LEXMARK

LEXMARK INTERNATIONAL

TEST REPORT

for

FCC PART 15
INDUSTRY CANADA RSS-210

TRADE NAME: Network Option Card for Dell 966 Printer

MODEL NUMBER: RJ596

Test Report Number: 553-EMC-2006-FCC-071706

Date: July 17, 2006

1 TABLE OF CONTENTS

2 TECHNICAL REPORT

Manufacturer of Equipment-under-test	Lexmark International, Inc.
Address of Manufacturer	740 New Circle Rd. Lexington, Kentucky 40511

Equipment Under Test		
Trade Name(s)	Network Option Card for Dell 966 Printer	
Model Number	RJ596	
FCC ID	IYLRJ596	
Industry Canada ID	2376A-RJ596	
Device Category	Mobile	
RF Exposure Category	General Population/Uncontrolled Environment	
Transmission Modes	802.11b	802.11g
Frequency Range (MHz)	2412 - 2462	2412 - 2462
Types of Transmission	QPSK, BSK, CCK	BPSK, QPSK, 16QAM, 64QAM
Maximum Conducted RF Output Power (dBm)	21.16	21.31
Antenna Type	Cabled from PCB to mounted antenna	
Antenna Location	Externally mounted to device	
Antenna Gain (dBi)	2	
Power Supply		
Manufacturer	Delta	
Model Number	21H0302	
Serial Number	TH-0GF361-17971-620-OLKQ	

2.1 PURPOSE OF TESTING

The purpose of this testing was to evaluate the EUT for compliance to the FCC and Industry Canada Rules for an 802.11 b/g wireless LAN device operating in the frequency range 2400 - 2483.5 MHz.

2.2 APPLIED STANDARDS

[1] FCC Part 15 Rules and Regulations

[2] RSS-210, Issue 5, *Low Power License-Exempt Radiocommunication Devices (All Frequency Bands).*

3 SUMMARY

The purpose of this testing was to evaluate the EUT for compliance to the FCC and Industry Canada Rules for an 802.11 b/g wireless LAN device operating in the frequency range 2400 - 2483.5 MHz. This data demonstrates that the EUT complies with these requirements.

The following is a summary of the testing documented in this report:

FCC Rules	Description of Test	Result	Page of this Report
§15.247(a)(2)	6 dB bandwidth	Compliant	11
§15.247(b)(3)	Conducted power	Compliant	13
§15.247(d)	Out of band emissions at antenna terminal	Compliant	17
§15.247(e)	Power spectral density	Compliant	24
§15.209	Radiated emissions	Compliant	26
§15.207	Conducted emissions	Compliant	35
§15.247(i)	RF exposure	Compliant	38

Industry Canada RSS-210	Description of Test	Result	Page of this Report
§6.2.2(o)(b)	6 dB bandwidth	Compliant	11
§6.2.2(o)(b)	Conducted power	Compliant	13
§6.2.2(o)(e1)	Out of band emissions at antenna terminal	Compliant	17
§6.2.2(o)(b)	Power spectral density	Compliant	24
§6.2.1	Radiated emissions	Compliant	26
§9	Conducted emissions	Compliant	35
§14	RF exposure	Compliant	43
§5.9.1	20 dB bandwidth	N/A	38

This report has been reviewed by:

Keith Hardin		July 17, 2006
Name	Signature	Date

OFFICIAL SIGNATORY: Keith Hardin (Lexmark) The signature on this page of the report indicates that this entire report and the data contained herein has been reviewed by the signatory. No additional signatures are required on any test data sheets contained in this report.

4 DESCRIPTION OF EUT

The Equipment Under Test (EUT) is a network option card for the Dell 966 inkjet printer. This option card includes circuitry for attaching the printer to either a wired 10 Mbps or 100 Mbps network or a wireless 802.11b or 802.11g network. The circuitry for the wireless network is contained on a small mini-PCMCIA card soldered onto the main printed circuit board of the EUT. The circuitry for the wired network is contained on the main printed circuit board of the EUT.

Either the wired or wireless network can be active at any time, but not both. The EUT will not support active connections via wired and wireless networks simultaneously. When powered on, if an ethernet connection is detected on the RJ45 connector, the wireless card is disabled. If no ethernet connection is detected, the wireless card is enabled.

4.1 EUT PHOTOS

Figure 1. Top view of EUT.

Figure 2. Bottom view of EUT.

Figure 3. View of EUT installed in host printer.

Figure 4. Front view of host printer.

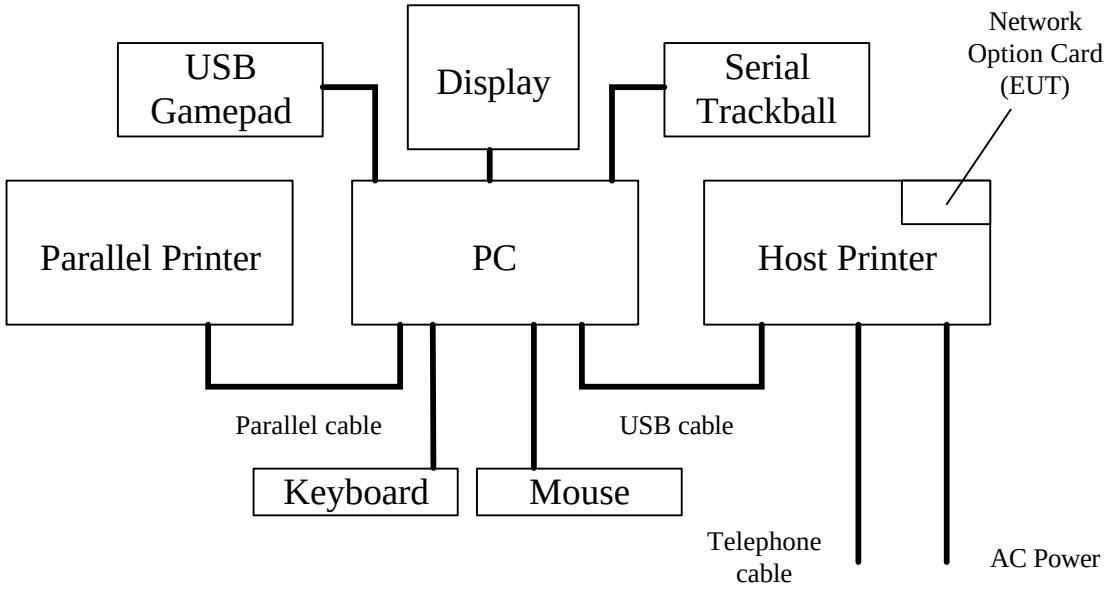
4.2 EUT SUPPRESSION COMPONENTS

Description	Part Number	Vendor
Toroid on coaxial cable to antenna	K5A RH7.8x4x18	Core Tech

4.3 EUT CLOCK FREQUENCIES

Description	Frequency (MHz)
Crystal to ASIC on main PCB	25.0
Crystal to ASIC on radio PCB	40.0

5 TEST CONFIGURATION



The following auxiliary equipment was used during the testing of the EUT:

Description	Manufacturer	Model
Printer for parallel port of PC	Lexmark	Z11
USB Gamepad	Microsoft	Game Pad Pro
Serial Trackball	Clear	ATB 2730
Personal Computer	Dell	Optiplex GX260
LCD Display	Dell	E173FP

6 CABLE INFORMATION

Cables used for testing included the following:

Cable Description	Cable Length (meters)	Ferrites	Shield Status
USB cable from PC to host printer	3	No	Shielded
PC to parallel printer	3	No	Shielded
PC to LCD display	2	Yes	Shielded
Telephone cable from EUT	1	No	Unshielded
PC to serial trackball	2	No	Shielded
PC to USB gamepad	2	Yes	Shielded

7 TESTING & MEASUREMENT EQUIPMENT

Description	Manufacturer	Model Number	Serial Number	Calibration Due Date
EMI receiver	Rhode & Schwarz	ESI7	100009	8/10/07
EMI receiver	Rhode & Schwarz	ESIB7	100093	5/25/07
EMI receiver	Rhode & Schwarz	ESIB40	1112950683	5/4/08
EMI receiver	Rhode & Schwarz	ESIB40	100148	5/5/07
Bi-Log antenna	Chase	CBL6111C	2449	9/12/07
Horn antenna (1 - 18 GHz)	Antenna Research	DRG-1181A	1091	N/A
Horn Antenna (18 - 40 GHz)	Antenna Research	DRG1840A	1047	N/A
LISN	Rhode & Schwarz	ESH2-Z5	848765/017	6/1/07
Power meter	Rhode & Schwarz	NRVD	100581	6/16/06
Diode power sensor	Rhode & Schwarz	NRV-Z4	100126	6/16/06
Signal Generator	Rhode & Schwarz	SMR40	100150	Output set & measured using power meter

8 TEST RESULTS

8.1 6 dB BANDWIDTH

Criteria for 6 dB Bandwidth [1**]:** For systems using digital modulation in the 2400 - 2483.5 MHz band, the minimum 6 dB bandwidth shall be at least 500 kHz.

Test Procedure for 6 dB Bandwidth: The antenna port of the EUT was connected directly to the input of the spectrum analyzer via a short coaxial cable. The resolution and video bandwidths of the analyzer were set to 100 kHz. The frequency span was set so that the entire channel of operation could be displayed on the spectrum analyzer. The max hold function was used to capture the maximum levels over this frequency range. Markers were then used to determine the two frequencies on the upper and lower edge of the channel where the amplitude was 6 dB below the highest amplitude within the channel. The difference in the frequencies of the upper and lower markers represents the 6 dB bandwidth of the channel.

The modes of operation with the highest and lowest data rates and with the highest conducted ouput power on the high, low and middle channels were measured and are reported.

Results for 6 dB Bandwidth: See Table 1 for results. The minimum 6 dB bandwidth measured was 10.707 MHz.

Channel	Data Rate (Mbps)	Channel Frequency (MHz)	6 dB Bandwidth (MHz)
1	1	2412	12.184
	2	2412	
	5.5	2412	
	11	2412	10.707
	6	2412	15.876
	9	2412	
	12	2412	
	18	2412	
	24	2412	16.456
	36	2412	
	48	2412	
	54	2412	16.245
6	1	2437	12.236
	2	2437	
	5.5	2437	
	11	2437	11.551
	6	2437	15.717
	9	2437	
	12	2437	15.770
	18	2437	
	24	2437	
	36	2437	
	48	2437	
	54	2437	16.508
11	1	2462	12.605
	2	2462	
	5.5	2462	
	11	2462	12.184
	6	2462	16.087
	9	2462	
	12	2462	
	18	2462	
	24	2462	16.508
	36	2462	
	48	2462	
	54	2462	16.508

Table 1. Measured data for 6 dB bandwidths.

8.2 CONDUCTED POWER

Criteria for Conducted Power [1**]:** For systems using digital modulation in the 2400 - 2483.5 MHz band and antenna gain less than 6 dBi, the maximum peak output power of the EUT shall not exceed 1 Watt (30 dBm). If multiple modes of operation are possible, the maximum conducted output power is the highest total transmit power occurring in any mode. The variation of the input power shall be also be measured with the supply voltage varied between 85% and 115% of the nominal rated supply voltage.

Test Procedure for Conducted Power: The antenna port of the EUT was connected directly to the input of a power meter via a short coaxial cable and an external 10 dB attenuator. The power was read directly from the power meter. This power is corrected to account for the loss in the interconnecting cable and external attenuator, giving the total power delivered to the antenna port.

Power measurements were performed with the AC supply voltage to the EUT set to 102V/60Hz (85% nominal), 120V/60Hz (nominal) and 138V/60Hz (115% nominal).

All modes of operation on the high, low and middle channels were measured and are reported.

Results for Conducted Power: See Tables 2 - 4 for results. The maximum conducted power for all measured channels, modes and supply voltages was 21.31 dBm.

