



Project: **01RT2063**
File: **MC1180**
Report: **010145**
Date: **January 31, 2001**
(Revised February 23, 2001)
Model: **85094 and 85095**

Test Report

On

Electromagnetic Compatibility Testing

Hunter Fan

Memphis, TN USA

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Test Report Details:

Tests Performed By: **Underwriters Laboratories Inc.
12 Laboratory Drive
Research Triangle Park, NC 27709**

Tests Performed For: **Hunter Fan
2500 Frisco Avenue
Memphis, TN 38114 USA**

Applicant Contact: **Mr. Steve Bias
(901) 248-2373**

Test Report Number: **010145**

Test Report Date: **January 31, 2001 (Revised February 23, 2001)**

Product Type: **Low-Power Transmitters for Ceiling Fan/Lamp**

Model Number: **85094 and 85095**

Sample Serial Number: **Non-serialized sample**

Sample Tag Number: **S01LB002**

EUT Category: **Transmitter - Low Power**

EUT Type: **Hand Held**

Sample Receive Date: **January 05, 2001**

Testing Start Date: **January 11, 2001**

Date Testing Complete: **January 15, 2001**

Underwriters Laboratories Inc. reports apply only to the specific samples tested under stated test conditions. All samples tested were in good operating condition throughout the entire test program. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. Underwriters Laboratories Inc. shall have no liability for any deductions, inferences or generalizations drawn by the client or others from Underwriters Laboratories Inc. issued reports. This report shall not be used to claim, constitute or imply product certification, approval, or endorsement by NVLAP or any agency of the US government.

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Summary of Testing:

Test #	Test Name Test Requirement/Specification	Comply	Does Not Comply	See Remark
1	Radiated Disturbance Emissions - 9 kHz to 30 MHz 47 CFR Part 15, Subpart C / 47 CFR Part 15, Subpart C, Section 15.209	X	-	
2	Radiated Disturbance Emissions - 30 MHz to 1000 MHz 47 CFR Part 15, Subpart C / 47 CFR Part 15, Subpart C, Section 15.209 and 15.231	X	-	
3	Radiated Disturbance Emissions - Above 1 GHz 47 CFR Part 15, Subpart C / 47 CFR Part 15, Subpart C, Section 15.209 and 15.231	X	-	
4	Radiated Disturbance Emissions - Peak-to-Average Ratio 47 CFR Part 15, Subpart C / 47 CFR Part 15, Subpart C, Section 15.231	X	-	
5	Radiated Disturbance Emissions - Occupied Bandwidth 47 CFR Part 15, Subpart C / 47 CFR Part 15, Subpart C, Section 15.231	X	-	
6	Radiated Disturbance Emissions - Restricted Bands 47 CFR Part 15, Subpart C / 47 CFR Part 15, Subpart C, Section 15.205	X	-	

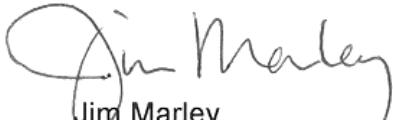
Remarks:

- 1) Data can also be considered applicable to Canada RSS-210 Section 6.1.1 (Momentarily Operated Devices).
- 2) Test setup photo shown in Test 1 section is valid for all tests in this report.
- 3) No transitional rules found in 15.37 apply to this product.
- 4) Antenna is permanently attached and no other antenna may be used.
- 5) Manufacturer states that there is insufficient space to locate the entire Part 15 statement on the remote due to the location of the battery door. A complete Part 15 statement is located in the user manual instead.
- 6) Manufacturer states that the value of capacitor C5 on transmitter determines the operating frequency. This is fixed for all North American units and verified to be 350 MHz. Frequency tolerance is +/- 500 kHz.

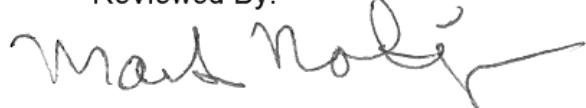
Conclusion:

The tests listed in the Summary of Testing section of this report have been performed and the results recorded by Underwriters Laboratories Inc. in accordance with the procedures stated in each test requirement and specification. The test list was determined by the Applicant as being applicable to the Equipment Under Test. As a result, the subject product has been verified to comply or not comply as noted in the Summary of Testing with each test specification. The test results relate only to the items tested.

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Test Facilities:

Test Location A) 10-Meter Anechoic Chamber (Industry Canada - IC 2953, NVLAP - 200246-0, VCCI - R-722)

Constructed by Lindgren RF Enclosures, this room consists of a 17.9 by 12 by 8.3 m (inside clearance) shielded room lined with TDK absorber material. The walls, floor (conducting ground plane) and ceiling are constructed of double sided galvanized sheet steel supported by 19 mm thick particle board. The interior walls and ceiling are covered with 10 by 10 cm, 4.6 mm thick ferrite tiles and partially covered with polystyrene absorber cones. Removable floor tiles and cones covering the floor between the EUT and antenna are provided when RF immunity testing is performed.

Room is provided with a 4.0 m diameter embedded turntable and a 1.2 by 2.1 m and 2.4 by 2.4 m double knife edge doors for access. Also, the room is fed electrical EUT power via permanently installed filters and is provided with a permanently mounted video surveillance camera. A remotely controllable antenna mast is located in the room for positioning the measuring antenna from 1 to 4 m above the ground plane.

Test Location B) Compact Anechoic Chamber

Constructed by Lindgren RF Enclosures, this room consists of a 6 by 3 by 2.9 m (inside clearance) shielded room lined with TDK absorber material. The walls, floor (conducting ground plane) and ceiling are constructed of double sided galvanized sheet steel supported by 19 mm thick particle board. The interior walls and ceiling are covered with 10 by 10 cm, 4.6 mm thick ferrite tiles and partially covered with polystyrene absorber cones. Removable floor tiles and cones covering the floor between the EUT and antenna are provided when RF immunity testing is performed.

Room is provided with a 1.5 m diameter embedded turntable and a 1.2 by 2.1 m double knife edge door for access. Also, the room is fed electrical EUT power via permanently installed filters and is provided with a permanently mounted video surveillance camera.

Test Location C) RF Shielded Room (VCCI - C-744, NVLAP - 200246-0)

Constructed by Lindgren RF Enclosures, this room consists of a 7.3 by 4.3 by 2.7 m (inside clearance) shielded room. The walls, floor (conducting ground plane) and ceiling are constructed of double sided galvanized sheet steel supported by 19 mm thick particle board. Room is provided with a 1.2 by 2.1m double knife edge door for access. Also, the room is fed electrical EUT power via permanently installed filters and is provided with a portable video surveillance camera.

Test Location D) Ground Reference Plane # 1 (VCCI - C-742, NVLAP - 200246-0)

Horizontal floor ground reference plane constructed of double sided galvanized sheet steel supported by 19 mm particle board and measures 3.6 by 3.0 m. Located next to one vertical wall of the Control Room and is, therefore, provided with a 3.0 by 3.6 m vertical ground reference plane constructed of the same material. The horizontal and vertical planes are continuously bonded along their entire length. Power filters and LISNs, when required, are placed on top of and bonded to the horizontal floor ground reference plane.

Test Location E) Ground Reference Plane # 2 (VCCI - C-743, NVLAP - 200246-0)

Horizontal floor ground reference plane constructed of double sided galvanized sheet steel supported by 19 mm particle board and measures 4.3 by 5.2 m. Located next to one vertical wall of the RFD Shielded Room and is, therefore, provided with a 4.3 by 2.8 m vertical ground reference plane constructed of the same material. The horizontal and vertical planes are continuously bonded along their entire length. Power filters and LISNs, when required, are placed on top of and bonded to the horizontal floor ground reference plane.

Test Location F) Ground Reference Plane # 3

Horizontal floor ground reference plane constructed of double sided galvanized sheet steel supported by 19 mm particle board and measures 3.6 by 3.6 m. Power filters and LISNs, when required, are placed on top of and bonded to the horizontal floor ground reference plane.

Test location G) Magnetic Field Ground Reference Plane

Horizontal floor ground reference plane constructed of 1.5 mm thick aluminum measuring 3.6 by 2.4 m.

Test Location H) Outdoor Ground Reference Plane

Horizontal floor ground reference plane constructed of 1.5 mm thick aluminum measuring 3.6 by 3 m and located next to the outside wall of the EMC lab rear entrance.

Test Location I) Harmonic Current Test Area

Located on Lab floor in front of Standard Source Impedance Power Supply.

Test Location X) Other

If needed, as described in the Comments Section of Test Results.

EUT Information:

Equipment Used During Test:

Use*	Product Type	Manufacturer	Model	Comments
EUT	Low-Power Transmitter	Hunter Fan	85095	RF Remote with reverse button (tested)
EUT	Low-Power Transmitter	Hunter Fan	85094	RF Remote with no reverse button (not tested)

* Use = EUT - Equipment Under Test, ACC - Accessory (Not Subjected to Test), or SIM - Simulator (Not Subjected to Test)

Input/Output Ports:

Port #	Name	Type*	Cable Max. >3m	Cable Shielded	Comments
0	Enclosure	N/E	No	No	

* AC = AC Power Port DC = DC Power Port N/E = Non-Electrical
I/O = Signal Input or Output Port (Not Involved in Process Control)
PMC = Process Measurement and Control Port

EUT Internal Operating Frequencies:

Frequency (MHz)*	Description
350	Approximate Transmit Frequency

* List all frequencies intentionally generated in the product above 9kHz.

Power Interface:

Mode #	Voltage (V)	Current (A)	Power (W)	Frequency (DC/AC-Hz)	Phases (#)	Comments
Rated	12	-	-	DC	X	A fresh battery was installed prior to test

EUT Operation Modes:

Mode #	Description
1	Product is transmitting continuously with the Fan Off button taped down.
2	Product is idle with no button depressed.

EUT Configuration Modes:

Mode #	Description
1	Product (Model 85095) alone on tabletop.

Equipment Under Test Information:

The data in this test report is considered applicable to two Hunter Fan models - 85094 and 85095. Both models are constructed from identical circuit boards with identical components. Model 85095 contains an additional button in the plastic enclosure when depressed and received by the receiver will reverse the direction of the fan. Model 85094 contains the pad on the printed circuit board for the button, but no button is included in the enclosure to depress the pad.

The test results in this report were taken using an 85095 sample.

Note of Manual Operation:

The test sample was observed using a spectrum analyzer tuned to the transmit frequency to verify that the transmission ended immediately upon release of all of the buttons. Each button was verified and no transmission was observed after release of any of the buttons.

Emissions Designator:

The transmitter sends a 100% Pulse Modulated bit pattern with long pulse (380 us) and short pulse (220 us) representing 0 and 1. Off period between pulses separates the bits. A longer off period is employed before repeating the transmission. See Test 5 (Peak-to-Average Ratio) for a timing diagram of the pattern.

The FCC designator from Part 2.201 for this pattern is judged to be:

L1D50K0 where:

L = Emission of Pulses Modulated in Width/Duration

1 = A single channel containing quantized or digital information without the use of a modulating sub-carrier, excluding time-division multiplex

D = Data transmission, telemetry, telecommand

50K0 = 50 kHz occupied bandwidth

Test 1: Radiated Disturbance Emissions - 9 kHz to 30 MHz

Test Requirement: 47 CFR Part 15, Subpart C

Test Specification: 47 CFR Part 15, Subpart C, Section 15.209

Test Procedure:

All testing was performed in UL's 10 meter semi-anechoic chamber. The chamber meets the FCC's site attenuation criteria for use as an alternative measurement site. The EUT was tested per ANSI C63.4:1992 test method placed on a non-conductive 1m x 1.5m table 80 cm above the ground plane. The receive antenna used was a loop antenna mounted on an antenna mast. The turntable was rotated from 0° to 360° to determine the worst-case emissions angle for each frequency. The antenna mast was raised and lowered between 1 and 4 meters above the ground plane to determine the worst-case height.

The loop antenna was positioned in each of the three axes (X, Y, and Z) and peak scans were taken for each test configuration. The peak field strength was recorded. Average field strength was calculated using the peak-to-average ratio determined in Test 1.

All measurements were made at a 3 meter distance. A 40 dB/decade adjustment was made to the signal for measurements below 30 MHz per FCC Section 15.31(f)(2). Magnetic Field to electric field conversion is made assuming the impedance of free space of 377Ω .

Radiated Disturbance Limits - General Requirements Section 15.209

Frequency Range MHz	Field Strength Limit μV/m	Field Strength Limit dBμV/m	Measurement Distance (m)
0.009 to 0.049	2400/F (kHz)	$20*\log(2400/F(kHz))$	300
0.049 to 1.705	24000/F (kHz)	$20*\log(24,000/F(kHz))$	30
1.705 to 30	30	29.5	30

Test Deviations:

None

Test Setup: Only the following ports were tested. See EUT Information for details.

Test Item	Port #	Port Name	EUT Operation Mode	EUT Configuration	Power Interface
A	0	Enclosure	1 (Transmitting)	1	1

Test 1 - Results: Radiated Disturbance Emissions - 9 kHz to 30 MHz

Test Results Summary:

Test Item	Test Location	Humidity (%)	Temperature (°C)	Pressure (kPa)	Pass/Fail (P/F)	Date Completed	Comment #
A	A	40	23.0	101.0	P	1/11/01	1

The EUT was considered to **Pass** the Requirements.

Comments:

Comment #	Description
1	Plots shown are a composite of X, Y, and Z axes.

