

Underwriters Laboratories Inc.  
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Melville, New York 11747-3081  
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**Report of Measurements  
of Electromagnetic Compatibility Testing**

Test Report File No.: **NC2219** Date of issue: 11/5/02  
Applicant: Lutron Electronics Co. Inc.  
Model.: HR-REP  
Product Type: RF Signal Repeater  
Power Supply: 120Vac, 60Hz  
Manufacturer: Same As Applicant  
License holder: Same As Applicant  
Address: 7200 Sutron Road  
Coopersburg, PA 18036  
Test Type:  **Compliance Investigation**  
 **Manufacturer's Specification**  
Test Project Number: 02ME20017  
References(s): FCC ID: JPZ0022

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## 1.0 G E N E R A L - Product Description

**Device Function:** The HR-REP acts as a signal repeater in an integrated lighting control system. It contains an FM transceiver and an antenna. The purpose of a RF communication is to transmit and receive command signals. Transmitted commands allow the triggering of system events and the updating of control indicator status.

**RF Function:** The receiver down converts a 431-437MHz-carrier frequency using a 420.3-426.3MHz voltage-controlled oscillator producing a 10.7MHz IF signal. The signal is further processed to decode data. The transmitter uses the voltage-controlled oscillator, which is frequency modulated, and power amplifier to produce the modulated carrier. The HR-REP contains a micro controller running at 32MHz to ensure that all transmissions stop within 5 seconds of a button release or within 5 seconds on the beginning of a transmission. A transmission shall automatically cease within 5 seconds after activation. Modulation is FM, sometimes referred to as Frequency Shift Keyed (FSK), data at 62.5kbps. The antenna cannot be modified or easily replaced by the user.

**Analog Function:** The HR-REP obtains power through a 120Vac to 9Vdc Class 2 transformer. The voltage is then linearly regulated down to a 5Vdc output, which is used to power all analog and micro controller activities.

### 1.1 Device Configuration During Test:

The device under test was tested in normal orientation that represents the worst-case orientation.

The device was tested in two modes of operation:

1. Continuously transmitting an intentional radio frequency in Continuous Wave (CW).
2. Standby mode (Receive). The device is waiting to receive a signal source.

The manufacturer configured the device.

The device was powered with 120VAC, 60Hz.

Device	Manufacturer	Model Number	Serial Number	FCC ID
RF Signal Repeater	Lutron	HR-REP	N/A	JPZ0022
Class 2 Power Supply	Lutron	280903003CO	N/A	-----

"The results contained in this report reflect the results for this particular model and serial number. It is the responsibility of the manufacturer to ensure that all production models meet the intent of the requirements detailed within this report"

### 1.2 Deviations from ANSI C63.4

Not applicable, the ANSI C63.4 test measurements procedures were employed

As described below:

### 1.3 Device Modifications Necessary for Compliance

- N/A
- As described below:

### 1.4 Test Summary

Test	Basic Standard	Considered	Tested	In Compliance
Conducted Voltage Emissions (Continuous Data Transmit Mode)	FCC Part 15 Subpart B, Class B. Paragraph 15.205	✓	✓	✓
Radiated Emissions	FCC Part 15 Subpart C, Class B, Intentional Radiators, Paragraph 15.209	✓	✓	✓
Radiated Emissions	FCC Part 15 Subpart B, Class B, Un-Intentional Radiators, Paragraph 15.109	✓	✓	✓
Cease Operation < 5 seconds	FCC Part 15 Subpart C, Paragraph 15.231	✓	✓	✓
Occupied Bandwidth	FCC Part 15 Subpart C, Paragraph 15.231	✓	✓	✓
Pulse Train Measurements Over One Complete Pulse Train	FCC Part 15 Subpart A, Paragraph 15.35	✓	✓	✓

File Number: NC2219  
Project Number: 02ME20017  
Model Number: HR-REP  
FCC ID: JPZ0022

Issued: 11/6/02

## **2.0 EMISSIONS TEST REGULATIONS**

FCC Part 15, Subpart B, Paragraph 15.107 & 15.109  
FCC Part 15 Subpart C, Paragraph 15.205, 15.207, 15.209 & 15.231

### **2.1 EUT OPERATION MODE - EMISSIONS TESTS**

As per manufacturer's instructions: Continuous Data Transmit for Conducted Emissions, Constant (Continuous) Wave Transmit and Receive modes for all other tests

File Number: NC2219  
Project Number: 02ME20017  
Model Number: HR-REP  
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### 2.1.1 Conducted Emissions Tests:

Test Applicable       Test Not Applicable

Temperature:                      21.1      °C  
Humidity:                         40        %RH  
Pressure:                         1035     milbar  
Date test performed:         18 October 2002

Mode: "Continuous Data Transmit" @ 437 MHz was determined worst-case emissions.

**Frequency range on each side of line.**

**Measurement Point**

150kHz to 30MHz       Voltage

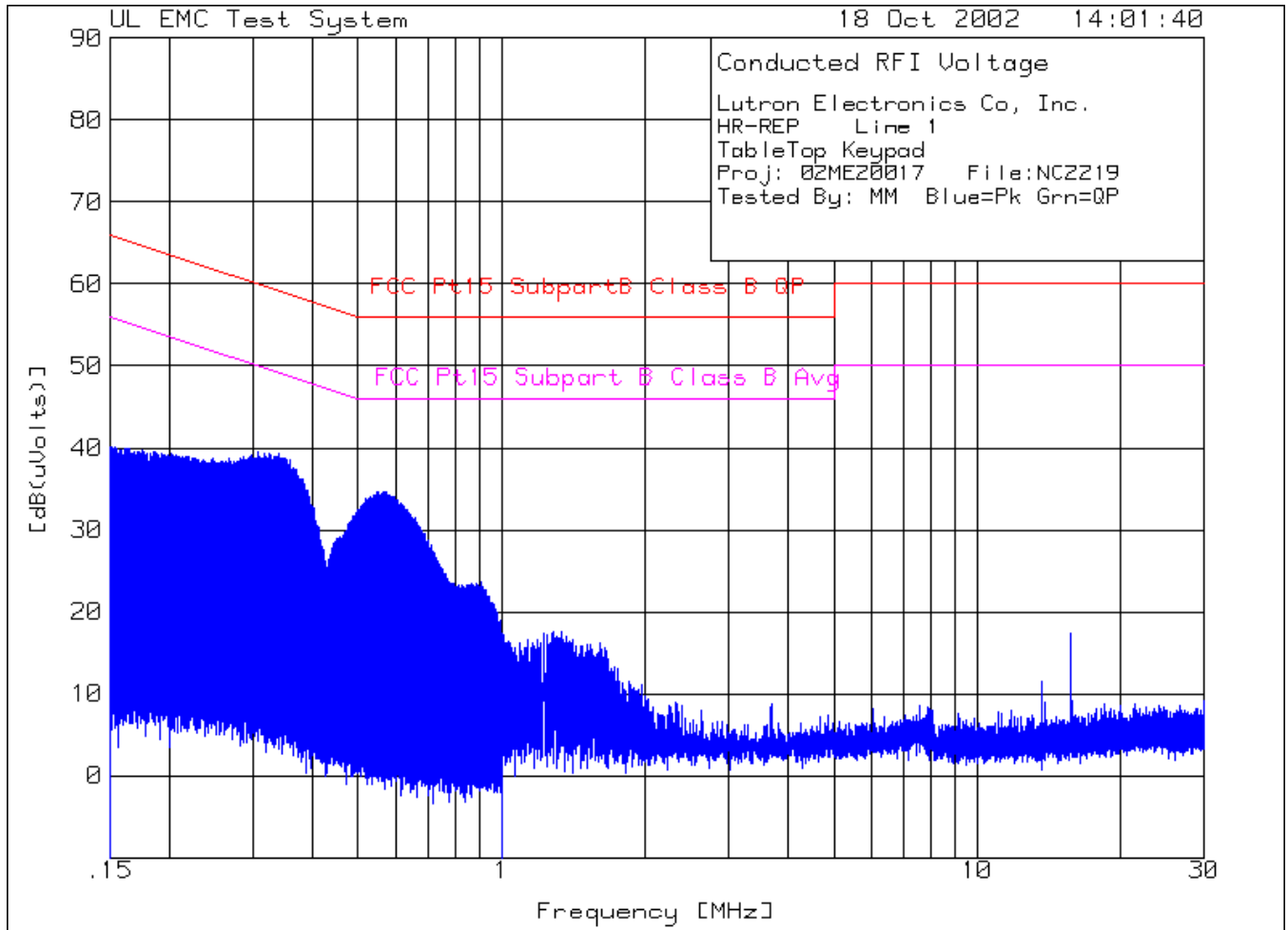
Mains

**Test equipment used for conducted emissions:**

<input checked="" type="checkbox"/> <b>ES126</b>	<b>Rhode &amp; Schwartz</b>	<b>EMI Receiver</b>	<b>Equipment No.: ME5B-081</b>
Range: 150k-30MHz	Last Calibration Date: 20 August 2002		Calibration Due Date: 20 August 2003

**Test Accessories for Conducted Emissions:**

<input checked="" type="checkbox"/> <b>11947A</b>	<b>Hewlett Packard</b>	<b>Transient Limiter</b>	<b>Equipment No.: ME5A-443</b>
Last Calibration Date: 16 January 2002      Calibration Due Date: 16 January 2003			
<input checked="" type="checkbox"/> <b>9252-50-R-24-BNC</b>	<b>Solar Electronics</b>	<b>LISN</b>	<b>Equipment No.: ME5A-637</b>
Last Calibration Date: 04 April 2002      Calibration Due Date: 04 April 2003			
<input checked="" type="checkbox"/> <b>Temp/Pressure</b>	<b>Oakton</b>	<b>Barometer</b>	<b>Equipment No.: ME4-263</b>
Range: 900-1040mbar	Last Calibration Date: 02 April 2002	Calibration Due Date: 02 April 2003	
<input checked="" type="checkbox"/> <b>453320</b>	<b>Ex-Tech</b>	<b>Hydro-Thermometer</b>	<b>Equipment No.: ME4-264</b>
Range: 0-80%	Last Calibration Date: 02 April 2002	Calibration Due Date: 02 April 2003	





File Number: NC2219  
 Project Number: 02ME20017  
 Model Number: HR-REP  
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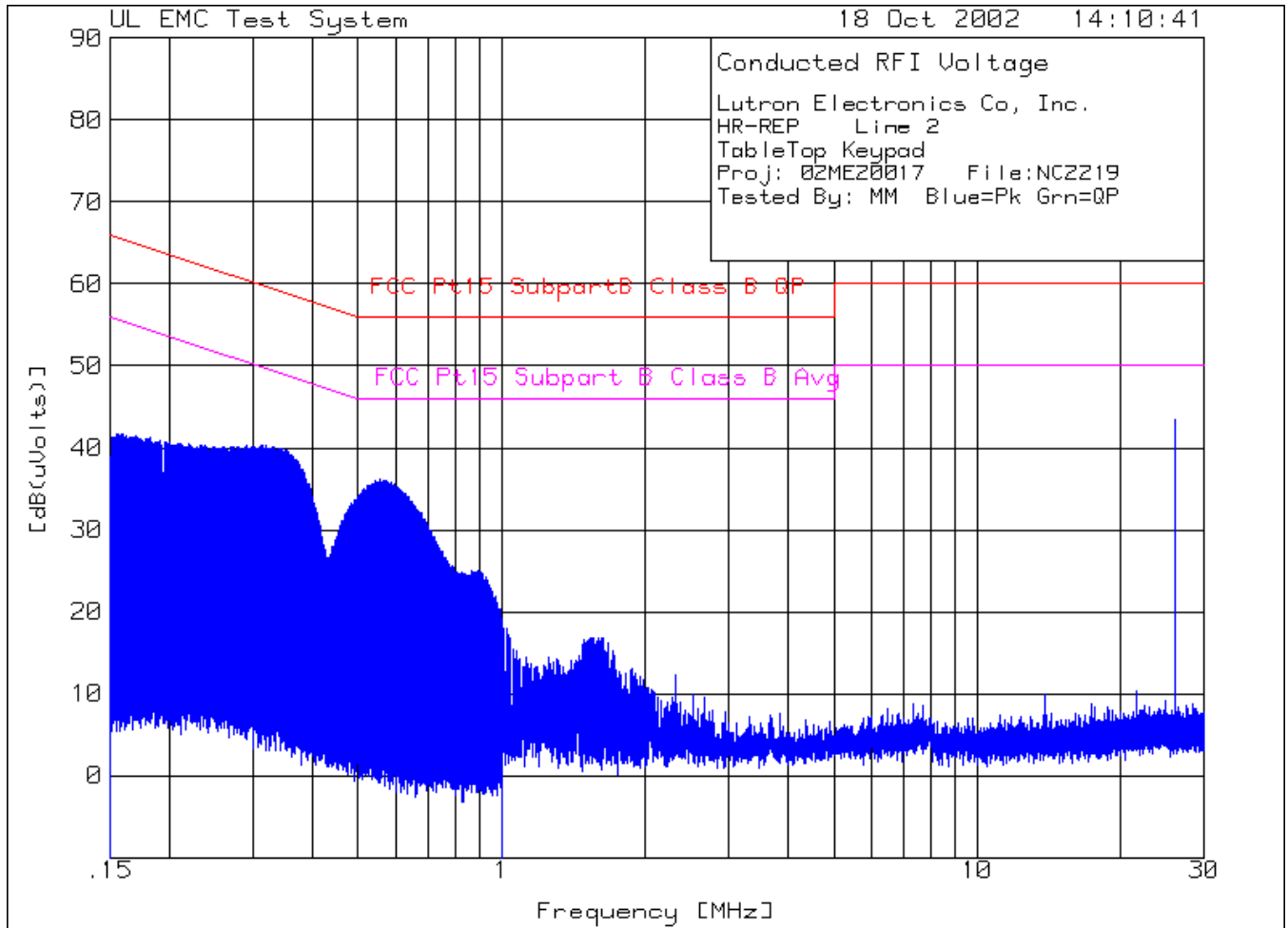
Issued: 11/6/02