Channel	Data Rate (Mbps)	Reading from Power Meter (dBm)	Factors (dB)	Total Power (dBm)	Limit (dBm)	Margin (dB)
1	1	5.25	11.10	**16.35**	30	13.65
	2	5.25	11.10	16.35	30	13.65
	5.5	4.92	11.10	16.02	30	13.98
	11	5.07	11.10	16.17	30	13.83
	6	6.85	11.10	17.95	30	12.05
	9	6.92	11.10	18.02	30	11.98
	12	7.87	11.10	18.97	30	11.03
	18	7.74	11.10	18.84	30	11.16
	24	8.25	11.10	**19.35**	30	10.65
	36	7.94	11.10	19.04	30	10.96
	48	7.45	11.10	18.55	30	11.45
	54	7.55	11.10	18.65	30	11.35
6	1	10.05	11.10	**21.15**	30	8.85
	2	10.04	11.10	21.14	30	8.86
	5.5	9.84	11.10	20.94	30	9.06
	11	9.94	11.10	21.04	30	8.96
	6	9.72	11.10	20.82	30	9.18
	9	9.77	11.10	20.87	30	9.13
	12	10.21	11.10	**21.31**	30	8.69
	18	10.19	11.10	21.29	30	8.71
	24	8.80	11.10	19.90	30	10.10
	36	8.59	11.10	19.69	30	10.31
	48	6.91	11.10	18.01	30	11.99
	54	7.01	11.10	18.11	30	11.89
11	1	2.50	11.10	**13.60**	30	16.40
	2	2.50	11.10	13.60	30	16.40
	5.5	2.15	11.10	13.25	30	16.75
	11	2.32	11.10	13.42	30	16.58
	6	4.05	11.10	15.15	30	14.85
	9	4.12	11.10	15.22	30	14.78
	12	5.19	11.10	16.29	30	13.71
	18	5.05	11.10	16.15	30	13.85
	24	5.72	11.10	**16.82**	30	13.18
	36	5.31	11.10	16.41	30	13.59
	48	5.33	11.10	16.43	30	13.57
	54	5.45	11.10	16.55	30	13.45

Table 2. Measured data for conducted power at nominal voltage.

Channel	Data Rate (Mbps)	Reading from Power Meter (dBm)	Factors (dB)	Total Power (dBm)	Limit (dBm)	Margin (dB)
1	1	5.26	11.10	**16.36**	30	13.64
	2	5.25	11.10	16.35	30	13.65
	5.5	4.91	11.10	16.01	30	13.99
	11	5.06	11.10	16.16	30	13.84
	6	6.85	11.10	17.95	30	12.05
	9	6.91	11.10	18.01	30	11.99
	12	7.85	11.10	18.95	30	11.05
	18	7.75	11.10	18.85	30	11.15
	24	8.25	11.10	**19.35**	30	10.65
	36	7.92	11.10	19.02	30	10.98
	48	7.45	11.10	18.55	30	11.45
	54	7.57	11.10	18.67	30	11.33
6	1	10.06	11.10	**21.16**	30	8.84
	2	10.06	11.10	21.16	30	8.84
	5.5	9.84	11.10	20.94	30	9.06
	11	9.93	11.10	21.03	30	8.97
	6	9.71	11.10	20.81	30	9.19
	9	9.75	11.10	20.85	30	9.15
	12	10.21	11.10	**21.31**	30	8.69
	18	10.16	11.10	21.26	30	8.74
	24	8.80	11.10	19.90	30	10.10
	36	8.55	11.10	19.65	30	10.35
	48	6.88	11.10	17.98	30	12.02
	54	7.00	11.10	18.10	30	11.90
11	1	2.53	11.10	**13.63**	30	16.37
	2	2.50	11.10	13.60	30	16.40
	5.5	2.18	11.10	13.28	30	16.72
	11	2.34	11.10	13.44	30	16.56
	6	4.05	11.10	15.15	30	14.85
	9	4.11	11.10	15.21	30	14.79
	12	5.19	11.10	16.29	30	13.71
	18	5.05	11.10	16.15	30	13.85
	24	5.71	11.10	**16.81**	30	13.19
	36	5.31	11.10	16.41	30	13.59
	48	5.33	11.10	16.43	30	13.57
	54	5.45	11.10	16.55	30	13.45

Table 3. Measured data for conducted power at 85% nominal voltage.

Channel	Data Rate (Mbps)	Reading from Power Meter (dBm)	Factors (dB)	Total Power (dBm)	Limit (dBm)	Margin (dB)
1	1	5.28	11.10	**16.38**	30	13.62
	2	5.27	11.10	16.37	30	13.63
	5.5	4.91	11.10	16.01	30	13.99
	11	5.09	11.10	16.19	30	13.81
	6	6.84	11.10	17.94	30	12.06
	9	6.91	11.10	18.01	30	11.99
	12	7.83	11.10	18.93	30	11.07
	18	7.72	11.10	18.82	30	11.18
	24	8.22	11.10	**19.32**	30	10.68
	36	7.91	11.10	19.01	30	10.99
	48	7.45	11.10	18.55	30	11.45
	54	7.55	11.10	18.65	30	11.35
6	1	10.06	11.10	**21.16**	30	8.84
	2	10.05	11.10	21.15	30	8.85
	5.5	9.84	11.10	20.94	30	9.06
	11	9.94	11.10	21.04	30	8.96
	6	9.71	11.10	20.81	30	9.19
	9	9.72	11.10	20.82	30	9.18
	12	10.19	11.10	**21.29**	30	8.71
	18	10.16	11.10	21.26	30	8.74
	24	8.80	11.10	19.90	30	10.10
	36	8.56	11.10	19.66	30	10.34
	48	6.90	11.10	18.00	30	12.00
	54	6.98	11.10	18.08	30	11.92
11	1	2.53	11.10	**13.63**	30	16.37
	2	2.50	11.10	13.60	30	16.40
	5.5	2.18	11.10	13.28	30	16.72
	11	2.32	11.10	13.42	30	16.58
	6	4.04	11.10	15.14	30	14.86
	9	4.11	11.10	15.21	30	14.79
	12	5.20	11.10	16.30	30	13.70
	18	5.06	11.10	16.16	30	13.84
	24	5.70	11.10	**16.80**	30	13.20
	36	5.31	11.10	16.41	30	13.59
	48	5.32	11.10	16.42	30	13.58
	54	5.45	11.10	16.55	30	13.45

Table 4. Measured data for conducted power at 115% nominal voltage.

8.3 OUT OF BAND EMISSIONS AT ANTENNA TERMINALS

Criteria for Out of Band Emissions at Antenna Terminals [1**]:** In any 100 kHz bandwidth outside the frequency band in which the digitally modulated EUT is operating, the radio frequency power that is produced by the EUT shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power. This measurement shall be based upon either an RF conducted or a radiated measurement provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based upon the use of RMS averaging over a time interval, the attenuation required shall be 30 dB instead of 20 dB.

Test Procedure for Out of Band Emissions at Antenna Terminals: The antenna port of the EUT was connected directly to the input of the spectrum analyzer. The resolution and video bandwidths of the analyzer were set to 100 kHz and 300 kHz, respectively. The frequency span was set to sweep from 30 MHz to 25 GHz. The max hold function was used to capture the maximum levels over this frequency range. Markers were then used to determine the difference in amplitude of the fundamental emission and the highest emission other than the fundamental.

The modes of operation with the highest conducted output power on the high, low and middle channels were measured and are reported.

Results for Out of Band Emissions at Antenna Terminals: See Figures 5 - 10 for results. This data indicates that all out of band emissions were at least 30 dB below the intended signal.

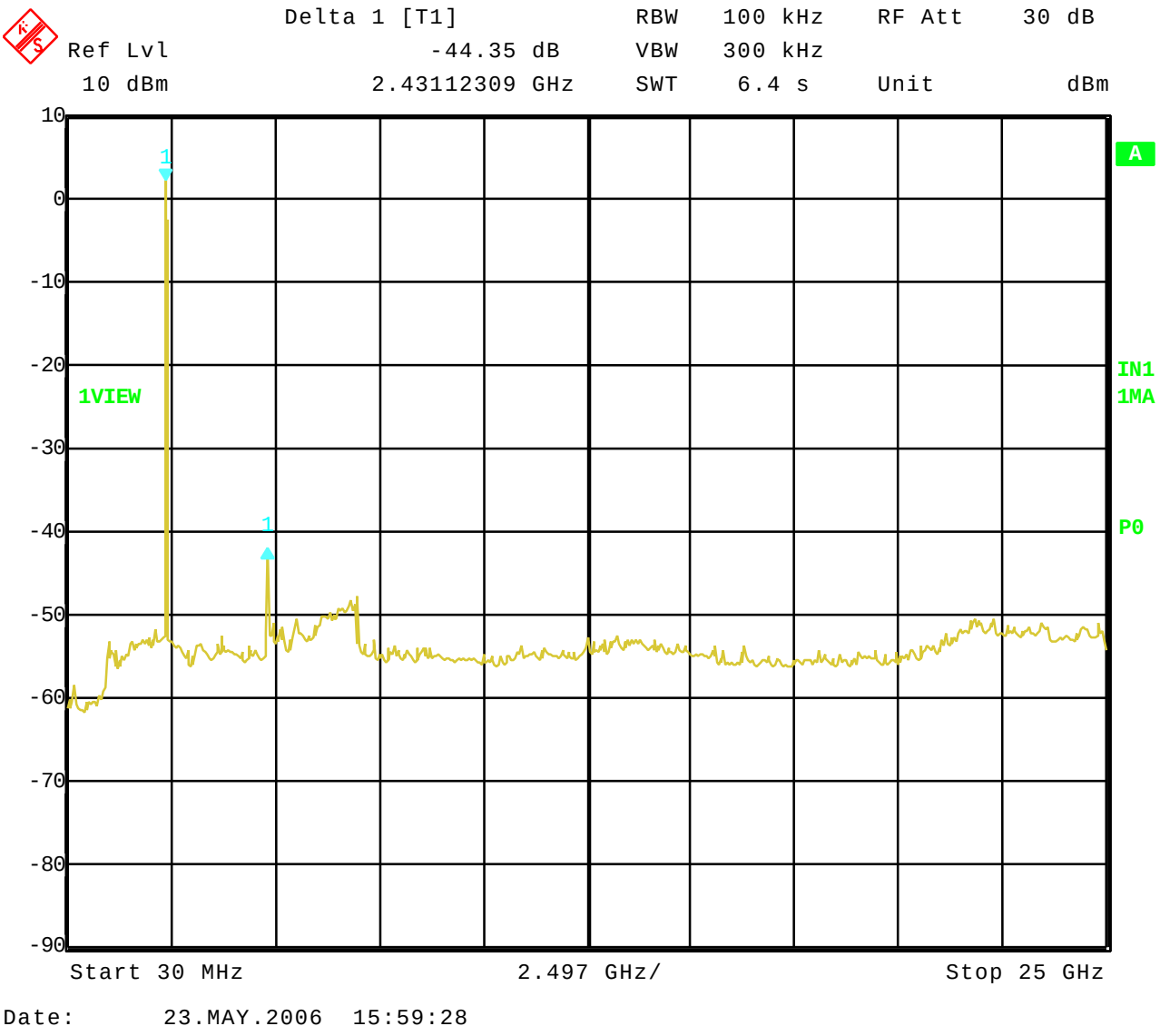


Figure 5. Out of band emissions at antenna port; Channel 1, 1 Mbps.

