Certification Report for WLAN 6220 Corporate Service Unit

FCC Part 15 & Industry Canada RSS-210

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Approvals

Function	Name	Job title	Signature
Document Release Approval	Real Perriard	Project Manager	Nov 26, 2004
Author	Denis Lalonde	Radio Compliance Discipline Leader	Nov. 26, 2004
Technical Reviewer	Jacques Rollin	EMC Advisor	Nov 26, 2004

Accreditations

Solectron Design & Engineering test facilities are accredited by the Standards Council of Canada (SCC) in accordance with the scope of accreditation outlined at the following web site http://www.scc.ca/scopes/reg126-eng-s.pdf. [1]. The SCC is a member of the APLAC [13] and ILAC [14] organizations which, through mutual recognition arrangements, provide accreditation of test facilities in the member countries.

Solectron Design & Engineering is ISO 9001:2000 and ISO-IEC 17025 certified and its processes are documented in the Solectron Design & Engineering Quality Manual [2] and Lab Operations Manual [3].

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1. Executive Summary

This test report documents the measurements performed on the WLAN 6220 Corporate Service Unit as part of an Original Equipment FCC and Industry Canada application.

The FCCID and Industry Canada certification number for this equipment are the following:

- FCCID: SQD-WCAP6220CSU
- IC: 5340A-6220CSU

On the basis of measurements performed in October and November 2004, the WLAN 6220 Corporate Service Unit is verified to be compliant with FCC Part 15 and Industry Canada RSS-210 requirements. The test data included in this report apply to the product titled above manufactured by MTI Co., Ltd. A detailed summary of compliance results is found in Table 2-1.

2. Compliance Summary

This section summarizes all the measurements performed on WLAN 6220 Corporate Service Unit and its compliance to FCC Part 15 and Industry Canada RSS-210.

Table 2-1: Compliance Results Summary

Product Summary			
Product Name:	WLAN 6220 Corporate Service Unit	Project Manager:	Real Perriard
Product Code:	6220	Measurements by :	D. Lalonde
Product Status:		Date:	Oct. 28 to Nov. 12, 2004

Test Cases					
Performed	**Description**	**Specification**	**Test Results**		**Notes**
			Pass	Fail	
■	RF Power	FCC Part 15.247 b) 3) RSS-210 6.2.2 o) b)	■	☐	
■	6 dB Bandwidth	FCC Part 15.247 a) 2)	■	☐	
■	Peak Power Spectral Density	FCC Part 15.247 d) RSS-210 6.2.2 o) b)	■	☐	
■	Conducted Spurious Emissions	FCC Part 15.247 c) RSS-210 6.2.2 o) e1)	■	☐	
■	Field Strength of Spurious Emissions	FCC Part 15.247 c)	■	☐	
■	Receiver Spurious Emissions	RSS-210 7.3	■	☐	
☐	AC Mains Conducted Emissions	FCC 2.1047 RSS-210 6.6 & 7.4	☐	☐	The equipment does not connect to public AC Mains
■	RF Exposure	FCC 1.1310 RSS-210 14.	■	☐	

3. Equipment Under Test (EUT)

3.1 Product Functional Description

The product trade name of the unit tested was "WLAN 6220 Corporate Service Unit".

The Wireless LAN Cable Access Point 6220 is an outdoor hardened, access point solution designed to extend the reach of cable operators' hybrid fiber coax network utilizing wireless technologies from existing rights of way. This solution from Nortel Networks provides cable operators a fast, low-cost alternative for delivering service to new customers by eliminating the time, permitting, and construction costs associated with extending aerial or buried drops.

Figure 3-1 shows pictures of the tested product.

Figure 3-1 Product Description

3.2 Manufacturer Information

Company Name	MTI Co., Ltd
Mailing Address	166-10 Karak-Dong, Songpa-ku, Seoul, Korea, 138-810
Product Name	WLAN 6220 Corporate Service Unit

3.3 Transmitter Specifications

Table 3-1 lists the specifications of the transmitter under test.

Table 3-1: Transmitter Specifications

Circuit Pack	Fundamental Frequencies (MHz)
Tx power	12.9 dBm
Tx frequency	2400 to 2483.5 MHz
Modulation	IEEE 802.11 b
Antenna gain	Built-in Panel Antenna (ET-PR12): 12.0 dBi

3.4 System Components

The system tested consists of the following units, as shown in Table 3-2.

Table 3-2: EUT Components

Component	Model	Serial Number
WLAN Access Point Unit CSU	NTPM99BC	NNTMDM20003A

3.5 EUT Interfaces and Cables

The system contained the following interfaces, as shown in Table 3-3:

Table 3-3: System Cables

Interface Type	EUT Connection	Description	Type	Length	Qty
Power and data	RJ45 connector	Category 5 with 4 twisted pairs	Shielded	10 m	1

3.6 Support Equipment

The support equipment used for operation and monitoring of the EUT is described in Table 3-4.

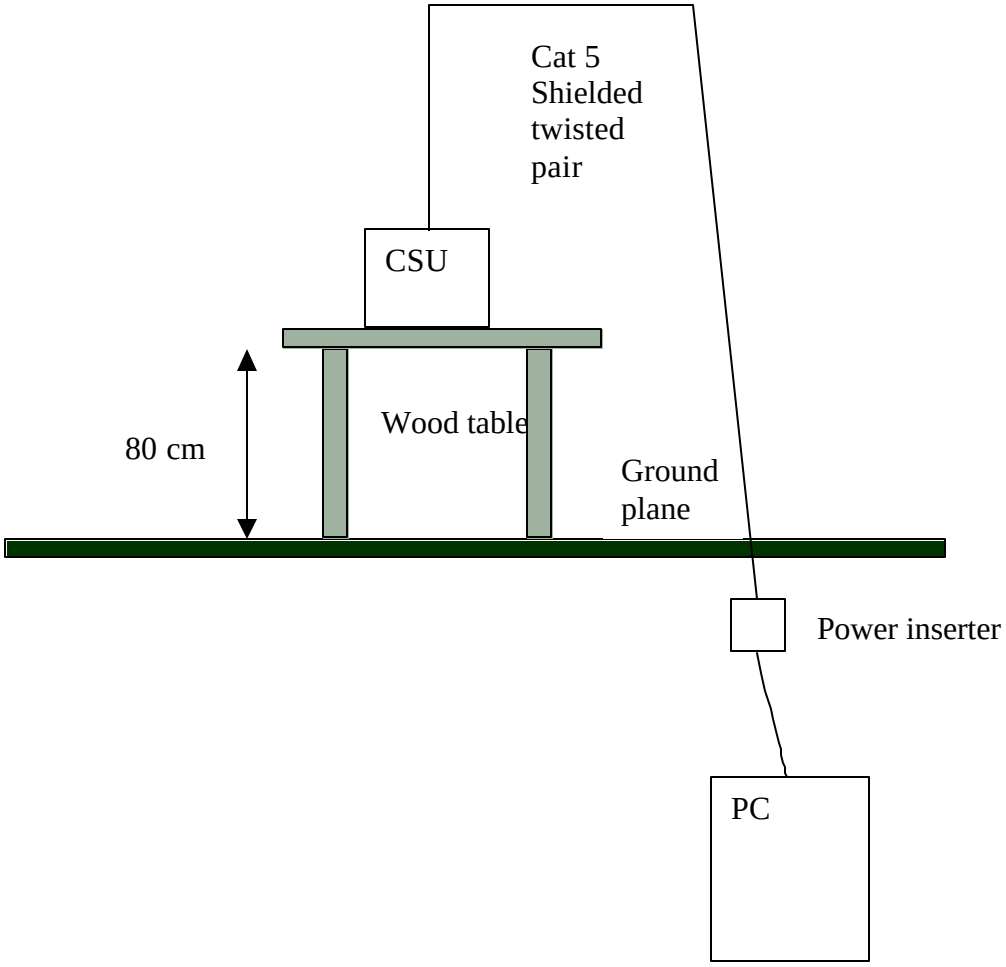
Table 3-4: Support Equipment

Description	Manufacturer	Model Number
PC	IBM	Thinkpad 600E
Power Inserter	Intermec	MobileLAN Power 071620-001

3.7 System Set-up and Test Configurations

The system configuration used for all test cases is presented in Figure 3-2.

Figure 3-2: EUT Configuration



A photograph of the test setup used in this test report is presented in Appendix B: Test Set-up Photographs, on page 37.

3.8 System Modifications

No modifications were required to pass the requirements.

4. General Test Conditions

4.1 Test Facility

Radiated emissions testing was performed in a 3-meter Ambient Free Chamber (AFC) located at the Electronics Test Centre MPB Technologies Inc., 302 Legget Drive, Kanata, Ontario, Canada. The AFC consists of a shielded room lined with ferrite tiles and RF absorbing material.

These test facilities are approved and registered by Industry Canada and the FCC.

4.2 Measurement Instrumentation

The measurement instrumentation conforms to ANSI C63.2 [5] and CISPR 16 [6]. Calibration of the measurement instrumentation is maintained in accordance with the supplier's recommendations, or as necessary to ensure its accuracy.

5. Detailed Test Results

5.1 RF Power

5.1.1 Test Specification

The system was tested to the requirements listed in Table 5-1:

Table 5-1: RF Power Requirements

Requirement	Part / Section
FCC	15.247 b) 3)
RSS-210	6.2.2 o) b)

5.1.1.1 Limits

The system was tested to the rated power of the EUT, listed in Table 5-2. In the case where transmitting antennas of directional gain greater than 6 dBi were used, the peak output power from the intentional radiator was reduced below 1W by the amount in dB that the directional gain of the antenna exceeded 6 dBi.

Table 5-2: RF Power Limit

Antenna	Power Reduction Because of Antenna Directional Gain	Power Limit
Built-in Panel Antenna (ET-PR12): 12.0 dBi	30 dBm – (12 – 6) dB	24 dBm

The value used for the RF power limit is 24 dBm.

5.1.2 Test Facility Information

Location: Solectron Design & Engineering Lab 1

Date tested: October 28, 2004

Tested by: Denis Lalonde

5.1.3 Test Procedure

The CSU was opened and the antenna disconnected, the output port of the radio transmitter was then connected to a power meter.

The RF signal was set at both extremities and in the middle of the frequency band. The power measurement was repeated for all the bit rate capabilities of the equipment.

5.1.4 Test Results

Test results are shown in Table 5-3.

Table 5-3: RF Power Levels

Channel (MHz)	RF Power at 1 Mbps (dBm)	RF Power at 2 Mbps (dBm)	RF Power at 5.5 Mbps (dBm)	RF Power at 11 Mbps (dBm)
2412 (channel 1)	12.9	12.1	11.1	10.6
2437 (channel 6)	12.8	12.0	11.0	10.5
2462 (channel 11)	12.9	12.1	11.1	10.5

5.1.5 Test Conclusion

The test results met the requirement.

5.1.6 Test Equipment List

Table 5-4: Test Equipment used for RF Power

Category	Manufacture	Model Number	Serial Number	Cal. Due
Power meter	Anritsu	M2438A	SSG012588	27 April 2005
Power sensor	Anritsu	M2424A	SSG012587	27 April 2005

The measurement instrumentation conforms to ANSI C63.2[5] and CISPR 16 [6].Calibration of the measurement instrumentation is maintained in accordance with the supplier's recommendations, or as necessary to ensure its accuracy.

5.2 6 dB Bandwidth

5.2.1 Test Specification

The system occupied bandwidth was evaluated according to the specifications listed in Table 5-5:

Table 5-5: Occupied Bandwidth

Requirement	Part / Section
FCC	15.247 a) 2)

5.2.2 Test Facility Information

Location: Solectron Design & Engineering Lab 1

Date tested: October 28, 2004

Tested by: Denis Lalonde

5.2.3 Limits

The system was tested to the requirement listed in Table 5-6.

Table 5-6: 6 dB Occupied Bandwidth Limit

6 dB Occupied Bandwidth Limit
> 500 kHz

5.2.4 Test Procedure

Three occupied bandwidth measurements were performed at channel 1, 6, and 11. The bit rate used for the occupied bandwidth was 11 Mbps.

For all of these measurements, the radio module output was connected to the spectrum analyzer through a RF cable.

5.2.5 Test Results

Table 5-7 lists the occupied bandwidth calculated and measured:

Table 5-7: Occupied Bandwidth Values

Channel	Bandwidth (MHz)	Reference
1	10.25	Figure 7-2
6	10.2	Figure 7-3
11	10.25	Figure 7-4

5.2.6 Test Conclusion

The test results met the requirement.

5.2.7 Test Equipment List

Table 5-8: Test Equipment used for 6 dB Occupied Bandwidth

Category	Manufacture	Model	Description	Serial Number	Cal. Due
Spectrum analyzer	HP	8564E	40 GHz	3835A01346	28/04/2005

The measurement instrumentation conforms to ANSI C63.2[5]. Calibration of the measurement instrumentation is maintained in accordance with the supplier's recommendations, or as necessary to ensure its accuracy.

5.3 Peak Power Spectral Density

5.3.1 Test Specification

The system was tested to the limits of the requirements listed in Table 5-9:

Table 5-9: Emission Mask Requirement

Requirement	Part / Section
FCC	15.247 a) 2)

5.3.1.1 Limits

The specification levels in Table 5-10 were used.

Table 5-10: Peak Power Spectral Density Limits

Peak Power Spectral Density Limits
8 dBm in any 3 kHz

5.3.2 Test Facility Information

Location: Solectron Design & Engineering Lab 1

Date tested: October 28, 2004

Tested by: Denis Lalonde

5.3.3 Test Procedure

Peak power spectral density measurements were performed on channel 1, 6, and 11 for all 4 bit rates (1, 2, 5.5 and 11 Mbps).

For all of these measurements, the EUT RF output was connected to the spectrum analyzer through a calibrated RF cable.

5.3.4 Test Results

Table 5-11 lists the highest emissions measured:

Table 5-11: Peak Power Spectral Density Results

Channel	Bit rate (Mbps)	PSD (dBm)	Reference
1	1	-2.7	Figure 7-5
	2	-1.5	Figure 7-6
	5.5	-7.8	Figure 7-7
	11	-11.5	Figure 7-8
6	1	-6.2	Figure 7-9
	2	-7.7	Figure 7-10
	5.5	-8.3	Figure 7-11
	11	-9.7	Figure 7-12
11	1	-1.5	Figure 7-13
	2	-9.8	Figure 7-14
	5.5	-9.7	Figure 7-15
	11	-11.5	Figure 7-16

5.3.5 Test Conclusion

The test results met the requirement.

5.3.6 Test Equipment List

Table 5-12: Test Equipment used for Peak Power Spectral Density

Category	Manufacture	Model	Description	Serial Number	Cal. Due
Spectrum analyzer	HP	8564E	40 GHz	3835A01346	28/04/2005

The measurement instrumentation conforms to ANSI C63.2[5]. Calibration of the measurement instrumentation is maintained in accordance with the supplier's recommendations, or as necessary to ensure its accuracy.

5.4 Conducted Spurious Emissions

5.4.1 Test Specification

The system was tested to the limits of the requirements listed in Table 5-13:

Table 5-13: Conducted Spurious Emissions Requirement

Requirement	Part / Section
FCC 15	15.247 c)
RSS-210	6.2.2 o) e1)

5.4.1.1 Limits

The following specification levels are applicable to this test:

Table 5-14: Conducted Spurious Emission Limit

Frequency Range (MHz)	Limit (dBc)
0 to 24620	-20 dBc in any 100 kHz

5.4.2 Test Facility Information

Location: Solectron Design & Engineering Lab 1

Date tested: October 28, 2004

Tested by: Denis Lalonde

5.4.3 Test Procedure

Conducted spurious emissions were measured at channel 1, 6, and 11. The measurement was performed while the bit rate was set to 1 Mbps to maximize the level of transmitter harmonics.

The EUT output was connected to the spectrum analyzer through a calibrated RF cable.

5.4.4 Test Results

The test result are shown in Table 5-15.

Table 5-15: Conducted Spurious Emissions

Channel (MHz)	Results	Reference
2412 (channel 1)	-49.0 dBc at 290 MHz -37.7 dBc at 2398.08 MHz	Figure 7-17 & Figure 7-18
2437 (channel 6)	-46.8 dBc at 290 MHz	Figure 7-19
2462 (channel 11)	-49.3 dBc at 290 MHz -58.0 dBc at 2769 MHz -60.7 dBc at 2488.08 MHz	Figure 7-20 & Figure 7-21

5.4.5 Test Conclusion

The test results met the requirement.

5.4.6 Test Equipment List

Table 5-16: Test Equipment used for Conducted Spurious Emissions

Category	Manufacture	Model Number	Description	Serial Number	Cal. Due
Spectrum analyzer	HP	8564E	40 GHz	3835A01346	28/04/2005

The measurement instrumentation conforms to ANSI C63.2[5] and CISPR 16 [6]. Calibration of the measurement instrumentation is maintained in accordance with the supplier's recommendations, or as necessary to ensure its accuracy.

5.5 Field Strength of Spurious Emissions

5.5.1 Test Specification

The system was tested to the limits of the following requirements:

Table 5-17: Emission Mask Requirement

Requirement	Part / Section
FCC Part 15	15.247 c)

5.5.1.1 Limits

The following specification levels are worst-case limits taken from all test specifications.

Table 5-18: Field Strength of Spurious Emissions Limit

Restricted Bands as per FCC Part 15.205	Radiated Emissions Limit at 3 m, AVG detection (dBuV/m)	Radiated Emissions Limit at 3 m, Peak detection (dBuV/m)
37.5–38.25 MHz	40	60
73–74.6 MHz	40	60
74.8–75.2 MHz	40	60
108–121.94 MHz	43.5	63.5
123–138 MHz	43.5	63.5
149.9–150.05 MHz	43.5	63.5
156.7–156.9 MHz	43.5	63.5

Restricted Bands as per FCC Part 15.205	Radiated Emissions Limit at 3 m, AVG detection (dBuV/m)	Radiated Emissions Limit at 3 m, Peak detection (dBuV/m)
156.52475–156.52525 MHz	43.5	63.5
162.0125–167.17 MHz	43.5	63.5
167.72–173.2 MHz	43.5	63.5
240–285 MHz	46	66
322–335.4 MHz	46	66
399.9–410 MHz	46	66
608–614 MHz	46	66
960–1240 MHz	54	74
1300–1427 MHz	54	74
1435–1626.5 MHz	54	74
1645.5–1646.5 MHz	54	74
1660–1710 MHz	54	74
1718.8–1722.2 MHz	54	74
2200–2300 MHz	54	74
2310–2390 MHz	54	74
2483.5–2500 MHz	54	74
2655–2900 MHz	54	74
3260–3267 MHz	54	74
3332–3339 MHz	54	74
3345.8–3358 MHz	54	74
3600–4400 MHz	54	74
4.5–5.15 GHz	54	74
5.35–5.46 GHz	54	74
7.25–7.75 GHz	54	74
8.025–8.5 GHz	54	74
9.0–9.2 GHz	54	74
9.3–9.5 GHz	54	74
10.6–12.7 GHz	54	74
13.25–13.4 GHz	54	74
14.47–14.5 GHz	54	74
15.35–16.2 GHz	54	74
17.7–21.4 GHz	54	74

Restricted Bands as per FCC Part 15.205	Radiated Emissions Limit at 3 m, AVG detection (dBuV/m)	Radiated Emissions Limit at 3 m, Peak detection (dBuV/m)
22.01–23.12 GHz	54	74
23.6–24.0 GHz	54	74

5.5.2 Test Facility Information

Location: Electronic Test Centre, MPB Technologies

Date tested: November 9 to 12, 2004

Tested by: Scott Drysdale

5.5.3 Test Procedure

The test was performed as per the relevant Test procedures: ANSI C63.4-2003 [4].

The system was tested in the following manner:

- The EUT was placed on a 80 cm high wooden table which was set on a turntable inside the AFC and it was configured as in normal operation. The cable routed up to a 2 m high wooden rack and then routed outside of the AFC where the EUTs support equipment was installed. The system was grounded in accordance with its normal installation specifications. No additional grounding connections are allowed.
- For tests between:
  - 30 MHz and 1 GHz, a broadband bilog antenna was placed at a 3 m distance;
  - 1 GHz and 2 GHz, a horn antenna , LNA, and a 1 GHz to 2 GHz band pass filter were placed at a 3 m distance.
  - 2 GHz and 3 GHz, a horn antenna , LNA (with 20 dB attenuator in front of it) were placed at a 3 m distance.
  - 3 GHz and 12.5 GHz, a horn antenna , LNA, and a 3 GHz high pass filter were placed at a 3 m distance.
  - 12.5 GHz and 26.5 GHz, a horn antenna and a LNA were placed at a 1 m distance.
- Between 30 MHz and 12.5 GHz, a pre-scan was performed to find emissions (frequencies) requiring detail measurement. The pre-scan was performed by rotating the system 360 degrees while recording all emissions (frequency and amplitude). This procedure was repeated for antenna heights of 1 to 4 meters, in steps of 1 meter, and for horizontal and vertical polarizations of the receiving antenna.
- Between 12.5 GHz 25 GHz, a pre-scan was performed to find emissions (frequencies) requiring detail measurement. The pre-scan was performed by rotating the system 360 degrees while recording all emissions (frequency and amplitude) at a antenna height of 1 meter. This procedure was repeated for horizontal and vertical polarizations of the

receiving antenna. The search of emissions in this frequency range also included the manual sweeping of the test antenna around a 1 meter sphere that surrounds the EUT.

- Prescan optimization was performed based on the pre-scan data. All frequencies, having emission levels within 10 dB of the specification(s) limits, were optimized. For each such frequency, the EUT was rotated in azimuth over 360 degrees and the direction of maximum emission was noted. Antenna height was then varied from 1 to 4 meters at this azimuth to obtain maximum emissions. Then the maximum level measured was recorded.
- The frequency range investigated was 30 MHz to 26 GHz.
- Between 30 MHz and 1 GHz, a resolution bandwidth of 120 kHz was used.
- Above 1 GHz, a 1 MHz resolution bandwidth and 3 kHz video bandwidth were used for the prescans. The video bandwidth was reduced to 3 Hz for optimization measurements.

The measurements were performed while the radio transmitted a 1 Mbps signal to maximize the level of transmitter harmonics. The internal panel antenna (12 dBi gain) was used to maximize the level of radiated emissions. All tests were repeated for operation on channel 1, 6, and 11.

Plots of the 30 MHz to 8 GHz prescan measurements are shown in Appendix F: Field Strength of Spurious Emissions Plots.