Lutron Electronics Co, Inc.  
 HR-REP Line 1  
 TableTop Keypad  
 Proj: 02ME20017 File:NC2219  
 Tested By: MM Blue=Pk Grn=QP

No.	Test Frequency [MHz]	Meter Reading [dB (uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level [dB (uVolts)]	Limit:1	2
=====							
Range: 1 .15 - 1MHz -----							
1	.16207	29.58 pk	10.3	0	39.88	65.4	55.4
				Margin [dB]		-25.52	-15.52
2	.18732	29.25 pk	10.3	0	39.55	64.2	54.2
				Margin [dB]		-24.65	-14.65
3	.33965	28.98 pk	10.3	0	39.28	59.2	49.2
				Margin [dB]		-19.92	-9.92
4	.56637	24.04 pk	10.3	0	34.34	56	46
				Margin [dB]		-21.66	-11.66
-----							
Range: 2 1 - 30MHz -----							
5	1.33643	7.22 pk	10.4	0	17.62	56	46
				Margin [dB]		-38.38	-28.38
6	15.66387	6.53 pk	10.9	0	17.43	60	50
				Margin [dB]		-42.57	-32.57

LIMIT 1: FCC Pt15 SubpartB Class B QP  
 LIMIT 2: FCC Pt15 Subpart B Class B Avg  
 LIMIT 3: NONE  
 LIMIT 4: NONE  
 LIMIT 5: NONE  
 LIMIT 6: NONE

pk - Peak detector  
 qp - Quasi-Peak detector  
 av - Average detector  
 avlg - denotes average log detection  
 avem - denotes EMI average detection  
 tm - Trace Math Result



Transmit at 437MHz

File Number: NC2219  
 Project Number: 02ME20017  
 Model Number: HR-REP  
 FCC ID: JPZ0022

Issued: 11/6/02

Lutron Electronics Co, Inc.  
 HR-REP Line 2  
 TableTop Keypad  
 Proj: 02ME20017 File:NC2219  
 Tested By: MM Blue=Pk Grn=QP

No.	Test Frequency [MHz]	Meter Reading [dB (uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level [dB (uVolts)]	Limit:1	2
Range: 1 .15 - 1MHz -----							
1	.15935	31.38 pk	10.3	0	41.68	65.5	55.5
				Margin [dB]		-23.82	-13.82
2	.18222	30.92 pk	10.3	0	41.22	64.4	54.4
				Margin [dB]		-23.18	-13.18
3	.3309	29.82 pk	10.3	0	40.12	59.4	49.4
				Margin [dB]		-19.28	-9.28
4	.57521	25.65 pk	10.3	0	35.95	56	46
				Margin [dB]		-20.05	-10.05
Range: 2 1 - 30MHz -----							
5	1.53945	6.46 pk	10.4	0	16.86	56	46
				Margin [dB]		-39.14	-29.14
6	25.9773	32.04 pk	11.3	0	43.34	60	50
				Margin [dB]		-16.66	-6.66

LIMIT 1: FCC Pt15 SubpartB Class B QP  
 LIMIT 2: FCC Pt15 Subpart B Class B Avg  
 LIMIT 3: NONE  
 LIMIT 4: NONE  
 LIMIT 5: NONE  
 LIMIT 6: NONE

pk - Peak detector  
 qp - Quasi-Peak detector  
 av - Average detector  
 avlg - denotes average log detection  
 avem - denotes EMI average detection  
 tm - Trace Math Result



Conducted Emissions Test Set-Up 150k-30MHz

File Number: NC2219  
Project Number: 02ME20017  
Model Number: HR-REP  
FCC ID: JPZ0022

Issued: 11/6/02

### 2.1.1 Cease Operation Within 5 Seconds

Test Applicable       Test Not Applicable

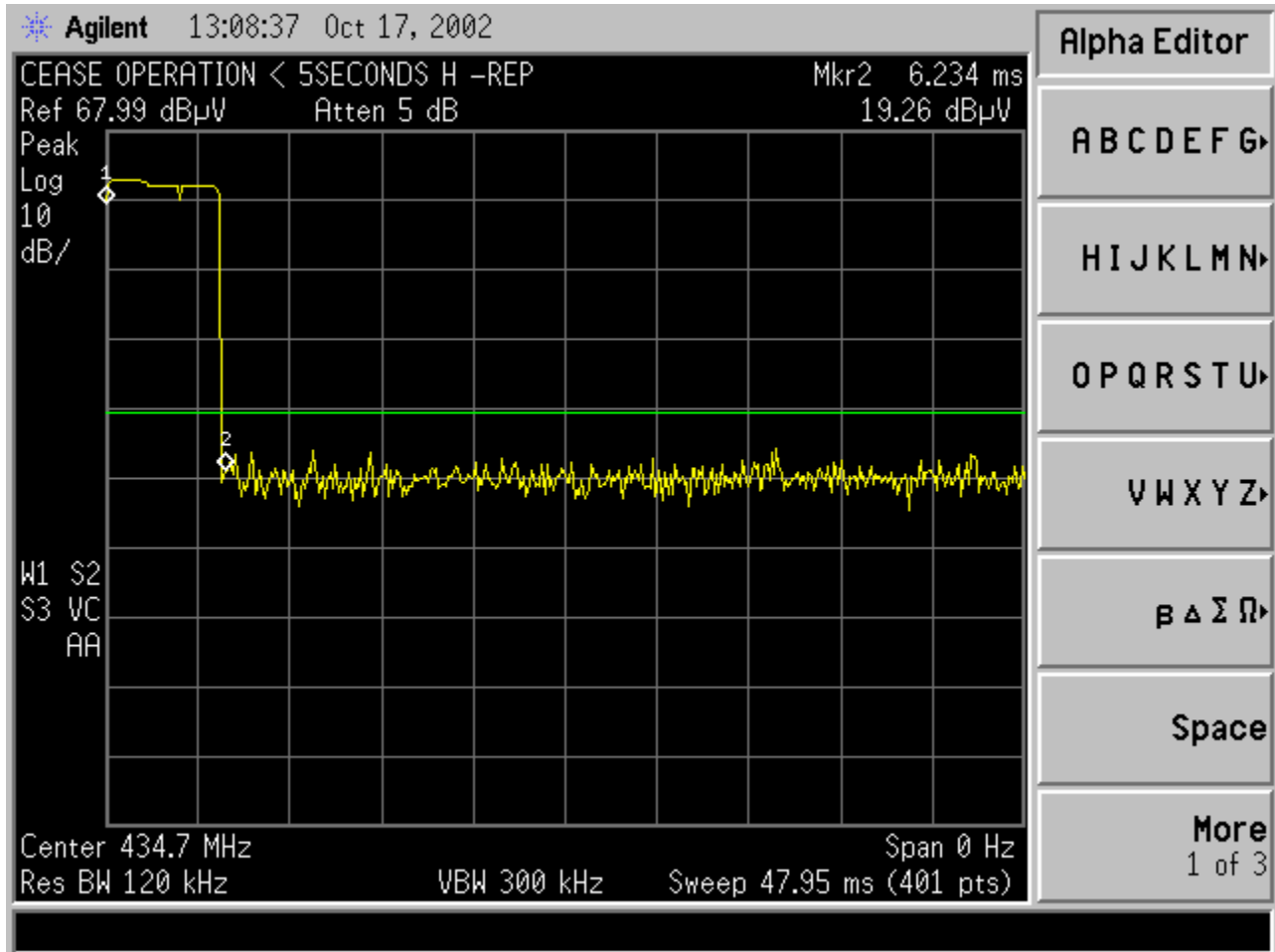
Test Procedure:

This test is performed one time at any frequency band. A manual operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

A transmitter activated automatically shall cease transmission within 5 seconds after activation.

**Test Accessories:**

<input checked="" type="checkbox"/> <b>E7402A</b>	<b>Agilent</b>	<b>EMC Analyzer</b>	<b>Equipment No.: 5B-123</b>
Last Calibration Date: 17 Sept. 2002		Calibration Due Date: 17 September 2003	
<input checked="" type="checkbox"/> <b>Temp/Pressure</b>	<b>Oakton</b>	<b>Barometer</b>	<b>Equipment No.: ME4-263</b>
Range:950-1045	Last Calibration Date: 2 April 02	Calibration Due Date:2 April 03	
<input checked="" type="checkbox"/> <b>453320</b>	<b>Ex-Tech</b>	<b>Hydro-Thermometer</b>	<b>Equipment No.: ME4-264</b>
Range:0-80%	Last Calibration Date:2 April 02	Calibration Due Date:2 April 03	



HR-REP < 5 Seconds (total activation time 6.234ms)



Test Set-Up Cease Operation < 5 seconds

### 2.1.3 Radiated Emissions Test (10 Meter Semi-Anechoic Chamber)

Test Applicable       Test Not Applicable

Temperature:                      22.1°C  
Humidity:                         44%RH  
Pressure:                         1030milbar  
Date test performed:         16 Oct. 2002

The EUT (equipment under test) was tested in 3 orthogonal axes and the orientation depicted in the Radiated Emission test set-up was deemed worst case.

Mode: "Constant Wave Transmit"

Measurement distance:         3 intentional Radiator    10 meters un-intentional radiator

Frequency Range:            Measurement Distance for 50Hz – 10kHz

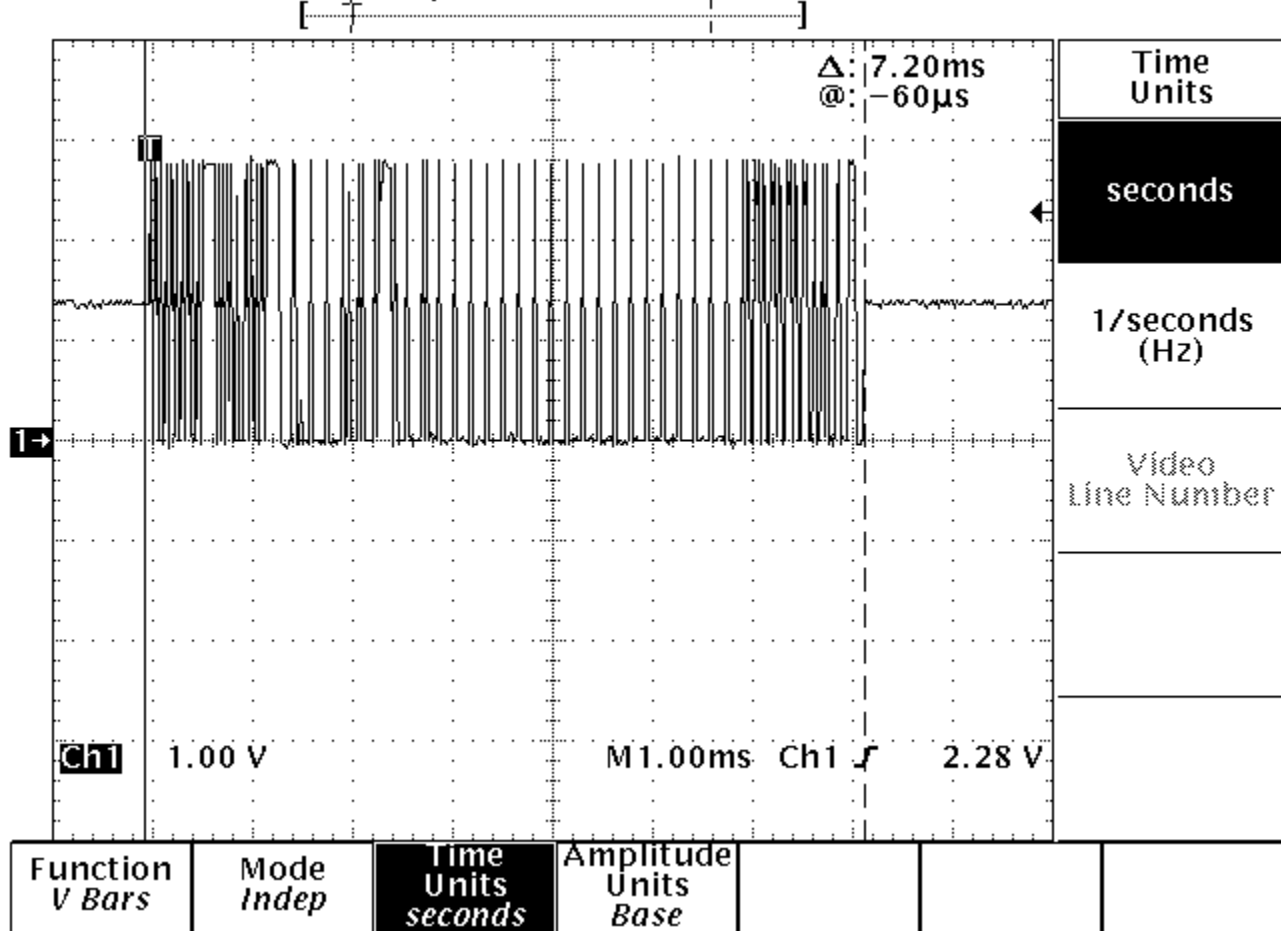
- |   |   |
|---|---|
| <input checked="" type="checkbox"/> 30MHz - 5000MHz | <input checked="" type="checkbox"/> Electric Intentional @ low band 431MHz & High band 437MHz   |
| <input checked="" type="checkbox"/> 30MHz - 2000MHz | <input checked="" type="checkbox"/> Electric Unintentional @ low band 431MHz & High band 437MHz |

#### Paragraph 15.35:

When the Radiated Limits are expressed in terms of the average value of the emissions, and pulse operation is employed, the pulse measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds (100ms) or in cases where the pulse train exceeds 0.1seconds the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value.

