Project:	**99RT13567**
File:	**MC1180**
Report:	**000153**
Date:	**March 05, 2000**
Model:	**W-52 Casablanca Fan Controller Transmitter**

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**
	- FAX
Test Report Number:	**000153**
Test Report Date:	**March 05, 2000**
Product Type:	**Low-Powered Transmitter**
Model Number:	**W-52**
Sample Serial Number:	**Unserialized sample**
Sample Tag Number:	**S99LB546B**
EUT Category:	**Special**
EUT Type:	**Hand-held**
Sample Receive Date:	**February 08, 2000**
Testing Start Date:	**February 08, 2000**
Date Testing Complete:	**March 05, 2000**

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Summary of Testing:

Test #	Test Name Test Requirement/Specification	Comply	Does Not Comply	See Remark
1	Radiated Disturbance Emissions - Occupied Bandwidth 47 CFR Part 15, Subpart C / 47 CFR Part 15, Subpart C Section 15.231	X	-	1
2	Radiated Disturbance Emissions - Peak-to-Average Ratio 47 CFR Part 15, Subpart C / 47 CFR Part 15, Subpart C Section 15.231	N/A	N/A	
3	Radiated Disturbance Emissions - 9 kHz to 30 MHz 47 CFR Part 15, Subpart C / 47 CFR Part 15, Subpart C Section 15.209	X	-	1
4	Radiated Disturbance Emissions - 30 to 1000 MHz Electric Field 47 CFR Part 15, Subpart C / 47 CFR Part 15, Subpart C Section 15.231	X	-	1
5	Radiated Disturbance Emissions - 1 to 3.5 GHz Electric Field 47 CFR Part 15, Subpart C / 47 CFR Part 15, Subpart C Section 15.231	X	-	1

Remarks:

1) The EUT was found to **comply** with FCC Part 15 Section 15.231 rules for manually operated transmitters. Results can also be considered applicable to Canadian RSS-210 Issue 2, Rev.1 Section 6.1.

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.

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-Powered Transmitter	Hunter Fan	W-52	

* Use = EUT - Equipment Under 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 Notes:

The EUT was observed to cease transmission immediately upon release of any of the control buttons on the front panel and thus meets the requirement in Section 15.231(1)(a).

EUT Internal Operating Frequencies:

Frequency (MHz)*	Description
350	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	1	
1	12	-	-	DC	1	A fresh battery was installed prior to test

EUT Operation Modes:

Mode #	Description
1	EUT with “Fan Off” button continuously depressed with tape.

EUT Configuration Modes:

Mode #	Description
1	EUT alone on table.

Test 1: 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	Bandwith Limit (% of fundamental)
40.66 to 40.70	.25%
Above 70	.50%

Test Deviations:

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 1 - Results: Radiated Disturbance Emissions - Occupied Bandwidth

Test Results Summary:

Test Item	Test Location	Humidity (%)	Temperature (ºC)	Pressure (kPa)	Pass/Fail (P/F)	Date Completed	Comment #
A	A	40	22.5	100.0	P	3/2/00	

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

Comments:

Comment #	Description

Test 1 - Test Equipment Used: Radiated Disturbance Emissions - Occupied Bandwidth

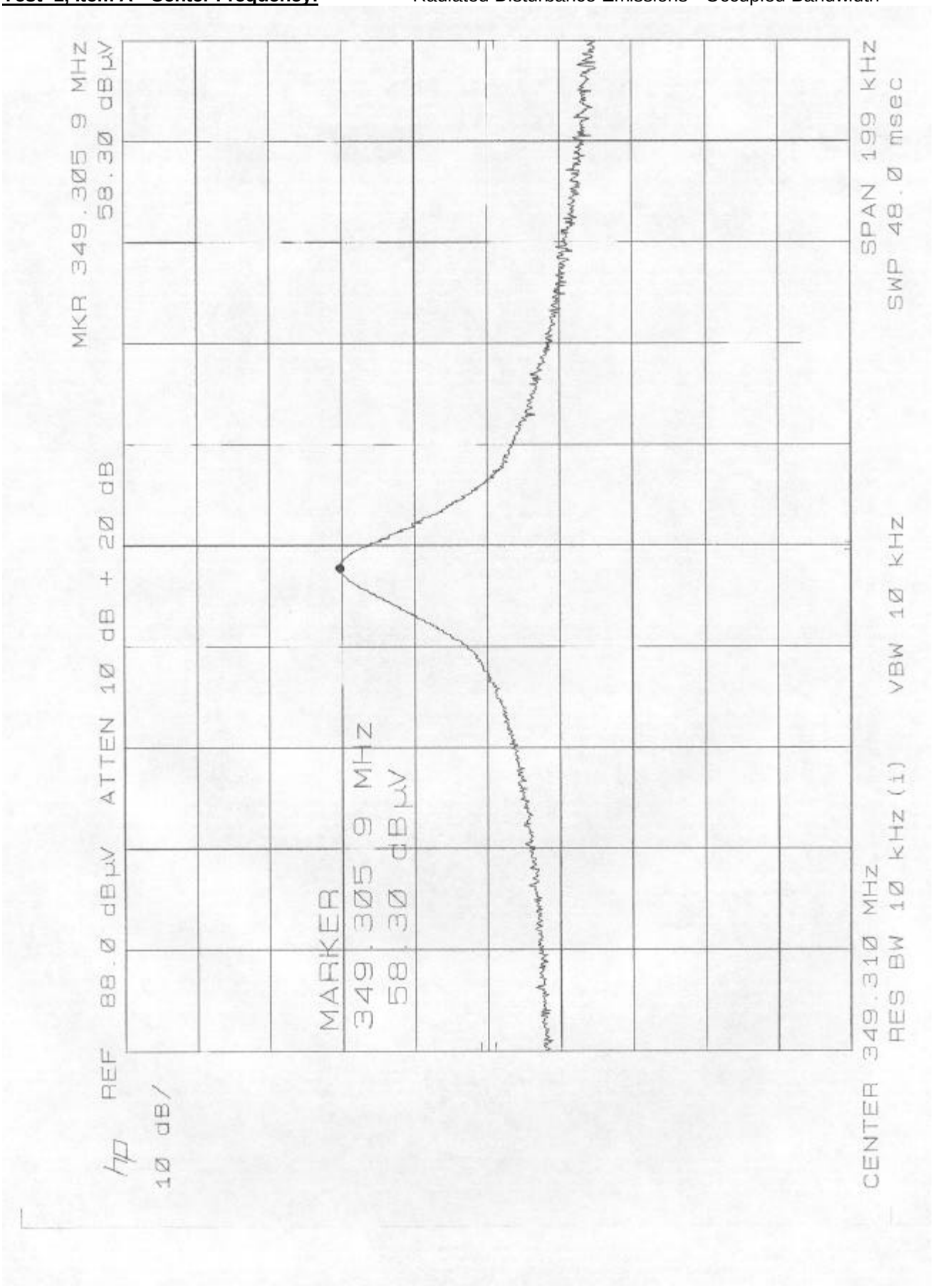
Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
AT0022	Log Periodic Antenna, 200 to 1000 MHz	Chase	UPA6109	4/2/99	4/30/00
ATA034	52ft Cable, N - N	UL	HELIAX	8/28/99	8/31/00
ATA038	33ft Cable, N - N	EMC Technologist	RG-214	7/30/99	7/31/00
HI0034	Temp/Humid. Indicator	Cole - Palmer	99760-00	12/20/99	12/31/00
SAR001	EMI Receiver	Hewlett Packard	8572A	12/14/99	12/31/00

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.

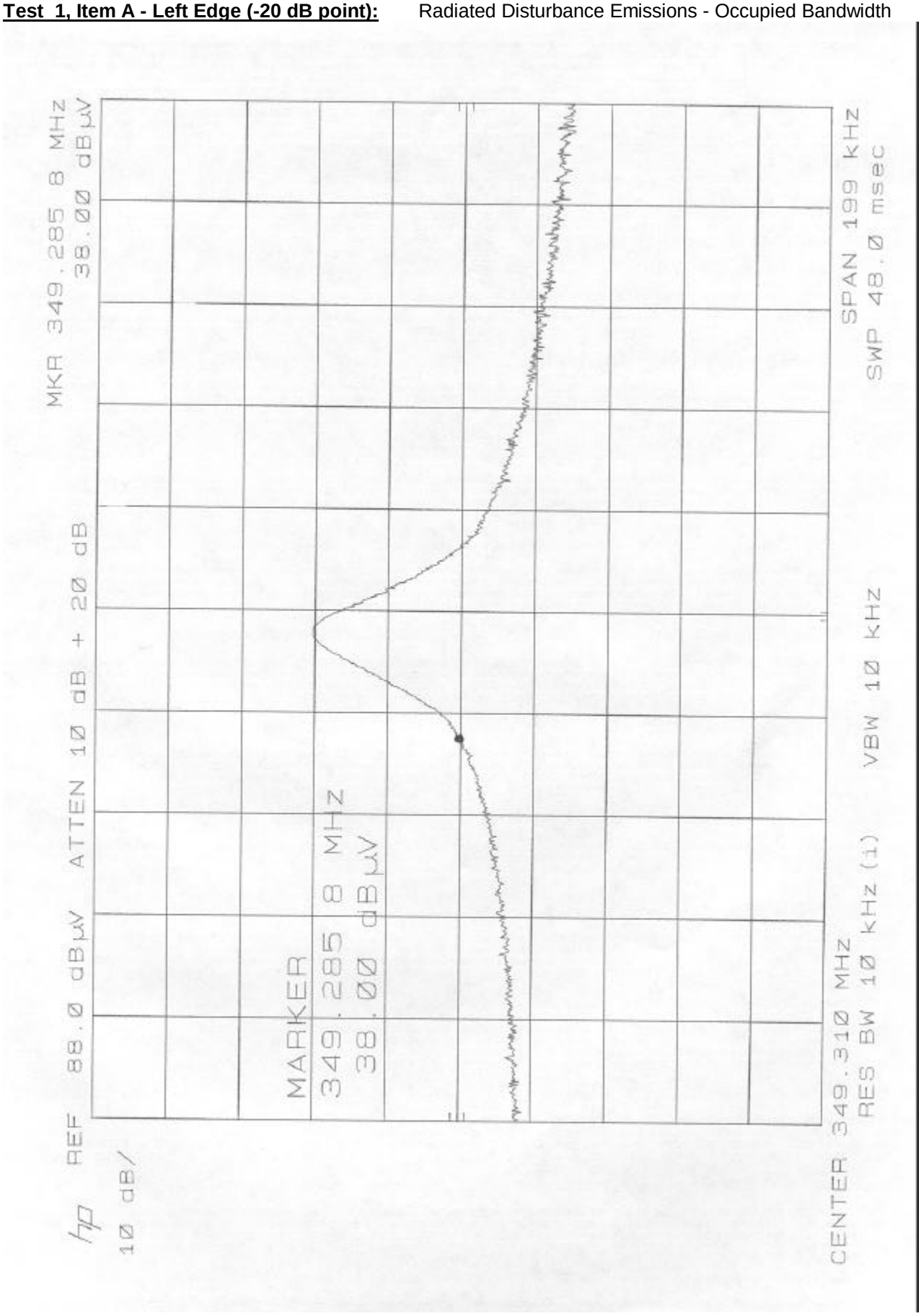
Test 1, Item A - Discrete Data: Radiated Disturbance Emissions - Occupied Bandwidth

Center Frequency (MHz)	Left Band Edge (MHz)	Right Band Edge (MHz)	Bandwidth (MHz)	Bandwidth (%)	Bandwidth Limit (%)
349.305	349.285	349.323	.038	.011%	.5%