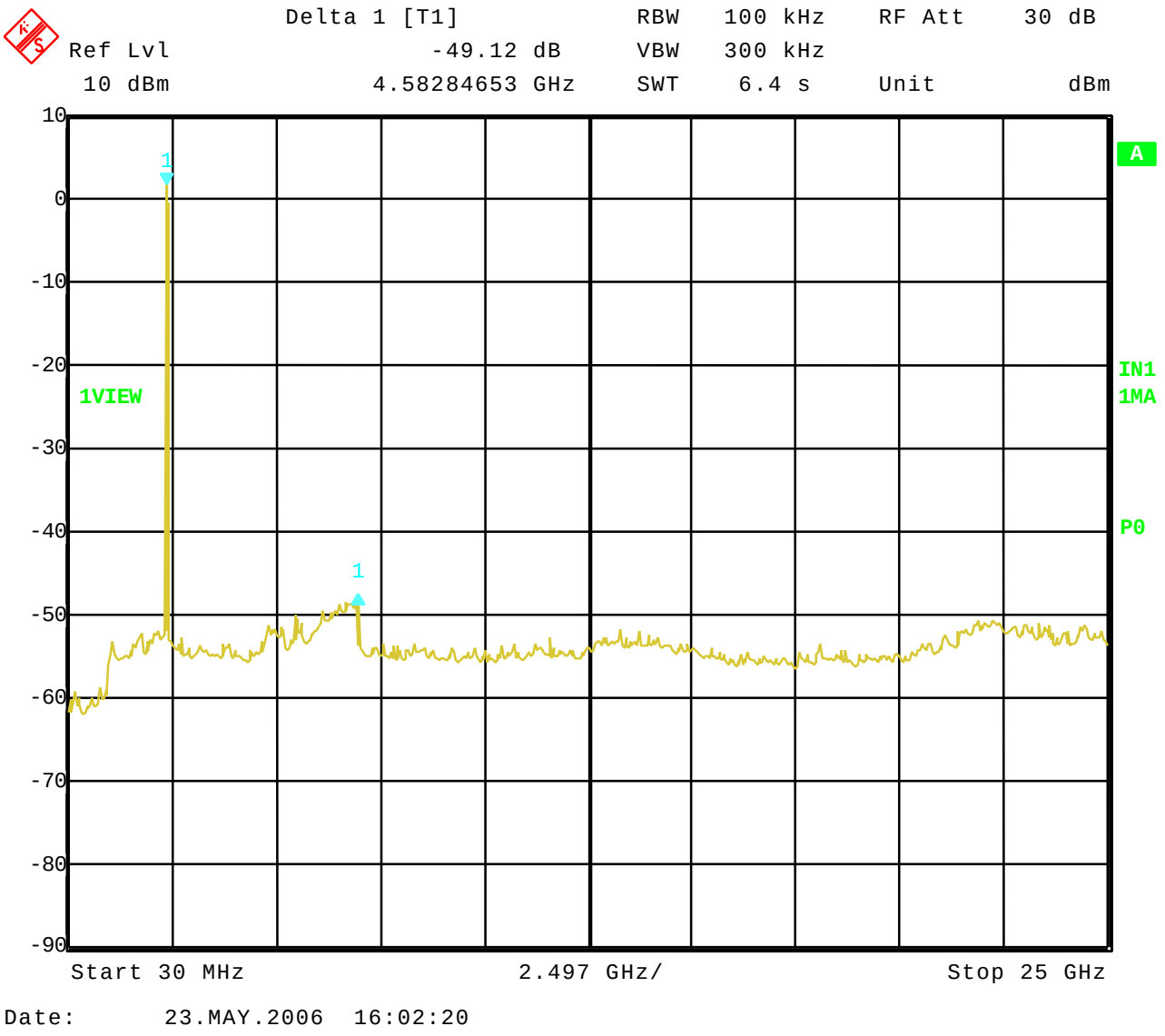


Figure 6. Out of band emissions at antenna port; Channel 1, 24 Mbps.

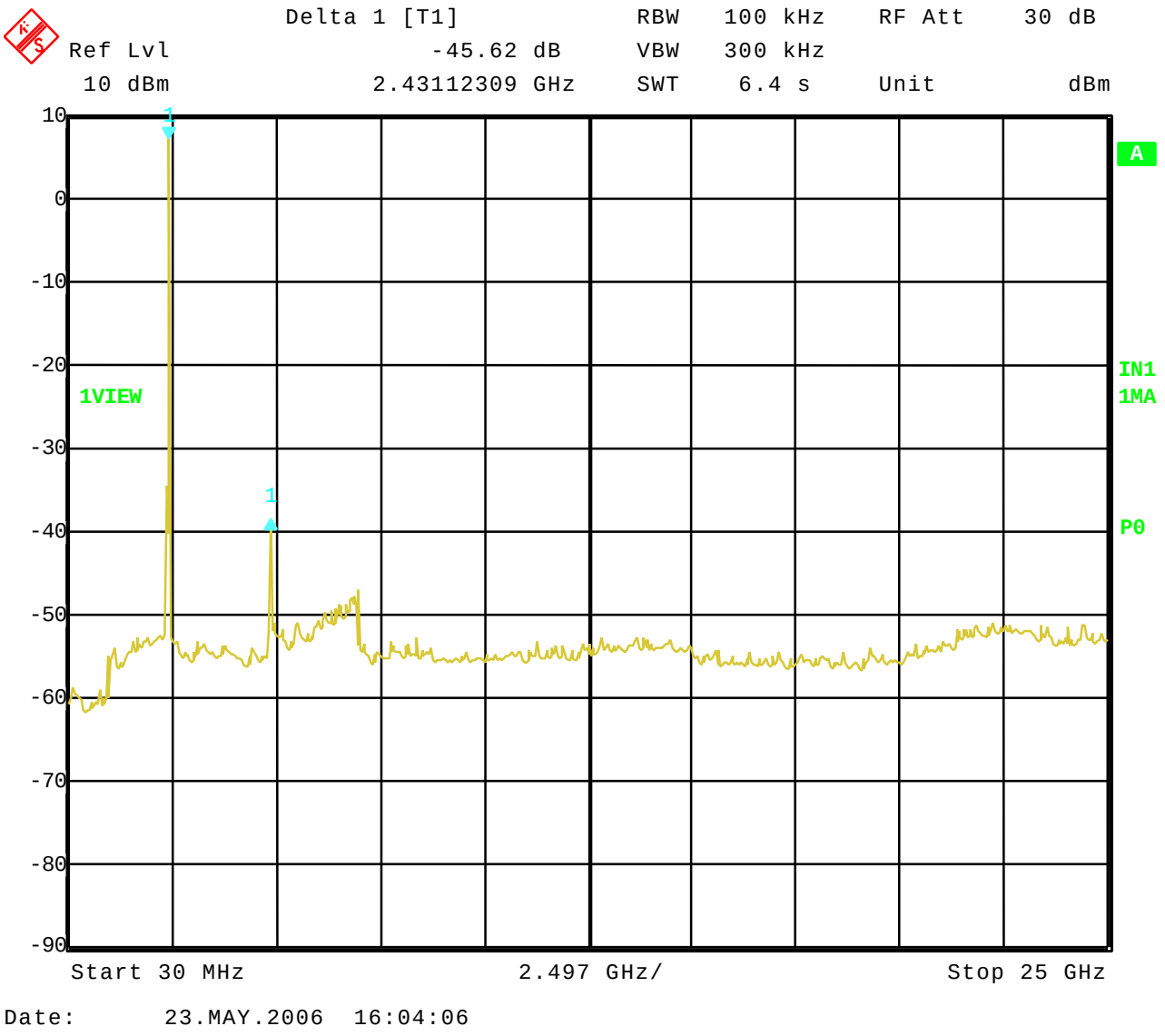


Figure 7. Out of band emissions at antenna port; Channel 6, 1 Mbps.

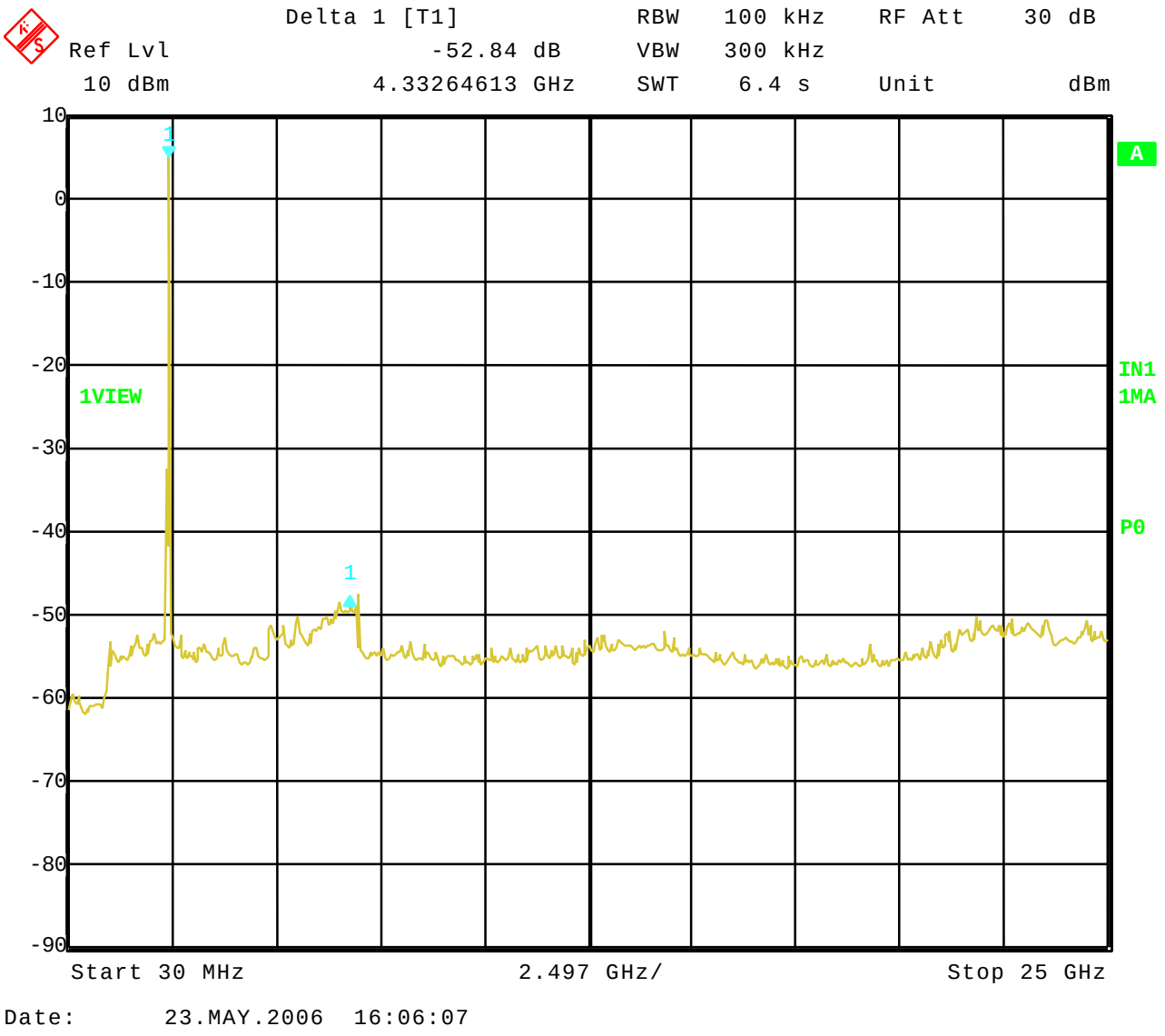


Figure 8. Out of band emissions at antenna port; Channel 6, 12 Mbps.