5.5.4 Test Results

Table 5-19 and Table 5-20 list the highest emissions measured:

Table 5-19: E-field Radiated Emissions Test Results #1 (Average Detection)

Parameter	Unit	Channel 1	Channel 1	Channel 1	Channel 1	Channel 6	Channel 6
Frequency	(MHz)	2390	2483.5	2715.27	4823.93	2390	2483.5
Azimuth	(deg)	7	40	351	18	2	2
Height	(cm)	143	125	149	149	122	122
Polarization		Vert	Vert	Vert	Vert	Vert	Vert
Meter Reading	(dBµV)	37.6	35.4	41.5	51.0	38.3	38.3
Detector	(Pk,QP,Av)	Av	Av	Av	Av	Av	Av
Gain / Loss Factor	(dB)	-22.7	-22.1	-20.9	-35.3	-22.7	-22.1
Transducer Factor	(dB)	30.3	30.6	31.1	34.8	30.3	30.6
Level	(dBµV/m)	45.2	43.9	51.7	50.5	45.9	46.8
Margin to FCC Part 15	(dB)	8.8	10.1	2.3	3.5	8.1	7.2

Table 5-20: E-field Radiated Emissions Test Results #2 (Average Detection)

Parameter	Unit	Channel 6	Channel 6	Channel 11	Channel 11	Channel 11
Frequency	(MHz)	2736.29	4873.98	2153.36	2390	2483.5
Azimuth	(deg)	4	331	352	275	354
Height	(cm)	123	147	137	108	138
Polarization		Vert	Horz	Vert	Vert	Vert
Meter Reading	(dBµV)	38.5	48.2	37.1	35.7	36.8
Detector	(Pk,QP,Av)	Av	Av	Av	Av	Av
Gain / Loss Factor	(dB)	-20.9	-35.8	-23.4	-22.7	-22.1
Transducer Factor	(dB)	31.2	35.0	29.5	30.3	30.6
Level	(dBµV/m)	48.8	47.4	43.2	43.3	45.3
Margin to FCC Part 15	(dB)	5.2	6.6	10.8	10.7	8.7

Table 5-21: E-field Radiated Emissions Test Results #1 (Peak Detection)

Parameter	Unit	Channel 1	Channel 1	Channel 1	Channel 1	Channel 6	Channel 6
Frequency	(MHz)	2390	2483.5	2715.27	4823.93	2390	2483.5
Azimuth	(deg)	7	40	351	18	2	2
Height	(cm)	143	125	149	149	122	122
Polarization		Vert	Vert	Vert	Vert	Vert	Vert
Meter Reading	(dBµV)	51.6	48.9	52.8	59.5	51.7	51.7
Detector	(Pk,QP,Av)	Pk	Pk	Pk	Pk	Pk	Pk
Gain / Loss Factor	(dB)	-22.7	-22.1	-20.9	-35.3	-22.7	-22.1
Transducer Factor	(dB)	30.3	30.6	31.1	34.8	30.3	30.6
Level	(dBµV/m)	59.2	57.4	63.0	59.0	59.3	60.2
Margin to FCC Part 15	(dB)	14.8	16.6	11.0	15.0	14.7	13.8

Table 5-22: E-field Radiated Emissions Test Results #2 (Peak Detection)

Parameter	Unit	Channel 6	Channel 6	Channel 11	Channel 11	Channel 11
Frequency	(MHz)	2736.29	4873.98	2153.36	2390	2483.5
Azimuth	(deg)	4	331	352	275	354
Height	(cm)	123	147	137	108	138
Polarization		Vert	Horz	Vert	Vert	Vert
Meter Reading	(dBµV)	52.2	56.7	49.8	49.6	50.5
Detector	(Pk,QP,Av)	Pk	Pk	Pk	Pk	Pk
Gain / Loss Factor	(dB)	-20.9	-35.8	-23.4	-22.7	-22.1
Transducer Factor	(dB)	31.2	35.0	29.5	30.3	30.6
Level	(dBµV/m)	62.5	55.9	55.9	57.2	59.0
Margin to FCC Part 15	(dB)	11.5	18.1	18.1	16.8	15.0

5.5.5 Calculation of the Compliance Margin

The following illustrates the manner in which the compliance margin is calculated in the "E-field Radiated Emissions Test Results" table(s) from Section 5.5.4 above.

The rows in these tables are defined as follows:

Meter Reading (dBmV) = Voltage measured using the spectrum analyzer with quasi-peak adapter

Gain/Loss Factor (dB) = Cumulative gain or loss of pre-amplifier and cables used in the measurement path (a negative value indicates gain)

Transducer Factor (dB) = Antenna factor

Level (dBmV/m) = Corrected value or field strength, i.e., the parameter of interest that is compared to the limit

Margin (dB) = Level with respect to the appropriate limit (a positive **Margin** indicates that the **Level** is below the limit and that the measurement is a PASS)

The values in the **Level** row are calculated as follows:

Level = Meter Reading + Gain/Loss Factor + Transducer Factor

The values in the **Margin** row are calculated as follows:

Margin = Limit – Level

5.5.6 Test Conclusion

The test results met the requirement.

5.5.7 Test Equipment List

Table 5-23: Test Equipment used for Field Strength of Spurious Emissions

Description	Manufacture	Model	Asset Number	Cal. Due
Spectrum Analyzer	HP	8566B	2747A05484	23-Jul-05
Quasi-Peak Adapter	HP	85650A	2811A01123	20-Jul-05
Bilog Antenna	Antenna Research	LPB 2520A	5078	Aug-05
Ridged Horn Antenna	Electro Metrics	RGA-60	2966	23-Dec-04
LNA (10 kHz to 20 GHz)	ETC MPB		2316	19-Jul-05
20 dB attenuator	Tenuline	8343-200	291	31-Dec-04
1-2 GHz Band Pass Filter	HP	8430A	SSG012120	13-Oct-05
3 GHz High Pass Filter	Micro Circuits	H3G020G1	SSG012728	31-Aug-05
Horn Antenna (18 - 26.5 GHz)	Emco	3160-09	SSG012292	29-Dec-04
Pre-Amplifier	Narda DBS Microwave	DB95-0040R	SSG012296	29-Dec-04
Spectrum Analyzer-portable	HP	8564E	SSG012069	28-Apr-05
Bulkhead to antenna cable	Semflex		MPB5519	NR
Bulkhead to LNA/SA cable	Semflex		MPB5058	NR

NR: not required

The measurement instrumentation conforms to ANSI C63.2[5] and CISPR 16 [6]. Calibration of the measurement instrumentation is maintained in accordance with the supplier's recommendations, or as necessary to ensure its accuracy.

5.6 Receiver Spurious Emissions

5.6.1 Test Specification

The system was tested to the limits of the following requirements:

Table 5-24: Emission Mask Requirement

Requirement	Part / Section
RSS-210	7.3

5.6.1.1 Limits

The following specification levels are worst-case limits taken from all test specifications.

Table 5-25: Field Strength of Receiver Spurious Emissions Limit

Frequency (MHz)	RSS 210 Table 3 requirement (dBuV/m)
30 – 88	40
88 – 216	43.5
216 – 960	46
960 – 1610	54.0
1610 – 12310	60.0

5.6.2 Test Facility Information

Location: Electronic Test Centre, MPB Technologies

Date tested: November 9 to 12, 2004

Tested by: Scott Drysdale

5.6.3 Test Procedure

The test was performed as per the relevant Test procedures: ANSI C63.4-2003 [4].

The system was tested in the following manner:

- The EUT was placed on a 80 cm high wooden table which was set on a turntable inside the AFC and it was configured as in normal operation. The cable routed up to a 2 m high wooden rack and then routed down to the basement of the AFC where the EUTs support equipment was installed. The system was grounded in accordance with its normal installation specifications. No additional grounding connections were installed.
- For tests between:
  - 30 MHz and 1 GHz, a broadband bilog antenna was placed at a 3 m distance;
  - 1 GHz and 12.5 GHz, a horn antenna and a LNA were placed at a 3 m distance.
- A pre-scan was performed to find emissions (frequencies) requiring detail measurement. The pre-scan (using a peak detector) was performed by rotating the system 360 degrees while recording all emissions (frequency and amplitude). This procedure was repeated for antenna heights of 1 to 4 meters, in steps of 1 meter, and for horizontal and vertical polarizations of the receiving antenna.
- Prescan optimization was performed based on the pre-scan data. All frequencies, having emission levels within 10 dB of the specification(s) limits, were optimized. For each such frequency, the EUT was rotated in azimuth over 360 degrees and the direction of maximum emission was noted. Antenna height was then varied from 1 to 4 meters at this azimuth to obtain maximum emissions. The procedure was repeated for both horizontal and vertical polarizations of the search antenna. Then the maximum level measured was recorded.
- The frequency range investigated was 30 MHz to 12.5 GHz.
- Between 30 MHz and 1 GHz, a resolution bandwidth of 120 kHz was used.
- Above 1 GHz, a 1 MHz resolution bandwidth and 1 MHz video bandwidth were used.

The measurements were performed while the radio was setup in receive/standby mode. The panel antenna (14 dBi gain) was used because it is the antenna with the highest gain.

Plots of the 30 MHz to 12.5 GHz prescan measurements are shown in Appendix F: Field Strength of Spurious Emissions Plots.

5.6.4 Test Results

Table 5-26 lists the highest emissions measured:

Table 5-26: E-field Radiated Emissions Test Results (30-1000 MHz)

Parameter	Unit	Emission 1	Emission 2	Emission 3	Emission 4	Emission 5	Emission 6
Frequency	(MHz)	68.91	96.13	99.04	99.04	330.20	429.27
Azimuth	(deg)	232	342	305	8	140	78
Height	(cm)	107	168	127	169	196	106
Polarization		Vert	Horz	Vert	Horz	Horz	Vert
Meter Reading	(dBµV)	41.7	47.1	45.5	49.4	47.4	49.4
Detector	(Pk,QP,Av)	QP	QP	QP	QP	QP	QP
Gain / Loss Factor	(dB)	-27.6	-27.8	-27.8	-27.8	-26.0	-25.4
Transducer Factor	(dB)	9.3	11.1	10.6	10.6	14.4	16.5
Level	(dBµV/m)	23.4	30.4	28.3	33.1	35.9	40.5
Margin to FCC Part 15	(dB)	16.6	13.1	15.2	10.4	10.1	5.5

Table 5-27: E-field Radiated Emissions Test Results (1 GHz to 12.5 GHz)

Parameter	Unit	Emission 7
Frequency	(MHz)	2153.36
Azimuth	(deg)	352
Height	(cm)	137
Polarization		Vert
Meter Reading	(dBµV)	37.1
Detector	(Pk,QP,Av)	Av
Gain / Loss Factor	(dB)	-23.4
Transducer Factor	(dB)	29.5
Level	(dBµV/m)	43.2
Margin to FCC Part 15	(dB)	10.8

5.6.5 Calculation of the Compliance Margin

The following illustrates the manner in which the compliance margin is calculated in the "E-field Radiated Emissions Test Results" table(s) from Section 5.6.4 above.

The rows in these tables are defined as follows:

Meter Reading (dBmV) = Voltage measured using the spectrum analyzer with quasi-peak adapter

Gain/Loss Factor (dB) =	Cumulative gain or loss of pre-amplifier and cables used in the measurement path (a negative value indicates gain)
Transducer Factor (dB) =	Antenna factor
Level (dBmV/m) =	Corrected value or field strength, i.e., the parameter of interest that is compared to the limit
Margin (dB) =	Level with respect to the appropriate limit (a positive **Margin** indicates that the **Level** is below the limit and that the measurement is a PASS)

The values in the **Level** row are calculated as follows:

Level = Meter Reading + Gain/Loss Factor + Transducer Factor

The values in the **Margin** row are calculated as follows:

Margin = Limit – Level

5.6.6 Test Conclusion

The test results met the requirement.

5.6.7 Test Equipment List

Table 5-28: Test Equipment used for Field Strength of Spurious Emissions

Description	Manufacture	Model	Asset Number	Cal. Due
Spectrum Analyzer	HP	8566B	2747A05484	23-Jul-05
Quasi-Peak Adapter	HP	85650A	2811A01123	20-Jul-05
Bilog Antenna	Antenna Research	LPB 2520A	5078	Aug-05
Ridged Horn Antenna	Electro Metrics	RGA-60	2966	23-Dec-04
LNA (10 kHz to 20 GHz)	ETC MPB		2316	19-Jul-05
Bulkhead to antenna cable	Semflex		MPB5519	NR
Bulkhead to LNA/SA cable	Semflex		MPB5058	NR

NR: not required

The measurement instrumentation conforms to ANSI C63.2[5] and CISPR 16 [6]. Calibration of the measurement instrumentation is maintained in accordance with the supplier's recommendations, or as necessary to ensure its accuracy.

5.7 RF Exposure

5.7.1 Test Specification

The system was tested to the limits of the following requirement:

Table 5-29: RF Exposure Requirement

Requirement	Part / Section
FCC Part 1	1.1310
RSS-210	14.

RSS-210 makes reference to the RSS-102 [17] requirements.

5.7.1.1 Limits

The specification levels are listed in Table 5-30.

Table 5-30: RF Exposure Limit

Frequency Range (MHz)	FCC and Industry Canada General Exposure Limit (mW/cm^2)
2412 to 2462	1.0

5.7.2 RF Exposure Evaluation

Table 5-30 and Table 5-31 demonstrate the results of RF exposure calculations:

Table 5-31: EIRP Calculations

Peak Power (W)	ET-PR12 Antenna gain	EIRP (W)
0.0195 (12.9 dBm)	15.8 (12 dBi)	0.308 (24.9 dBm)

Table 5-32: RF Exposure Evaluation

Power Density at 20 cm (mW/cm^2)	FCC and Industry Canada RF Exposure limit (mW/cm^2)
0.061	1

The power density was calculated using the following equation.

$S = (P \times G) / (4 \times pi \times R^2)$

where: S = power density (in appropriate units, e.g. mW/cm^2)

P = power input to the antenna (in appropriate units, e.g., mW)

G = power gain of the antenna in the direction of interest relative to an isotropic radiator

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

5.7.3 Evaluation Conclusion

The test results met the requirement.

6. References

1. Standards Council of Canada Scope of Accreditation Letter SCC 1003-15/163 dated 2002-12-16 (Scope of accreditation is effective until 2005-10-05 and includes FCC Part 15 and ICES-003). This scope of accreditation is outlined at the following web site http://www.scc.ca/scopes/reg126-eng-s.pdf.
2. Solectron Design & Engineering Inc. Quality Manual, K0000608-QD-QM-01-05, March 2003.
3. Solectron Design & Engineering Inc. Lab Operations Manual KG000347-QD-LAB-01-03, January 2003.
4. ANSI C63.4-2003, Methods of Measurement of Radio-Noise Emission from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz, January 2004.
5. ANSI C63.2-1996, American National Standard for Electromagnetic Noise and Field Strength Instrumentation, 10 Hz to 40 GHz – Specifications.
6. CISPR 16-1, Specification for Radio Disturbance and Immunity Measuring Apparatus and Methods - Part 1: Radio Disturbance and Immunity Measuring Apparatus, Edition 2.0, 1999-10.
7. Solectron Design & Engineering Inc., EMC General Lab Test Procedure, KP000270-LP-EMC-01-04 July 2004.
8. FCC Rules for Radio Frequency Devices, Title 47 of the Code of Federal Regulations), Part 1, U.S. Federal Communications Commission.
9. FCC Rules for Radio Frequency Devices, Title 47 of the Code of Federal Regulations), Part 2, U.S. Federal Communications Commission.
10. FCC Rules for Radio Frequency Devices, Title 47 of the Code of Federal Regulations), Part 15, U.S. Federal Communications Commission.
11. RSS-210, Issue 5, “Low Power License-Exempt Radiocommunication Devices (All Frequency Bands)”, November, 2001.
12. VCCI, V-3/02.04 16th edition, April 2002.Title: AGREEMENT OF VOLUNTARY CONTROL COUNCIL FOR INTERFERENCE BY INFORMATION TECHNOLOGY EQUIPMENT
13. APLAC, Asia Pacific Laboratory Accreditation Cooperation, Website (February 10th, 2004): http://www.aplac.org.
14. ILAC, International Laboratory Accreditation Cooperation, Website (February 10th, 2004): http://www.ilac.org/
15. Industry Canada, RSS 212, Test Facilities and Test Methods for Radio Equipment, Issue 1 (Provisional), February 27, 1999.
16. NAMAS Publication NIS 81: “The Treatment of Uncertainty in EMC Measurements”, Edition 1, May 1994.

17. RSS-102, Issue 1 (Provisional), Evaluation Procedure for Mobile and Portable Radio Transmitters with respect to Health Canada's Safety Code 6 for Exposure of Humans to Radio Frequency Fields, September 25, 1999.

7. Appendices

7.1 Appendix A: Glossary

Included below are definitions and abbreviations of terms used in this document.

Term	Definition
AC	Alternating Current
AFC	Ambient Free Chamber
AM	Amplitude modulation
ANSI	American National Standards Institute
AVG	Average detector
CISPR	Comité International Spécial Perturbation Radioélectrique (International Special Committee on Radio Interference)
Class A	Class A Limits for typical commercial establishments
Class B	Class B Limits for typical domestic and residential establishments
dB	Decibel
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EN	European Normative
EUT	Equipment Under Test
FCC	Federal Communications Commission, USA
GND	Ground
IC	Industry Canada
PA	Broadband Power Amplifier
RBW	Resolution Bandwidth
RF	Radio-Frequency
RFI	Radio-Frequency Interference
SCC	Standards Council of Canada

7.2 Appendix B: Test Set-up Photographs

Figure 7-1: WLAN 6220 Corporate Service Unit Radiated Emissions Set-up

7.3 Appendix C: 6 dB Bandwidth Plots

This appendix presents all occupied bandwidth plots for the test cases measured.

Figure 7-2: 6 dB Occupied Bandwidth, Channel 1, 11 Mbps

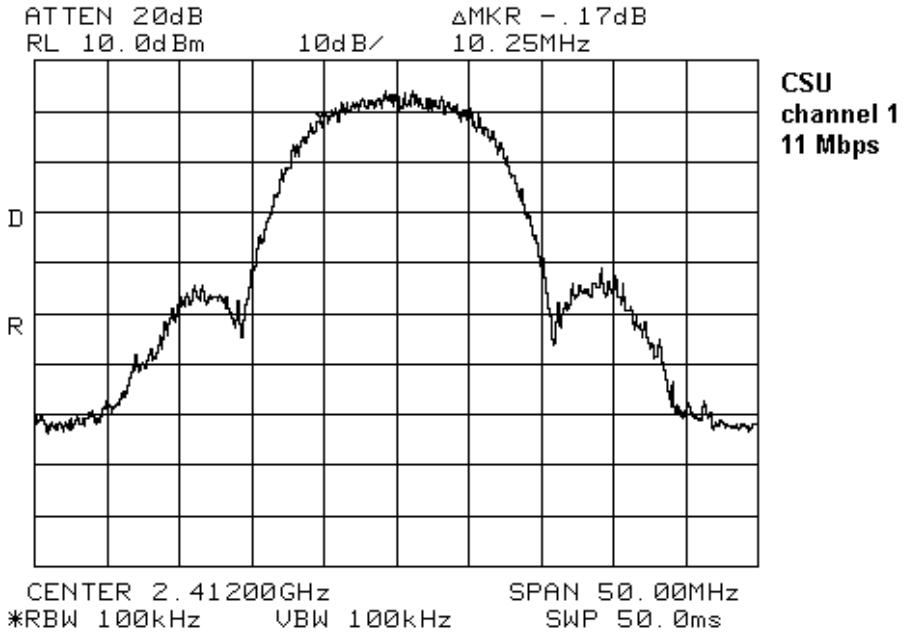


Figure 7-3: 6 dB Occupied Bandwidth, Channel 6, 11 Mbps

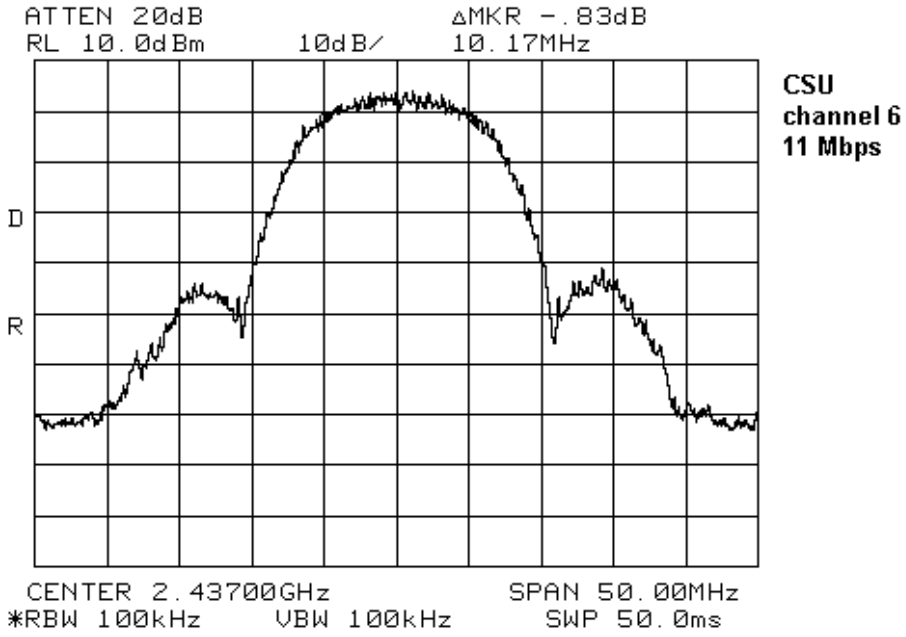
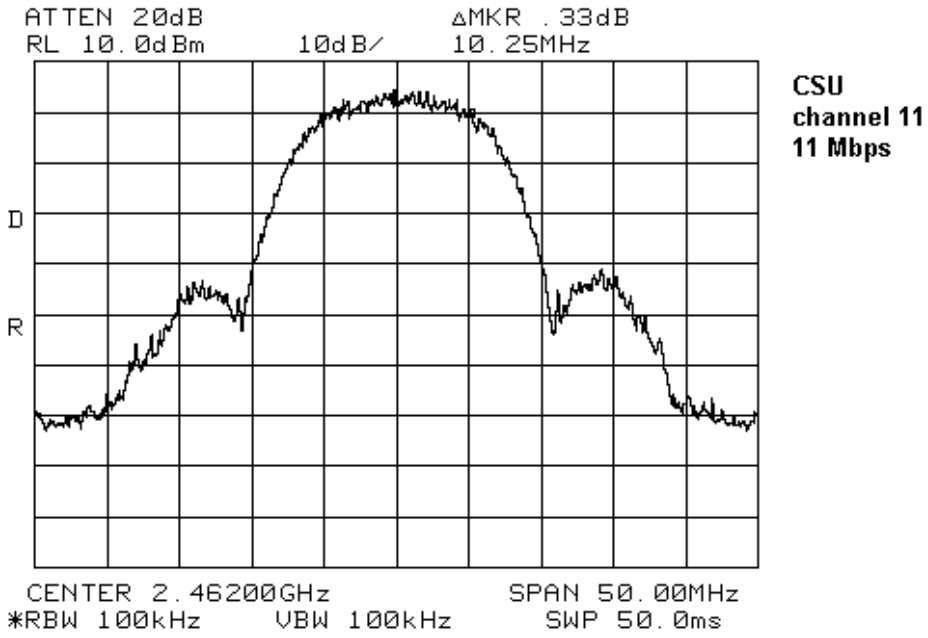


Figure 7-4: 6 dB Occupied Bandwidth, Channel 11, 11 Mbps



7.4 Appendix D: Peak Power Spectral Density plots

This appendix presents all peak power spectral density plots for the test cases measured.