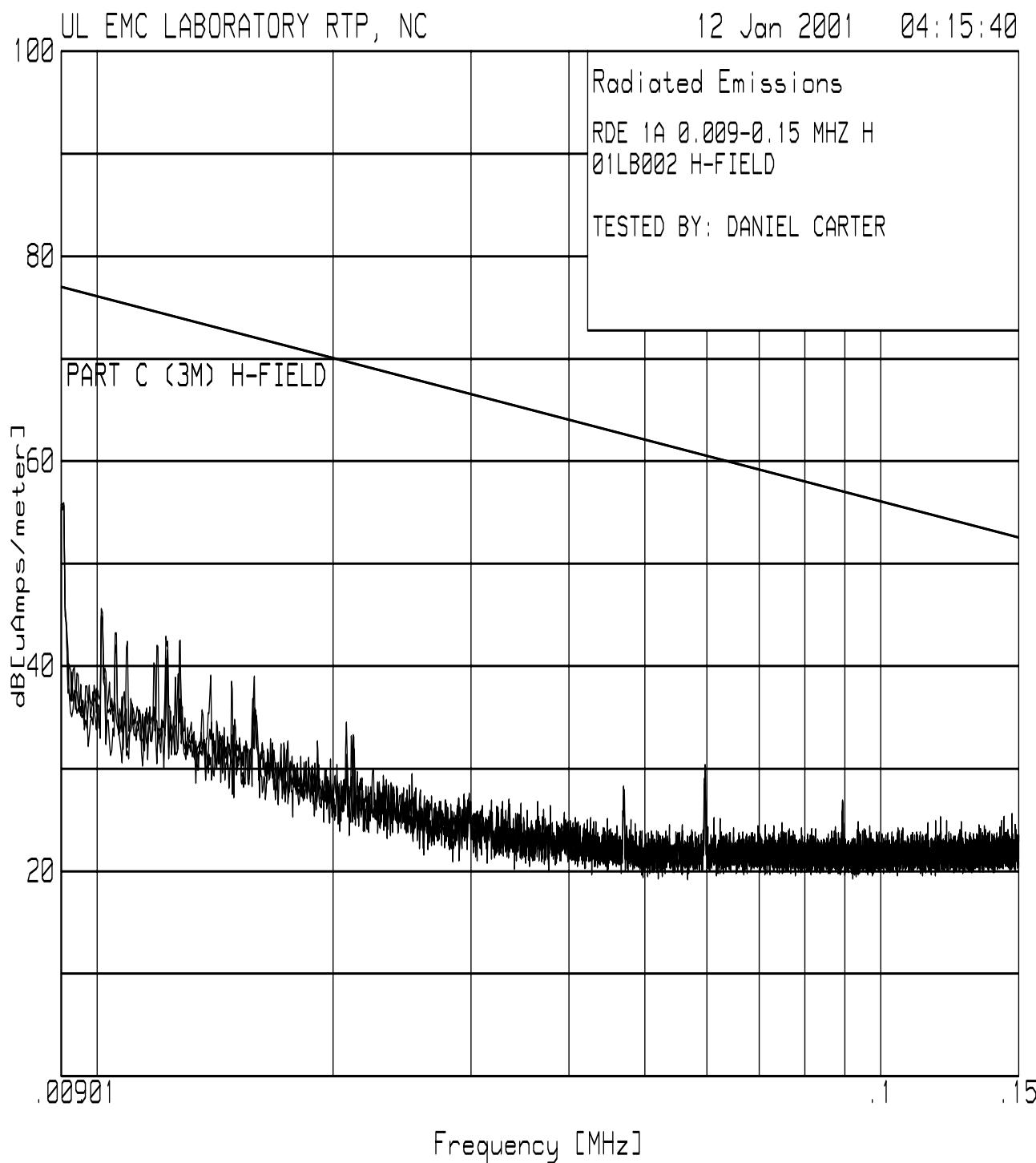
Test 1 - Test Equipment Used: Radiated Disturbance Emissions - 9 kHz to 30 MHz

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
AT0001	Loop Antenna, 30 Hz to 1 MHz	Electro-Metrics	EM-6871	11/20/00	11/30/01
AT0006	Loop Antenna, 10 kHz to 30 MHz	Electro-Metrics	EM-6879	11/20/00	11/30/01
ATA011	20 ft Cable, BNC - BNC	UL	RG-223	2/18/00	2/28/01
ATA096	50 ft, N male - N male	Micro coax	Coaxial Cable	8/14/00	8/31/01
HI0023	Humidity/Temperature/Pressure Indicator	Cole-Parmer	99760-00	10/5/00	10/31/01
MG0491	5 meter Tape Measure	Lufkin	Y35ME	5/3/99	5/31/02
SAR002	Spectrum Analyzer	Hewlett-Packard	8566B	7/21/00	7/31/01

The above equipment has been calibrated and is within the manufacturer's published limit of error. Calibration is traceable to the National Institute of Standards & Technology(NIST) and conforms to ANSI/NCSL Z540-1-1994.

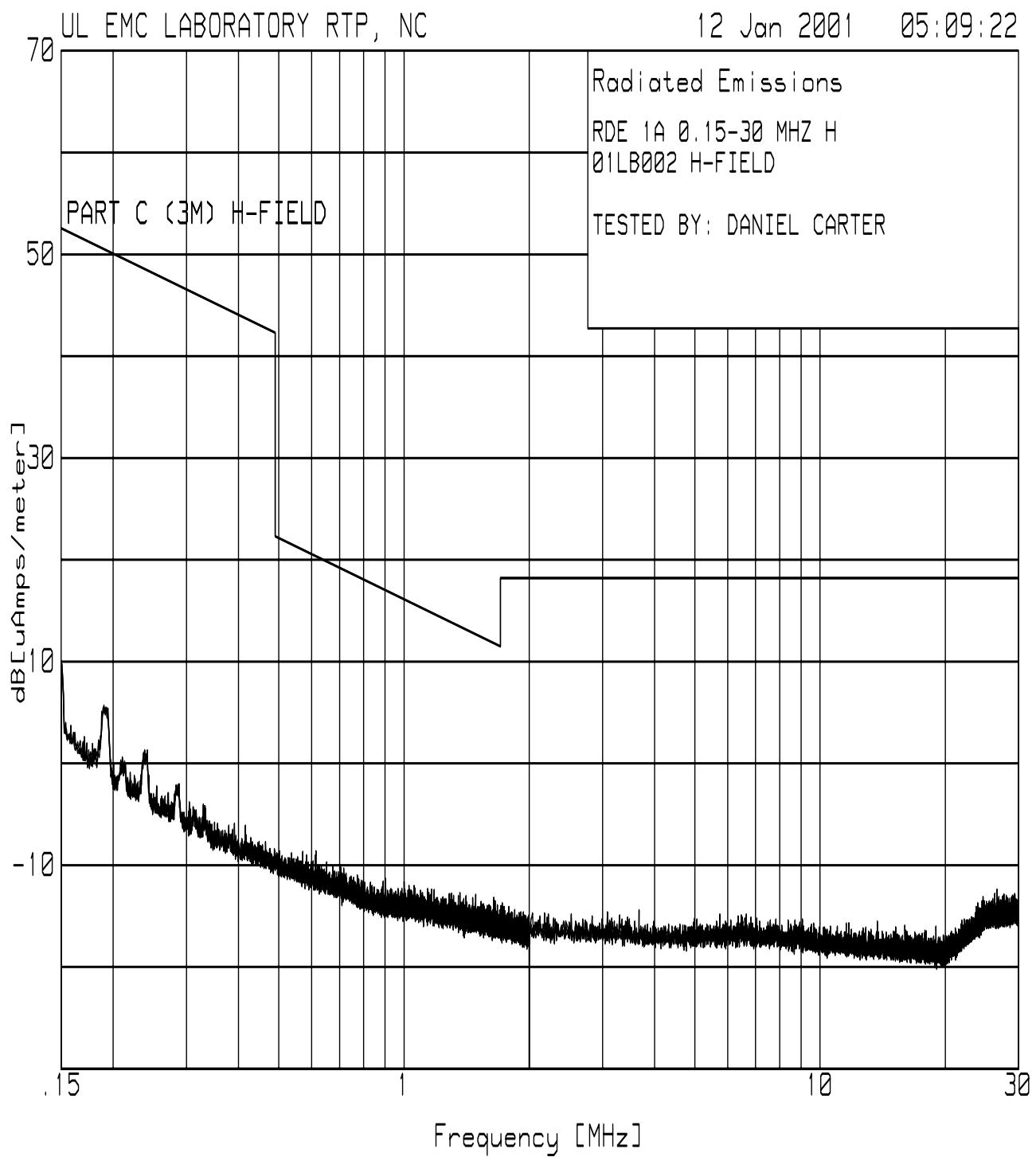
Test 1, Item A - Peak Plot (Amplitude in dBuV/m):

Radiated Disturbance Emissions - 9 kHz to 30 MHz



Test 1, Item A - Peak Plot (Amplitude in dBuV/m):

Radiated Disturbance Emissions - 9 kHz to 30 MHz



Test 1, Item A - Discrete Data:

Radiated Disturbance Emissions - 9 kHz to 30 MHz

Notes: * P = Peak, Q = Quasi-Peak, A = Average.

** See the Limit Adjustment statement below for conversion from FCC Stated Limits to Adjusted Limits.

*** # = See Comment Number Under The Preceeding Test Comments Section.

Sample Calculation: Corrected Value = Measured Value + Equipment Correction

Equipment Correction = Antenna Factor (dB/m) + Cable Loss (dB) - Amplifier Gain (dB, if used)

Limit Adjustment

FCC Limit is adjusted 40 dB/decade for 3 meter measurements by adding 80 dB for measurements below 490 kHz and 40 dB for measurements between 490 kHz and 30 MHz. The Limits are further converted to Magnetic Field measurements subtracting 377 ohms (51.5 dB) the impedance of free space.

Test 1, Item A - Test Set-Up Photo - Maximum Emissions Configuration:

Radiated Disturbance Emissions - 9 kHz to 30 MHz



Test 2: Radiated Disturbance Emissions - 30 MHz to 1000 MHz

Test Requirement: 47 CFR Part 15, Subpart C

Test Specification: 47 CFR Part 15, Subpart C, Section 15.209 and 15.231

Test Procedure:

The test was performed in accordance with the Test Requirement and Specification and configured as noted in the Test Setup. The EUT was placed inside the anechoic chamber with a fresh battery installed. A peak measurement was first made by scanning the entire test frequency range and maximizing the EUT emissions by rotating the EUT and raising the antenna height from 1 to 4 meters above the ground reference plane. Then, a measurement was taken for all peak emissions to verify each were below the Test Limits.

Radiated Disturbance Limits for Manually Operated Transmitters - Section 15.231
at a measurement distance of 3 meters

Fundamental Frequency (MHz)	Field Strength of Fundamental		Field Strength of Spurious	
	(μ V/m)	(dB μ V/m)	(μ V/m)	(dB μ V/m)
40.66 to 40.70	2250	67.04	225	47.04
70 to 130	1250	61.94	125	41.94
130 to 174	1250 to 3750	61.94 to 71.48	125 to 375	41.94 to 51.48
174 to 260	3750	71.48	375	51.48
260 to 470	3750 to 12,500	71.48 to 81.93	375 to 1250	51.48 to 61.93
above 470	12,500	81.93	1250	61.93

** Linear Interpolations

Test Clarifications (Specific Limts for this transmit frequency):

At fundamental frequency, 350 MHz, Average field strength limit = 7500 μ V/m (77.5 dB μ V/m).

Harmonic field strength limit = 750 μ V/m (57.5 dB μ V/m).

Per 15.35(b) peak limit is 20 dB above average limit for each frequency.

Test Deviations:

None

Test Setup: Only the following ports were tested. See EUT Information for details.

Test Item	Port #	Port Name	EUT Operation Mode	EUT Configuration	Power Interface
A	0	Enclosure	1 (Transmitting)	1	1
B	0	Enclosure	2 (Idle)	1	1

Test 2 - Results: Radiated Disturbance Emissions - 30 MHz to 1000 MHz

Test Results Summary:

Test Item	Test Location	Humidity (%)	Temperature (°C)	Pressure (kPa)	Pass/Fail (P/F)	Date Completed	Comment #
A	A	40	23.0	101.0	P	1/11/01	1
B	A	40	23.0	101.0	P	1/11/01	2, 5

The EUT was considered to **Pass** the Requirements.

Comments:

Comment #	Description
1	Experiment showed transmit frequency highest emission was with transmitter oriented flat on table. Data is recorded in this orientation.
2	The intent of test item B (idle test) is to demonstrate that general limits are met at all frequencies when no button is depressed.
3	Peak limit is calculated to be 20 dB above Average limit per 15.35.
4	Limits for Peak and Average for transmit frequency (350 MHz) and 2nd harmonic (700 MHz) found in 15.231(b). Average calculated using peak-to-average ratio results in Test 4 of -10.1 dB.
5	General Limits in 15.209 are applied for idle test.

