



Project: 02RT8928  
File: MC1324  
Report: 020248  
Date: July 24, 2002  
Model: W-52

# **Test Report**

## **On**

# **Electromagnetic Compatibility Testing**

**Hunter Fan Co**

**Memphis, TN**

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## **Test Report Details:**

Tests Performed By:	<b>Underwriters Laboratories Inc. 12 Laboratory Drive Research Triangle Park, NC 27709</b>
Tests Performed For:	<b>Hunter Fan Co 2500 Frisco Avenue Memphis, TN 38114</b>
Applicant Contact:	<b>Mr. Robert Davis Safety and Test Engineer - International Voice: +1 (901) 248-2212 Fax: +1 (901) 248-2382</b>
Test Report Number:	<b>020248</b>
Test Report Date:	<b>July 24, 2002</b>
Product Type:	<b>RF Ceiling Fan/Lamp Remote Control</b>
Model Number:	<b>W-52</b>
Sample Serial Number:	<b>Not Serialized</b>
Sample Tag Number:	<b>S02LB366</b>
EUT Category:	<b>Transmitter - Low Power</b>
EUT Type:	<b>Hand Held</b>
Sample Receive Date:	<b>July 10, 2002</b>
Testing Start Date:	<b>July 11, 2002</b>
Date Testing Complete:	<b>July 19, 2002</b>

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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 - Occupied Bandwidth 47 CFR Part 15, Subpart C / 47 CFR Part 15, Subpart C, Section 15.231	X	-	
5	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	
6	Radiated Disturbance Emissions - Restricted Bands 47 CFR Part 15, Subpart C / 47 CFR Part 15, Subpart C, Section 15.205	X	-	

## **Remarks:**

- 1) This device was tested and found to comply with the requirements of FCC Part 15.231. Where applicable the limits of 15.209 (General Limits) and 15.205 (Restricted Bands) are also met.
- 2) Results are considered applicable to Canadian requirements for Low-Powered Transmitters RSS-210. This device complies with section 6.1 (Momentarily Operated Devices).

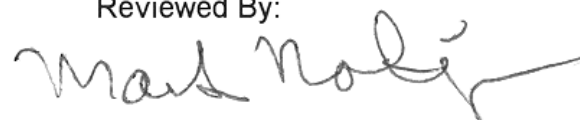
## **Conclusion:**

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 video 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. It is located and bonded 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. 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. It is located and bonded 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. 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) Ground Reference Plane # 4 (Automotive)**

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.

### **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 in front of Standard Source Impedance Power Supply.**

### **Test Location J) 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 P) Ground Reference Plane # 5**

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.

### **Test Location X) Other - As described in the Comments Section of Test Results.**

## **EUT Information:**

### **Equipment Used During Test:**

Use*	Product Type	Manufacturer	Model	Comments
EUT	RF Transmitter	Hunter Fan Co.	W-52	Sold under Casablanca Fan Co. Brand.

\* 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

### **Test Notes:**

- 1) A new battery was installed prior to test.
- 2) The worst-case orientation was determined at the transmit frequency prior to final measurement. The orientations examined were:
  - flat on tabletop
  - positioned on side (long edge of Printed Circuit Board adjacent to table)
  - positioned on end (short edge of Printed Circuit Board adjacent to table)The worst-case orientation was determined to be flat on the table top with receive antenna horizontally polarized.
- 3) The device was observed to cease transmission immediately upon release of buttons.
- 4) The antenna is not detachable or replaceable by the user.
- 5) Per FCC Part 2.1093(c) this device is not required to undergo testing for radiofrequency radiation exposure.

**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	X	
1	12	-	-	DC	X	

**EUT Operation Modes:**

Mode #	Description
1	Transmitter button continuously depressed.
2	Equipment under test idle (no button depressed).

**EUT Configuration Modes:**

Mode #	Description
1	W-52 on non-conductive table.
2	84592, 85095, and W-52 on non-conductive table (tested simultaneously).

## 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 documented elsewhere in this report.

All measurements were made at a 3 meter distance in an attempt to identify any emission produced by the EUT. 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  $377\Omega$  (or 51.5 dB $\Omega$ ).

Radiated Disturbance Limits - General Requirements Section 15.209

Frequency Range MHz	Field Strength Limit $\mu\text{V/m}$	Field Strength Limit dB $\mu\text{V/m}$	Measurement Distance (m)
0.009 to 0.490	2400/F (kHz)	$20*\log(2400/F(\text{kHz}))$	300
0.490 to 1.705	24,000/F (kHz)	$20*\log(24,000/F(\text{kHz}))$	30
1.705 to 30	30	29.5	30

Limits adjusted to 3 meter measurement distance and converted to magnetic field

Frequency Range MHz	Field Strength Limit $\mu\text{V/m}$	Field Strength Limit dB $\mu\text{V/m}$	Field Strength Limit (magnetic) dB $\mu\text{A/m}$	Limit Range dB $\mu\text{A/m}$
0.009 to 0.490	$2400/F(\text{kHz}) * 10^4$	$20*\log(24,000,000/F(\text{kHz}))$	$20*\log(2400/F(\text{kHz}))+28.5$	77 to 42.3
0.490 to 1.705	$24,000/F(\text{kHz}) * 100$	$20*\log(2,400,000/F(\text{kHz}))$	$20*\log(24,000/F(\text{kHz}))-11.5$	22.3 to 11.4
1.705 to 30	$30 * 100$	69.5	18	18

### 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	2	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	56	23.0	100.3	P	7/19/02	