Figure 7-5: PSD, Channel 1, 1 Mbps

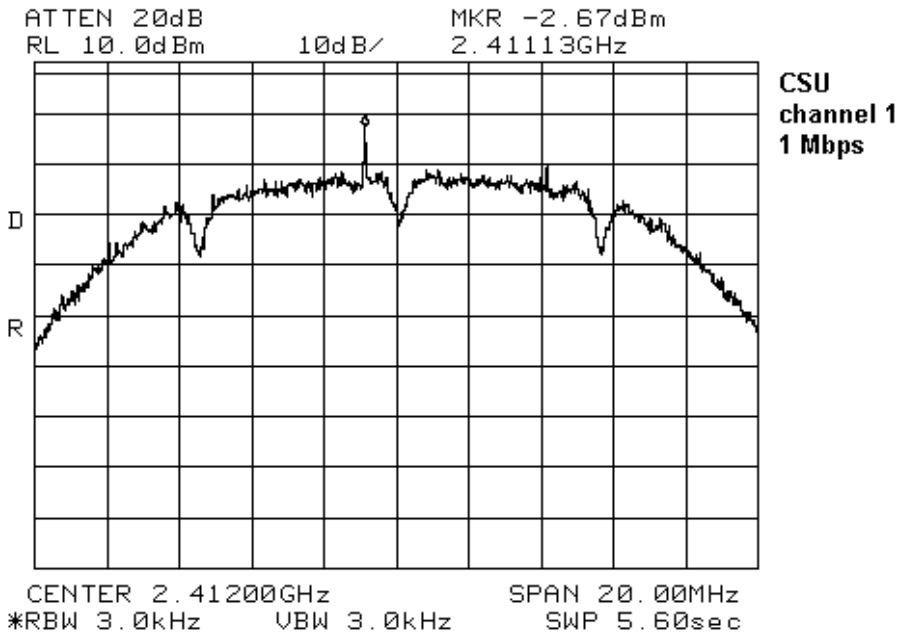


Figure 7-6: PSD, Channel 1, 2 Mbps

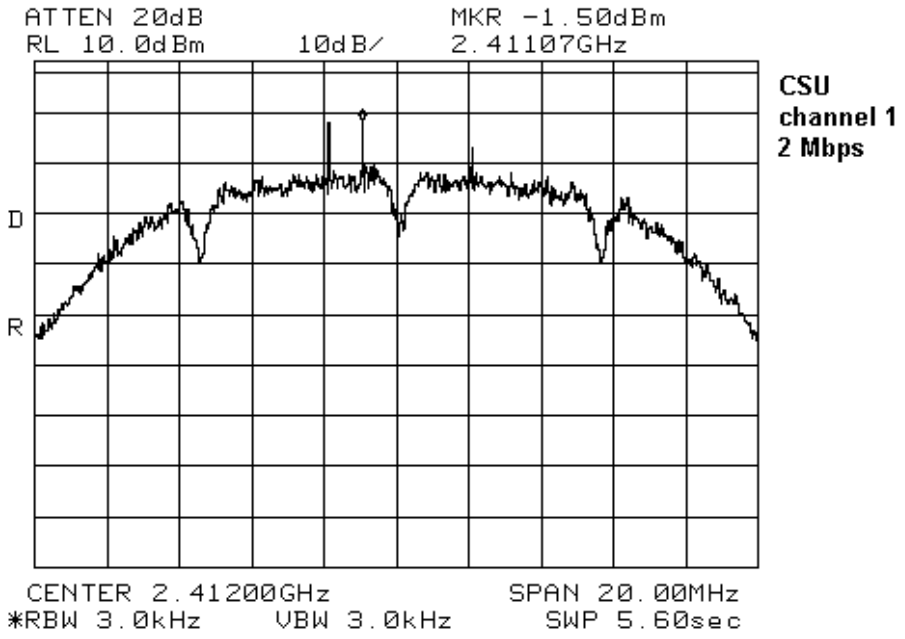


Figure 7-7: PSD, Channel 1, 5.5 Mbps

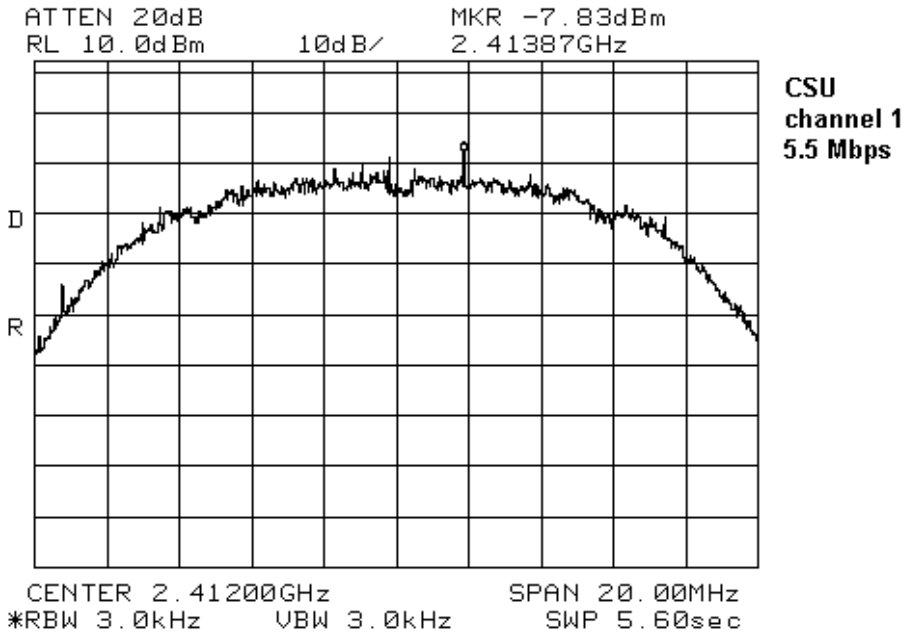


Figure 7-8: PSD, Channel 1, 11 Mbps

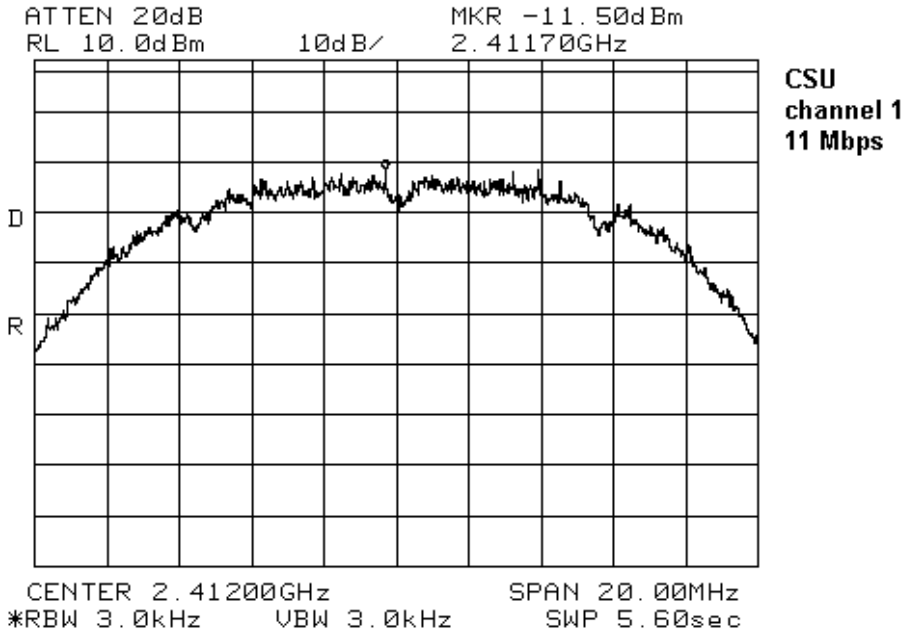


Figure 7-9: PSD, Channel 6, 1 Mbps

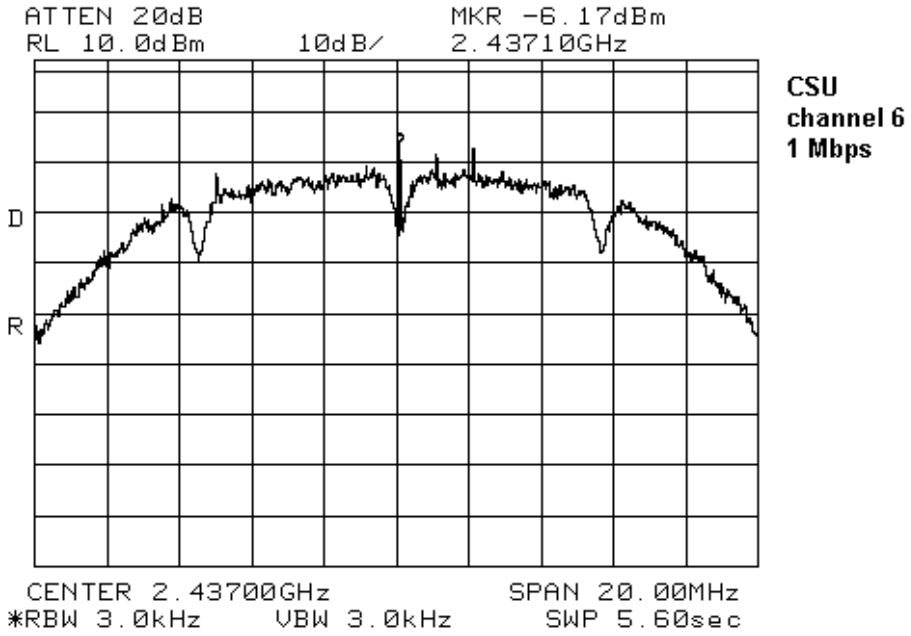


Figure 7-10: PSD, Channel 6, 2 Mbps

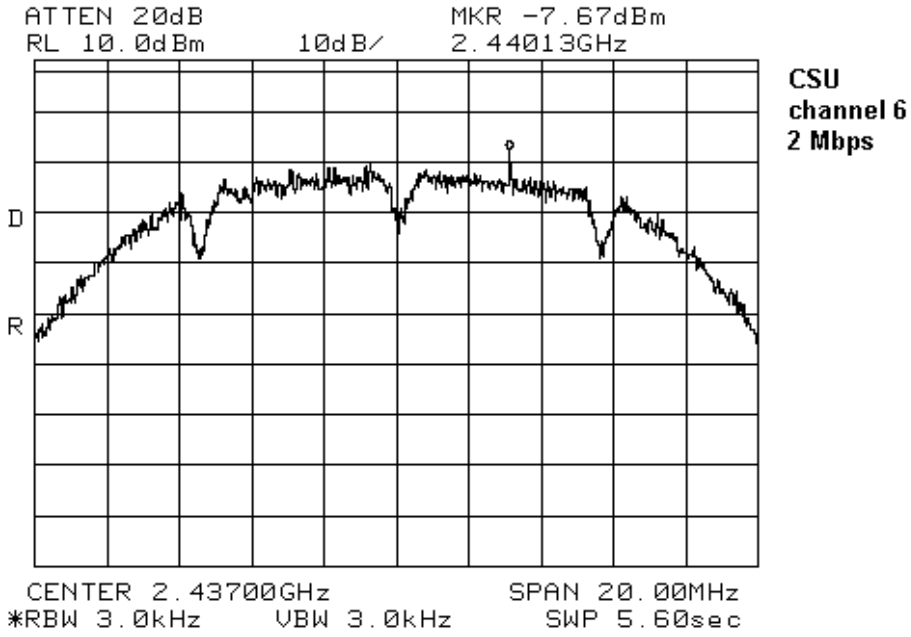


Figure 7-11: PSD, Channel 6, 5.5 Mbps

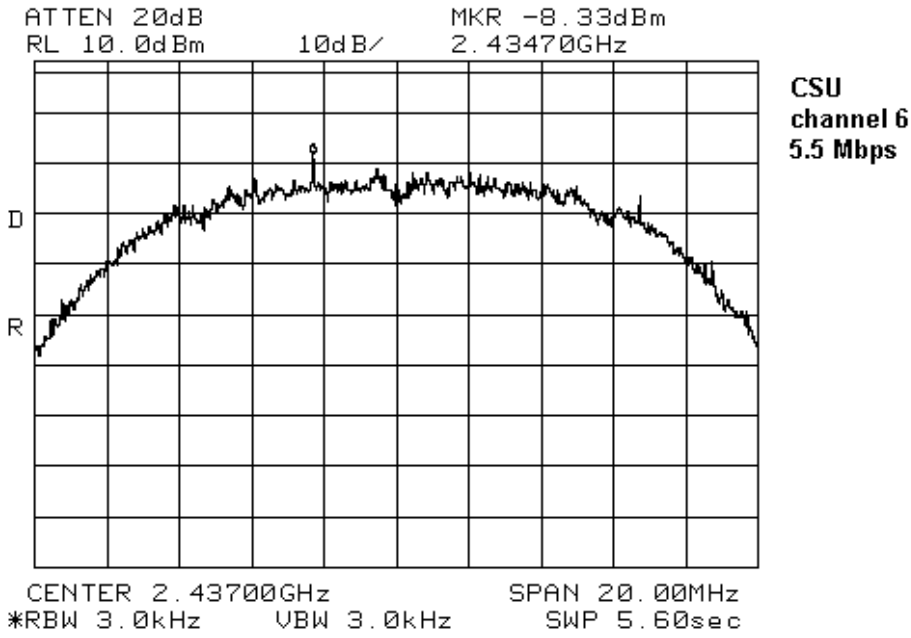


Figure 7-12: PSD, Channel 6, 11 Mbps

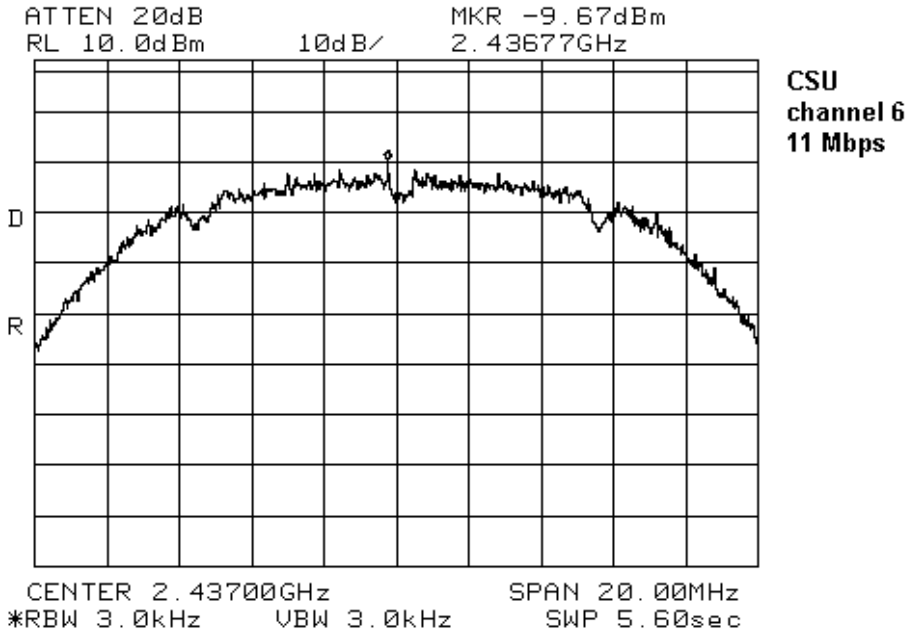


Figure 7-13: PSD, Channel 11, 1 Mbps

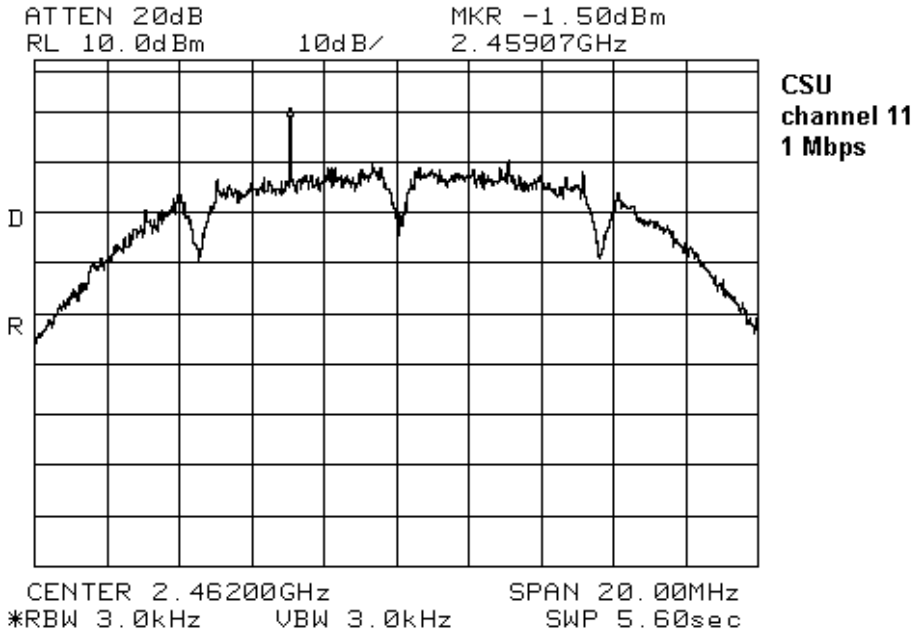


Figure 7-14: PSD, Channel 11, 2 Mbps

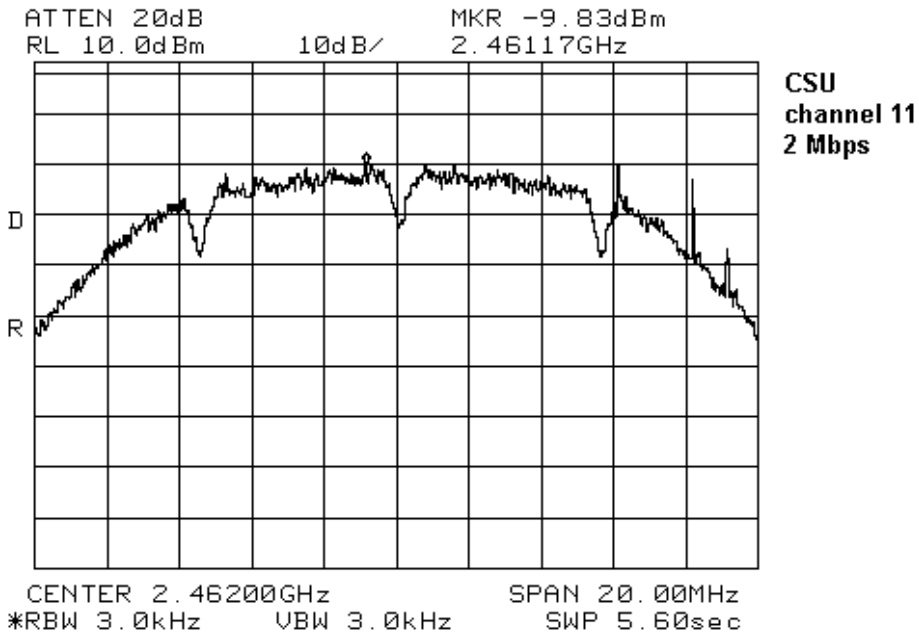


Figure 7-15: PSD, Channel 11, 5.5 Mbps

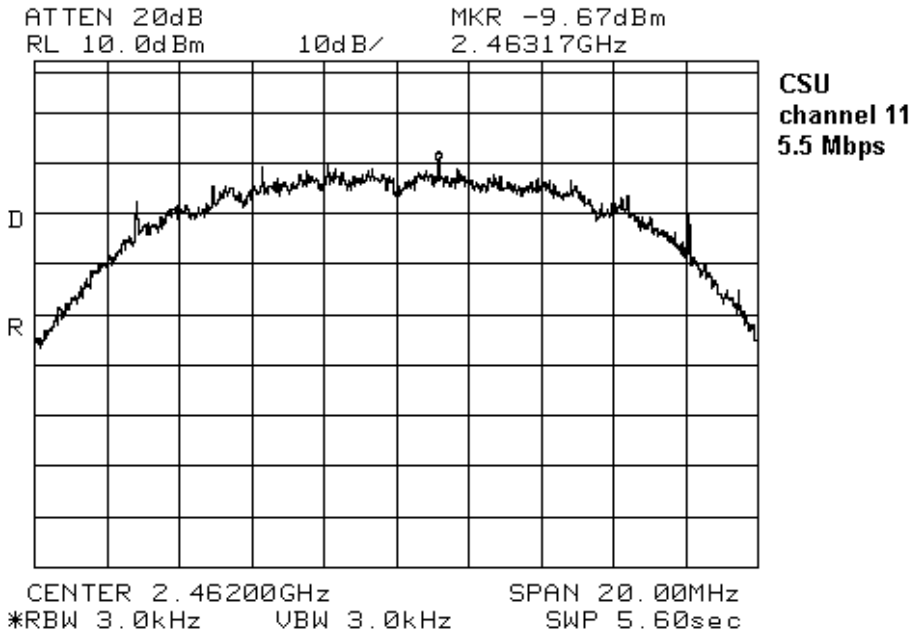
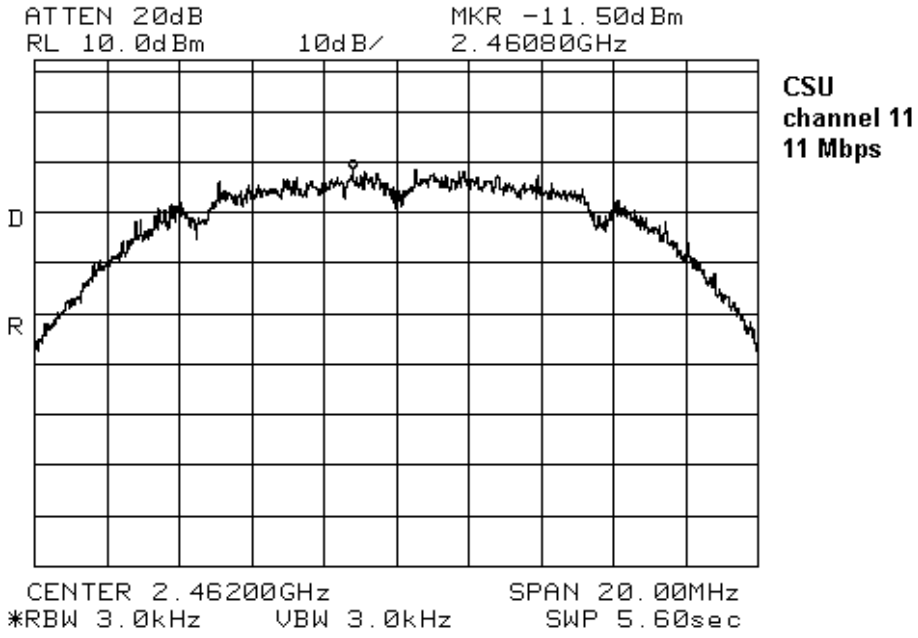


Figure 7-16: PSD, Channel 11, 11 Mbps



7.5 Appendix E: Conducted Spurious Emissions Plots

Figure 7-17: Conducted Spurious Emissions Between 30 MHz and 25 GHz, Channel 1, 1 Mbps

