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**Report of Measurements
of Electromagnetic Compatibility Testing**

Test Report File No.	:	MC2219	Date of issue: 09/06/2001
Applicant	:	Lutron Electronics Co. Inc.	
Model / Serial No.	:	RA-VCTX-WH /	
Product Type	:	Car Visor Control	
Power Supply	:	2 - 3VDC lithium cell batteries	
Manufacturer	:	Same As Applicant	
License holder	:	Same As Applicant	
Address	:	7200 Suter Road	
	:	Coopersburg, PA 18036	
Test Type	:	☒ Compliance Investigation ☐ Manufacturer's Specification	
Test Project Number	:	01ME16420	
References(s)	:	FCC ID: JPZ0017	

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Report Directory

1.0	<i>GENERAL - Product Description</i>	3
1.1	Device Configuration During Test	3
1.2	Deviations from ANSI C63.4.....	3
1.3	Device Modifications Necessary for Compliance.....	4
1.4	Test Summary.....	4
1.5	Immunity Performance Criteria	5
2.0	<i>EMISSIONS TEST REGULATIONS</i>	6
2.1	EUT OPERATION MODE - EMISSIONS TESTS.....	6
2.1.1	Radiated Emissions Test (10 Meter Semi-Anechoic Chamber)	7
3.0	<i>SUMMARY:</i>	20

1.0 G E N E R A L - Product Description

The EUT (equipment under test) is a device that intentionally transmits a Radio frequency (RF) communication to a receiver that control various devices manufactured by the customer. The device remains in a sleep mode until a switch is closed. When a switch is closed the circuit encodes a custom protocol to be repetitively sent out.

The overall specification of the device is as follows:

- 3 switch inputs for 7 possible functions
- Baud rate is 2.5kbps – 86bit packets with 400us bit widths
- Minimum of 4 transmitted packets per switch enclosure

The antenna is not removable because it is an actual trace on the PCB.

1.1 Device Configuration During Test

The device under test was modified by the manufacturer to continuously transmit data packets. The device operates on (2) 3VDC Lithium coin cell batteries

The device was tested lying flat. This represents the worst-case orthogonal orientation.

A new (fresh) battery was installed prior to each test.

"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

☐ As described below:

1.3 Device Modifications Necessary for Compliance

☐

N/A

☒

As described below:

Resistor R18 was changed from 6.8ohms to 39ohms

1.4 Test Summary

Test	Basic Standard	Considered	Tested	In Compliance
Conducted Voltage Emissions				
Discontinuous Interference (Click) Emissions				
Conducted Current Emissions				
Radiated Emissions	FCC Part 15	✓	✓	✓
RFI Power				
Harmonic Distortion	EN61000-3-2			
Immunity to Voltage Fluctuations and Flicker	EN51000-3-3			
Magnetic Field Emissions				
Immunity to Electrostatic Discharge	EN61000-4-2			
Immunity to Continuous Radiated Disturbances	EN61000-4-3			
Immunity to Electrical Fast transients	EN61000-4-4			
Immunity to Surges	EN61000-4-5			
Immunity to Continuous Conducted Disturbances	EN61000-4-6			
Immunity to Power-Frequency Magnetic Fields	EN61000-4-8			
Immunity to Voltage Dips and Interruptions	EN61000-4-11			

1.5 Immunity Performance Criteria

Performance Criteria A: The apparatus shall continue to operate as intended. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the apparatus is used as intended. The performance level may be replaced by a permissible loss of performance. If the minimum performance level or the permissible performance loss is not specified by the manufacturer then either of these may be derived from the product description and documentation and what the user may reasonable expect from the apparatus if used as intended.

Performance Criteria B: The apparatus shall continue to operate as intended after the test. No degradation of performance or loss of function is allowed below a performance level specified by the manufacturer, when the apparatus is used as intended. The performance level may be replaced by a permissible loss of performance. During the test, degradation of performance is however allowed. No change of actual operating state or stored data is allowed. If the minimum performance level or the permissible performance loss is not specified by the manufacturer then either of these may be derived from the product description and documentation and what the user may reasonable expect from the apparatus if used as intended.

Performance Criteria C: Temporary loss of function is allowed, provided the function is self recoverable or can be restored by the operation of the controls.

1.5.1 Manufacturer's Criteria for Immunity

(Supporting above criteria for each test)

Environmental conditions in the lab:

	<u>Range</u>
Temperature:	20-25°C
Relative Humidity	30 - 60 %
Atmospheric pressure	680 - 1060 mbar

File Number: MC2219
Project Number: 01ME16420
Model Number: RA-VCTX-WH

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2.0 EMISSIONS TEST REGULATIONS

FCC Part 15, Subpart C, 15.231, 15.209, 15.205

2.1 EUT OPERATION MODE - EMISSIONS TESTS

- ☐ Standby
- ☐ Test program (H-Pattern)
- ☐ Test program (color bar)
- ☐ Test program (customer specific)
- ☐ Practice operation
- ☐ Normal operation Mode:
- ☒ As per manufacturer's instructions: Continuous Transmissions of Data Packets

2.1.1 Radiated Emissions Test (10 Meter Semi-Anechoic Chamber)

☒ **Test Applicable** ☐ **Test Not Applicable**

Measurement distance: ☒ 3 ☐ 10 meters

Frequency Range: ☐ 50Hz – 10kHz ☐ Magnetic

Measurement Distance for 50Hz – 10kHz

☐ 10cm (Rack mount Equipment)

☐ 1m (Equipment not intended to be rackmounted.)