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

**Comments:**

Comment #	Description

**Test Equipment Used:**

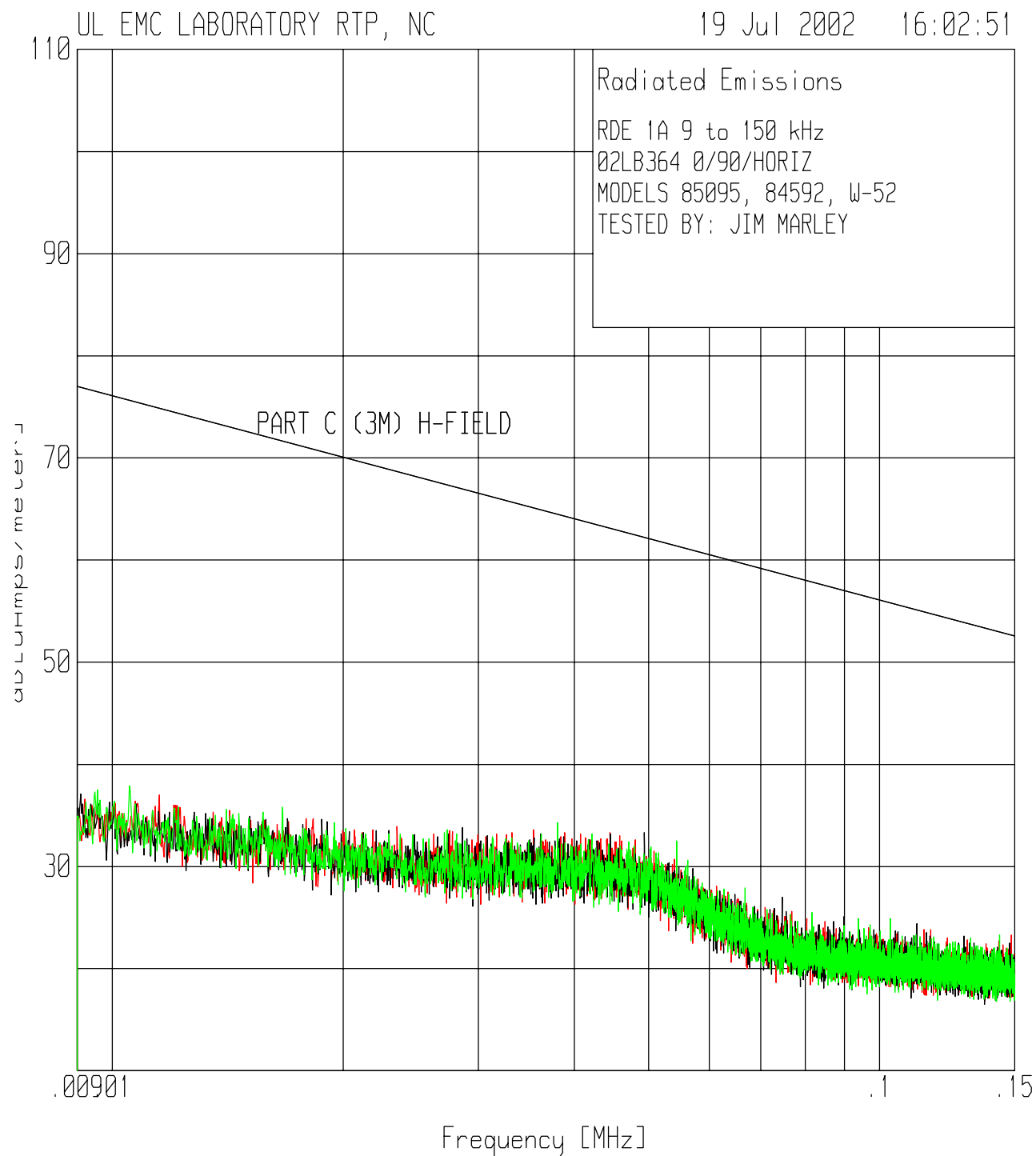
Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
AT0036	Loop Antenna, 100 kHz to 30 MHz	Electro-Metrics	EM-6872	12/5/01	12/31/02
ATA026	20 ft Cable, BNC - N	UL	RG-223	4/26/02	4/30/03
ATA093	1 ft, N male - N male	Micro-Coax	Coaxial Cable	4/26/02	4/30/03
ATA096	50 ft, N male - N male	Micro-Coax	Coaxial Cable	4/30/02	4/30/03
ATA143	6ft., N-male to N-male	Microcoax	Coaxial Cable	4/26/02	4/30/03
HI0034	Environmental Indicator	Cole-Palmer	99760-00	10/1/01	10/31/02
SAR001	Spectrum Analyzer / Receiver	Hewlett-Packard	8572A	12/3/01	12/31/02

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.



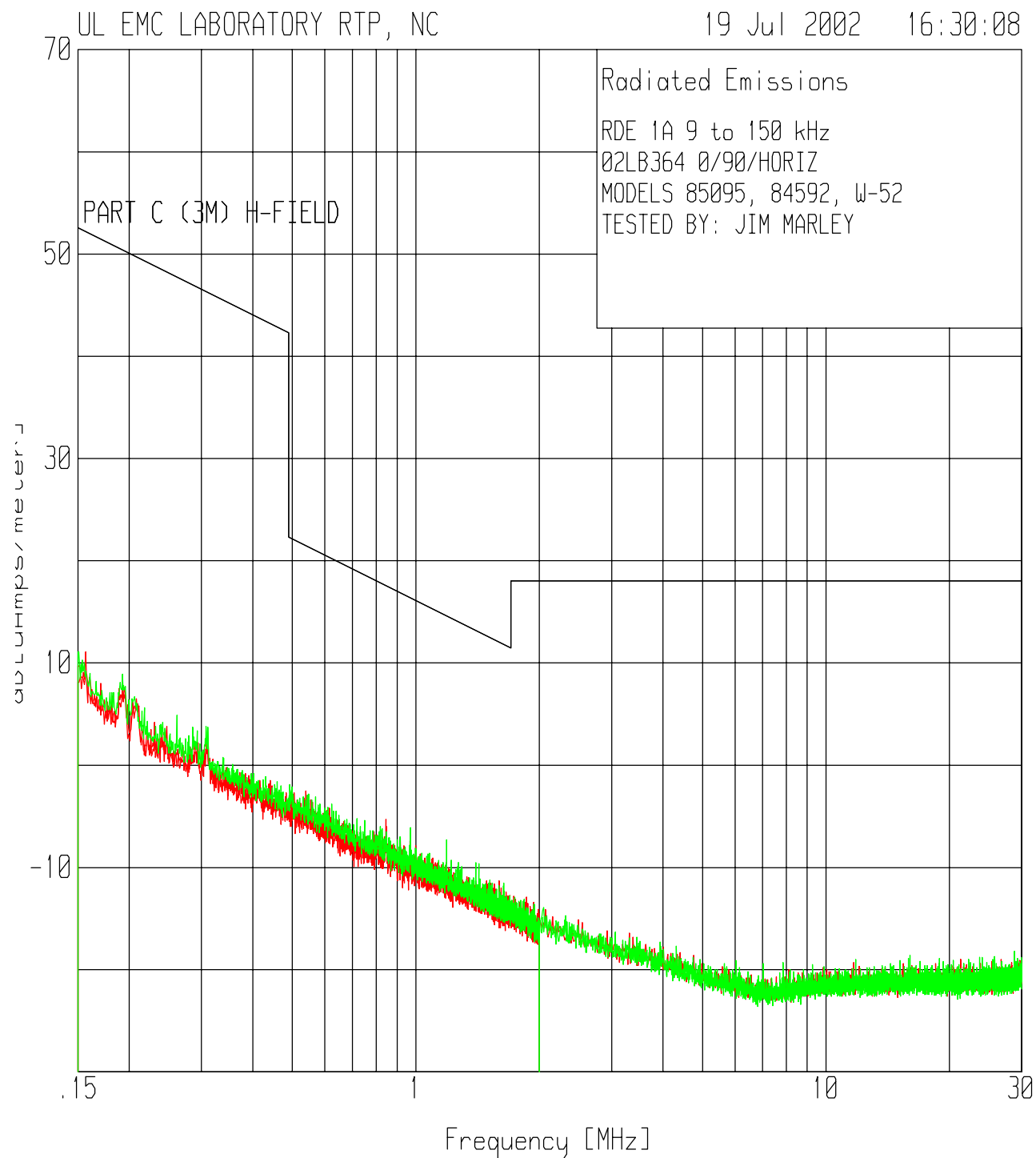
**Test 1, Item A (Transmitting) - Peak Plot (Amplitude in dBuV/m):**