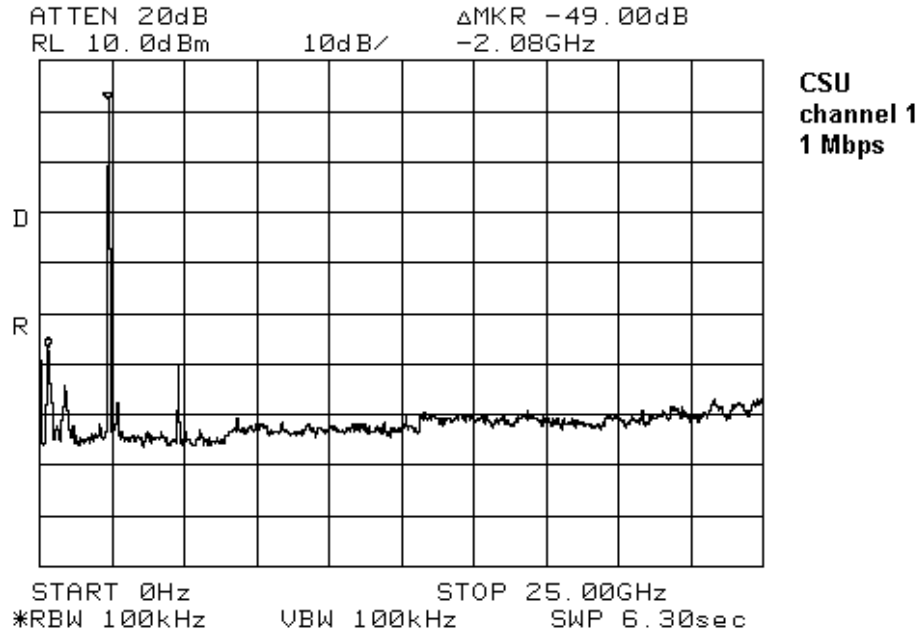


Figure 7-18: Conducted Spurious Emissions at 2400 MHz, Channel 1, 1 Mbps

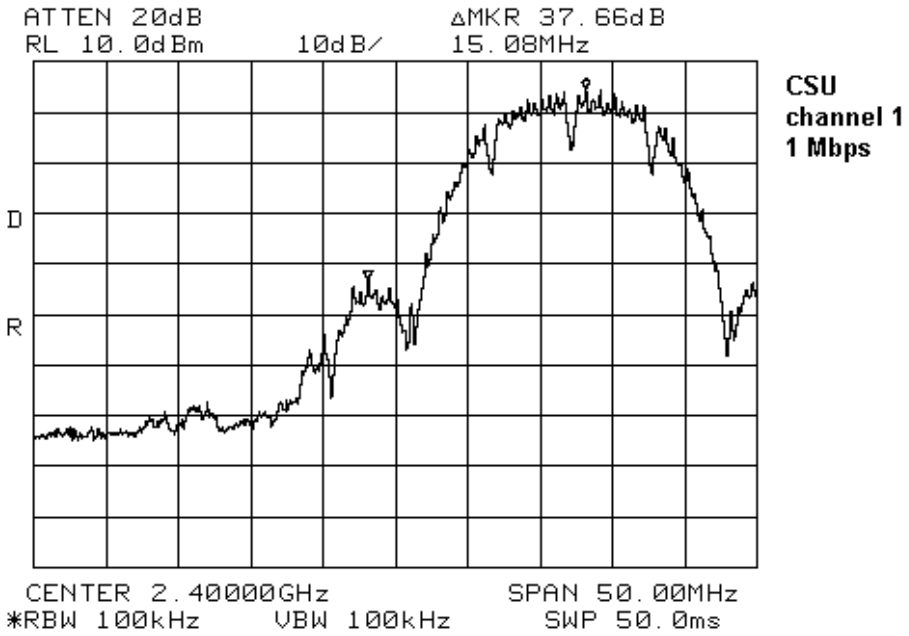


Figure 7-19: Conducted Spurious Emissions at Between 30 MHz and 25 GHz, Channel 6, 1 Mbps

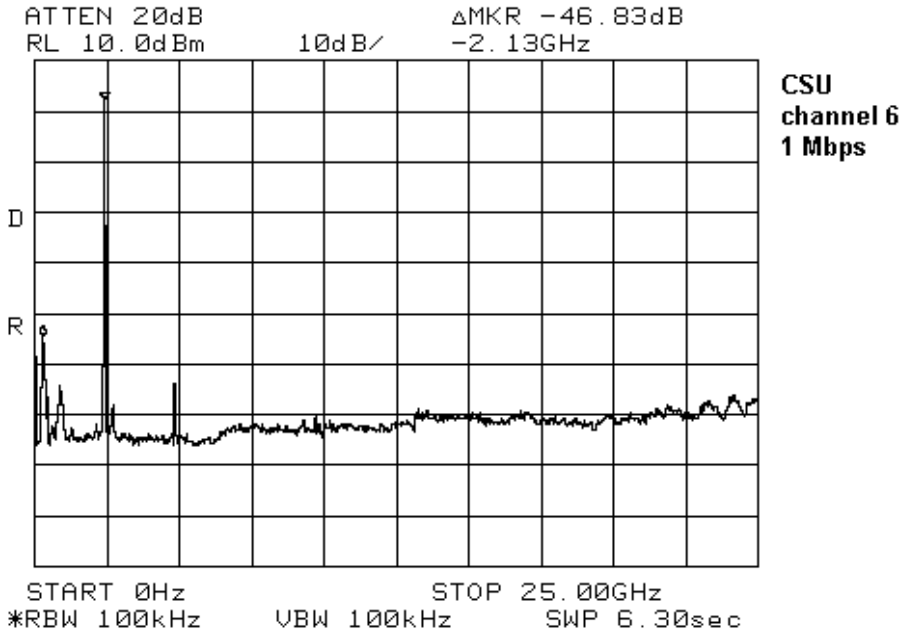


Figure 7-20: Conducted Spurious Emissions Between 30 MHz and 25 GHz, Channel 11, 1 Mbps

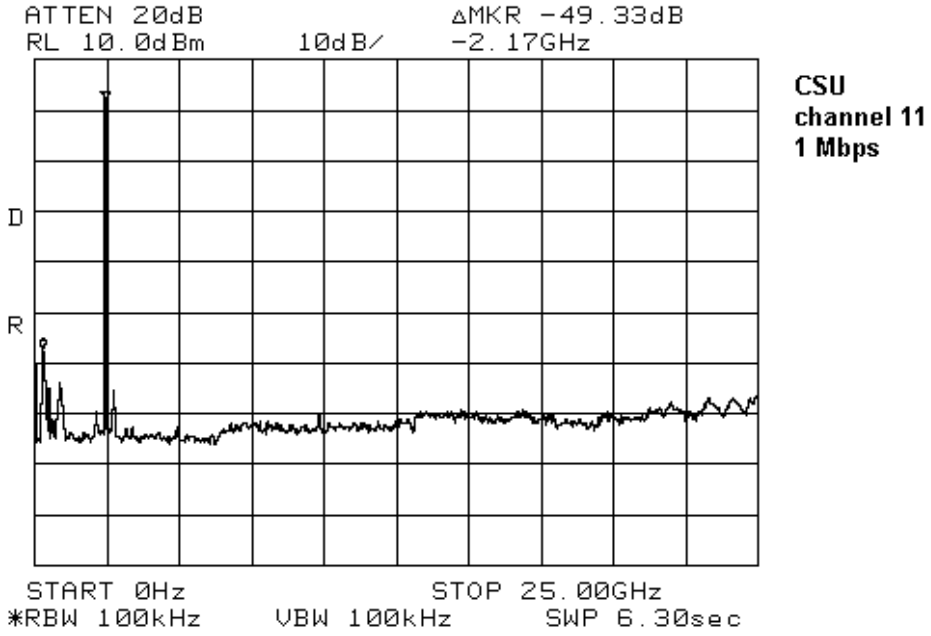
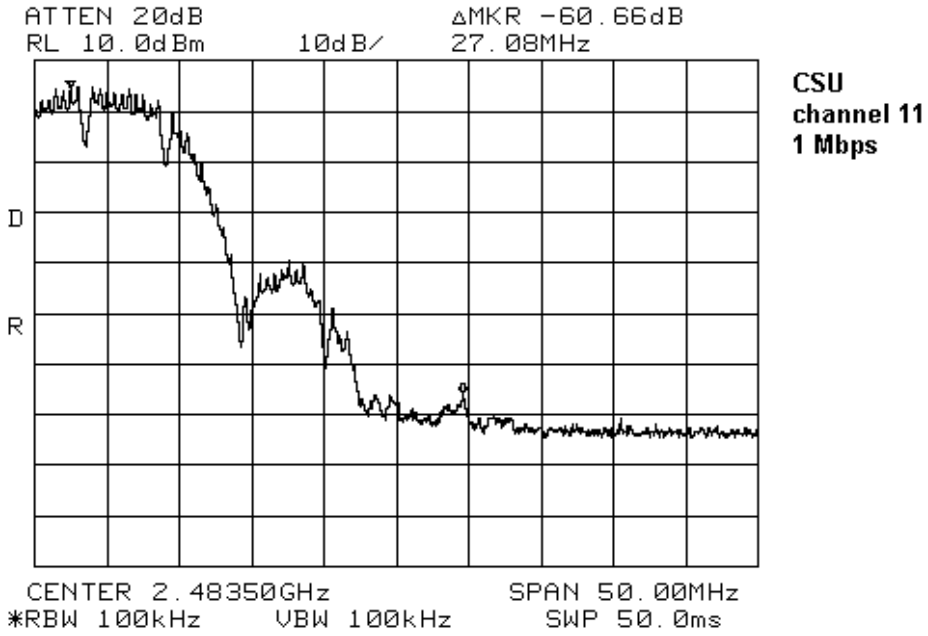


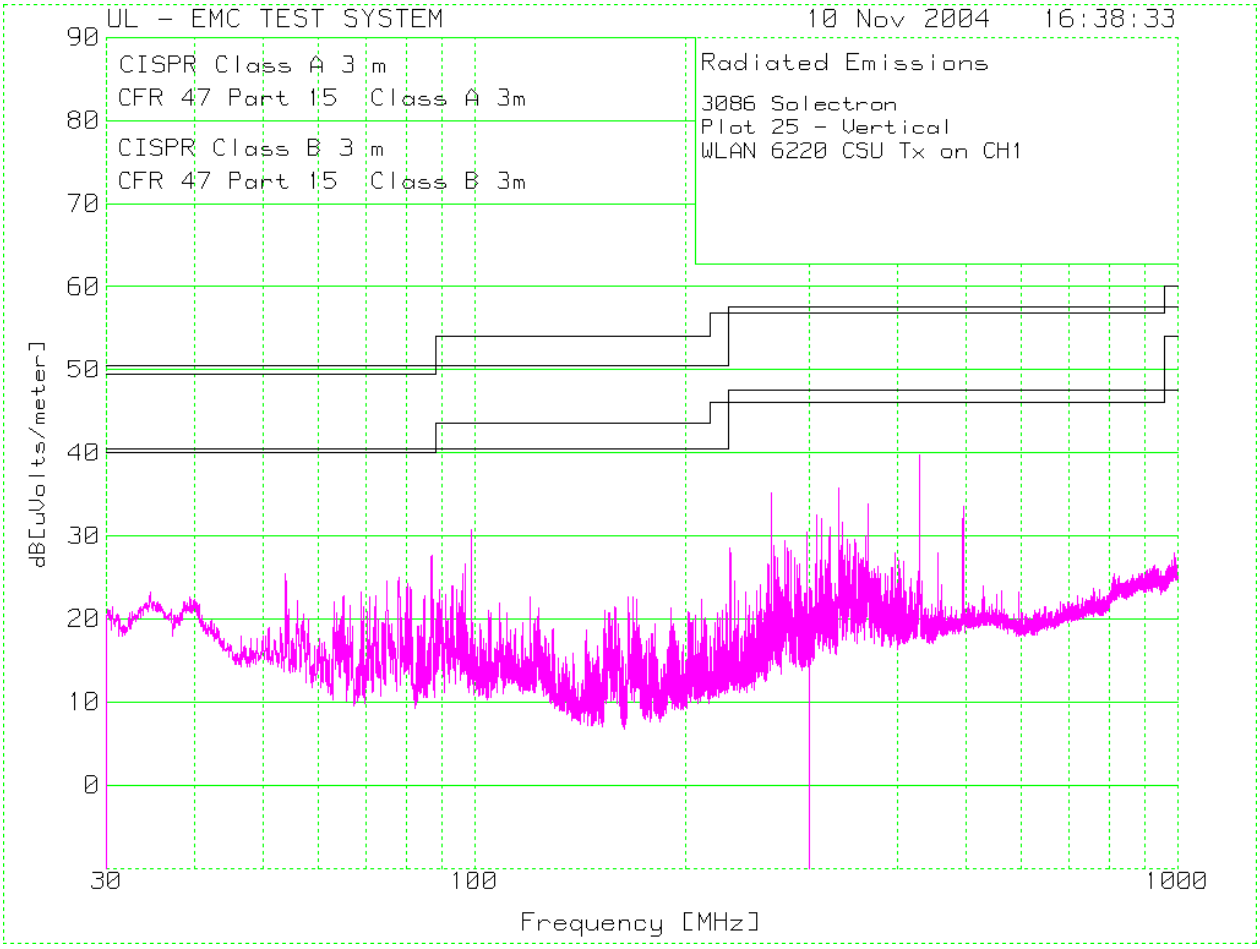
Figure 7-21: Conducted Spurious Emissions at 2483.5 MHz, Channel 11, 1 Mbps



7.6 Appendix F: Field Strength of Spurious Emissions Plots

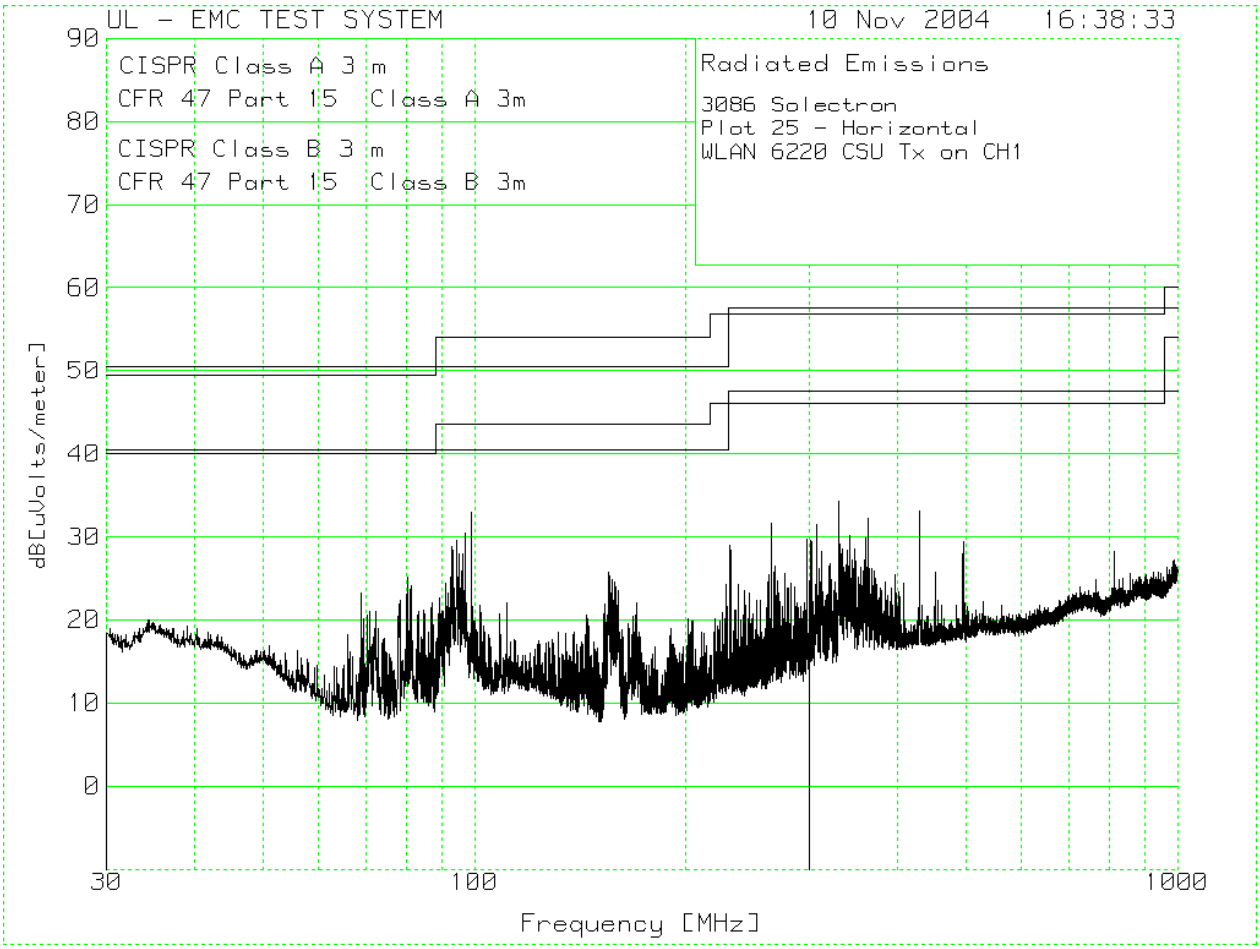
This appendix presents all field strength plots for the test cases measured.

Figure 7-22: Field Strength on Channel 1 (1 Mbps), 30 MHz to 1 GHz (Vertical Polarization)



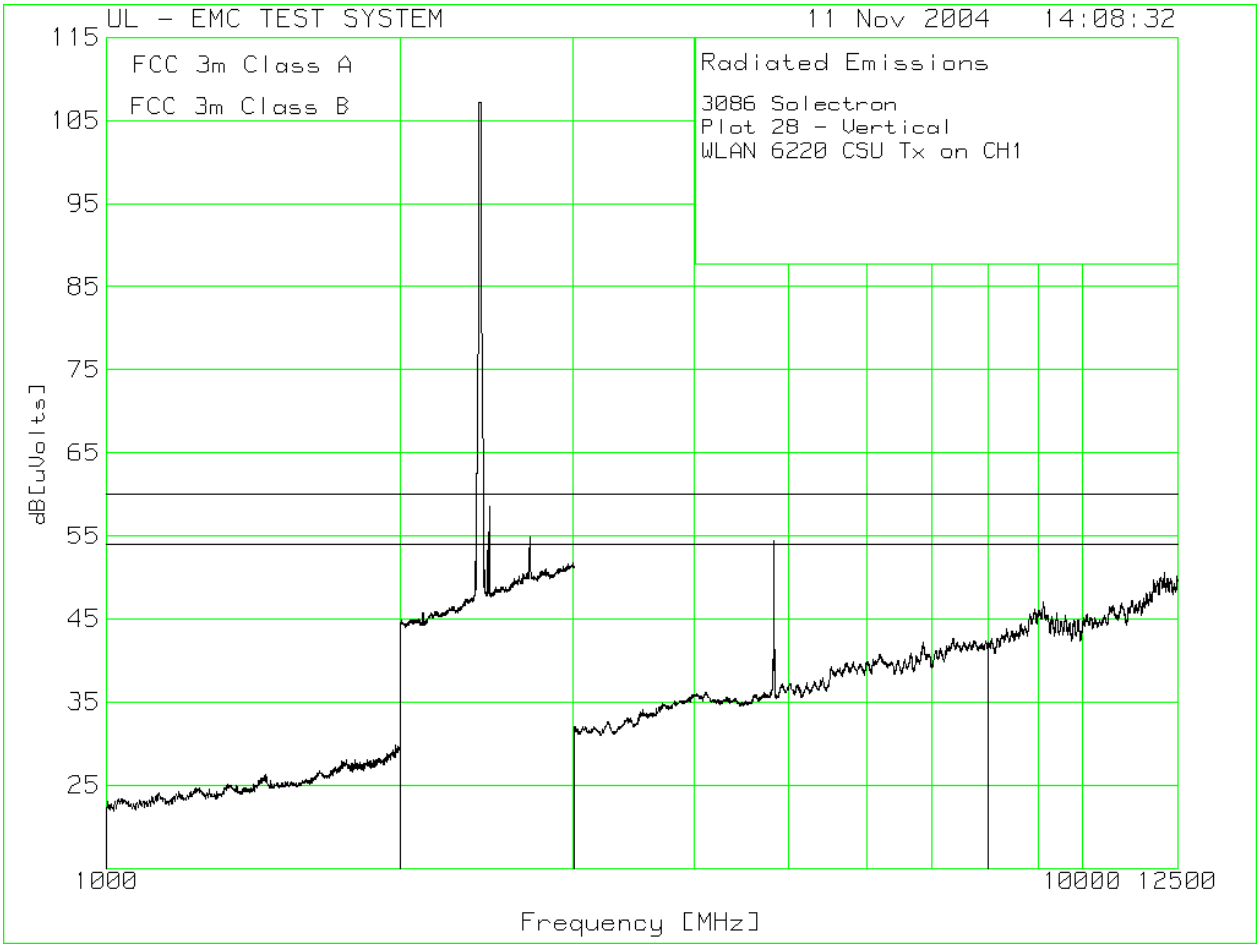
Note: the signals at 99 MHz and 429 MHz are outside the FCC 15.205 Restricted bands

Figure 7-23: Field Strength on Channel 1 (1 Mbps), 30 MHz to 1 GHz (Horizontal Polarization)



Note: the signal at 99 MHz and is outside the FCC 15.205 Restricted bands

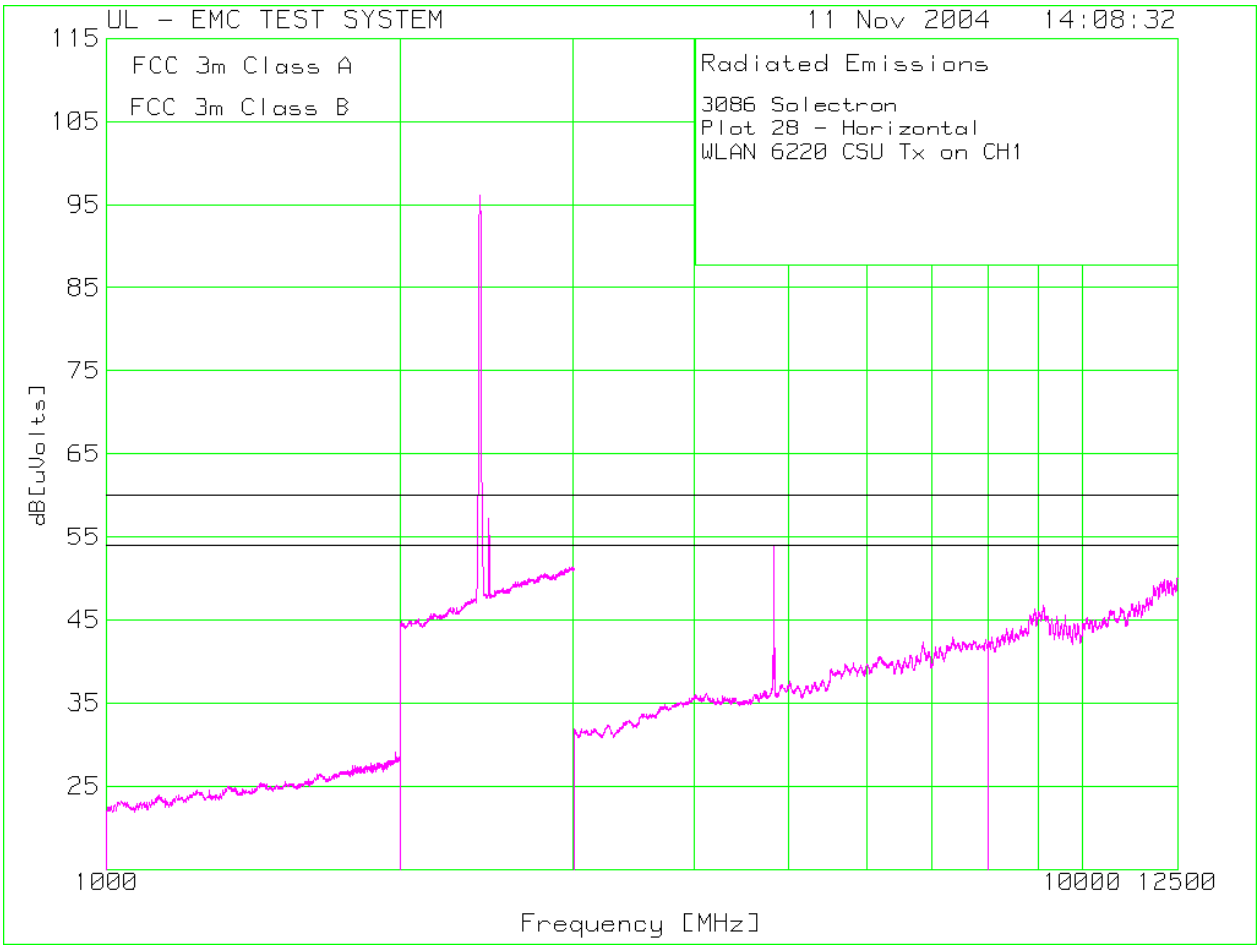
Figure 7-24: Field Strength on Channel 1 (1 Mbps), 1 GHz to 12.5 GHz (Vertical)



Note 1: the signal strength at 2.7 GHz and 4.8 GHz is actually lower than it appears on this plot (see average detection test results in section 5.5.4)

Note 2: the signal at 2761 MHz (with a level of 58 dBuV/m) is an ambient from another WiFi transmitter that was in proximity from the radio lab. This signal disappeared when attempts were made to measure it with lower frequency spans.

