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.	:	**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

Report Directory

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:

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

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:

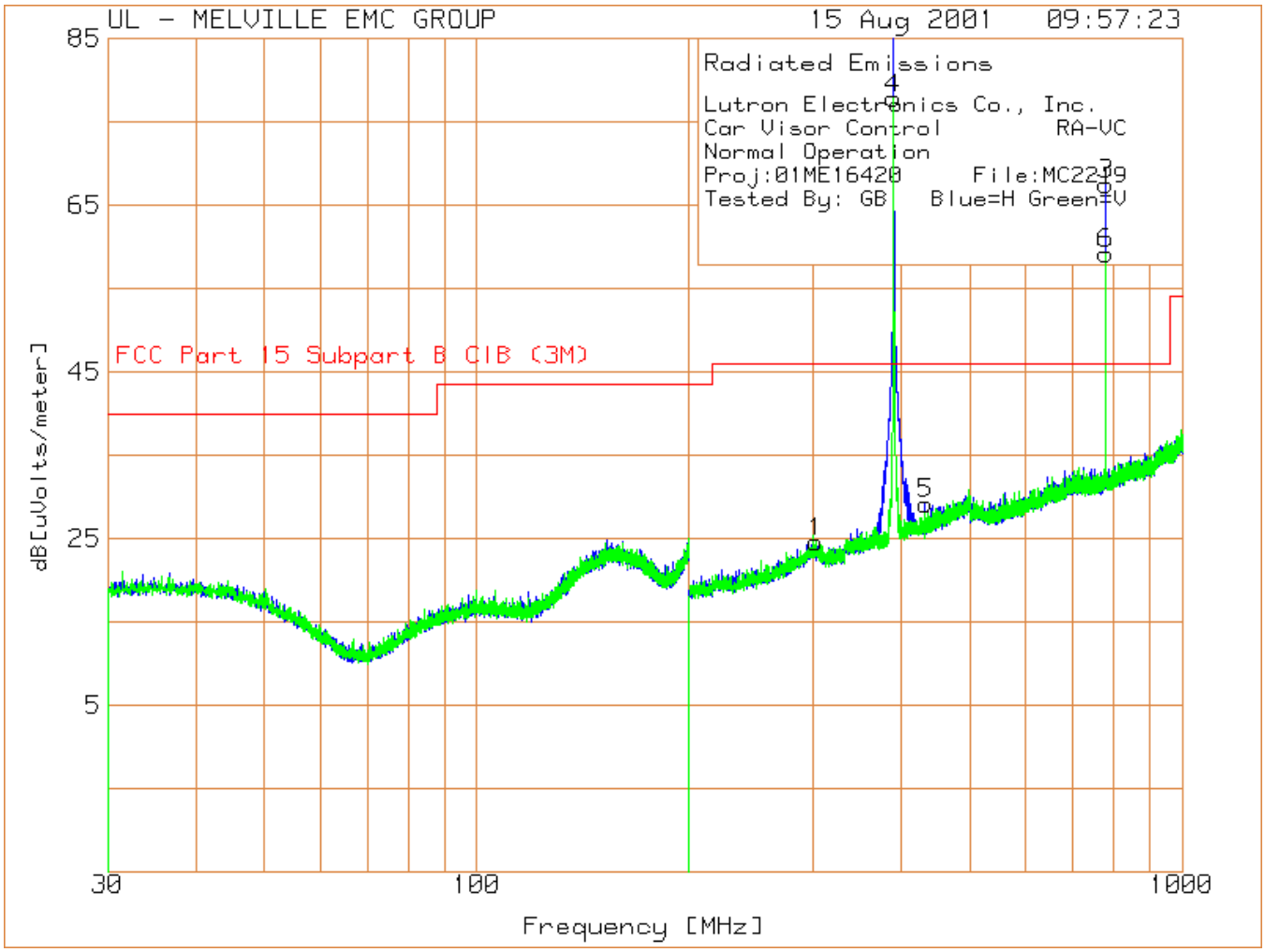
HP - 8566B	**Hewlett-Packard**	**Spectrum Analyzer,** **Resolution BW: 1MHz** **Video BW: 1MHz**
HP - 85662A	**Hewlett-Packard**	**Analyzer Display**
HP - 85650A	**Hewlett-Packard**	**Quasi-Peak Adapter,** **BW: 120kHz**
HP - 85685A	**Hewlett-Packard**	**Preselector**