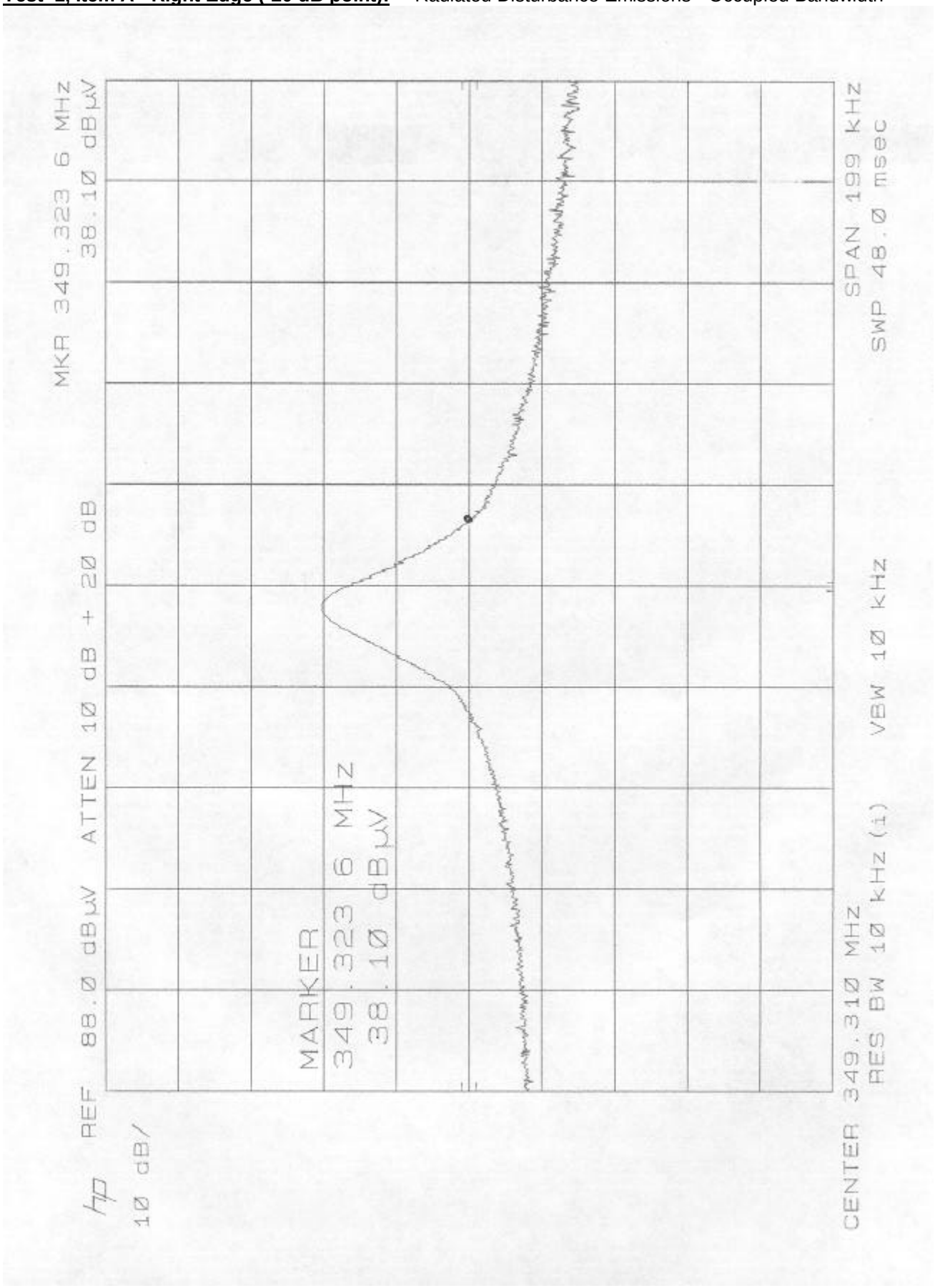
Test 1, Item A - Center Frequency: Radiated Disturbance Emissions - Occupied Bandwidth



Test 1, Item A - Left Edge (-20 dB point): Radiated Disturbance Emissions - Occupied Bandwidth



Test 1, Item A - Right Edge (-20 dB point): Radiated Disturbance Emissions - Occupied Bandwidth



Test 1, Item A - Test Set-Up Photo: Radiated Disturbance Emissions - Occupied Bandwidth

Test 2: 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 2 - Results: Radiated Disturbance Emissions - Peak-to-Average Ratio

Test Results Summary:

Test Item	Test Location	Humidity (%)	Temperature (ºC)	Pressure (kPa)	Pass/Fail (P/F)	Date Completed	Comment #
A	A	40	22.5	100.0	N/A	3/2/00	

No Pass/Fail criteria for this test. Peak-to-Average Ratio is used to calculate average values in subsequent tests.

Comments:

Comment #	Description

Test 2 - Test Equipment Used: Radiated Disturbance Emissions - Peak-to-Average Ratio

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
AT0022	Log Periodic Antenna, 200 to 1000 MHz	Chase	UPA6109	4/2/99	4/30/00
ATA034	52ft Cable, N - N	UL	HELIAX	8/28/99	8/31/00
ATA038	33ft Cable, N - N	EMC Technologist	RG-214	7/30/99	7/31/00
HI0034	Temp/Humid. Indicator	Cole - Palmer	99760-00	12/20/99	12/31/00
SAR001	EMI Receiver	Hewlett Packard	8572A	12/14/99	12/31/00

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 - Calculation: Radiated Disturbance Emissions - Peak-to-Average Ratio

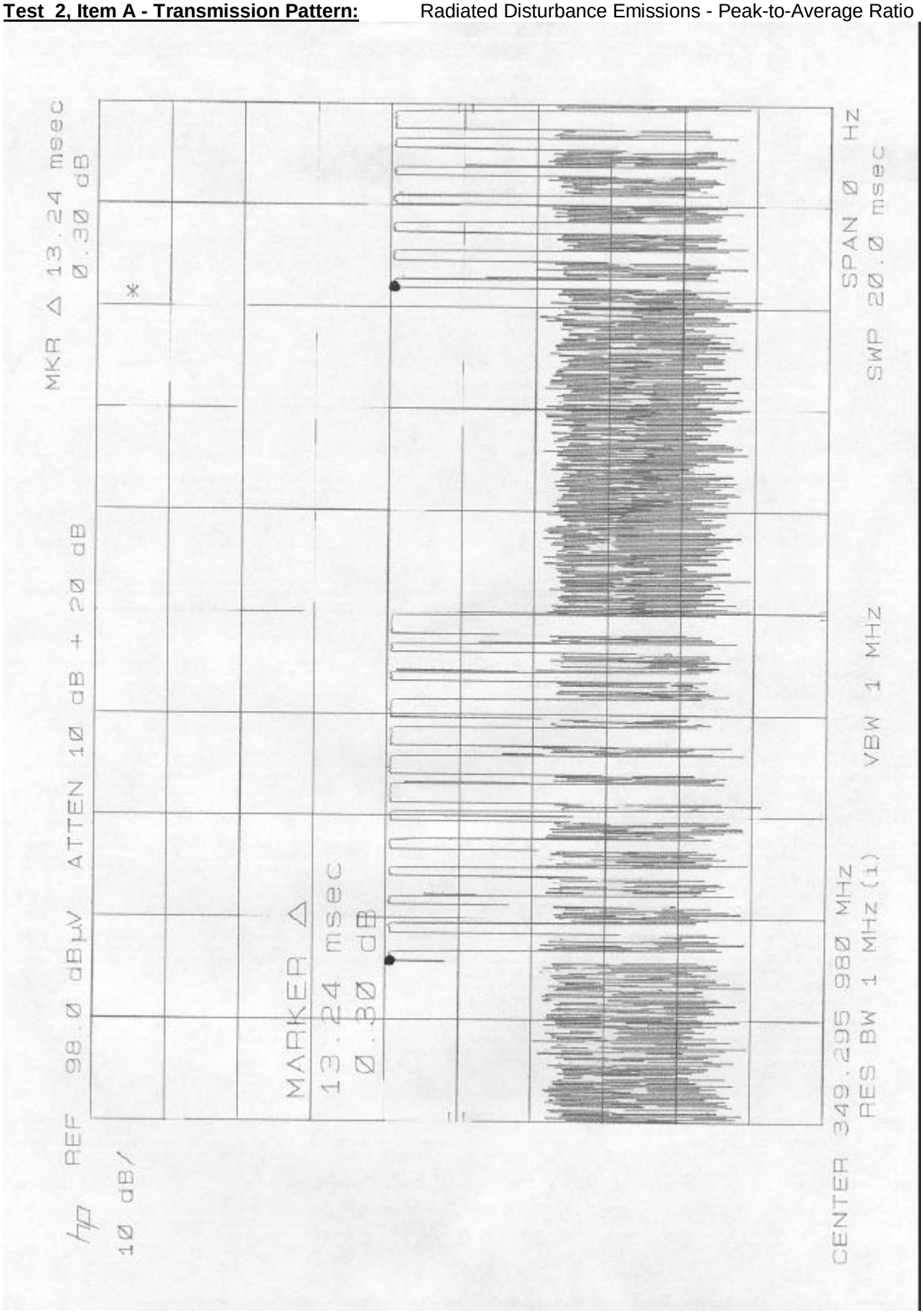
The total period of the transmission from beginning of one burst to the beginning of the next burst was measured to be 13.24 ms. The pulse train produced by each of the buttons was observed. The transmission produced by the "Fan Off" button was found to have the greatest on time per burst.

Fan Off Button
8 short pulses per burst * 0.220 ms per pulse = 1.760 ms
5 long pulses per burst * 0.380 ms per pulse = 1.900 ms

Total on time per burst = 3.66 ms

Duty cycle = 3.66 ms / 13.24 ms = **27.6% or 11.1 dB**

Test 2, Item A - Transmission Pattern: Radiated Disturbance Emissions - Peak-to-Average Ratio



Test 3: 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 in an attempt to identify any emission produced by the EUT. All data recorded was a result of the measurement noise floor and no emission produced by the EUT was found in this frequency range.

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 impedence 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:

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 3 - Results: Radiated Disturbance Emissions - 9 kHz to 30 MHz

Test Results Summary:

Test Item	Test Location	Humidity (%)	Temperature (ºC)	Pressure (kPa)	Pass/Fail (P/F)	Date Completed	Comment #
A	A	40	22.5	100.0	P	3/2/00	

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

Comments:

Comment #	Description

Test 3 - 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	10/13/99	10/31/00
AT0006	Loop Antenna, 10 kHz to 30 MHz	Electro-Metrics	EM-6879	10/27/99	10/31/00
ATA034	52ft Cable, N - N	UL	HELIAX	8/28/99	8/31/00
ATA038	33ft Cable, N - N	EMC Technologist	RG-214	7/30/99	7/31/00
ATA048	25dB Amp, 0.1 to 1300 MHz	Hewlett-Packard	8447D/10	4/30/99	4/30/00
HI0034	Temp/Humid. Indicator	Cole - Palmer	99760-00	12/20/99	12/31/00
SAR001	EMI Receiver	Hewlett Packard	8572A	12/14/99	12/31/00

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 - Discrete Data: Radiated Disturbance Emissions - 9 kHz to 30 MHz

Test Item	Detector Type* (P/Q/A)	Antenna Polarity (H/V)	Measured Frequency (MHz)	Measured Value (dBµV)	Equipment Correction (dB/m)	Distance/ Magnetic-Electric Correction (dB)	Corrected Value (dBµV/m)	Specified Limit** (dBµV/m)	Spec Margin (dB)	See Comment #
A	P	X	0.0194	10.2	5.8	-28.5	-12.5	41.8	-54.3	Noise Floor
A	P	X	0.0242	11.8	5.3	-28.5	-11.4	39.9	-51.3	Noise Floor
A	P	X	0.0298	12.7	4.9	-28.5	-10.9	38.1	-49.0	Noise Floor
A	P	X	0.0388	12.2	5.3	-28.5	-11.0	35.8	-46.8	Noise Floor
A	P	X	0.0479	12.3	5.1	-28.5	-11.1	34.0	-45.1	Noise Floor
A	P	X	0.0564	9.2	5.4	-28.5	-13.9	32.6	-46.5	Noise Floor
A	P	Y	0.0091	13.6	10.3	-28.5	-4.6	48.4	-53.0	Noise Floor
A	P	Y	0.0159	13.5	6.9	-28.5	-8.1	43.6	-51.7	Noise Floor
A	P	Y	0.0381	15.4	5.2	-28.5	-7.9	36.0	-43.9	Noise Floor
A	P	Y	0.0450	16.4	5.1	-28.5	-7.0	34.5	-41.5	Noise Floor
A	P	Y	0.1033	10.8	6.2	-28.5	-11.5	27.3	-38.8	Noise Floor
A	P	Y	0.1454	9.5	6.7	-28.5	-12.3	24.4	-36.7	Noise Floor
A	P	Z	0.0091	14.0	10.4	-28.5	-4.1	48.4	-52.5	Noise Floor
A	P	Z	0.0159	14.0	6.9	-28.5	-7.6	43.6	-51.2	Noise Floor
A	P	Z	0.0218	14.1	5.5	-28.5	-8.9	40.8	-49.7	Noise Floor
A	P	Z	0.0490	17.1	5.0	-28.5	-6.4	33.8	-40.2	Noise Floor
A	P	Z	0.0746	11.9	5.9	-28.5	-10.7	30.1	-40.8	Noise Floor
A	P	Z	0.1119	10.0	6.3	-28.5	-12.2	26.6	-38.8	Noise Floor
A	P	X	0.2066	15.4	-18.2	-28.5	-31.3	21.3	-52.6	Noise Floor
A	P	X	0.2494	15.3	-18.3	-28.5	-31.5	19.7	-51.2	Noise Floor
A	P	X	0.3890	15.2	-18.5	-28.5	-31.8	15.8	-47.6	Noise Floor
A	P	X	0.5174	15.5	-18.7	11.5	8.3	33.3	-25.0	Noise Floor
A	P	X	0.6513	15.3	-18.7	11.5	8.1	31.3	-23.2	Noise Floor
A	P	X	0.9131	15.4	-18.8	11.5	8.1	28.4	-20.3	Noise Floor
A	P	Y	0.2429	15.8	-18.3	-28.5	-31.0	19.9	-50.9	Noise Floor
A	P	Y	0.2631	15.5	-18.5	-28.5	-31.5	19.2	-50.7	Noise Floor
A	P	Y	0.3435	15.2	-18.6	-28.5	-31.9	16.9	-48.8	Noise Floor

* 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.