Figure 7-25: Field Strength on Channel 1 (1 Mbps), 1 GHz to 2 GHz (Horizontal)



Note 1: the signal strength at 4.8 GHz is actually lower than it appears on this plot (see average detection test results in section 5.5.4)

Note 2: the signal at 2761 MHz (with a level of 58 dBuV/m) is an ambient from another WiFi transmitter that was in proximity from the radio lab. This signal disappeared when attempts were made to measure it with lower frequency spans.

Figure 7-26: Field Strength on Channel 1 (1 Mbps), 10 GHz to 18 GHz (Vertical Polarization)

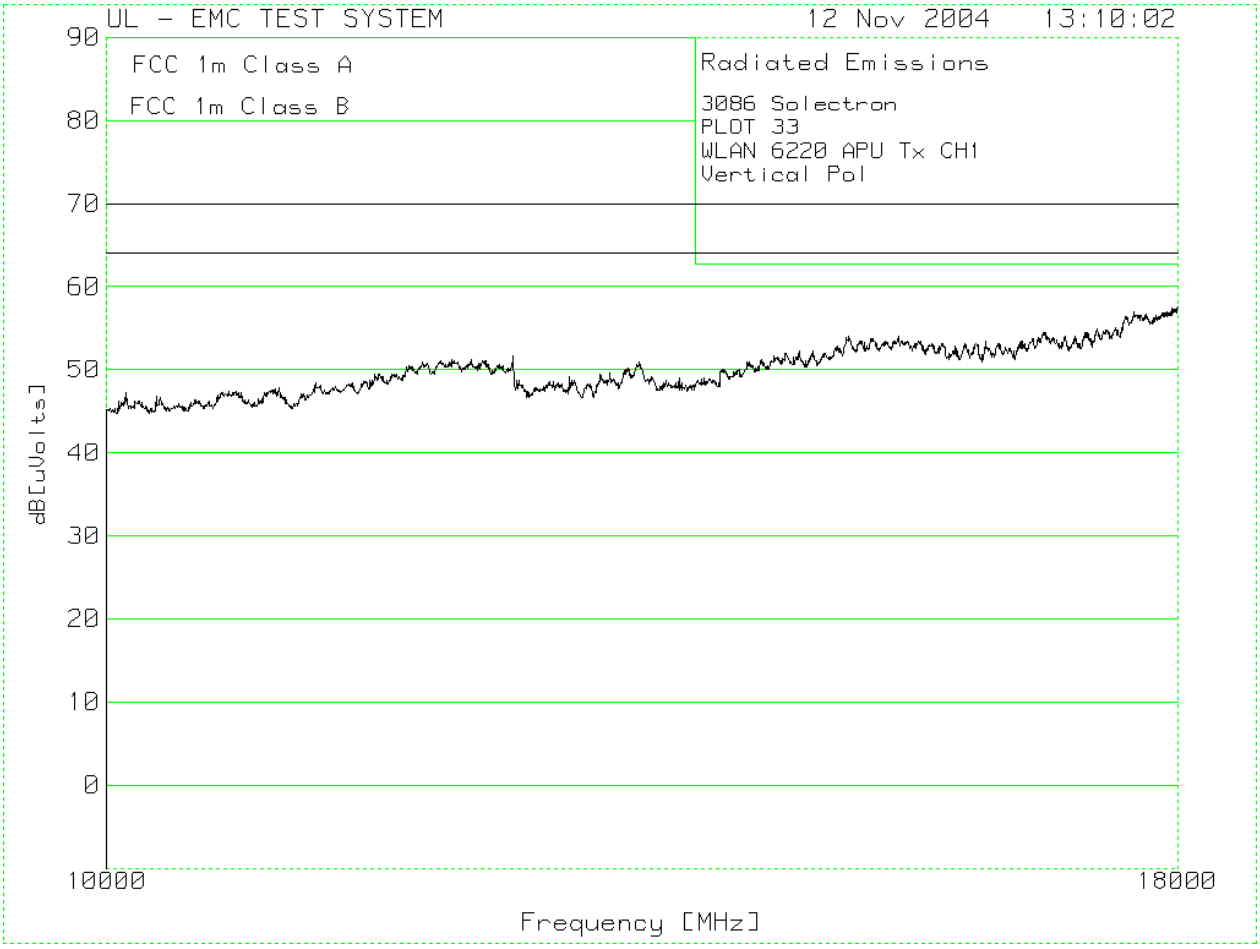


Figure 7-27: Field Strength on Channel 1 (1 Mbps), 10 GHz to 18 GHz (Horizontal Polarization)

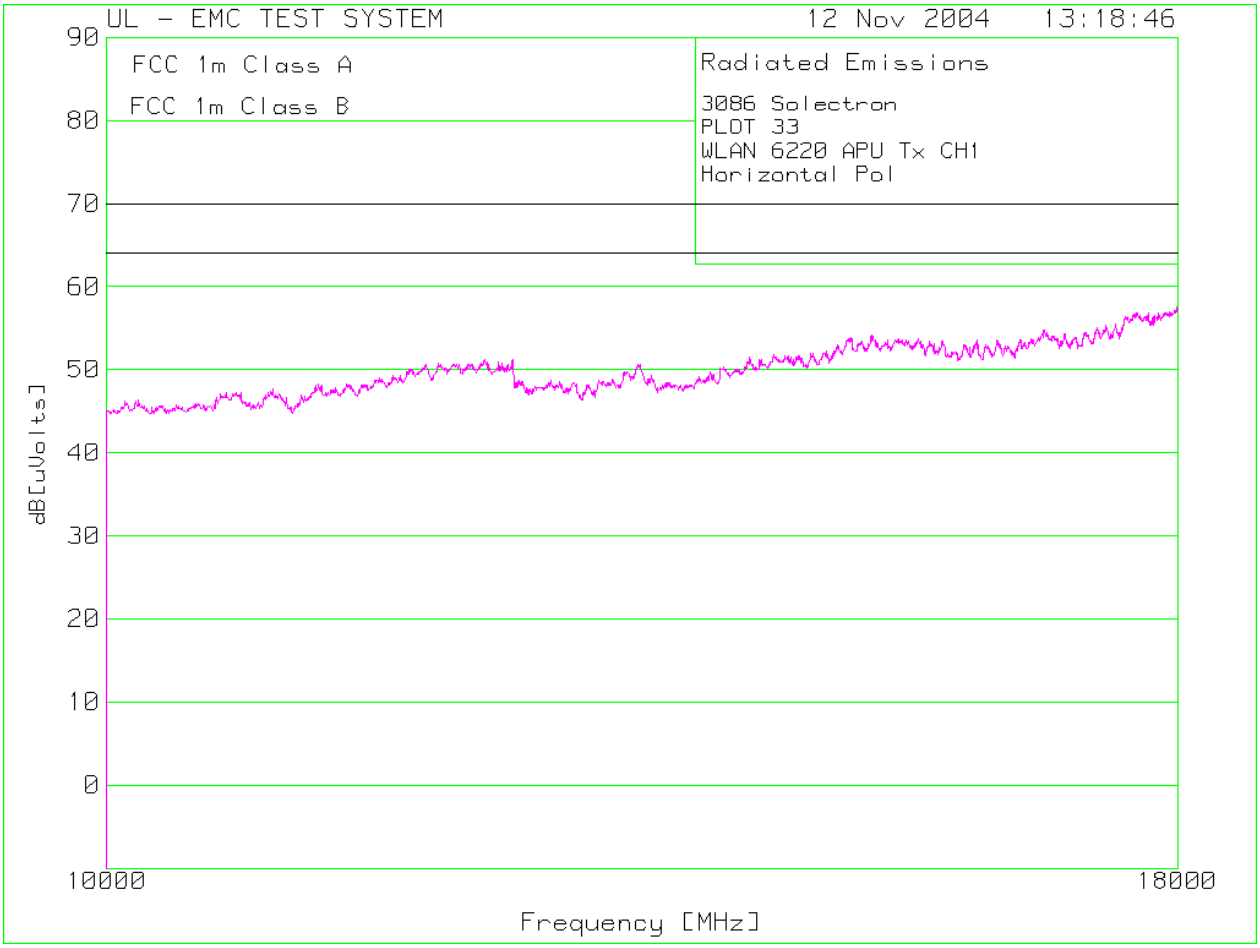


Figure 7-28: Field Strength on Channel 1 (1 Mbps), 18 GHz to 26 GHz (Vertical Polarization)

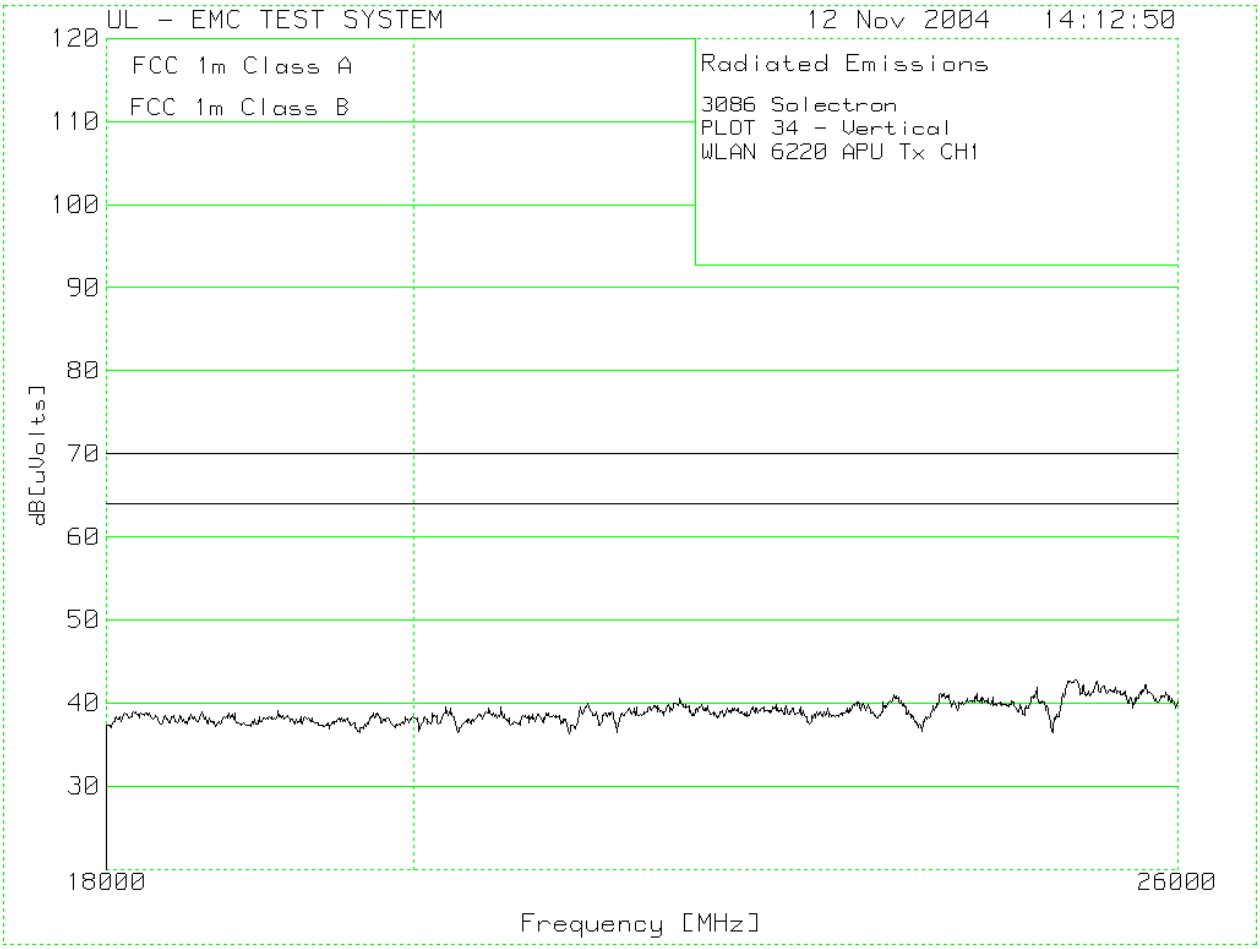


Figure 7-29: Field Strength on Channel 1 (1 Mbps), 18 GHz to 26 GHz (Horizontal Polarization)

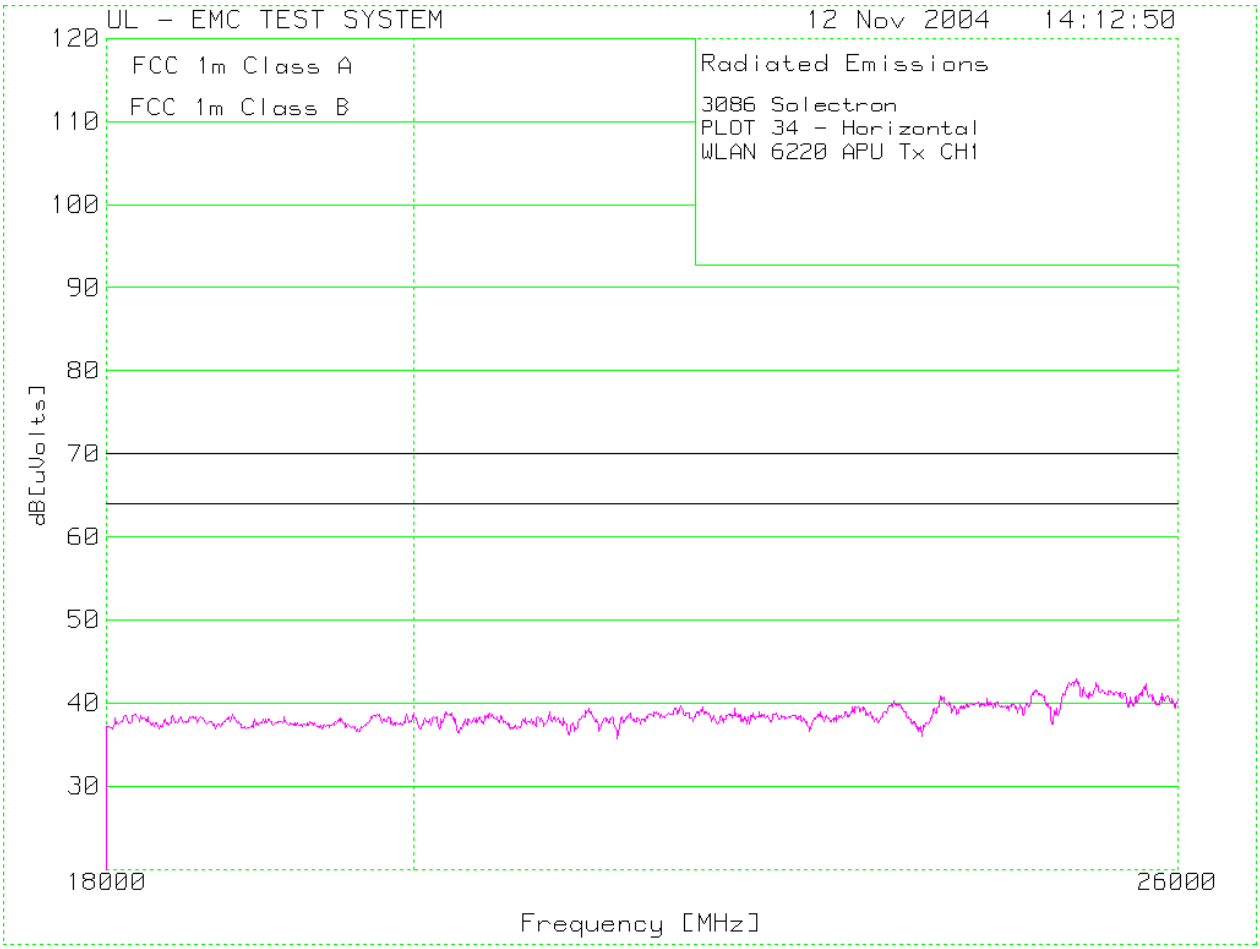
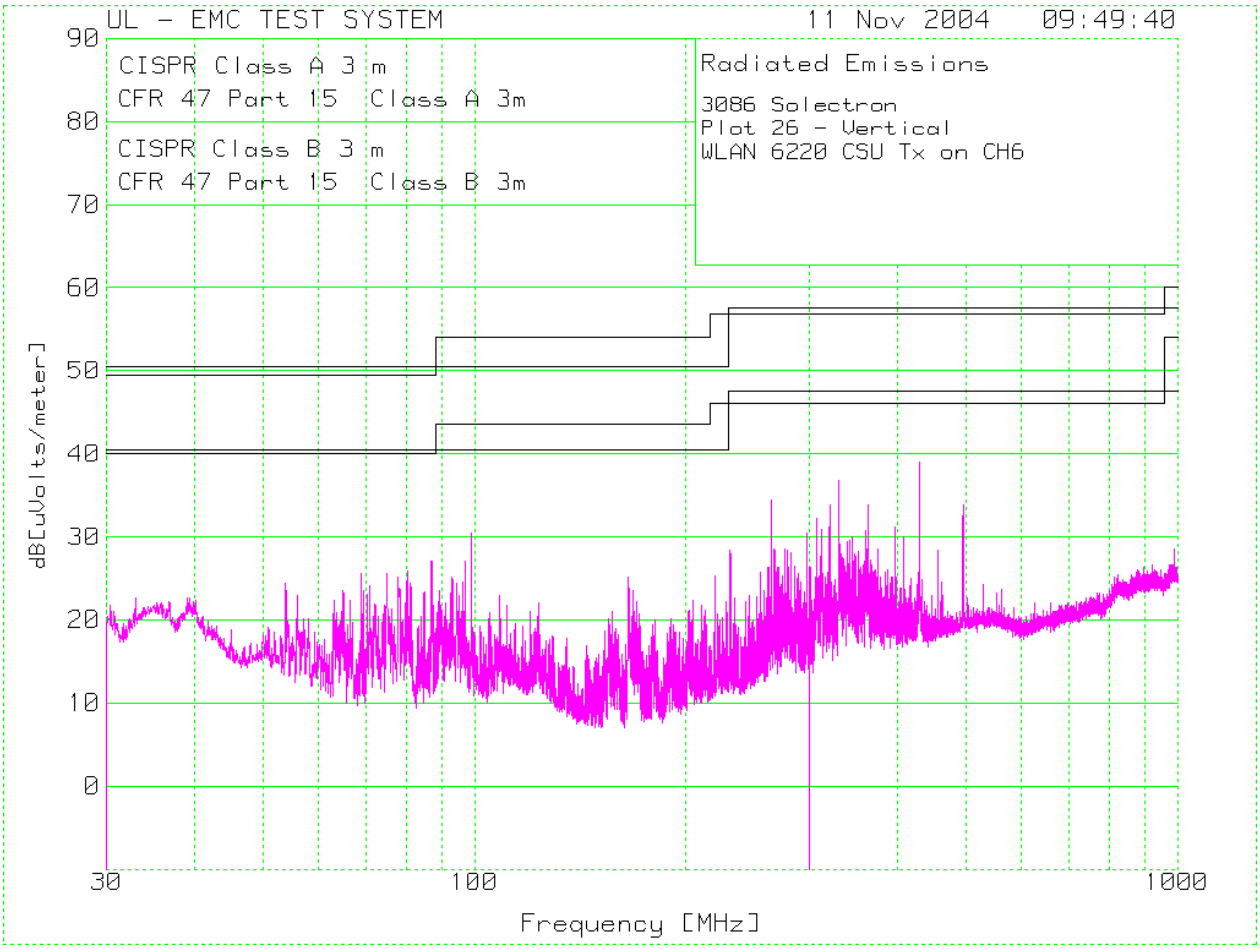
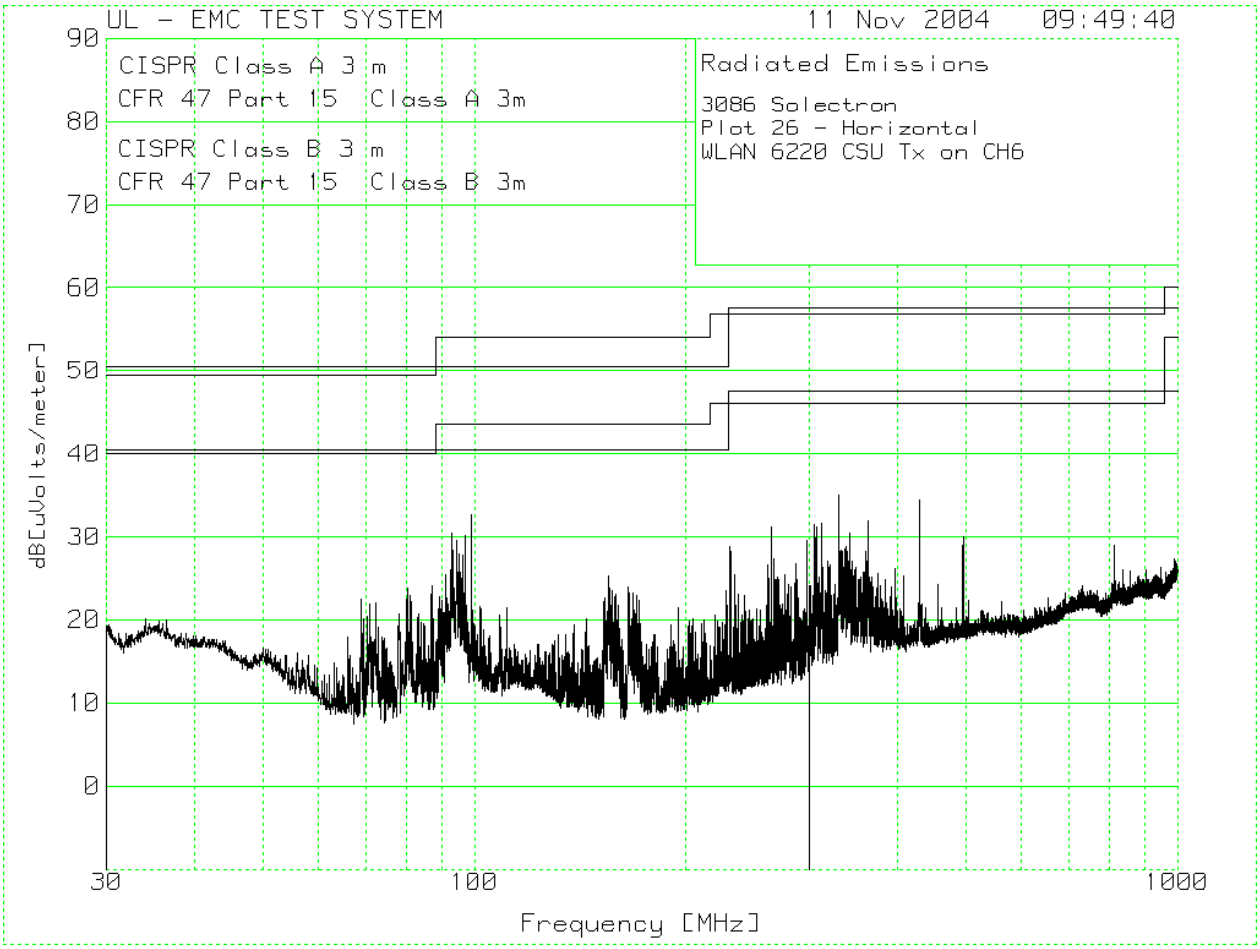


