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MPBT Report No.: v06e2776-1 Rev: 1 Date: 24 June 2003

Report for Emissions Testing of the Bin Buddy remote level sensor alarm In accordance with FCC Part 15, Subpart C (2000)

Test Personnel: David Raynes

Prepared for: Viagrow Fertilizers
RR #1
Blackie, Alberta
Canada
T0L 0J0

_____
David Raynes
Laboratory Supervisor
Electronics Test Centre (Airdrie)
Authorized Signatory

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1.0 INTRODUCTION

1.1 SCOPE

The purpose of this report is to present the findings and results of compliance testing performed in accordance with CFR Title 47 FCC Part 15, Subpart C, Intentional Radiators.

1.2 APPLICANT

This test report has been prepared for Viagrow Fertilizers, located in Blackie, Alberta, Canada.

1.3 APPLICABILITY

All test procedures, limits, and results defined in this document apply to the Viagrow Fertilizers Bin Buddy unit, referred to herein as the Equipment Under Test (EUT).

The results contained in this report relate only to the item tested.

This report does not imply product endorsement by A2LA, NVLAP, or the Canadian or US governments.

1.4 TEST SAMPLE DESCRIPTION

The test sample provided for testing was a Bin Buddy grain auger alarm system. The system consists of a pair of devices: one transmitter, and one receiver. These devices are marketed as a pair, and have no independent use.

The transmitter is attached to the outlet end of the auger, where it can sense that the level of the product is approaching the tip of the auger. An alarm signal is sent to the receiver, which emits a loud audible tone to alert the operator. This alarm condition remains active until the auger is moved away from the suface of the product, thus preventing equipment damage, and possible operator injury.

Product Type:	Remote sensor alarm system
Model Number:	VF1
Serial Number:	n/a
Cables:	nil
Power Requirements:	Transmitter: Three AA batteries Receiver: 12 VDC nominal

More detailed information is provided by Viagrow Fertilizers in Appendix A.

1.5 GENERAL TEST CONDITIONS AND ASSUMPTIONS

The EUT was set up and exercised using the configurations, modes of operation and arrangements defined in this report only. All inputs and outputs to and from other equipment associated with the EUT were adequately simulated.

Where relevant, the EUT was only tested using the monitoring methods and test criteria defined in this report.

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1.6 SCOPE OF TESTING

Testing was performed in accordance with FCC Part 15 Subpart C (2000), and ANSI C63.4 (2000).

1.6.1 VARIATIONS IN TEST METHODS

There were no variations from the test procedures outlined above.

1.6.2 MARGINAL EMISSIONS MEASUREMENTS

As noted in Section 4, some emissions were measured to be within -6 dB of the specified limit:

1.6.3 TEST SAMPLE CONFIGURATION & MODIFICATIONS

For the duration of the transmit tests, the touch sensor sensitivity was adjusted such that the unit transmitted constantly. Testing was performed with the EUT positioned as shown in the photos located in Section 4.

No EUT modifications were performed in order to meet the specifications

2.0 ABBREVIATIONS

AP -Average Peak
CE -Conducted Emissions
E -Field - Electric Field
H -Field - Magnetic Field
N/T -Not Tested
N/A -Not Applicable
PK -Peak
QP -Quasi Peak
RE -Radiated Emissions

3.0 MEASUREMENT UNCERTAINTY

For Radiated E-Field Emissions and Conducted Emissions, the uncertainties in the measurements were calculated using the methods outlined in the NAMAS document, NIS81: May 1984.

Frequency = ± 1 kHz
Amplitude (RE) = ± 4.01 dB
Amplitude (CE) = ± 3.25 dB

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4.0 TEST CONCLUSION

The EUT was subjected to the following tests. Compliance status is reported as **PASS** or **FAIL**. Test conditions that are not applicable to the EUT are marked **n/a**. If testing was not performed at this time, the appropriate field is marked **n/t**.

The following table summarizes the test results in terms of the specification and class or level applied, the unique test sample identification, the EUT modification state, and configuration as applicable.

TEST CASE	TEST TYPE	SPECIFICATION	TEST SAMPLE	MOD. STATE	CONFIGURATION	RESULT
§4.1	Conducted Emissions at AC lines	FCC Part 15.207	Bin Buddy	nil	See § 1.6.3	**n/a**
§4.2	Conducted Emissions at Antenna Port	FCC Part 15.231	Bin Buddy	nil	See § 1.6.3	**PASS**
§4.3a	Radiated Emissions (Rx)	FCC Part 15.109	Bin Buddy	nil	See § 1.6.3	**PASS**
§4.3b	Radiated Emissions (Tx)	FCC Parts 15.205, 15.209 and 15.231	Bin Buddy	nil	See § 1.6.3	**PASS**

STATEMENT OF COMPLIANCE

The client equipment referred to in this report was found to comply with the requirements as stated above.

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4.1 CONDUCTED EMISSIONS ON AC POWER LINES

Test Lab: Electronics Test Centre (Airdrie) Test Personnel: n/a Test Date: n/a	Product: Bin Buddy
Test Result, Bin Buddy: **Not Applicable**	
The Bin Buddy was not tested for Conducted Emissions. This is a DC powered device. There is no connection to the AC mains.	

4.2 CONDUCTED EMISSIONS MEASURED AT ANTENNA PORT

Test Lab: Electronics Test Centre (Airdrie) Test Personnel: David Raynes Test Date: 23 June 2003	Product: Bin Buddy

Test Result, Bin Buddy: **PASS**

§ 15.231(a)	Application	Permitted
§ 15.231(a)(1)	Manual 5-second timeout	n/a
§ 15.231(a)(2)	Automatic 5-second timeout	n/a
§ 15.231(a)(3)	Periodic polling less than 1 s/hr	n/a
§ 15.231(a)(4)	Emergency alarm operation	Equipment operator safety
§ 15.231(c)	BW $\leq$ 0.25 % **f**c	20 dB BW = 2.2 kHz
§ 15.231(d)	Frequency tolerance	n/a
§ 15.231(b)	Spurious $\leq$ -20 dB **f**c	Frequencies of interest are identified in the following plots. See also § 4.3b
§ 15.231(b)(1)	Radiated Emissions @ 3 m	See § 4.3a & 4.3b
§ 15.231(b)(2)	Average or Quasi-Peak?	Calculated average applied to Peak. See § 4.3b
§ 15.231(b)(3)	15.209 General Limits	See § 4.3b

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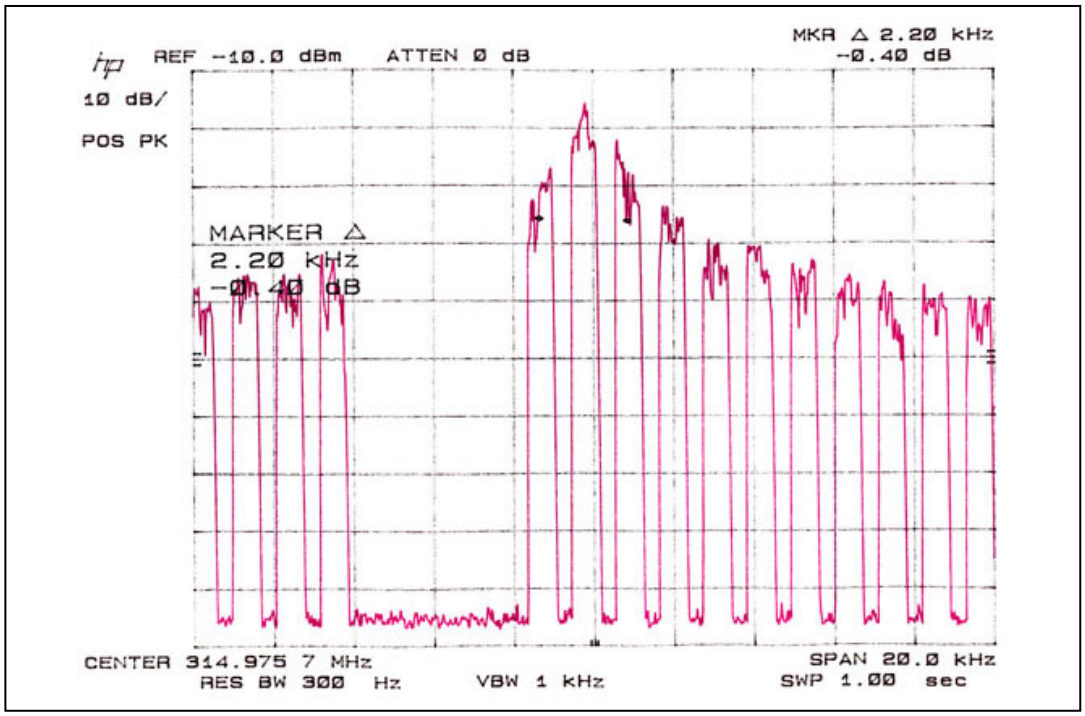
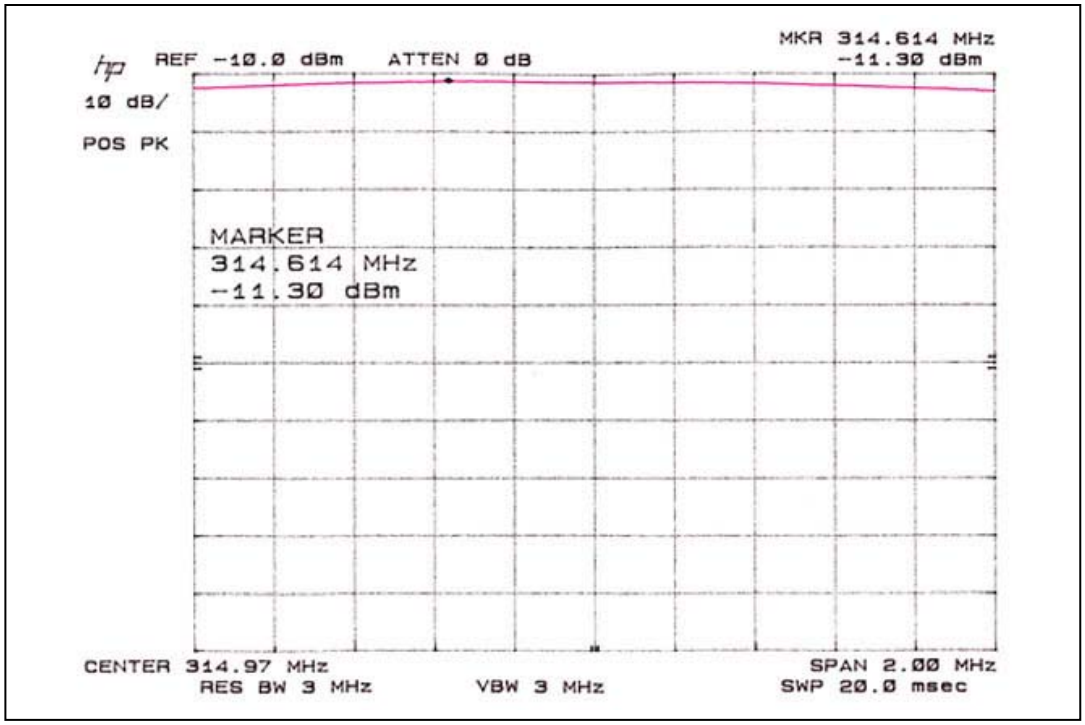
Spectrum Analyzer Plot of -20 dB Bandwidth: Tx @ 315 MHz