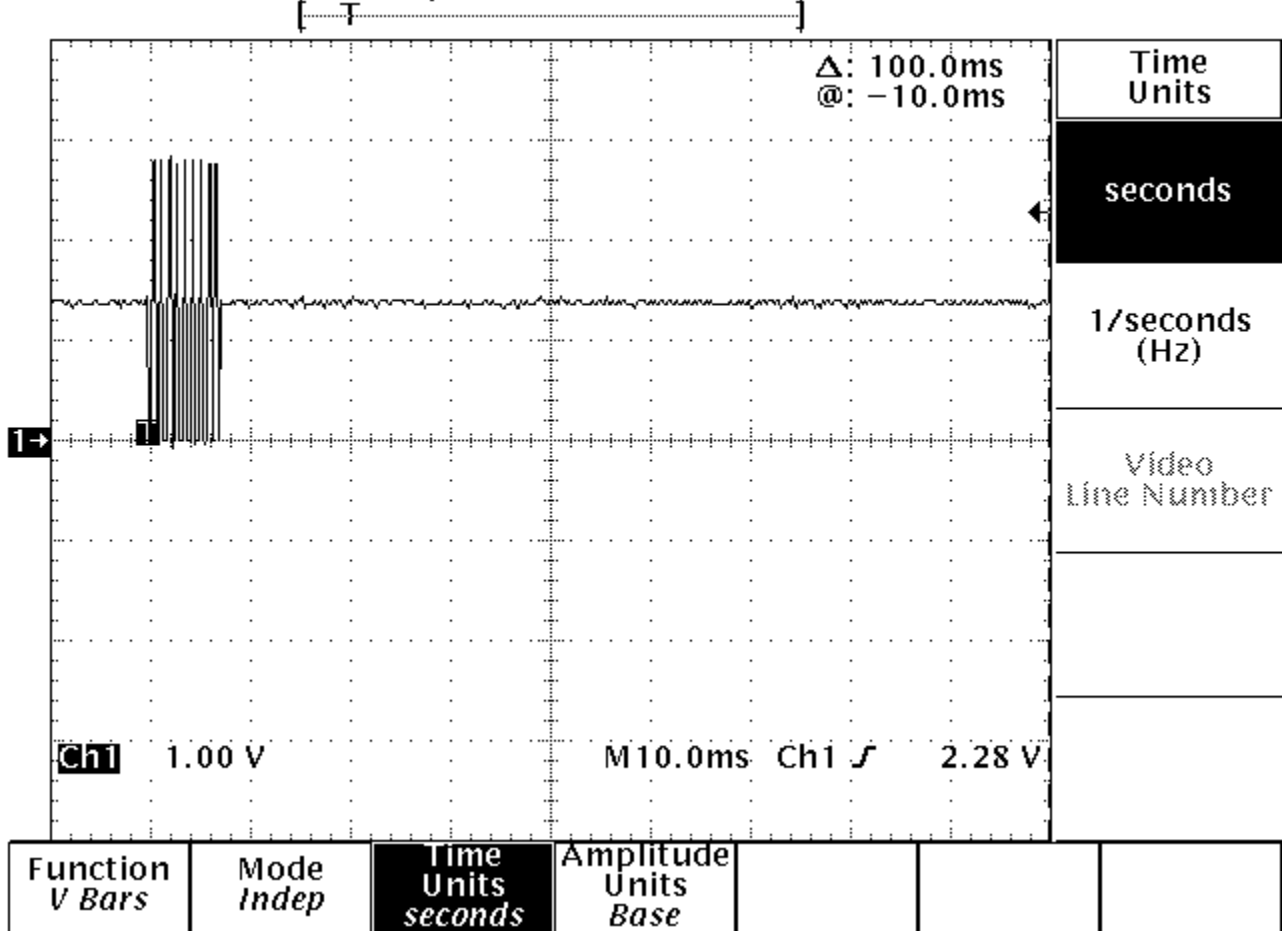


Tek Run: 50.0kS/s Sample



HR-REP One Complete Pulse Train 7.2ms expanded view profile

Tek Run: 5.00kS/s Sample



HR-REP One Complete Pulse Train < 100ms wide profile

File Number: NC2219  
 Project Number: 02ME20017  
 Model Number: HR-REP  
 FCC ID: JPZ0022

Issued: 11/6/02

**Test equipment used for final radiated emissions tests:**

**HP 8574A**                      **Hewlett-Packard**                      **EMI Receiver,**                      **Equipment No.: ME5A-461**  
 Range:30-1000MHz      Last Calibration Date:25 Jan 02                      Calibration Due Date: 25 Jan 03

**Consisting of:**

<b>HP - 8566B</b>	<b>Hewlett-Packard</b>	<b>Spectrum Analyzer,</b>
	<b>Resolution BW:</b>	<b>9kHz to 30 MHz</b>
		<b>30MHz to 1000 MHz</b>
	<b>Video BW:</b>	<b>9kHz to 30 MHz</b>
		<b>30MHz TO 1000MHz</b>
<b>HP - 85662A</b>	<b>Hewlett-Packard</b>	<b>Analyzer Display</b>
<b>HP - 85650A</b>	<b>Hewlett-Packard</b>	<b>Quasi-Peak Adapter,</b>
	<b>Quasi Peak BW:</b>	<b>9kHz to 150kHz</b>
		<b>150kHz to 30MHz</b>
		<b>30 to 1000 MHz</b>
<b>HP - 85685A</b>	<b>Hewlett-Packard</b>	<b>Preselector</b>

**For Measurements above 1GHz:**

**HP - 8566B**                      **Hewlett-Packard**                      **Spectrum Analyzer,**                      **Equipment No.: ME5A-461**  
**Resolution BW: 1MHz**  
**Video BW: 1MHz**

Range: 1- 2 GHz      Last Calibration Date:30 April 02      Calibration Due Date: 30 April 03

**HP - 85662A**                      **Hewlett-Packard**                      **Analyzer Display**                      **Equipment No. ME5A-461**  
 Last Calibration Date:30 April 02                      Calibration Due Date: 30 April 03

**Test Accessories for Radiated Emissions:**

**94455-1**                      **Ailtech**                      **Biconnical Antenna**                      **Equipment No.: ME5-439**  
 Last Calibration Date:16 Oct 02                      Calibration Due Date: 16 Oct 03

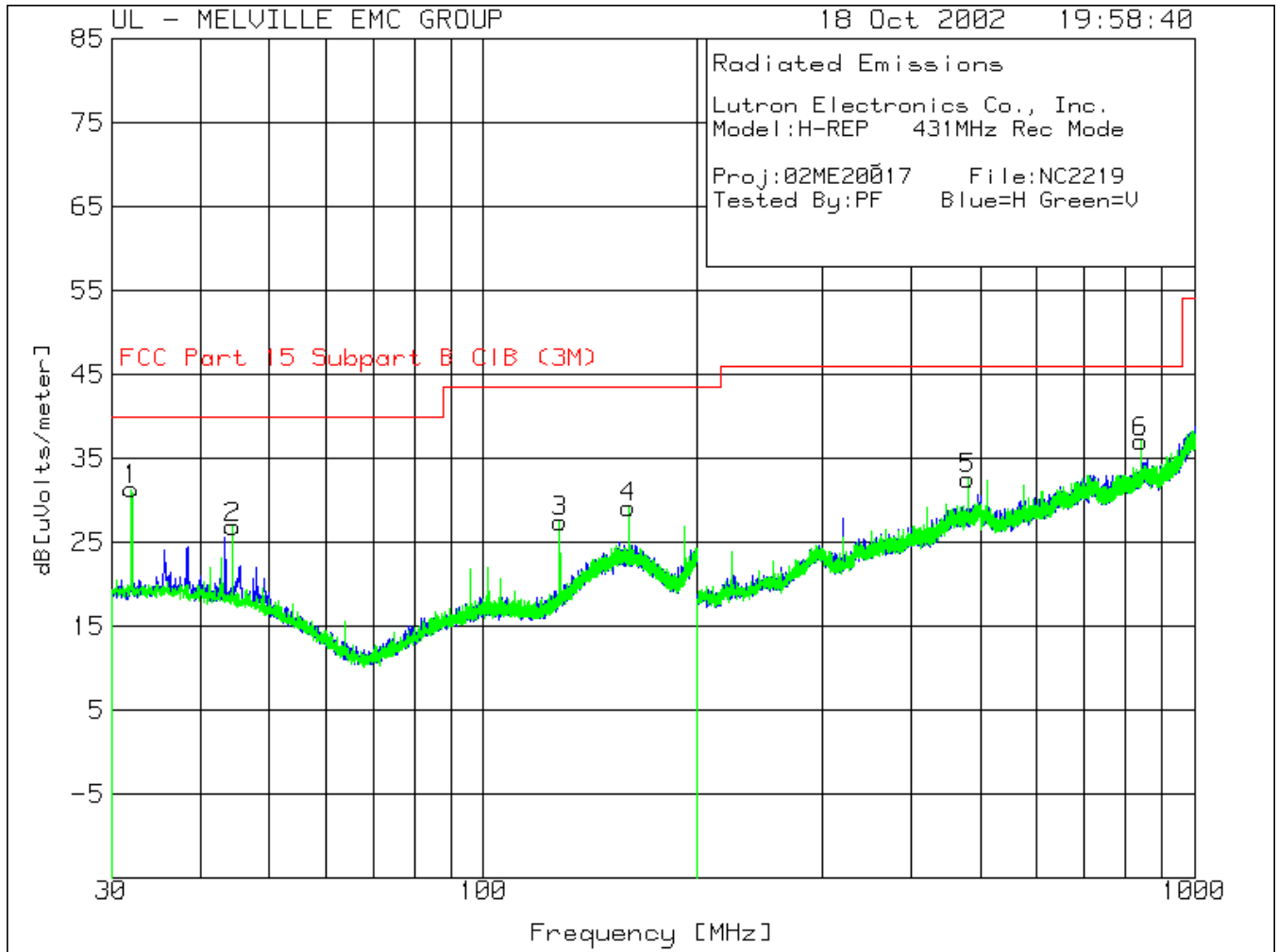
**3146**                      **EMCO**                      **Log Periodic Antenna**                      **Equipment No.: ME5-451**  
 Last Calibration Date:15 Oct 02                      Calibration Due Date: 15 Oct 03

**Temp/Pressure**                      **Oakton**                      **Barometer**                      **Equipment No.: ME4-263**  
 Range:950-1045      Last Calibration Date: 2 April 02                      Calibration Due Date:2 April 03

**453320**                      **Ex-Tech**                      **Hydro-Thermometer**                      **Equipment No.: ME4-264**  
 Range:0-80%      Last Calibration Date:2 April 02                      Calibration Due Date:2 April 03



Pulse Train Test Set-Up



431MHz Receive Mode

File Number: NC2219  
 Project Number: 02ME20017  
 Model Number: HR-REP  
 FCC ID: JPZ0022