☐ 9kHz - 30MHz ☐ Magnetic ☐ Electric

☒ 30MHz - 1000MHz ☒ Electric

☐ 1GHz - 2GHzv ☒ Electric

☒ 1GHz - 5GHz ☒ Electric

☐ 1GHz - 7.5GHz ☒ Electric

☐ 1GHz - 10GHz ☒ Electric

Test equipment used for final radiated emissions tests:

☒ **HP 8574A Hewlett-Packard EMI Reciever, Equipment No.: ME5A-461**
Range: 30 – 1000MHz Last Calibration Date: 01/27/01 Calibration Due Date: 01/27/02

Consisting of:

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

For Measurements above 1GHz:

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

Range: 1- 5GHz Last Calibration Date: 01/27/01 Calibration Due Date: 01/27/02

☒ **HP - 85662A Hewlett-Packard Analyzer Display Equipment No. ME5A-461**
Last Calibration Date: 01/27/01 Calibration Due Date: 01/27/02

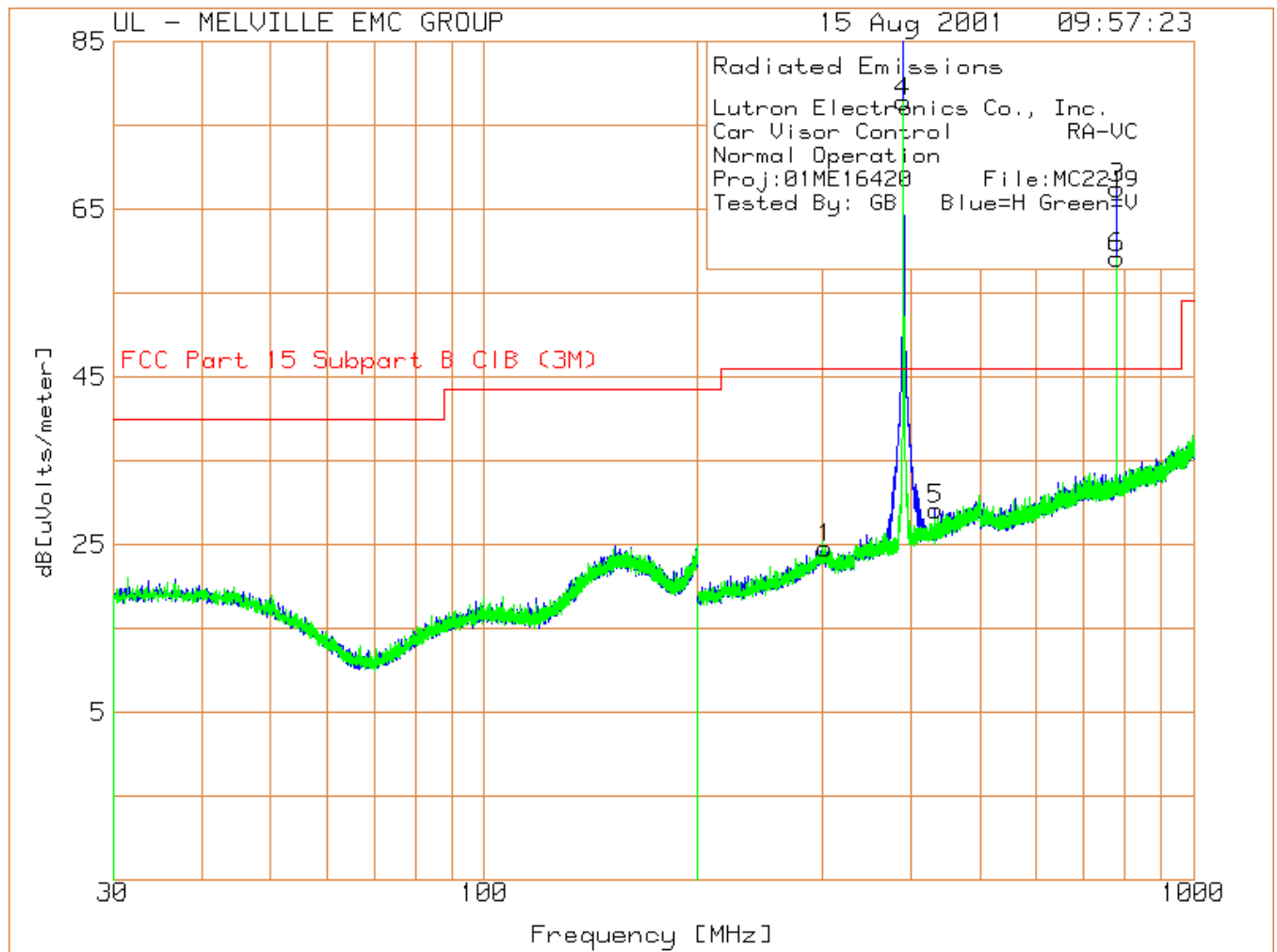
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Test Accessories for Radiated Emissions:

☒ 94455-1	Ailtech	Biconnical Antenna	Equipment No.: ME5-439
Last Calibration Date: 9/28/00		Calibration Due Date: 09/28/01	
☒ 3146	EMCO	Log Periodic Antenna	Equipment No.: ME5-451
Last Calibration Date: 09/26/00		Calibration Due Date: 09/26/02	
☒ RGA-180	EMCO	Horn Antenna	Equipment No.:ME5-565
Last Calibration Date: 05/24/01		Calibration Due Date: 05/24/02	
☒ 8449B	Hewlett Packard	1-26GHz Pre-Amp	Equipment No.:ME5-914



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Lutron Electronics Co., Inc.
 Car Visor Control RA-VC
 Normal Operation
 Proj:01ME16420 File:MC2219
 Tested By: GB Blue=H Green=V

Test No.	Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dB[uVolts/meter]	Limit:1	2	3	4
1	302.448	6.4 pk	2.3	15.9	24.6	46	N/A	N/A	N/A
Azimuth: 155		Height:200	Horz	Margin	[dB]	-21.4	N/A	N/A	N/A
2	389.975	72.7 pk	2.9	16	91.6	46	N/A	79.4	N/A
Azimuth: 90		Height:98	Horz	Margin	[dB]	45.6	N/A	12.2	N/A
3	389.9084	58.9 pk	2.9	16	77.8	46	N/A	79.4	N/A
Azimuth: 169		Height:298	Vert	Margin	[dB]	31.8	N/A	-1.6	N/A
4	779.9167	40.7 pk	4.2	22.6	67.5	46	59.4	N/A	N/A
Azimuth: 270		Height:98	Horz	Margin	[dB]	21.5	8.1	N/A	N/A
5	779.9167	32.4 pk	4.2	22.6	59.2	46	59.4	N/A	N/A
Azimuth: 147		Height:199	Vert	Margin	[dB]	13.2	-0.2	N/A	N/A
6	432.2065	9.3 pk	3.2	16.7	29.2	46	N/A	N/A	N/A
Azimuth: 224		Height:200	Horz	Margin	[dB]	-16.8	N/A	N/A	N/A

LIMIT 1: FCC Part 15 Subpart B ClB (3M)
 LIMIT 2: FCC Part 15 Spurious emissions (3M)
 LIMIT 3: FCC Part 15 Intentional Transmitter Fundamental (3M)
 LIMIT 4: NONE

pk - Peak detector
 qp - Quasi-Peak detector
 av - Average detector
 tm - Trace Math Result