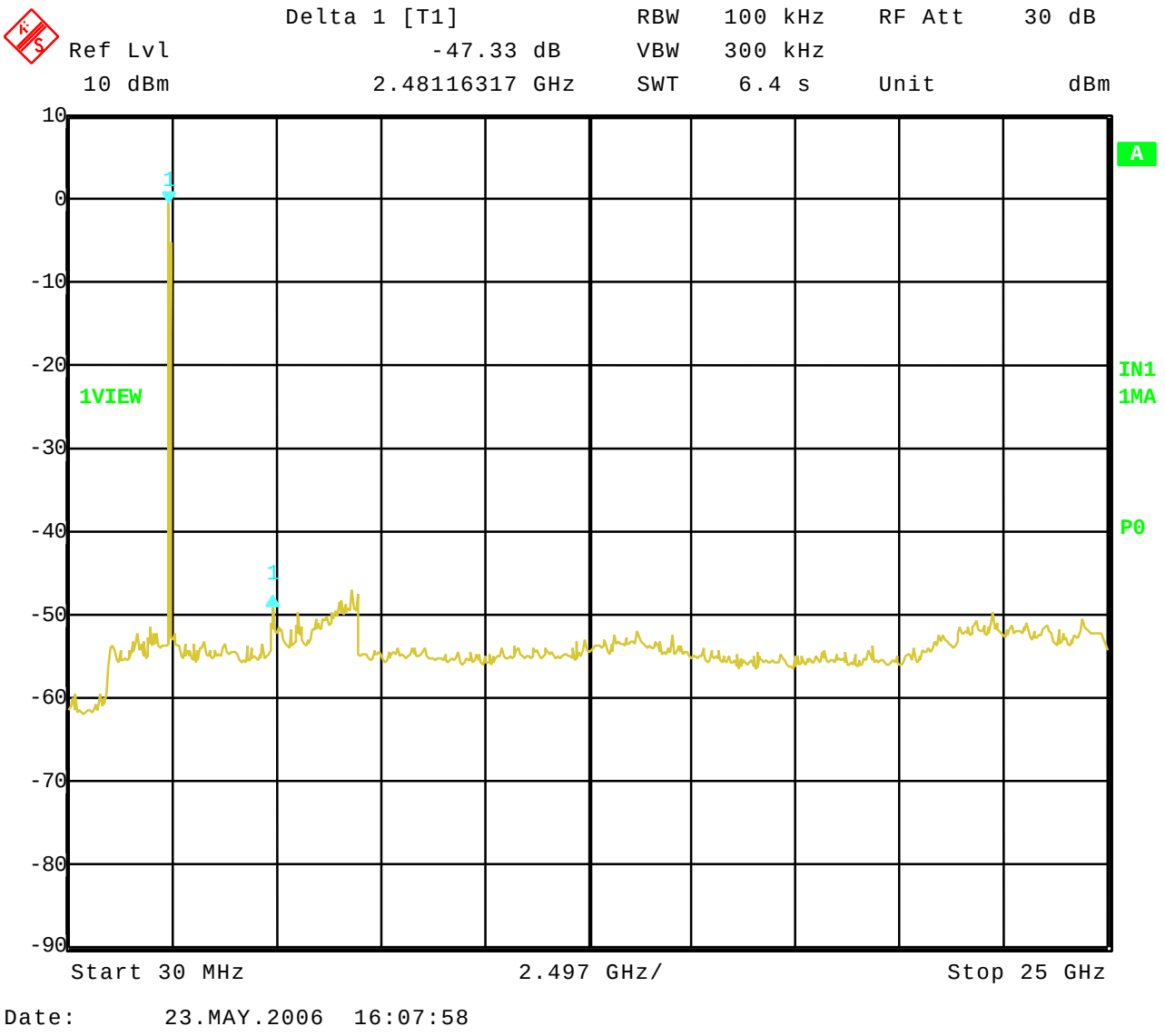


Figure 9. Out of band emissions at antenna port; Channel 11, 1 Mbps.

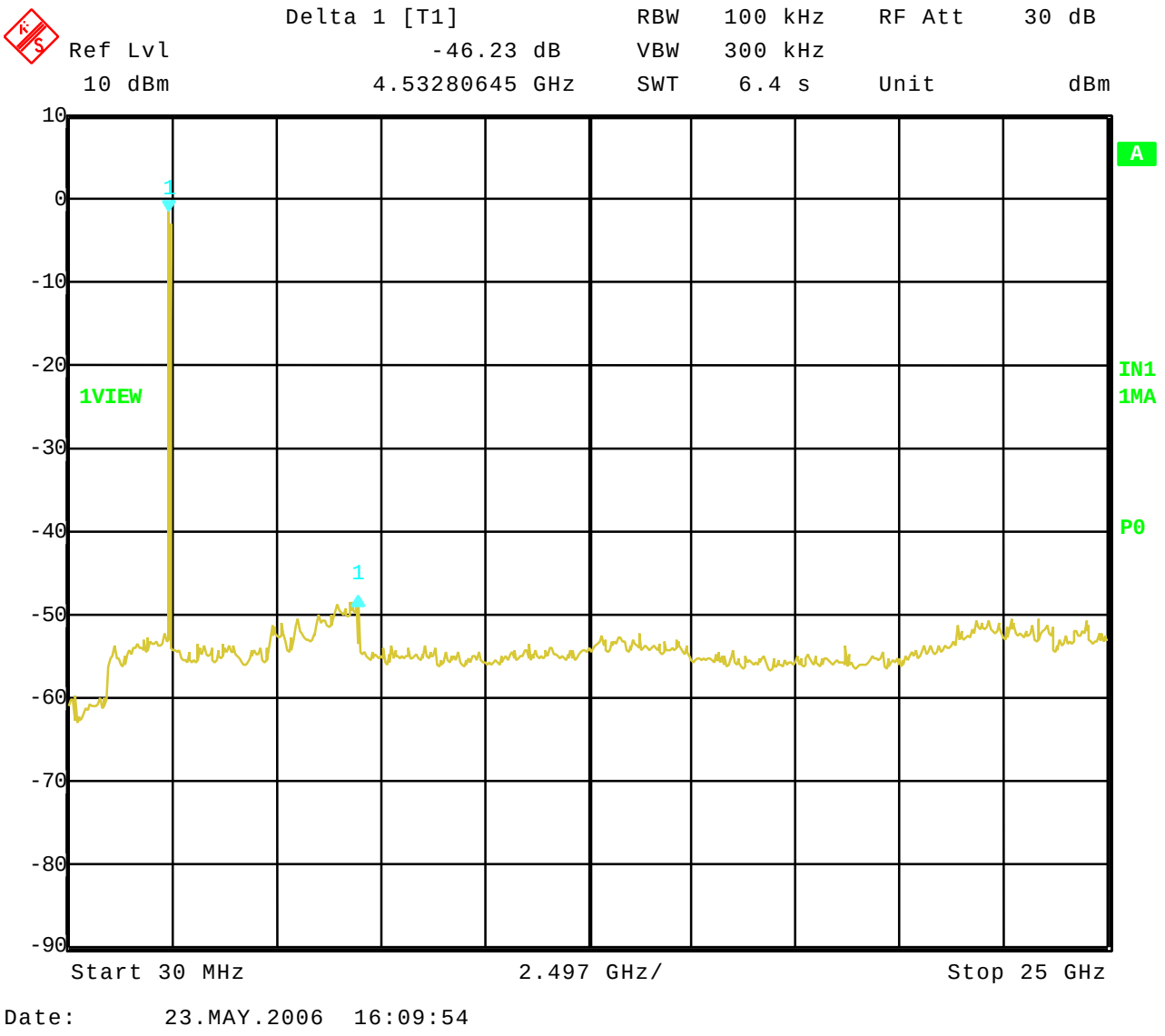


Figure 10. Out of band emissions at antenna port; Channel 11, 24 Mbps.

8.4 POWER SPECTRAL DENSITY

Criteria for Power Spectral Density [1**]:** For digitally modulated EUTs, the power spectal density conducted from the EUT to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

Test Procedure for Power Spectral Density: The antenna port of the EUT was connected directly to the input of the spectrum analyzer via a short coaxial cable. The resolution and video bandwidths of the analyzer were initially set to 100 kHz. The span was set so that the entire channel could be included on the display. The center frequency of the spectrum analyzer was then set to the frequency within the channel bandwidth that had the highest amplitude The frequency span was set to 600 kHz and the resolution and video bandwidths were set to 3 kHz. The maximum amplitude over this frequency span was then recorded. This amplitude is corrected to account for the attenuation of the coaxial cable interconnecting the EUT and the spectrum analyzer.

These measurements were made for all modes on the middle channel. For the high and low channels, these measurements were made for the lowest and highest data rates and those data rates that had the highest conducted power.

Results for Power Spectral Density: See Table 5 for results. The maximum power spectral density measured was -2.84 dBm.

Channel	Data Rate (Mbps)	Reading from Spectrum Analyzer (dBm)	Factors (dB)	Total Power (dBm)	Limit (dBm)	Margin (dB)
1	1	-14.18	1.61	-12.57	8	20.57
	2					
	5.5					
	11	-11.05	1.61	-9.44	8	17.44
	6	-15.05	1.61	-13.44	8	21.44
	9					
	12					
	18					
	24	-13.21	1.61	-11.60	8	19.60
	36					
	48					
	54	-13.90	1.61	-12.29	8	20.29
6	1	-8.91	1.61	-7.30	8	15.30
	2	-4.45	1.61	**-2.84**	8	10.84
	5.5	-5.68	1.61	-4.07	8	12.07
	11	-5.70	1.61	-4.09	8	12.09
	6	-11.20	1.61	-9.59	8	17.59
	9	-11.82	1.61	-10.21	8	18.21
	12	-12.05	1.61	-10.44	8	18.44
	18	-11.43	1.61	-9.82	8	17.82
	24	-13.54	1.61	-11.93	8	19.93
	36	-13.45	1.61	-11.84	8	19.84
	48	-15.33	1.61	-13.72	8	21.72
	54	-15.45	1.61	-13.84	8	21.84
11	1	-16.72	1.61	-15.11	8	23.11
	2					
	5.5					
	11	-13.58	1.61	-11.97	8	19.97
	6	-17.75	1.61	-16.14	8	24.14
	9					
	12					
	18					
	24	-15.65	1.61	-14.04	8	22.04
	36					
	48					
	54	-16.97	1.61	-15.36	8	23.36

Table 5. Measured data for power spectral density.

8.5 RADIATED SPURIOUS EMISSIONS

Criteria for Radiated Spurious Emissions [1]: The radiated spurious emissions of the transmitter shall not exceed the values in Table 6.

Frequency Range (MHz)	Limit (dB(μV/m))	Measurement Distance (m)
30 - 88	40	3
88 - 216	43.5	3
216 - 960	46	3
960 - 1000	54	3
Above 1000	54 (average detector) 74 (peak detector)	3

Table 6. Limits for spurious emissions.

Test Procedure for Radiated Spurious Emissions: Radiated spurious emissions were measured in Lexmark's 10 meter semi-anechoic chamber. This facility is registered with the FCC (registration number 949691) and Industry Canada (reference file number IC 2376).

The EUT configuration shown in Section 5 was placed atop a 0.8 meter high wooden table with a rectangular surface measuring 1.5m x 1.0m. The test setup is shown in Figures 19 and 20.

The receiving antenna was connected to a spectrum analyzer. While the spectrum analyzer was in peak hold mode, the EUT configuration was rotated continuously and the antenna scanned from 1 - 4 meters in height. After obtaining a plot of the peak emissions, those emissions close to the limit were investigated using either the quasi-peak or average detector, as required. The frequency range from 30 MHz - 25 GHz was investigated for spurious emissions.

The EUT was exercised by sending data to the printer via a wireless router.

Results for Radiated Spurious Emissions: Tables 7 - 18 contain data on the radiated spurious emissions of significant amplitude from the EUT configuration shown in Section 5. In addition, in order to verify that the limits in the restricted frequency ranges immediately adjacent to the lower and upper channels were complied with, the emissions immediately below Channel 1 and above Channel 11 were investigated. These results are found in Figures 11 - 18. Some of the emissions may be due to parts of the configuration in Section 5 other than the EUT. Since the emissions were under the limit, the exact source of the emission was not determined.

Frequency (MHz)	Polarization	Cable Loss (dB)	Antenna Factor dB(1/m)	Quasi-peak Amplitude (dB(μV/m))	Quasi-peak Limit (dB(μV/m))	Quasi-peak Margin (dB)
63.92	V	7.07	5.92	25.97	40	14.03
384.87	V	9.26	15.33	41.0	46	4.99
451.6	H	9.49	17.15	33.73	46	12.27
500.02	H	9.61	17.98	43.59	46	2.41
500.03	V	9.61	17.98	43.02	46	2.98
635.97	H	10.28	20.5	32.86	46	13.14
860.61	H	10.84	23.08	35.04	46	10.96
926.028	V	11.03	23.92	36.81	46	9.19

Table 7. Results for radiated spurious emissions < 1 GHz; Channel 1, 11 Mbps.

Frequency (MHz)	Polarization	Cable Loss (dB)	Antenna Factor dB(1/m)	Peak Amplitude (dB(μV/m))	Peak Limit (dB(μV/m))	Peak Margin (dB)	Average Amplitude (dB(μV/m))	Average Limit (dB(μV/m))	Average Margin (dB)
1075.8	V	-29.58	23.46	57.22	74	16.78	22.77	54	31.23
1125.2	H	-29.48	23.63	54.19	74	19.81	30.21	54	23.79
1146.4	H	-29.44	23.7	55.5	74	18.5	22.55	54	31.45
1570.8	V	-27.7	25.14	53.72	74	20.28	24.76	54	29.24
1939.6	H	-26.38	26.4	53.23	74	20.78	25.63	54	28.37
2722.9	H	-24.74	28.99	53.66	74	20.34	29.36	54	24.64

Table 8. Results for radiated spurious emissions > 1 GHz; Channel 1, 11 Mbps.

