107 and §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.

11.2 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 11-1 Conducted Emission Limit for FCC §15.107 and §15.207

Frequency Range (MHz)	Quasi Peak Limit (dBuV)	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

11.3 Test Results

The Lexmark MarkNet N8052 met the power line conducted emission requirements of §15.107 and §15.207. The graphical data, measured with peak detection, was all below the class B quasi-peak and average limits. The test was performed on the AC input to printer that was housing the Lexmark MarkNet N8052. This test was performed in receive and transmit modes.

Figure 11-1: Power Line Conducted Emissions Receive Mode (Lines 1 and 2)

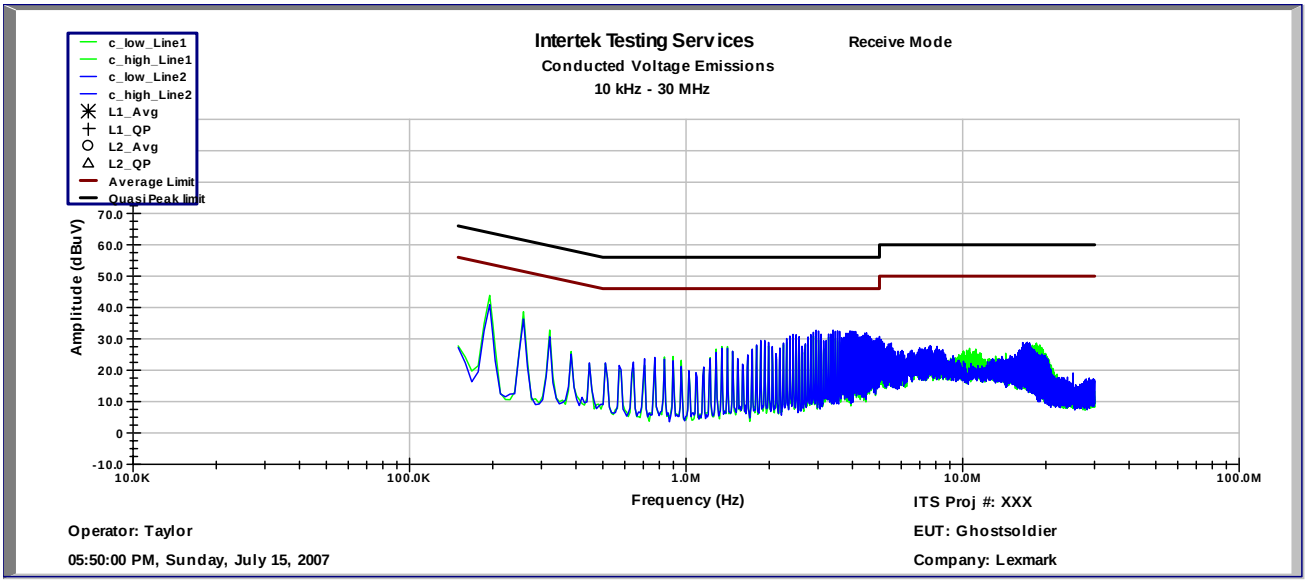


Figure 11-2: Power Line Conducted Emissions Transmit Mode (Lines 1 and 2)