File Number: MC2219
 Project Number: 01ME16420
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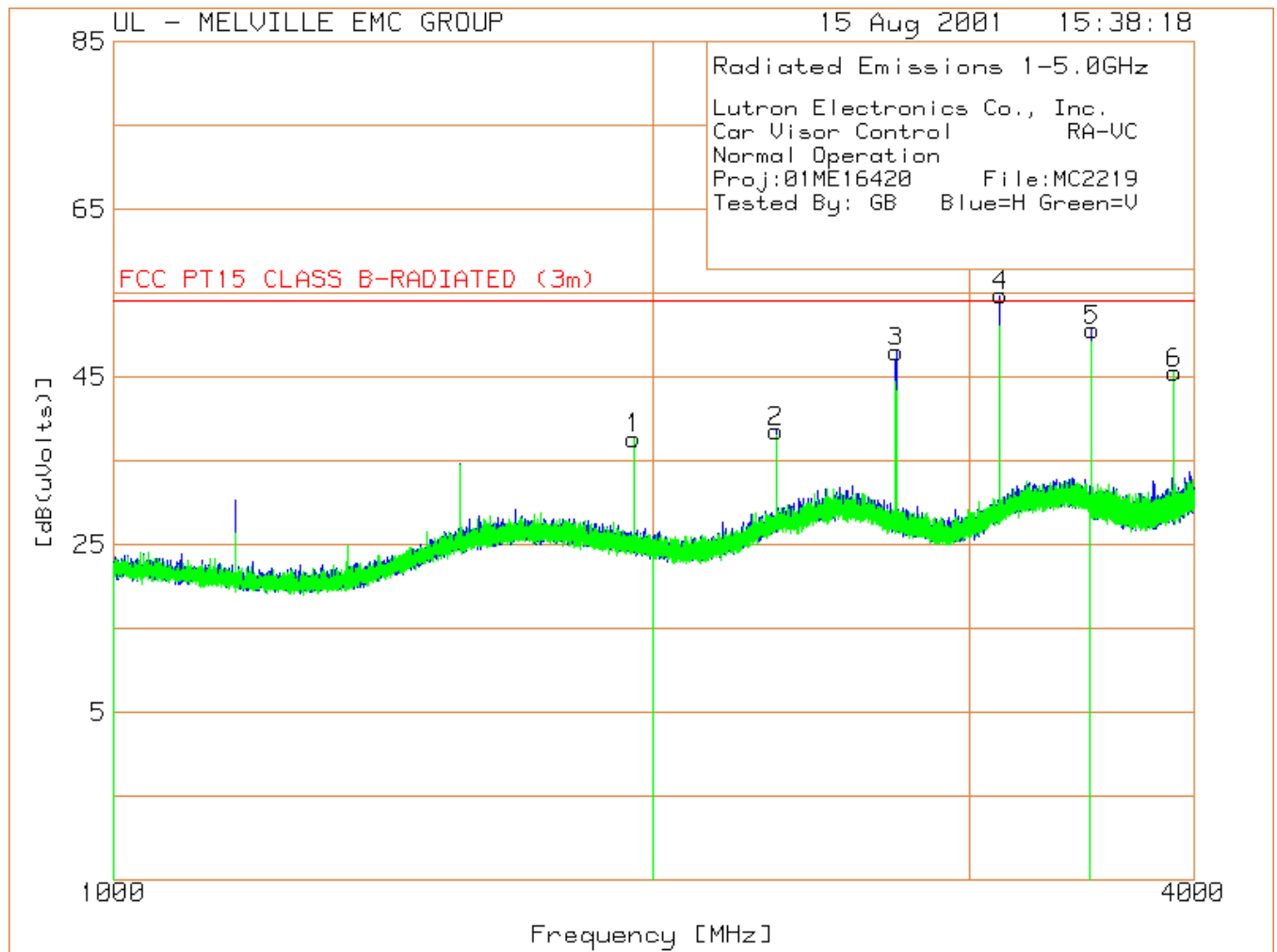
Lutron Electronics Co., Inc.
 Car Visor Control RA-VC
 Normal Operation
 Proj:01ME16420 File:MC2219
 Tested By: GB Blue=H Green=V

Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level Limit:1 dB[uVolts/meter]	2	3	4
302.41	-1.07 qp	2.3	15.9	17.13	46	N/A	N/A
Azimuth: 5	Height:230	Horz	Margin [dB]	-28.87	N/A	N/A	N/A
390.0462	59.01 qp	2.9	16	77.91	46	N/A	79.4
Azimuth: 186	Height:283	Vert	Margin [dB]	31.91	N/A	-1.49	N/A
390.047	70.31 qp	2.9	16	89.21	46	N/A	79.4
Azimuth: 90	Height:104	Horz	Margin [dB]	43.21	N/A	9.81	N/A
390.0482	28.2 av	2.9	16	47.1	46	N/A	79.4
Azimuth: 187	Height:283	Vert	Margin [dB]	1.1	N/A	-32.3	N/A
390.094	34.1 av	2.9	16	53	46	N/A	79.4
Azimuth: 273	Height:102	Horz	Margin [dB]	7	N/A	-26.4	N/A
432.406	1.13 qp	3.2	16.7	21.03	46	N/A	N/A
Azimuth: 0	Height:134	Horz	Margin [dB]	-24.97	N/A	N/A	N/A
780.1204	19.3 av	4.2	22.6	46.1	46	59.4	N/A
Azimuth: 27	Height:108	Horz	Margin [dB]	.1	-13.3	N/A	N/A
780.1239	39.5 qp	4.2	22.6	66.3	46	59.4	N/A
Azimuth: 48	Height:106	Horz	Margin [dB]	20.3	6.9	N/A	N/A
780.1468	18.3 av	4.2	22.6	45.1	46	59.4	N/A
Azimuth: 179	Height:224	Vert	Margin [dB]	-.9	-14.3	N/A	N/A
780.1502	32.72 qp	4.2	22.6	59.52	46	59.4	N/A
Azimuth: 18	Height:116	Vert	Margin [dB]	13.52	0.12	N/A	N/A

LIMIT 1: FCC Part 15 Subpart B ClB (3M)
 LIMIT 2: FCC Part 15 Spurious emissions (3M)
 LIMIT 3: FCC Part 15 Intentional Transmitter Fundamental (3M)
 LIMIT 4: NONE

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

Average measurements obtained with the following analyzer settings:
 Span set to 0Hz, Video BW set to 100kHz, Resolution BW set to 10Hz



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 Normal Operation
 Proj:01ME16420 File:MC2219
 Tested By: GB Blue=H Green=V