Frequency (MHz)	Polarization	Cable Loss (dB)	Antenna Factor dB(1/m)	Quasi-peak Amplitude (dB(μV/m))	Quasi-peak Limit (dB(μV/m))	Quasi-peak Margin (dB)
34.46	V	6.88	16.52	30.95	40	9.05
144.06	H	7.78	11.29	31.26	43.5	12.24
500.02	H	9.61	17.98	43.41	46	2.59
500.04	V	9.61	17.98	42.35	46	3.65
649.73	H	10.17	20.41	33.32	46	12.68
917.86	V	11.1	23.57	36.49	46	9.51
968.75	H	10.93	24.71	37.08	54	16.92

Table 9. Results for radiated spurious emissions < 1 GHz; Channel 1, 48 Mbps.

Frequency (MHz)	Polarization	Cable Loss (dB)	Antenna Factor dB(1/m)	Peak Amplitude (dB(μV/m))	Peak Limit (dB(μV/m))	Peak Margin (dB)	Average Amplitude (dB(μV/m))	Average Limit (dB(μV/m))	Average Margin (dB)
1253.1	V	-29	24.06	53.83	74	20.17	22.70	54	31.3
1953.1	H	-26.44	26.44	55.77	74	18.23	25.93	54	28.07
2330.3	V	-25.82	27.69	59.67	74	14.33	27.19	54	26.81

Table 10. Results for radiated spurious emissions > 1 GHz; Channel 1, 48 Mbps.

Frequency (MHz)	Polarization	Cable Loss (dB)	Antenna Factor dB(1/m)	Quasi-peak Amplitude (dBμV/m))	Quasi-peak Limit (dBμV/m))	Quasi-peak Margin (dB)
500.03	H	9.61	17.98	43.41	46	2.59
695.61	H	10.33	20.6	32.71	46	13.3
779.42	H	10.64	21.99	34.19	46	11.81
811.64	V	10.51	22.03	34.05	46	11.95
863.37	V	10.85	23.06	36.51	46	9.49
881.05	V	10.97	22.81	35.71	46	10.29
905.63	H	11.08	23.26	35.59	46	10.41
919.86	V	11.08	23.65	36.37	46	9.63

Table 11. Results for radiated spurious emissions < 1 GHz; Channel 6, 11 Mbps.

Frequency (MHz)	Polarization	Cable Loss (dB)	Antenna Factor dB(1/m)	Peak Amplitude (dBμV/m))	Peak Limit (dBμV/m))	Peak Margin (dB)	Average Amplitude (dBμV/m))	Average Limit (dBμV/m))	Average Margin (dB)
1041.9	V	-29.83	23.34	61.21	74	12.79	27.06	54	26.94
1186.9	H	-29.26	23.84	53.34	74	20.66	21.97	54	32.03
1353.4	H	-28.56	24.4	50.73	74	23.27	23.07	54	30.93
1372.3	V	-28.54	24.47	51.7	74	22.3	24.54	54	29.46
1375.2	H	-28.54	24.48	52.33	74	21.67	35.57	54	18.43
2240	H	-25.85	27.39	51.79	74	22.21	32.83	54	21.17
2740.3	V	-24.54	29.04	52.77	74	21.23	29.45	54	24.55

Table 12. Results for radiated spurious emissions > 1 GHz; Channel 6, 11 Mbps.

Frequency (MHz)	Polarization	Cable Loss (dB)	Antenna Factor dB(1/m)	Quasi-peak Amplitude (dBμV/m))	Quasi-peak Limit (dBμV/m))	Quasi-peak Margin (dB)
500.03	H	9.61	17.98	37.75	46	8.25
574.82	V	9.92	19.91	33.21	46	12.79
711.0	H	10.42	20.96	32.89	46	13.11
750.59	H	10.68	22.17	33.48	46	12.52
833.70	H	10.61	22.95	36.56	46	9.45
855.38	V	10.8	23.05	36.06	46	9.94
867.44	H	10.88	23.03	34.99	46	11.01
897.30	H	11.08	23.03	36.04	46	9.96

Table 13. Results for radiated spurious emissions < 1 GHz; Channel 6, 48 Mbps.

Frequency (MHz)	Polarization	Cable Loss (dB)	Antenna Factor dB(1/m)	Peak Amplitude (dBμV/m))	Peak Limit (dBμV/m))	Peak Margin (dB)	Average Amplitude (dBμV/m))	Average Limit (dBμV/m))	Average Margin (dB)
1491.0	H	-27.97	24.87	53.18	74	20.82	23.44	54	30.56
1731.8	V	-26.95	25.69	54.51	74	19.49	25.33	54	28.67

Table 14. Results for radiated spurious emissions > 1 GHz; Channel 6, 48 Mbps.

Frequency (MHz)	Polarization	Cable Loss (dB)	Antenna Factor dB(1/m)	Quasi-peak Amplitude (dB(μV/m))	Quasi-peak Limit (dB(μV/m))	Quasi-peak Margin (dB)
34.26	V	6.87	16.62	31.79	40	8.21
70.58	V	7.12	6.47	31.61	40	8.39
383.35	V	9.25	15.26	41.85	46	4.15
500.02	V	9.61	17.98	43.43	46	2.57
899.79	V	11.09	23.10	35.82	46	10.18
927.12	V	11.02	23.95	36.49	46	9.51
989.21	V	11.08	24.55	37.18	54	16.82
500.03	H	9.61	17.98	42.95	46	3.05

Table 15. Results for radiated spurious emissions < 1 GHz; Channel 11, 11 Mbps.

Frequency (MHz)	Polarization	Cable Loss (dB)	Antenna Factor dB(1/m)	Peak Amplitude (dB(μV/m))	Peak Limit (dB(μV/m))	Peak Margin (dB)	Average Amplitude (dB(μV/m))	Average Limit (dB(μV/m))	Average Margin (dB)
1229.8	H	-29.16	23.98	50.85	74	23.15	22.42	54	31.58
1281.8	V	-28.93	24.16	56.70	74	17.3	24.31	54	29.69
2340.8	H	-25.66	27.73	49.19	74	24.81	30.43	54	23.57
2732.2	V	-24.4	29.02	54.5	74	19.5	29.41	54	24.59

Table 16. Results for radiated spurious emissions > 1 GHz; Channel 11, 11 Mbps.

Frequency (MHz)	Polarization	Cable Loss (dB)	Antenna Factor dB(1/m)	Quasi-peak Amplitude (dB(μV/m))	Quasi-peak Limit (dB(μV/m))	Quasi-peak Margin (dB)
31.3	V	6.83	17.98	34.21	40	5.79
34.55	V	6.88	16.47	32.92	40	7.08
35.49	V	6.89	15.99	31.43	40	8.57
443.67	V	9.42	17.02	36.04	46	9.96
500.05	H	9.61	17.98	36.69	46	9.31
603.29	H	10.16	19.68	33.76	46	12.24
655.69	V	10.12	20.4	30.76	46	15.25
971.38	V	10.94	24.68	37.25	54	16.75

Table 17. Results for radiated spurious emissions < 1 GHz; Channel 11, 48 Mbps.

Frequency (MHz)	Polarization	Cable Loss (dB)	Antenna Factor dB(1/m)	Peak Amplitude (dB(μV/m))	Peak Limit (dB(μV/m))	Peak Margin (dB)	Average Amplitude (dB(μV/m))	Average Limit (dB(μV/m))	Average Margin (dB)
1290.3	V	-28.89	24.19	57.36	74	16.64	23.6	54	30.4
1473.7	H	-28.08	24.81	54.09	74	19.91	23.27	54	30.73
2324.6	V	-25.82	27.67	53.86	74	20.14	27.72	54	26.28
2756.2	V	-24.79	29.1	55.9	74	18.1	28.97	54	25.03

Table 18. Results for radiated spurious emissions > 1 GHz; Channel 11, 48 Mbps.

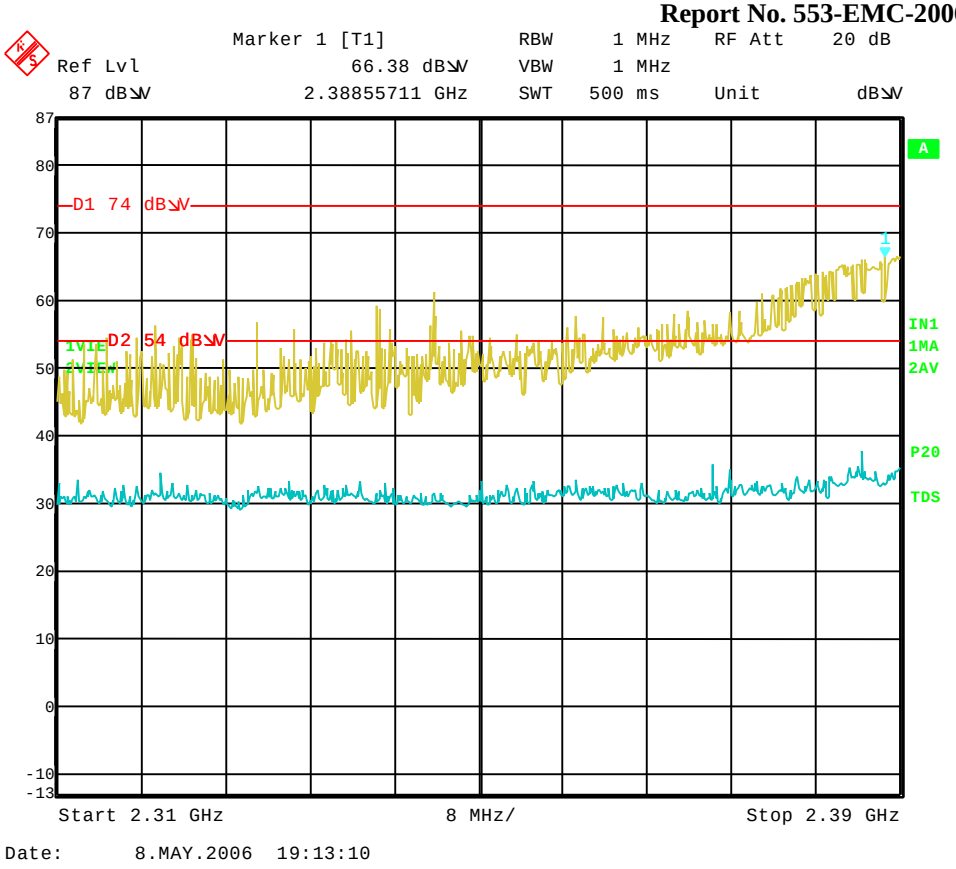


Figure 11. Radiated spurious emissions; Channel 1, 11 Mbps, vertical polarization.

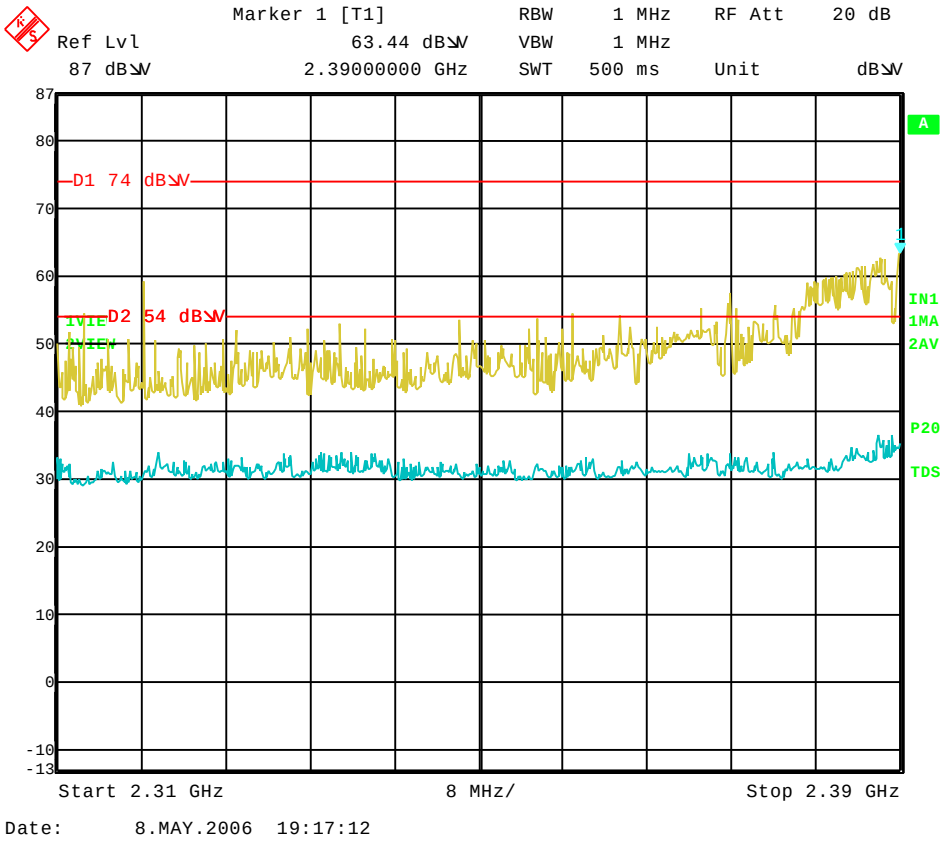


Figure 12. Radiated spurious emissions; Channel 1, 11 Mbps, horizontal polarization.