Sample Calculation: Corrected Value = Measured Value + Equipment Correction + Distance/Magnetic-Electric Correction

- Equipment Correction = Antenna Factor (dB/m) + Cable Loss (dB) - Amplifier Gain (dB ,if used)
- Distance Correction/Magnetic-Electric Correction = Distance Correction (40 dB/decade) + Magnetic-to-Electric Field Conversion (377 Ω, 51.5 dB)

Test 3, Item A - Discrete Data: Radiated Disturbance Emissions - 9 kHz to 30 MHz

Test Item	Detector Type* (P/Q/A)	Antenna Polarity (H/V)	Measured Frequency (MHz)	Measured Value (dBµV)	Equipment Correction (dB/m)	Distance/ Magnetic-Electric Correction (dB)	Corrected Value (dBµV/m)	Specified Limit** (dBµV/m)	Spec Margin (dB)	See Comment #
A	P	Y	0.5507	15.5	-18.7	11.5	8.3	32.8	-24.5	Noise Floor
A	P	Y	0.7123	14.9	-18.8	11.5	7.6	30.6	-23.0	Noise Floor
A	P	Y	0.8763	16.1	-18.8	11.5	8.8	28.8	-20.0	Noise Floor
A	P	Z	0.2378	15.6	-18.3	-28.5	-31.2	20.1	-51.3	Noise Floor
A	P	Z	0.3753	15.3	-18.5	-28.5	-31.7	16.1	-47.8	Noise Floor
A	P	Z	0.5966	15.3	-18.7	11.5	8.1	32.1	-24.0	Noise Floor
A	P	Z	0.6891	15.2	-18.8	11.5	7.9	30.8	-22.9	Noise Floor
A	P	Z	0.8679	15.4	-18.8	11.5	8.1	28.8	-20.7	Noise Floor
A	P	Z	0.9931	15.5	-18.6	11.5	8.4	27.7	-19.3	Noise Floor
A	P	X	1.8104	4.5	-12.3	11.5	3.7	30.0	-26.3	Noise Floor
A	P	X	3.0764	5.0	-13.2	11.5	3.3	30.0	-26.7	Noise Floor
A	P	X	11.7103	6.1	-14.5	11.5	3.1	30.0	-26.9	Noise Floor
A	P	X	12.6536	5.6	-14.7	11.5	2.4	30.0	-27.6	Noise Floor
A	P	X	25.0006	4.6	-11.8	11.5	4.3	30.0	-25.7	Noise Floor
A	P	X	27.8474	4.9	-11.5	11.5	4.9	30.0	-25.1	Noise Floor
A	P	Y	1.3147	5.1	-11.2	11.5	5.4	25.2	-19.8	Noise Floor
A	P	Y	4.8380	4.8	-13.6	11.5	2.7	30.0	-27.3	Noise Floor
A	P	Y	8.7049	4.5	-13.9	11.5	2.1	30.0	-27.9	Noise Floor
A	P	Y	11.7542	5.0	-14.5	11.5	2.0	30.0	-28.0	Noise Floor
A	P	Y	25.9656	5.3	-11.7	11.5	5.1	30.0	-24.9	Noise Floor
A	P	Y	27.8957	5.0	-11.5	11.5	5.0	30.0	-25.0	Noise Floor
A	P	Z	1.5941	5.3	-11.8	11.5	5.0	30.0	-18.6	Noise Floor
A	P	Z	2.9373	4.7	-13.2	11.5	3.0	30.0	-27.0	Noise Floor
A	P	Z	5.8311	4.9	-13.6	11.5	2.8	30.0	-27.2	Noise Floor
A	P	Z	10.7231	5.2	-14.4	11.5	2.3	30.0	-27.7	Noise Floor
A	P	Z	25.0006	4.8	-11.8	11.5	4.5	23.6	-25.5	Noise Floor
A	P	Z	29.1502	5.1	-11.5	11.5	5.1	30.0	-24.9	Noise Floor

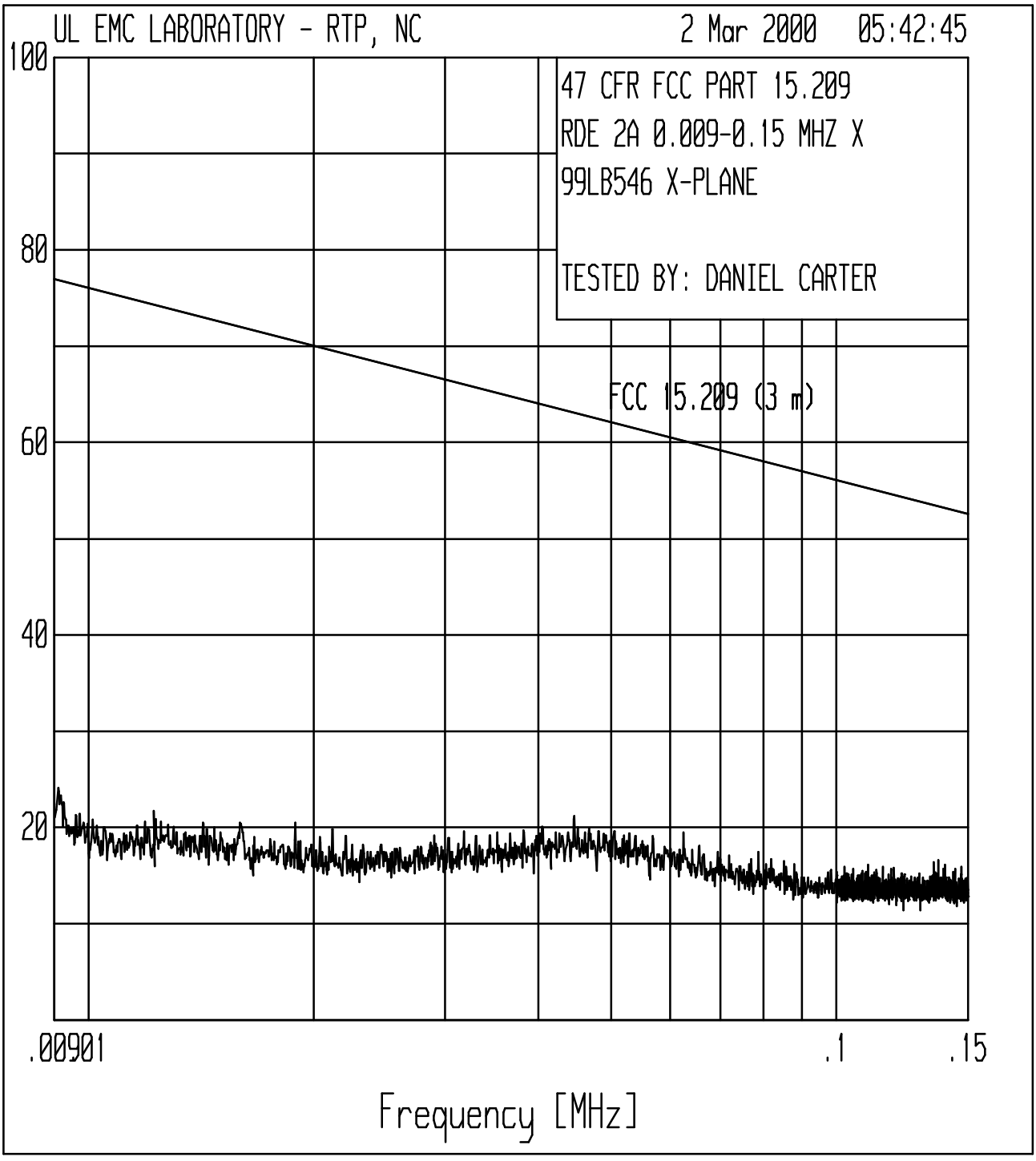
* P = Peak, Q = Quasi-Peak, A = Average.

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

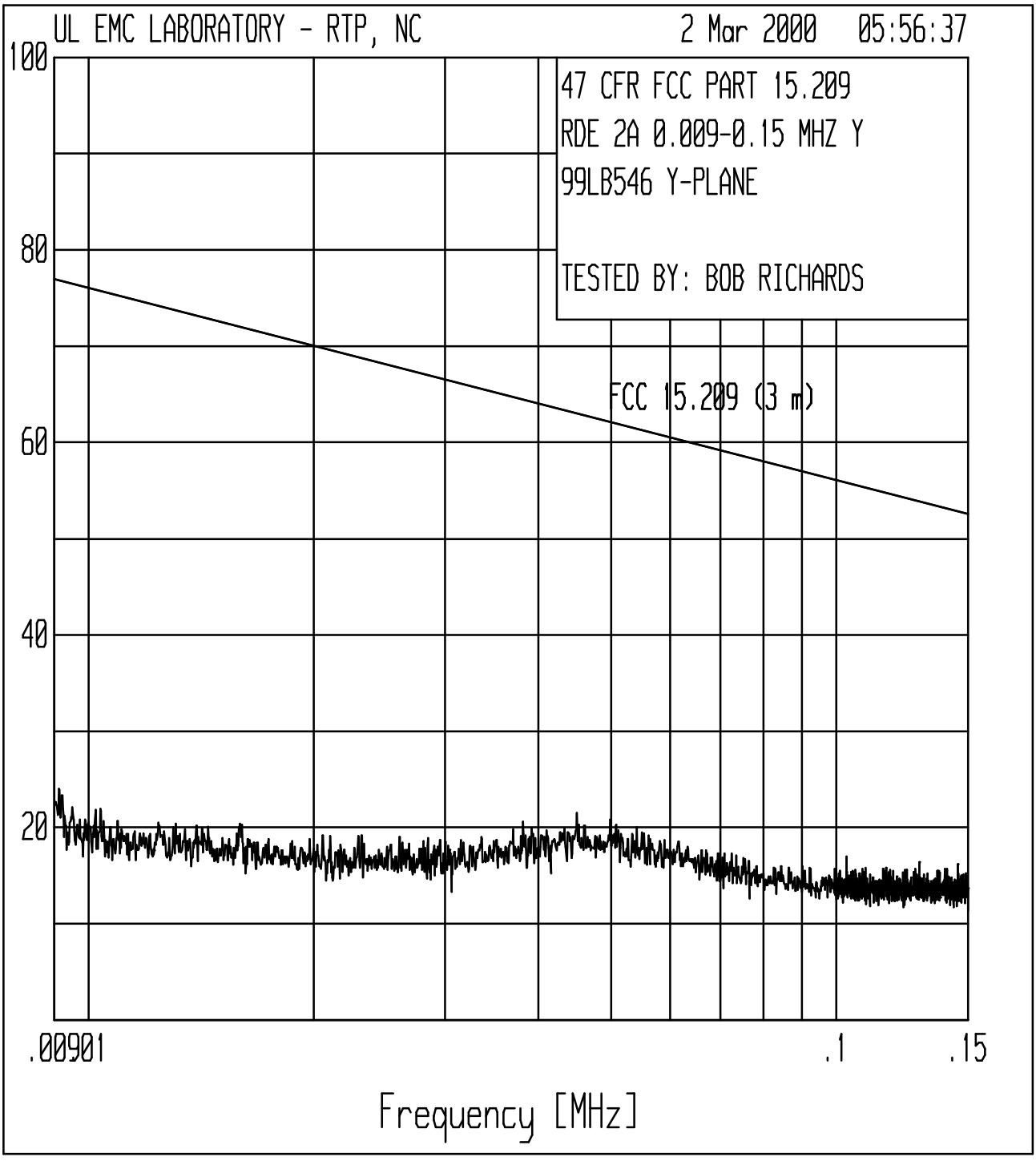
Sample Calculation: Corrected Value = Measured Value + Equipment Correction + Distance/Magnetic-Electric Correction