Test No.	Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level [dB(uVolts)]	Limit:1	2	3	4
1	1950.208	39.7 pk	-30.9	28.9	37.7	54	59.4	N/A	N/A
Azimuth: 157		Height:99	Vert	Margin	[dB]	-16.3	-21.7	N/A	N/A
2	2339.828	38.8 pk	-30.5	30.2	38.5	54	59.4	N/A	N/A
Azimuth: 249		Height:98	Horz	Margin	[dB]	-15.5	-20.9	N/A	N/A
3	2729.861	46.7 pk	-29.9	31.2	48	54	59.4	N/A	N/A
Azimuth: 37		Height:98	Horz	Margin	[dB]	-6	-11.4	N/A	N/A
4	3120.27	51.4 pk	-28.7	32	54.7	54	59.4	N/A	N/A
Azimuth: 0		Height:199	Horz	Margin	[dB]	.7	-4.7	N/A	N/A
5	3510.616	45.1 pk	-27.1	32.6	50.6	54	59.4	N/A	N/A
Azimuth: 0		Height:199	Horz	Margin	[dB]	-3.4	-8.8	N/A	N/A
6	3900.774	38.8 pk	-27.3	34	45.5	54	59.4	N/A	N/A
Azimuth: 0		Height:199	Vert	Margin	[dB]	-8.5	-13.9	N/A	N/A

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

pk - Peak detector
 qp - Quasi-Peak detector
 av - Average detector
 tm - Trace Math Result

File Number: MC2219
 Project Number: 01ME16420
 Model Number: RA-VCTX-WH

Issued: 09/06/2001

FCC ID: JPZ0017

Lutron Electronics Co., Inc.
 Car Visor Control RA-VC
 Normal Operation
 Proj:01ME16420 File:MC2219
 Tested By: GB Blue=H Green=V

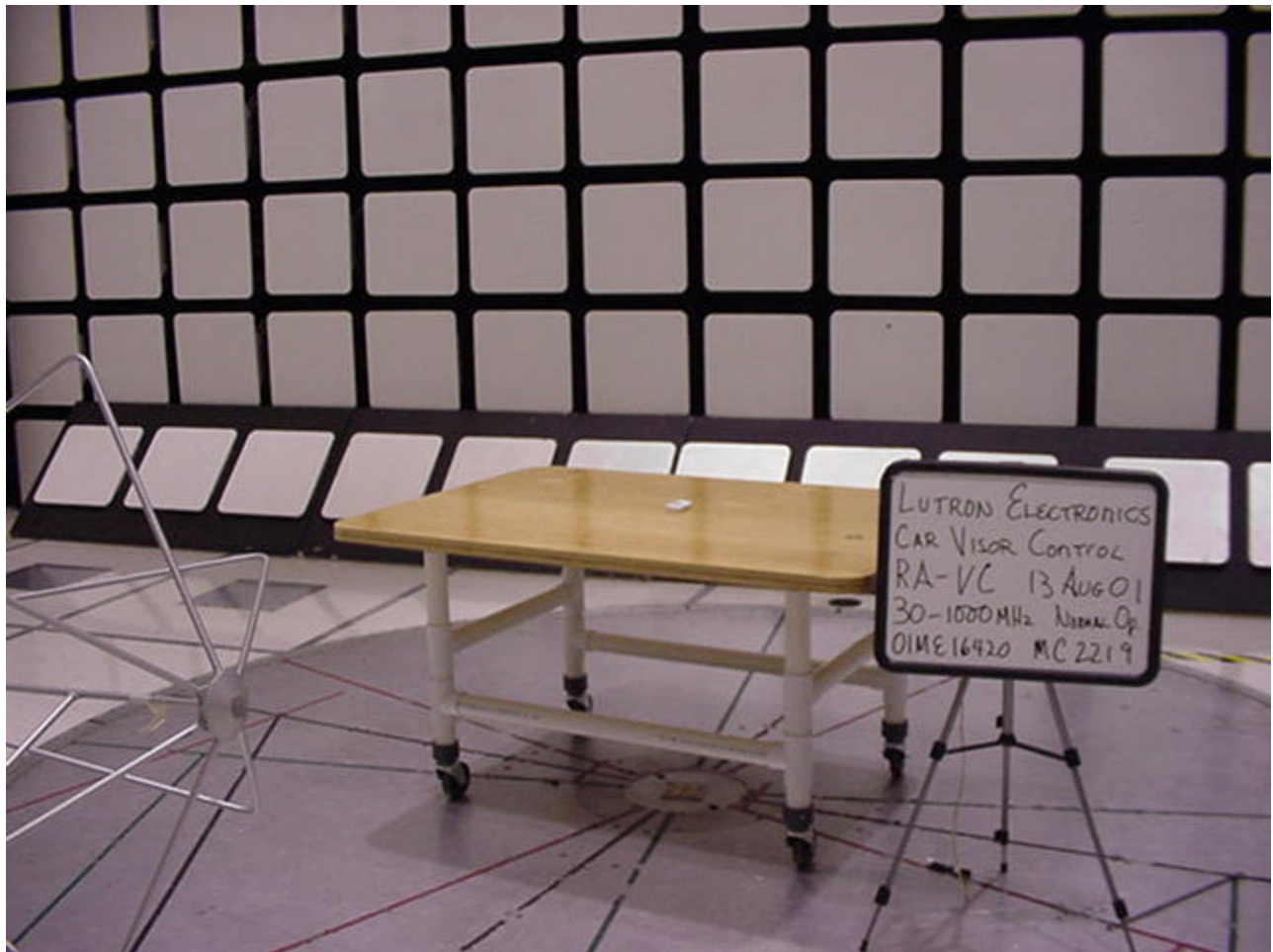
Test	Meter	Gain/Loss	Transducer	Level	Limit:1	2	3	4
Frequency	Reading	Factor	Factor		[dB(uVolts)]			
[MHz]	[dB(uV)]	[dB]	[dB]					
3120.62	48.6 av	-28.7	32	51.9	54	59.4	N/A	N/A
Azimuth: 286	Height:176	Horz	Margin	[dB]	-2.1	-7.5	N/A	N/A
3510.678	42.89 av	-27.1	32.6	48.39	54	59.4	N/A	N/A
Azimuth: 267	Height:158	Horz	Margin	[dB]	-5.61	-11.01	N/A	N/A
2730.5473	40.5 av	-29.9	31.2	41.8	54	59.4	N/A	N/A
Azimuth: 140	Height:179	Horz	Margin	[dB]	-12.2	-17.6	N/A	N/A
3900.7615	33.8 av	-27.3	34	40.5	54	59.4	N/A	N/A
Azimuth: 150	Height:197	Vert	Margin	[dB]	-13.5	-18.9	N/A	N/A