Spectrum Analyzer Plot of peak output power: Tx @ 315 MHz



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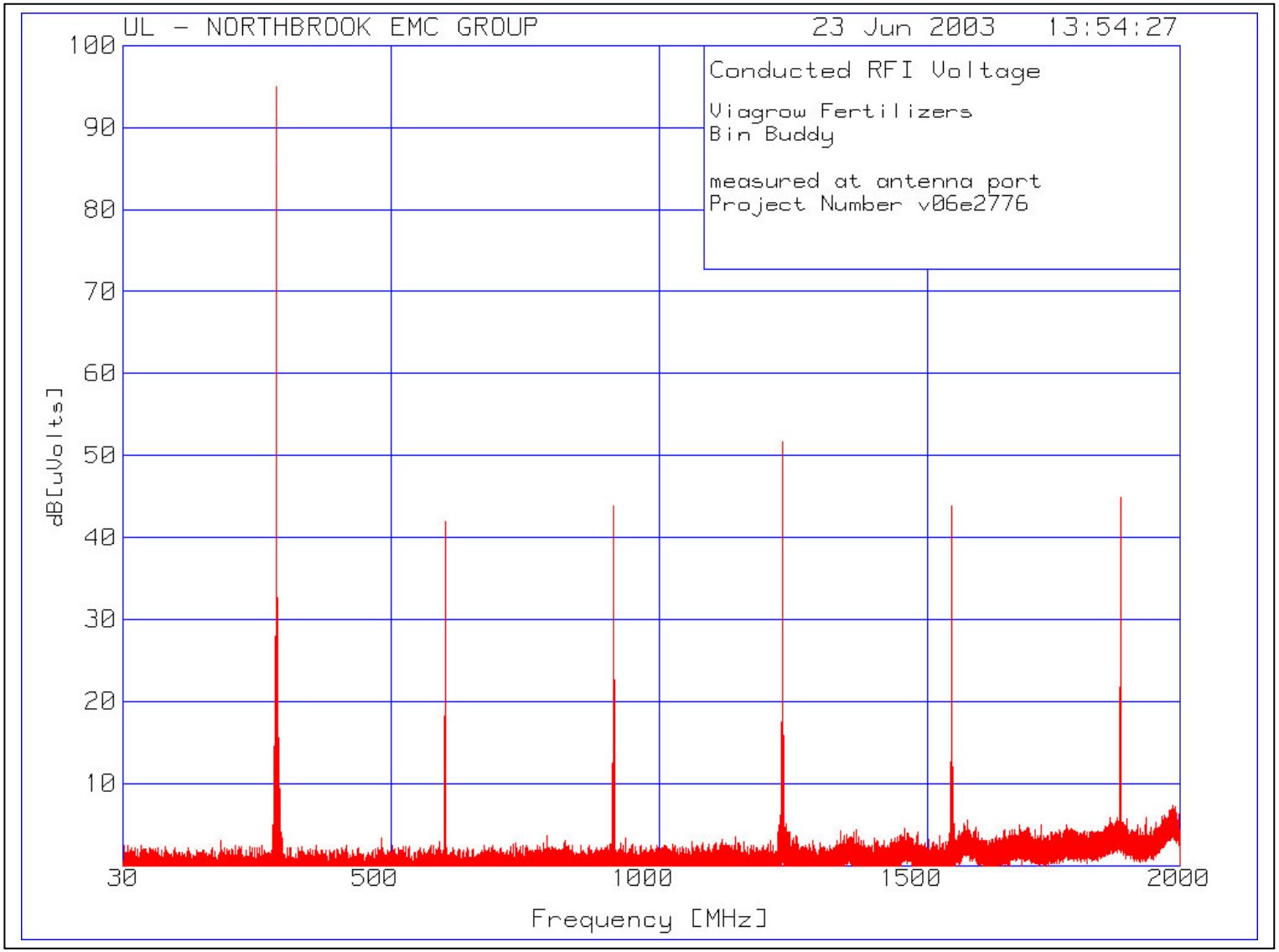
Plot of Conducted Emissions:



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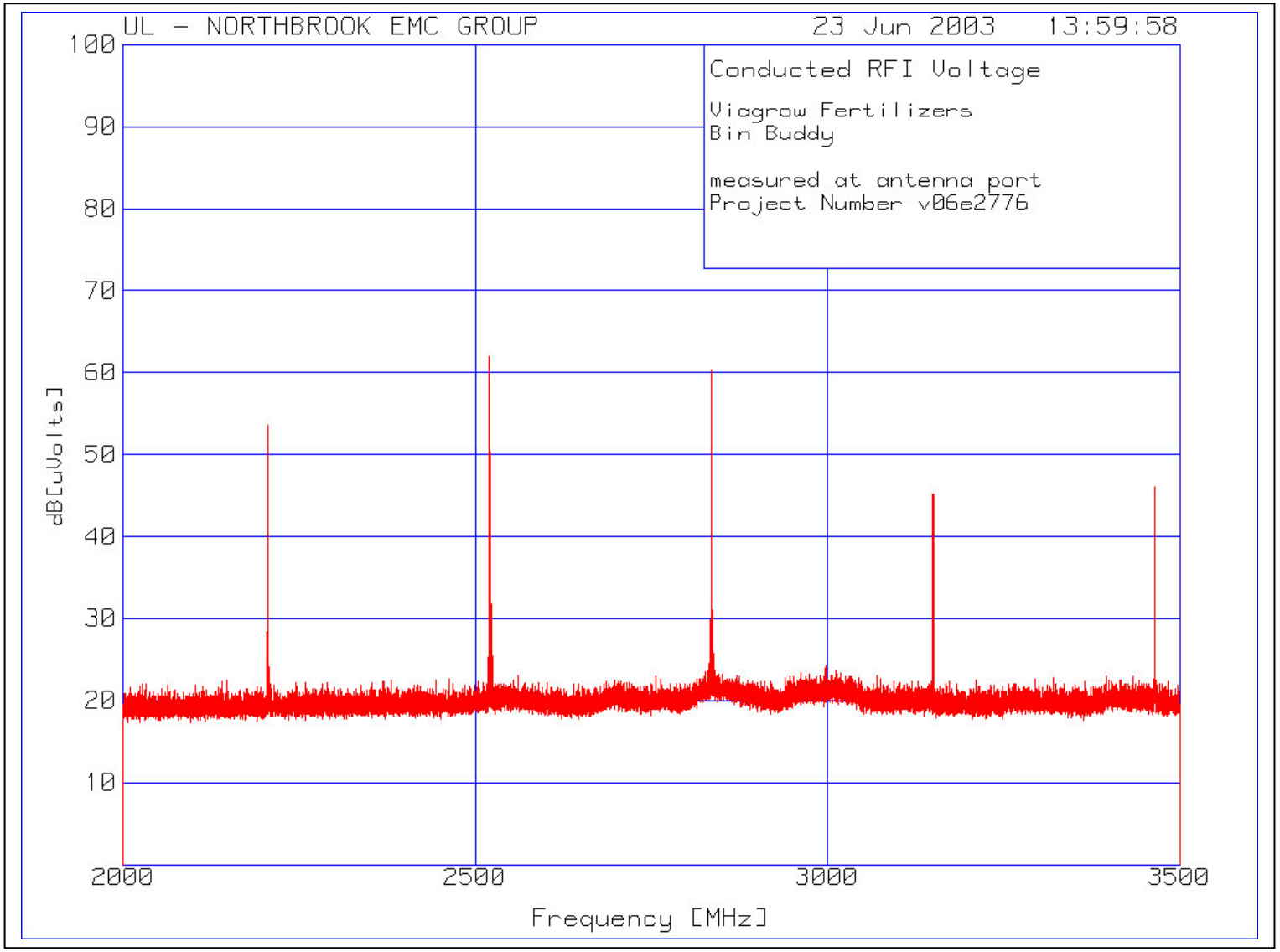
Plot of Conducted Emissions:



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4.3 RADIATED EMISSIONS, INCLUDING RESTRICTED BANDS OF OPERATION

4.3a Receiver

Test Lab: MPB Technologies Inc. Airdrie Test Personnel: David Raynes Test Date: 29 April 2003	Product: Bin Buddy
Test Result, Bin Buddy: **PASS**	
Objectives/Criteria The Radiated E-Field emissions produced by a system or sub-system, measured at a distance of 3m from the EUT, shall not exceed the limits for the specifications as stated. **Emission levels should meet the requirements with a margin of 6dB.** The EUT was assessed against the requirements of **15.109**. Temperature = 22 °C Humidity = 27%	Specification: FCC Part 15.109 Frequency [MHz] / Class A QP @ 3m / **Class B** QP @ 3m 30 – 88 / 49.54 / **40.00** 88 – 216 / 53.98 / **43.52** 216 – 960 / 56.90 / **46.02** above 960 / 60.00 / **53.98**
There were no emissions measured within -10 dB of the specified limit. Refer to the test data and plots for more detail.	

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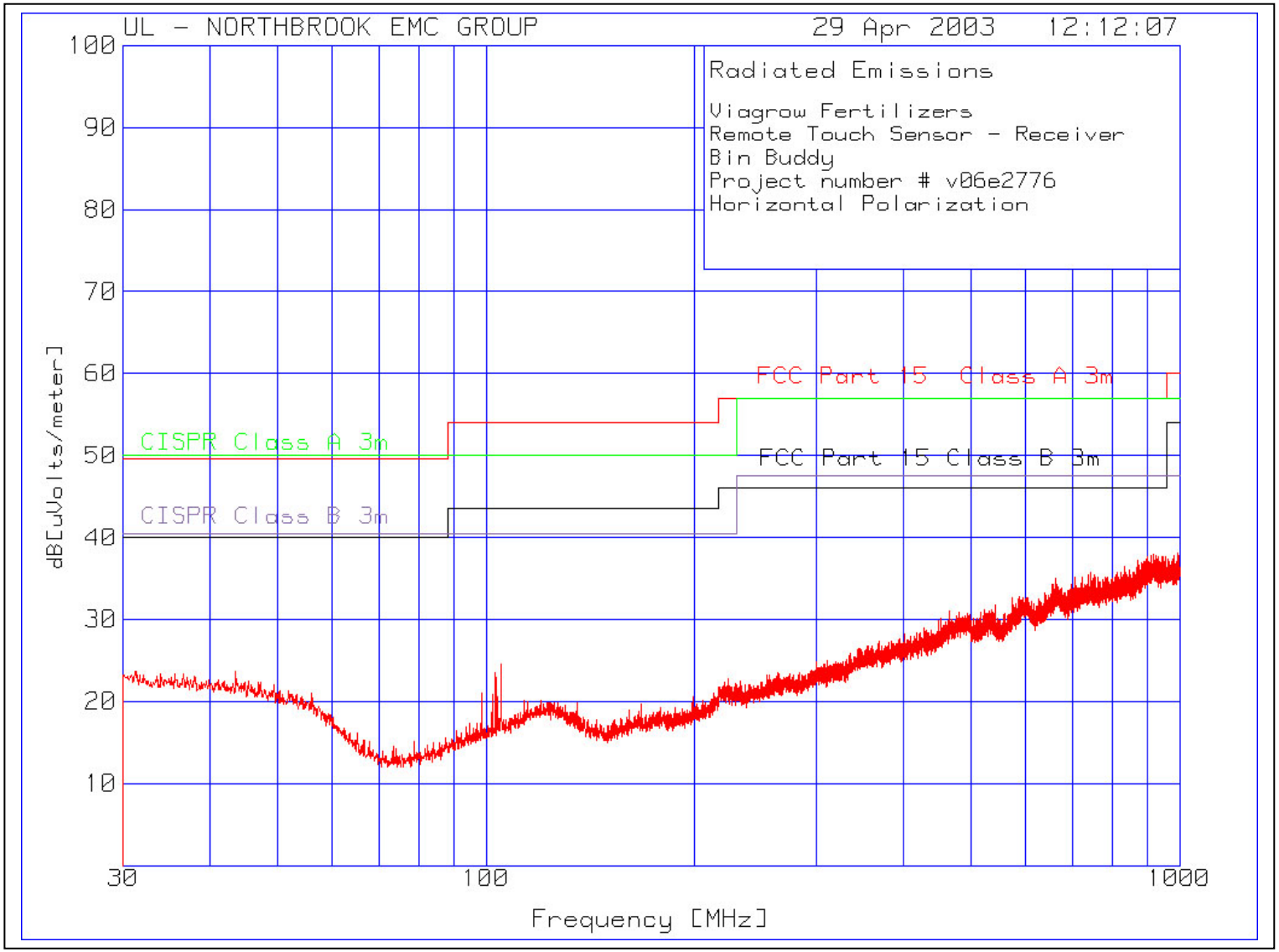
Plot of Radiated Emissions - Horizontal:



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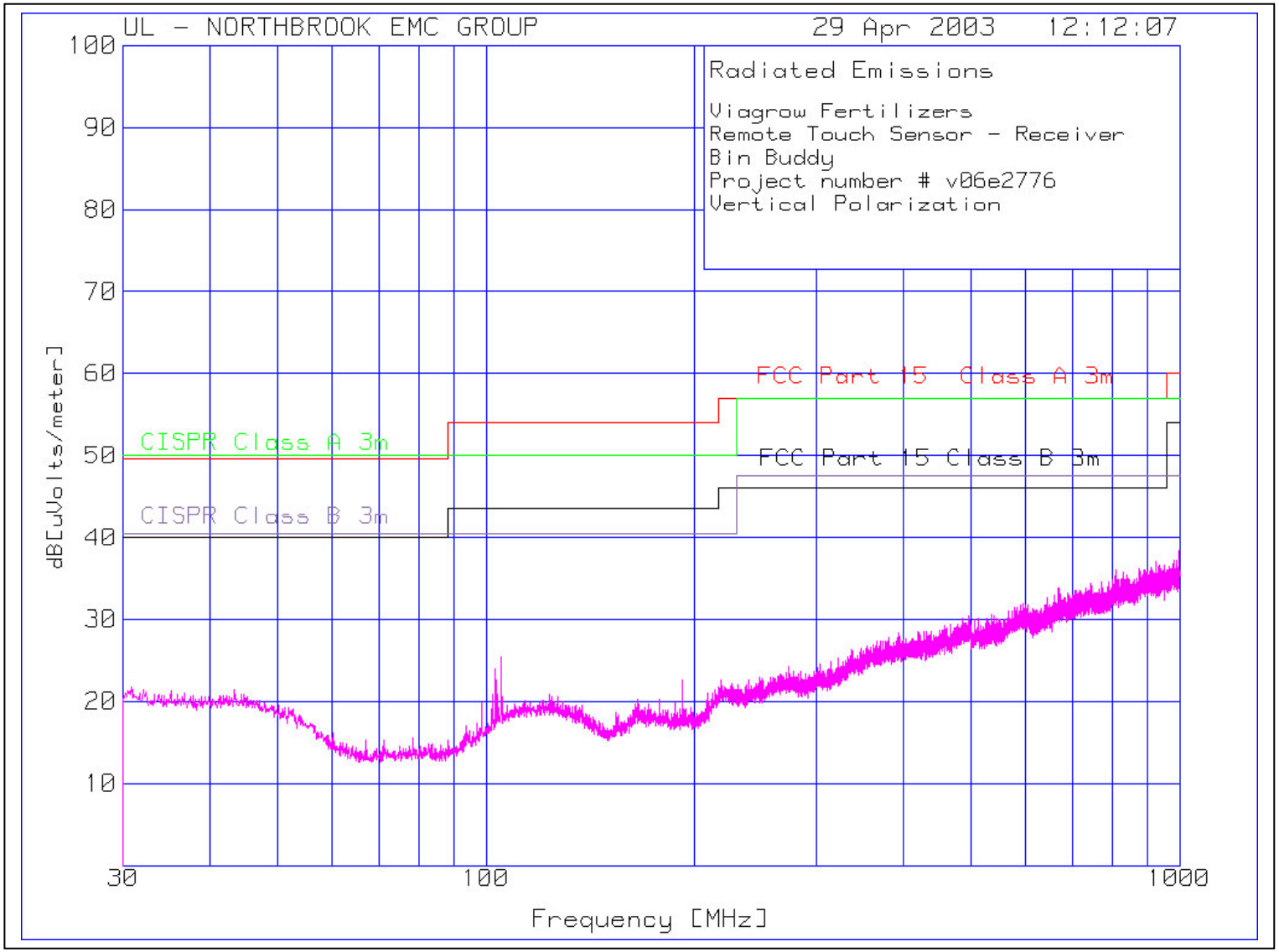
Plot of Radiated Emissions - Vertical:



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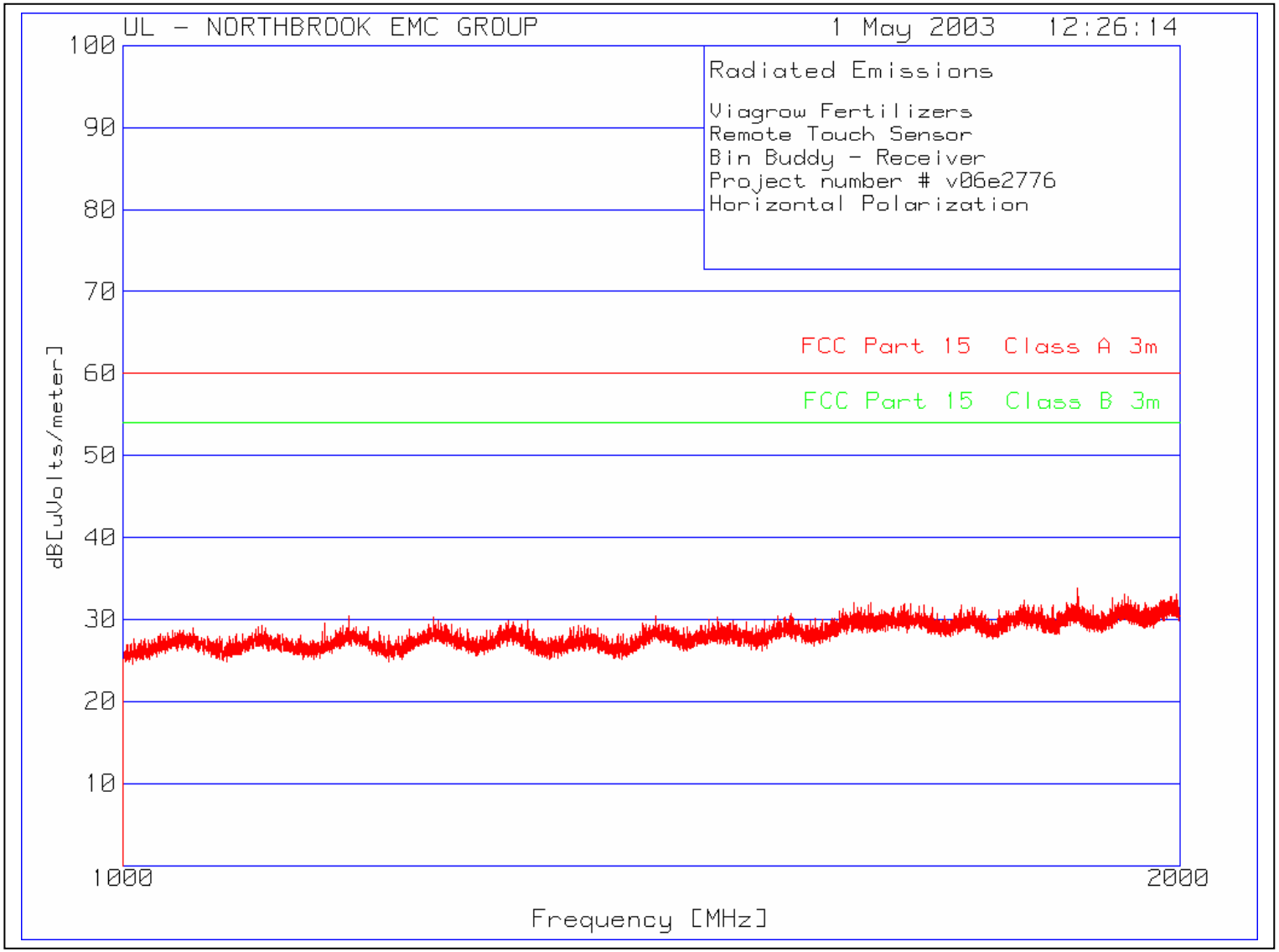
Plot of Radiated Emissions - Horizontal:



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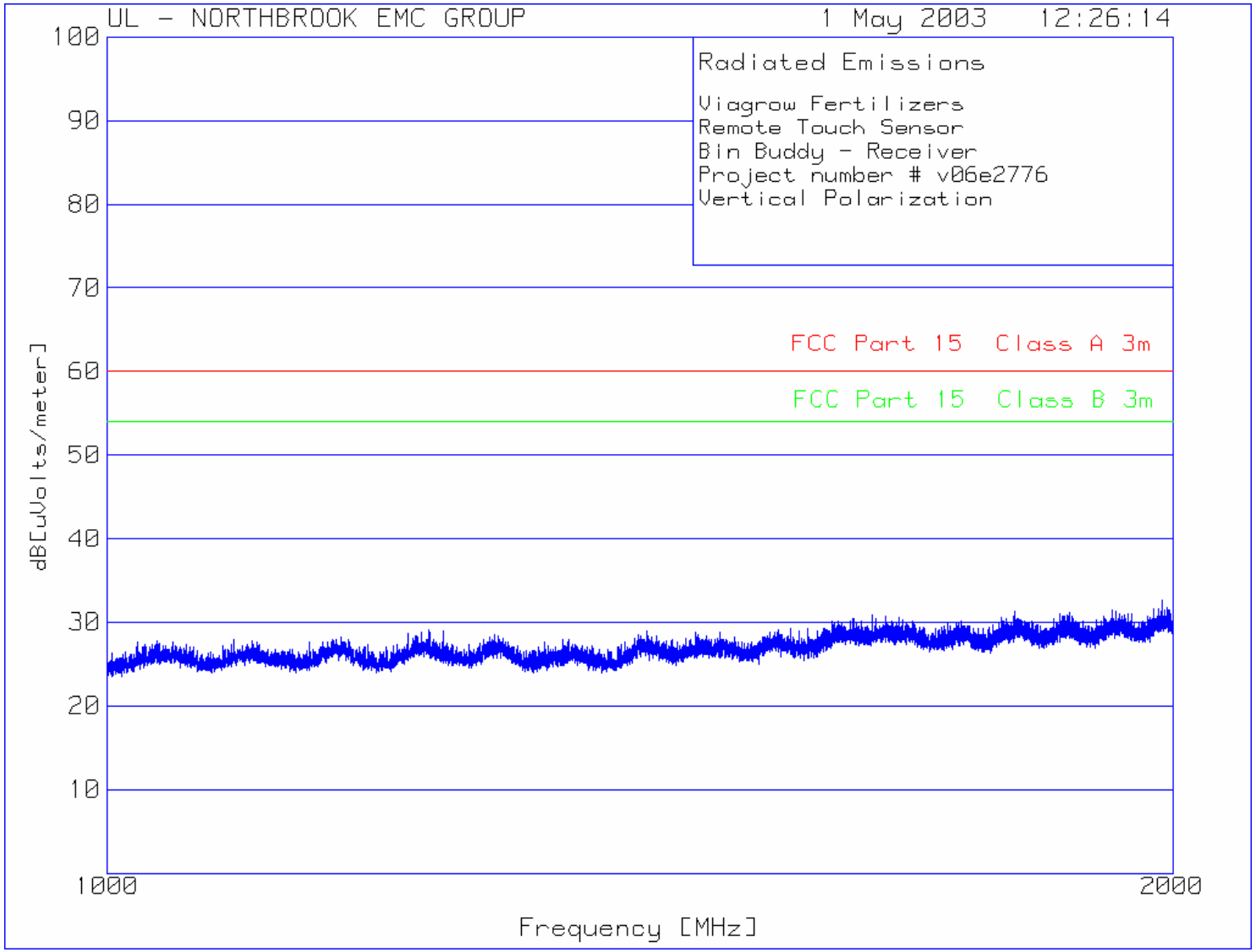
Plot of Radiated Emissions – Vertical:



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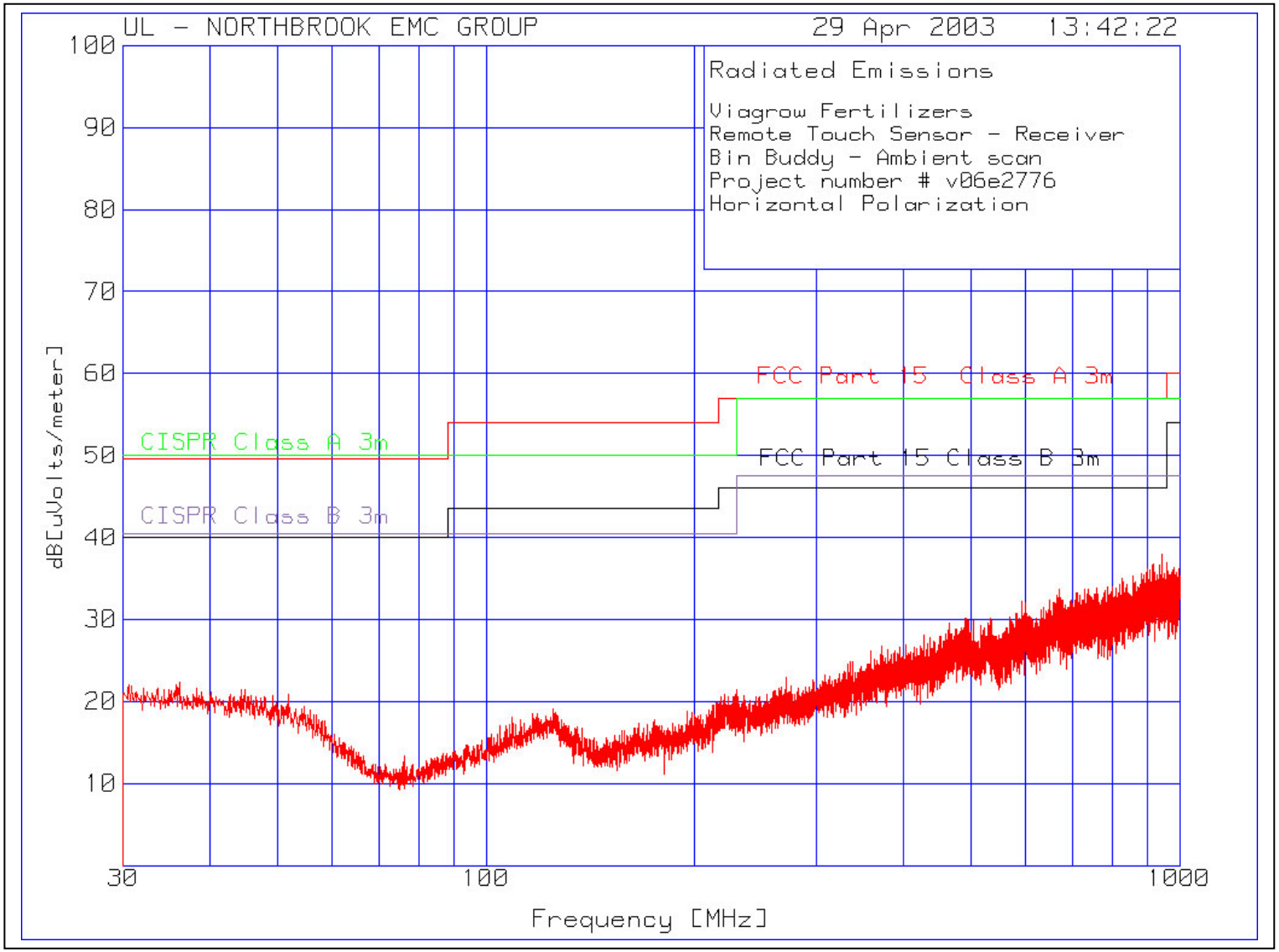
Plot of Ambient Radiated Emissions - Horizontal:



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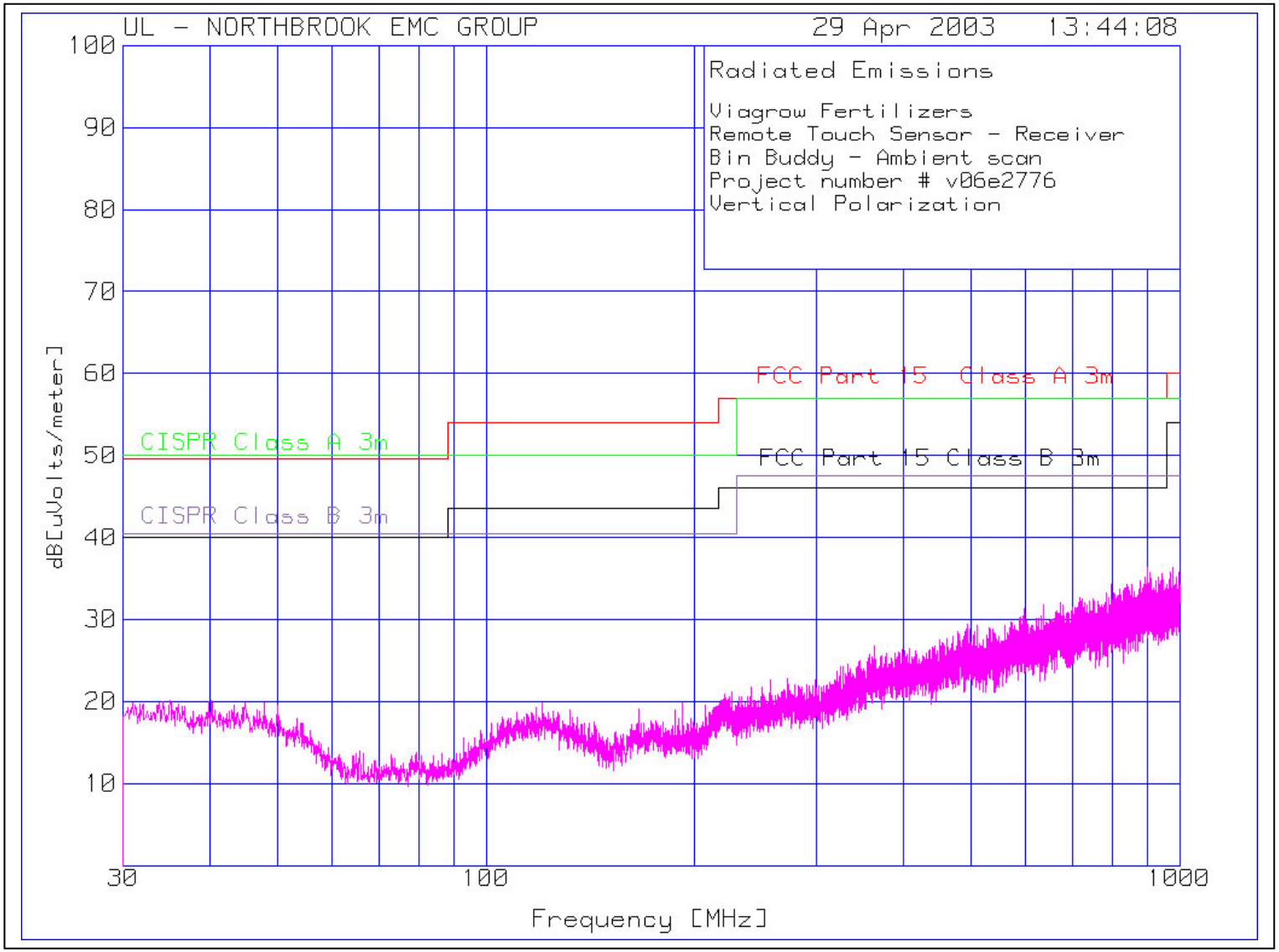
Plot of Ambient Radiated Emissions - Vertical:



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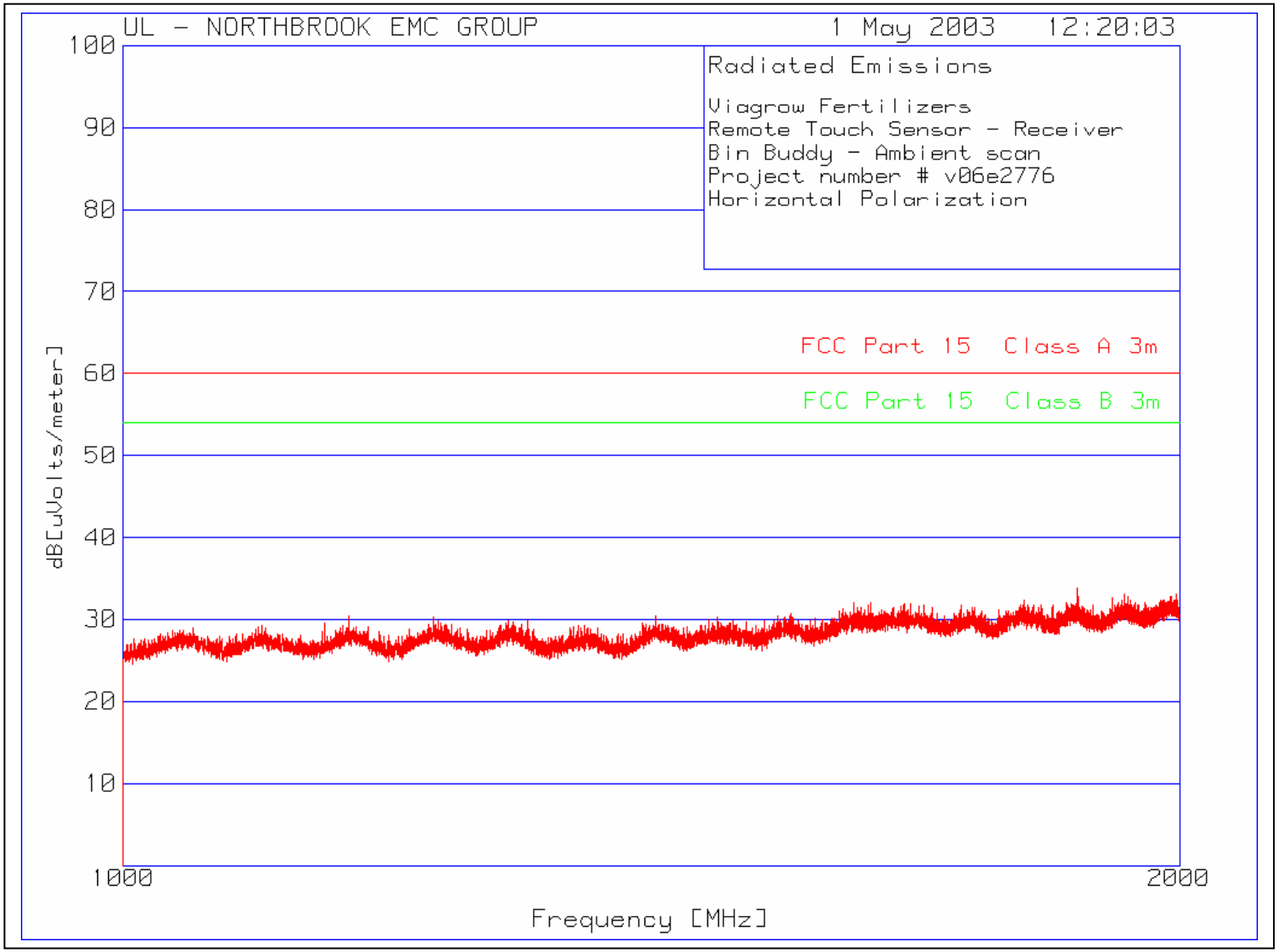
Plot of Ambient Radiated Emissions - Horizontal:



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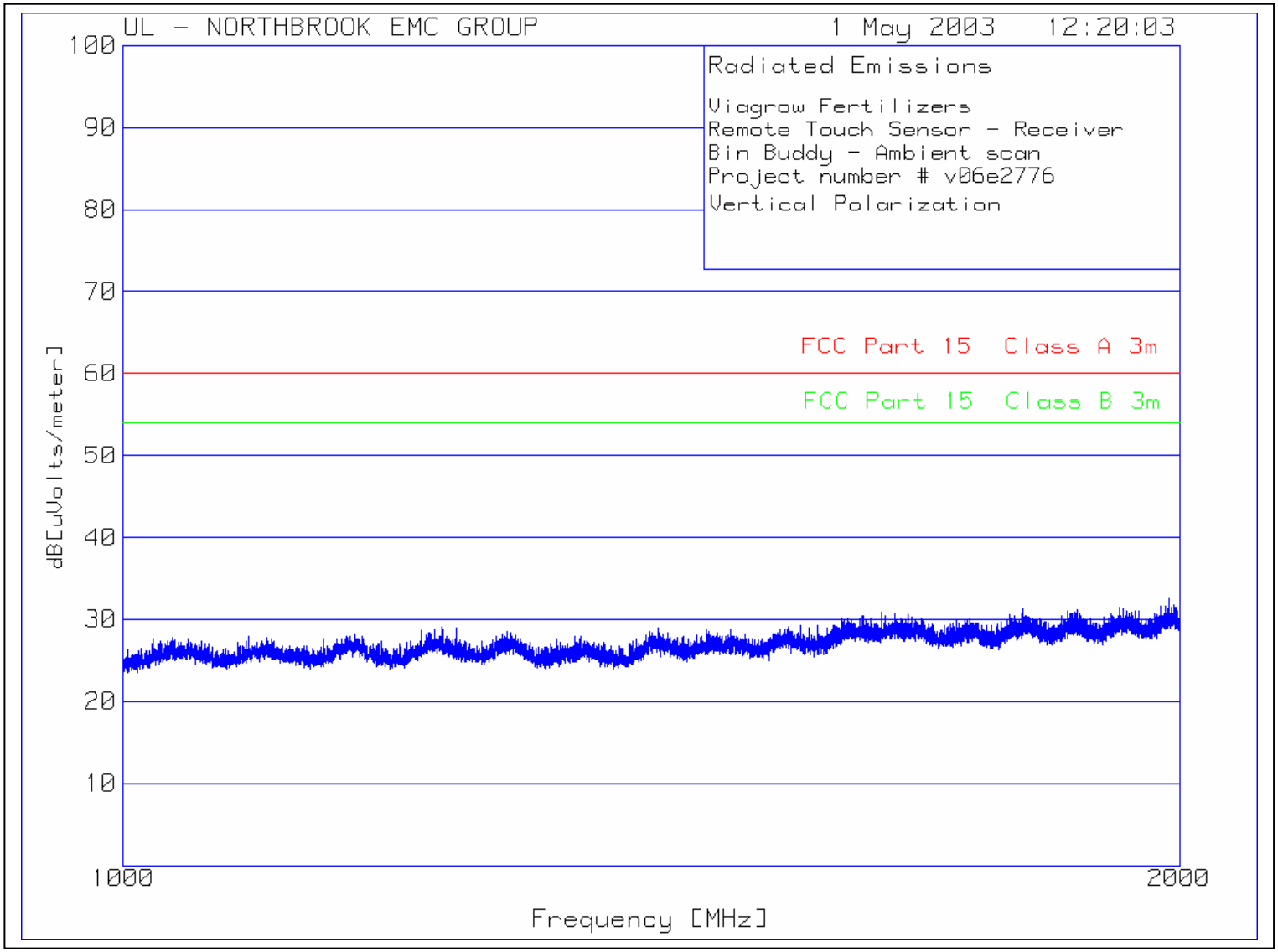
Plot of Ambient Radiated Emissions - Vertical:



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4.3b Transmitter

Test Lab: MPB Technologies Inc. Airdrie Test Personnel: David Raynes Date: 23 June 2003	Product: Bin Buddy
Test Result, Bin Buddy: **PASS**	
Objectives/Criteria The Radiated E-Field emissions produced by EUT, measured at a distance of 3m, shall not exceed these limits within the restricted bands of operation. Any emissions lying outside these bands shall be at least 20 dB down from the level of the fundamental. Attenuation below the limits of 15.209 is not required. Note: See the table below for the Restricted Bands of Operation per Part 15.205 **Emission levels should meet the requirements with a margin of 6dB.**	Specification: FCC Part 231(b) @ 315 MHz = 75.62 dBμV/m FCC Part 15.209 Frequency [MHz] — Limit (QP @ 3m) [dBμV/m] .009 – 0.490 — 88.5 – 53.8 .490 – 1.7 — 53.8 – 43 1.7 – 30 — 49.50 30 – 88 — 40.00 88 – 216 — 43.52 216 – 960 — 46.02 above 960 — 53.98

Restricted Bamds of Operation per Part 15.205:

MHz	MHz	MHz	MHz	MHz	GHz	GHz
0.0900000 – 0.1100000	8.2910000 - 8.2940000	16.804250 - 16.804750	162.01250 - 167.17000 *	1660.0000 – 1710.0000	3.6000000 – 4.4000000	14.470000 – 14.500000
0.4950000 - 0.5050000 *	8.3620000 - 8.3660000	25.500000 - 25.670000	167.72000 - 173.20000 *	1718.8000 – 1722.2000	4.5000000 – 5.1500000	15.350000 – 16.200000
2.1735000 - 2.1905000	8.3762500 - 8.3867500	37.500000 - 38.250000	240.00000 – 285.00000	2200.0000 – 2300.0000	5.3500000 – 5.4600000	17.700000 – 21.400000
4.1250000 - 4.1280000	8.4142500 - 8.4147500	73.000000 - 74.600000	322.00000 - 335.40000	2310.0000 – 2390.0000	7.2500000 – 7.7500000	22.010000 – 23.120000
4.1772500 - 4.1777500	12.290000 - 12.293000	74.800000 - 75.200000	399.90000 – 410.00000	2483.5000 – 2500.0000 *	8.0250000 – 8.5000000	23.600000 – 24.000000
4.2072500 - 4.2077500	12.519750 - 12.520250	108.00000 - 121.94000 **	608.00000 – 614.00000	2655.0000 – 2900.0000	9.0000000 – 9.2000000	31.200000 – 31.800000
5.6770000 - 5.6830000	12.576750 - 12.577250	123.00000 - 138.00000 **	960.00000 – 1240.0000 ***	3260..0000 – 3267.0000	9.3000000 – 9.5000000	36.430000 – 36.500000
6.2150000 - 6.2180000	13.360000 - 13.410000	149.90000 - 150.05000 *	1300.0000 – 1427.0000 ***	3332.0000 – 3339.0000	10.600000 – 12.700000	Above 38.600000
6.2677500 - 6.2682500	16.420000 - 16.423000	156.52475- 156.52525	1435.0000 – 1626.5000	3345.8000 – 3358.0000	13.250000 – 13.400000	
6.3117500 - 6.3122500	16.694750 - 16.695250	156.70000 - 156.90000	1645.5000 – 1646.5000	3500.0000 – 3600.0000 ****		

* US only ** Canada 108 – 138 MHz *** Canada 960 – 1427 MHz **** Canada only

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Radiated Emissions Data:

Bin Buddy transmitter:

Note: The carrier is transmitted for 20 of 36 modulation timing periods, producing a calculated average which is –5.11 dB from the peak field strength.

Nominal f_c (MHz)	Actual **f** (MHz)	Field Strength (dBμV/m) Peak	Field Strength (dBμV/m) Average	Limit (dBμV/m) Average per Part 15.231(b)	Delta (dB)	Antenna Polarization	Antenna Height (cm)	Turntable Azimuth (Degrees)
315	314.9609	60.01	54.90	75.62	-20.72	H	142	273
315	314.9598	75.78	70.67	75.62	-4.95	V	152	168
630	629.9380	47.53	42.42	55.62	-13.20	H	148	281
630	629.9359	54.53	49.42	55.62	-6.20	V	100	98
945	944.9139	43.93	38.82	55.62	-16.80	H	142	272
945	944.9037	46.76	41.65	55.62	-13.97	V	101	112
1260	1259.7920	28.29	23.18	55.62	-32.44	H	144	285
1260	1259.7690	33.80	28.69	55.62	-26.93	V	100	14
1575	1574.9210	32.16	27.05	53.98	-26.93	H	146	281
1575	1574.7911	35.66	30.55	53.98	-23.43	V	264	263
1890	1889.7640	32.77	27.66	55.62	-27.96	H	120	328
1890	1889.8332	31.47	26.36	55.62	-29.26	V	211	219
2205	2204.7810	46.45	41.34	53.98	-12.64	H	127	320
2205	2204.8250	46.95	41.84	53.98	-12.14	V	103	357
2520	2519.7230	53.29	48.18	55.62	-7.44	H	100	321
2520	2519.7500	48.80	43.69	55.62	-11.93	V	111	125
2835	2834.7200	52.17	47.06	53.98	-6.92	H	172	98
2835	2834.7770	49.50	44.39	53.98	-9.59	V	112	318
3150	3149.7340	44.94	39.83	55.62	-15.79	H	178	295
3150	3149.7030	49.24	44.13	55.62	-11.49	V	100	147

Highlighting indicates an emission that falls within a restricted band of operation.

There were no other emissions found to be within -10 dB of the applicable limit.

See the following data plots for more detail.

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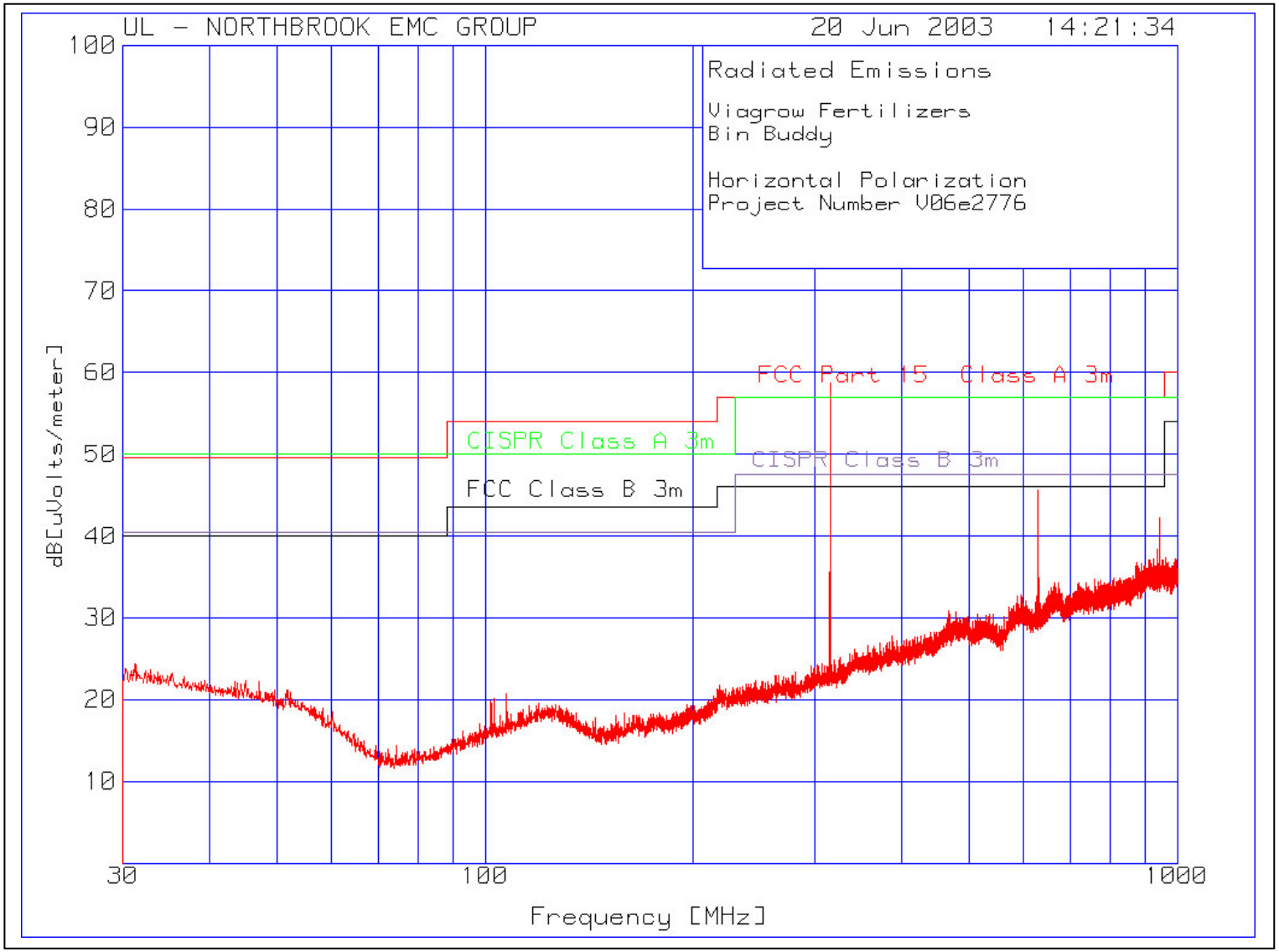
Plot of Radiated Emissions - Horizontal:



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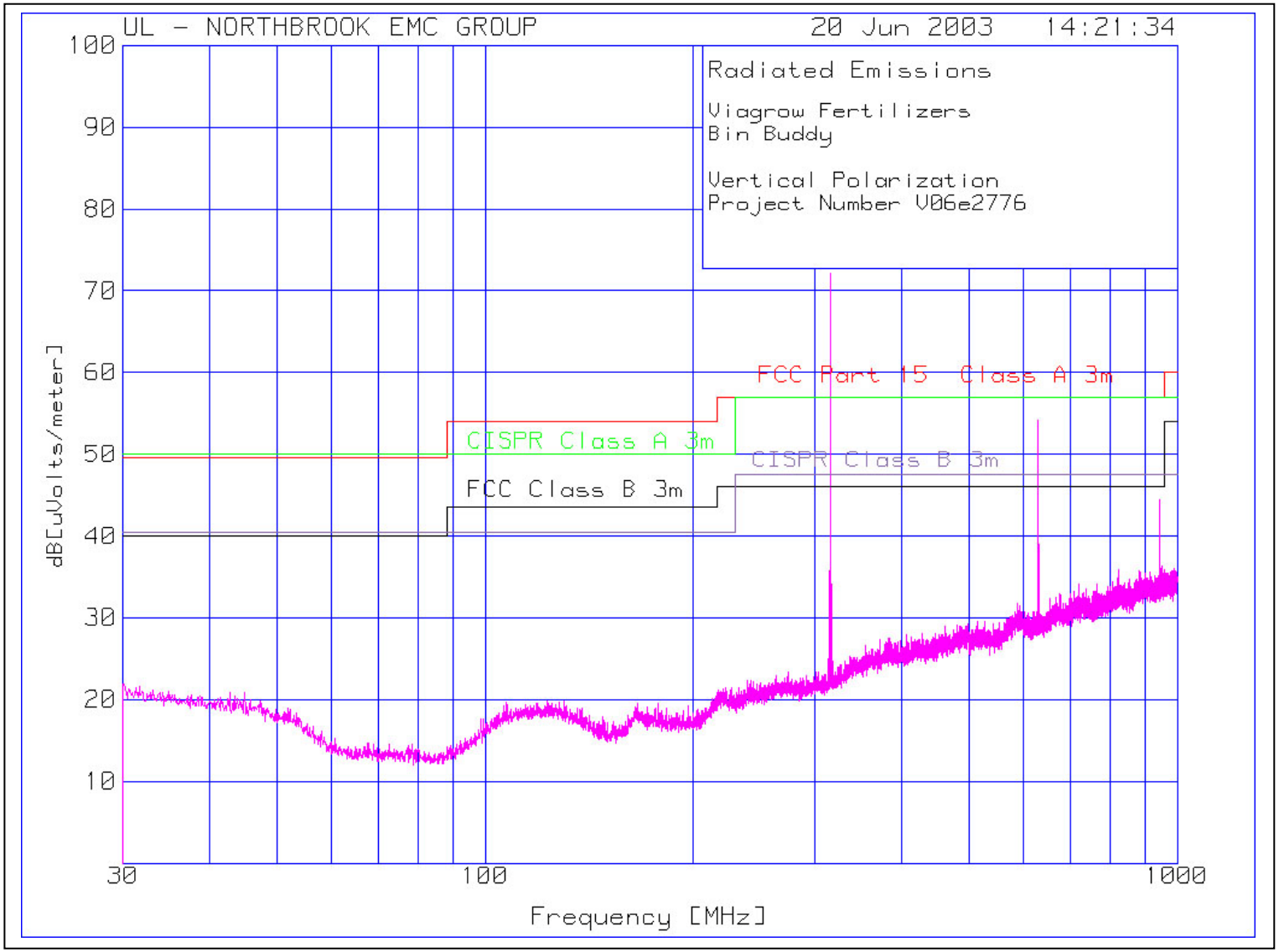
Plot of Radiated Emissions - Vertical:



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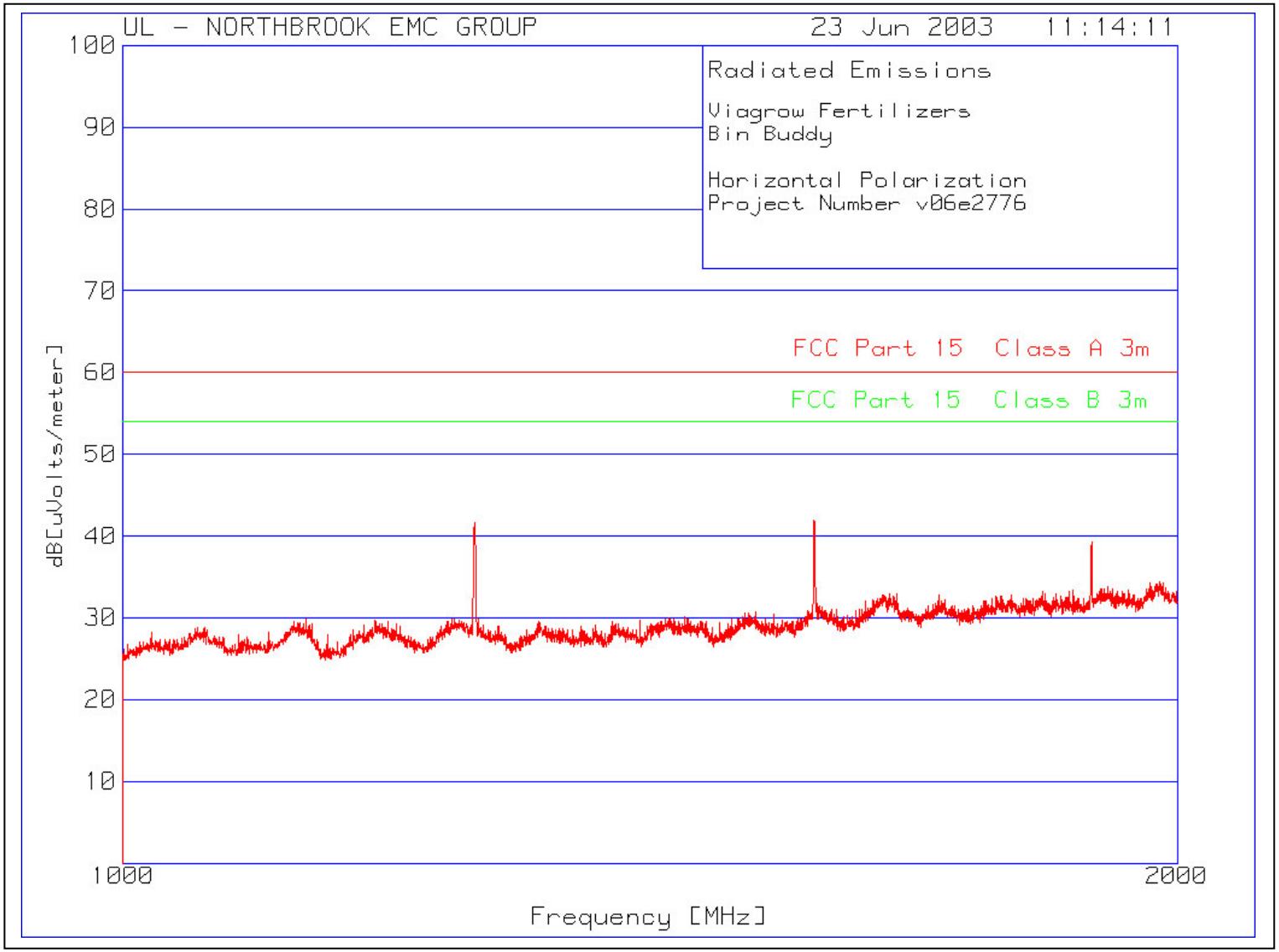
Plot of Radiated Emissions - Horizontal:



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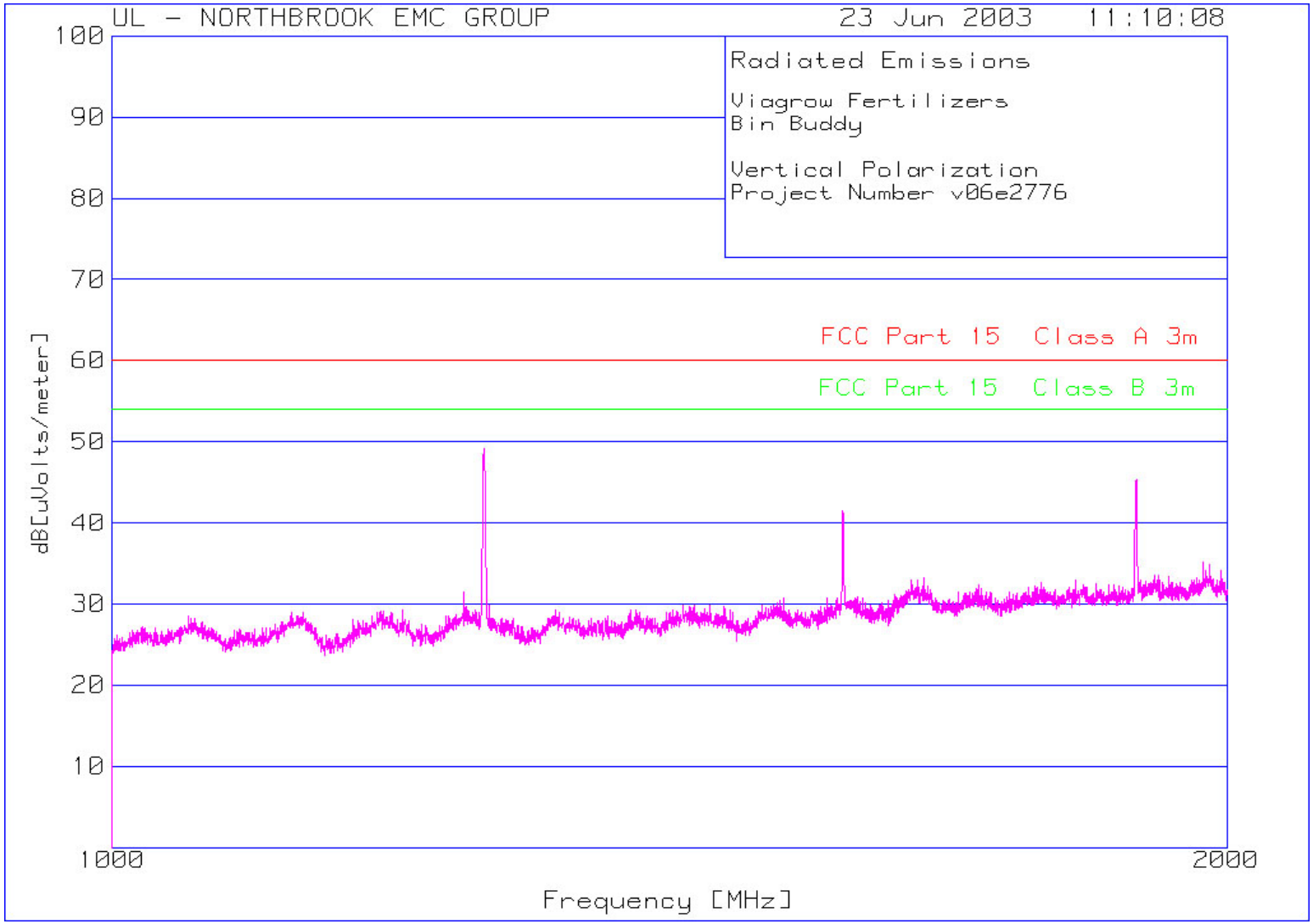
Plot of Radiated Emissions – Vertical:



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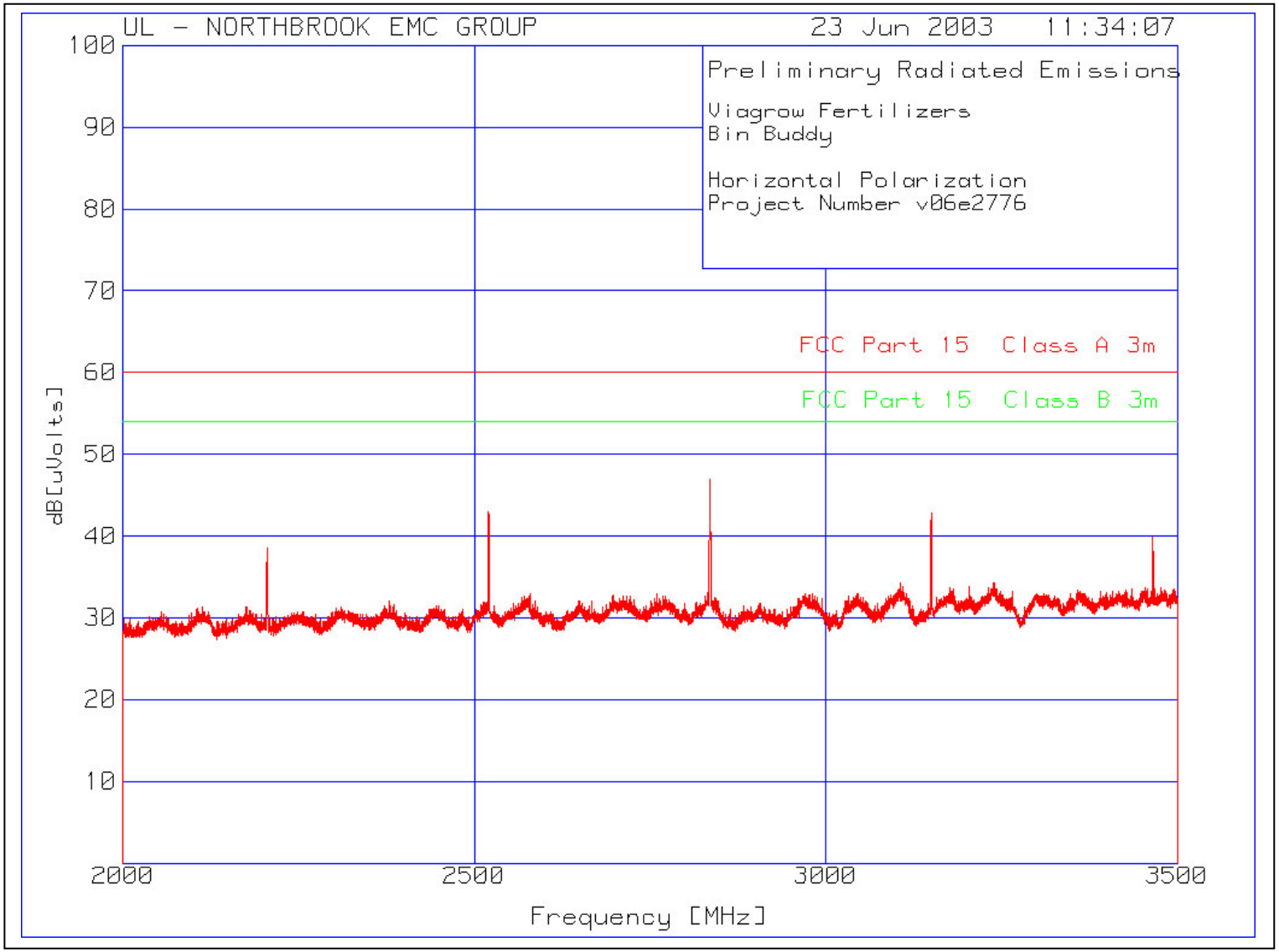
Plot of Radiated Emissions - Horizontal:



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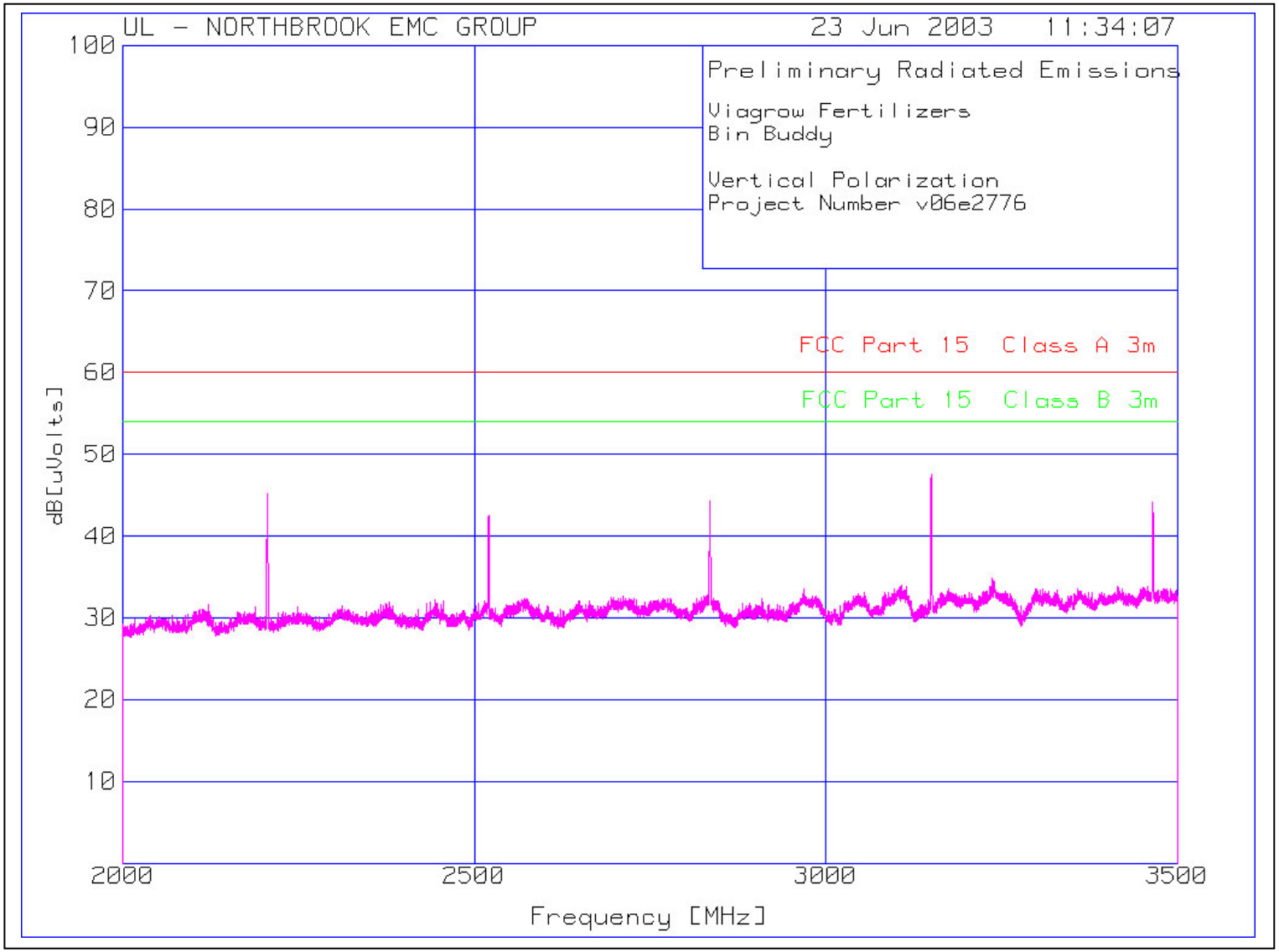
Plot of Radiated Emissions - Vertical:



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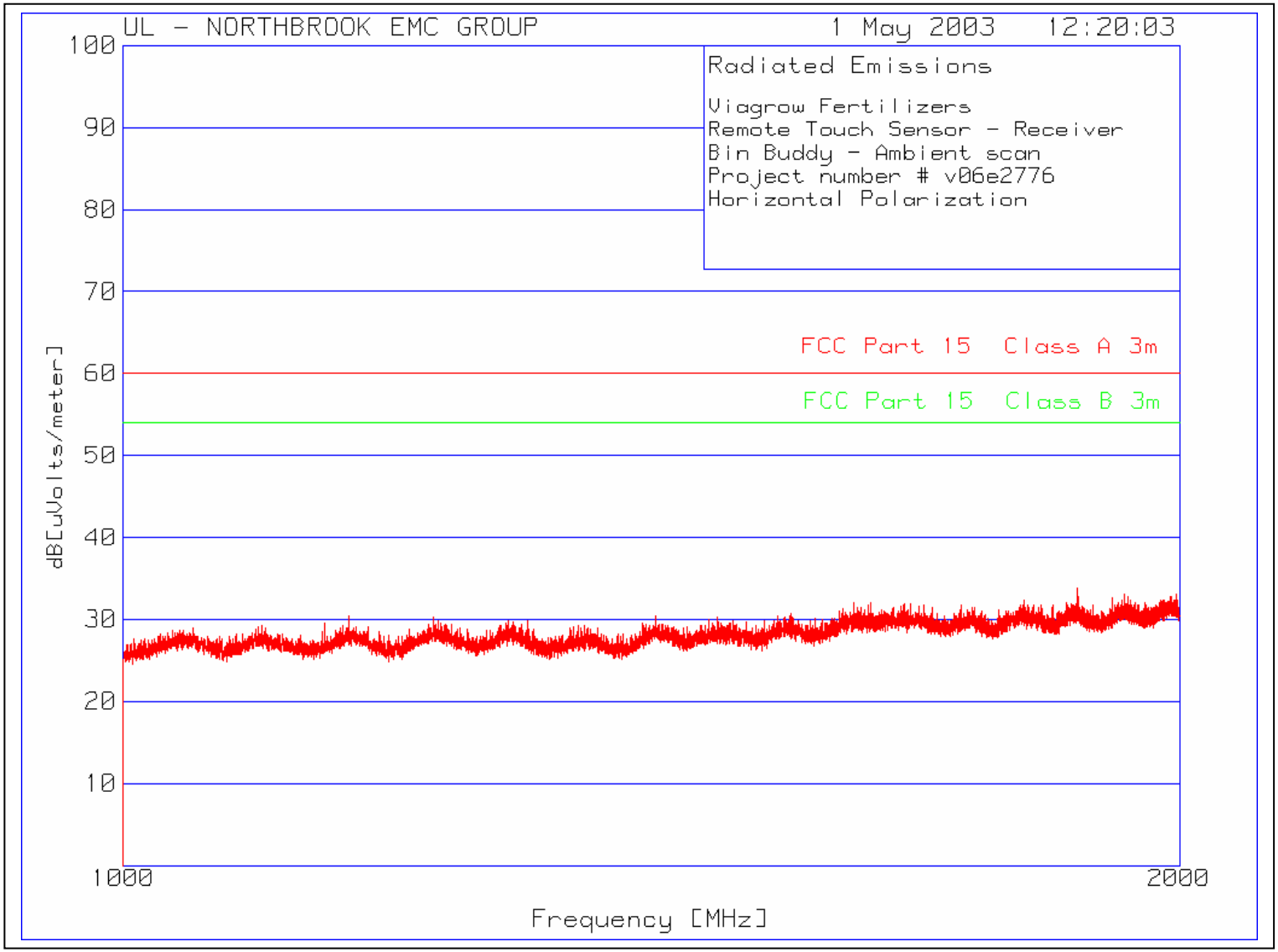
Plot of Ambient Radiated Emissions - Horizontal:



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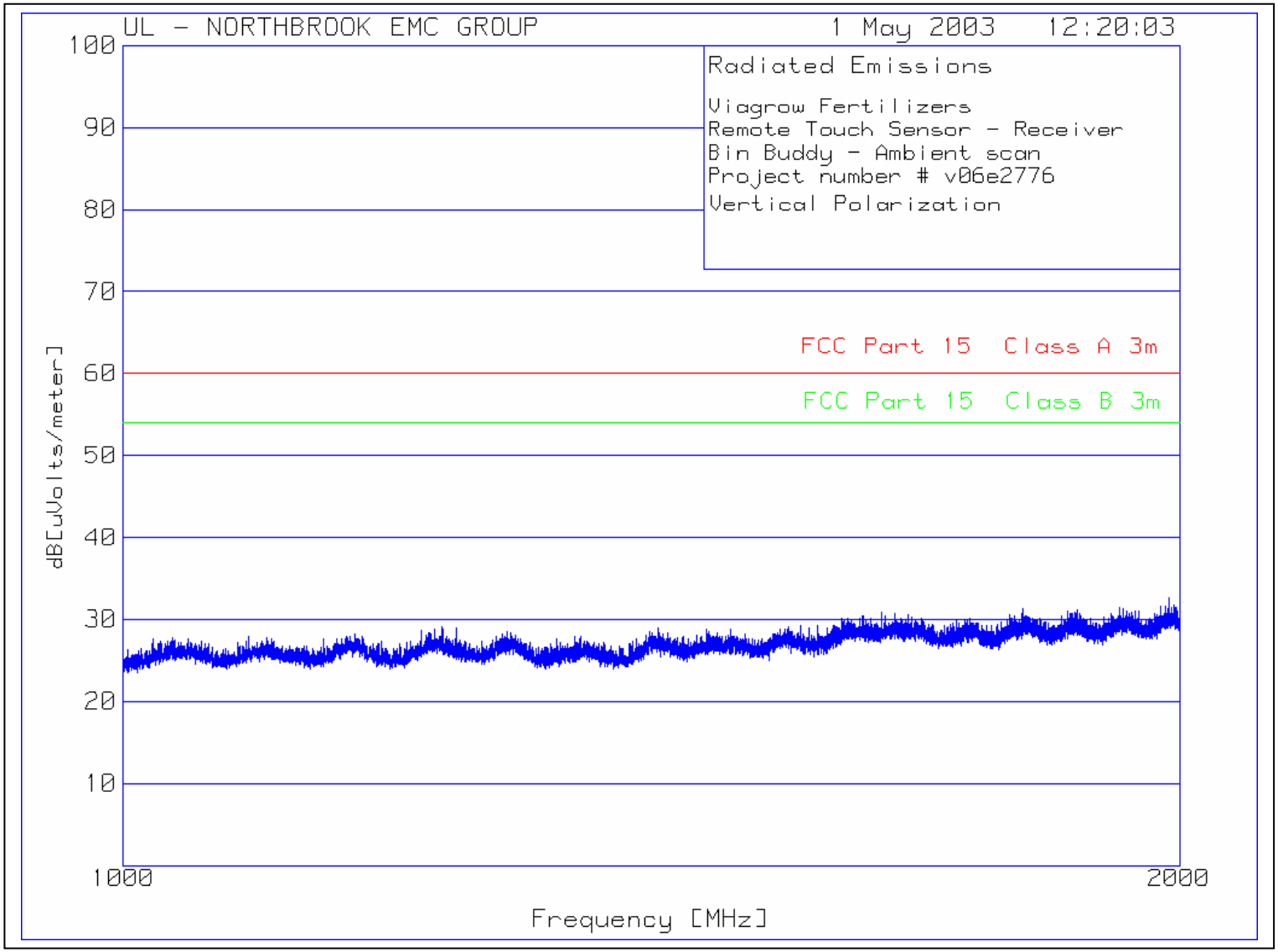
Plot of Ambient Radiated Emissions - Vertical:



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5.0 TEST FACILITY

5.1 LOCATION

The EUT was tested for Electromagnetic Compatibility at the Electronics Test Centre, located in Airdrie, Alberta, Canada.

The RF Anechoic Chamber (RFAC) is identified as Chamber 1, located in the main building complex at the Electronics Test Centre. Its usable working space measures 10.6 m long x 7.3 m wide x 6.5 m high.

This test site is listed with the FCC under Registration Number 99541. Measurements taken at this site are accepted by Industry Canada per file number IC 2046-1.

The floor, walls and ceiling consist of annealed steel panels. The walls and ceiling are covered with ferrite tile, augmented by RF absorbant foam material on the end wall nearest the turntable, and on the adjacent walls and the ceiling. The chamber floor supports a 15 cm high internal floor, constructed of annealed steel panels, that forms the ground plane, and is bonded to the chamber walls.

The 3-m diameter turntable is flush-mounted with the floor. A sub-floor cable-way is provided to route cables between the turntable pit and EUT support equipment. Cables reach the EUT through an opening in the centre of the turntable.

Test instrumentation and EUT support equipment is located in two shielded vestibules located at the side of the main room. Cables are routed through bulkhead panels between the rooms as required. Power feeds are routed into the main room and vestibules through line filters providing at least 100 dB of attenuation between 10 kHz and 10 GHz.

5.2 GROUNDING PLAN

The EUT was located on a wooden table 80 cm above the ground plane.

In accordance with Viagrow Fertilizers specifications, the EUT was not grounded.

5.3 POWER

The Bin Buddy transmitter was powered by three AA batteries clipped onto the circuit board. The receiver was powered by an external battery, simulating the tractor electrical system.

5.4 EMISSIONS PROFILE

Ambient radiated electromagnetic emission profiles were generated throughout the tests and are included in the test data.