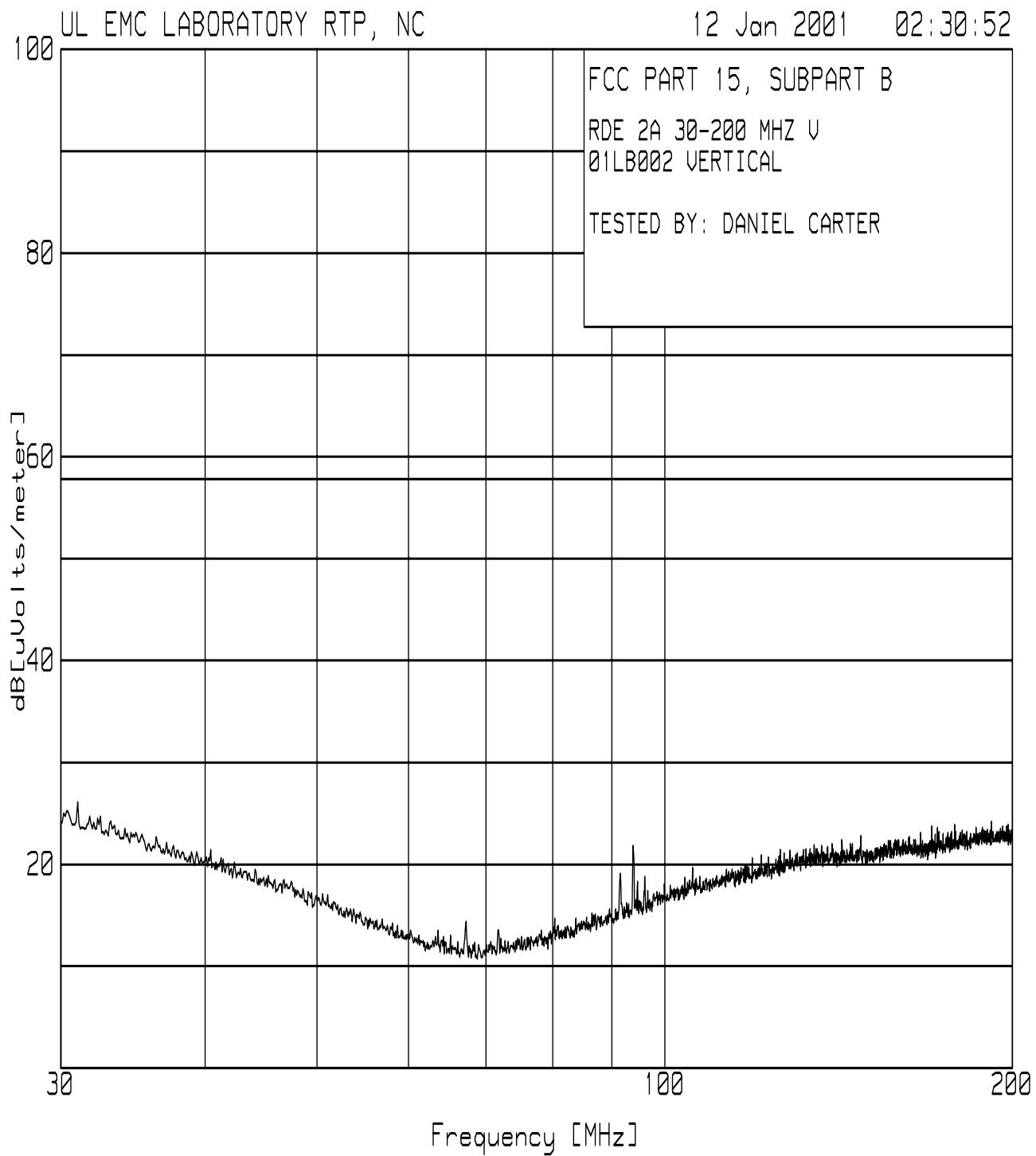
Test 2 - Test Equipment Used: Radiated Disturbance Emissions - 30 MHz to 1000 MHz

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
AT0021	Biconical Antenna, 20 to 300 MHz	Chase	VBA6106A	5/17/00	5/31/01
AT0022	Log Periodic Antenna, 200 to 1000 MHz	Chase	UPA6109	5/17/00	5/31/01
ATA096	50 ft, N male - N male	Micro coax	Coaxial Cable	8/14/00	8/31/01
ATA108	10m, N male - N male	UL	RG214	10/27/00	10/31/01
HI0023	Humidity/Temperature/Pressure Indicator	Cole-Parmer	99760-00	10/5/00	10/31/01
MG0491	5 meter Tape Measure	Lufkin	Y35ME	5/3/99	5/31/02
SAR002	Spectrum Analyzer	Hewlett-Packard	8566B	7/21/00	7/31/01

The above equipment has been calibrated and is within the manufacturer's published limit of error. Calibration is traceable to the National Institute of Standards & Technology(NIST) and conforms to ANSI/NCSL Z540-1-1994.

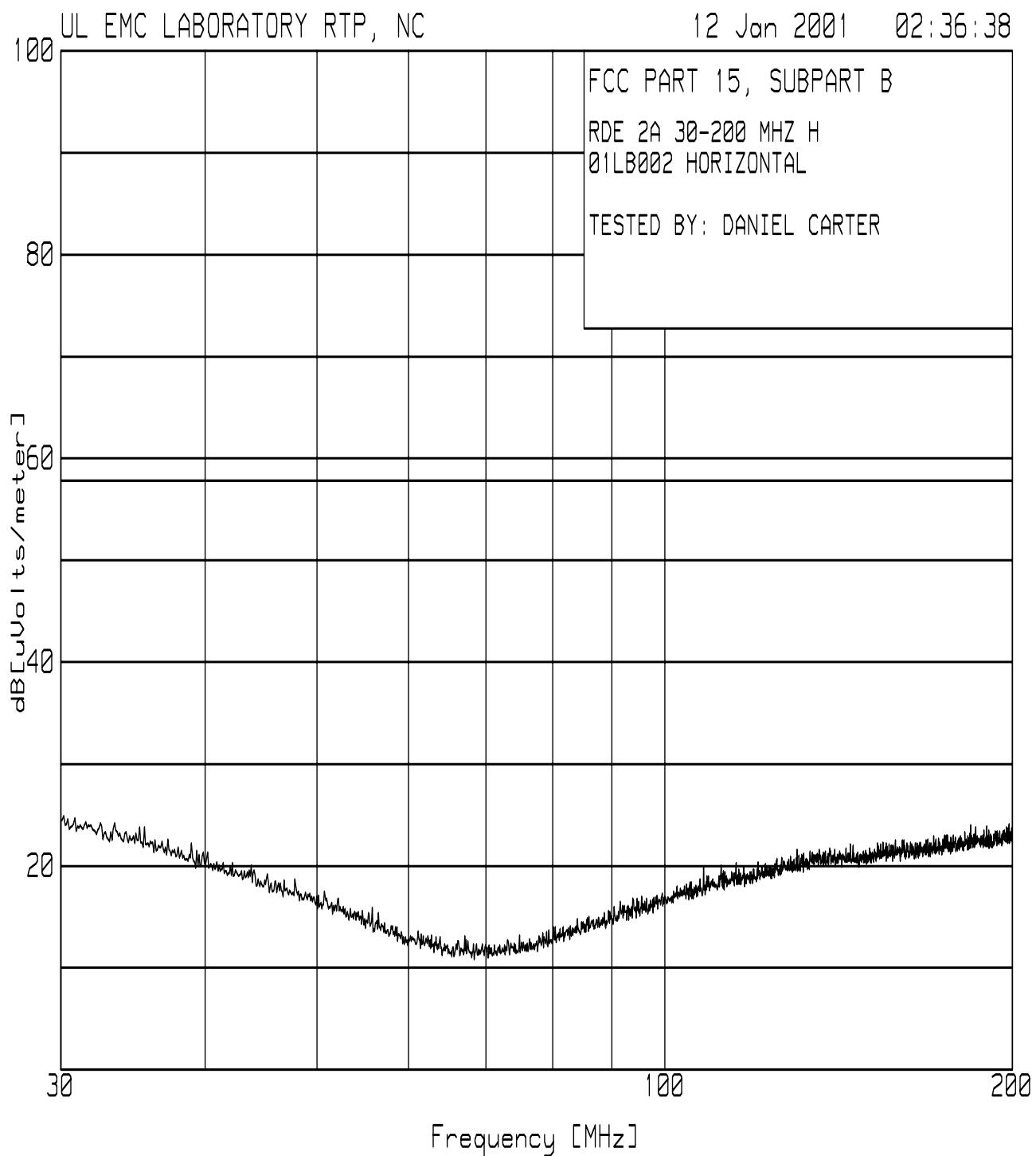
Test 2, Item A - Peak Plot (Amplitude in dBuV/m):

Radiated Disturbance Emissions - 30 MHz to 1000 MHz



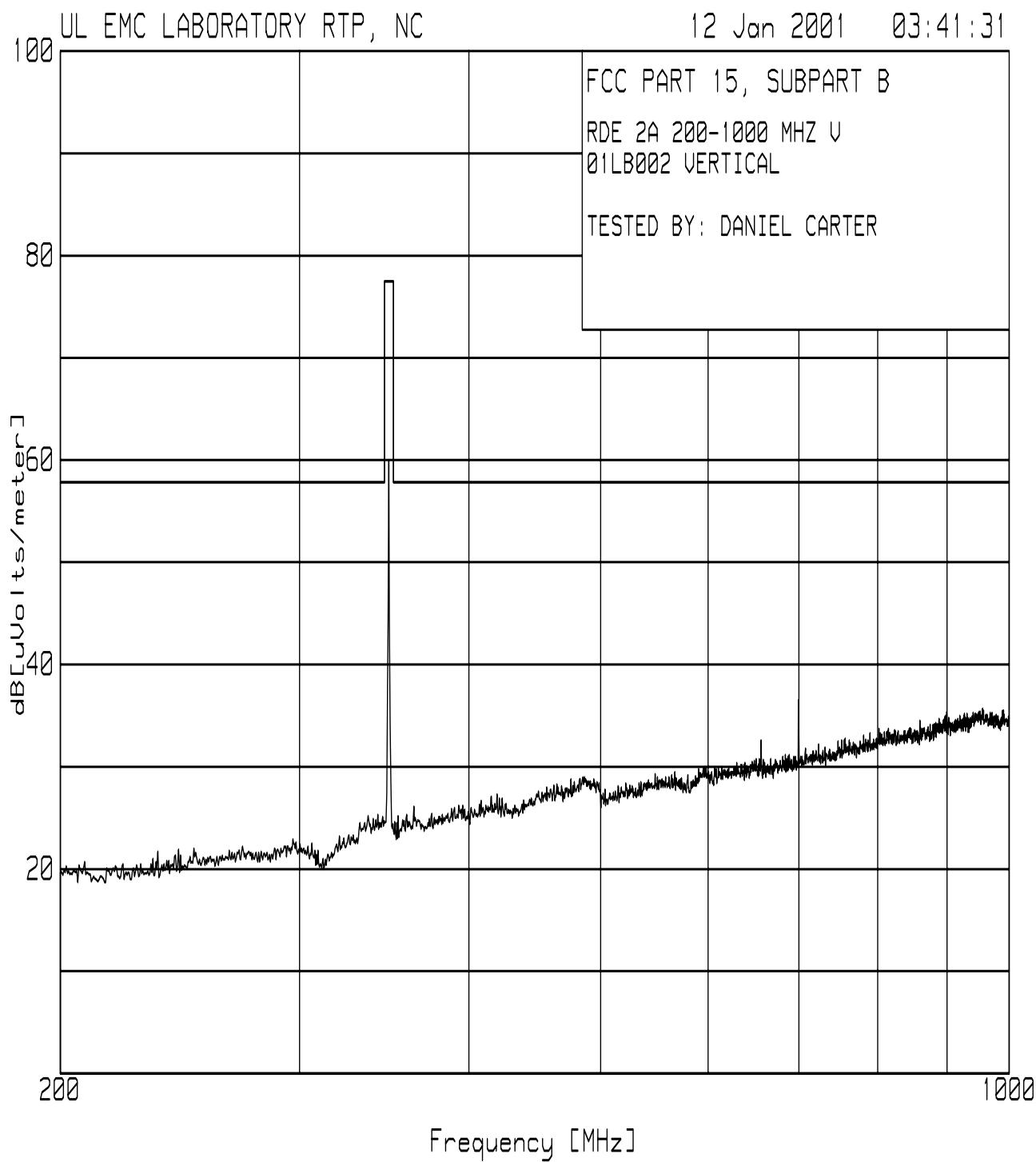
Test 2, Item A - Peak Plot (Amplitude in dBuV/m):