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

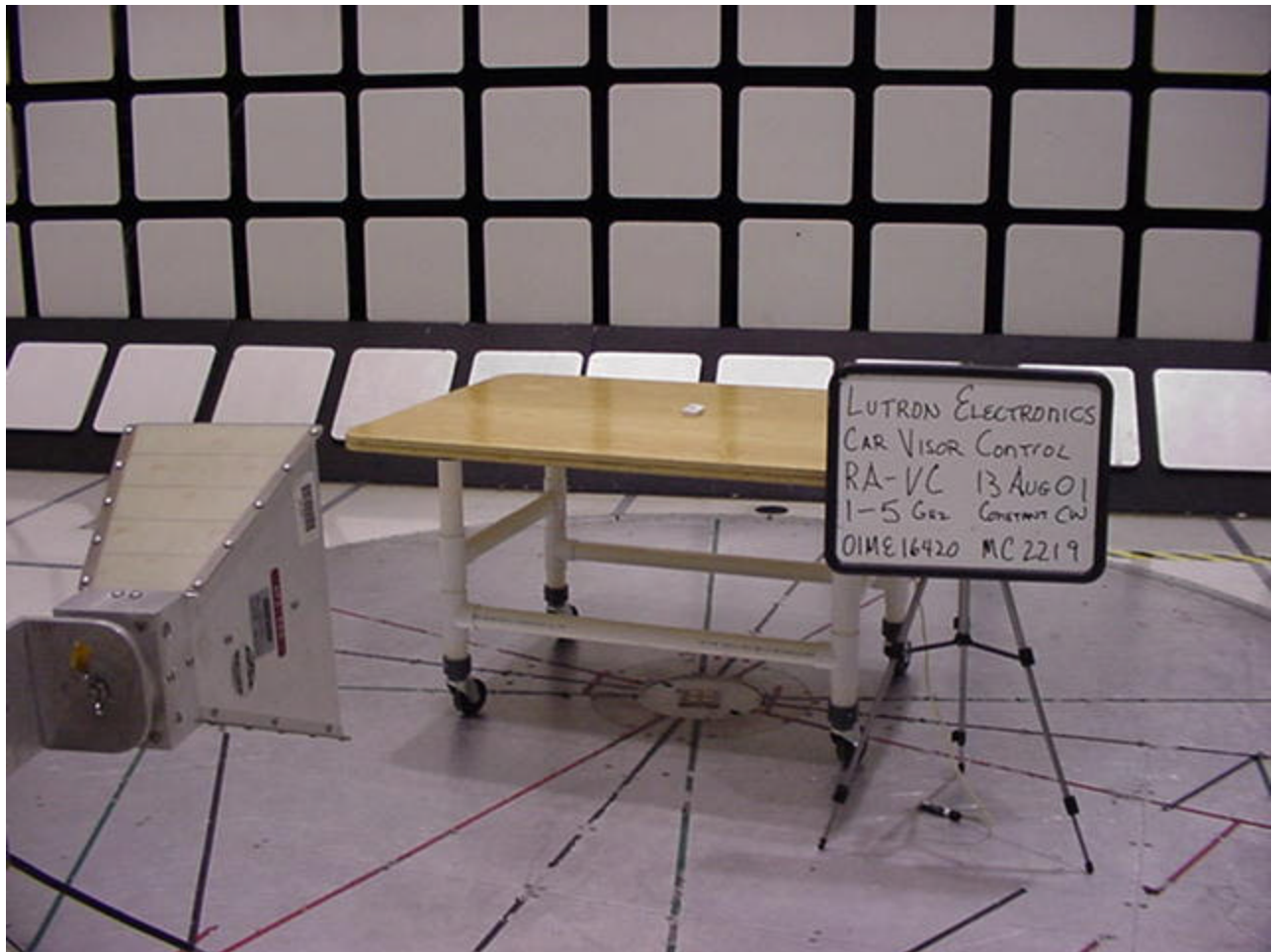
pk - Peak detector
 qp - Quasi-Peak detector
 av - Average detector