- Equipment Correction = Antenna Factor (dB/m) + Cable Loss (dB) - Amplifier Gain (dB ,if used)
- Distance Correction/Magnetic-Electric Correction = Distance Correction (40 dB/decade) + Magnetic-to-Electric Field Conversion (377 Ω, 51.5 dB)

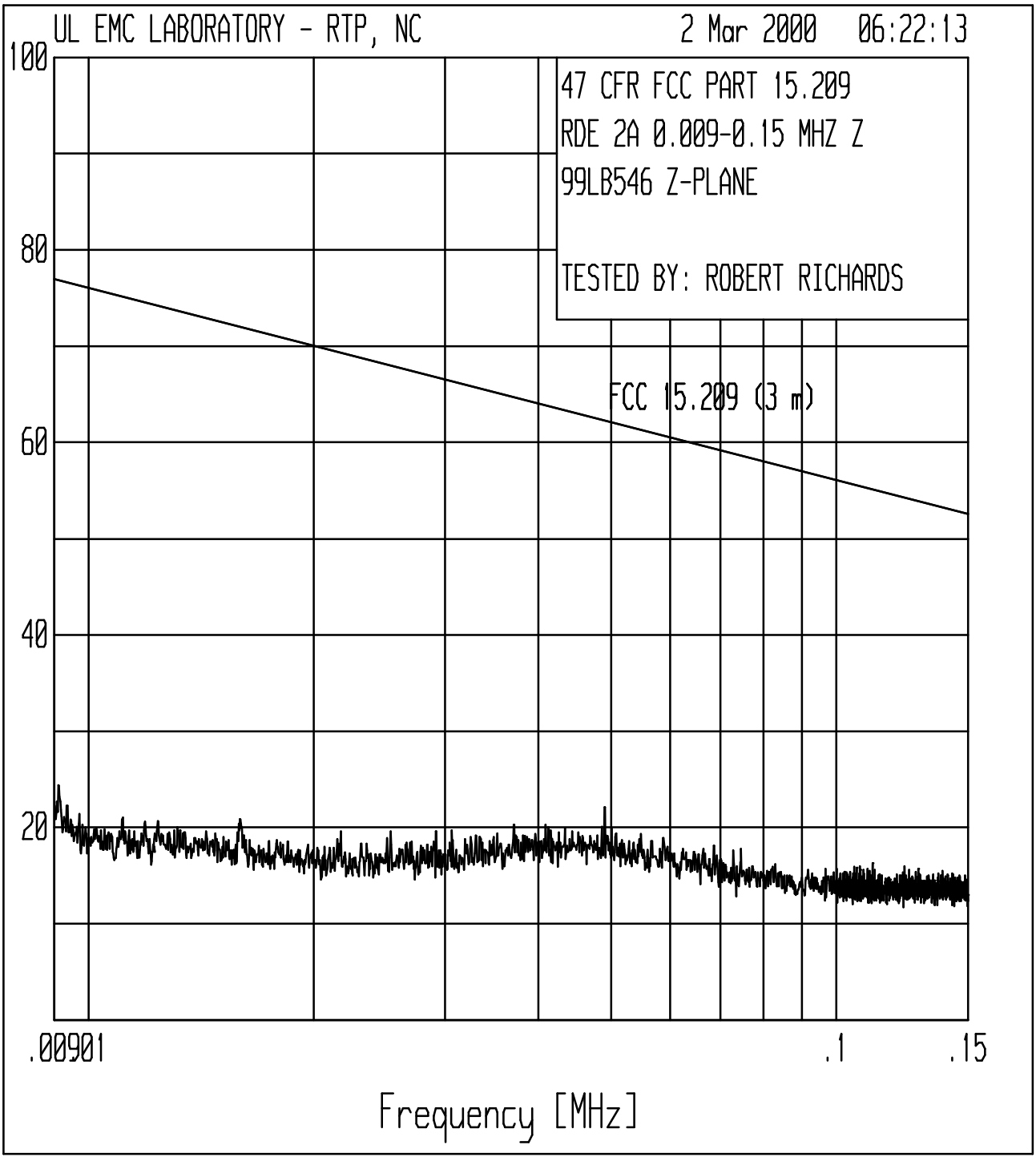
Test 3, Item A - Peak Plot: Radiated Disturbance Emissions - 9 kHz to 30 MHz



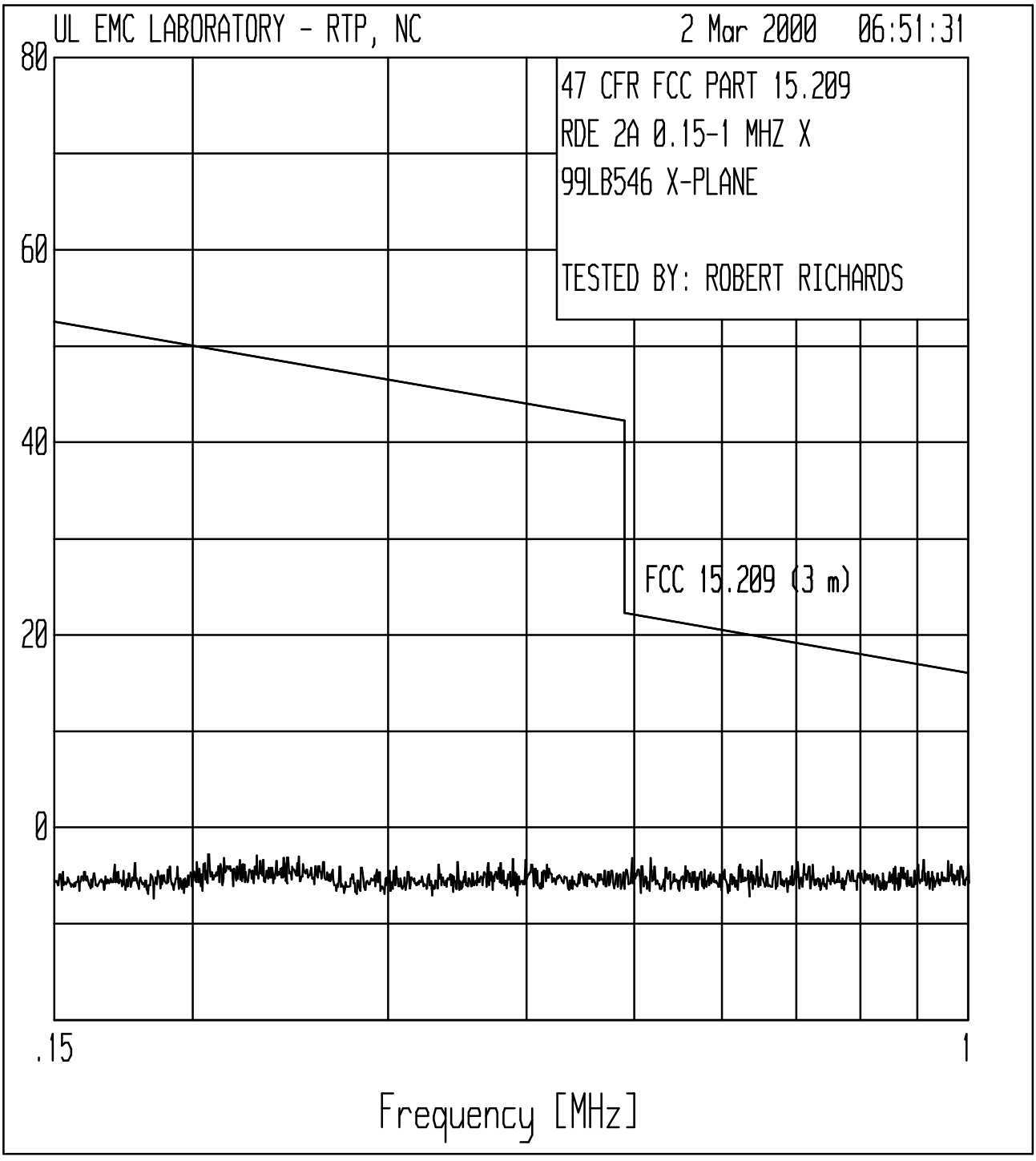
Test 3, Item A - Peak Plot: Radiated Disturbance Emissions - 9 kHz to 30 MHz



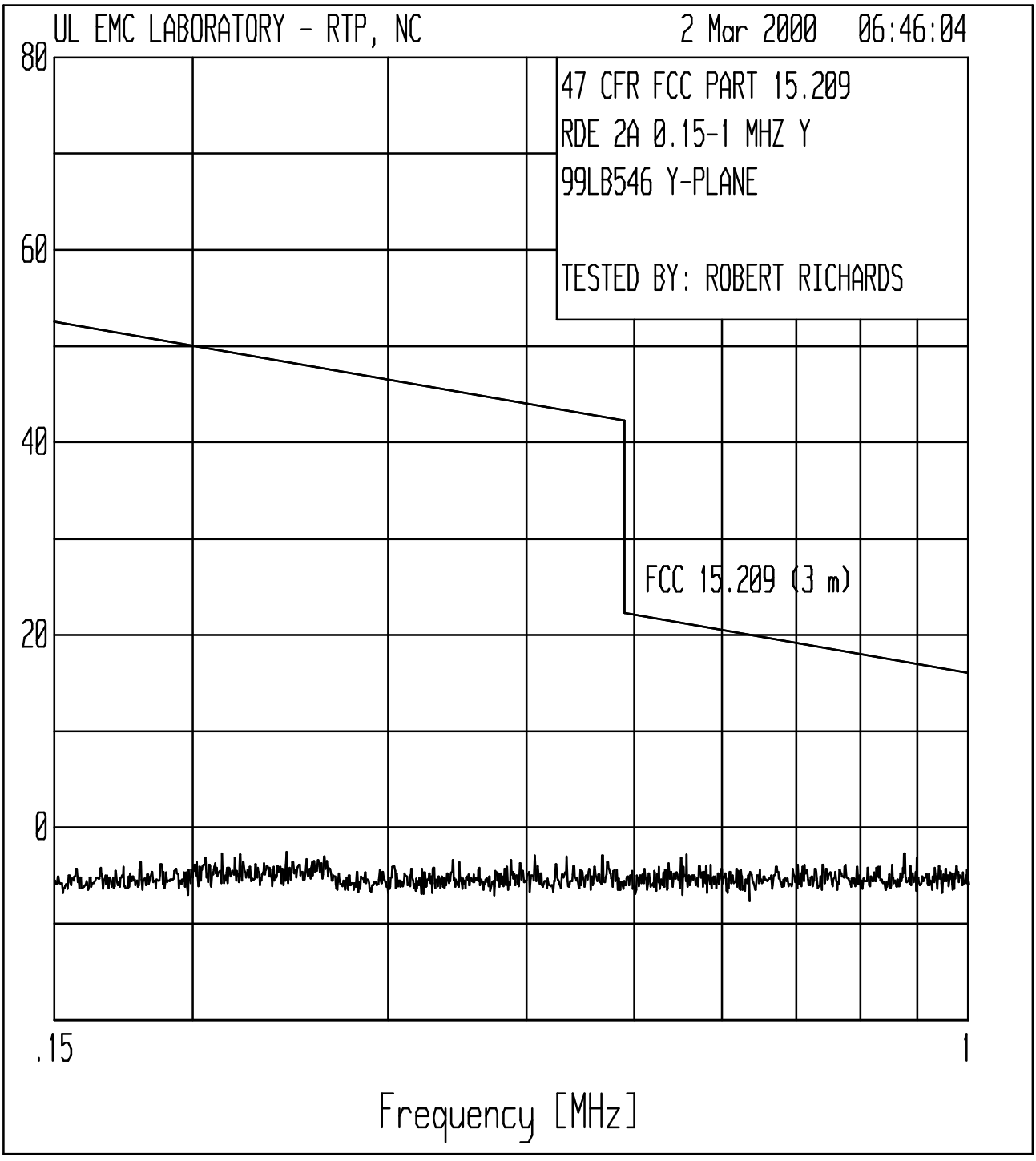
Test 3, Item A - Peak Plot: Radiated Disturbance Emissions - 9 kHz to 30 MHz