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

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**


UL - MELVILLE EMC GROUP
15 Aug 2001 09:57:23
Radiated Emissions
Lutron Electronics Co., Inc.
Car Visor Control RA-VC
Normal Operation
Proj:01ME16420 File:MC2219
Tested By: GB Blue=H Green=V
FCC Part 15 Subpart B CIB (3M)
dB[uVolts/meter]
85
65
45
25
5
30
100
1000
Frequency [MHz]

Lutron Electronics Co., Inc.
Car Visor Control RA-VC
Normal Operation
Proj:01ME16420 File:MC2219
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	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

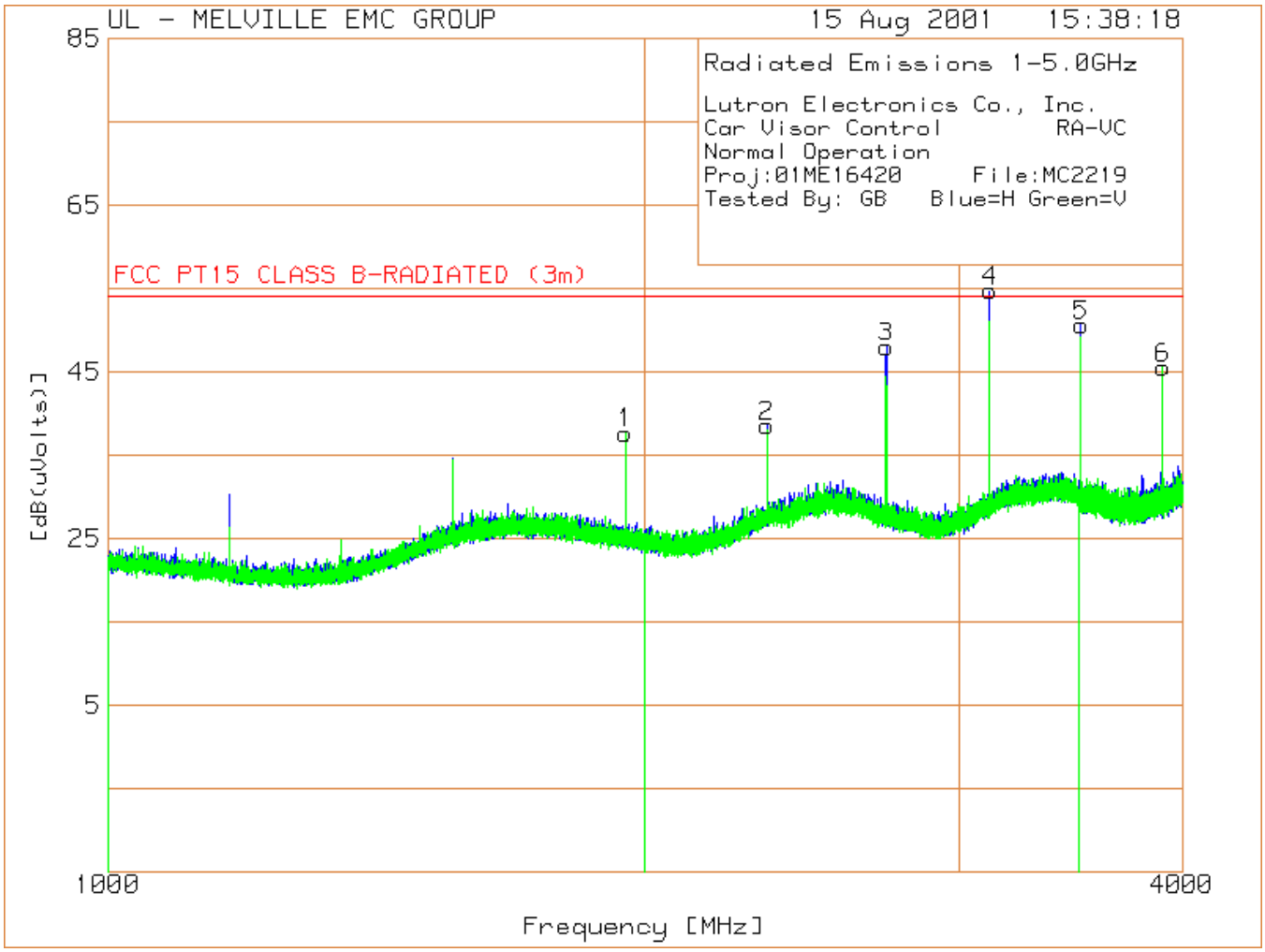
Lutron Electronics Co., Inc.
Car Visor Control RA-VC
Normal Operation
Proj:01ME16420 File:MC2219
Tested By: GB Blue=H Green=V

Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level dB[uVolts/meter]	Limit:1	2	3	4
302.41	-1.07 qp	2.3	15.9	17.13	46	N/A	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	N/A
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	N/A
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	N/A
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	N/A
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	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	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	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	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	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


UL - MELVILLE EMC GROUP
15 Aug 2001 15:38:18
Radiated Emissions 1-5.0GHz
Lutron Electronics Co., Inc.
Car Visor Control RA-VC
Normal Operation
Proj:01ME16420 File:MC2219
Tested By: GB Blue=H Green=V
FCC PT15 CLASS B-RADIATED (3m)
85
65
45
25
5
dB(uVolts)
1000
4000
Frequency [MHz]
1
2
3
4
5
6

Lutron Electronics Co., Inc.
Car Visor Control RA-VC
Normal Operation
Proj:01ME16420 File:MC2219
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)]	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
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av - Average detector
tm - Trace Math Result

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

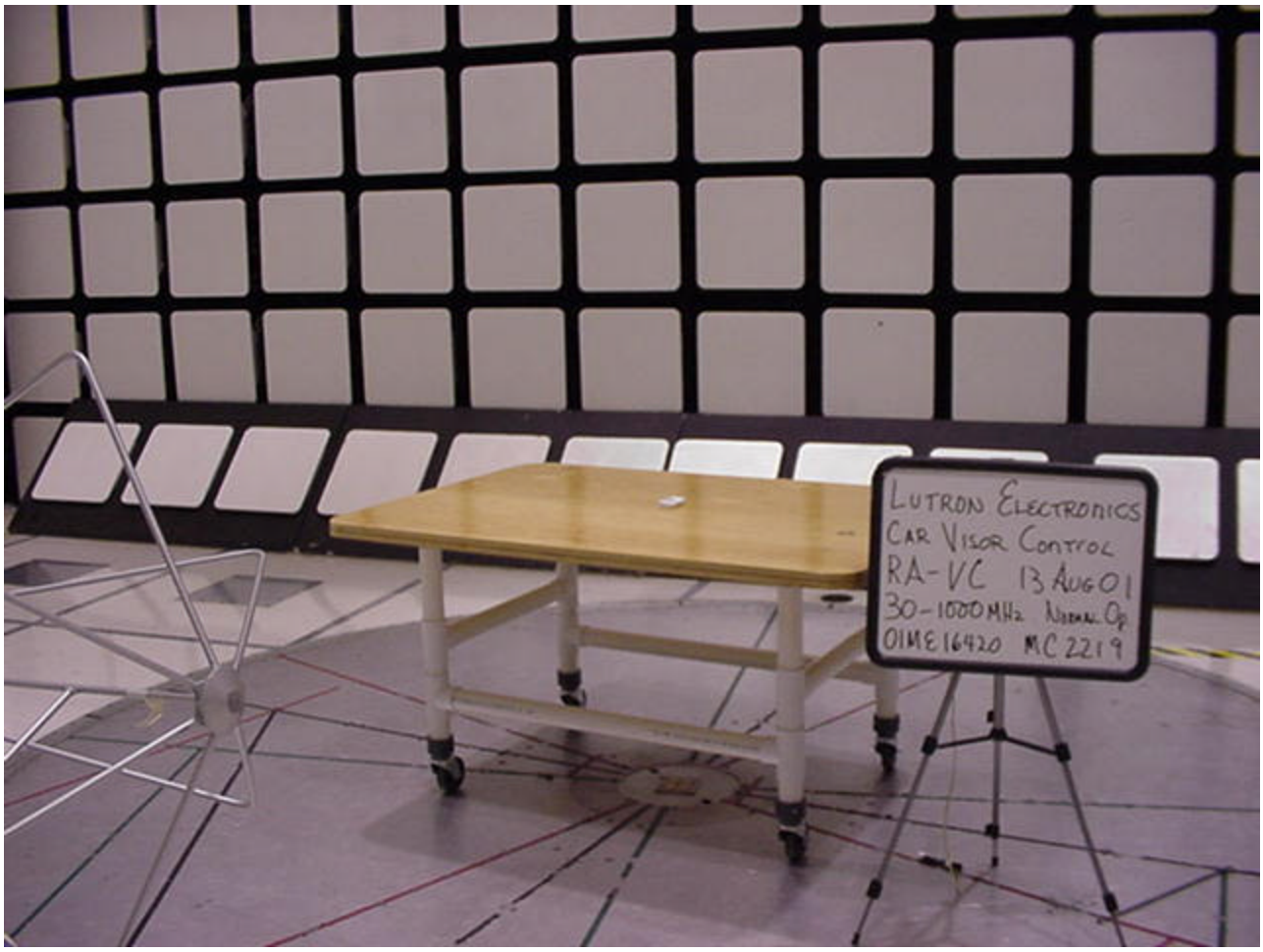
Test Frequency [MHz]	Meter Reading [dB(uV)]	Gain/Loss Factor [dB]	Transducer Factor [dB]	Level [dB(uVolts)]	Limit:1	2	3	4
3120.62	48.6 av	-28.7	32	51.9	54	59.4	N/A	N/A
Azimuth: 286	Height:176 Horz		Margin [dB]	-2.1		-7.5	N/A	N/A
3510.678	42.89 av	-27.1	32.6	48.39	54	59.4	N/A	N/A
Azimuth: 267	Height:158 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