Average measurements obtained with the following analyzer settings:

Span set to 0Hz, Video BW set to 100kHz, Resolution BW set to 10Hz



Radiated Emissions 30 - 1000MHz



Radiated Emissions 1 - 5GHz

Fundamental Frequency and Spurious Emissions Measurement Limit Calculations

If Frequency is 390MHz

$$\frac{260\text{MHz}}{3750\text{uV}} = \frac{390\text{MHz}}{X\text{uV}}$$

$$260\text{MHz}(X) = 1462500\text{MHz}(\text{uV})$$

$$X=5625\text{uV}$$

$$\text{Limit} = 5625\text{uV} + 3750\text{uV} = 9375\text{uV} (79.4\text{dBuV/m})$$

$$\text{Limit for Fundamental} = 79.4\text{dBuV/m}$$

$$\text{Limit for Spurious Emissions} = 20\text{dB below fundamental limits} = 59.4\text{dBuV/m}$$

Radiated Emissions Limit conversion from mV/m to dBmV/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.

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

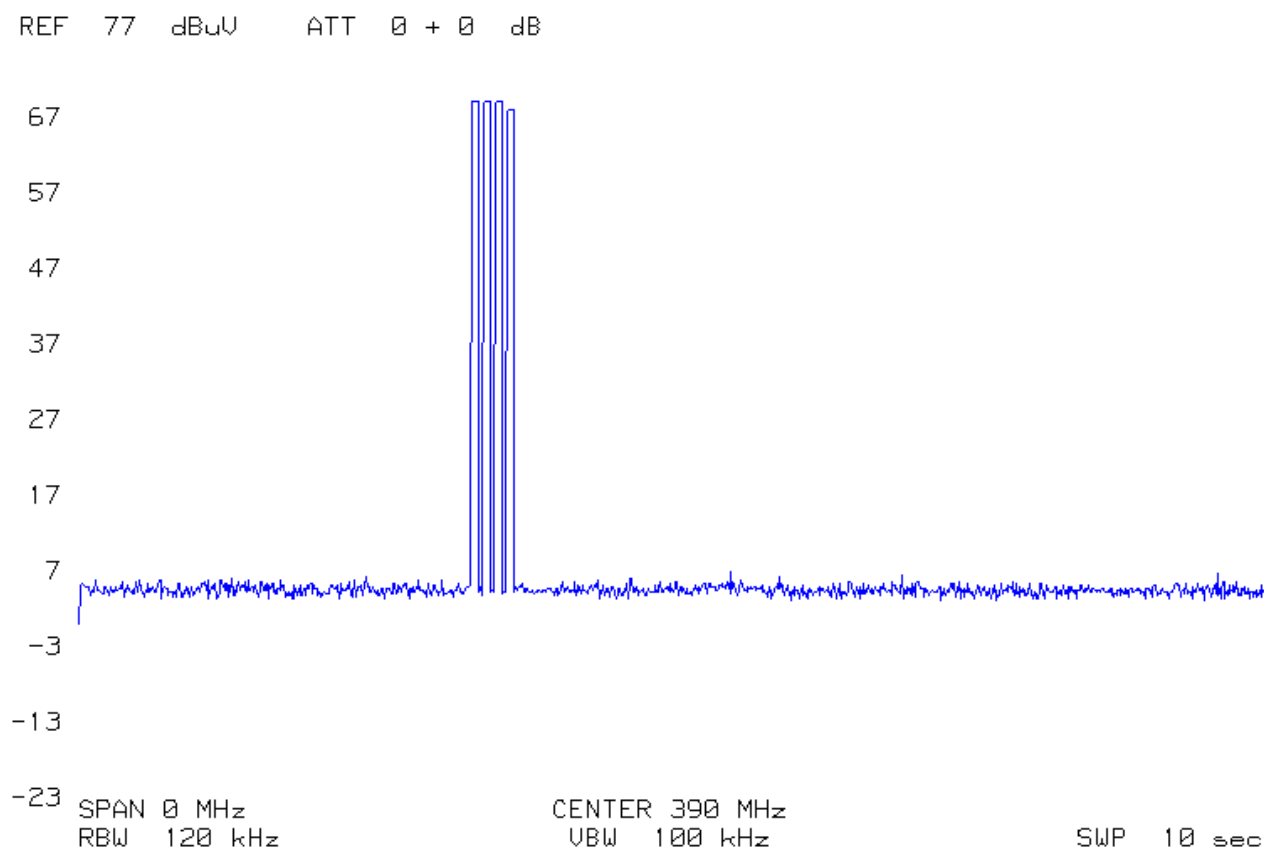
$$\text{Field Strength (dB}\mu\text{V/m)} = 19.7\text{dB}\mu\text{V/m} + 12.5\text{dB} + 0.3\text{dB}$$