Radiated Disturbance Emissions - 30 MHz to 1000 MHz



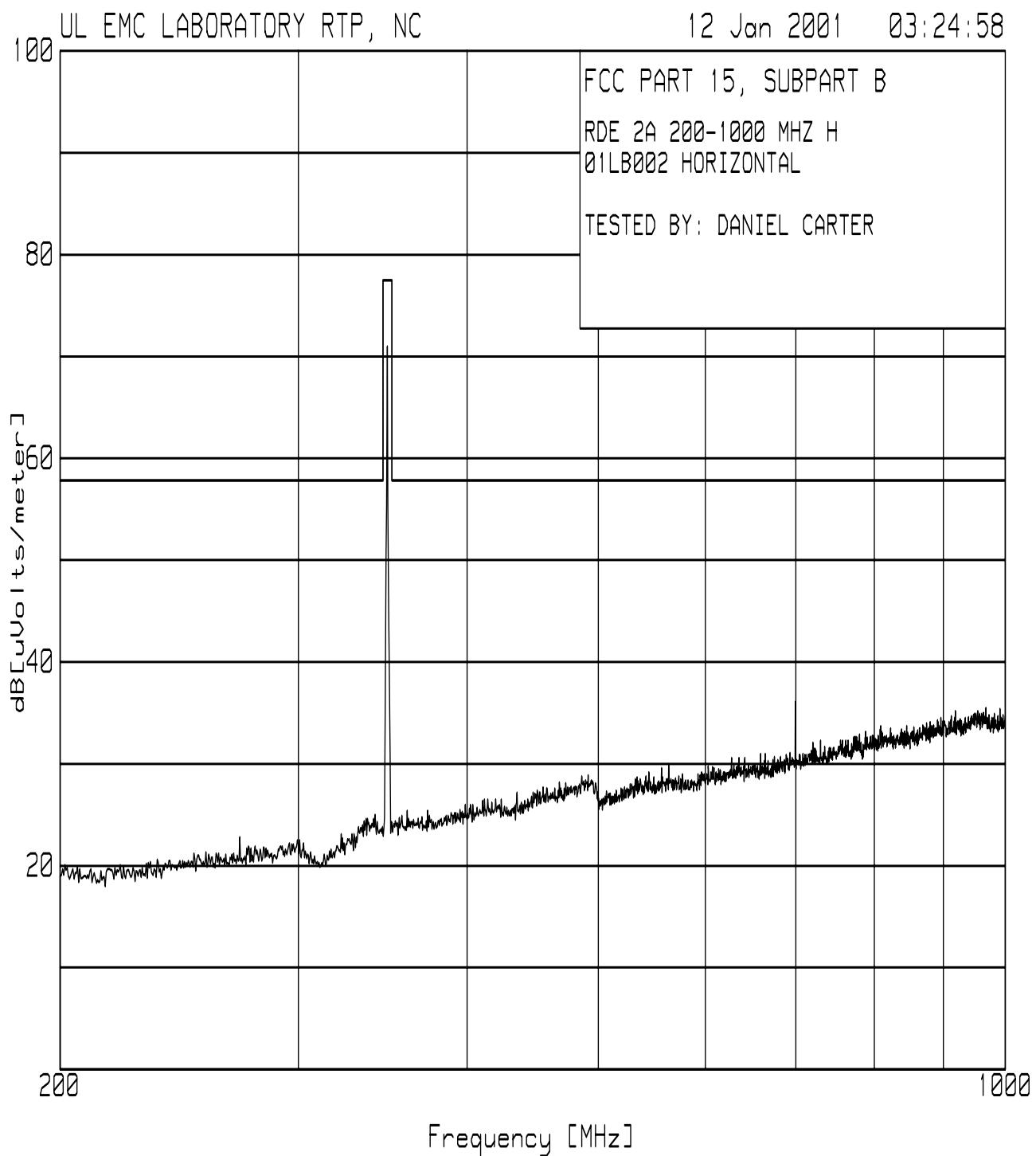
Test 2, Item A - Peak Plot (Amplitude in dBuV/m):

Radiated Disturbance Emissions - 30 MHz to 1000 MHz



Test 2, Item A - Peak Plot (Amplitude in dBuV/m):

Radiated Disturbance Emissions - 30 MHz to 1000 MHz



Test 2, Item A - Discrete Data:

Radiated Disturbance Emissions - 30 MHz to 1000 MHz

Notes: * P = Peak, Q = Quasi-Peak, A = Average.

** The Specified Limit is for the type measurement indicated. When Peak data is indicated, the tightest limit applicable is indicated.

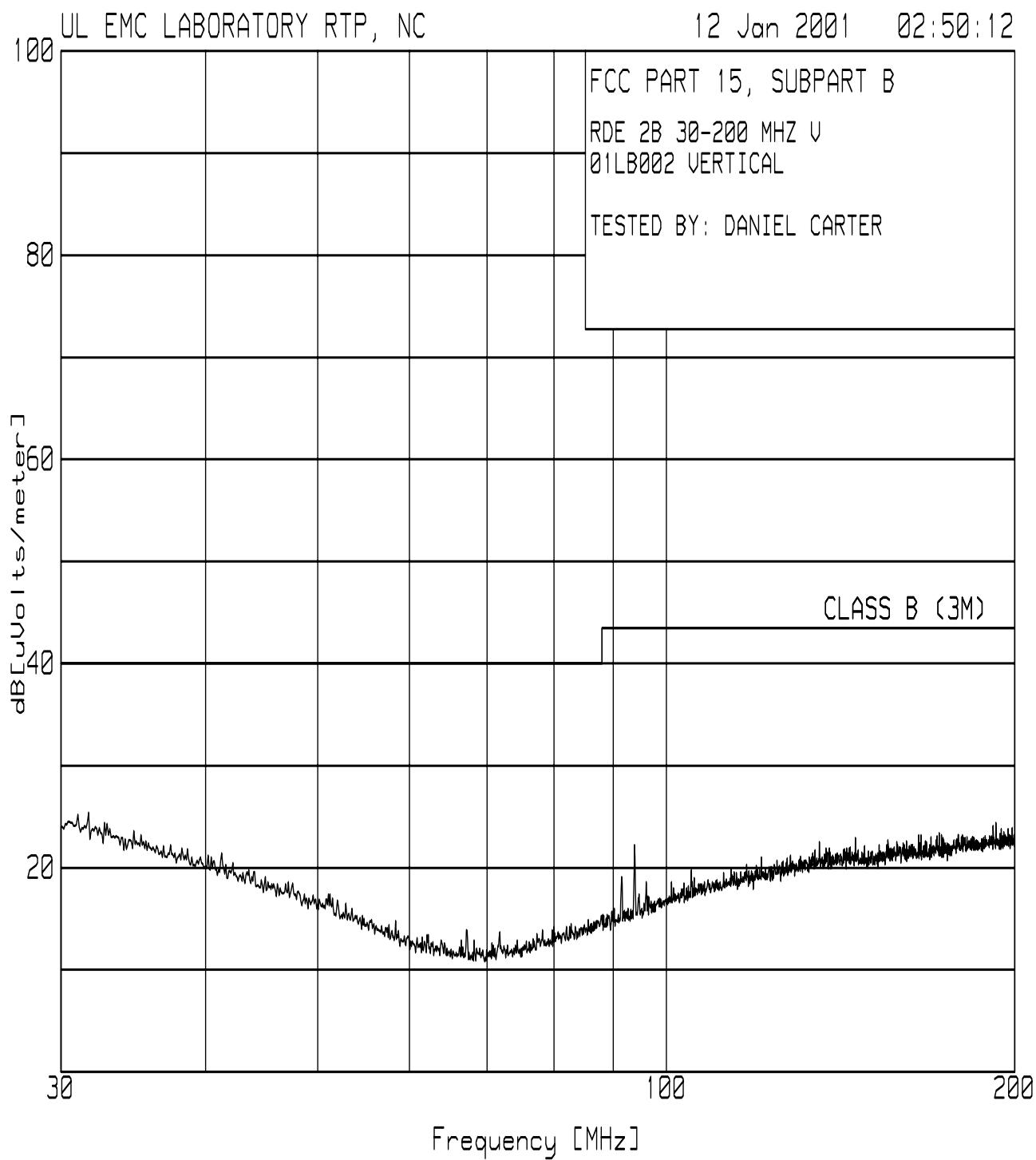
*** # = See Comment Number Under The Preceeding Test Comments Section.

Sample Calculation: Corrected Value = Measured Value + Equipment Correction

Equipment Correction = Antenna Factor (dB/m) + Cable Loss (dB) - Amplifier Gain (dB, if used)

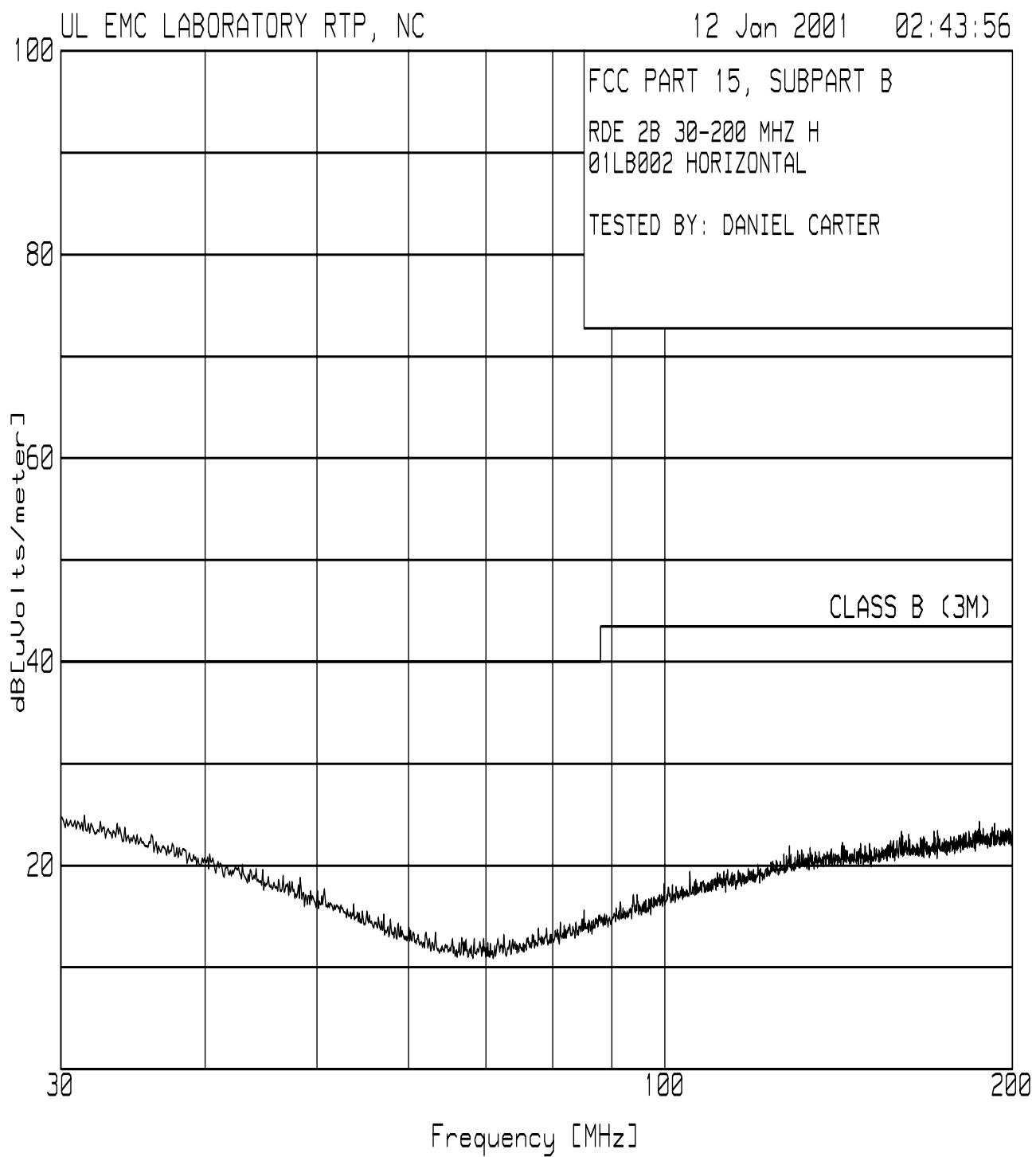
Test 2, Item B (Idle Test) - Peak Plot (Amplitude in dBuV/m):

Radiated Disturbance Emissions - 30 MHz to 1000 MHz



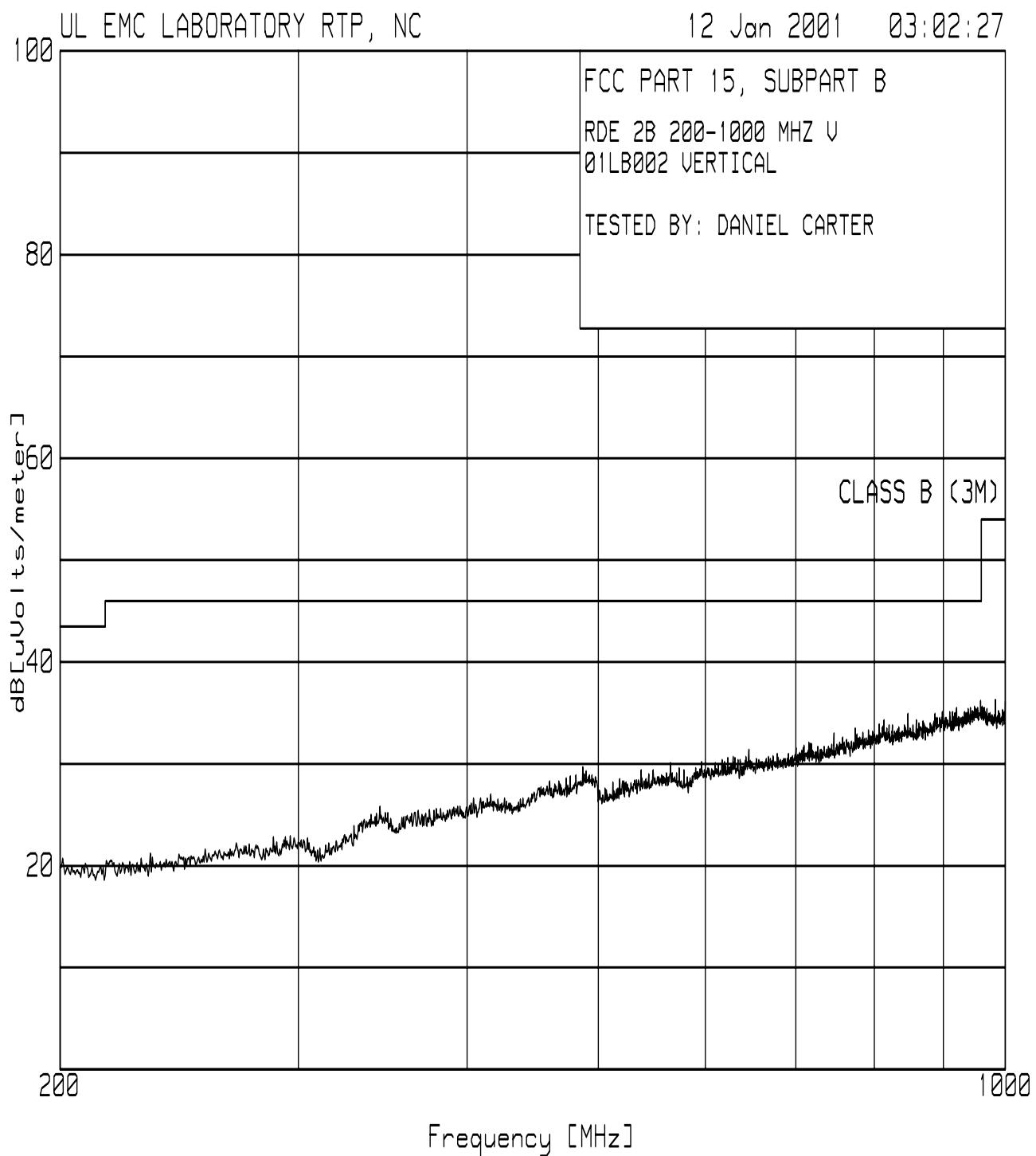
Test 2, Item B (Idle Test) - Peak Plot (Amplitude in dBuV/m):