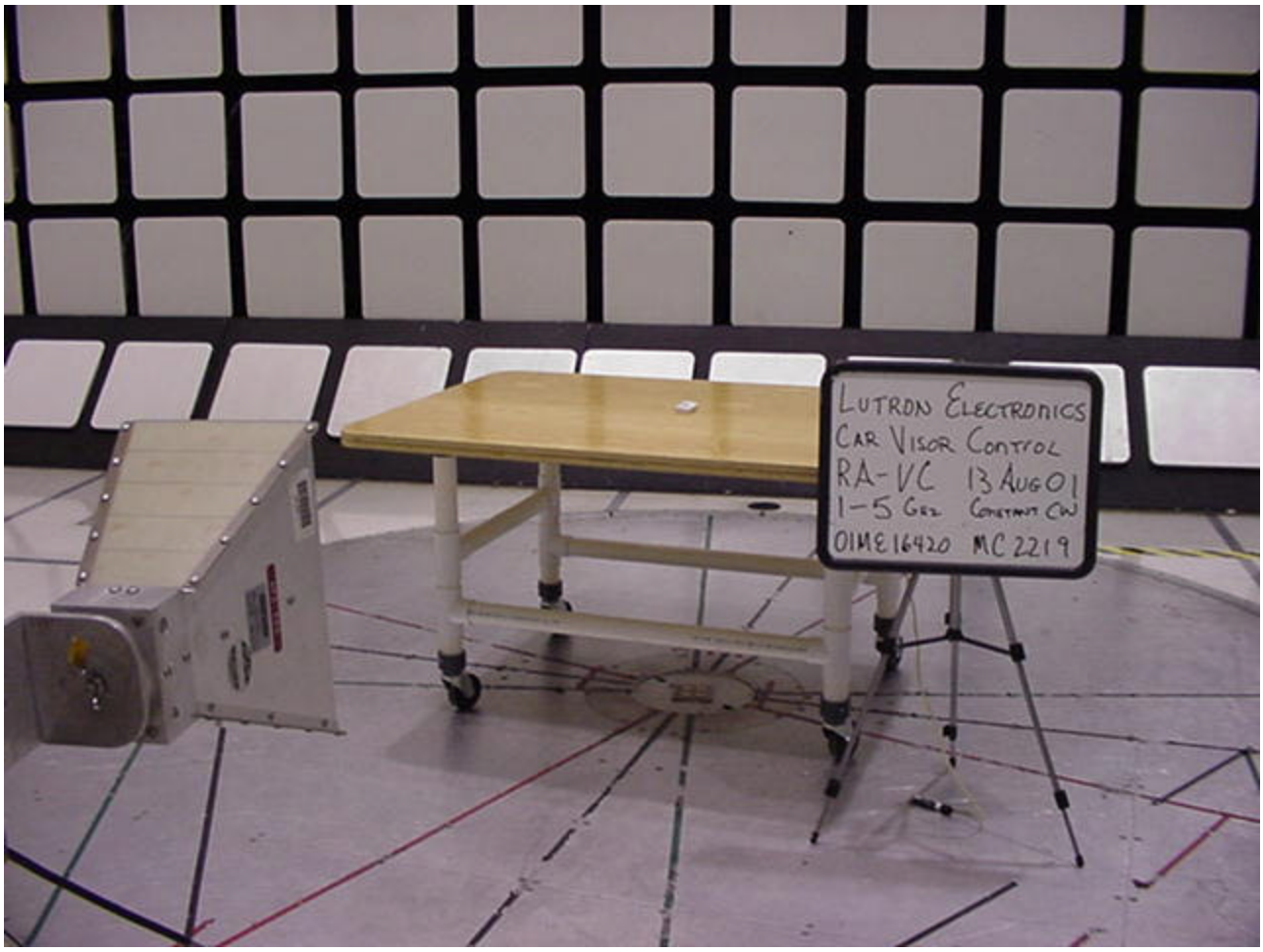
pk - Peak detector
qp - Quasi-Peak detector
av - Average detector