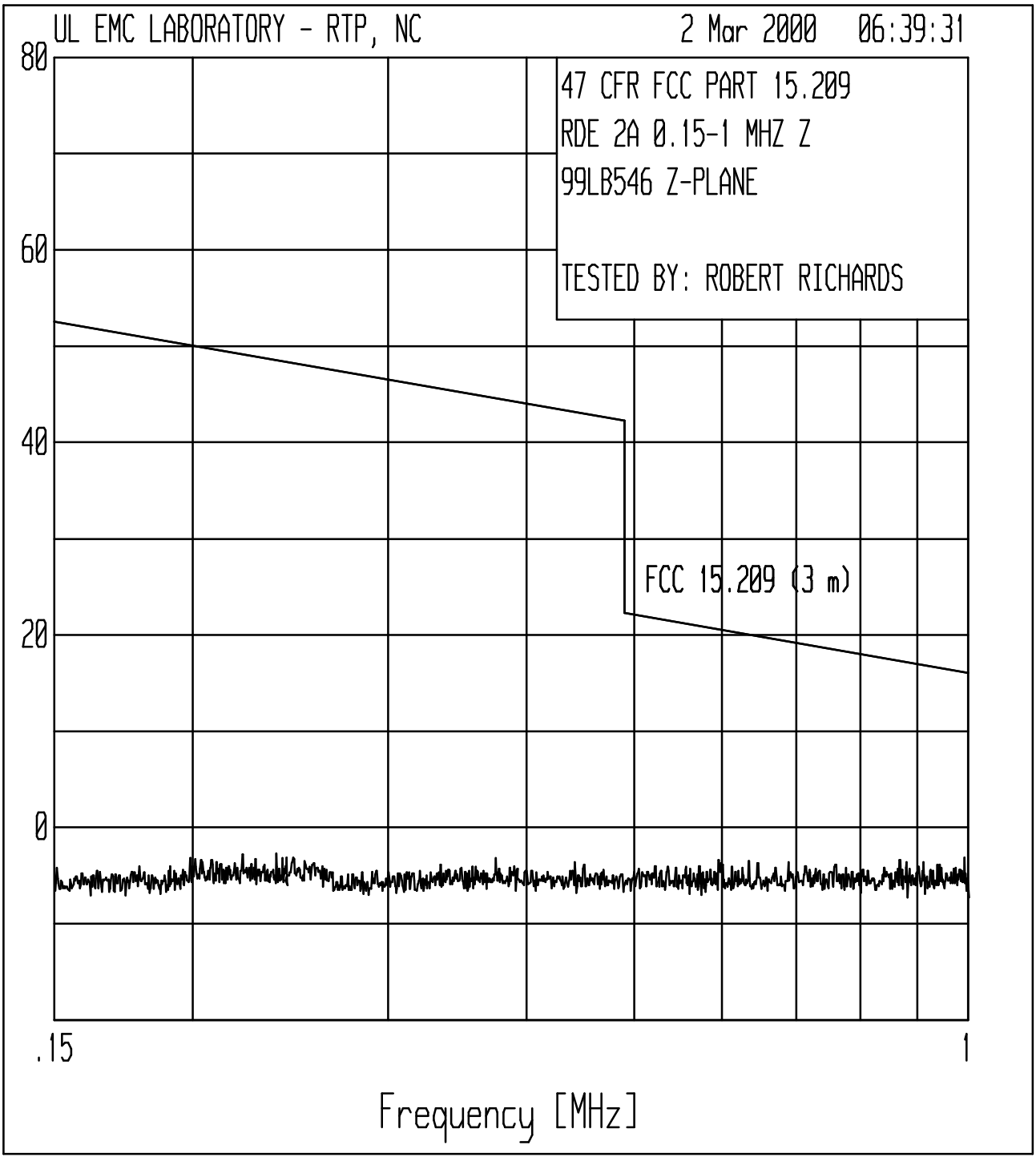
Test 3, Item A - Peak Plot: Radiated Disturbance Emissions - 9 kHz to 30 MHz



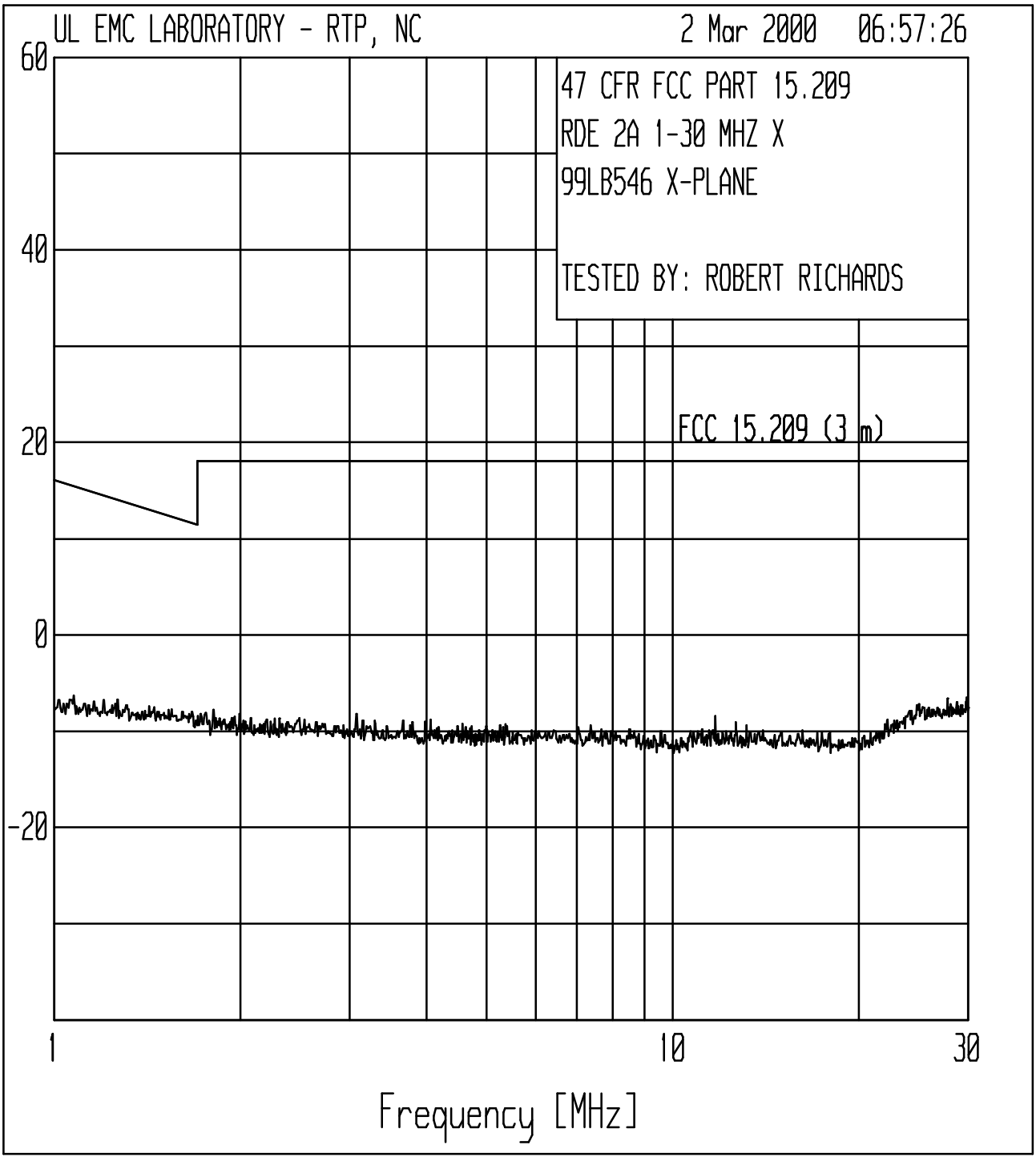
Test 3, Item A - Peak Plot: Radiated Disturbance Emissions - 9 kHz to 30 MHz



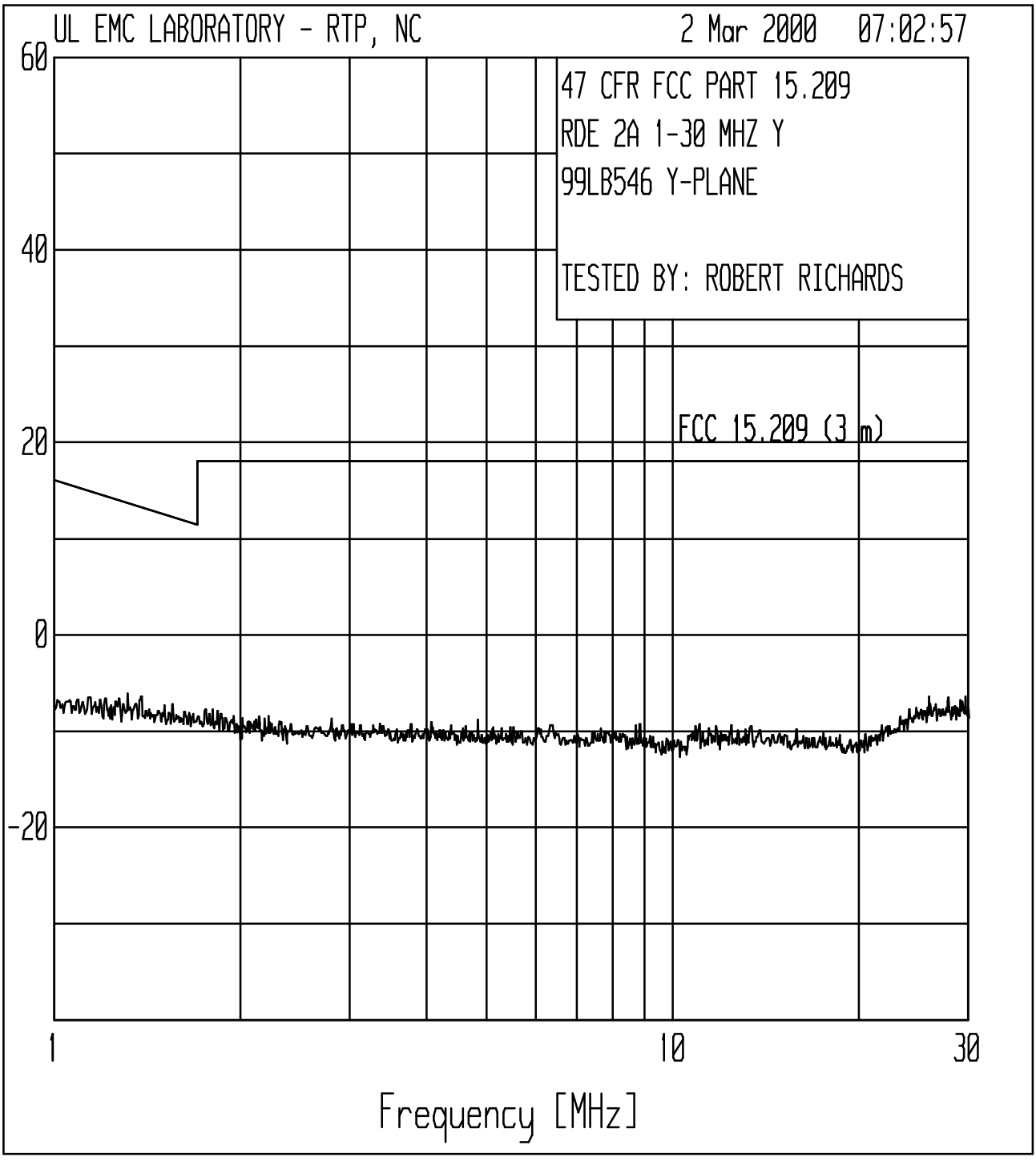
Test 3, Item A - Peak Plot: Radiated Disturbance Emissions - 9 kHz to 30 MHz