Radiated Disturbance Emissions - 30 MHz to 1000 MHz



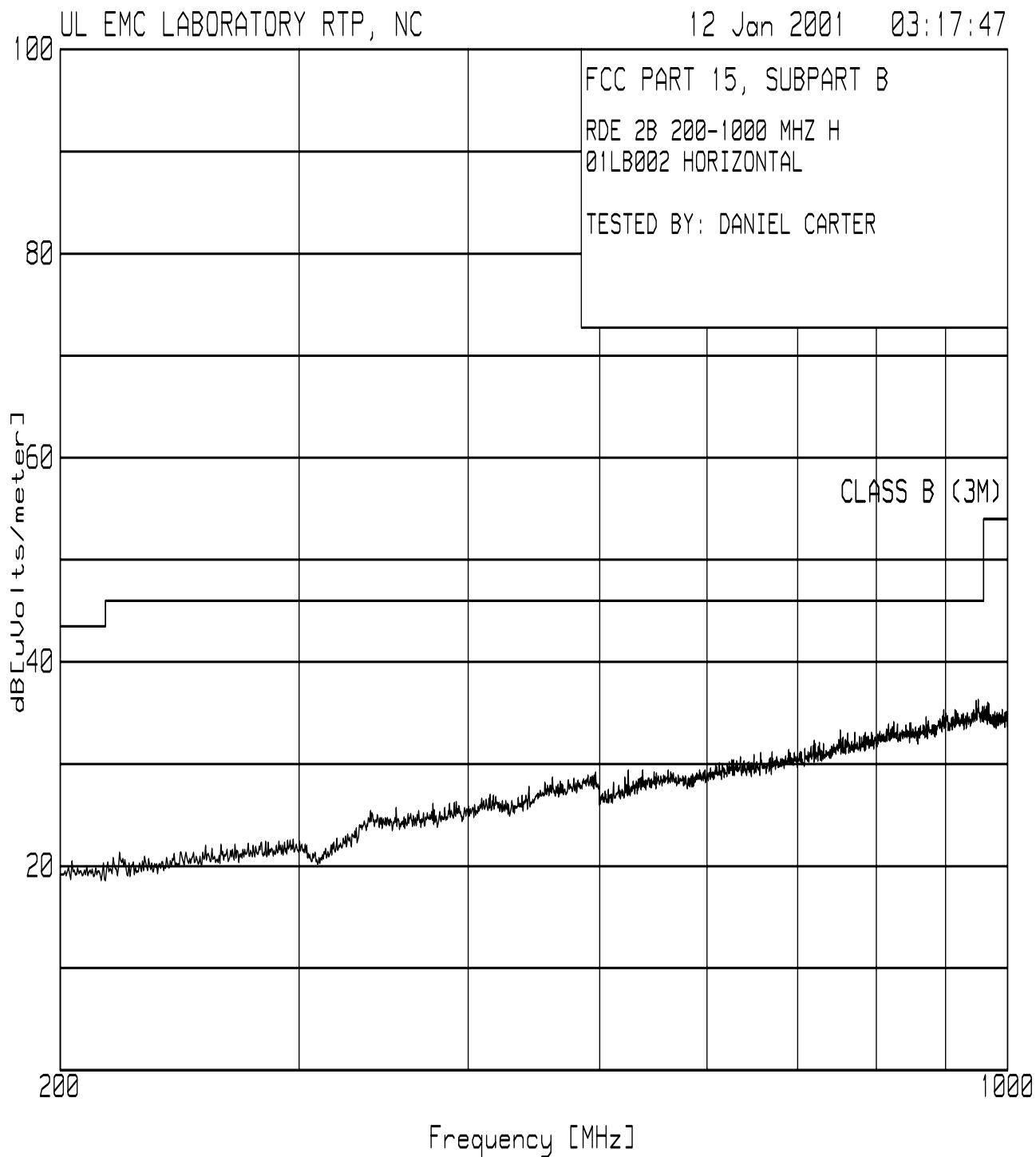
Test 2, Item B (Idle Test) - Peak Plot (Amplitude in dBuV/m):

Radiated Disturbance Emissions - 30 MHz to 1000 MHz



Test 2, Item B (Idle Test) - Peak Plot (Amplitude in dBuV/m):

Radiated Disturbance Emissions - 30 MHz to 1000 MHz



Test 2, Item B (Idle Test) - Discrete Data:

Radiated Disturbance Emissions - 30 MHz to 1000 MHz

Notes: * P = Peak, Q = Quasi-Peak, A = Average.

** The Specified Limit is for the type measurement indicated. When Peak data is indicated, the tightest limit applicable is indicated.

*** # = See Comment Number Under The Preceeding Test Comments Section.

Sample Calculation: Corrected Value = Measured Value + Equipment Correction

Equipment Correction = Antenna Factor (dB/m) + Cable Loss (dB) - Amplifier Gain (dB, if used)

Test 3: Radiated Disturbance Emissions - Above 1 GHz

Test Requirement: 47 CFR Part 15, Subpart C

Test Specification: 47 CFR Part 15, Subpart C, Section 15.209 and 15.231

Test Procedure:

The test was performed in accordance with the Test Requirement and Specification and configured as noted in the Test Setup. The EUT was placed inside the anechoic chamber with a fresh battery installed. A peak measurement was first made by scanning the entire test frequency range and maximizing the EUT emissions by rotating the EUT and raising the antenna height from 1 to 4 meters above the ground reference plane. Then, a measurement was taken for all peak emissions to verify each were below the Test Limits.

Radiated Disturbance Limits for Manually Operated Transmitters - Section 15.231
at a measurement distance of 3 meters

Fundamental Frequency (MHz)	Field Strength of Fundamental		Field Strength of Spurious	
	(μ V/m)	(dB μ V/m)	(μ V/m)	(dB μ V/m)
40.66 to 40.70	2250	67.04	225	47.04
70 to 130	1250	61.94	125	41.94
130 to 174	1250 to 3750	61.94 to 71.48	125 to 375	41.94 to 51.48
174 to 260	3750	71.48	375	51.48
260 to 470	3750 to 12,500	71.48 to 81.93	375 to 1250	51.48 to 61.93
above 470	12,500	81.93	1250	61.93

** Linear Interpolations

Test Clarifications (Specific Limits for this Transmit Frequency):

At fundamental frequency, 350 MHz, Average field strength limit = 7500 μ V/m (77.5 dB μ V/m).

Harmonic field strength limit = 750 μ V/m (57.5 dB μ V/m).

Per 15.35(b) peak limit is 20 dB above average limit for each frequency.

Per 15.33(a) spurious emissions are measured through the tenth harmonic.

Test Deviations:

None

Test Setup: Only the following ports were tested. See EUT Information for details.

Test Item	Port #	Port Name	EUT Operation Mode	EUT Configuration	Power Interface
A	0	Enclosure	1 (Transmitting)	1	1
B	0	Enclosure	2 (Idle)	1	1

Test 3 - Results: Radiated Disturbance Emissions - Above 1 GHz

Test Results Summary:

Test Item	Test Location	Humidity (%)	Temperature (°C)	Pressure (kPa)	Pass/Fail (P/F)	Date Completed	Comment #
A	A	39	23.0	101.0	P	1/11/01	1
B	A	39	23.0	101.1	P	1/11/01	2, 4

The EUT was considered to **Pass** the Requirements.

Comments:

Comment #	Description
1	Data is recorded with transmitter flat on tabletop. This orientation was found to be worst case for the transmit frequency in Test 2.
2	The intent of test item B (idle test) is to demonstrate that general limits are met at all frequencies when no button is depressed.
3	All average values were calculated using peak-to-average ratio determined in Test 4 of -10.1 dB. Restricted Bands are considered in Test 6.
4	General Limits from 15.209 apply for idle test.

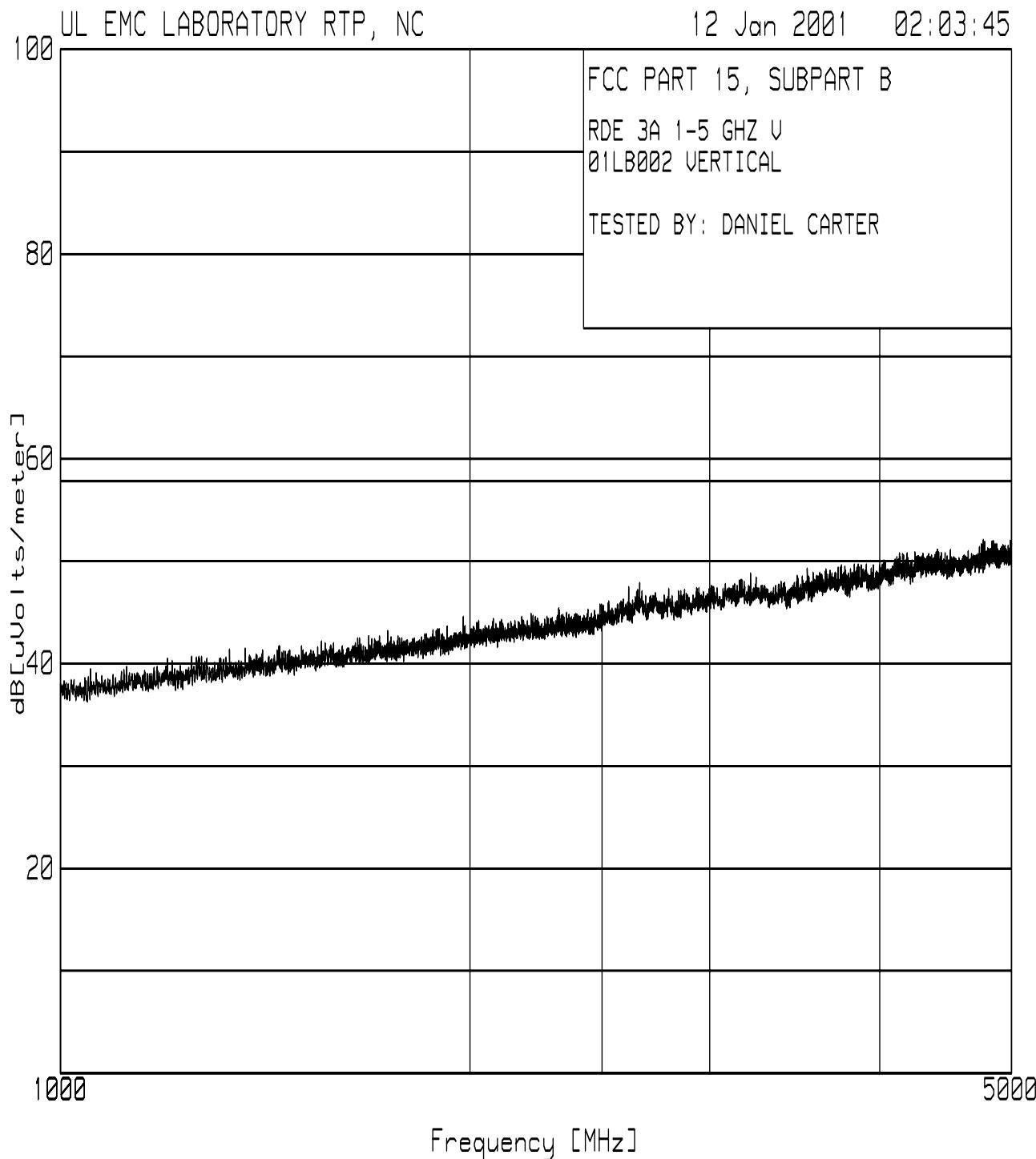
Test 3 - Test Equipment Used: Radiated Disturbance Emissions - Above 1 GHz

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
AT0005	Horn Antenna, 1 to 18 GHz	Electro-Metrics	EM-6961	6/8/00	6/30/01
ATA033	52 ft Cable, N - N	UL	Heliax	8/29/00	8/31/01
ATA094	6 ft, N male - N male	Micro coax	Coaxial Cable	5/24/00	5/31/01
ATA096	50 ft, N male - N male	Micro coax	Coaxial Cable	8/14/00	8/31/01
HI0023	Humidity/Temperature/Pressure Indicator	Cole-Parmer	99760-00	10/5/00	10/31/01
RTP052	Preamplifier 1 - 26 GHZ	Hewlett-Packard	8449B/H02	01/08/01	01/31/02
SAR002	Spectrum Analyzer	Hewlett-Packard	8566B	7/21/00	7/31/01

The above equipment has been calibrated and is within the manufacturer's published limit of error. Calibration is traceable to the National Institute of Standards & Technology(NIST) and conforms to ANSI/NCSL Z540-1-1994.