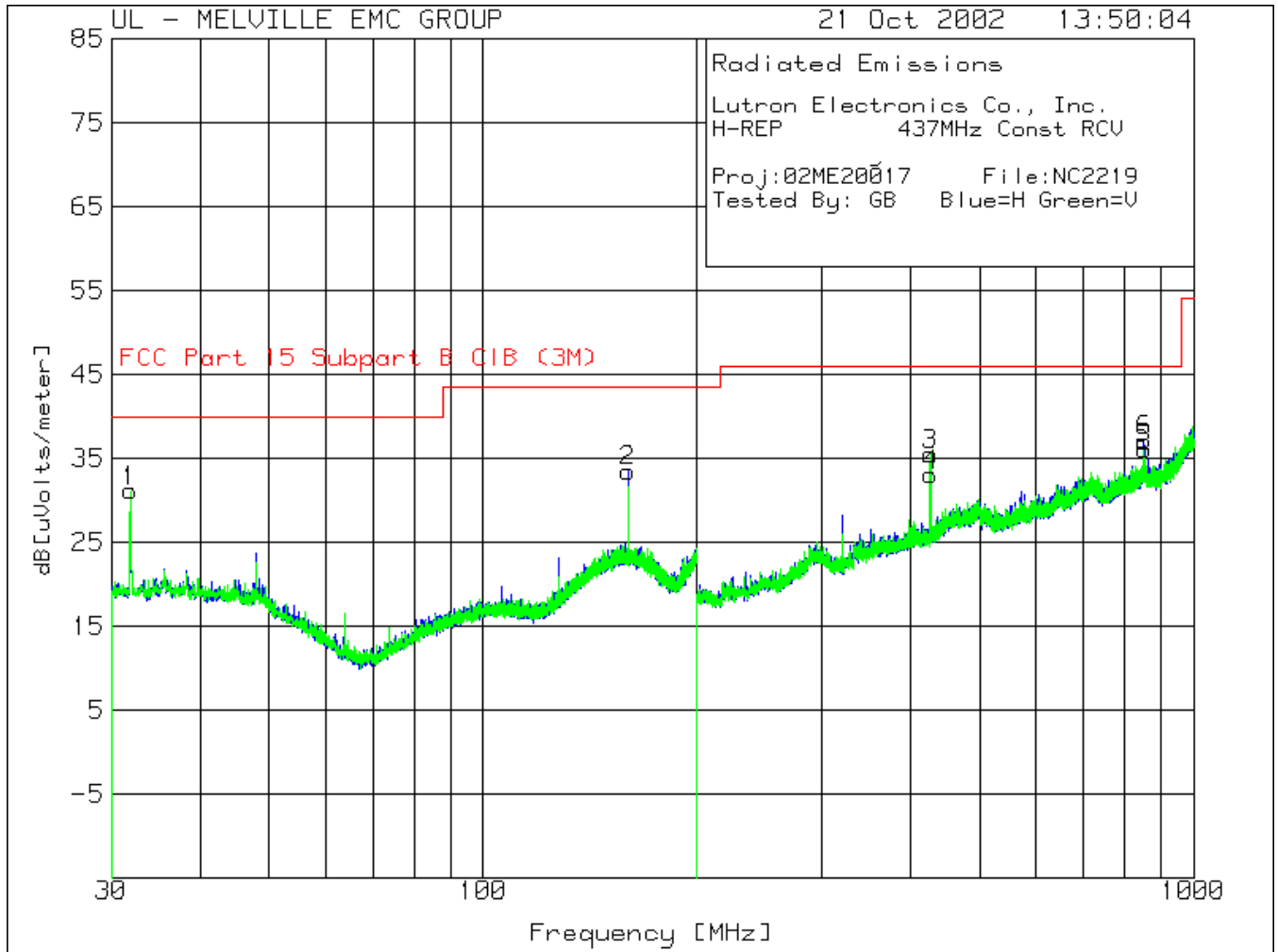
Issued: 11/6/02

Lutron Electronics Co., Inc.  
 Model:H-REP 431MHz Rec Mode  
 RF Signal Repeater  
 Proj:02ME20017 File:NC2219  
 Tested By:PF Blue=H Green=V

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dB[uVolts/meter]	Limit:1
Range: 2 30 - 200MHz -----						
1	31.9535	16.44 pk	.86	14	31.3	40
	Azimuth:255	Height:100	Vert	Margin [dB]		-8.7
2	44.3967	12.71 pk	.99	13.1	26.8	40
	Azimuth:126	Height:100	Vert	Margin [dB]		-13.2
3	127.9953	13.55 pk	1.61	12.34	27.5	43.5
	Azimuth:3	Height:100	Vert	Margin [dB]		-16
4	160.0375	10.52 pk	1.8	16.88	29.2	43.5
	Azimuth:179	Height:100	Vert	Margin [dB]		-14.3
Range: 4 200 - 1000MHz -----						
5	480.0333	11.29 pk	3.41	17.9	32.6	46
	Azimuth:351	Height:101	Vert	Margin [dB]		-13.4
6	840.1332	9.5 pk	4.29	23.21	37	46
	Azimuth:341	Height:101	Vert	Margin [dB]		-9

LIMIT 1: FCC Part 15 Subpart B ClB (3M)  
 LIMIT 2: NONE  
 LIMIT 3: NONE  
 LIMIT 4: NONE  
 LIMIT 5: NONE  
 LIMIT 6: NONE

pk - Peak detector  
 qp - Quasi-Peak detector  
 av - Average detector  
 avlg - denotes average log detection  
 tm - Trace Math Result



File Number: NC2219  
 Project Number: 02ME20017  
 Model Number: HR-REP  
 FCC ID: JPZ0022

Issued: 11/6/02

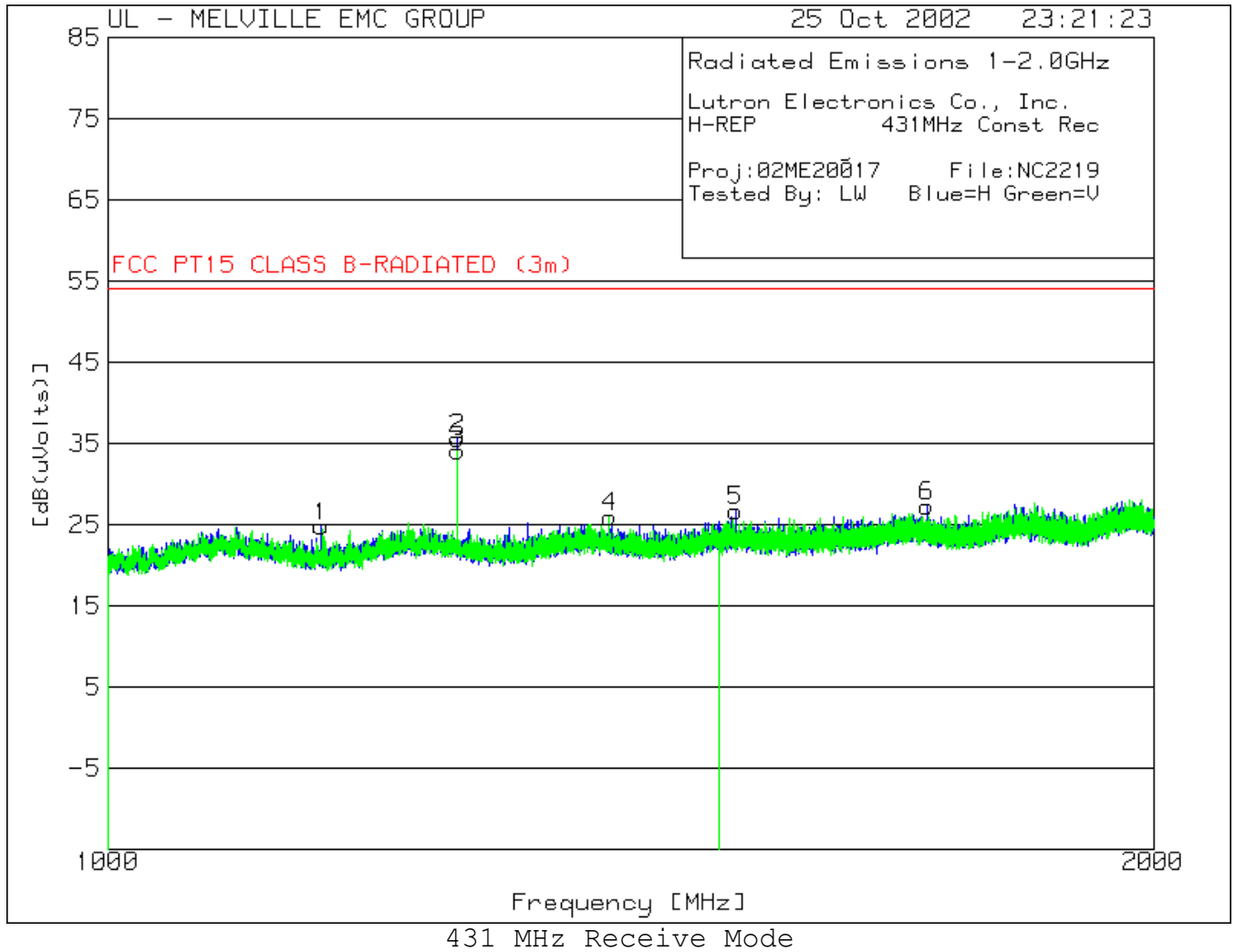
Lutron Electronics Co., Inc.  
 HR-REP 437MHz Const RCV  
 RF Signal Repeater  
 Proj:02ME20017 File:NC2219  
 Tested By: GB Blue=H Green=V

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dB[uVolts/meter]	Limit:1
-----						
Range: 1 30 - 200MHz -----						
2	159.9101	14.8 pk	1.8	16.9	33.5	43.5
	Azimuth:256	Height:199	Horz	Margin [dB]		-10
-----						
Range: 2 30 - 200MHz -----						
1	31.8686	16.24 pk	.86	14	31.1	40
	Azimuth:152	Height:399	Vert	Margin [dB]		-8.9
-----						
Range: 3 200 - 1000MHz -----						
4	426.0783	13.66 pk	3.14	16.2	33	46
	Azimuth:295	Height:100	Horz	Margin [dB]		-13
6	851.99	9.23 pk	4.37	23.5	37.1	46
	Azimuth:222	Height:100	Horz	Margin [dB]		-8.9
-----						
Range: 4 200 - 1000MHz -----						
3	426.0783	16.16 pk	3.14	16.2	35.5	46
	Azimuth:350	Height:200	Vert	Margin [dB]		-10.5
5	851.99	8.23 pk	4.37	23.5	36.1	46
	Azimuth:133	Height:200	Vert	Margin [dB]		-9.9

LIMIT 1: FCC Part 15 Subpart B ClB (3M)  
 LIMIT 2: NONE  
 LIMIT 3: NONE  
 LIMIT 4: NONE  
 LIMIT 5: NONE  
 LIMIT 6: NONE

pk - Peak detector  
 qp - Quasi-Peak detector  
 av - Average detector  
 avlg - denotes average log detection  
 tm - Trace Math Result





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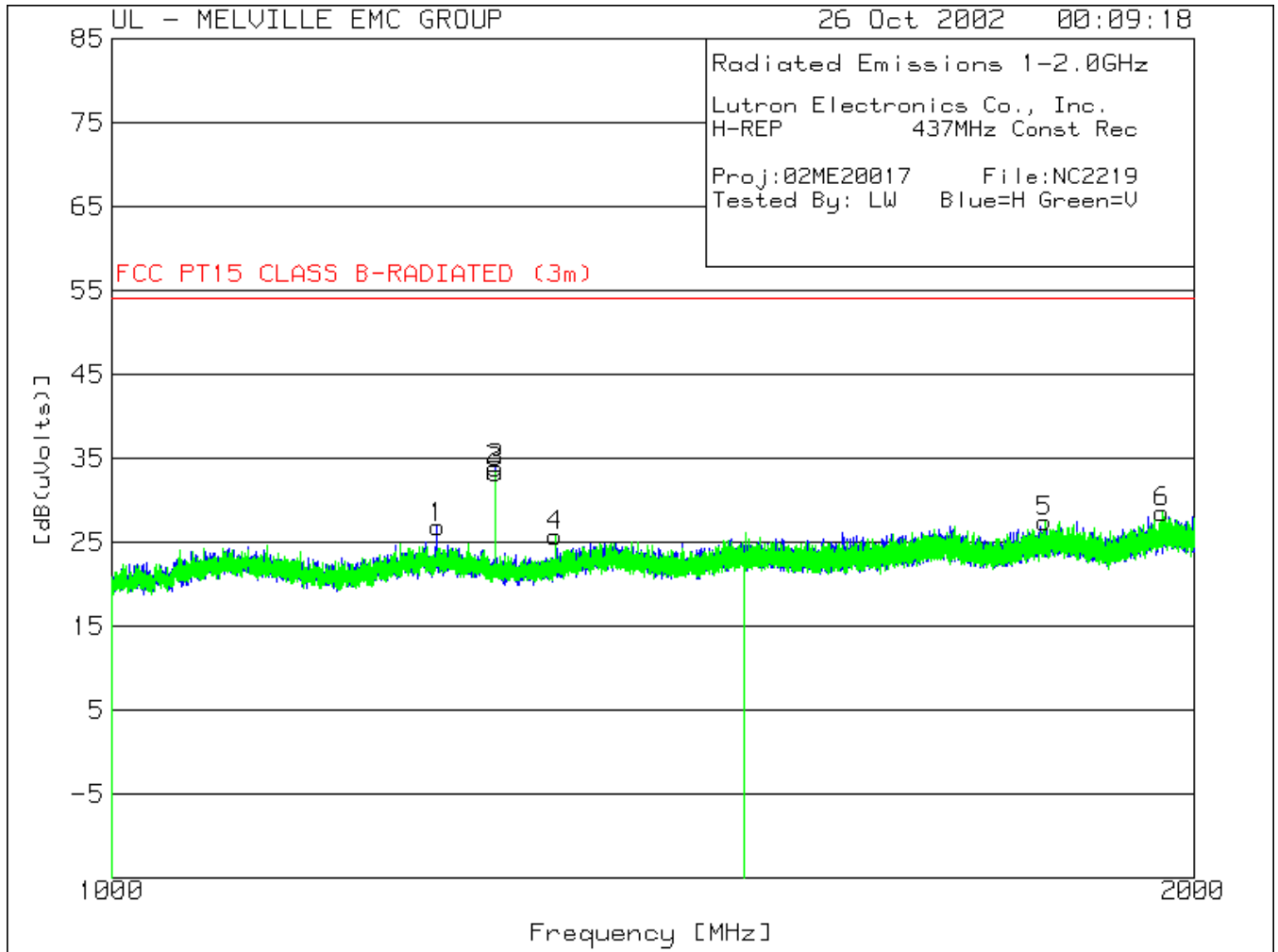
Issued: 11/6/02

Lutron Electronics Co., Inc.  
 HR-REP 431MHz Const Rec  
 RF Signal Repeater  
 Proj:02ME20017 File:NC2219  
 Tested By: LW Blue=H Green=V