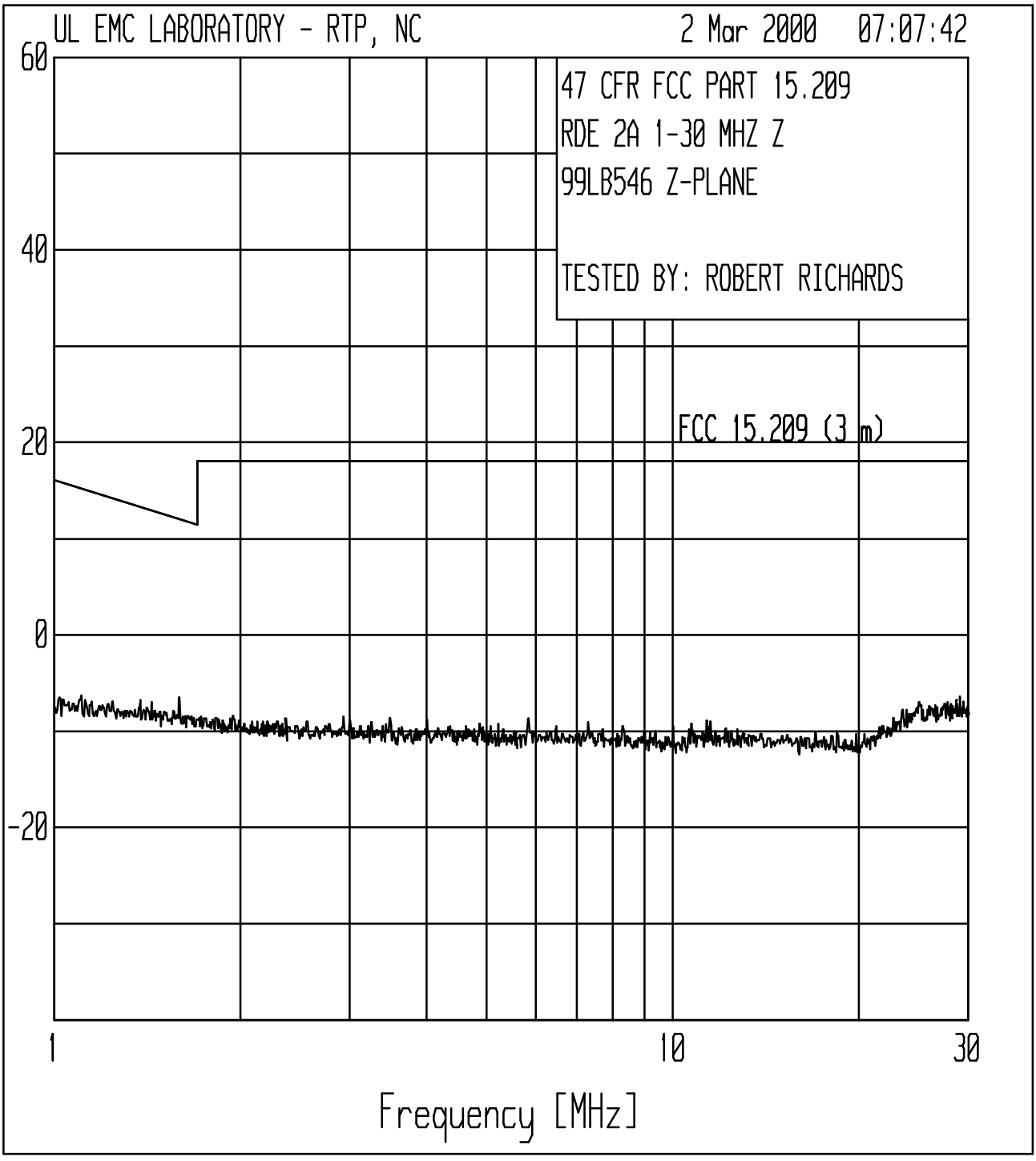
Test 3, Item A - Peak Plot: Radiated Disturbance Emissions - 9 kHz to 30 MHz



Test 3, Item A - Peak Plot: Radiated Disturbance Emissions - 9 kHz to 30 MHz



Test 3, Item A - Peak Plot: Radiated Disturbance Emissions - 9 kHz to 30 MHz



Test 4: Radiated Disturbance Emissions - 30 to 1000 MHz Electric Field

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 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

Frequency Range MHz	Field Strength of Fundamental µV/m	(dBµV/m)	Field Strength of Fundamental µV/m	(dBµV/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 Deviations/Clarifications:

At fundamental frequency, 350 MHz, Average field strength limit = 7500 µV/m (77.5 dBµV/m).
Harmonic field strength limit = 750 µV/m (57.5 dBµV/m).
Per 15.35(b) peak limit is 20 dB above average limit for each frequency.

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 - 30 to 1000 MHz Electric Field

Test Results Summary:

Test Item	Test Location	Humidity (%)	Temperature (ºC)	Pressure (kPa)	Pass/Fail (P/F)	Date Completed	Comment #
A	A	47	21.5	99.9	P	3/7/00	1

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

Comments:

Comment #	Description
1	Average calculated using peak-to-average ratio of 11.1 dB. See page 17 for details.

Test 4 - Test Equipment Used: Radiated Disturbance Emissions - 30 to 1000 MHz Electric Field

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
AT0021	Biconical Antenna, 20 to 300 MHz	Chase	VBA6106A	4/2/99	4/30/00
AT0022	Log Periodic Antenna, 200 to 1000 MHz	Chase	UPA6109	4/2/99	4/30/00
ATA034	52ft Cable, N - N	UL	HELIAX	8/28/99	8/31/00
ATA038	33ft Cable, N - N	EMC Technologist	RG-214	7/30/99	7/31/00
HI0034	Temp/Humid. Indicator	Cole - Palmer	99760-00	12/20/99	12/31/00
SAR001	EMI Receiver	Hewlett Packard	8572A	12/14/99	12/31/00

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.

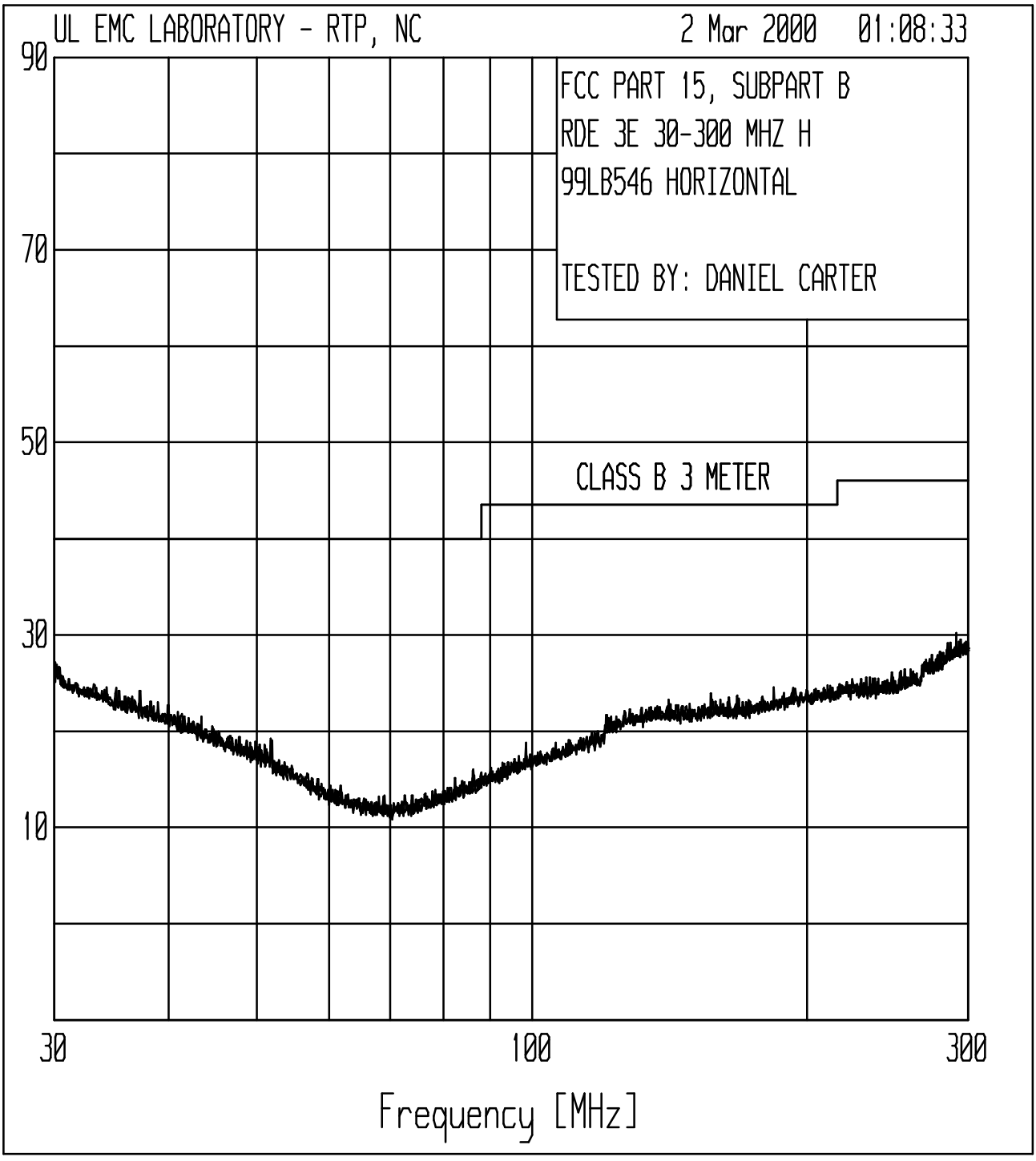
Test 4, Item A - Discrete Data: Radiated Disturbance Emissions - 30 to 1000 MHz Electric Field

Test Item	Detector Type* (P/Q/A)	Antenna Polarity (H/V)	Antenna Distance (m)	Measured Frequency (MHz)	Measured Value (dBµV)	Equipment Correction (dB/m)	Corrected Value (dBµV/m)	Specified Limit** (dB µV/m)	Spec Margin (dB)	See Comment #
A	P	H	3	349.396	58.0	19.5	77.5	97.0	-19.5	
A	A	H	3	349.396	47.0	19.5	66.5	77.0	-10.5	1
A	P	H	3	698.801	14.5	25.7	40.2	77.0	-36.8	
A	A	H	3	698.801	3.5	25.7	29.2	57.0	-27.8	1
A	P	V	3	349.396	38.3	18.9	57.2	97.0	-39.8	
A	A	V	3	349.396	27.3	18.9	46.2	77.0	-30.8	1
A	P	V	3	698.801	10.4	25.7	36.1	77.0	-40.9	
A	A	V	3	698.801	-0.6	25.7	25.1	57.0	-31.9	1

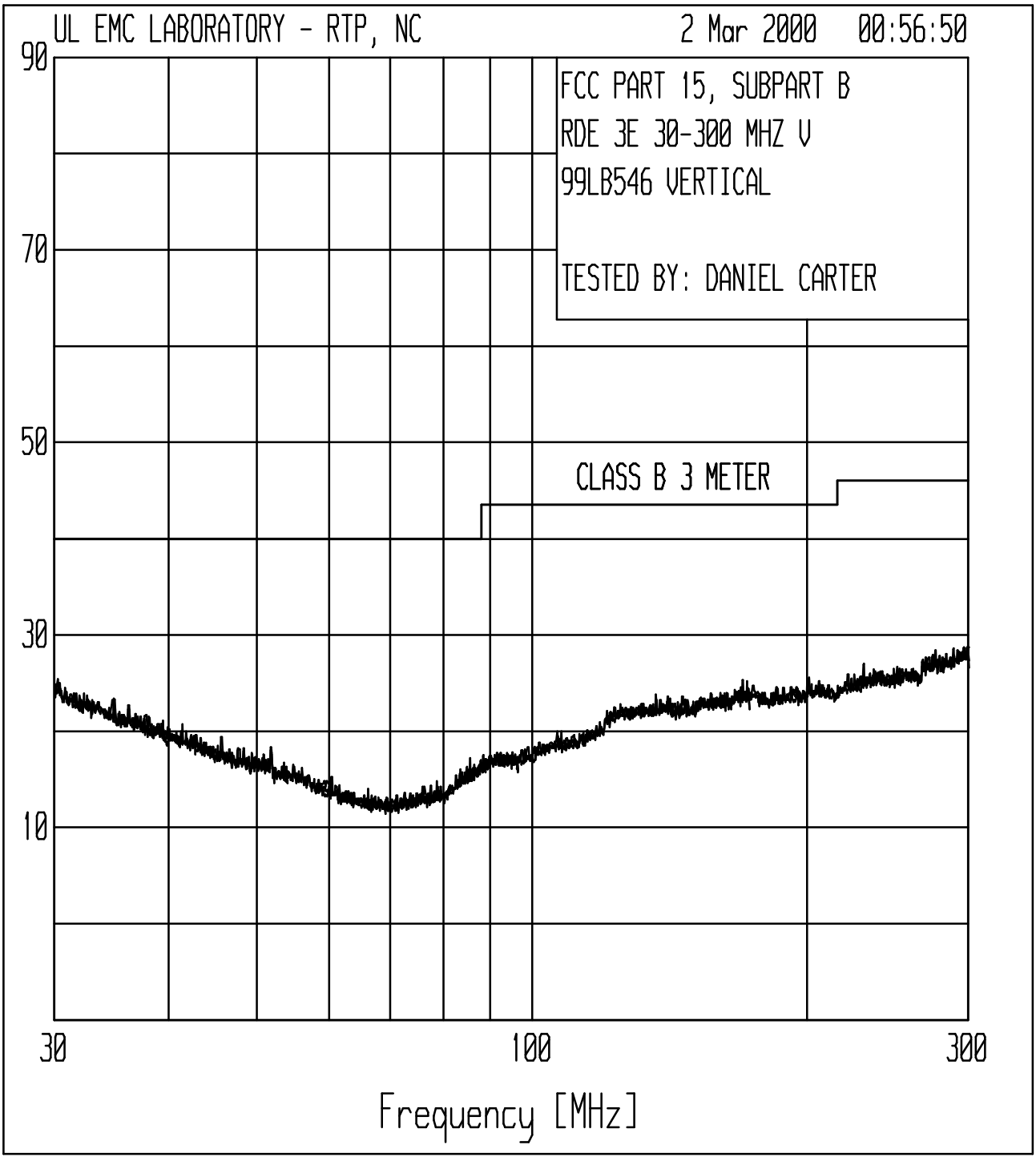
Comments: See Page 34.