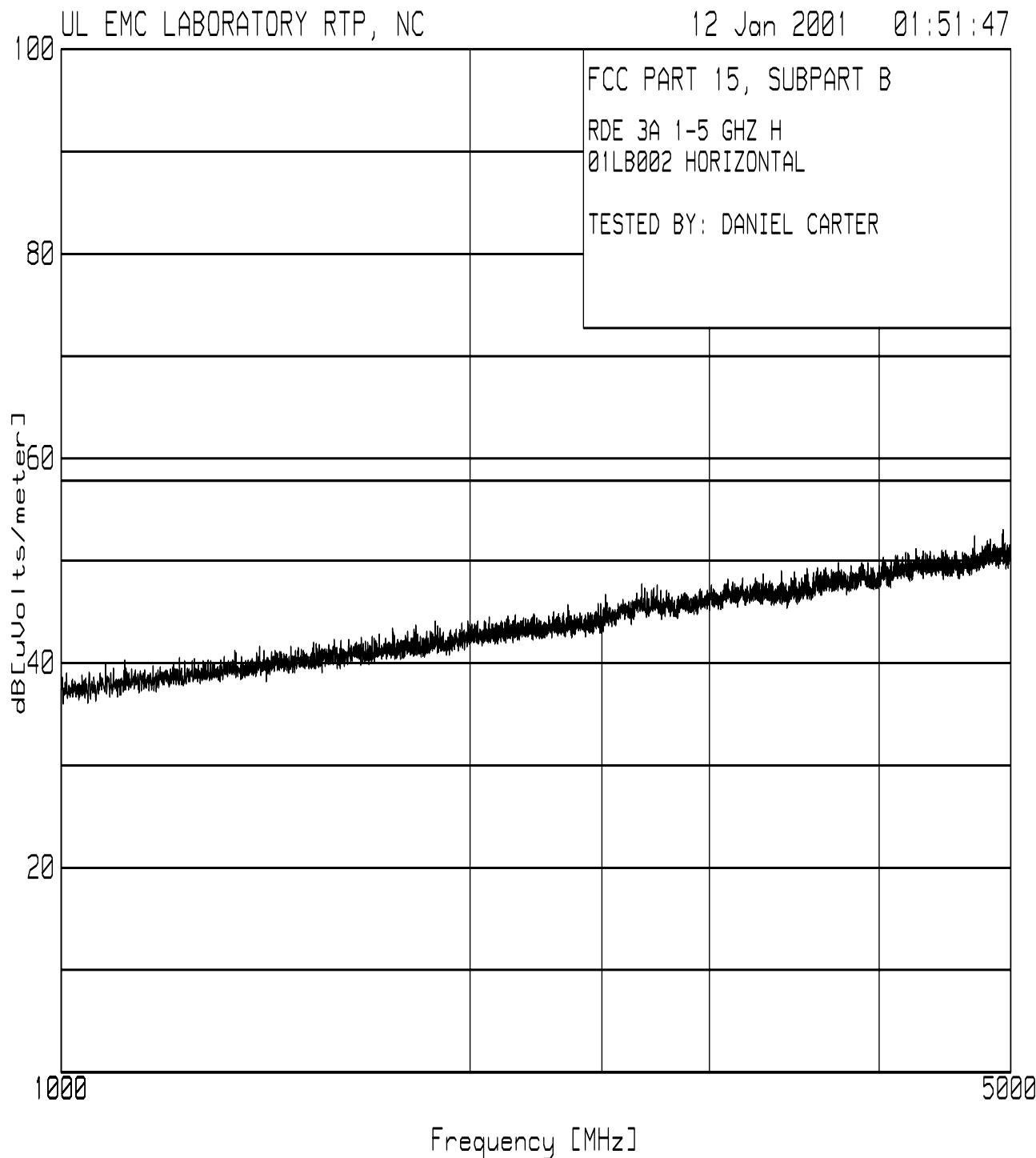
Test 3, Item A - Peak Plot (Amplitude in dBuV/m):

Radiated Disturbance Emissions - Above 1 GHz



Test 3, Item A - Peak Plot (Amplitude in dBuV/m):

Radiated Disturbance Emissions - Above 1 GHz



Test 3, Item A - Discrete Data:**Radiated Disturbance Emissions - Above 1 GHz**

Test Item (A-Z)	Detector Type* (P/Q/A)	Antenna Polarity (H/V)	Antenna Distance (m)	Measured Frequency (MHz)	Measured Value (dB μ V)	Equipment Correction (dB/m)	Corrected Value (dB μ V/m)	Specified Limit** (dB μ V/m)	Spec Margin (dB)	See Comments on Page 29
A	P	V	3	1050	48.6	-9.6	39.0	77.5	-38.5	
A	A	V	3	1050	-	-	28.9	57.5	-28.6	3
A	P	V	3	1400	48.5	-6.9	41.6	77.5	-35.9	
A	A	V	3	1400	-	-	31.5	57.5	-26.0	3
A	P	V	3	1750	47.4	-5.0	42.4	77.5	-35.1	
A	A	V	3	1750	-	-	32.3	57.5	-25.2	3
A	P	V	3	2100	46.8	-3.0	43.8	77.5	-33.7	
A	A	V	3	2100	-	-	33.7	57.5	-23.8	3
A	P	V	3	2450	46.2	-1.6	44.6	77.5	-32.9	
A	A	V	3	2450	-	-	34.5	57.5	-23.0	3
A	P	V	3	2800	47.2	-0.7	46.5	77.5	-31.0	
A	A	V	3	2800	-	-	36.4	57.5	-21.1	3
A	P	V	3	3150	48.0	0.3	48.3	77.5	-29.2	
A	A	V	3	3150	-	-	38.2	57.5	-19.3	3
A	P	V	3	3500	46.6	1.7	48.3	77.5	-29.2	
A	A	V	3	3500	-	-	38.2	57.5	-19.3	3
A	P	H	3	1050	47.8	-6.3	41.5	77.5	-36.0	
A	A	H	3	1050	-	-	31.4	57.5	-26.1	3
A	P	H	3	1400	48.2	-8.9	39.3	77.5	-38.2	
A	A	H	3	1400	-	-	29.2	57.5	-28.3	3
A	P	H	3	1750	47.7	-4.6	43.1	77.5	-34.4	
A	A	H	3	1750	-	-	33.0	57.5	-24.5	3
A	P	H	3	2100	47.3	-2.9	44.4	77.5	-33.1	
A	A	H	3	2100	-	-	34.3	57.5	-23.2	3
A	P	H	3	2450	46.9	-1.4	45.5	77.5	-32.0	
A	A	H	3	2450	-	-	35.4	57.5	-22.1	3
A	P	H	3	2800	46.7	-0.8	45.9	77.5	-31.6	
A	A	H	3	2800	-	-	35.8	57.5	-21.7	3
A	P	H	3	3150	48.0	0.3	48.3	77.5	-29.2	
A	A	H	3	3150	-	-	38.2	57.5	-19.3	3

Notes: * P = Peak, Q = Quasi-Peak, A = Average.

** The Specified Limit is for the type measurement indicated. When Peak data is indicated, the tightest limit applicable is indicated.

*** # = See Comment Number Under The Preceeding Test Comments Section.

Sample Calculation: Corrected Value = Measured Value + Equipment Correction

Equipment Correction = Antenna Factor (dB/m) + Cable Loss (dB) - Amplifier Gain (dB, if used)

Test 3, Item A - Discrete Data:

Radiated Disturbance Emissions - Above 1 GHz

Notes: * P = Peak, Q = Quasi-Peak, A = Average.

** The Specified Limit is for the type measurement indicated. When Peak data is indicated, the tightest limit applicable is indicated.

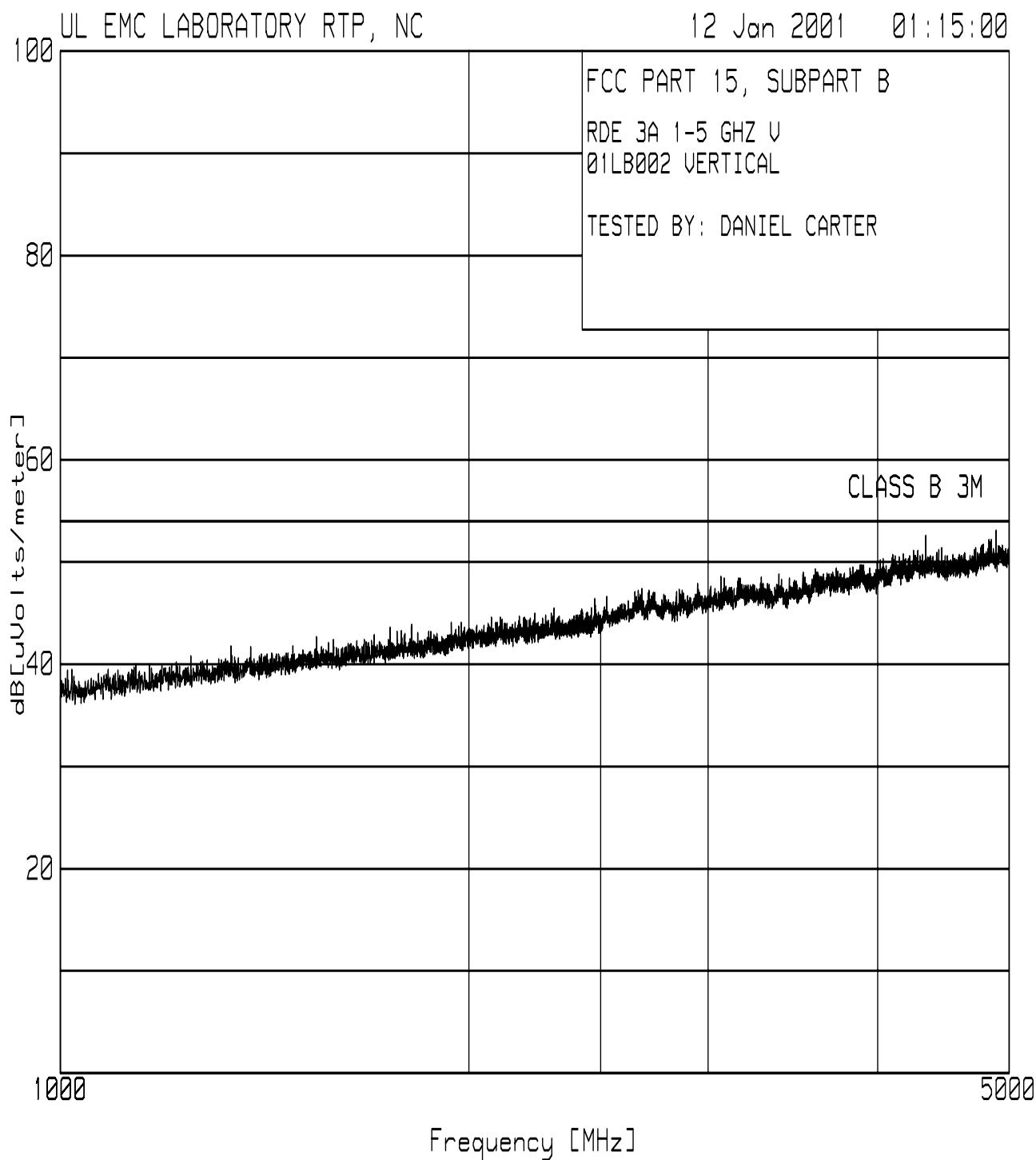
*** # = See Comment Number Under The Preceeding Test Comments Section.