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level [dB(uVolts)]	Limit:1
-----						
Range: 1 1000 - 1500MHz -----						
1	1151.873	32.64 pk	-33.29	25.45	24.8	54
	Azimuth:169	Height:100	Horz	Margin [dB]		-29.2
2	1260.866	42.76 pk	-33	25.84	35.6	54
	Azimuth:144	Height:100	Horz	Margin [dB]		-18.4
-----						
Range: 2 1500 - 2000MHz -----						
5	1515.924	32.23 pk	-32.3	26.77	26.7	54
	Azimuth:351	Height:200	Horz	Margin [dB]		-27.3
6	1721.119	31.27 pk	-31.64	27.67	27.3	54
	Azimuth:162	Height:100	Horz	Margin [dB]		-26.7
-----						
Range: 3 1000 - 1500MHz -----						
3	1260.866	41.26 pk	-33	25.84	34.1	54
	Azimuth:293	Height:100	Vert	Margin [dB]		-19.9
4	1394.421	32.32 pk	-32.64	26.32	26	54
	Azimuth:147	Height:100	Vert	Margin [dB]		-28

LIMIT 1: FCC PT15 CLASS B-RADIATED (3m)  
 LIMIT 2: NONE  
 LIMIT 3: NONE  
 LIMIT 4: NONE  
 LIMIT 5: NONE  
 LIMIT 6: NONE

pk - Peak detector  
 qp - Quasi-Peak detector  
 av - Average detector  
 avlg - denotes average log detection  
 tm - Trace Math Result



437MHz Receive Mode

File Number: NC2219  
 Project Number: 02ME20017  
 Model Number: HR-REP  
 FCC ID: JPZ0022

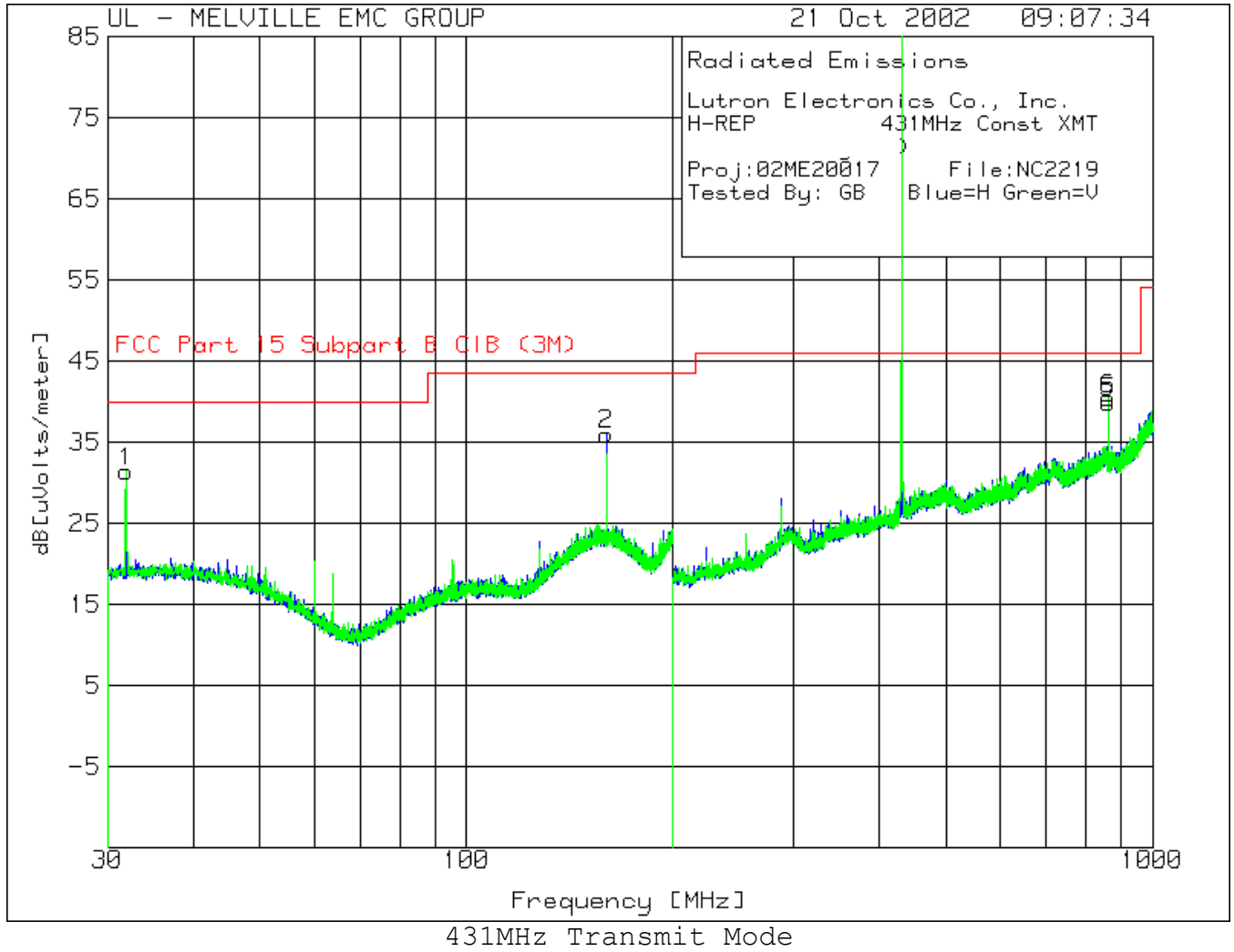
Issued: 11/6/02

Lutron Electronics Co., Inc.  
 HR-REP 437MHz Const Rec  
 RF Signal Repeater  
 Proj:02ME20017 File:NC2219  
 Tested By: LW Blue=H Green=V

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level [dB(uVolts)]	Limit:1
-----						
Range: 1 1000 - 1500MHz -----						
1	1231.89	34.14 pk	-33.07	25.73	26.8	54
	Azimuth:128	Height:100	Horz	Margin [dB]		-27.2
2	1278.851	40.85 pk	-32.95	25.9	33.8	54
	Azimuth:176	Height:100	Horz	Margin [dB]		-20.2
-----						
Range: 3 1000 - 1500MHz -----						
3	1278.851	40.35 pk	-32.95	25.9	33.3	54
	Azimuth:291	Height:100	Vert	Margin [dB]		-20.7
4	1328.809	32.53 pk	-32.81	26.08	25.8	54
	Azimuth:241	Height:100	Vert	Margin [dB]		-28.2
-----						
Range: 4 1500 - 2000MHz -----						
5	1818.284	30.73 pk	-31.33	28.1	27.5	54
	Azimuth:76	Height:200	Vert	Margin [dB]		-26.5
6	1960.472	30.75 pk	-30.88	28.73	28.6	54
	Azimuth:353	Height:100	Vert	Margin [dB]		-25.4

LIMIT 1: FCC PT15 CLASS B-RADIATED (3m)  
 LIMIT 2: NONE  
 LIMIT 3: NONE  
 LIMIT 4: NONE  
 LIMIT 5: NONE  
 LIMIT 6: NONE

pk - Peak detector  
 qp - Quasi-Peak detector  
 av - Average detector  
 avlg - denotes average log detection  
 tm - Trace Math Result



File Number: NC2219  
 Project Number: 02ME20017  
 Model Number: HR-REP  
 FCC ID: JPZ0022

Issued: 11/6/02

Lutron Electronics Co., Inc.  
 HR-REP 431MHz Const XMT  
 RF Signal Repeater  
 Proj:02ME20017 File:NC2219  
 Tested By: GB Blue=H Green=V

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dB[uVolts/meter]	Limit:1	Limit2
-----							
Range: 1 30 - 200MHz -----							
2	159.9101	17.3 pk	1.8	16.9	36	N/A	43.5
	Azimuth:229	Height:200	Horz	Margin [dB]			-7.5
-----							
Range: 2 30 - 200MHz -----							
1	31.8898	16.54 pk	.86	14	31.4	N/A	40
	Azimuth:332	Height:100	Vert	Margin [dB]			-8.6
-----							
Range: 3 200 - 1000MHz -----							
4	430.741	70.9 pk	3.16	16.44	90.5	80.7	
	Azimuth:295	Height:101	Horz	Margin [dB]		9.8	
5	861.4488	12.36 pk	4.41	23.13	39.9	60.7	
	Azimuth:45	Height:101	Horz	Margin [dB]		-20.8	
-----							
Range: 4 200 - 1000MHz -----							
3	430.741	71.4 pk	3.16	16.44	91	80.7	
	Azimuth:13	Height:100	Vert	Margin [dB]		10.3	
6	861.3156	12.86 pk	4.41	23.13	40.4	60.7	
	Azimuth:221	Height:100	Vert	Margin [dB]		-20.3	

LIMIT 1: FCC Part 15 Subpart C-Section 15.231  
 LIMIT 2: FCC Part 15 Subpart B ClB (3M)

pk - Peak detector  
 qp - Quasi-Peak detector  
 av - Average detector  
 avlg - denotes average log detection  
 tm - Trace Math Result

File Number: NC2219  
 Project Number: 02ME20017  
 Model Number: HR-REP  
 FCC ID: JPZ0022

Issued: 11/6/02

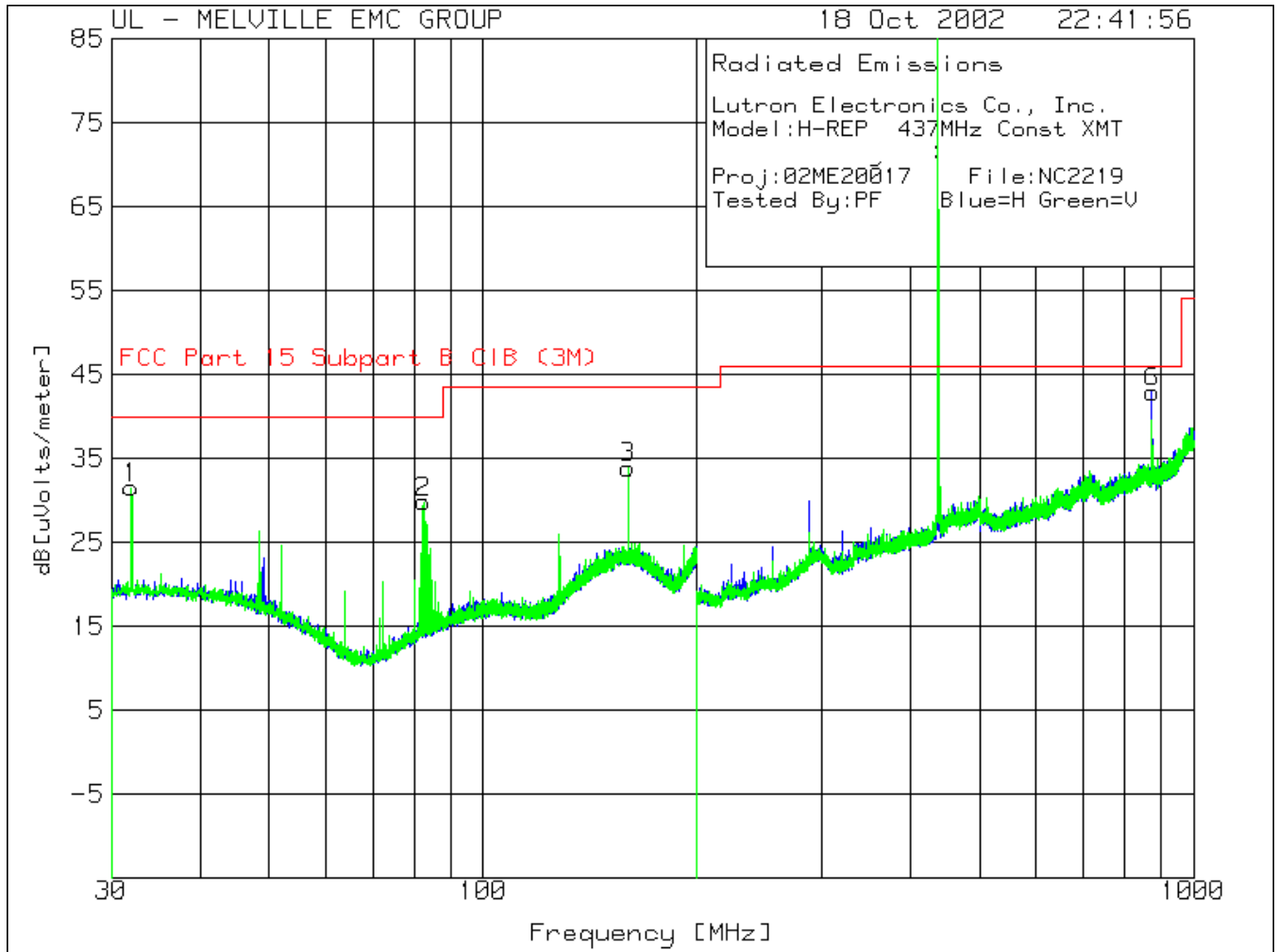
Lutron Electronics Co., Inc.  
 HR-REP 431MHz Const XMT  
 RF Signal Repeater  
 Proj:02ME20017 File:NC2219  
 Tested By: GB Blue=H Green=V

Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level	Limit:1 dB[uVolts/meter]	Limit2
Range: 1 30 - 200MHz						
159.946	12.64 av	1.8	16.9	31.34	60.7	
Azimuth: 61		Height:120	Horz	Margin [dB]:	-29.36	
Range: 2 30 - 200MHz						
31.9165	15.38 av	.86	14	30.24	60.7	
Azimuth: 348		Height:386	Vert	Margin [dB]:	-30.46	
Range: 3 200 - 1000MHz						
861.94	6.16 av	4.41	23.1	33.67	60.7	
Azimuth: 39		Height:133	Horz	Margin [dB]:	-27.03	
430.9139	*46.27 av	3.17	16.45	*65.89	80.7	
Azimuth: 56		Height:211	Horz	Margin [dB]:	-14.81	
Range: 4 200 - 1000MHz						
430.9677	*49.89 av	3.17	16.45	*69.51	80.7	
Azimuth: 41		Height:162	Vert	Margin [dB]:	-11.19	
861.9197	14.2 av	4.41	23.1	41.71	60.7	
Azimuth: 0		Height:149	Vert	Margin [dB]:	-18.99	

LIMIT 1: FCC Part 15 Subpart C-Section 15.231  
 LIMIT 2: FCC Part 15 Subpart B ClB (3M)

pk - Peak detector  
 qp - Quasi-Peak detector  
 av - Average detector  
 avlg - Average log detector

**\* Duty Cycle correction factor of -22.8db added to Average level.**





File Number: NC2219  
 Project Number: 02ME20017  
 Model Number: HR-REP  
 FCC ID: JPZ0022

Issued: 11/6/02

Lutron Electronics Co., Inc.  
 Model:HR-REP 437MHz Const XMT  
 RF Signal Repeater  
 Proj:02ME20017 File:NC2219  
 Tested By:PF Blue=H Green=V

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level	Limit:1 dB[uVolts/meter]	Limit2
-----							
Range: 2 30 - 200MHz -----							
1	31.9535	16.64 pk	.86	14	31.5	N/A	40
	Azimuth:28	Height:101	Vert	Margin [dB]			-8.5
2	82.3632	19.5 pk	1.29	9.01	29.8	N/A	40
	Azimuth:266	Height:101	Vert	Margin [dB]			-10.2
3	160.0375	15.22 pk	1.8	16.88	33.9	N/A	43.5
	Azimuth:155	Height:101	Vert	Margin [dB]			-9.6
-----							
Range: 3 200 - 1000MHz -----							
4	436.8693	73.36 pk	3.2	16.84	93.4	80.9	
	Azimuth:254	Height:100	Horz	Margin [dB]			12.5
6	873.9717	15.05 pk	4.45	23.4	42.9	60.9	
	Azimuth:82	Height:100	Horz	Margin [dB]			-18
-----							
Range: 4 200 - 1000MHz -----							
5	436.8693	74.56 pk	3.2	16.84	94.6	80.9	
	Azimuth:65	Height:100	Vert	Margin [dB]			13.7

LIMIT 1: FCC Part 15 Subpart C-Section 15.231  
 LIMIT 2: FCC Part 15 Subpart B ClB (3M)

pk - Peak detector  
 qp - Quasi-Peak detector  
 av - Average detector  
 avlg - denotes average log detection  
 tm - Trace Math Result

File Number: NC2219  
 Project Number: 02ME20017  
 Model Number: HR-REP  
 FCC ID: JPZ0022

Issued: 11/6/02

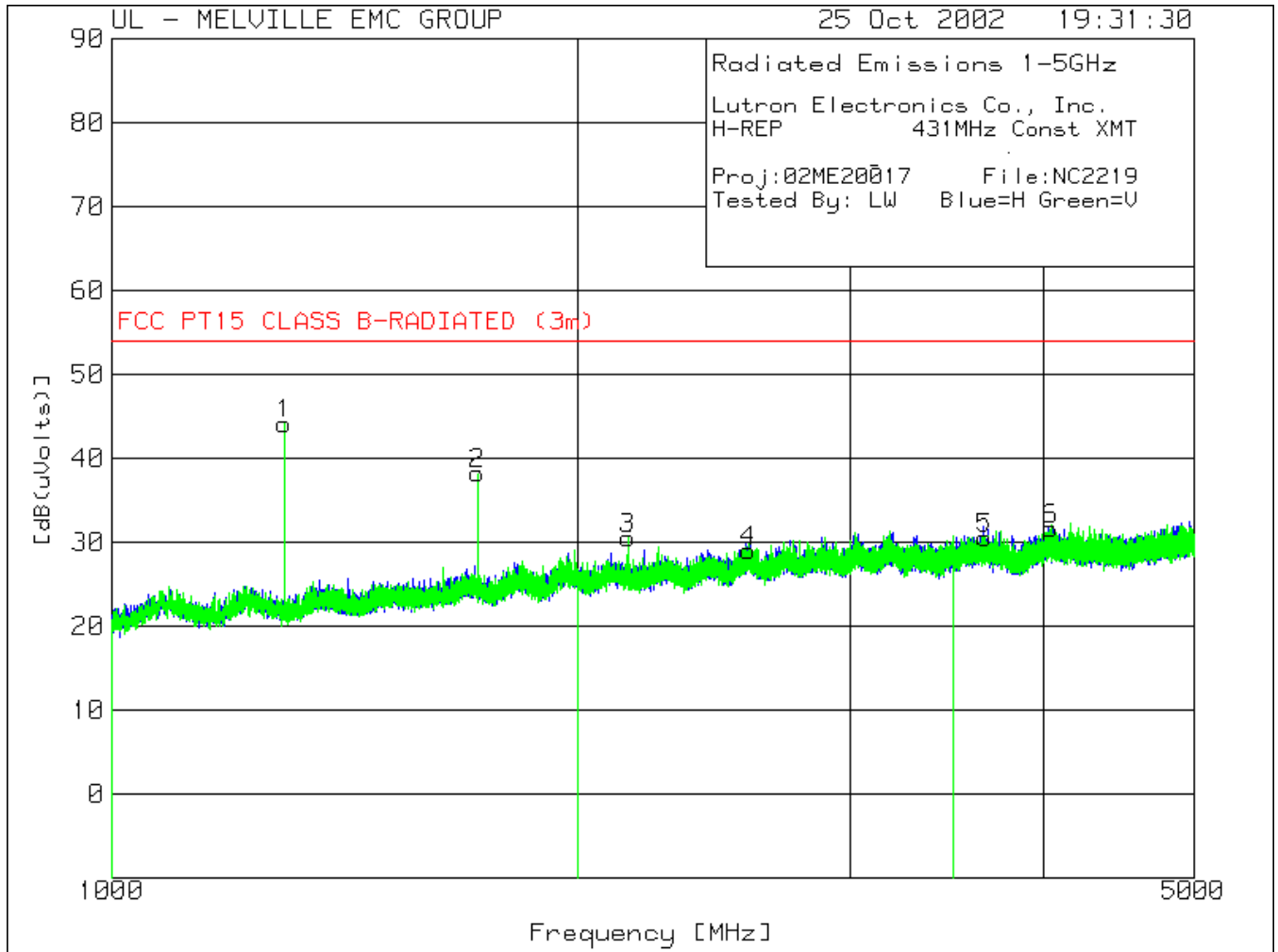
Lutron Electronics Co., Inc.  
 Model:HR-REP 437MHz Const XMT  
 RF Signal Repeater  
 Proj:02ME20017 File:NC2219  
 Tested By:PF Blue=H Green=V

Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level	Limit:1 dB[uVolts/meter]	Limit2
Range: 2 30 - 200MHz						
32.0115	10.15 av	.86	14.04	25.05	60.9	
Azimuth: 339 Height:295 Vert			Margin [dB]:		-35.85	
80.0102	13.33 av	1.28	8.38	22.99	60.9	
Azimuth: 125 Height:282 Vert			Margin [dB]:		-37.91	
160.0191	12.05 av	1.8	16.89	30.74	60.9	
Azimuth: 129 Height:99 Vert			Margin [dB]:		-30.16	
Range: 3 200 - 1000MHz						
436.999	*49.69 av	3.2	16.85	*69.74	80.9	
Azimuth: 264 Height:102 Horz			Margin [dB]:		-11.16	
874.004	13.71 av	4.45	23.4	41.56	60.9	
Azimuth: 82 Height:102 Horz			Margin [dB]:		-19.34	
Range: 4 200 - 1000MHz						
437.049	*51.34 av	3.2	16.85	*71.39	80.9	
Azimuth: 166 Height:122 Vert			Margin [dB]:		-9.51	

LIMIT 1: FCC Part 15 Subpart C-Section 15.231  
 LIMIT 2: FCC Part 15 Subpart B ClB (3M)

pk - Peak detector  
 qp - Quasi-Peak detector  
 av - Average detector  
 avlg - Average log detector

**\* Duty Cycle correction factor of -22.8db added to Average level.**



File Number: NC2219  
 Project Number: 02ME20017  
 Model Number: HR-REP  
 FCC ID: JPZ0022

Issued: 11/6/02

Lutron Electronics Co., Inc.  
 HR-REP 431MHz Const XMT  
 RF Signal Repeater  
 Proj:02ME20017 File:NC2219  
 Tested By: LW Blue=H Green=V

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level [dB(uVolts)]	Limit:1	Limit2
-----							
Range: 2 2000 - 3500MHz -----							
4	2580.18	28.5 pk	-30.24	30.74	29	60.7	
	Azimuth:290	Height:200	Horz	Margin [dB]		-31.7	
-----							
Range: 3 3500 - 5000MHz -----							
5	3666.729	24.37 pk	-27.2	33.33	30.5	60.7	
	Azimuth:126	Height:100	Horz	Margin [dB]		-30.2	
6	4042.338	24.65 pk	-27.39	34.34	31.6	60.7	
	Azimuth:157	Height:100	Horz	Margin [dB]		-29.1	
-----							
Range: 5 1000 - 2000MHz -----							
1	1292.756	51.06 pk	-32.91	25.95	44.1	60.7	
	Azimuth:299	Height:200	Vert	Margin [dB]		-16.6	
2	1724.063	42.14 pk	-31.63	27.69	38.2	60.7	
	Azimuth:182	Height:100	Vert	Margin [dB]		-22.5	
-----							
Range: 6 2000 - 3500MHz -----							
3	2154.552	31.72 pk	-30.65	29.43	30.5	60.7	
	Azimuth:150	Height:199	Vert	Margin [dB]		-30.2	

LIMIT 1: FCC Part 15 Subpart C-Section 15.231  
 LIMIT 2: NONE

pk - Peak detector  
 qp - Quasi-Peak detector  
 av - Average detector  
 avlg - denotes average log detection  
 tm - Trace Math Result

File Number: NC2219  
 Project Number: 02ME20017  
 Model Number: HR-REP  
 FCC ID: JPZ0022

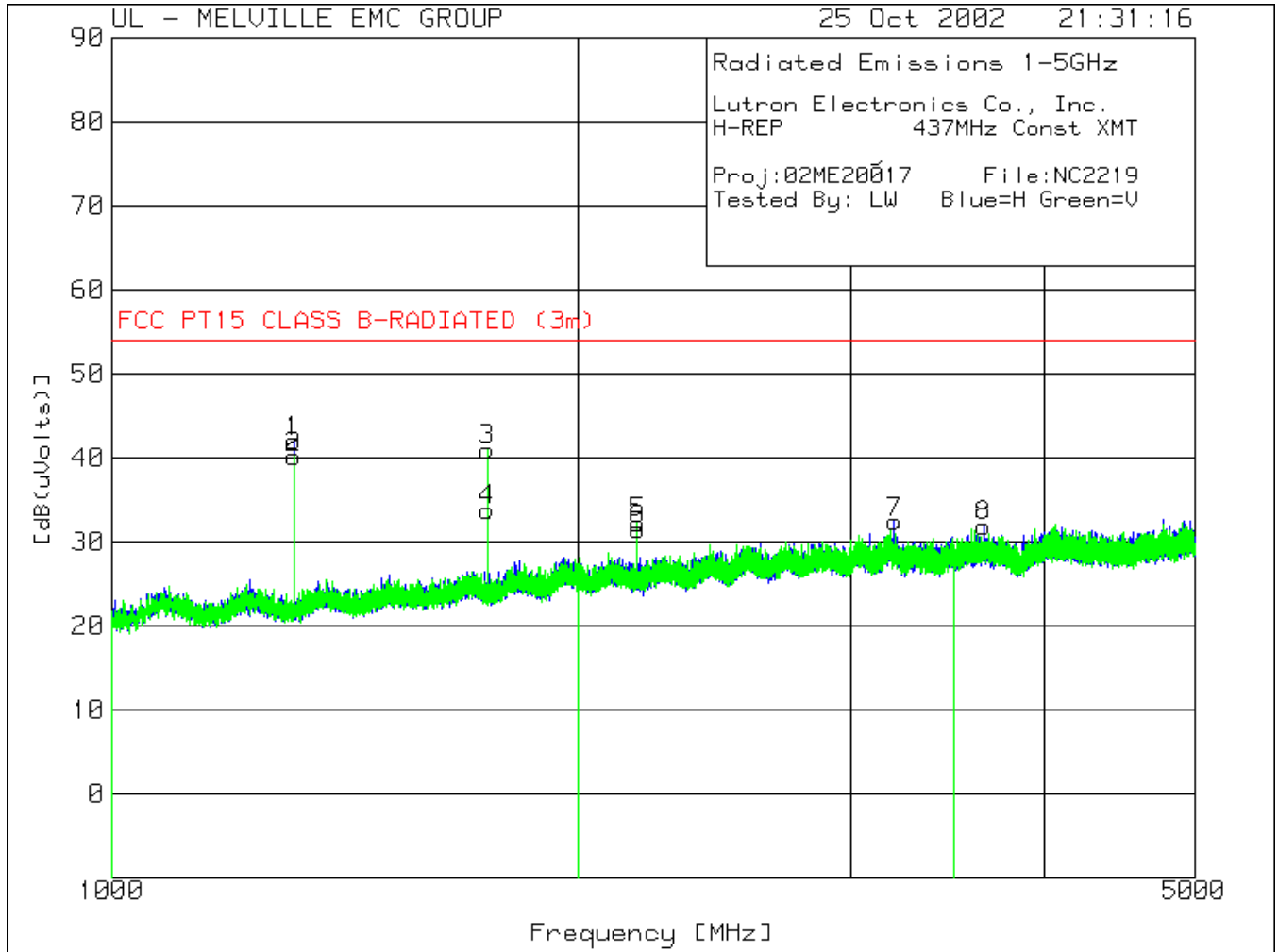
Issued: 11/6/02

Lutron Electronics Co., Inc.  
 HR-REP 431MHz Const XMT  
 RF Signal Repeater  
 Proj:02ME20017 File:NC2219  
 Tested By: LW Blue=H Green=V

Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level [dB(uVolts)]	Limit:1
Range: 1 1000 - 2000MHz					
1292.998	45.62 av	-32.91	25.95	38.66	60.7
Azimuth: 68		Height:142 Horz	Margin [dB]:		-22.04
1723.995	36.33 av	-31.63	27.69	32.39	60.7
Azimuth: 82		Height:100 Horz	Margin [dB]:		-28.31
Range: 2 2000 - 3500MHz					
2154.995	28.82 av	-30.65	29.43	27.6	60.7
Azimuth: 276		Height:192 Horz	Margin [dB]:		-33.1
Range: 5 1000 - 2000MHz					
1293.003	55.05 av	-32.91	25.95	48.09	60.7
Azimuth: 301		Height:125 Vert	Margin [dB]:		-12.61
1723.9975	42.34 av	-31.63	27.69	38.4	60.7
Azimuth: 5		Height:101 Vert	Margin [dB]:		-22.3
Range: 6 2000 - 3500MHz					
2155.001	31.34 av	-30.65	29.43	30.12	60.7
Azimuth: 204		Height:197 Vert	Margin [dB]:		-30.58

LIMIT 1: FCC Part 15 Subpart C-Section 15.231  
 LIMIT 2: NONE

pk - Peak detector  
 qp - Quasi-Peak detector  
 av - Average detector  
 avlg - Average log detector



File Number: NC2219  
 Project Number: 02ME20017  
 Model Number: HR-REP  
 FCC ID: JPZ0022

Issued: 11/6/02

Lutron Electronics Co., Inc.  
 HR-REP 437MHz Const XMT  
 RF Signal Repeater  
 Proj:02ME20017 File:NC2219  
 Tested By: LW Blue=H Green=V

No.	Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level [dB(uVolts)]	Limit:1
-----						
Range: 1 1000 - 2000MHz -----						
1	1310.741	48.84 pk	-32.86	26.02	42	60.9
	Azimuth:37	Height:101	Horz	Margin [dB]		-18.9
4	1748.043	37.57 pk	-31.56	27.79	33.8	60.9
	Azimuth:128	Height:101	Horz	Margin [dB]		-27.1
-----						
Range: 2 2000 - 3500MHz -----						
6	2184.713	32.6 pk	-30.63	29.53	31.5	60.9
	Azimuth:326	Height:200	Horz	Margin [dB]		-29.4
7	3199.7	28.74 pk	-28.36	32.02	32.4	60.9
	Azimuth:211	Height:101	Horz	Margin [dB]		-28.5
-----						
Range: 3 3500 - 5000MHz -----						
8	3657.924	25.78 pk	-27.19	33.31	31.9	60.9
	Azimuth:281	Height:101	Horz	Margin [dB]		-29
-----						
Range: 5 1000 - 2000MHz -----						
2	1310.741	46.94 pk	-32.86	26.02	40.1	60.9
	Azimuth:318	Height:200	Vert	Margin [dB]		-20.8
3	1748.043	44.77 pk	-31.56	27.79	41	60.9
	Azimuth:164	Height:100	Vert	Margin [dB]		-19.9
-----						
Range: 6 2000 - 3500MHz -----						
5	2184.713	33.4 pk	-30.63	29.53	32.3	60.9
	Azimuth:311	Height:200	Vert	Margin [dB]		-28.6

LIMIT 1: FCC Part 15 Subpart C-Section 15.231  
 LIMIT 2: NONE

pk - Peak detector  
 qp - Quasi-Peak detector  
 av - Average detector  
 avlg - denotes average log detection  
 tm - Trace Math Result

File Number: NC2219  
 Project Number: 02ME20017  
 Model Number: HR-REP  
 FCC ID: JPZ0022

Issued: 11/6/02

Lutron Electronics Co., Inc.  
 HR-REP 437MHz Const XMT  
 RF Signal Repeater  
 Proj:02ME20017 File:NC2219  
 Tested By: LW Blue=H Green=V

Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level [dB(uVolts)]	Limit:1
Range: 1 1000 - 2000MHz					
1311	46.31 av	-32.86	26.02	39.47	60.9
Azimuth: 146		Height:116	Horz	Margin [dB]:	-21.43
1747.998	39.41 av	-31.56	27.79	35.64	60.9
Azimuth: 112		Height:116	Horz	Margin [dB]:	-25.26
Range: 2 2000 - 3500MHz					
2185.0038	30.52 av	-30.63	29.53	29.42	60.9
Azimuth: 293		Height:124	Horz	Margin [dB]:	-31.48
3199.7	25.99 av	-28.36	32.02	29.65	60.9
Azimuth: 223		Height:126	Horz	Margin [dB]:	-31.25
Range: 3 3500 - 5000MHz					
3657.92	23.44 av	-27.19	33.31	29.56	60.9
Azimuth: 33		Height:153	Horz	Margin [dB]:	-31.34
Range: 5 1000 - 2000MHz					
1311.006	50.48 av	-32.86	26.02	43.64	60.9
Azimuth: 308		Height:120	Vert	Margin [dB]:	-17.26
1747.995	40.16 av	-31.56	27.79	36.39	60.9
Azimuth: 149		Height:124	Vert	Margin [dB]:	-24.51
Range: 6 2000 - 3500MHz					
2185.004	32.17 av	-30.63	29.53	31.07	60.9
Azimuth: 8		Height:117	Vert	Margin [dB]:	-29.83

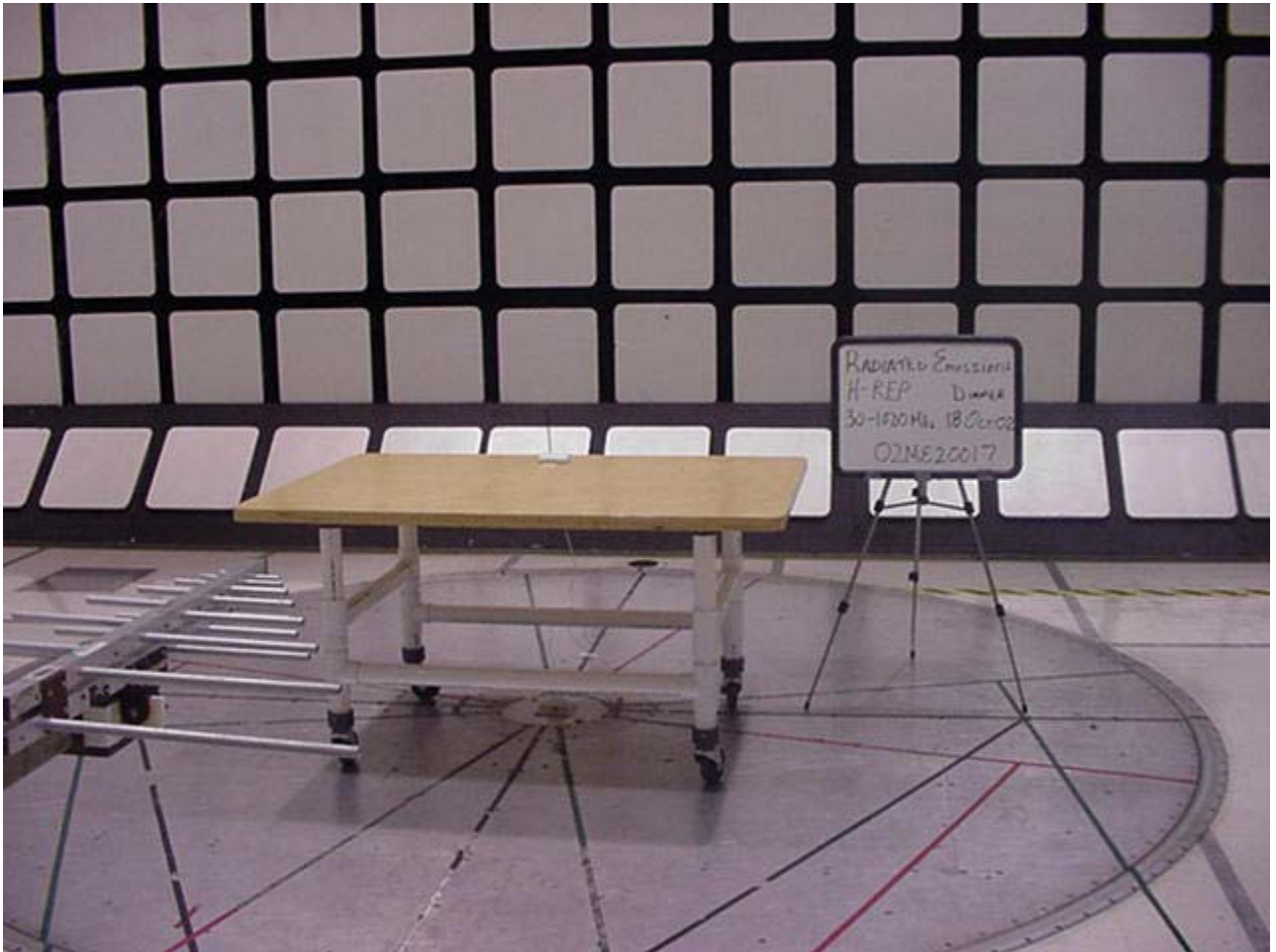
LIMIT 1: FCC Part 15 Subpart C-Section 15.231  
 LIMIT 2: NONE

pk - Peak detector  
 qp - Quasi-Peak detector  
 av - Average detector  
 avlg - Average log detector

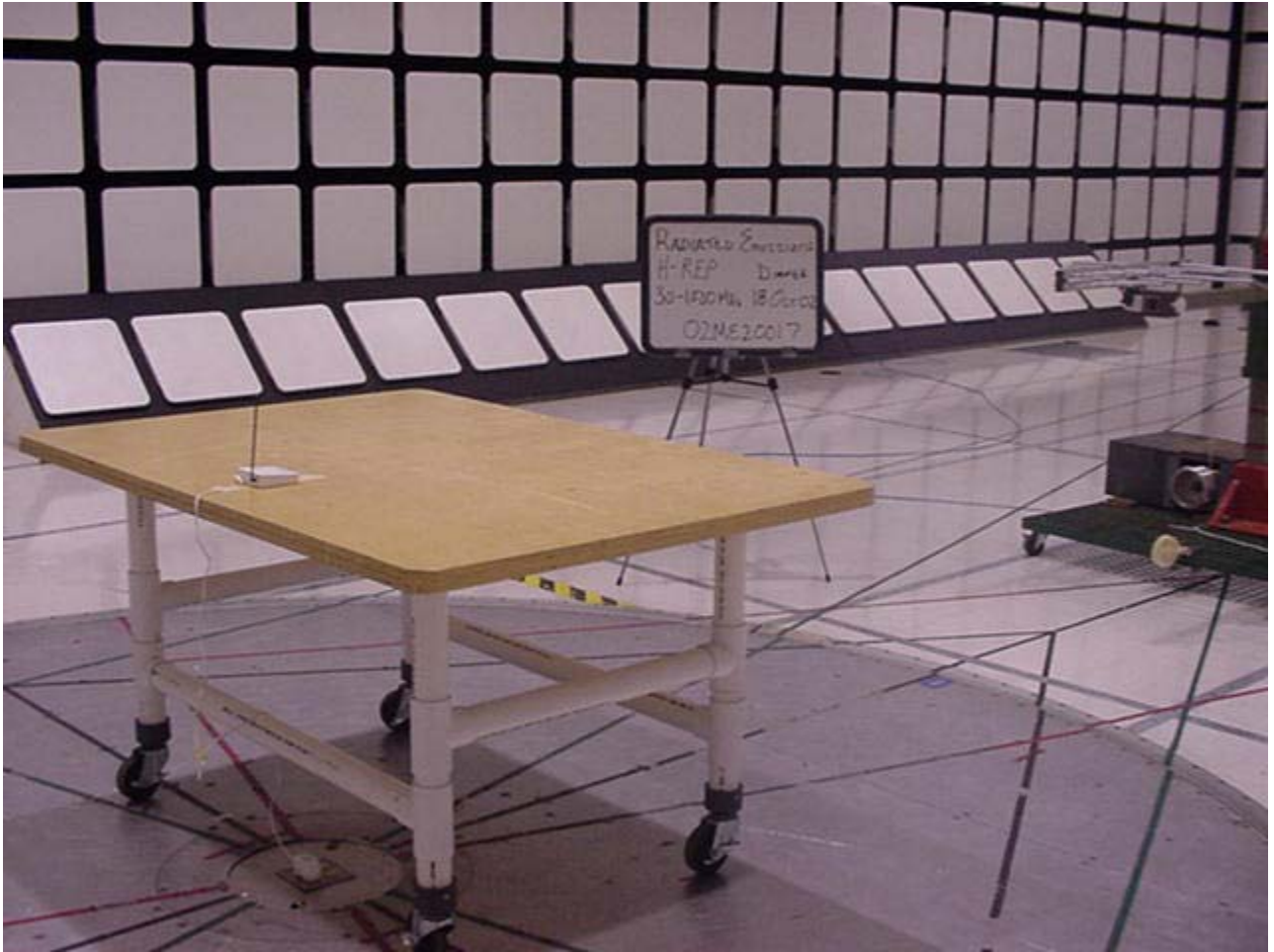




Pulse Train Test Set-Up



Radiated Emission Test Set-Up 30-1000MHz Front View



Radiated Emission Test Set-Up 30-1000MHz Rear View





Radiated Emission Test Set-Up 1-5GHz Front View

File Number: NC2219  
Project Number: 02ME20017  
Model Number: HR-REP  
FCC ID: JPZ0022

Issued: 11/6/02

## 2.1.4 Occupied Bandwidth

Test Applicable       Test Not Applicable

Temperature:            20.8 °C  
Humidity:                69%RH  
Pressure:                1040mbar  
Date test performed: 24 Oct 2002

The bandwidth of the emissions shall be no wider than 0.25% of the center frequency for the devices operating above 70 MHz and below 900 MHz. Bandwidth is determined at the points 20 dB down from the modulated carrier.