Radiated Disturbance Emissions - 9 kHz to 30 MHz



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

**Radiated Disturbance Emissions - 9 kHz to 30 MHz**



**Test 1, Item A - Test Set-Up Photo:**

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 ( $\mu\text{V/m}$ ) (dB $\mu\text{V/m}$ )		Field Strength of Spurious ( $\mu\text{V/m}$ ) (dB $\mu\text{V/m}$ )	
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  $\mu\text{V/m}$  (77.5 dB $\mu\text{V/m}$ ).  
Harmonic field strength limit = 750  $\mu\text{V/m}$  (57.5 dB $\mu\text{V/m}$ ).  
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)	2	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	56	22.5	100.3	P	7/19/02	

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

**Comments:**

Comment #	Description
1	See Test 3 for Setup Photo.

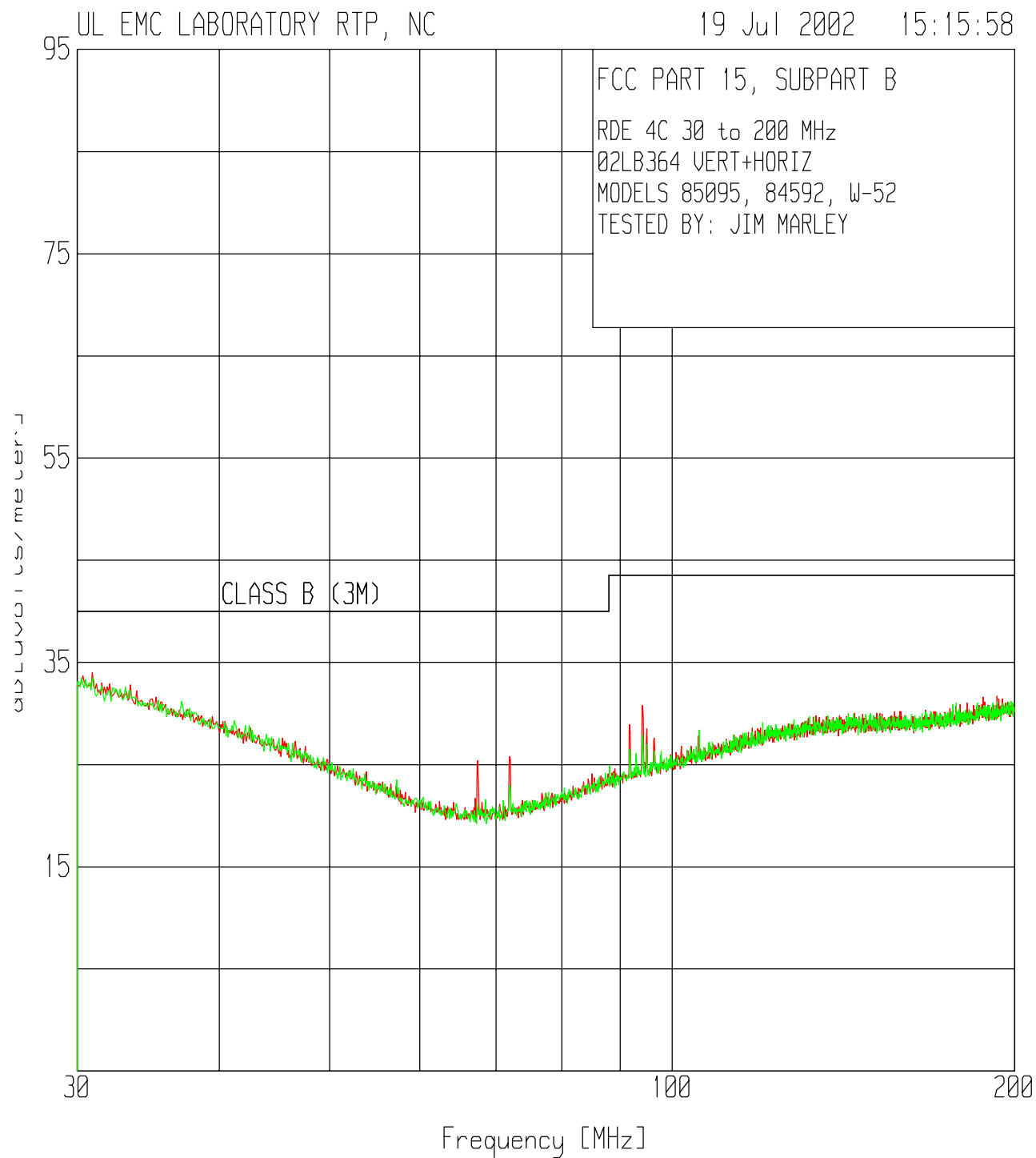
**Test Equipment Used:**

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
AT0025	Biconical Antenna, 30 to 300 MHz	Schaffner, EMC	VBA6106A	3/23/02	3/31/03
AT0030	Log periodic Antenna, 200 MHz to 1000 MHz	Schaffner, EMC	3160-07	11/5/01	11/30/02
ATA084	Attenuator 6 dB, 2 GHz	Pasternack	PE7002-6	4/26/02	4/30/03
ATA085	Attenuator 6 dB, 2 GHz	Pasternack	PE7002-6	4/26/02	4/30/03
ATA093	1 ft, N male - N male	Micro-Coax	Coaxial Cable	4/26/02	4/30/03
ATA096	50 ft, N male - N male	Micro-Coax	Coaxial Cable	4/30/02	4/30/03
ATA108	10 m, N male - N male	UL	RG214	4/26/02	4/30/03
ATA110	RF Amplifier, 1 to 1000 MHz	Miteq	AM-3A-000110-N	4/30/02	4/30/03
ATA124	RF Amplifier, 1 to 1000 MHz	Miteq	AM-3A-000110-N(M-F)	4/30/02	4/30/03
ATA140	RG214 Ferrite Cable	EMC Eupen	N/A	4/26/02	4/30/03
ATA143	6ft., N-male to N-male	Microcoax	Coaxial Cable	4/26/02	4/30/03
HI0034	Environmental Indicator	Cole-Palmer	99760-00	10/1/01	10/31/02
SAR001	Spectrum Analyzer / Receiver	Hewlett-Packard	8572A	12/3/01	12/31/02

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.