Sample Calculation: Corrected Value = Measured Value + Equipment Correction

Equipment Correction = Antenna Factor (dB/m) + Cable Loss (dB) - Amplifier Gain (dB, if used)

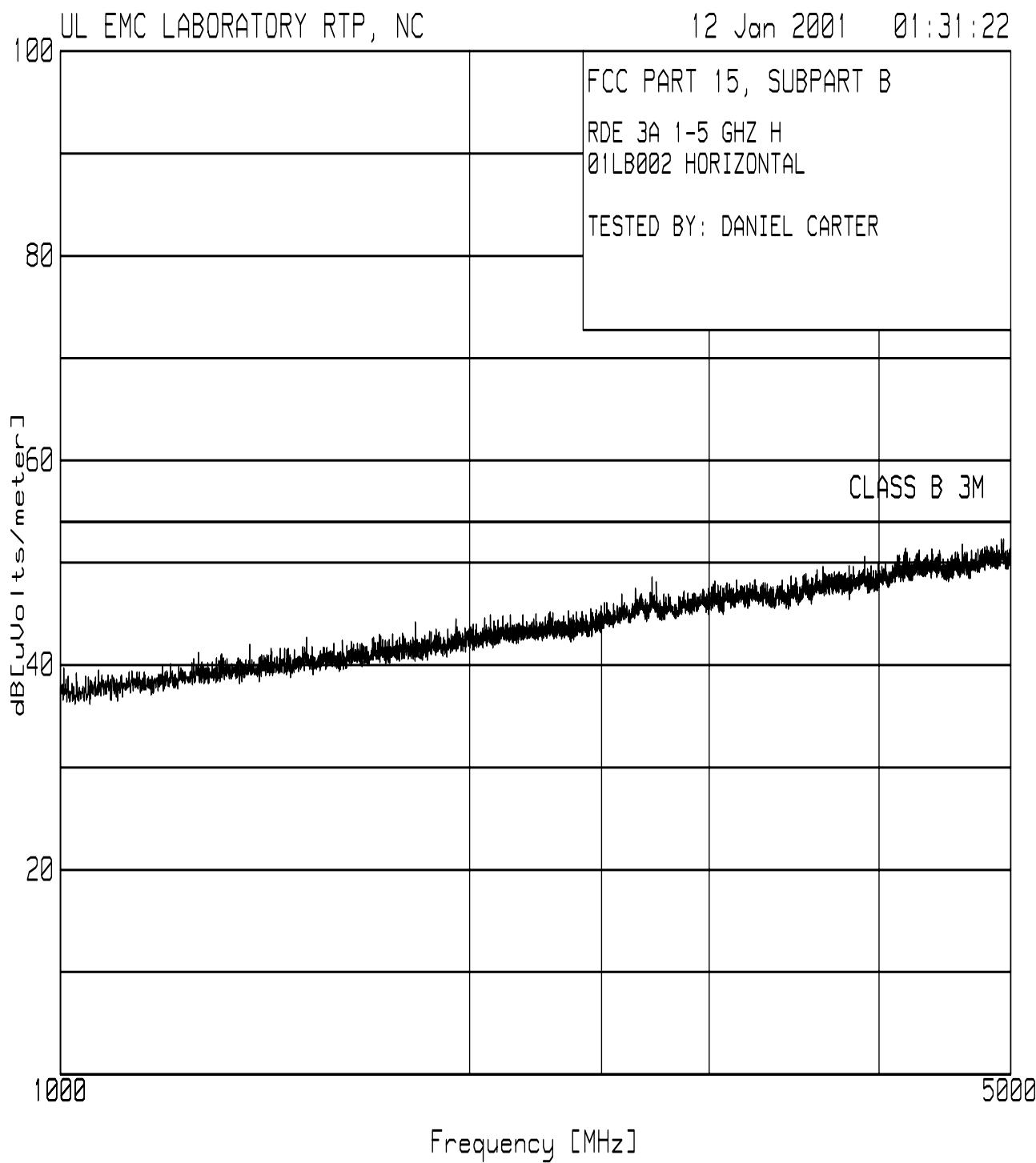
Test 3, Item B (Idle Test) - Peak Plot (Amplitude in dBuV/m):

Radiated Disturbance Emissions - Above 1 GHz



Test 3, Item B (Idle Test) - Peak Plot (Amplitude in dBuV/m):

Radiated Disturbance Emissions - Above 1 GHz



Test 3, Item B (Idle Test) - Discrete Data:

Radiated Disturbance Emissions - Above 1 GHz

Test Item (A-Z)	Detector Type* (P/Q/A)	Antenna Polarity (H/V)	Antenna Distance (m)	Measured Frequency (MHz)	Measured Value (dB μ V)	Equipment Correction (dB/m)	Corrected Value (dB μ V/m)	Specified Limit** (dB μ V/m)	Spec Margin (dB)	See Comments on Page 29
A	P	V	3	1050	48.2	-9.3	38.9	74.0	-35.1	
A	A	V	3	1050	-	-	28.8	54.0	-25.2	3
A	P	V	3	1400	48.6	-7.1	41.5	74.0	-32.5	
A	A	V	3	1400	-	-	31.4	54.0	-22.6	3
A	P	V	3	1750	47.5	-4.8	42.7	74.0	-31.3	
A	A	V	3	1750	-	-	32.6	54.0	-21.4	3
A	P	V	3	2100	46.7	-2.5	44.2	74.0	-29.8	
A	A	V	3	2100	-	-	34.1	54.0	-19.9	3
A	P	V	3	2450	46.7	-1.8	44.9	74.0	-29.1	
A	A	V	3	2450	-	-	34.8	54.0	-19.2	3
A	P	V	3	2800	48.2	-0.9	47.3	74.0	-26.7	
A	A	V	3	2800	-	-	37.2	54.0	-16.8	3
A	P	V	3	3150	47.2	0.2	47.4	74.0	-26.6	
A	A	V	3	3150	-	-	37.3	54.0	-16.7	3
A	P	V	3	3500	47.0	0.9	47.9	74.0	-26.1	
A	A	V	3	3500	-	-	37.8	54.0	-16.2	3
A	P	H	3	1050	48.4	-9.8	38.6	74.0	-35.4	
A	A	H	3	1050	-	-	28.5	54.0	-25.5	3
A	P	H	3	1400	47.9	-6.9	41.0	74.0	-33.0	
A	A	H	3	1400	-	-	30.9	54.0	-23.1	3
A	P	H	3	1750	48.5	-4.9	43.6	74.0	-30.4	
A	A	H	3	1750	-	-	33.5	54.0	-20.5	3
A	P	H	3	2100	47.5	-2.9	44.6	74.0	-29.4	
A	A	H	3	2100	-	-	34.5	54.0	-19.5	3
A	P	H	3	2450	46.5	-1.4	45.1	74.0	-28.9	
A	A	H	3	2450	-	-	35.0	54.0	-19.0	3
A	P	H	3	2800	47.6	-0.9	46.7	74.0	-27.3	
A	A	H	3	2800	-	-	36.6	54.0	-17.4	3
A	P	H	3	3150	48.1	0.3	48.4	74.0	-25.6	
A	A	H	3	3150	-	-	38.3	54.0	-15.7	3

Notes: * P = Peak, Q = Quasi-Peak, A = Average.

** The Specified Limit is for the type measurement indicated. When Peak data is indicated, the tightest limit applicable is indicated.

*** # = See Comment Number Under The Preceeding Test Comments Section.

Sample Calculation: Corrected Value = Measured Value + Equipment Correction

Equipment Correction = Antenna Factor (dB/m) + Cable Loss (dB) - Amplifier Gain (dB, if used)

Test 3, Item B (Idle Test) - Discrete Data:

Radiated Disturbance Emissions - Above 1 GHz

Notes: * P = Peak, Q = Quasi-Peak, A = Average.

** The Specified Limit is for the type measurement indicated. When Peak data is indicated, the tightest limit applicable is indicated.

*** # = See Comment Number Under The Preceeding Test Comments Section.

Sample Calculation: Corrected Value = Measured Value + Equipment Correction # - See Comment Number Under The Preceding Test Comments

Equipment Correction = Antenna Factor (dB/m) + Cable Loss (dB) - Amplifier Gain (dB, if used)

Test 4: Radiated Disturbance Emissions - Peak-to-Average Ratio

Test Requirement: 47 CFR Part 15, Subpart C

Test Specification: 47 CFR Part 15, Subpart C, Section 15.231

Test Procedure:

The test was performed in accordance with the Test Requirement and Specification and configured as noted in the Test Setup. The EUT was placed inside the anechoic chamber on connected to the proper power supply source. A peak measurement was first made by scanning the entire test frequency range and maximizing the EUT emissions by rotating the EUT and raising the antenna height from 1 to 4 meters above the ground reference plane.

The measurement spectrum analyzer is centered on the EUT's transmit frequency and span is reduced to 0 Hz to obtain a time domain measurement. The period of one complete transmit cycle is recorded. Next each button on the transmitter is depressed in sequence to determine which button produces the largest duty cycle. The duration of each pulse in the cycle is recorded and the percentage of time the EUT is transmitting is calculated.

No limit is expressed in Section 15.231 for this test, however the result of this test is used to calculate average values for the remaining measurements.

Test Deviations:

None

Test Setup: Only the following ports were tested. See EUT Information for details.

Test Item	Port #	Port Name	EUT Operation Mode	EUT Configuration	Power Interface
A	0	Enclosure	1	1	1

Test 4 - Results: Radiated Disturbance Emissions - Peak-to-Average Ratio

Test Results Summary:

Test Item	Test Location	Humidity (%)	Temperature (°C)	Pressure (kPa)	Pass/Fail (P/F)	Date Completed	Comment #
A	A	33	23.5	100.7	P	1/15/01	

The EUT was considered to **Pass** the Requirements.

Comments:

Comment #	Description

Test 4 - Test Equipment Used: Radiated Disturbance Emissions - Peak-to-Average Ratio

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
ATA022	52 ft Cable, N - N	UL	RG-223	1/2/01	1/31/02
ATA096	50 ft, N male - N male	Micro coax	Coaxial Cable	8/14/00	8/31/01
ATA108	10m, N male - N male	UL	RG214	10/27/00	10/31/01
HI0023	Humidity/Temperature/Pressure Indicator	Cole-Parmer	99760-00	10/5/00	10/31/01
SAR002	Spectrum Analyzer	Hewlett-Packard	8566B	7/21/00	7/31/01

The above equipment has been calibrated and is within the manufacturer's published limit of error. Calibration is traceable to the National Institute of Standards & Technology(NIST) and conforms to ANSI/NCSL Z540-1-1994.

Test 4, Item A - Discrete Data:

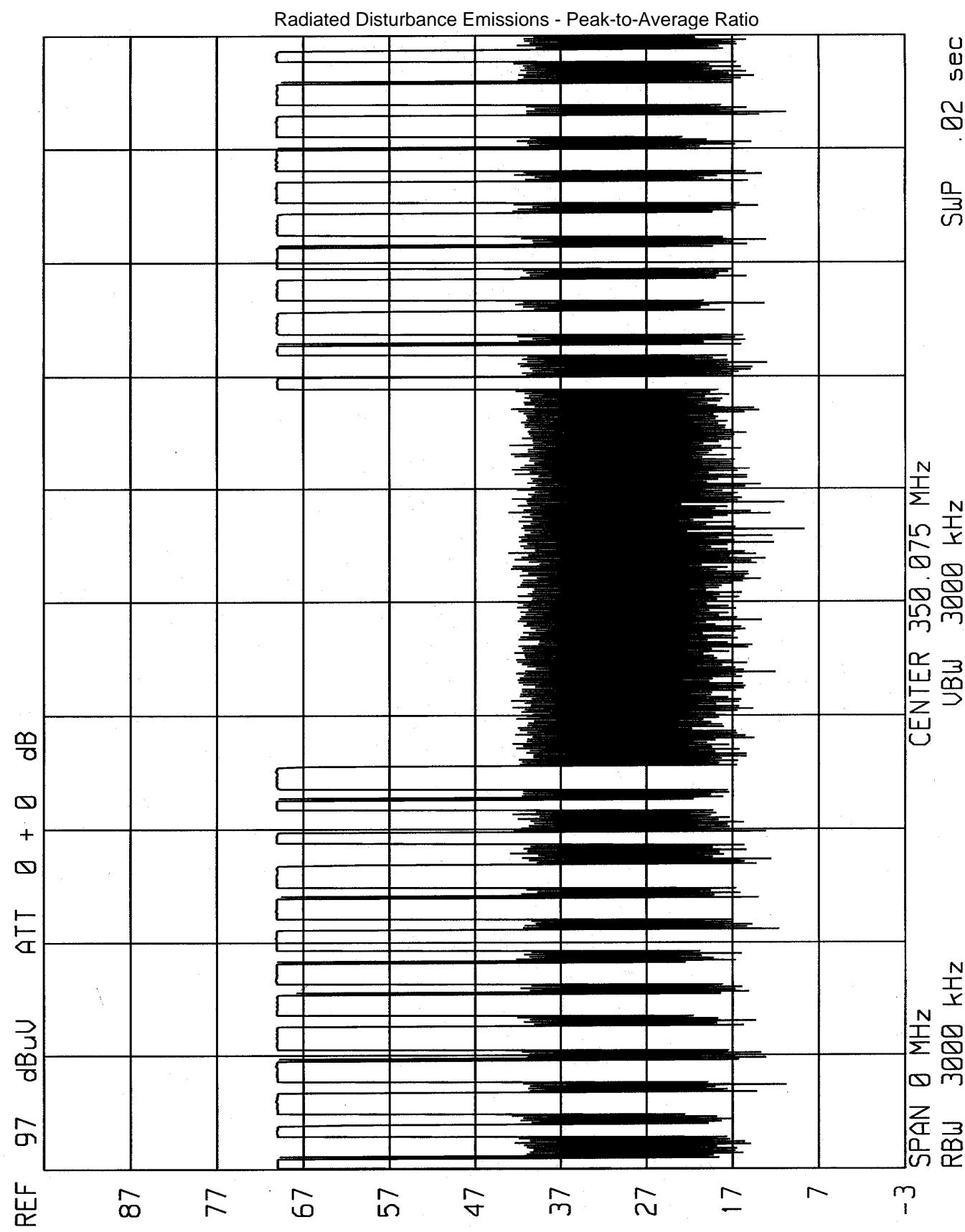
Radiated Disturbance Emissions - Peak-to-Average Ratio

Notes: * Or 100 milliseconds, whichever is less

** Peak-to-Average Ratio = $20 * \log (\text{Duty Cycle})$

*** # = See Comment Number Under The Preceeding Test Comments Section.

Test 4, Item A - Peak Plot (Amplitude in dBuV/m):



Test 5: Radiated Disturbance Emissions - Occupied Bandwidth

Test Requirement: 47 CFR Part 15, Subpart C

Test Specification: 47 CFR Part 15, Subpart C, Section 15.231

Test Procedure:

All testing was performed in UL's 10 meter semi-anechoic chamber. The chamber meets the FCC's site attenuation criteria for use as an alternative measurement site. The EUT was tested per ANSI C63.4:1992 test method placed on a non-conductive 1m x 1.5m table 80 cm above the ground plane. The receive antenna used was a log-periodic antenna mounted on an antenna mast. The turntable was rotated from 0° to 360° to determine the worst-case emissions angle for the transmit frequency. The antenna mast was raised and lowered between 1 and 4 meters above the ground plane to determine the worst-case height.