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

Automatic Cease Operation

1. Set analyzer sweep time for 10 seconds
2. Key transmitter and release button
3. Ensure transmission stops before signal passes 5 second (5 divisions)

Complies (Y/N) YES

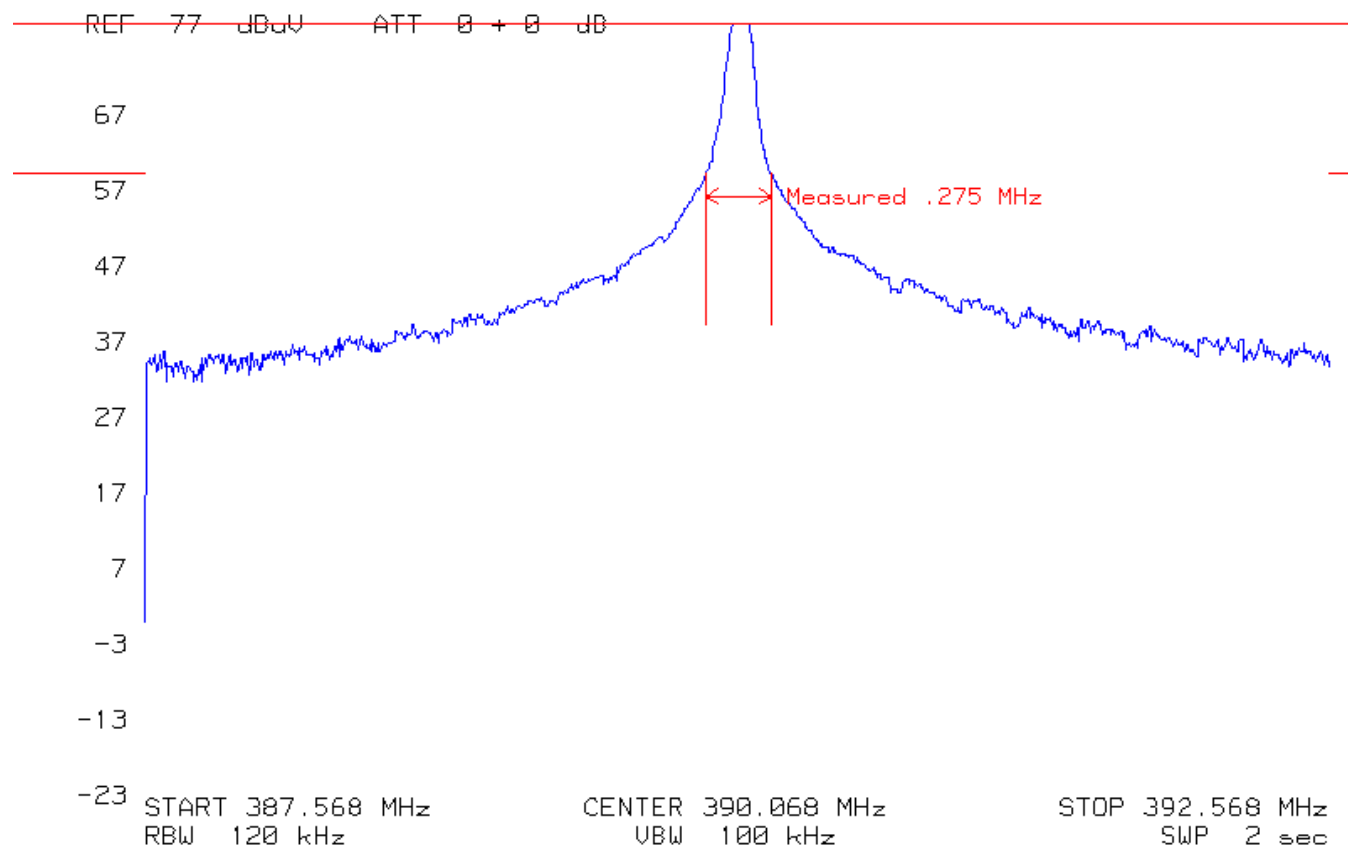


The data shown above illustrates the amount of time the device transmits by depressing the transmit button and releasing it. The amount of time is approximately 0.5 seconds.

Bandwidth Determination

□ Max bandwidth (0.25% of Fundamental Frequency) = $390\text{MHz} * .0025 = 975\text{Khz}$.

Complies (Y/N) Yes



The data shown above illustrates the occupied bandwidth determination. The maximum bandwidth for a transmitter at 390MHz is 975KHz. The bandwidth for the device under test is 275KHz.

The bandwidth was determined by setting the left and right markers -20dB from the peak reading.

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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: 8/13/2001

Test Completion Date: 9/4/2001

- UNDERWRITERS LABORATORIES, INC. -

Project Engineer

Reviewer



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