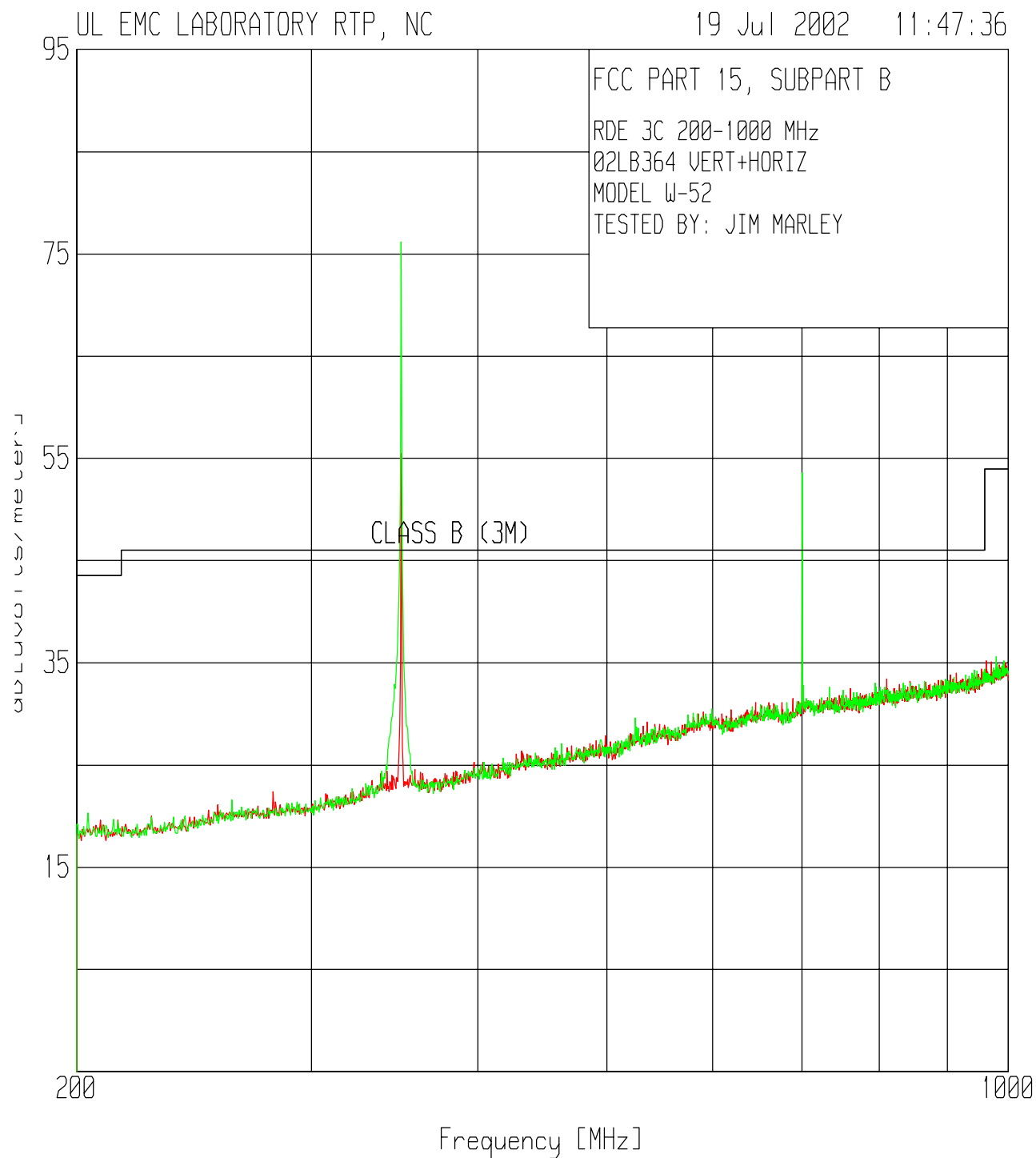
**Test 2, Item A (Transmitting) - Peak Plot (Amplitude in dBuV/m):**