The spectrum analyzer Resolution Bandwidth and Video Bandwidth were set to 10 kHz for the measurement. A plot of the spectrum analyzer display screen is produced with marker points displaying the center frequency and the left and right side points that are 20 dB below the field strength at the center frequency.

Occupied Bandwidth Limit - Manually Operated Transmitter Section 15.231

Transmit Frequency MHz	Bandwidth Limit (% of fundamental)
70 to 900 MHz	.25%
Above 900 MHz	.50%

Test Deviations:

None

Test Setup: Only the following ports were tested. See EUT Information for details.

Test Item	Port #	Port Name	EUT Operation Mode	EUT Configuration	Power Interface
A	0	Enclosure	1	1	1

Test 5 - Results: Radiated Disturbance Emissions - Occupied Bandwidth

Test Results Summary:

Test Item	Test Location	Humidity (%)	Temperature (°C)	Pressure (kPa)	Pass/Fail (P/F)	Date Completed	Comment #
A	A	33	23.5	100.7	P	1/15/01	

The EUT was considered to **Pass** the Requirements.

Comments:

Comment #	Description

Test 5 - Test Equipment Used: Radiated Disturbance Emissions - Occupied Bandwidth

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
ATA022	52 ft Cable, N - N	UL	RG-223	1/2/01	1/31/02
ATA096	50 ft, N male - N male	Micro coax	Coaxial Cable	8/14/00	8/31/01
ATA108	10m, N male - N male	UL	RG214	10/27/00	10/31/01
HI0023	Humidity/Temperature/Pressure Indicator	Cole-Parmer	99760-00	10/5/00	10/31/01
SAR002	Spectrum Analyzer	Hewlett-Packard	8566B	7/21/00	7/31/01

The above equipment has been calibrated and is within the manufacturer's published limit of error. Calibration is traceable to the National Institute of Standards & Technology(NIST) and conforms to ANSI/NCSL Z540-1-1994.

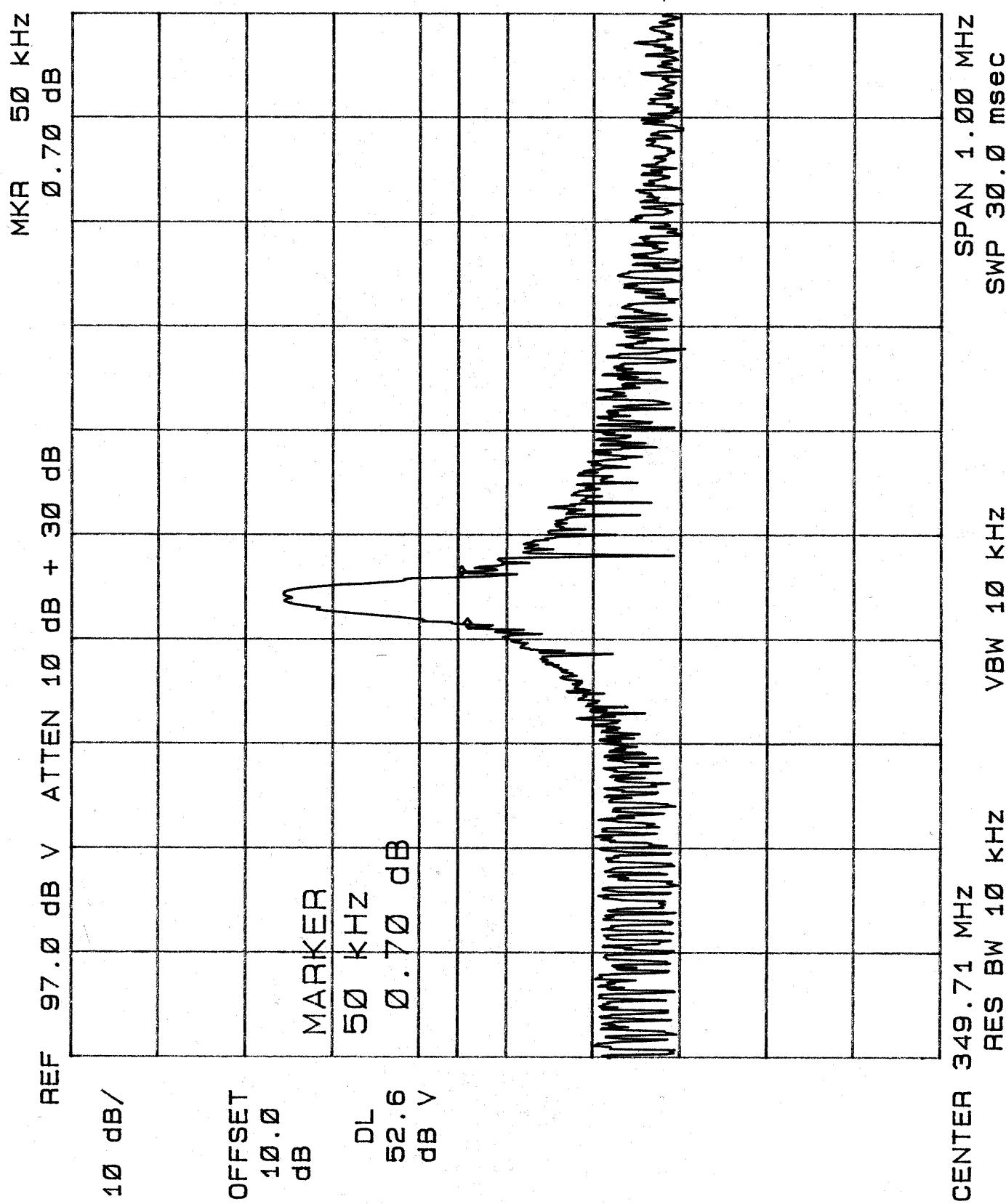
Test 5, Item A - Discrete Data:

Radiated Disturbance Emissions - Occupied Bandwidth

Notes: *** # = See Comment Number Under The Preceeding Test Comments Section.

Test 5, Item A - Peak Plot (Amplitude in dBuV/m):

Radiated Disturbance Emissions - Occupied Bandwidth



Test 6: Radiated Disturbance Emissions - Restricted Bands

Test Requirement: 47 CFR Part 15, Subpart C

Test Specification: 47 CFR Part 15, Subpart C, Section 15.205

Test Procedure:

The EUT is verified to produce only spurious emissions in the bands listed below. Where spurious emissions exist they must comply with the general limits from 47 CFR Part 15, Section 15.209.

Results from measurements are examined to ensure that no spurious emission in a restricted band (below) exceeds the general limits in Section 15.209. The restricted bands from Section 15.205 are:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	608 - 614	4.5 - 5.15
0.495 - 0.505	16.69475 - 16.69525	960 - 1240	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	1300 - 1427	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1435 - 1626.5	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1645.5 - 1646.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1660 - 1710	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1718.8 - 1722.2	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	2200 - 2300	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2310 - 2390	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2483.5 - 2500	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2655 - 2900	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	3260 - 3267	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3332 - 3339	23.6 - 24.0
12.29 - 12.293	127.72 - 167.17	3345.8 - 3358	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3600 - 4400	36.43 - 36.5
12.57675 - 12.57725	332-335.4		Above 38.6
13.36 - 13.41	399.9 - 410		

All spurious emissions, including harmonics falling within restricted bands were observed to meet the general limits of 15.209.

Test Deviations:

None

Test Setup: Only the following ports were tested. See EUT Information for details.

Test Item	Port #	Port Name	EUT Operation Mode	EUT Configuration	Power Interface
A	0	Enclosure	1	1	1

Test 6 - Results: Radiated Disturbance Emissions - Restricted Bands

Test Results Summary:

Test Item	Test Location	Humidity (%)	Temperature (°C)	Pressure (kPa)	Pass/Fail (P/F)	Date Completed	Comment #
A	A	40	23.0	101.0	P	1/11/01	1

The EUT was considered to **Pass** the Requirements.

Comments:

Comment #	Description
1	No emission was found to exceed the general limits of 15.209 in the restricted bands. See measurements of tests 1, 2, 3, and 5 for details.

Accreditation Certificates:



Industry Canada Industrie Canada

Certification and Engineering Bureau
1241 Clyde Avenue
Ottawa, Ontario
K2C 1Y3

Tel. No. (613) 952-3650
Fax. No. (613) 952-1088

December 11, 1997

Jodine E. Smyth
Underwriters Laboratory Inc.
333 Pfingsten Road
Northbrook, Illinois 60062-2096

Our File: 46390-2953
Submission: 20309 O

Dear Ms. Smyth,

The Bureau has received your test report for the Alternate Test Site located at Research Triangle Park, North Carolina, dated December 5, 1997. I have reviewed the report and find it complies with RSP 100, Issue 7, section 3.3 Description of Open Area Test Site.

The site is acceptable to Industry Canada for the performance of radiated measurements. Please reference the file number "IC 2953" in the body of all test reports containing measurements made on this site. This reference number is the indication of Industry Canada's acceptance of your site.

Whenever major construction or repairs to the site are completed, a re-submission of the site attenuation characteristics will be required.

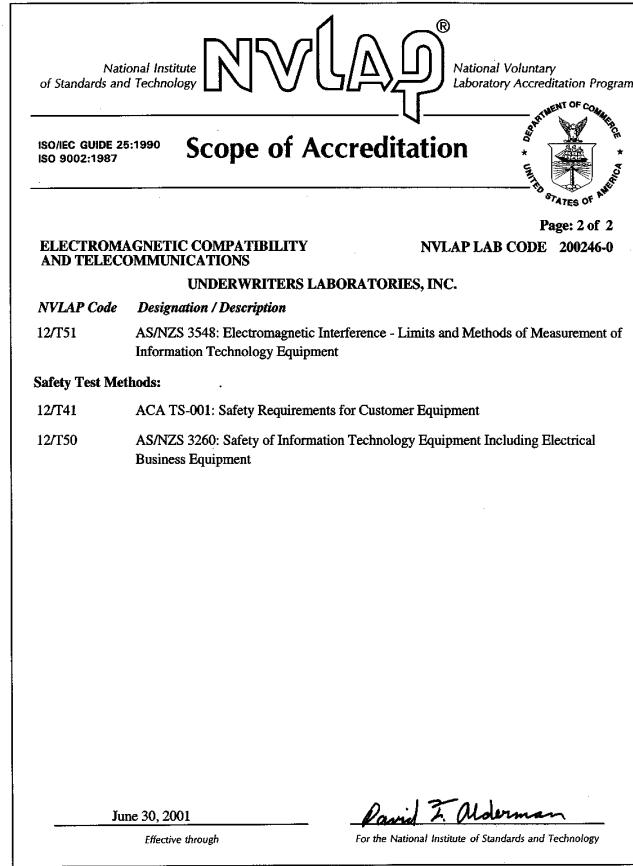
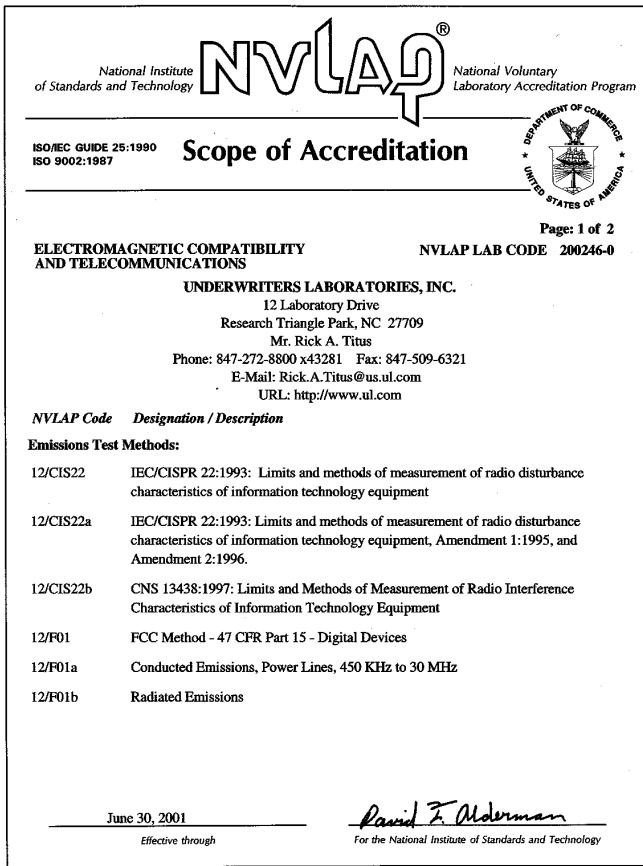
Yours sincerely,

Brian Kasper

Brian Kasper
Head, EMC and Standards
Certification and Engineering Bureau

Canada

Accreditation Certificates:



Measurement Uncertainty Statement

The limits and test levels have been set taking into account the measurement uncertainty contributions from the test equipment and facilities which meet the accuracy limits stated in the relevant basic standard. In the case of emissions tests, the measured value shall be compared directly with the limits. If the measured value is equal to or less than the limit the product sample is deemed to pass the test. (REF: prEN 50222:1997). The measured value does not need to be adjusted by the measurement uncertainty to determine compliance.

Example of Measurement of field strength between 30 dBuV/m and 60 dBuV/m over the frequency range 30 MHz to 200 MHz (biconical) In UL Anechoic Chamber @ 10m

Expanded Std Uncertainty 3.71 dB

Example of Measurement of field strength between 30 dBuV/m and 60 dBuV/m over the frequency range 200 MHz to 1000 MHz (log) In UL Anechoic Chamber @ 10m

Expanded Std Uncertainty 3.19 dB

Example of Measurement of conducted voltage, signal strength between 30 dBuV/m and 50 dBuV/m over the frequency range 150 kHz to 30 MHz

Expanded Std Uncertainty 2.16 dB