Figure 7-30: Field Strength on Channel 6 (1 Mbps), 30 MHz to 1 GHz (Vertical Polarization)



Note: the signals at 99 MHz and 429 MHz are outside the FCC 15.205 Restricted bands

Figure 7-31: Field Strength on Channel 6 (1 Mbps), 30 MHz to 1 GHz (Horizontal Polarization)



Note: the signal at 99 MHz is outside the FCC 15.205 Restricted bands

Figure 7-32: Field Strength on Channel 6 (1 Mbps), 1 GHz to 12.5 GHz (Vertical)

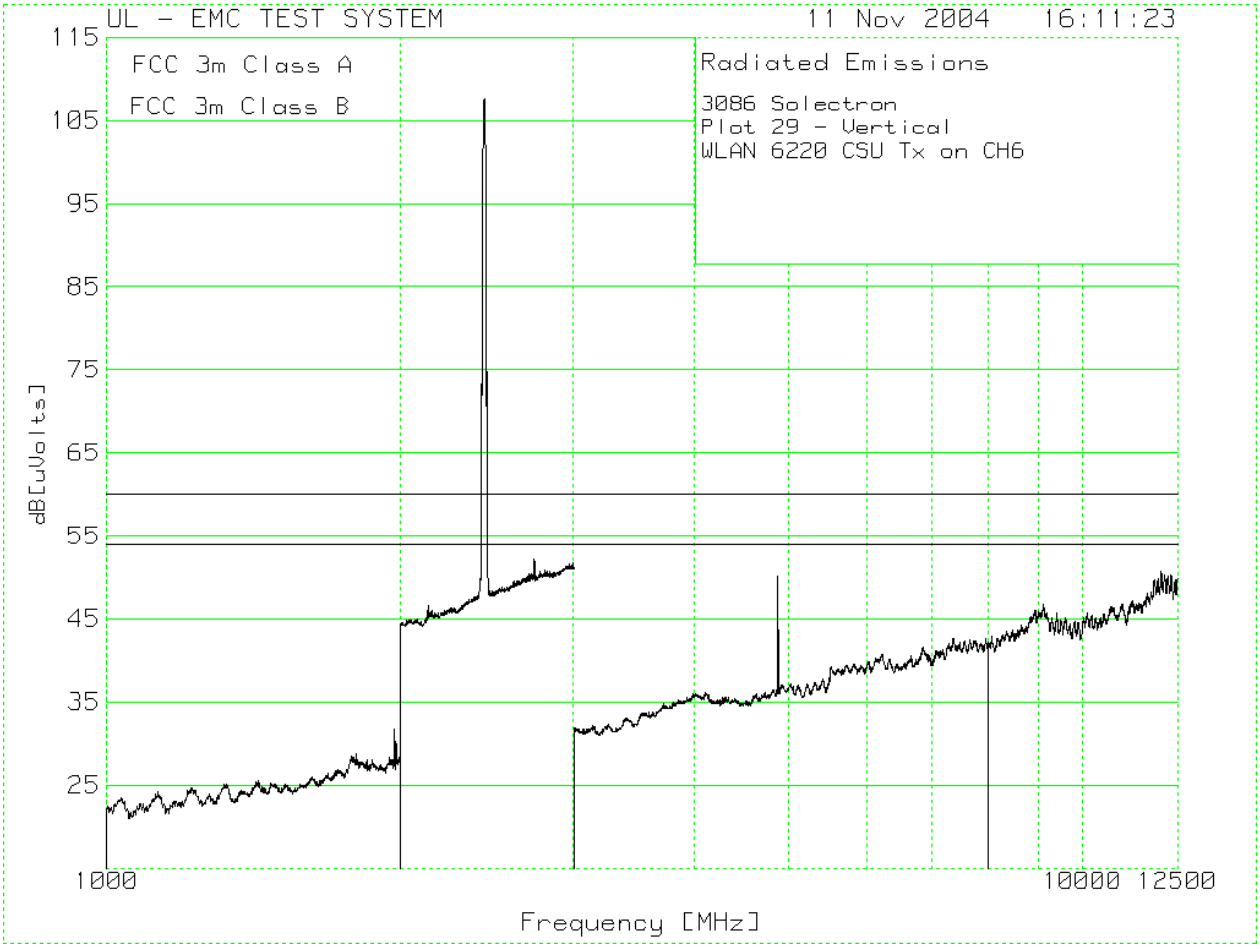


Figure 7-33: Field Strength on Channel 1 (1 Mbps), 1 GHz to 2 GHz (Horizontal)

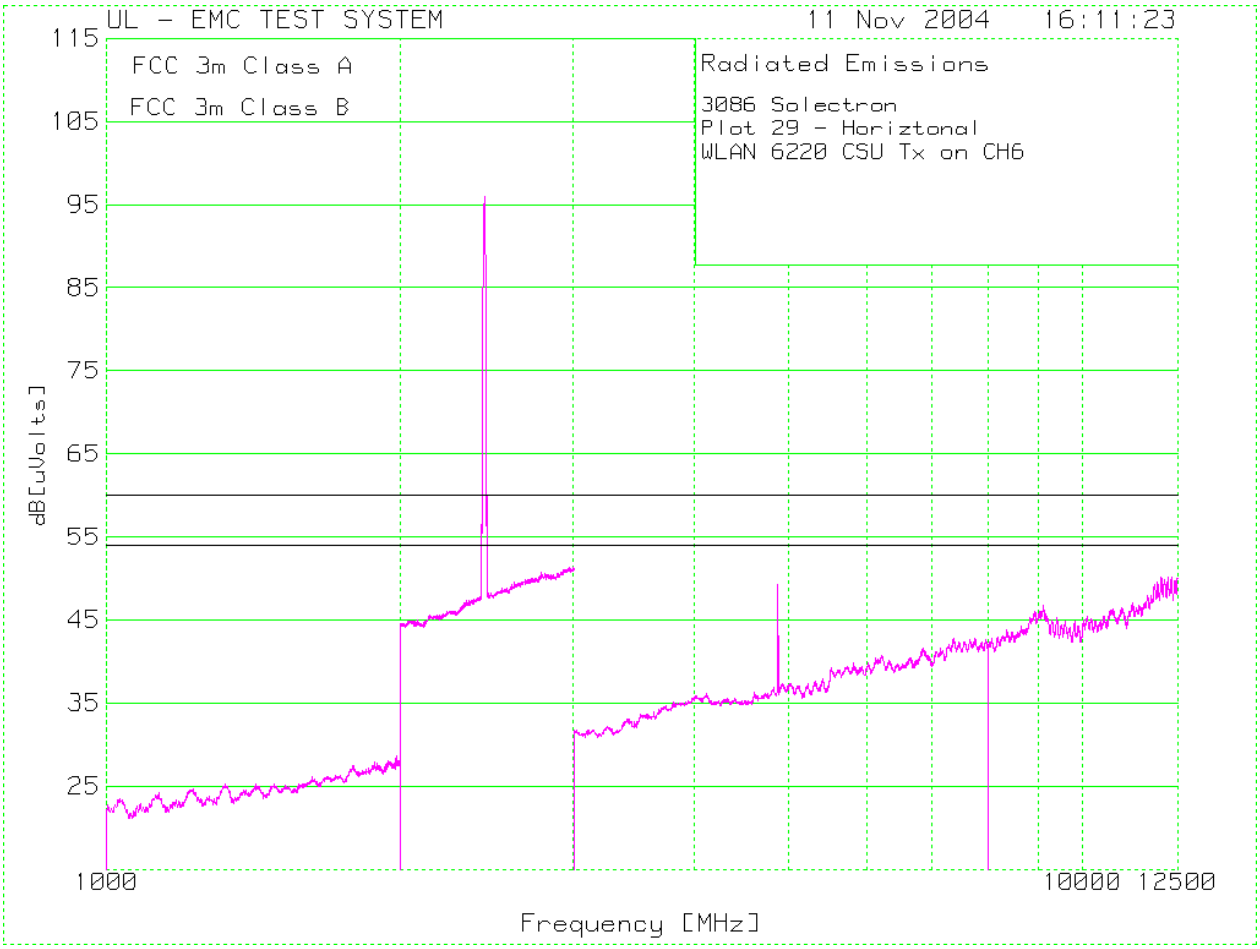


Figure 7-34: Field Strength on Channel 6 (1 Mbps), 10 GHz to 18 GHz (Vertical Polarization)

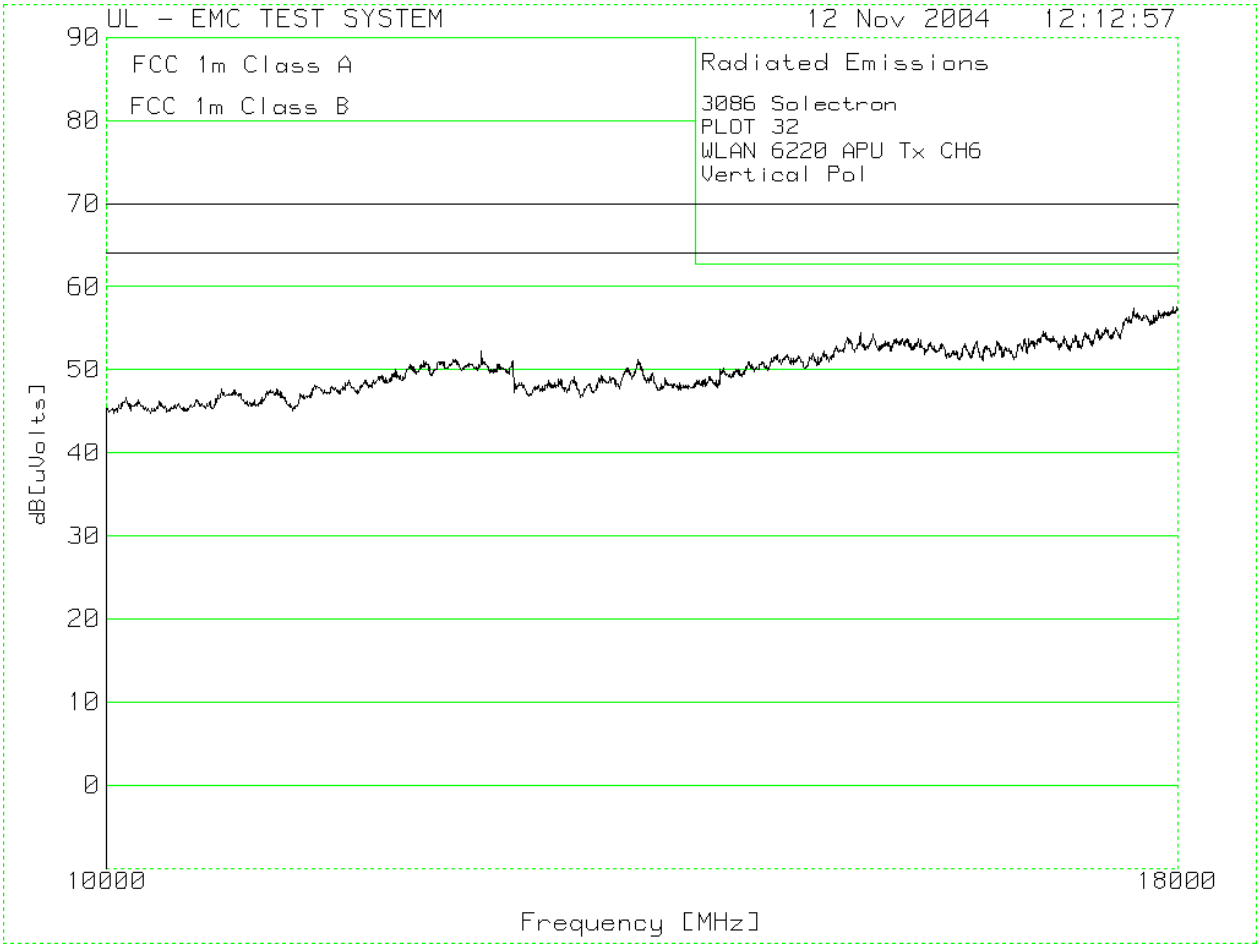


Figure 7-35: Field Strength on Channel 6 (1 Mbps), 10 GHz to 18 GHz (Horizontal Polarization)

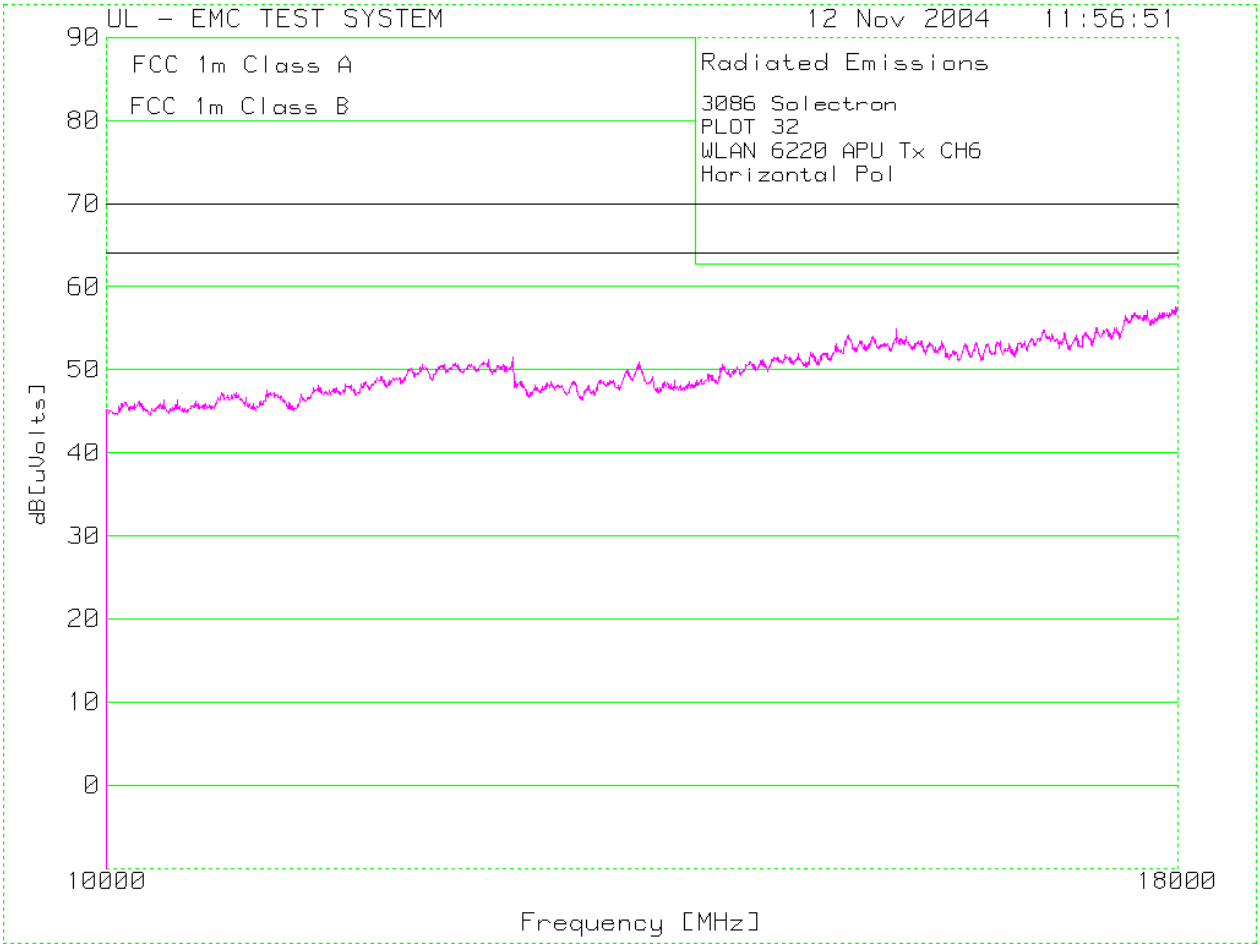


Figure 7-36: Field Strength on Channel 6 (1 Mbps), 18 GHz to 26 GHz (Vertical Polarization)

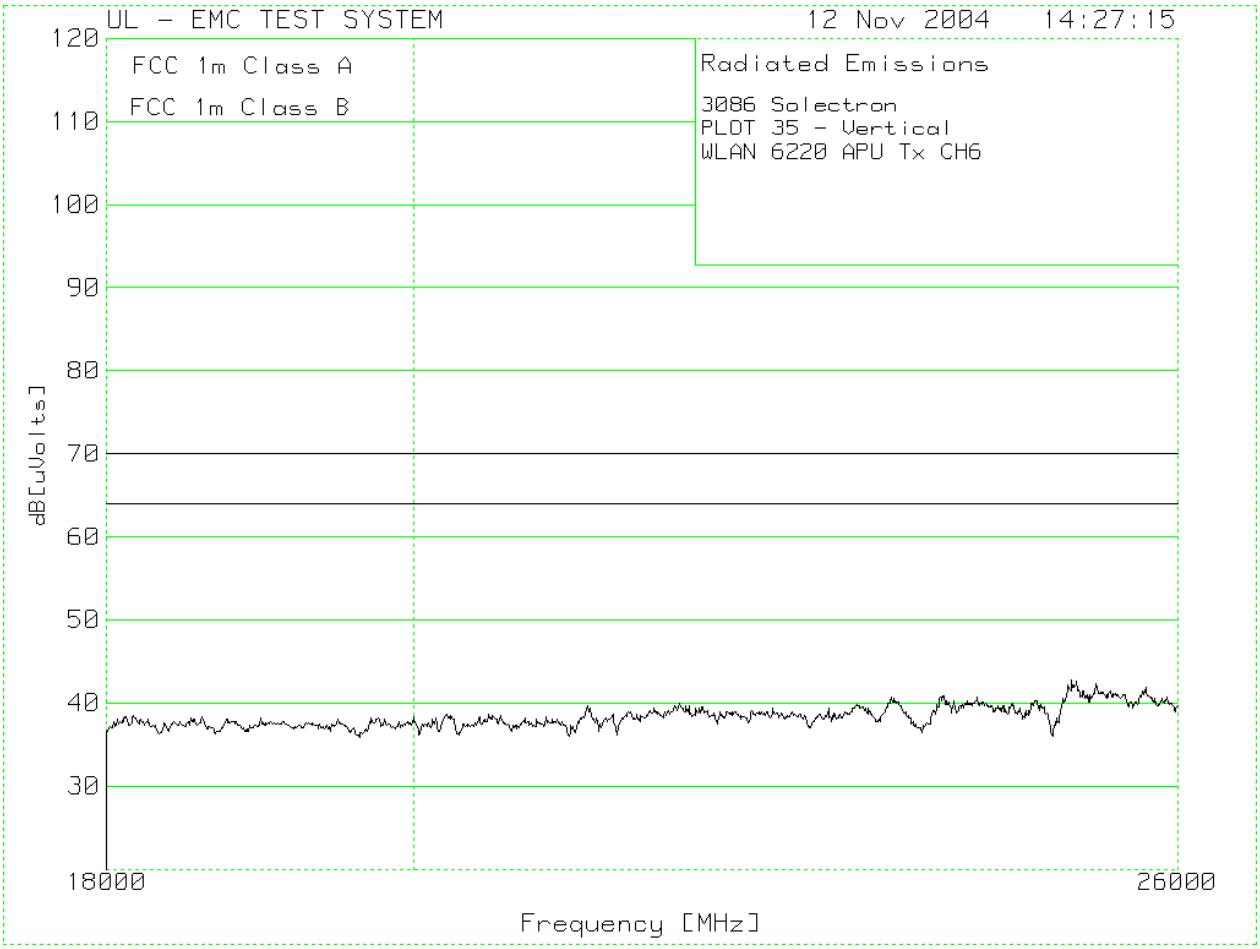


Figure 7-37: Field Strength on Channel 6 (1 Mbps), 18 GHz to 26 GHz (Horizontal Polarization)