Radiated Disturbance Emissions - 30 MHz to 1000 MHz



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

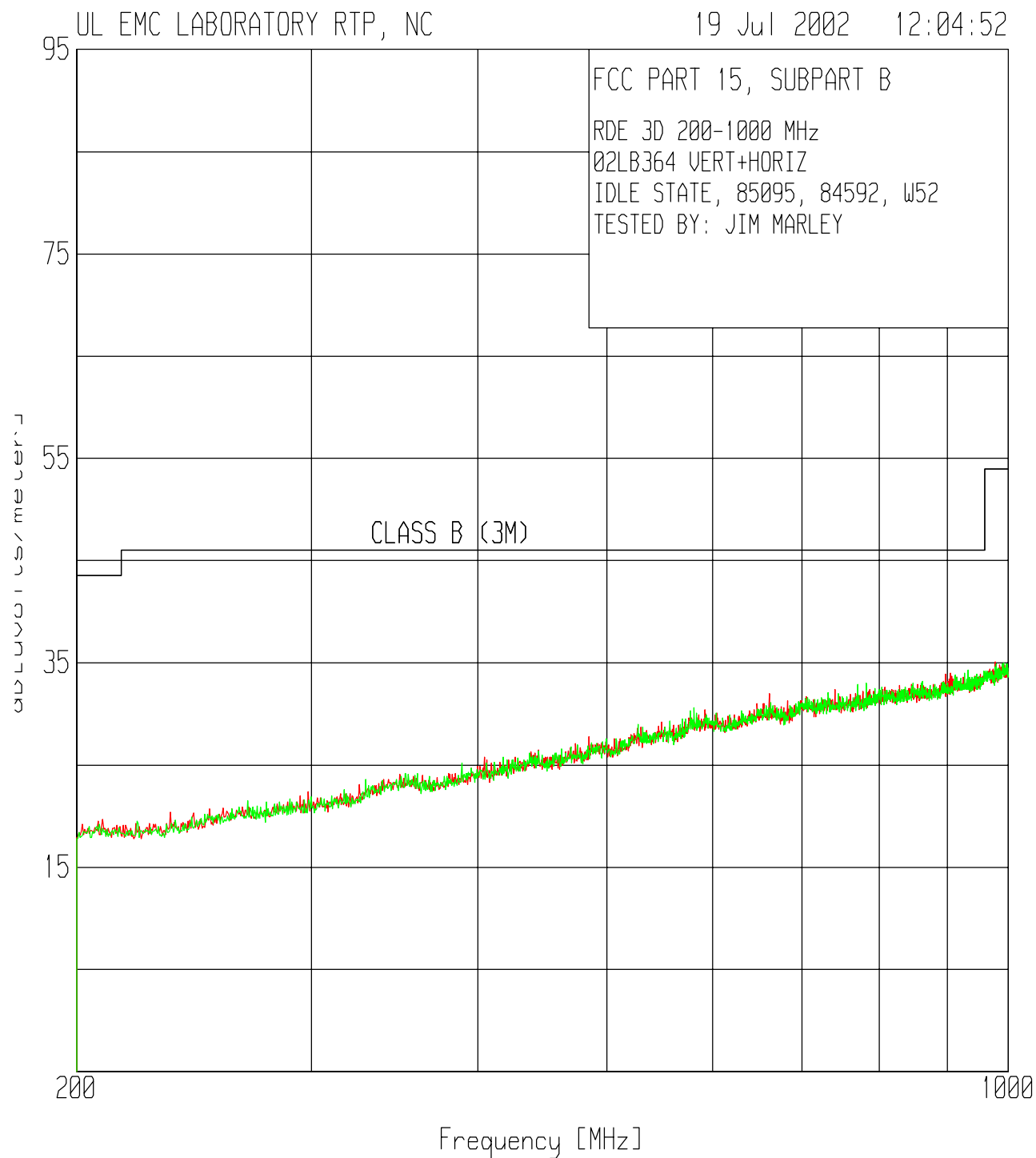
Radiated Disturbance Emissions - 30 MHz to 1000 MHz





**Test 2, Item B (Idle, Not Transmitting) - Peak Plot (Amplitude in dBuV/m):**

Radiated Disturbance Emissions - 30 MHz to 1000 MHz





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

Frequency Range MHz	Field Strength of Fundamental $\mu\text{V/m}$ (dB $\mu\text{V/m}$ )		Field Strength of Fundamental $\mu\text{V/m}$ (dB $\mu\text{V/m}$ )	
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  $\mu\text{V/m}$  (77.5 dB $\mu\text{V/m}$ ).  
Harmonic field strength limit = 750  $\mu\text{V/m}$  (57.5 dB $\mu\text{V/m}$ ).  
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	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	53	22.5	100.4	P	7/19/02	