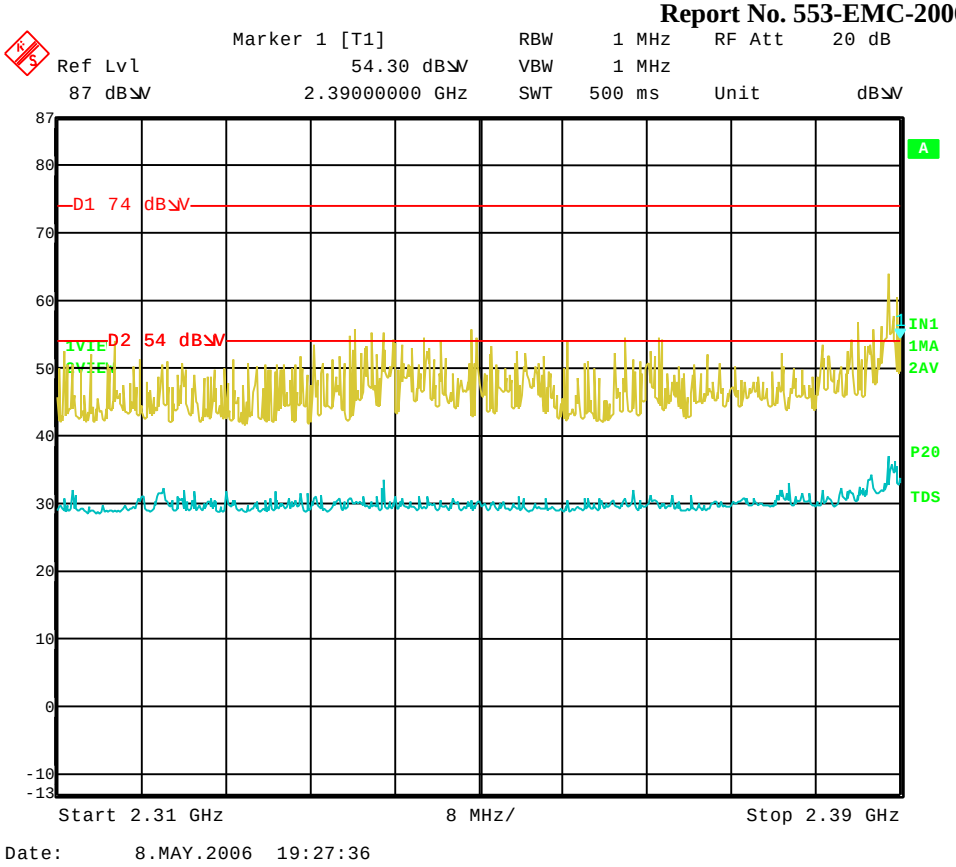


Figure 13. Radiated spurious emissions; Channel 1, 48 Mbps, vertical polarization.

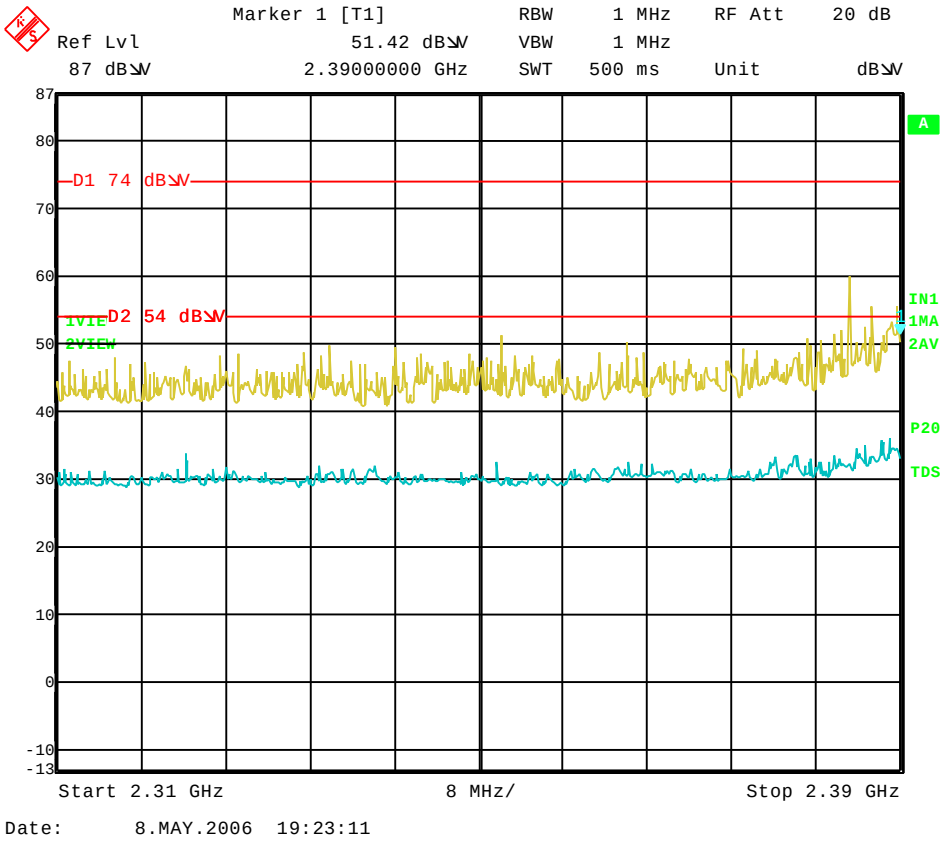


Figure 14. Radiated spurious emissions; Channel 1, 48 Mbps, horizontal polarization.

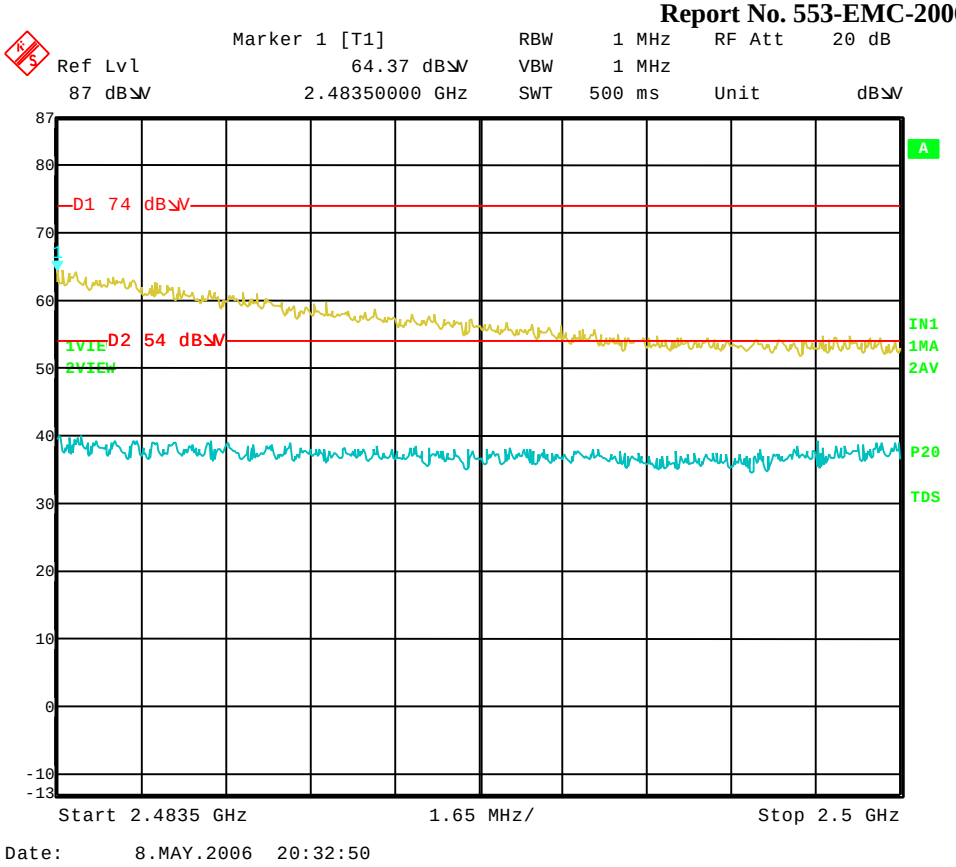


Figure 15. Radiated spurious emissions; Channel 11, 11 Mbps, vertical polarization.

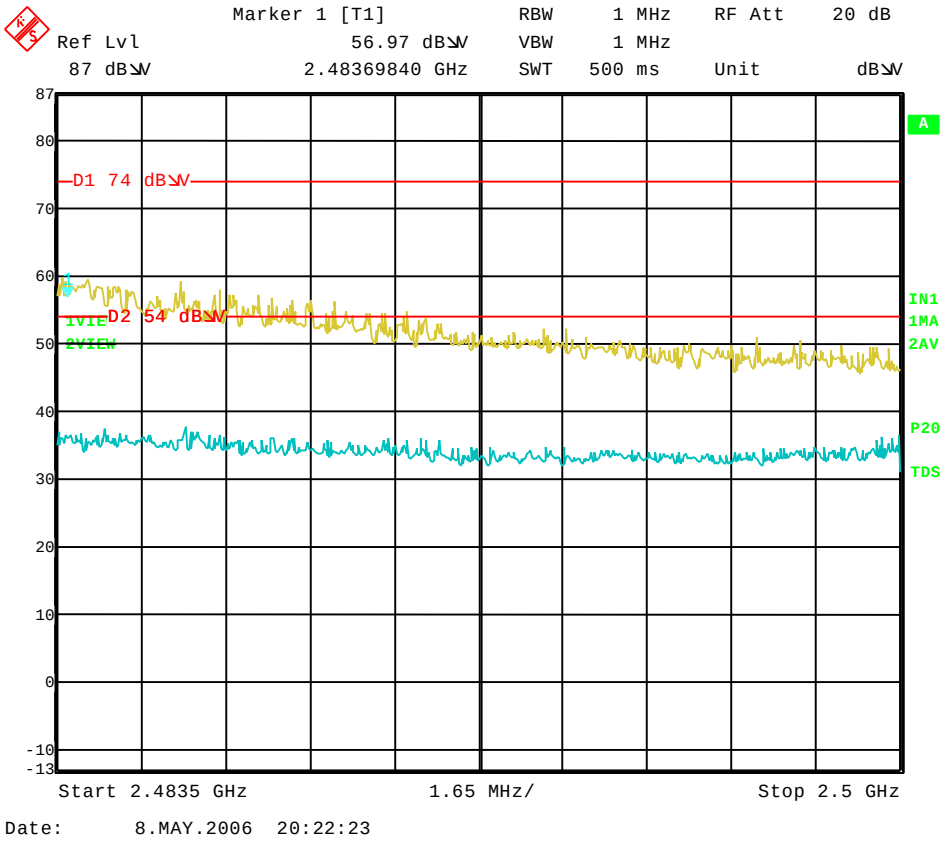


Figure 16. Radiated spurious emissions; Channel 11, 11 Mbps, horizontal polarization.