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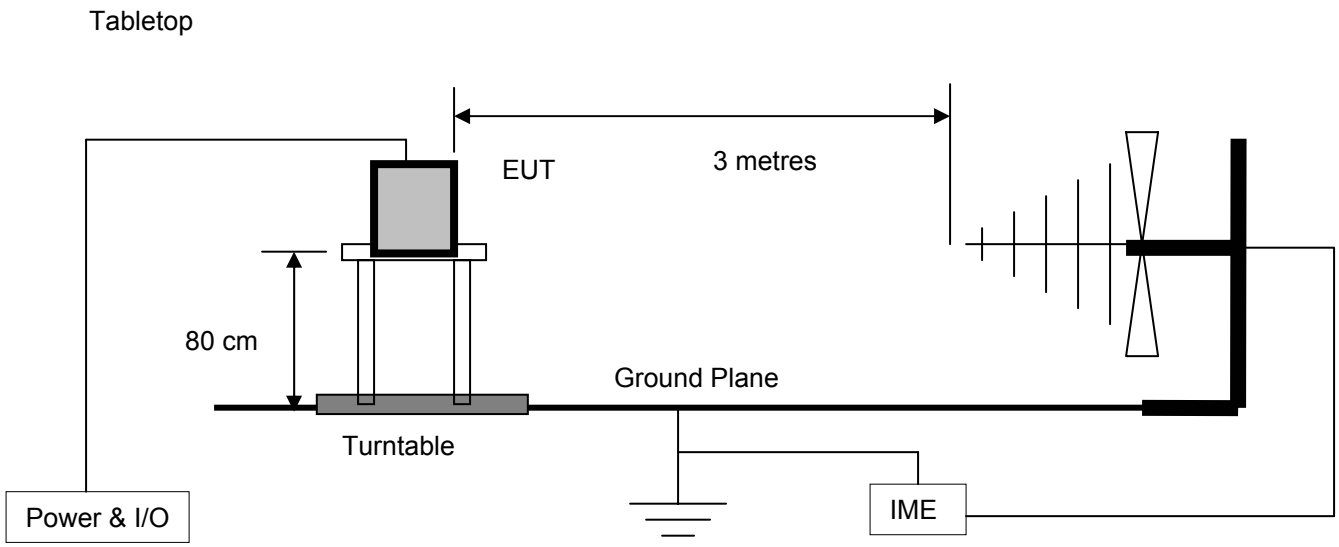
5.5 TEST CONFIGURATION

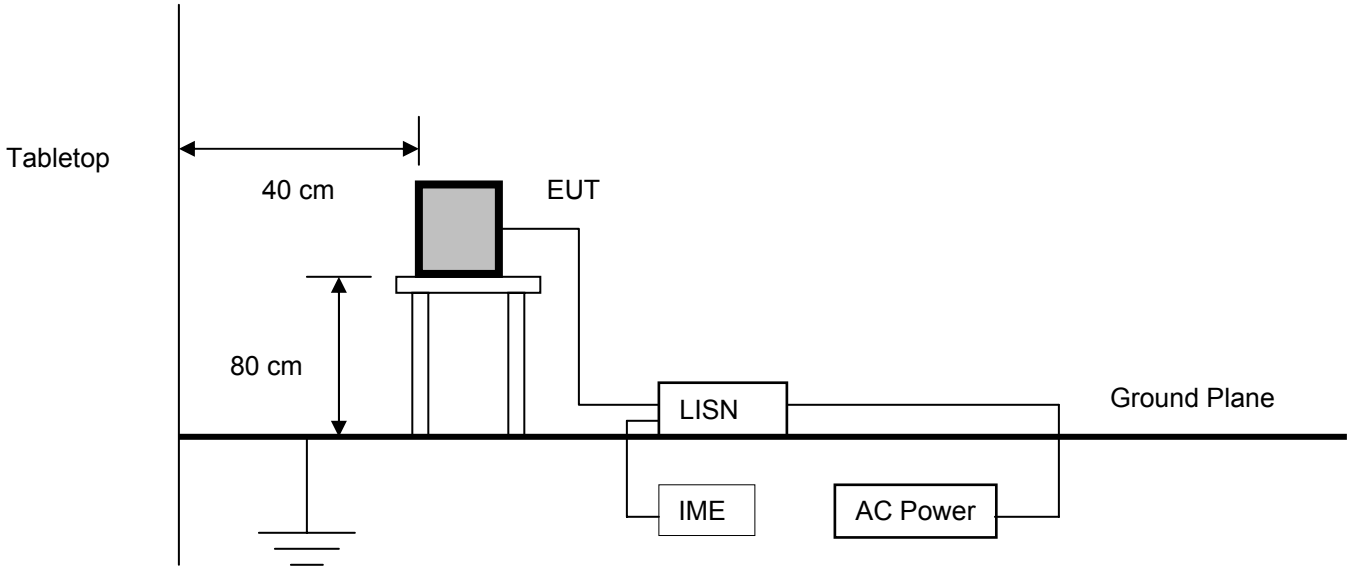
5.5.1 Tabletop Equipment

The following diagrams illustrate the configuration of the EUT test and measurement equipment for Radiated and Conducted Emissions Testing of tabletop equipment.

Radiated



Conducted Emissions



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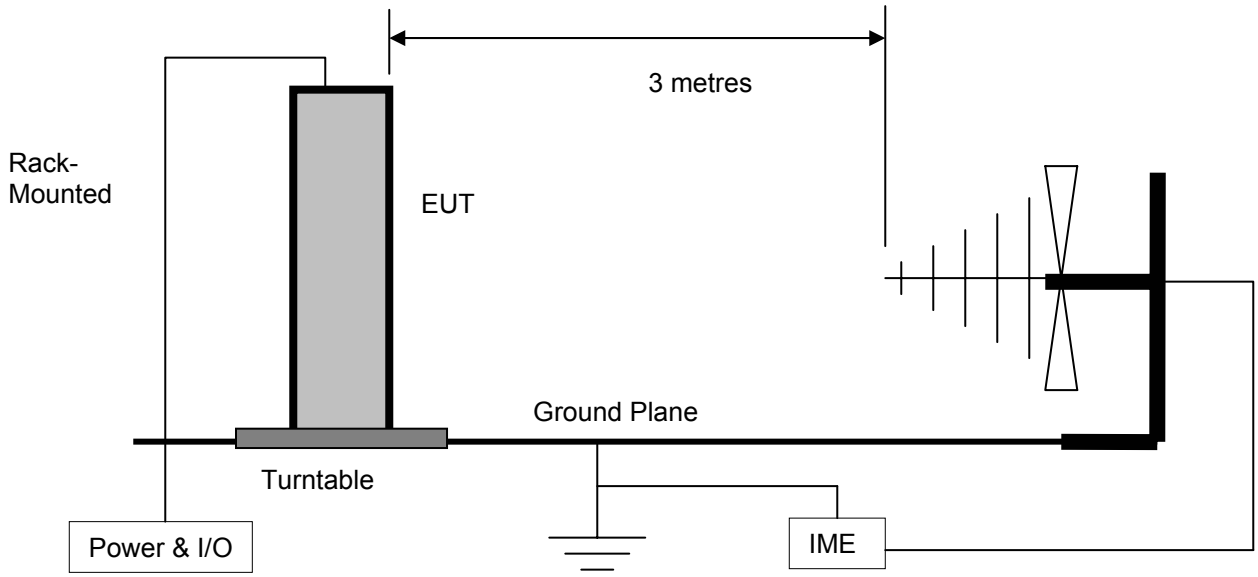
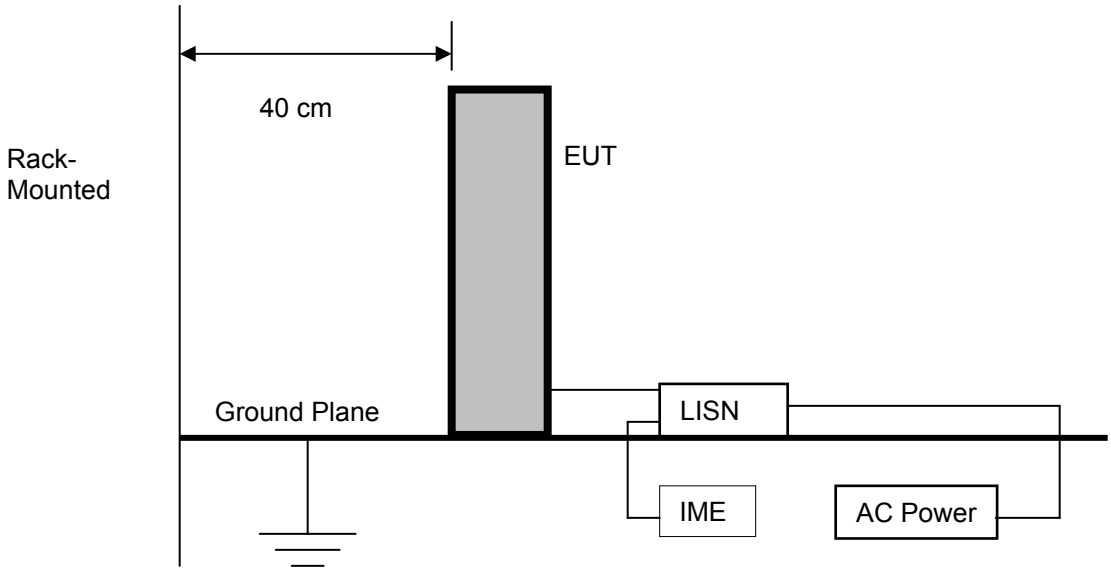
5.5.2 Rack Mount

The following diagrams illustrate the configuration of the EUT test and measurement equipment for Radiated and Conducted Emissions Testing of rack mounted equipment.

Radiated



Conducted Emissions



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6.0 TEST EQUIPMENT

The following equipment was used for this procedure. All measurement devices are calibrated traceable to NIST.

6.1 RADIATED EMISSIONS

a) Spectrum Analyzer with RF Preselector
b) CISPR Quasi-peak Adapter
c) Power Isolation Transformers
d) Biconilog antenna (20 MHz to 2 GHz)
e) Antenna mast positioner, and controller
f) Flush-mounted turntable, and controller
g) Personal Computer and EMC software

6.2 CONDUCTED EMISSIONS

a) Spectrum Analyzer with RF Preselector
b) Line Impedance Stabilization Network, 50 μH
c) CISPR Quasi-peak Adapter
d) Isolation Transformer
e) Personal Computer and EMC software

6.3 CALIBRATION

All measurement instrumentation conforms to ANSI C63.2. Calibration is maintained in accordance with manufacturer recommendations. Each measurement device is labeled with its ETC asset number and calibration due date.

6.3.1 CALIBRATION ACCURACY

Test equipment used to provide quantitative measurements are calibrated with standards traceable to the National Research Council, National Institute of Standards and Technology or other national standards. Instrumentation systems for emissions measurements have the following accuracies:

Frequency = ± 1 kHz
Amplitude (RE) = ± 4.01 dB
Amplitude (CE) = ± 3.25 dB

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6.3.2 TEST EQUIPMENT DESCRIPTION

The equipment used in the tests was selected from the following list.

Instrument	Manufacturer	Model No.	Asset No.	Calibration Due
Spectrum Analyzer	Hewlett Packard	8566B	9565	13 November 2003
Spectrum Analyzer	Hewlett Packard	8566B	9168	10 December 2003
RF Preselector	Hewlett Packard	85685A	9728	30 July 2004
RF Preselector	Hewlett Packard	85685A	9563	14 August 2004
Quasi-Peak Adapter	Hewlett Packard	85650A	4411	30 July 2004
Quasi-Peak Adapter	Hewlett Packard	85650A	9243	7 August 2004
Line Impedance Stabilization Network	EMCO	3825/2r	9331	2 November 2003
Line Impedance Stabilization Network	EMCO	3825/2r	9259	2 November 2003
Biconilog Antenna	ARA	Lpb-2520/A	4318	2 August 2004
Dual Ridged Guide Antenna	EMCO	3115	9588	2 August 2004
Low Noise Amplifier	MITEQ	JS43-01001800-21-5P	4354	3 November 2003

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Appendix A

Bin Buddy

Test Sample Description
(from data provided by Viagrow Fertilizers)

Product Application	**Product Category**
Commercial ✔ Military o	Telecommunications o Information Technology o Surface Transportation o Aerospace o Test & Measurement o Other ✔ __Equipment Operator Safety_
Product Name	Bin Buddy
Part/Model No.	VF1
Serial Number	n/a
Power Requirements: **(Voltage, AC/DC, Hz, Current)**	Transmitter: Three AA batteries, nominal 4.5 VDC Receiver: 12 VDC
Typical Installation Instructions or Configuration	The Bin Buddy transmitter is hung from the end of the grain auger. The receiver unit is plugged into the hitch connector mounted on the tractor.
Ground Connection **(in addition to power cord)**	nil
Internally Generated Frequencies	315 MHz
Peripheral Support Equipment	nil
Description and number of interconnecting Leads & Cables	nil
Brief Functional Description	The Bin Buddy transmitter unit senses when the bin or silo is filled to a point near the tip of the auger. The alarm is transmitted to the receiver unit, which alerts the operator. This ensures that the equipment will be shut down before over-filling causes equipment damage or possible operator injury.

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