* 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.
Sample Calculation: Corrected Value = Measured Value + Equipment Correction
Equipment Correction = Antenna Factor (dB/m) + Cable Loss (dB) - Amplifier Gain (dB ,if used)

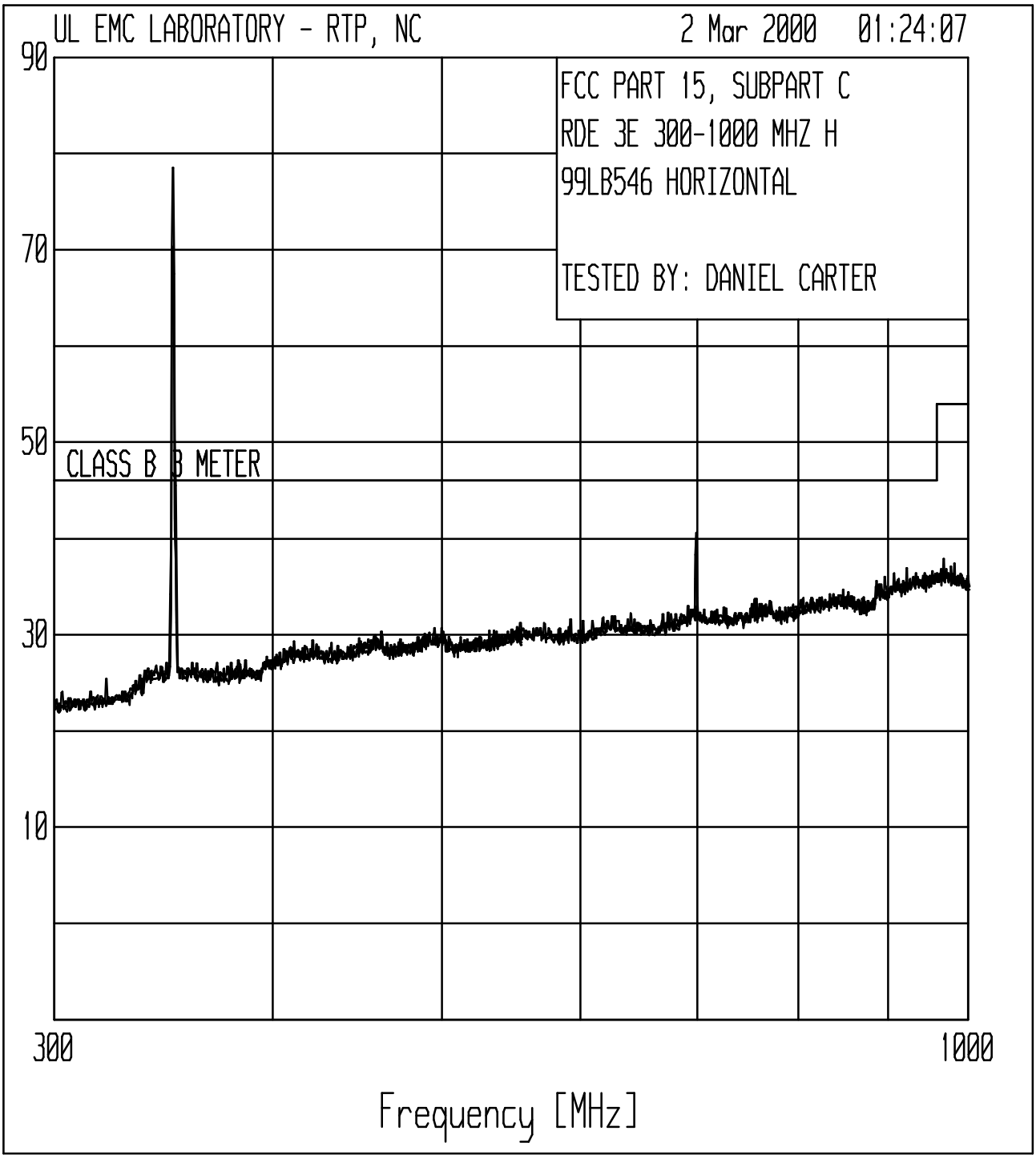
Test 4, Item A - Peak Plot: Radiated Disturbance Emissions - 30 to 1000 MHz Electric Field



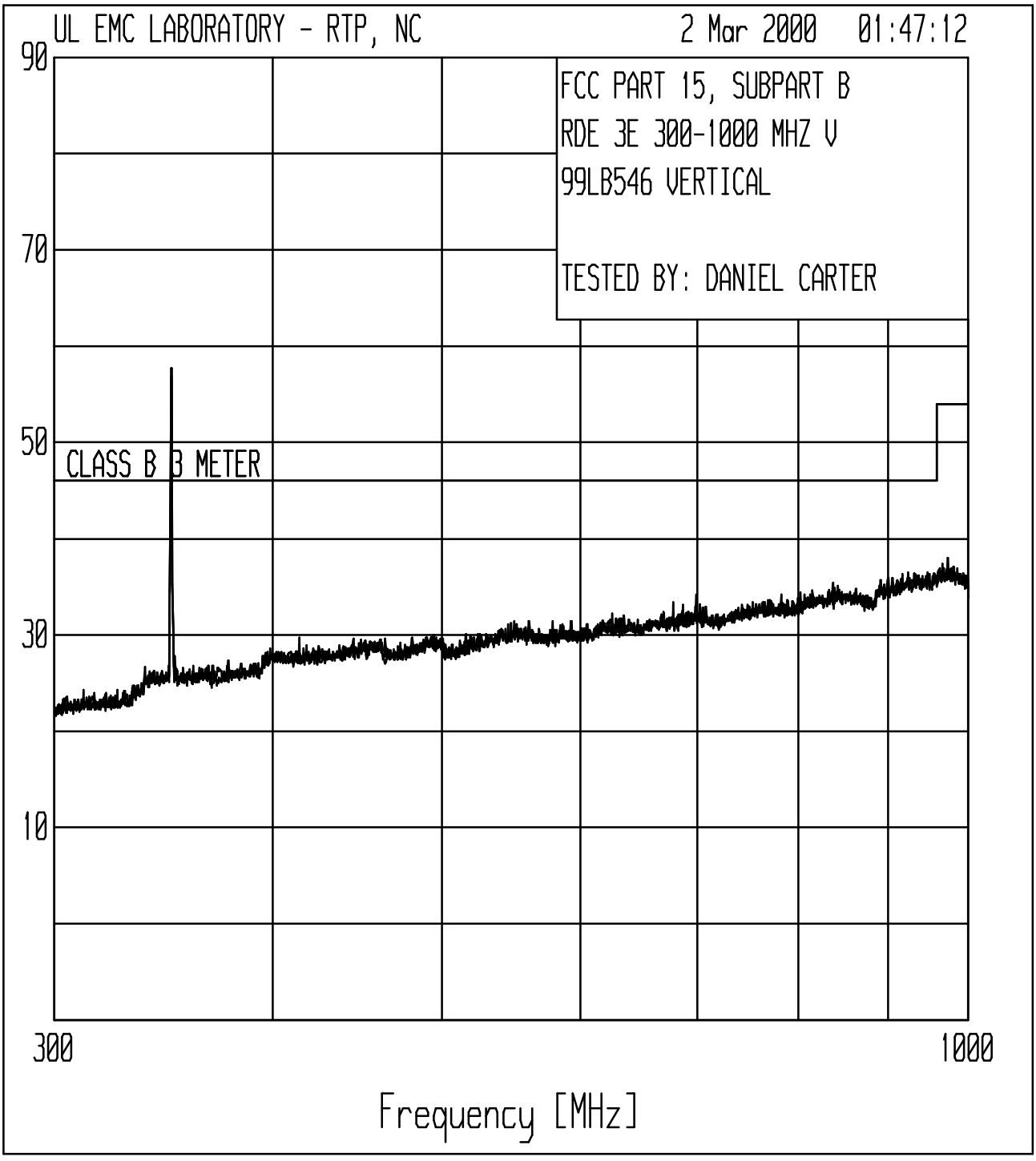
Test 4, Item A - Peak Plot: Radiated Disturbance Emissions - 30 to 1000 MHz Electric Field



Test 4, Item A - Peak Plot: Radiated Disturbance Emissions - 30 to 1000 MHz Electric Field



Test 4, Item A - Peak Plot: Radiated Disturbance Emissions - 30 to 1000 MHz Electric Field



Test 5: Radiated Disturbance Emissions - 1 to 3.5 GHz Electric Field

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 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

Frequency Range MHz	Field Strength of Fundamental µV/m	(dBµV/m)	Field Strength of Fundamental µV/m	(dBµV/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 Deviations/Clarifications:

At fundamental frequency, 350 MHz, Average field strength limit = 7500 µV/m (77.5 dBµV/m).
Harmonic field strength limit = 750 µV/m (57.5 dBµV/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	1	1

Test 5 - Results: Radiated Disturbance Emissions - 1 to 3.5 GHz Electric Field

Test Results Summary:

Test Item	Test Location	Humidity (%)	Temperature (ºC)	Pressure (kPa)	Pass/Fail (P/F)	Date Completed	Comment #
A	A	40	22.5	100.0	P	3/2/00	1

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

Comments:

Comment #	Description
1	Average calculated using peak-to-average ratio of 11.1 dB. See page 17 for details.

Test 5 - Test Equipment Used: Radiated Disturbance Emissions - 1 to 3.5 GHz Electric Field

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
AT0005	Horn Antenna, 1 to 18 GHz	Electro-Metrics	EM-6961	5/15/99	5/31/00
ATA034	52ft Cable, N - N	UL	HELIAX	8/28/99	8/31/00
ATA076	27ft, N male-N male	Micro-Coax	Low Loss Coaxial	10/28/99	10/31/00
HI0034	Temp/Humid. Indicator	Cole - Palmer	99760-00	12/20/99	12/31/00
SAR001	EMI Receiver	Hewlett Packard	8572A	12/14/99	12/31/00

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 - 1 to 3.5 GHz Electric Field

Test Item	Detector Type* (P/Q/A)	Antenna Polarity (H/V)	Antenna Distance (m)	Measured Frequency (MHz)	Measured Value (dBµV)	Equipment Correction (dB/m)	Corrected Value (dBµV/m)	Specified Limit** (dB µV/m)	Spec Margin (dB)	See Comment #
A	P	H	3	1047.333	47.1	-9.2	37.9	77.5	-39.6	
A	A	H	3	1047.333	36.0	-9.2	26.8	57.5	-30.7	1
A	P	H	3	1397.104	35.3	-7.1	28.2	77.5	-49.3	Noise Floor
A	A	H	3	1397.104	24.2	-7.1	17.1	57.5	-40.4	1
A	P	H	3	1746.089	39.1	-4.8	34.3	77.5	-43.2	
A	A	H	3	1746.089	28.0	-4.8	23.2	57.5	-34.3	1
A	P	H	3	2094.822	35.4	-2.4	33.0	77.5	-44.5	Noise Floor
A	A	H	3	2094.822	24.3	-2.4	21.9	57.5	-35.6	1
A	P	H	3	2444.625	33.7	0.4	34.1	77.5	-43.4	Noise Floor
A	A	H	3	2444.625	22.6	0.4	23.0	57.5	-34.5	1
A	P	H	3	2793.519	34.0	2.0	36.0	77.5	-41.5	Noise Floor
A	A	H	3	2793.519	22.9	2.0	24.9	57.5	-32.6	1
A	P	H	3	3142.843	33.1	3.7	36.8	77.5	-40.7	Noise Floor
A	A	H	3	3142.843	22.0	3.7	25.7	57.5	-31.8	1
A	P	H	3	3491.750	32.1	5.3	37.4	77.5	-40.1	Noise Floor
A	A	H	3	3491.750	21.0	5.3	26.3	57.5	-31.2	1

Comments: See page 42.