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

**Comments:**

Comment #	Description

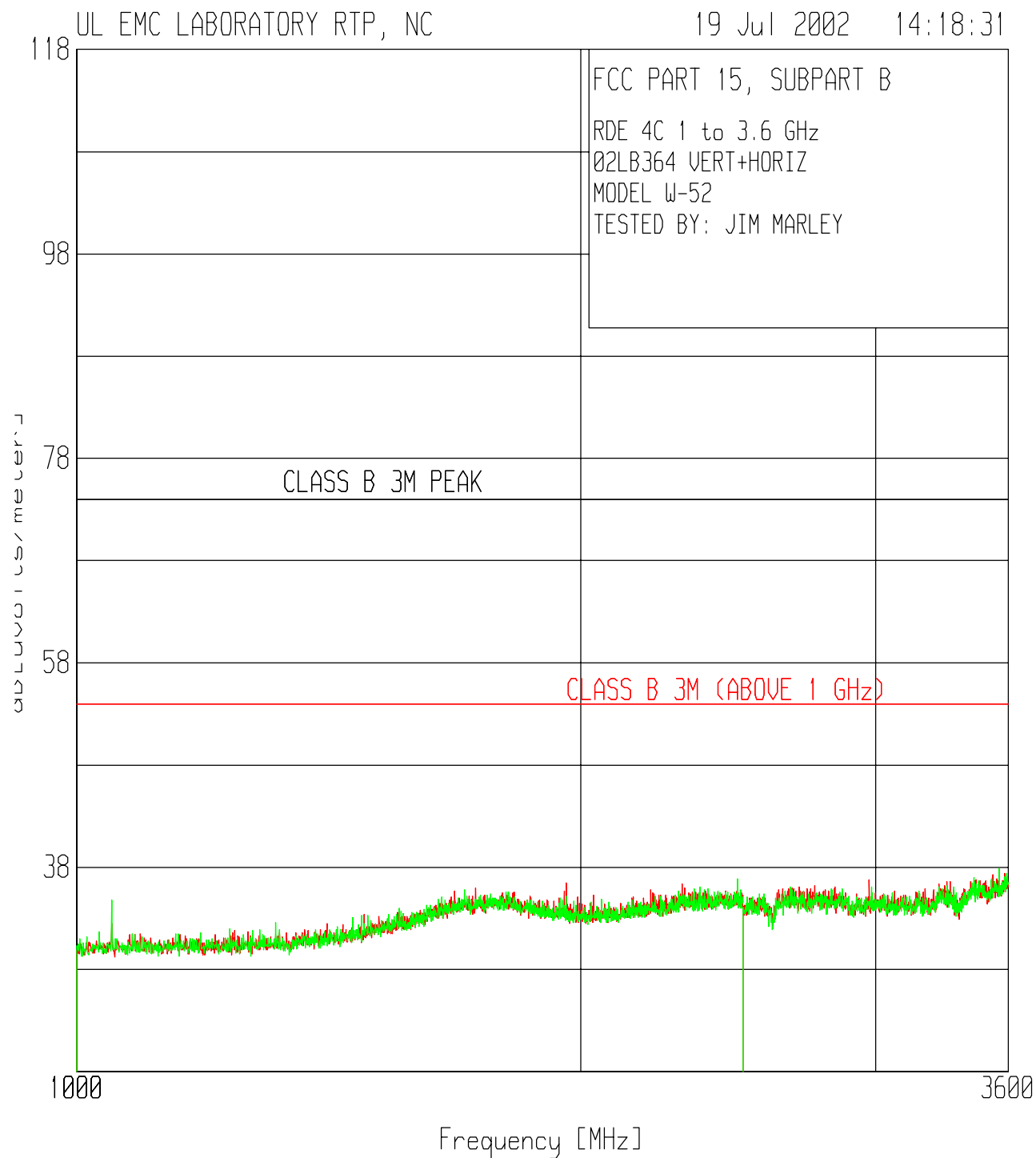
**Test Equipment Used:**

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
AT0032	Horn Antenna 1 to 18 GHz	EMC Test Systems	3115	5/01/02	5/31/03
ATA085	Attenuator 6 dB, 2 GHz	Pasternack	PE7002-6	4/26/02	4/30/03
ATA093	1 ft, N male - N male	Micro-Coax	Coaxial Cable	4/26/02	4/30/03
ATA096	50 ft, N male - N male	Micro-Coax	Coaxial Cable	4/30/02	4/30/03
ATA143	6ft., N-male to N-male	Microcoax	Coaxial Cable	4/26/02	4/30/03
HI0034	Environmental Indicator	Cole-Palmer	99760-00	10/1/01	10/31/02
SAR001	Spectrum Analyzer / Receiver	Hewlett-Packard	8572A	12/3/01	12/31/02

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 (Transmitting) - 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 (dBμV)	Equipment Correction (dB/m)	Corrected Value (dBμV/m)	Specified Limit** (dBμV/m)	Spec Margin (dB)	See Comment (#) ***
C	P	H	3	1050.0	48.9	-14.1	34.8	74.0	-39.2	Restr. Band
C	A	H	3	1050.0	-	-	24.0	54.0	-30.0	Restr. Band
C	P	H	3	1400.0	43.1	-11.2	31.9	74.0	-42.1	Restr. Band
C	A	H	3	1400.0	-	-	21.1	54.0	-32.9	Restr. Band
C	P	H	3	1750.0	43.0	-7.6	35.4	77.5	-42.1	
C	A	H	3	1750.0	-	-	24.6	57.5	-32.9	
C	P	H	3	2100.0	41.7	-7.6	34.1	77.5	-43.4	
C	A	H	3	2100.0	-	-	23.3	57.5	-34.2	
C	P	H	3	2450.0	41.4	-5.8	35.6	77.5	-41.9	
C	A	H	3	2450.0	-	-	24.8	57.5	-32.7	
C	P	H	3	2800.0	40.1	-4.6	35.5	74.0	-38.5	Restr. Band
C	A	H	3	2800.0	-	-	24.7	54.0	-29.3	Restr. Band
C	P	H	3	3150.0	38.6	-3.4	35.2	77.5	-42.3	
C	A	H	3	3150.0	-	-	24.4	57.5	-33.1	
C	P	H	3	3500.0	39.5	-2.6	36.9	77.5	-40.6	
C	A	H	3	3500.0	-	-	26.1	57.5	-31.4	
C	P	V	3	1050.0	46.6	-14.1	32.5	74.0	-41.5	Restr. Band
C	A	V	3	1050.0	-	-	21.7	54.0	-32.3	Restr. Band
C	P	V	3	1400.0	43.8	-11.3	32.5	74.0	-41.5	Restr. Band
C	A	V	3	1400.0	-	-	21.7	54.0	-32.3	Restr. Band
C	P	V	3	1750.0	43.0	-7.7	35.3	77.5	-42.2	
C	A	V	3	1750.0	-	-	24.5	57.5	-33.0	
C	P	V	3	2100.0	42.0	-7.5	34.5	77.5	-43.0	
C	A	V	3	2100.0	-	-	23.7	57.5	-33.8	
C	P	V	3	2450.0	41.5	-5.8	35.7	77.5	-41.8	
C	A	V	3	2450.0	-	-	24.9	57.5	-32.6	
C	P	V	3	2800.0	40.2	-4.4	35.8	74.0	-38.2	Restr. Band
C	A	V	3	2800.0	-	-	25.0	54.0	-29.0	Restr. Band
C	P	V	3	3150.0	39.0	-3.4	35.6	77.5	-41.9	
C	A	V	3	3150.0	-	-	24.8	57.5	-32.7	
C	P	V	3	3500.0	39.4	-2.7	36.7	77.5	-40.8	
C	A	V	3	3500.0	-	-	25.9	57.5	-31.6	

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 This Test's 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 - Test Set-Up Photo:**

Radiated Disturbance Emissions



## Test 4: 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	.25%
Above 900	.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 4 - 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	55	22.5	100.4	P	7/19/02	

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

**Comments:**

Comment #	Description

**Test Equipment Used:**

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
HI0034	Environmental Indicator	Cole-Palmer	99760-00	10/1/01	10/31/02
SAR001	Spectrum Analyzer / Receiver	Hewlett-Packard	8572A	12/3/01	12/31/02

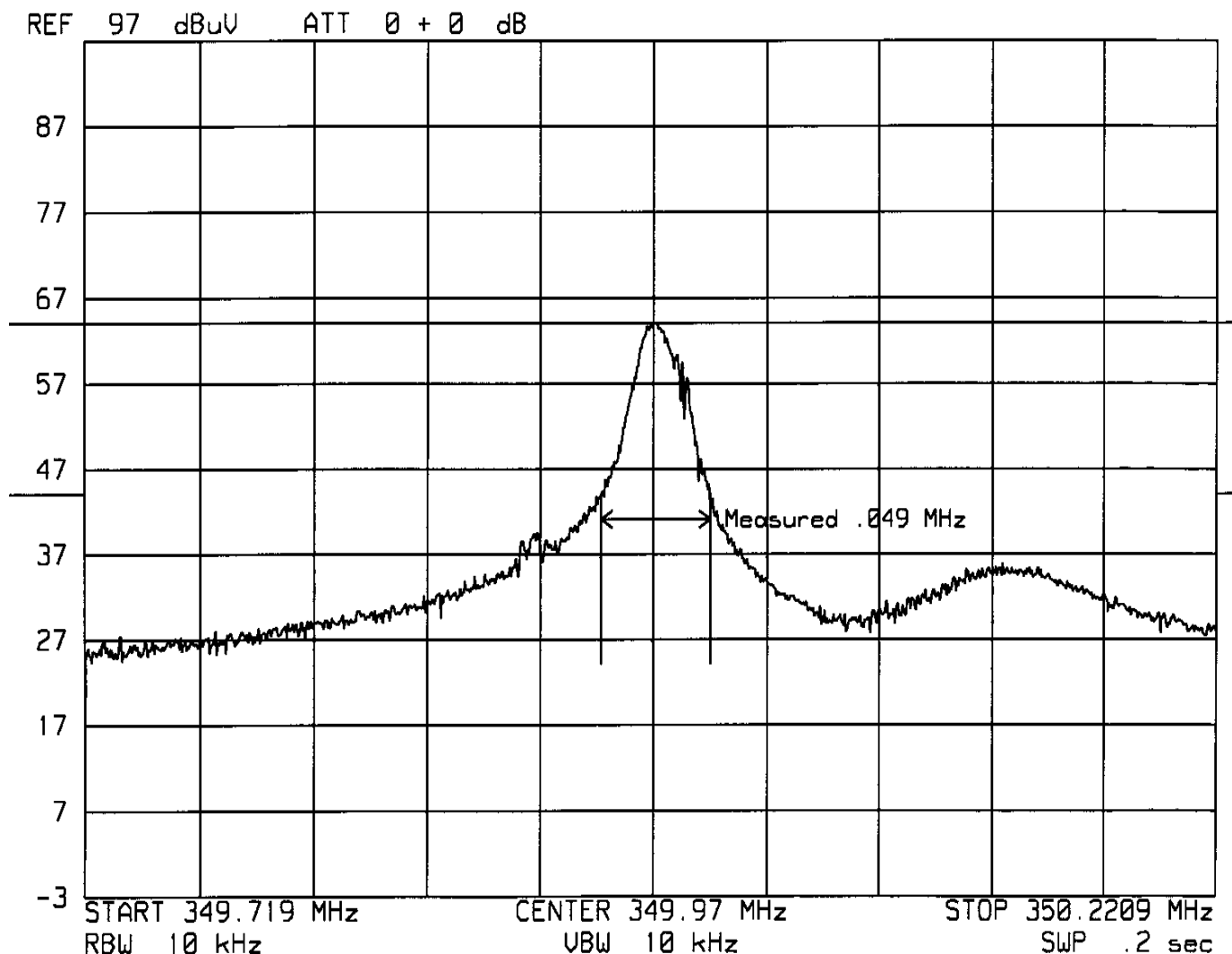
The above equipment has been calibrated and is within the manufacturer's published limit of error. Calibration is traceable to the National Institute of Standards & Technology(NIST) and conforms to ANSI/NCSL Z540-1-1994.