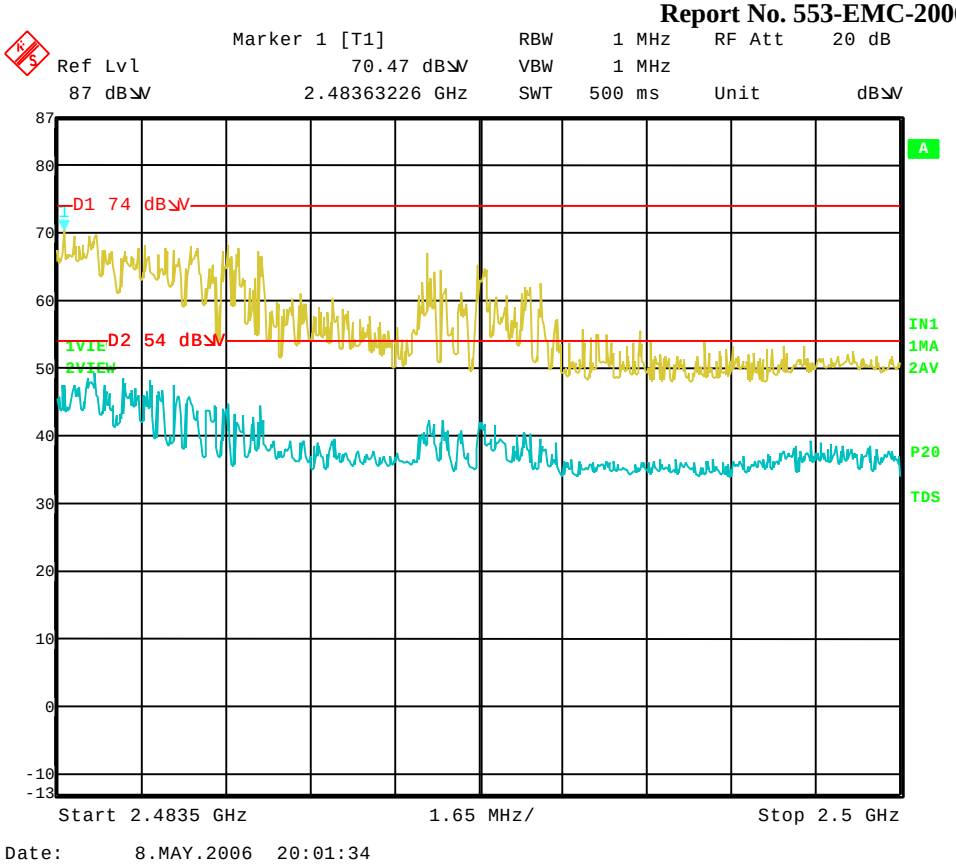


Figure 17. Radiated spurious emissions; Channel 11, 48 Mbps, vertical polarization.

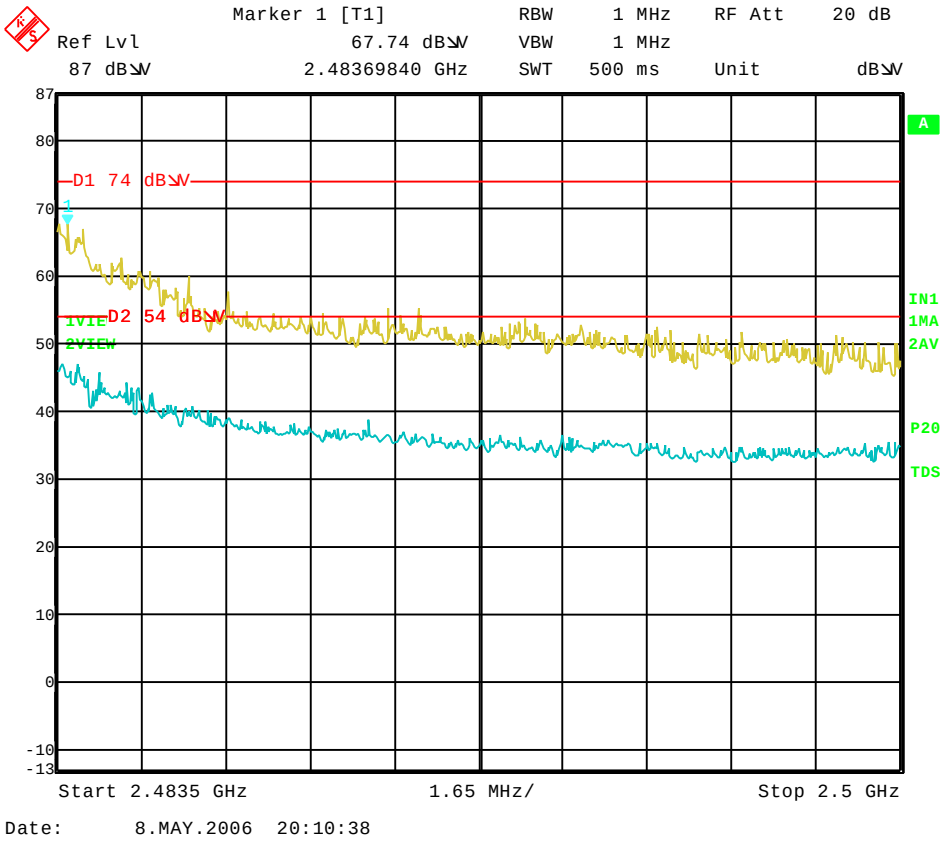


Figure 18. Radiated spurious emissions; Channel 11, 48 Mbps, horizontal polarization.

Figure 19. Test configuration for transmitter spurious emissions (front view).

Figure 20. Test configuration for transmitter spurious emissions (front view).

8.6 CONDUCTED EMISSIONS

Criteria for Conducted Emissions [1**]:** The emissions conducted onto the AC power line by the EUT shall not exceed the values in Table 19.

Frequency Range (MHz)	**Quasi-peak Limit (dB(μV))**	**Average Limit (dB(μV))**
0.15 - 0.5	66 to 56	56 to 46
0.5 - 5	56	46
5 - 30	60	50

Table 19. Limits for conducted emissions.

Test Procedure for Conducted Emissions: The test configuration shown in Figures 21 and 22 was used for this testing. Conducted emissions testing was performed in an 18 ft. x 18 ft. all-welded shielded room located at Lexmark International's EMC test facilities. This facility is registered with the FCC (registration number 949691).

The EUT configuration shown in Section 5 was placed atop a 0.8 meter high wooden table with a rectangular surface measuring 1.5m x 1.0m. The back edges of all devices were located 40 cm from the metal wall of the shielded room.

The AC line cord of the EUT was plugged into the LISN (Line Impedance Stabilization Network) with the excess of the EUT line cord length bundled in the center. The USB cable was draped down from the rear of the EUT and PC, but hung no closer than 40 cm to the floor (ground plane). The excess of these cables were serpentined to form a bundle 30-40 cm in length, with the overall length of the cable not to exceed 1.0 meter in length

The EUT was exercised by sending print data to the printer via a wireless router.

Results for Conducted Emissions: Tables 20 - 22 contain the conducted emission results for one mode on the high, low and middle channels. The EUT met the requirements for conducted emissions given in Table 19.

Frequency (MHz)	Line	Correction Factors (dB)	Quasi-peak Amplitude (dB(mV))	Quasi-peak Limit (dB(mV))	Quasi-peak Margin (dB)	Average Amplitude (dB(mV))	Average Limit (dB(mV))	Average Margin (dB)
0.152	Phase	11.218	50.75	65.94	**15.19**	22.4	55.94	33.54
0.181	Phase	10.692	49.35	65.11	15.76	39.54	55.11	15.57
0.191	Phase	10.692	46.5	64.83	18.33	23.81	54.83	31.02
1.45	Phase	10.18	40.02	56	15.98	39.52	46	**6.48**
0.152	Neutral	11.218	50.62	65.93	15.31	22.26	55.93	33.67
0.157	Neutral	11.218	50.27	65.79	15.52	22.02	55.79	33.77
0.169	Neutral	10.692	48.79	65.47	16.68	21.99	55.47	33.48

Table 20. Limits for conducted emissions; Channel 1, 11 Mbps.

Frequency (MHz)	Line	Correction Factors (dB)	Quasi-peak Amplitude (dB(mV))	Quasi-peak Limit (dB(mV))	Quasi-peak Margin (dB)	Average Amplitude (dB(mV))	Average Limit (dB(mV))	Average Margin (dB)
0.153	Phase	11.218	50.76	65.93	15.17	22.38	55.93	33.55
0.16	Phase	11.218	49.8	65.73	15.93	21.8	55.73	33.93
0.174	Phase	10.692	47.98	65.31	17.33	27.9	55.31	27.41
0.152	Neutral	11.218	50.81	65.95	**15.14**	22.41	55.95	33.54
0.163	Neutral	10.692	49.6	65.64	16.04	21.58	55.64	34.06
0.18	Neutral	10.692	48.7	65.14	16.44	38.63	55.14	**16.51**

Table 21. Limits for conducted emissions; Channel 6, 11 Mbps.

Frequency (MHz)	Line	Correction Factors (dB)	Quasi-peak Amplitude (dB(mV))	Quasi-peak Limit (dB(mV))	Quasi-peak Margin (dB)	Average Amplitude (dB(mV))	Average Limit (dB(mV))	Average Margin (dB)
0.153	Phase	11.218	50.54	65.91	**15.37**	22.22	55.91	33.69
0.162	Phase	10.692	49.5	65.67	16.17	21.6	55.67	34.07
0.167	Phase	10.692	48.73	65.5	16.77	21.5	55.5	34
0.155	Neutral	11.218	50.19	65.86	15.67	21.88	55.86	33.98
0.16	Neutral	11.218	49.65	65.73	16.08	21.67	55.73	34.06
0.177	Neutral	10.692	48.01	65.21	17.2	34.52	55.21	20.69

Table 22. Limits for conducted emissions; Channel 11, 11 Mbps.

Figure 21. Test configuration for transmitter conducted emissions (front view).

Figure 22. Test configuration for transmitter conducted emissions (side view).

8.7 20 dB BANDWIDTH

Test Procedure for 20 dB Bandwidth: The antenna port of the EUT was connected directly to the input of the spectrum analyzer via a short coaxial cable. The resolution and video bandwidths of the analyzer were set to 100 kHz. The frequency span was set so that the entire channel of operation could be displayed on the spectrum analyzer. The max hold function was used to capture the maximum levels over this frequency range. Markers were then used to determine the two frequencies on the upper and lower edge of the channel where the amplitude was 20 dB below the highest amplitude within the channel. The difference in the frequencies of the upper and lower markers represents the 20 dB bandwidth of the channel.

The modes of operation with the highest and lowest data rates on the high, low and middle channels were measured and are reported.

Results for 20 dB Bandwidth: See Table 23 and Figures 23 - 28 for results. The maximum 20 dB bandwidth measured was 17.22 MHz.

Channel	Data Rate (Mbps)	20 dB Bandwidth (MHz)
1	1	17.19
	54	17.12
6	1	17.22
	54	17.12
11	1	17.17
	54	17.12

Table 23. Measured data for 6 dB bandwidths.

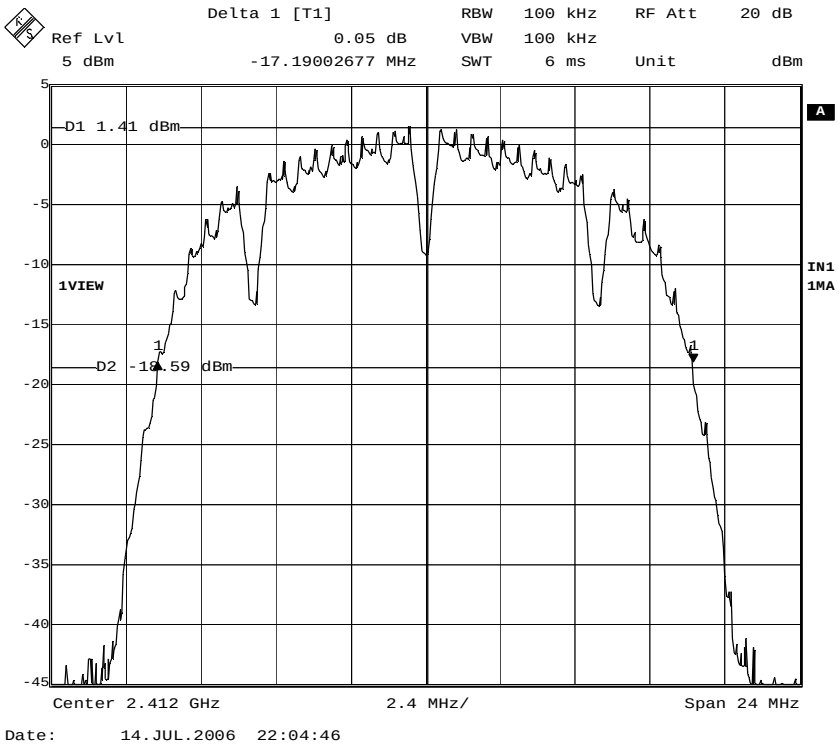


Figure 23. 20 dB bandwidth; Channel 1, 1 Mbps.