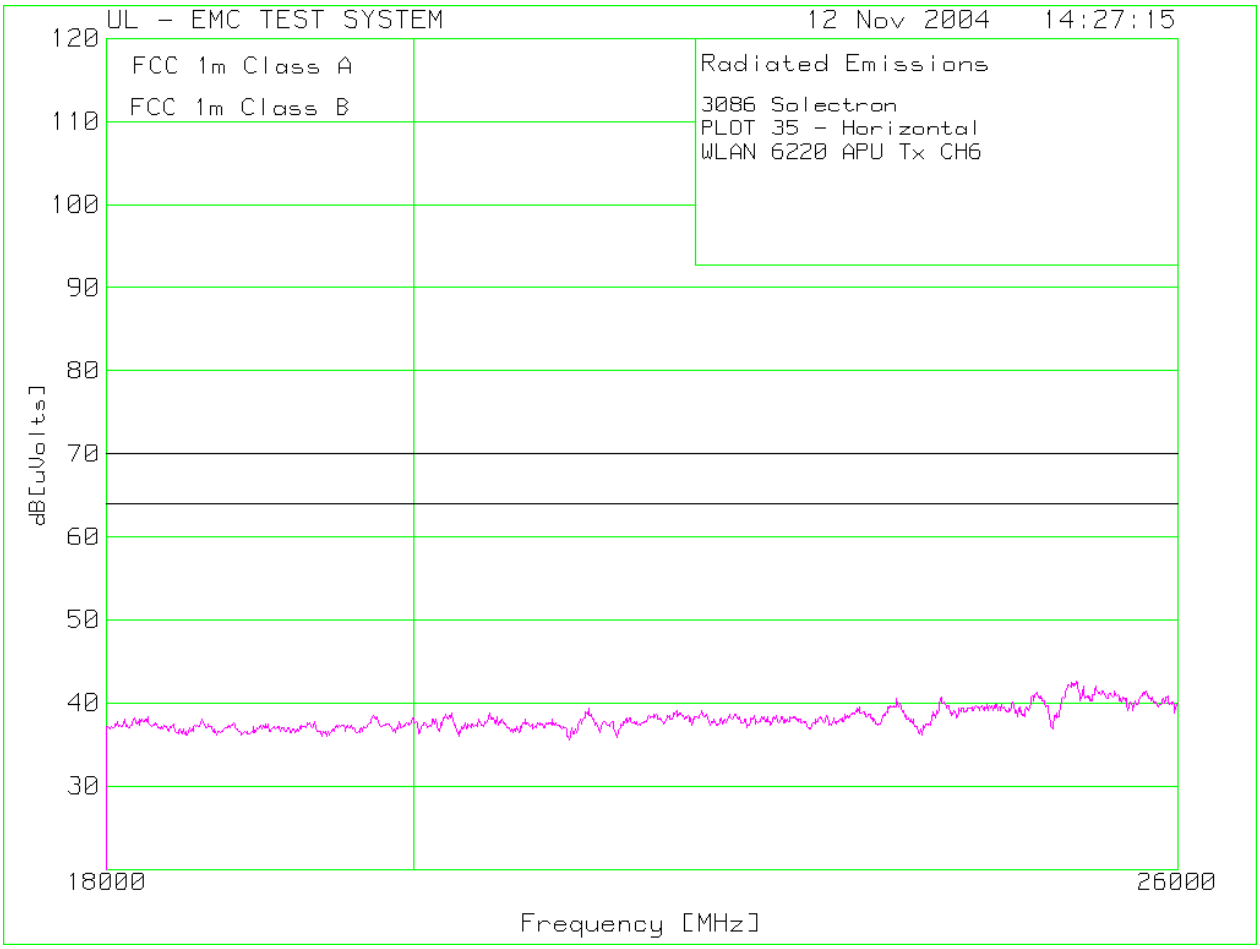
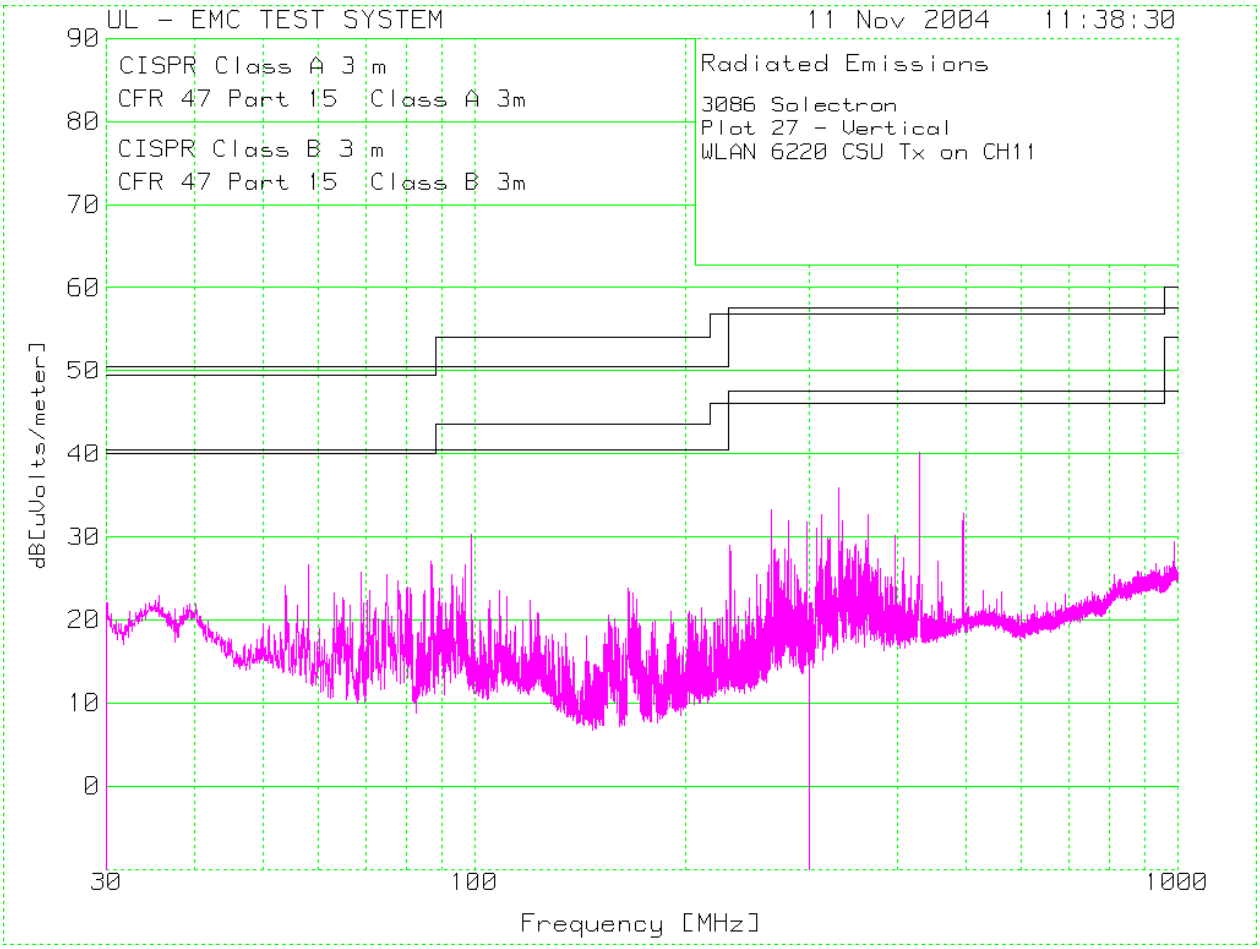
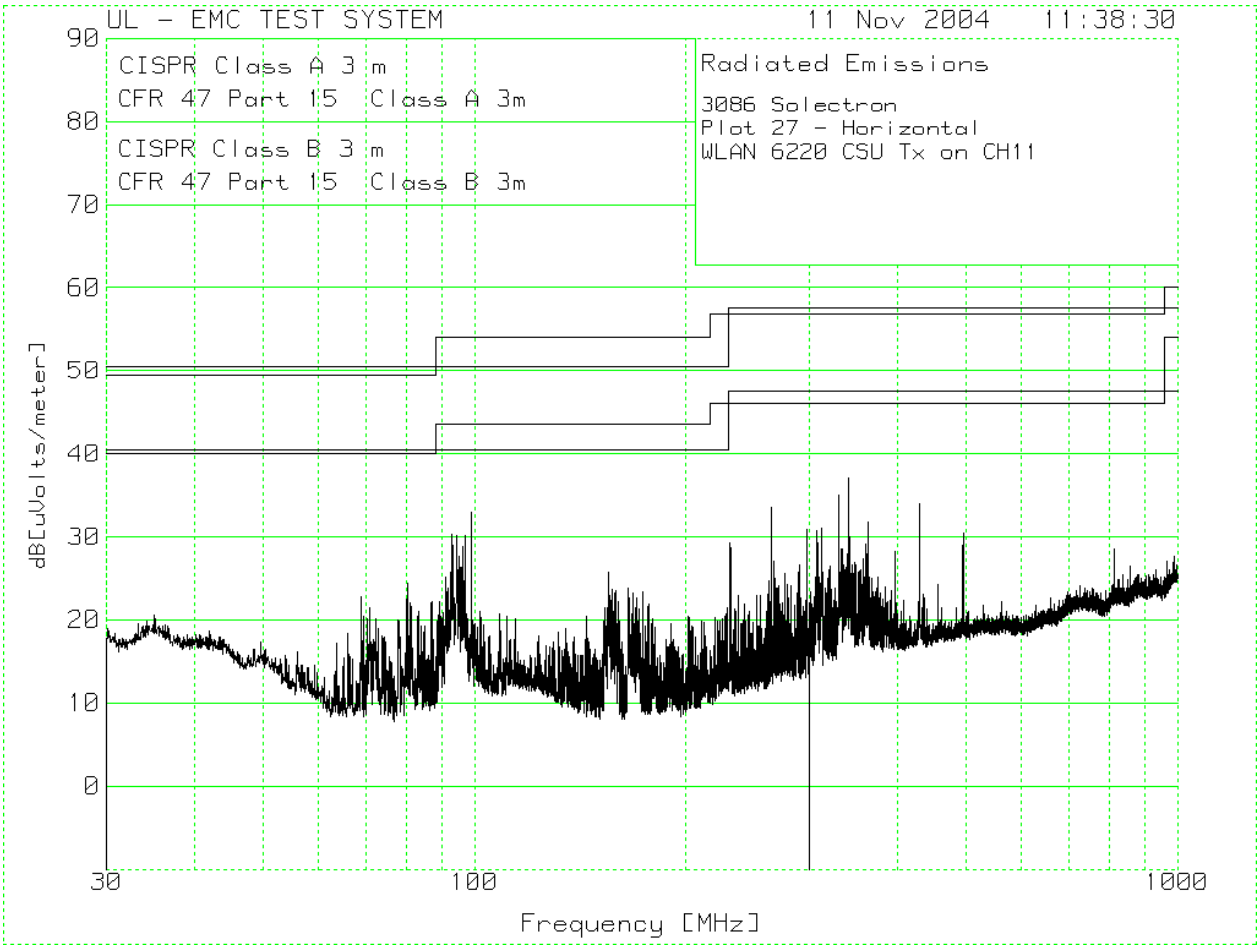


Figure 7-38: Field Strength on Channel 11 (1 Mbps), 30 MHz to 1 GHz (Vertical Polarization)



Note: the signals at 99 MHz and 429 MHz are outside the FCC 15.205 Restricted bands

Figure 7-39: Field Strength on Channel 11 (1 Mbps), 30 MHz to 1 GHz (Horizontal Polarization)



Note: the signal at 99 MHz is outside the FCC 15.205 Restricted bands

Figure 7-40: Field Strength on Channel 11 (1 Mbps), 1 GHz to 12.5 GHz (Vertical)

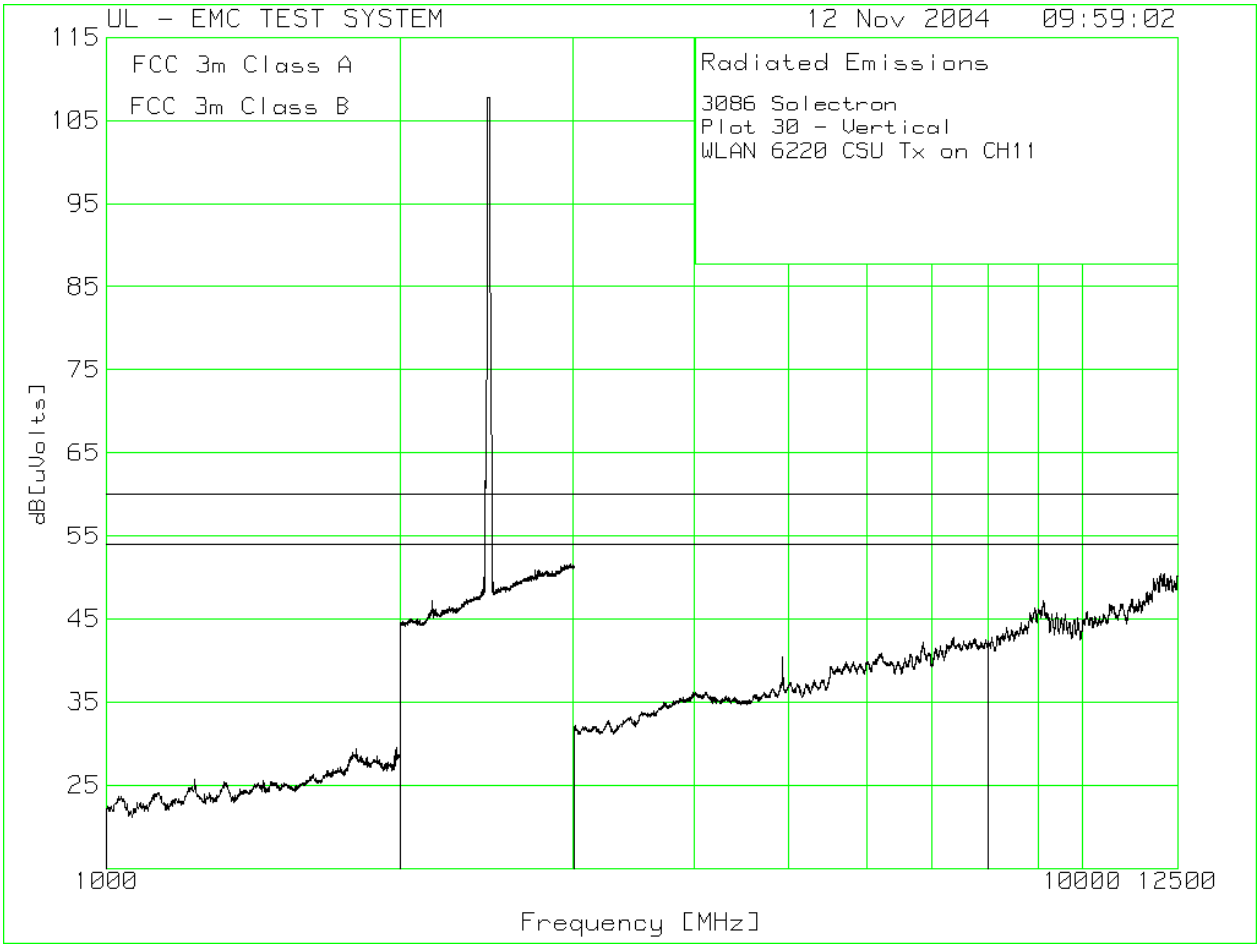


Figure 7-41: Field Strength on Channel 11 (1 Mbps), 1 GHz to 2 GHz (Horizontal)

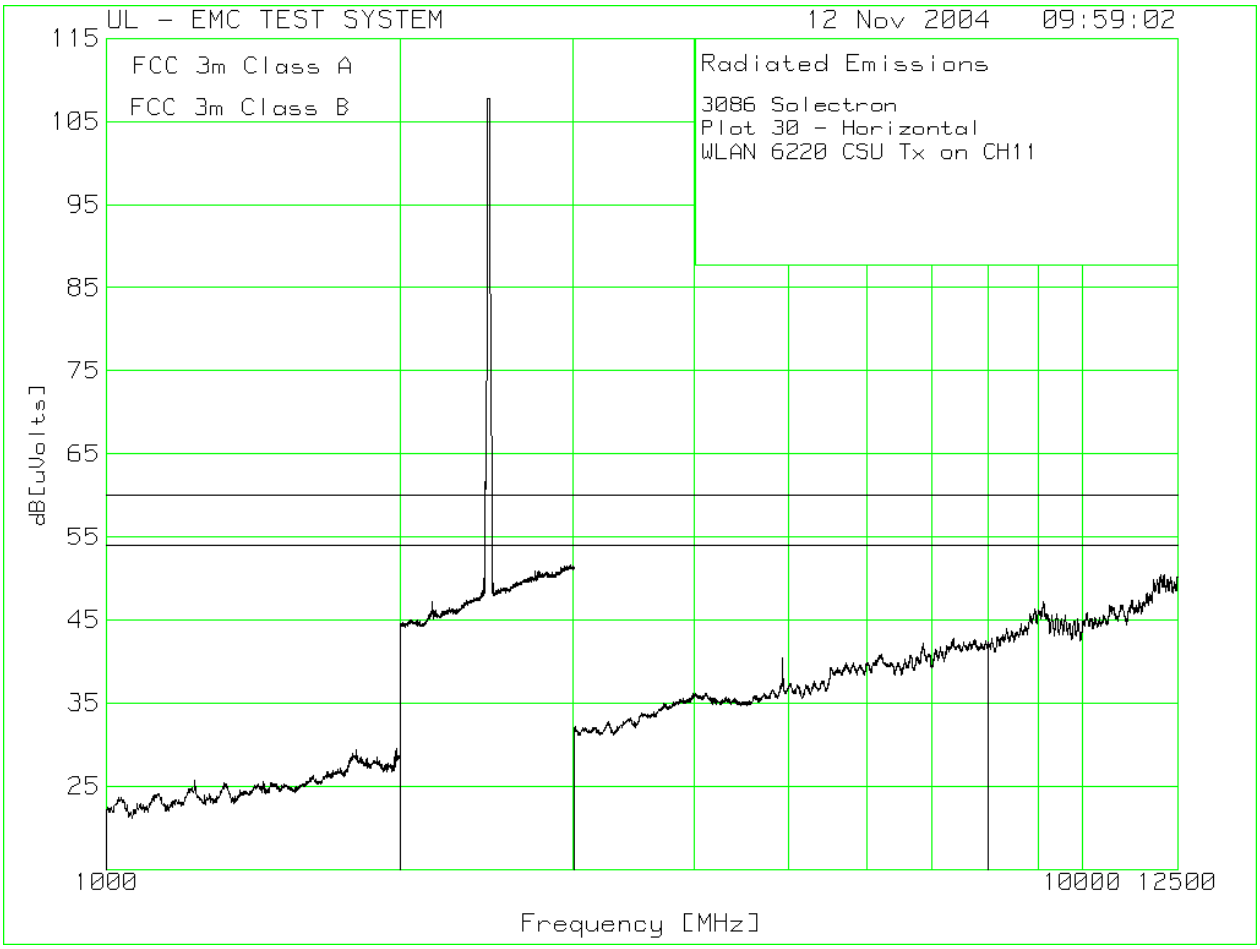


Figure 7-42: Field Strength on Channel 11 (1 Mbps), 10 GHz to 18 GHz (Vertical Polarization)

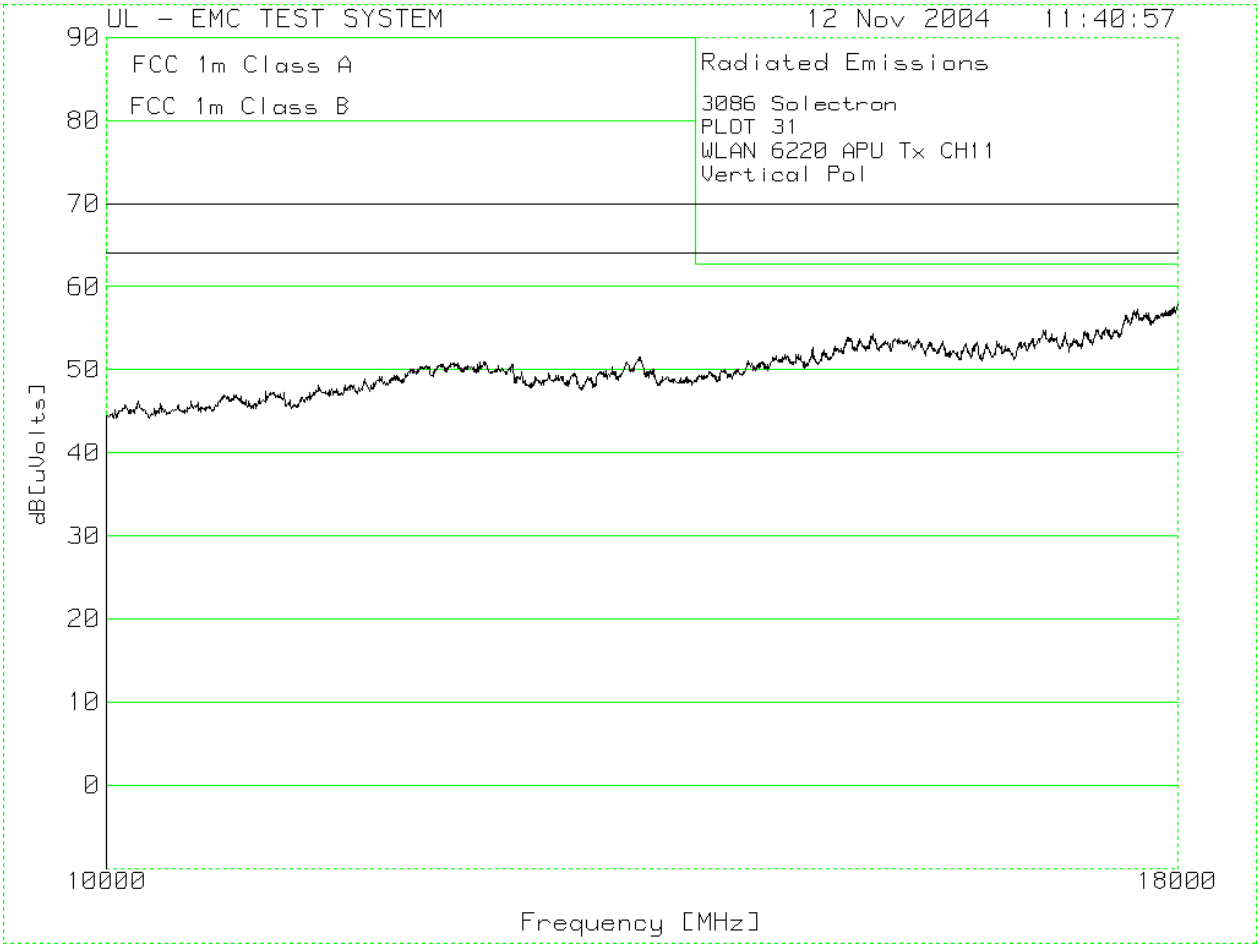


Figure 7-43: Field Strength on Channel 11 (1 Mbps), 10 GHz to 18 GHz (Horizontal Polarization)

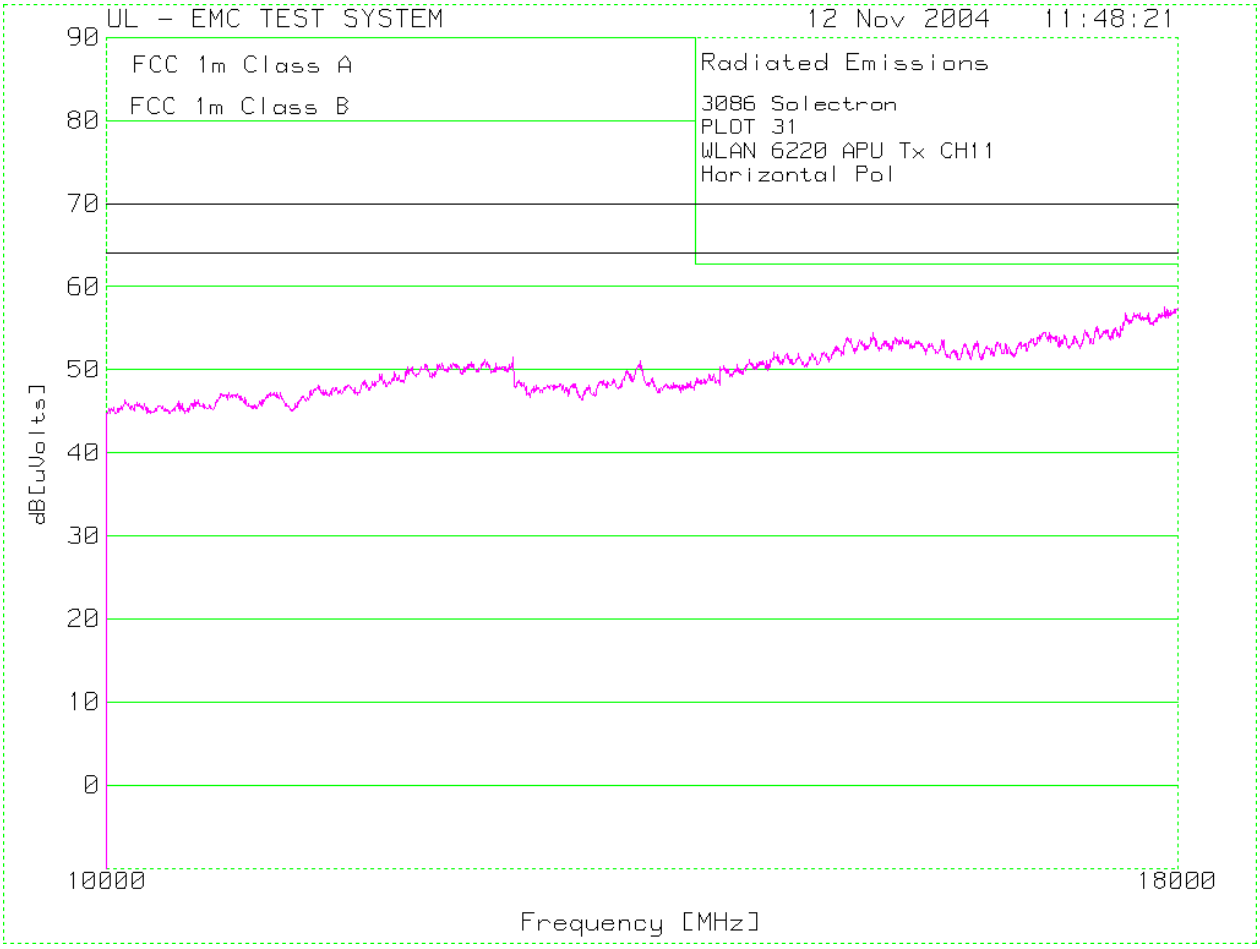


Figure 7-44: Field Strength on Channel 11 (1 Mbps), 18 GHz to 26 GHz (Vertical Polarization)