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

Radiated Disturbance Emissions - Occupied Bandwidth

MODEL W-52



**Discrete Data:**

Test Item (A-Z)	Center Frequency (MHz)	Measured Bandwidth (MHz)	Bandwidth (% of Center Frequency)	Maximum Permitted Bandwidth (% of Center Frequency)	Pass/Fail (P/F)	See Comment*** (#)
A	350	0.049	0.014%	0.25%	P	

Notes: \*\*\* # = See Comment Number Under This Test's Comments Section.

## Test 5: 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 5 - 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	D	43	22.0	100.0	N/A	7/16/02	

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

**Comments:**

Comment #	Description
1	Each transmission: 4 short pulses x 160 us + 9 long pulses x 340 us = 3700 us total on time.

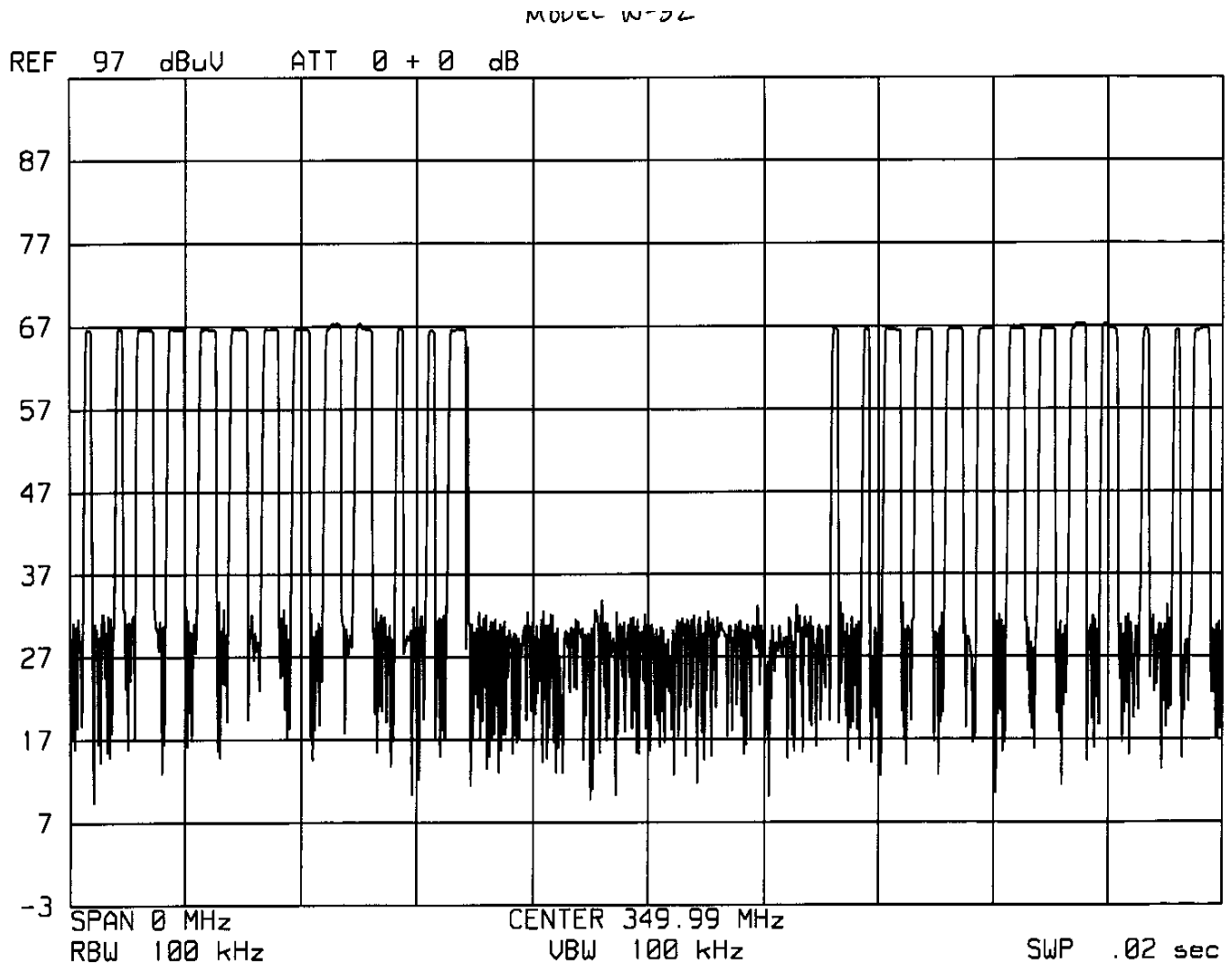
**Test Equipment Used:**

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
HI0034	Environmental Indicator	Cole-Palmer	99760-00	10/1/01	10/31/02
SAR001	Spectrum Analyzer / Receiver	Hewlett-Packard	8572A	12/3/01	12/31/02