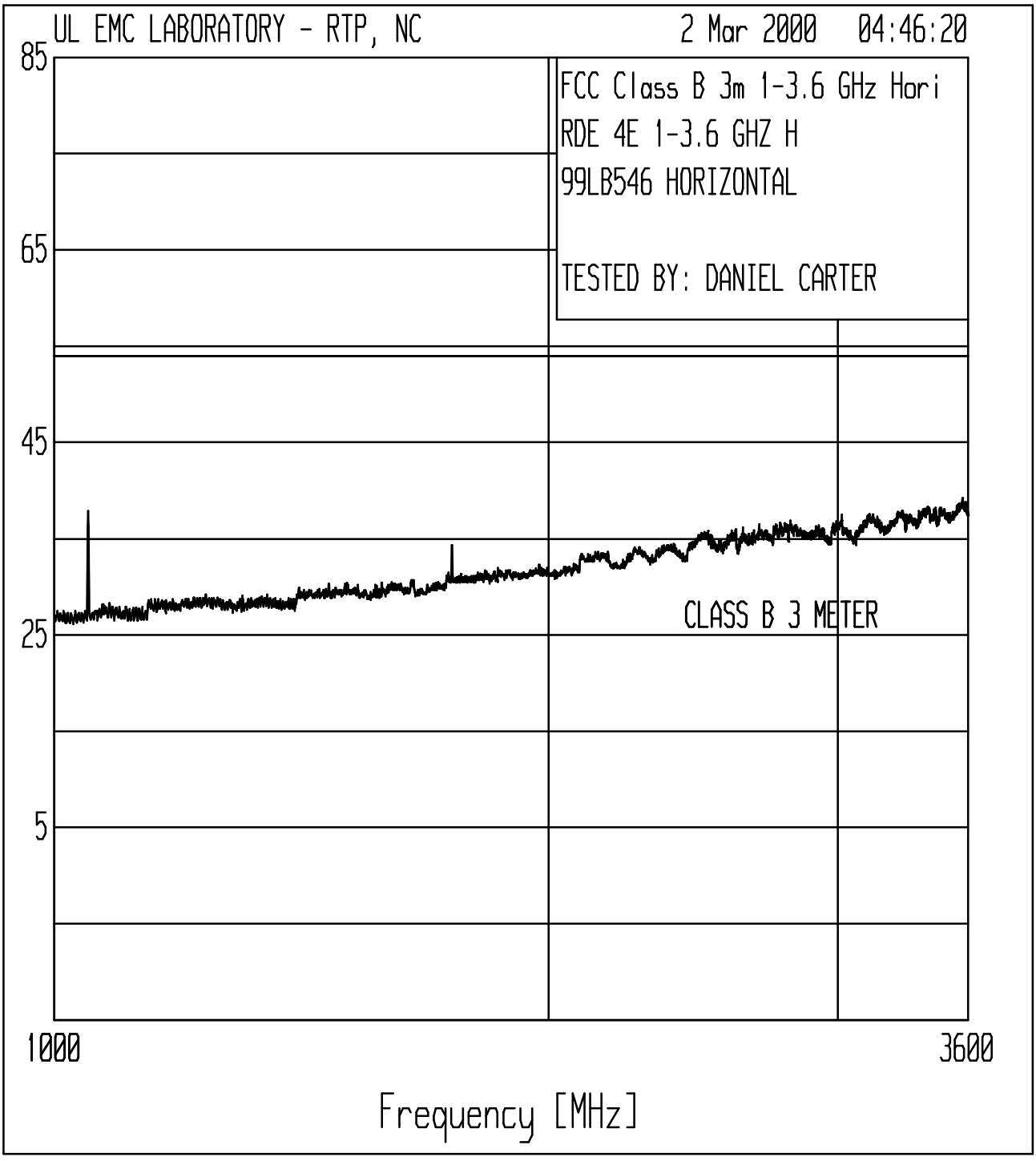
* P = Peak, Q = Quasi-Peak, A = Average.
** The Specified Limit is for the type measurement indicated. When Peak data is indicated, the tightest limit applicable is indicated.
Sample Calculation: Corrected Value = Measured Value + Equipment Correction
Equipment Correction = Antenna Factor (dB/m) + Cable Loss (dB) - Amplifier Gain (dB ,if used)

Test 5, Item A - Discrete Data: Radiated Disturbance Emissions - 1 to 3.5 GHz Electric Field

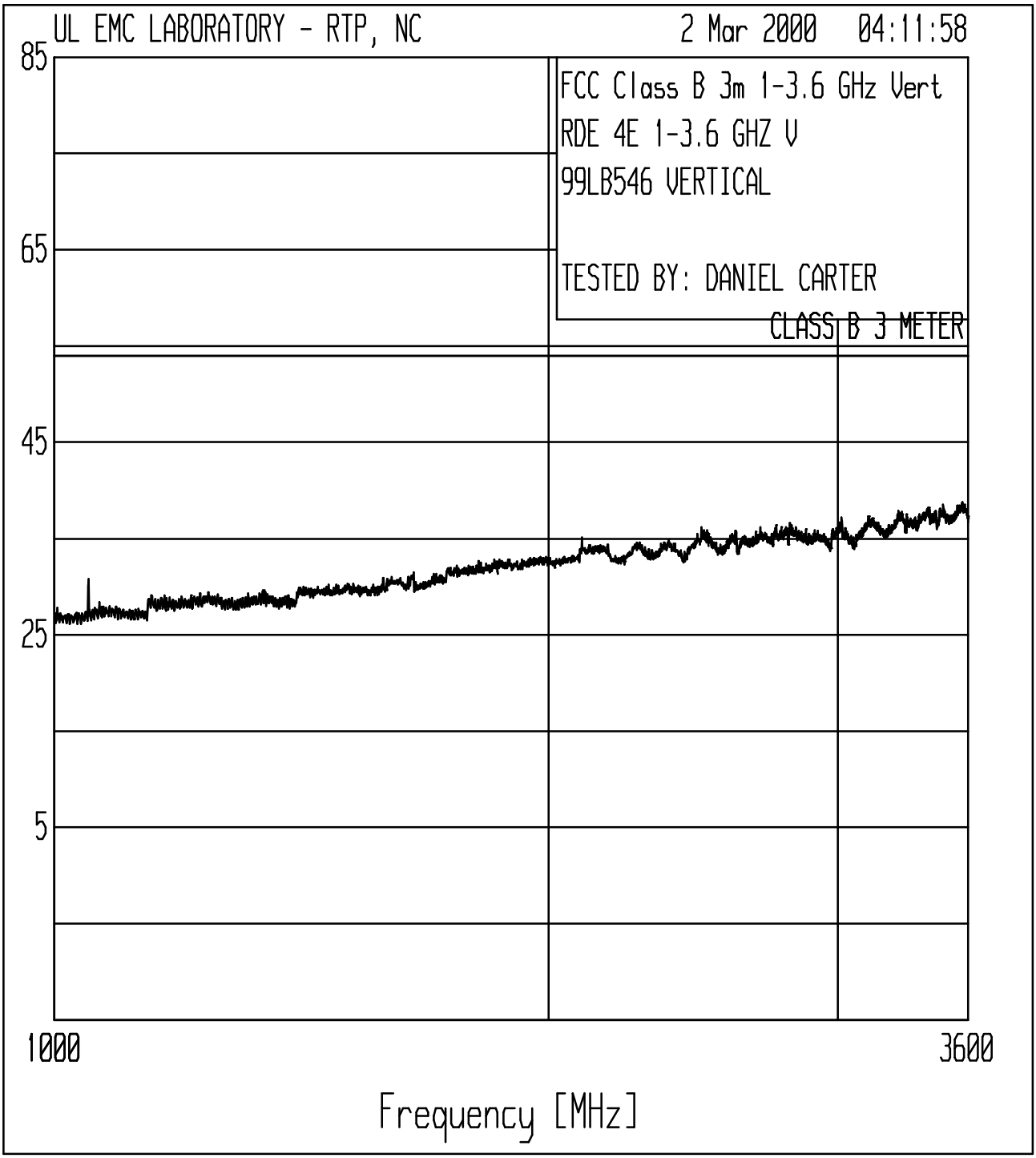
Test Item	Detector Type* (P/Q/A)	Antenna Polarity (H/V)	Antenna Distance (m)	Measured Frequency (MHz)	Measured Value (dBµV)	Equipment Correction (dB/m)	Corrected Value (dBµV/m)	Specified Limit** (dB µV/m)	Spec Margin (dB)	See Comment #
A	P	V	3	1047.571	40.0	-9.2	30.8	77.5	-46.7	
A	A	V	3	1047.571	28.9	-9.2	19.7	57.5	-37.8	1
A	P	V	3	1397.104	34.9	-6.9	28.0	77.5	-48.5	Noise Floor
A	A	V	3	1397.104	23.8	-6.9	17.9	57.5	-39.6	1
A	P	V	3	1746.089	35.6	-4.1	31.5	77.5	-46.0	Noise Floor
A	A	V	3	1746.089	24.5	-4.1	20.4	57.5	-37.1	1
A	P	V	3	2094.822	35.3	-1.5	33.8	77.5	-43.7	Noise Floor
A	A	V	3	2094.822	24.2	-1.5	22.7	57.5	-34.8	1
A	P	V	3	2444.625	33.8	0.4	34.2	77.5	-43.3	Noise Floor
A	A	V	3	2444.625	22.7	0.4	23.1	57.5	-34.4	1
A	P	V	3	2793.519	34.0	1.6	35.6	77.5	-41.9	Noise Floor
A	A	V	3	2793.519	22.9	1.6	24.5	57.5	-33.0	1
A	P	V	3	3142.843	33.1	3.3	36.4	77.5	-41.1	Noise Floor
A	A	V	3	3142.843	22.0	3.3	25.3	57.5	-32.2	1
A	P	V	3	3491.750	32.2	5.1	37.3	77.5	-40.2	Noise Floor
A	A	V	3	3491.750	21.1	5.1	26.2	57.5	-31.3	1

* 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.
Sample Calculation: Corrected Value = Measured Value + Equipment Correction
Equipment Correction = Antenna Factor (dB/m) + Cable Loss (dB) - Amplifier Gain (dB ,if used)

Test 5, Item A - Peak Plot: Radiated Disturbance Emissions - 1 to 3.5 GHz Electric Field



Test 5, Item A - Peak Plot: Radiated Disturbance Emissions - 1 to 3.5 GHz Electric Field



Appendix A: Accreditation Certificate

National Institute of Standards and Technology — NVLAP® — National Voluntary Laboratory Accreditation Program

ISO/IEC GUIDE 25:1990
ISO 9002:1987

Scope of Accreditation

Page: 1 of 1

ELECTROMAGNETIC COMPATIBILITY AND TELECOMMUNICATIONS

NVLAP LAB CODE 200246-0

UNDERWRITERS LABORATORIES, INC.
12 Laboratory Drive
Research Triangle Park, NC 27709
Mr. Rick A. Titus
Phone: 847-272-8800 x43281 Fax: 847-509-6219
E-Mail: titusr@ul.com
URL: http://www.ul.com

NVLAP Code	*Designation / Description*
International Special Committee on Radio Interference (CISPR) Methods	
12/CIS22	IEC/CISPR 22:1993: Limits and methods of measurement of radio disturbance characteristics of information technology equipment
Federal Communications Commission (FCC) Methods	
12/F01	FCC Method - 47 CFR Part 15 - Digital Devices
12/F01a	Conducted Emissions, Power Lines, 450 KHz to 30 MHz
12/F01b	Radiated Emissions
Australian Standards referred to by clauses in ACA Technical Standards	
12/T51	AS/NZS 3548: Electromagnetic Interference - Limits and Methods of Measurement of Information Technology Equipment

June 30, 2000
Effective through

For the National Institute of Standards and Technology

NVLAP 01S (11-95)

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 300 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 300 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

Appendix A: Accreditation Certificate

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 Reasearch 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