431MHz and 437MHz

Bandwidth = 0.25% of 431MHz = 1.0775MHz

Bandwidth = 0.25% of 437MHz = 1.09255MHz

### Test equipment used for Occupied Bandwidth Measurements:

**ESI**                                      **Rhode &Swharz**                                      **EMI Test Receiver,**                                      **Equipment No.: 5B-081**  
Range: 20Hz -26.5GHz    Last Calibration Date:20 August 02    Calibration Due Date: 20 August 03

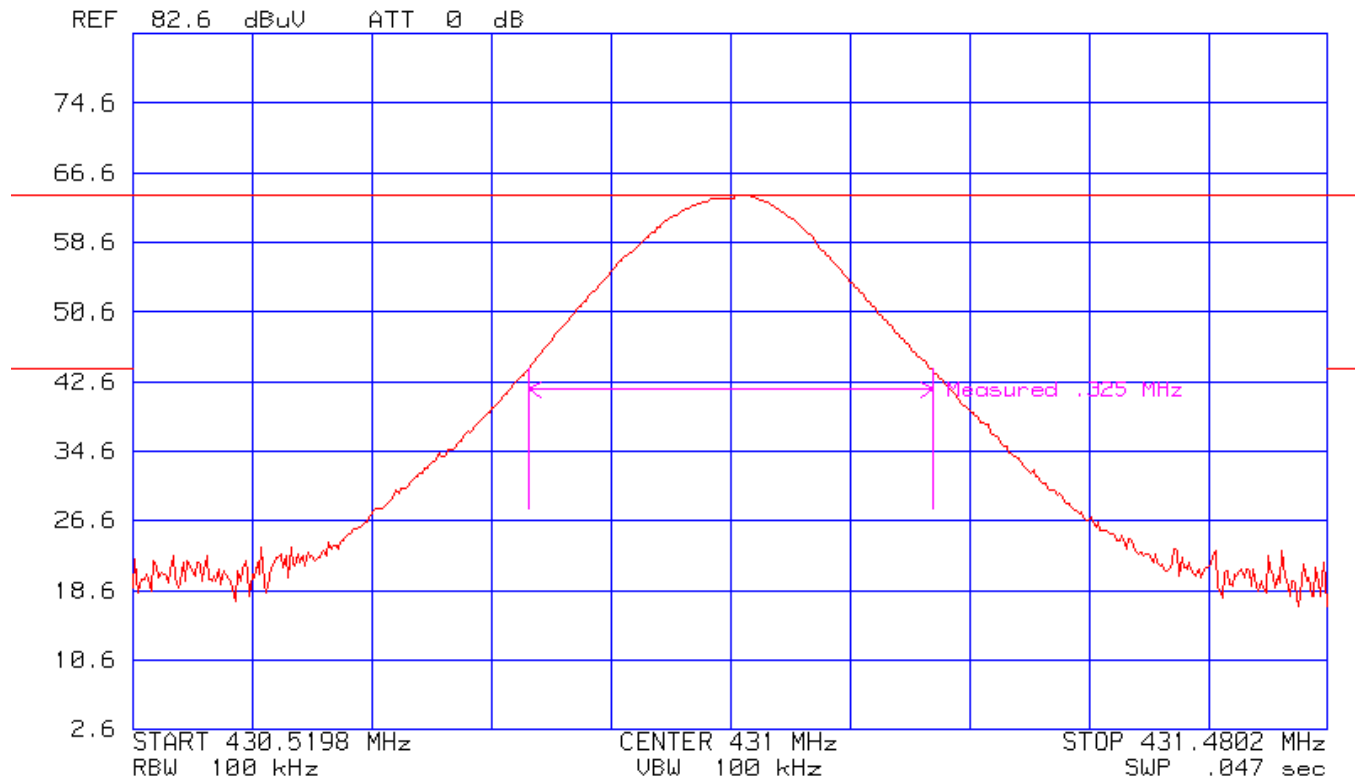
#### Consisting of:

<b>HP - 8566B</b>	<b>Hewlett-Packard</b>	<b>Spectrum Analyzer,</b>
	<b>Resolution BW: 1MHz</b>	
	<b>Video BW: 1MHz</b>	
<b>HP - 85662A</b>	<b>Hewlett-Packard</b>	<b>Analyzer Display</b>
<b>HP - 85650A</b>	<b>Hewlett-Packard</b>	<b>Quasi-Peak Adapter,</b>
	<b>BW: 120kHz</b>	
<b>HP - 85685A</b>	<b>Hewlett-Packard</b>	<b>Preselector</b>

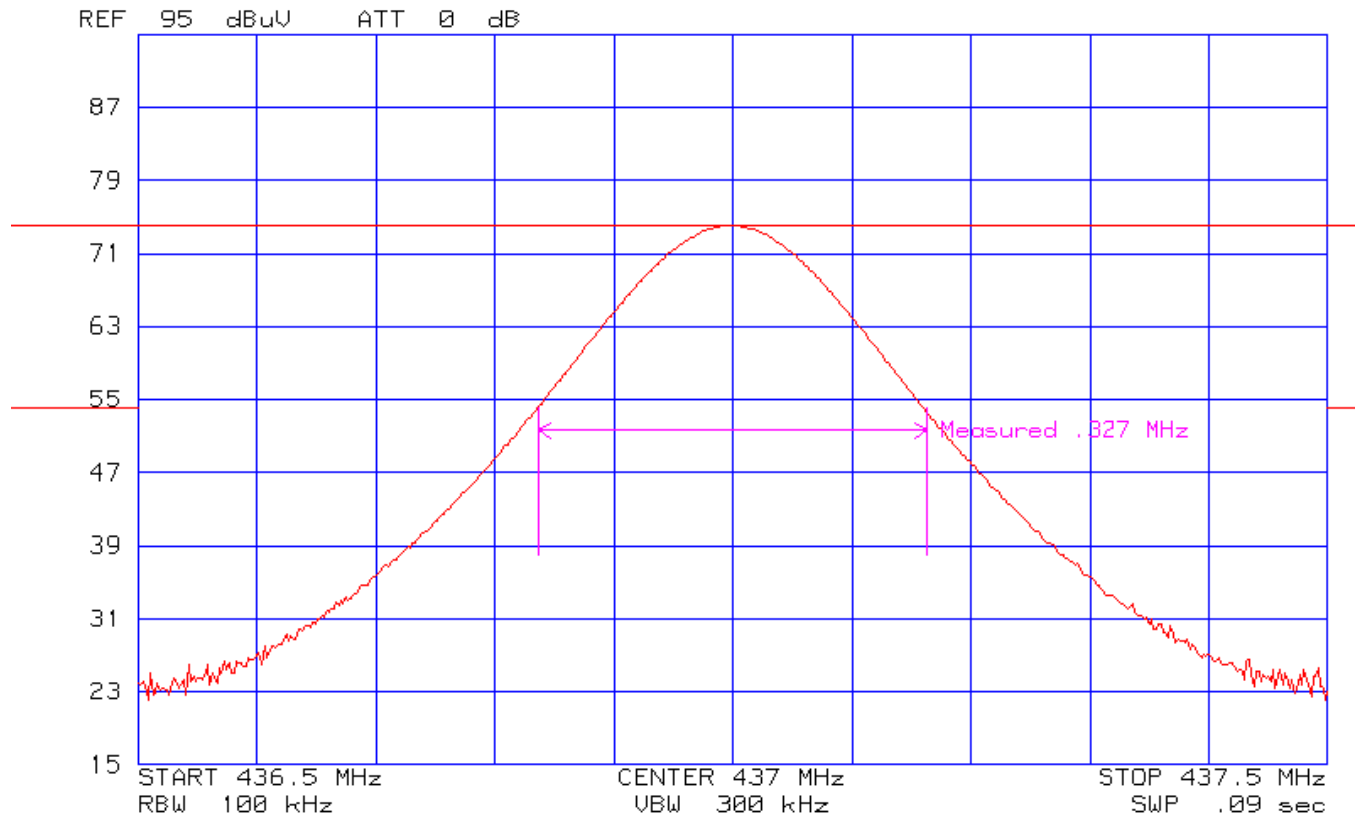
**3121C**                                      **The Electro Mechanics**                                      **Dipole ANTenna**                                      **Equipment No.:**  
Last Calibration Date:10 Dec.01    Calibration Due Date: 10 DEC 02

**Temp/Pressure**                                      **Oakton**                                      **Barometer**                                      **Equipment No.: ME4-263**  
Range:950-1045                                      Last Calibration Date: 2 April 02                                      Calibration Due Date:2 April 03

**453320**                                      **Ex-Tech**                                      **Hydro-Thermometer**                                      **Equipment No.: ME4-264**  
Range:0-80%                                      Last Calibration Date:2 April 02                                      Calibration Due Date:2 April 03



431MHz Occupied Bandwidth @ 20 db = 0.325MHz



437MHz Occupied Bandwidth @ 20 db = 0.327MHz



Occupied Bandwidth Test Set-up HR-REP



## 2.1.5 Fundamental Frequency and Spurious Emissions Measurement Limit Calculations

### Limit Calculation

Fundamental Frequency is 431MHz

From table in section 15.231

$$\text{Limit} = 41.6667(431) - 7083.3333$$

$$\text{Limit} = 10846.3\mu\text{V}$$

$$\text{Limit} = \text{Log } 10846.3(20)$$

$$\text{Limit} = 80.7\text{dBuV}$$

$$\text{Limit for Spurious Emissions} = 20\text{dB lower then fundamental} = 60.7\text{dBuV/m}$$

Fundamental Frequency is 437MHz

From table in section 15.231

$$\text{Limit} = 41.6667(437) - 7083.3333$$

$$\text{Limit} = 11125.018\mu\text{V}$$

$$\text{Limit} = \text{Log } 11125.018 (20)$$

$$\text{Limit} = 80.9\text{dBuV}$$

$$\text{Limit for Spurious Emissions} = 20\text{dB lower then fundamental} = 60.9\text{dBuV/m}$$

### ***Radiated Emissions Limit conversion from $\mu\text{V/m}$ to $\text{dB}\mu\text{V/m}$ (accordance with paragraph 15.109)***

$$\text{Radiated Emissions Limit (dB}\mu\text{V/m)} = 20 * \log (\mu\text{V/m})$$

$$\text{Radiated Emissions Limit (dB}\mu\text{V/m)} = 20 * \log (90)$$

$$\text{Radiated Emissions Limit (dB}\mu\text{V/m)} = 39.1$$

### ***Radiated Emissions test data obtained during measurements.***

Field Strength (dB $\mu\text{V/m}$ ) = Measured field strength(dB $\mu\text{V/m}$ ) + Antenna Factor(dB) + Cable Factor(dB)

$$\text{Field Strength (dB}\mu\text{V/m)} = 19.7\text{dB}\mu\text{V/m} + 12.5\text{dB} + 0.3\text{dB}$$

$$\text{Field Strength (dB}\mu\text{V/m)} = 32.5$$

### **Duty Cycle factor calculation.**

Total number of pulses counted in 100ms.

Total time on = 7.2ms

$$\text{Duty cycle correction factor} = 20 \log (7.2\text{ms} / 100\text{ms})$$

$$= 20 \log (0.072)$$

$$= - 22.8\text{dB}$$

The correction factor is added to the measured field strength in dBuV/m

File Number: NC2219  
Project Number: 02ME20017  
Model Number: HR-REP  
FCC ID: JPZ0022

Issued: 11/6/02

### 3.0 SUMMARY:

The equipment under test has

met the technical requirements as defined under section(s)  2.0 and  3.0

not met the technical requirements as defined under section(s)  2.0 and  3.0

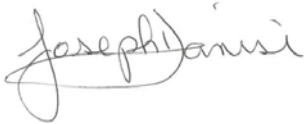
Test Start Date: 15 October 2002

Test Completion Date: 29 October 2002

#### - UNDERWRITERS LABORATORIES, INC. -

Project Engineer

Reviewer



Joseph Danisi (Ext.23055)  
Senior Engineering Associate  
International EMC Services  
Conformity Assessment Services-3014AMEL

Corey Hyatt (Ext.22452)  
Associate Manager  
International EMC Services  
Conformity Assessment Services -3014AMEL