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 - Peak Plot (Amplitude in dBuV):**

Radiated Disturbance Emissions - Peak-to-Average Ratio



**Discrete Data:**

Test Item (A-Z)	Total ON time per transmission (ms)	Total period of transmission (ms)*	Duty Cycle (On time/ total period)	Peak-to-Average Ratio (dB)**	See Comment*** (#)
C	3.7	12.8	29%	-10.78	

Notes: \* Or 100 milliseconds, whichever is less

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

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

## 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	D	45	220	100.1	P	7/16/02	1

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

**Comments:**

Comment #	Description
1	See Tests 1 through 3 for data.
2	The transmit frequency was not located within a restricted band.
3	All spurious emissions located within a restricted band were found to comply with the general limits found in 15.209.

**Accreditation Certificates:**

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

ISO/IEC 17025:1999  
ISO 9002:1994

**Scope of Accreditation**

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ELECTROMAGNETIC COMPATIBILITY AND TELECOMMUNICATIONS NVLAP LAB CODE 200246-0

UNDERWRITERS LABORATORIES, INC.

NVLAP Code Designation / Description

12/P01	FCC Method - 47 CFR Part 15 - Digital Devices
12/P01a	Conducted Emissions, Power Lines, 450 KHz to 30 MHz
12/P01b	Radiated Emissions
12/T01	AS/NZS 3548: Electromagnetic Interference - Limits and Methods of Measurement of Information Technology Equipment

Immunity Test Methods:

12/T01	IEC 61000-4-2 (1995) and Amendment 1 (1998): Electrostatic Discharge Immunity Test
12/T02	IEC 61000-4-3 (1995) and Amendment 1 (1998): Radiated, Radio-Frequency Electromagnetic Field Immunity Test
12/T03	IEC 61000-4-4 (1995): Electrical Fast Transient/Burst Immunity Test
12/T04	IEC 61000-4-5 (1995): Surge Immunity Test
12/T05	IEC 61000-4-6 (1996): Immunity to Conducted Disturbances, Induced Radio-Frequency Fields
12/T06	IEC 61000-4-8 (1993): Power Frequency Magnetic Field Immunity Test

June 30, 2003

David F. Alderman

Effective through

For the National Institute of Standards and Technology

NVLAP-013 (08-01)

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

ISO/IEC 17025:1999  
ISO 9002:1994

**Scope of Accreditation**

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ELECTROMAGNETIC COMPATIBILITY AND TELECOMMUNICATIONS NVLAP LAB CODE 200246-0

UNDERWRITERS LABORATORIES, INC.

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E-Mail: Rick.A.Titus@us.ul.com  
URL: http://www.ul.com

NVLAP Code Designation / Description

Emissions Test Methods:

12/CIS14	CISPR 14-1 (March 30, 2000): Limits and methods of measurement of radio interference characteristics of household electrical appliances, portable tools and similar electrical apparatus - Part 1: Emissions
12/CIS14a	EN 55014-1 (1993) with Amendments A1 (1997) & A2 (1999)
12/CIS14b	AS/NZS 1944 (1995)
12/CIS22	IEC/CISPR 22 (1997) and EN 55022 (1998): Limits and methods of measurement of radio disturbance characteristics of information technology equipment
12/CIS22a	IEC/CISPR 22:1993: Limits and methods of measurement of radio disturbance characteristics of information technology equipment, Amendment 1:1995, and Amendment 2:1996
12/CIS22b	CNS 13408:1997: Limits and Methods of Measurement of Radio Interference Characteristics of Information Technology Equipment

June 30, 2003

David F. Alderman

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For the National Institute of Standards and Technology

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ISO/IEC 17025:1999  
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**Scope of Accreditation**

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ELECTROMAGNETIC COMPATIBILITY AND TELECOMMUNICATIONS NVLAP LAB CODE 200246-0

UNDERWRITERS LABORATORIES, INC.

NVLAP Code Designation / Description

12/T07	IEC 61000-4-11 (1994): Voltage Dips, Short Interruptions and Voltage Variations Immunity Tests
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Safety Test Methods:

12/T41	ACA TS-001: Safety Requirements for Consumer Equipment
12/T58	AS/NZS 3260: Safety of Information Technology Equipment Including Electrical Business Equipment

June 30, 2003

David F. Alderman

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For the National Institute of Standards and Technology

NVLAP-013 (08-01)

### **Measurement Uncertainty Statement**

The limits and test levels used in this report are based on the referenced standards and/or specifications listed without regard to the estimated uncertainty of measurements factors listed below. Any statement in this report related to the compliance or non-compliance with the applicable limits does not include adjustments for the estimates of measurement uncertainty.

1. For those results that remain within the stated limits after the application of the estimate of measurement uncertainty factors, the statement of compliance of items, as tested, is confirmed.
2. For those results that do not remain within the stated limits after the application of the estimate of measurement uncertainty factors, the statement of compliance is **not** changed by UL; however, the manufacturer is advised that the margin of compliance should be improved to ensure that margin of compliance with condition 1 listed above is achieved.

**Note:** The final determination of compliance or non-compliance with the limits of a particular standard and/or specification may require including the application of the measurement uncertainty factors listed, if required by the standard or specification. Manufacturers are advised to consider this possible requirement in issuing declarations of conformity, certificates of compliance, or the like based on this test report.

<b>Test</b>	<b>Expanded Estimate of Uncertainty</b> (k = 2, for 95% of a normal distribution)	<b>Units</b>
Radiated Emissions: <ul style="list-style-type: none"><li>• 3 and 10 meter measurement distances</li><li>• 1 meter measurement distance</li></ul>	+/- 3.1 dB +/- 2.5 dB	Volts/meter Volts/meter
Conducted Emissions:	+/- 0.9 dB	Volts
Electrostatic Discharge	+/- 2.2 %	Volts
Radiated RF Immunity:	+/- 2.7 dB	Volts/meter
Electrical Fast Transients/Bursts Immunity	+/- 4.6 %	Volts
Surge Immunity	+/- 4.6 %	Volts
Conducted RF Immunity	+/- 2.8 %	Volts
Power Frequency Magnetic Field Immunity	+/-13.6 %	Amps/meter
Voltage Dips and Short Interrupts	+/-4.2 %	Volts
Radiated RF Immunity (Tri-plate)	+/-3.2 %	Volts/meter