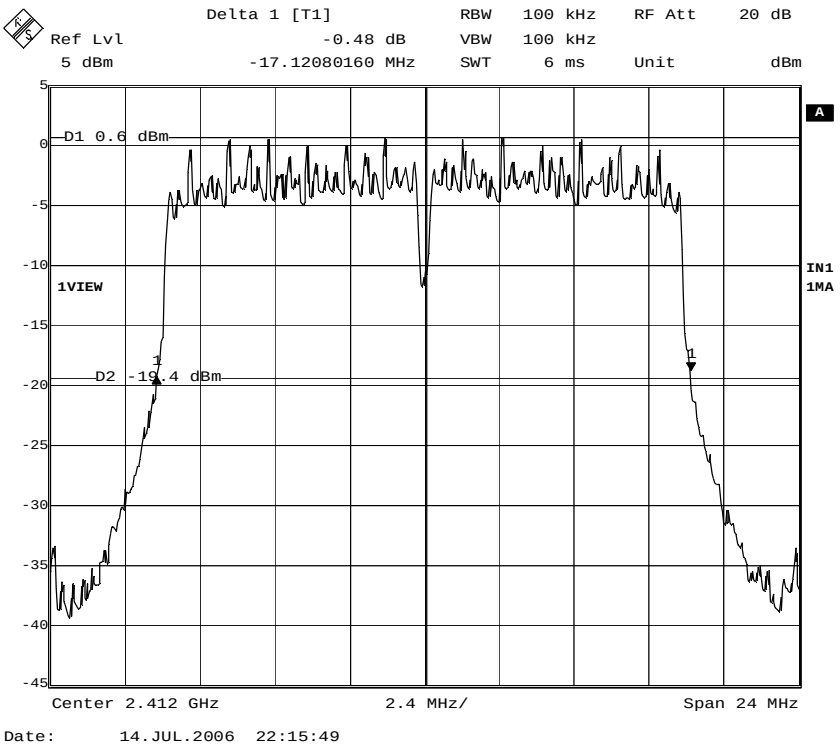


Figure 24. 20 dB bandwidth; Channel 1, 54 Mbps.

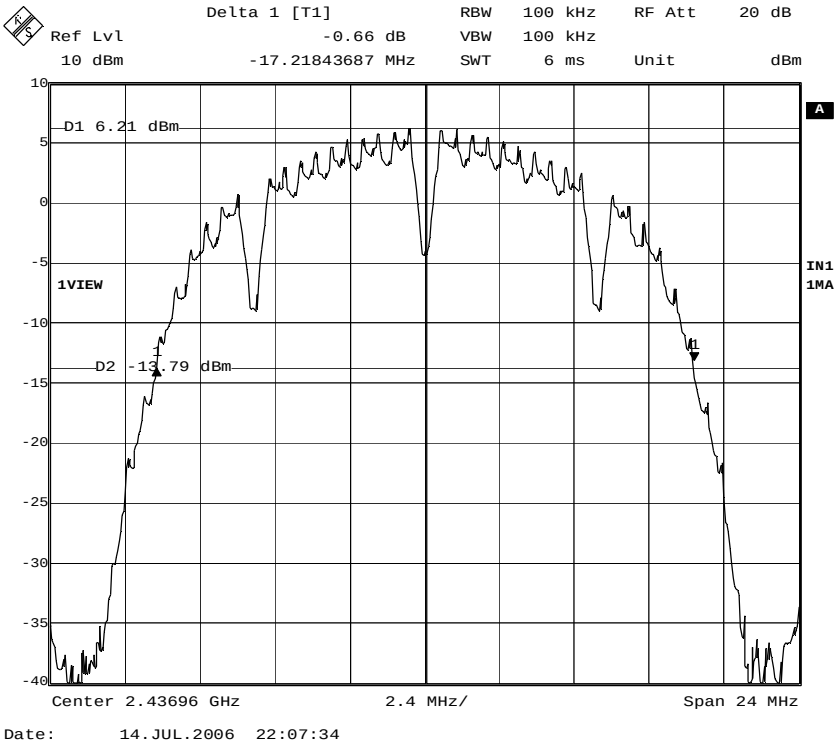


Figure 25. 20 dB bandwidth; Channel 6, 1 Mbps.

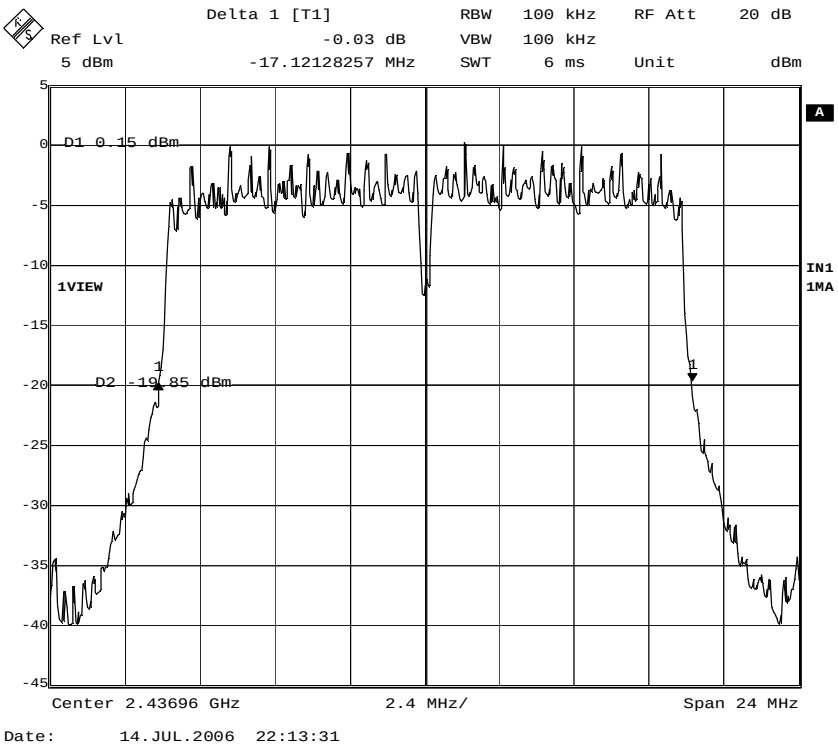


Figure 26. 20 dB bandwidth; Channel 6, 54 Mbps.

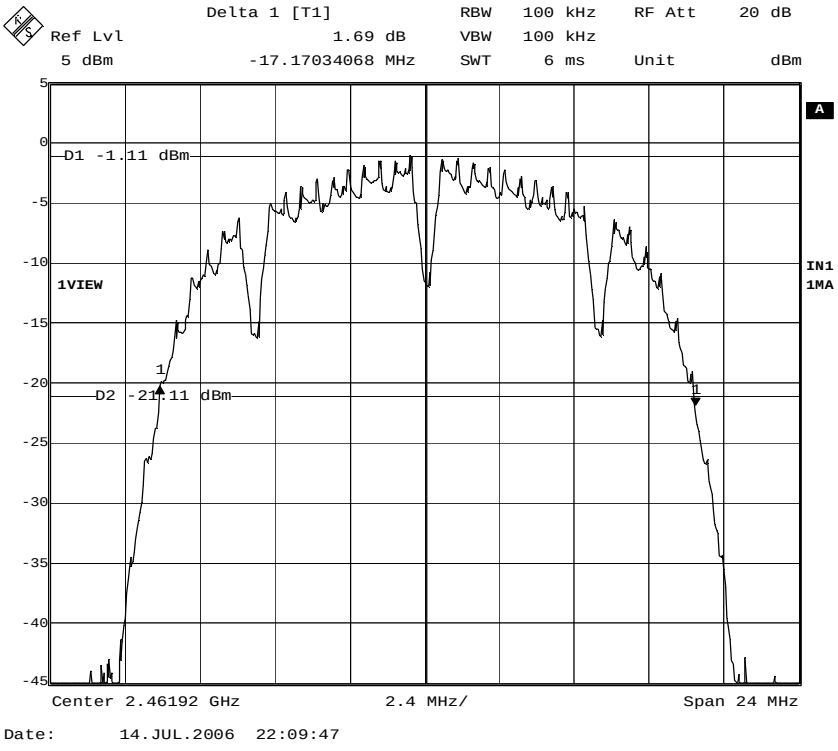


Figure 27. 20 dB bandwidth; Channel 11, 1 Mbps.

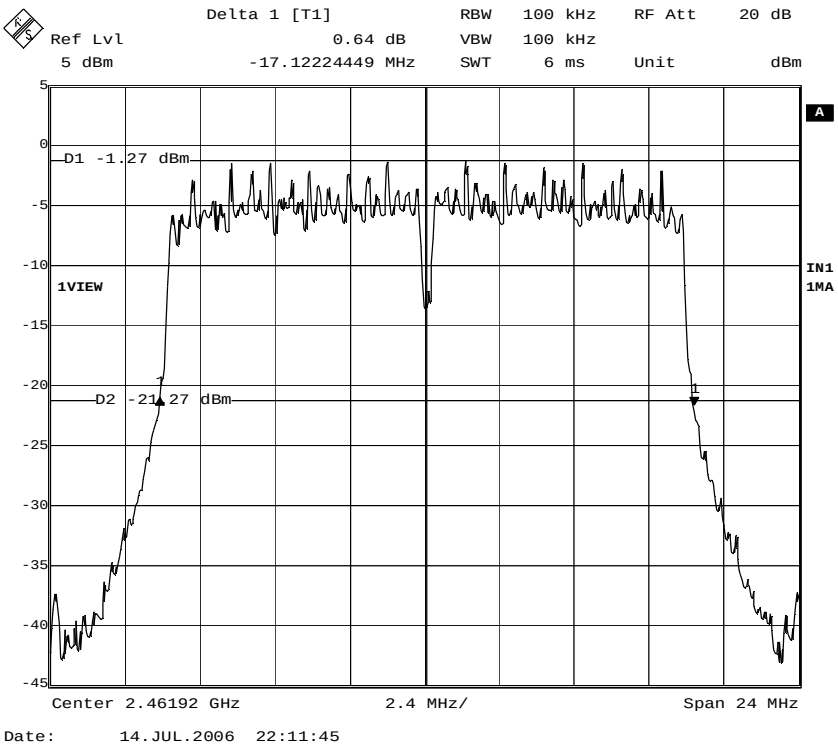


Figure 28. 20 dB bandwidth; Channel 11, 54 Mbps.

8.8 MAXIMUM PERMISSIBLE EXPOSURE CALCULATIONS

Test Procedure for Maximum Permissable Exposure: Using the power measurements previously reported in this report, the power density at a distance of 20 cm from the EUT must be calculated.

The power density at a distance *d* from an antenna can be calculated from the following equation:

$$s = \frac{P_{inc} G}{4pd^2}$$

where P_{inc} is the power incident to the antenna and *G* is the gain of the antenna. From the conducted power measurements previously reported, the maximum for all modes of operation is 21.31 dBm (135.21 mW). Given the gain of the antenna to be 2 dBi (1.585), the power density at a distance of 20 cm from the EUT is given by:

$$s = \frac{(135.21mW)(1.585)}{4p(20cm)^2} = \frac{0.0426mW}{cm^2}$$

It is expected that due to the nature of the EUT, the user will be located at least 20 cm from the EUT.

Criteria for Maximum Permissable Exposure: Per §1.1310 of the FCC Rules, the limit of radiation exposure for a device operating in the frequency range of 2400 - 2483.5 MHz under the Limits for General Population/Uncontrolled Exposure, the maximum power density is 1.0 mW/cm^2. The EUT was well below this value for separation distances of 20 cm or greater.

NOTE:

The following conditions apply to this report:

This report shall not be --

1. **reproduced without the permission of the Lexmark EMC Department, nor**

2. **reproduced, except in full.**