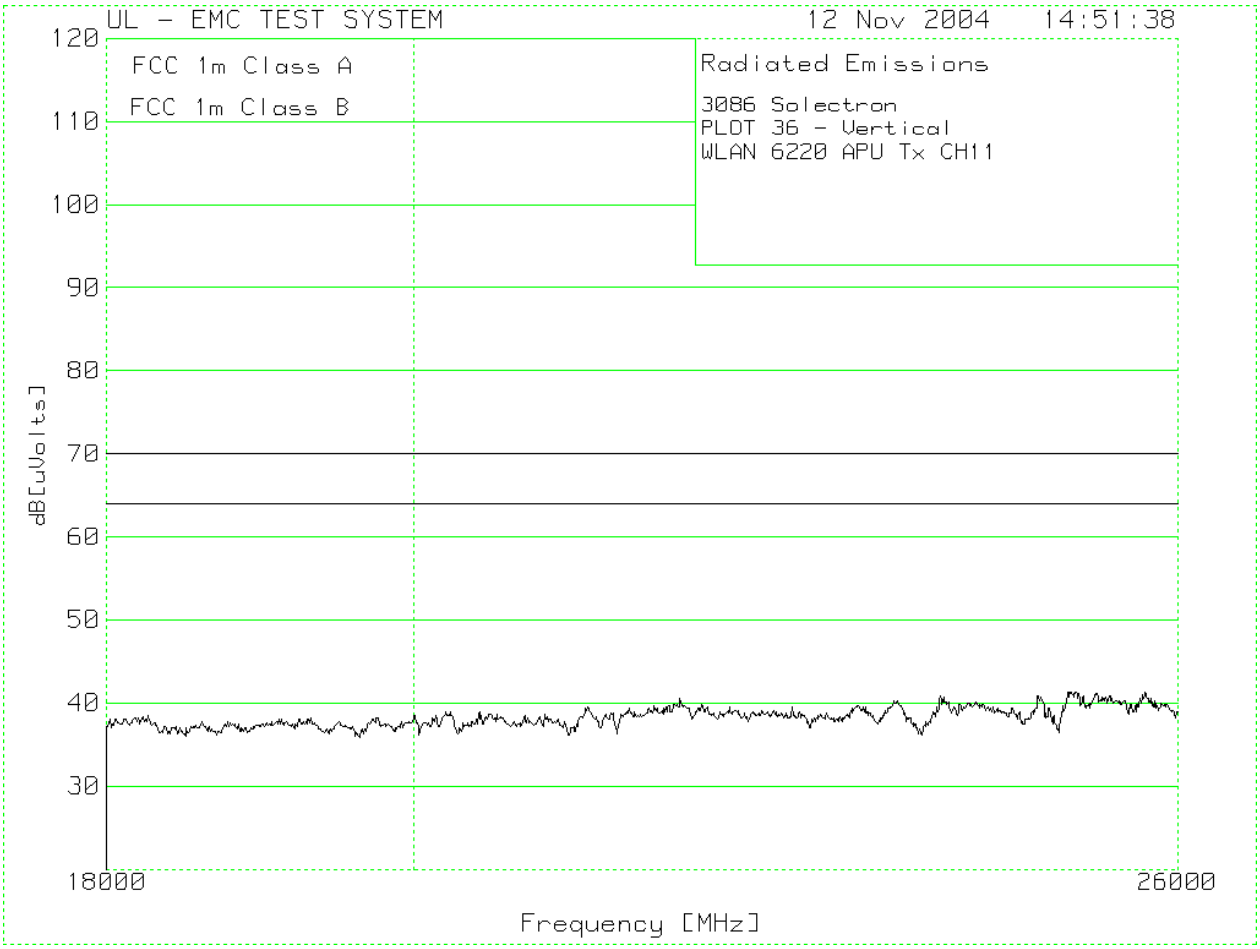


Figure 7-45: Field Strength on Channel 11 (1 Mbps), 18 GHz to 26 GHz (Horizontal Polarization)

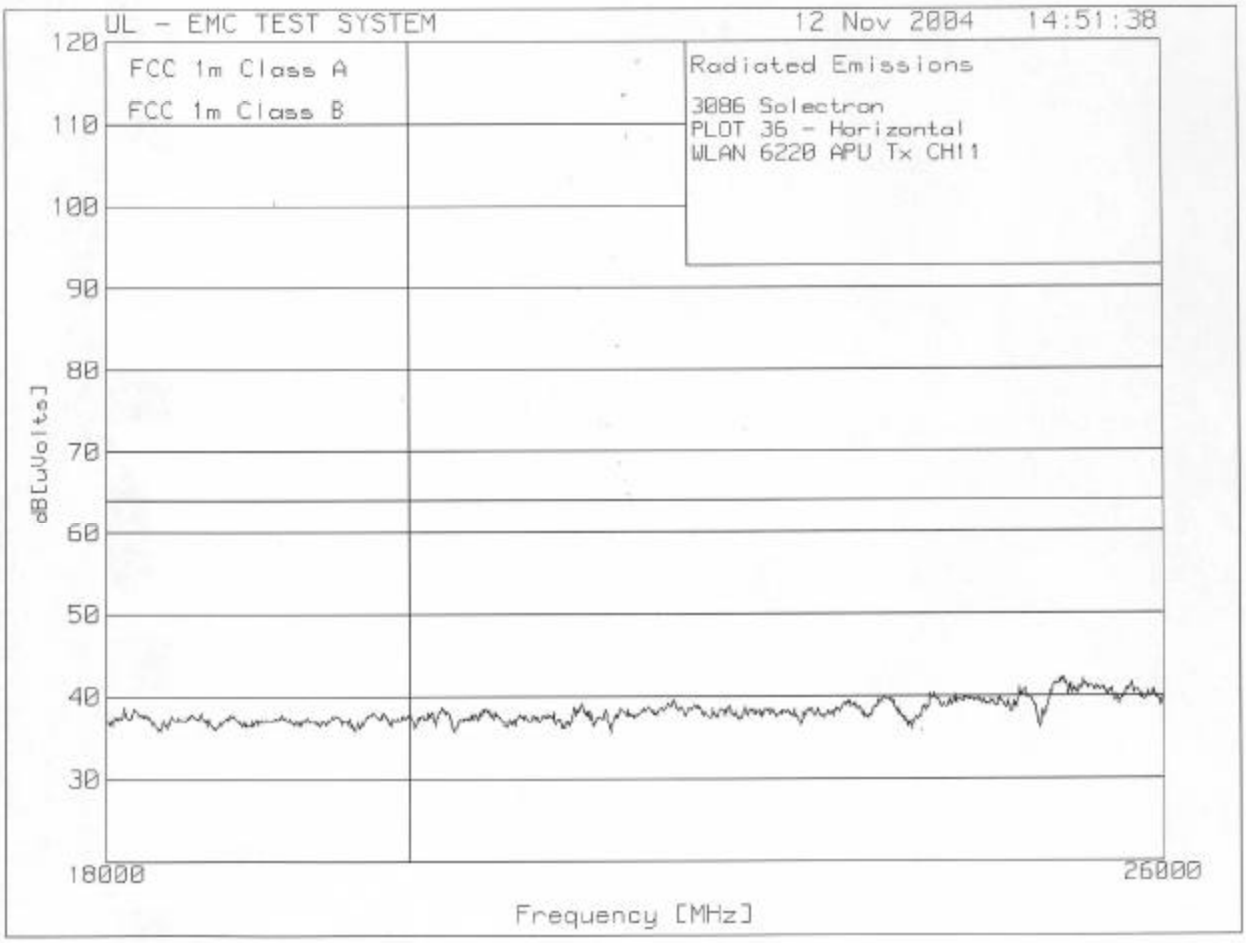


Figure 7-46: Field Strength of Receiver Emissions, 30 MHz to 1 GHz (Vertical Polarization)

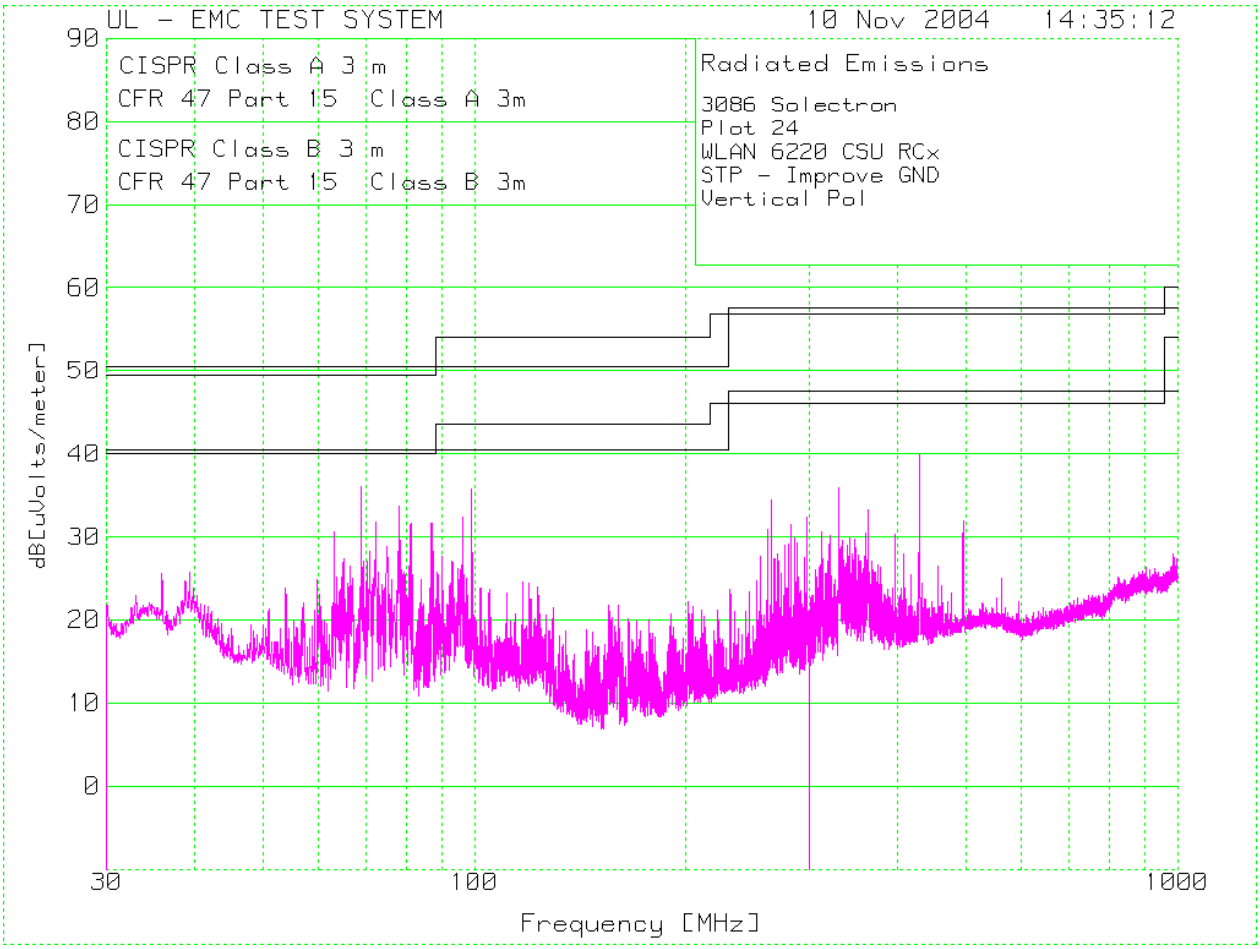


Figure 7-47: Field Strength of Receiver Emissions, 30 MHz to 1 GHz (Horizontal Polarization)

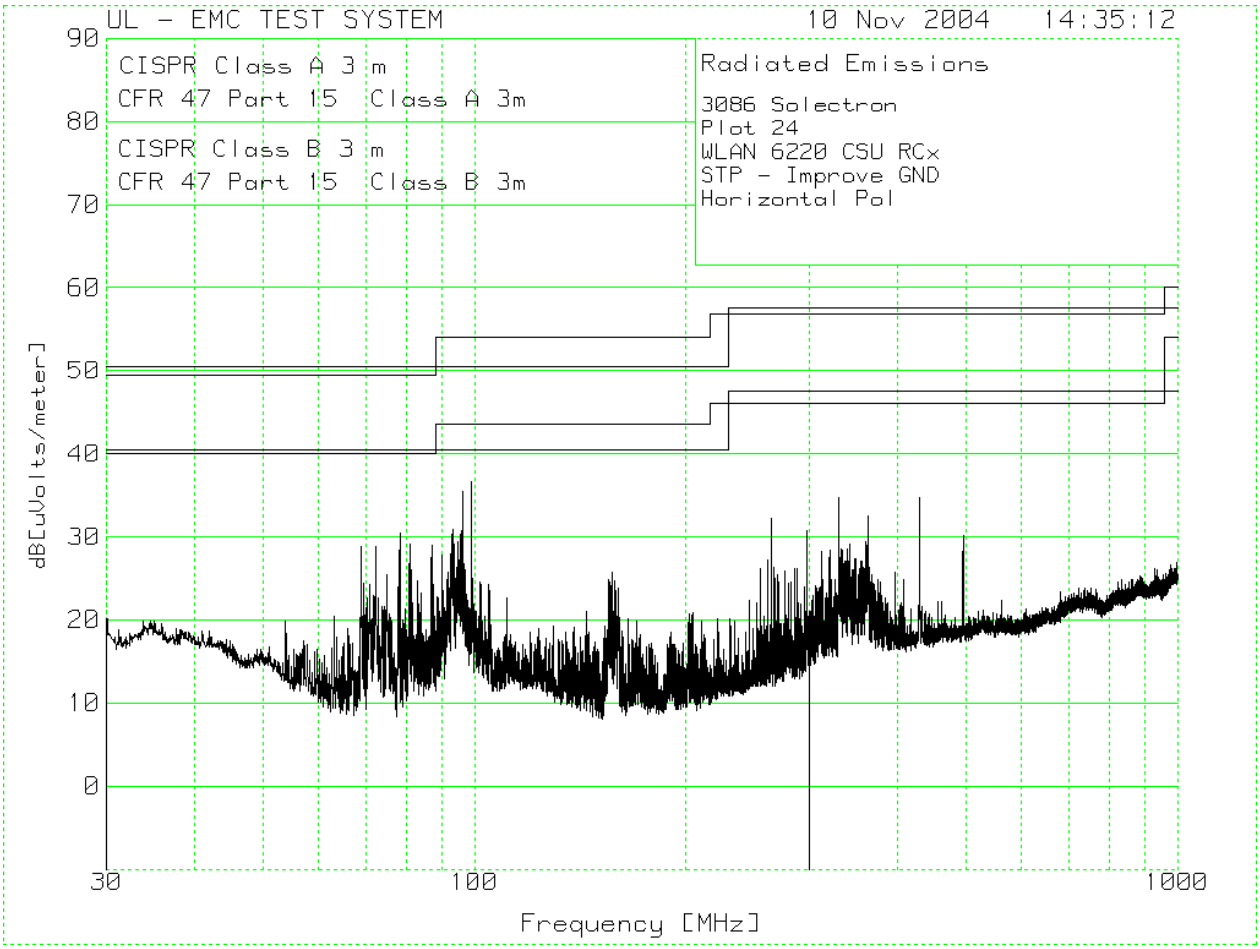
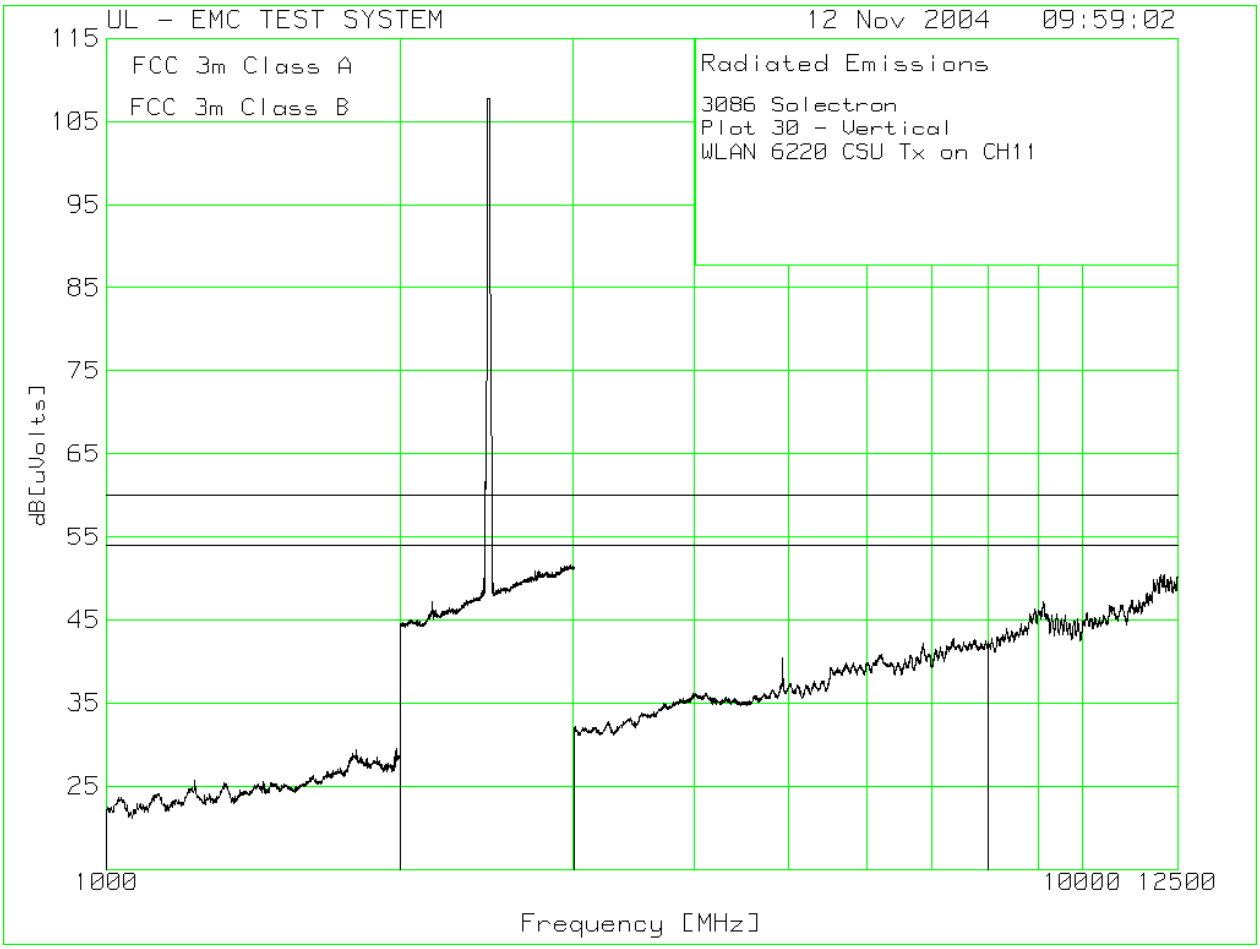


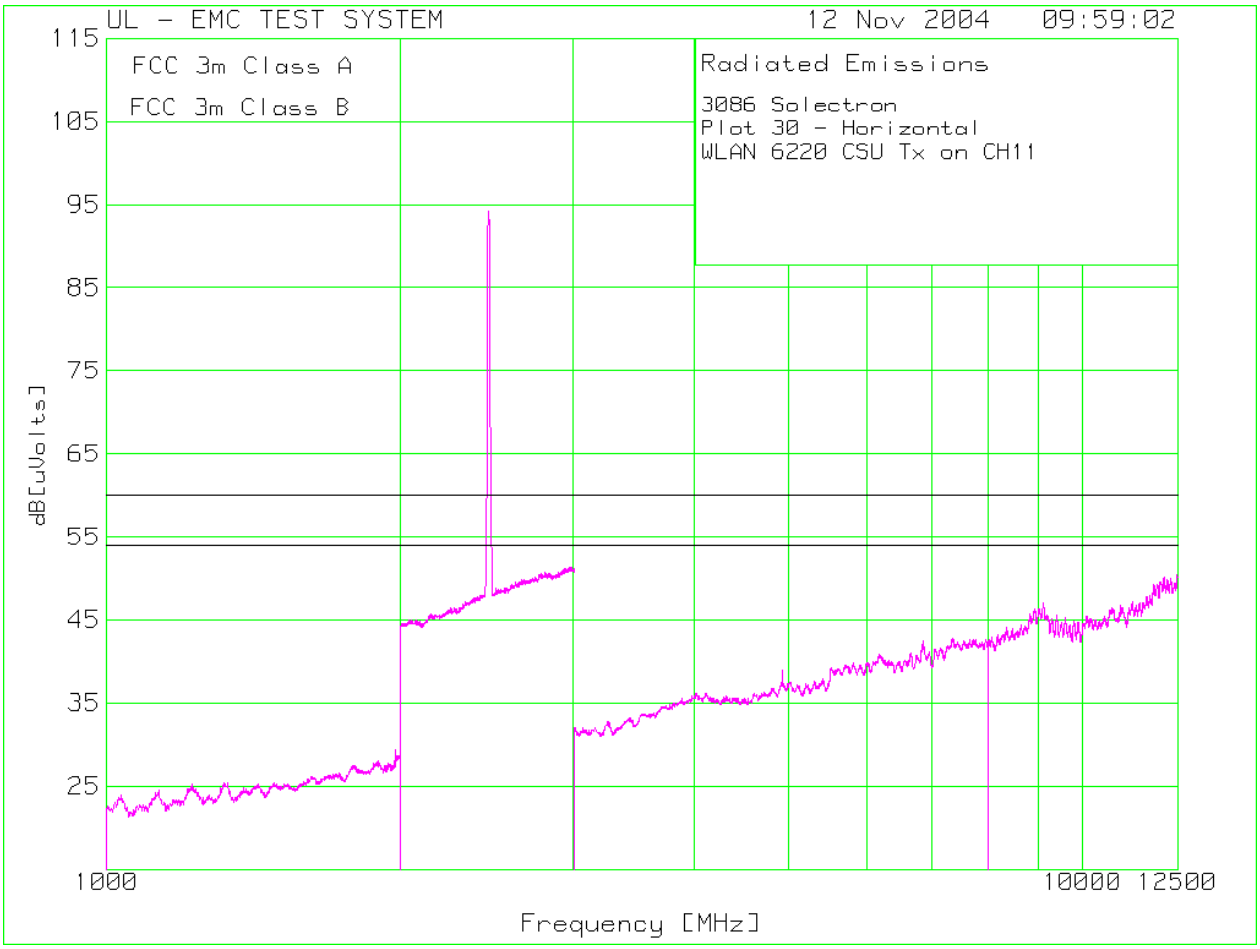
Figure 7-48: Field Strength of Receiver Emissions, 1 GHz to 12.5 GHz (Vertical Polarization)



Note 1: the limit shown on this plot should be at a level of 60 dBuV/m from 1610 MHz to 12310 MHz

Note 2: this measurement was done while both the transmitter and the receiver were activated. The 2.4 GHz signal on this plot is reduced to the noise floor level when the transmitter is off.

Figure 7-49: Field Strength of Receiver Emissions, 1 GHz to 12.5 GHz (Horizontal Polarization)



Note 1: the limit shown on this plot should be at a level of 60 dBuV/m from 1610 MHz to 12310 MHz

Note 2: this measurement was done while both the transmitter and the receiver were activated. The 2.4 GHz signal on this plot is reduced to the noise floor level when the transmitter is off.

SOLECTRON DESIGN & ENGINEERING INC.

Certification Report for WLAN 6220 Corporate Service Unit

FCC Part 15 & Industry Canada RSS-210