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

260MHz = 390MHz
3750uV XuV

260MHz(X) = 1462500MHz(uV)

X=5625uV

Limit = 5625uV+3750uV = 9375uV (79.4dBuV/m)
Limit for Fundamental = 79.4dBuV/m
Limit for Spurious Emissions = 20dB below fundamental limits = 59.4dBuV/m

Radiated Emissions Limit conversion from mV/m to dBmV/m (accordance with paragraph 15.109)

Radiated Emissions Limit (dBµV/m) = 20*log (µV/m)
Radiated Emissions Limit (dBµV/m) = 20 * log (90)
Radiated Emissions Limit (dBµV/m) = 39.1

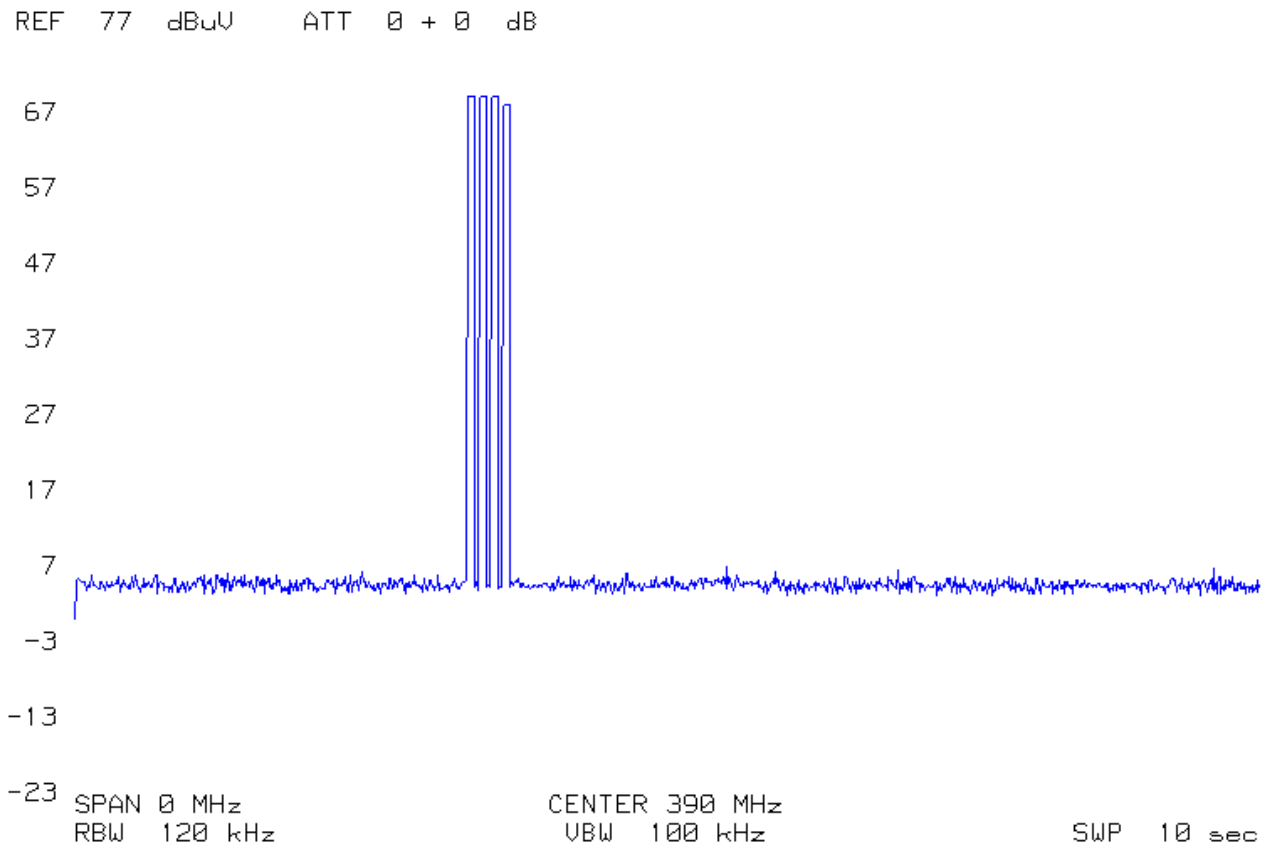
Radiated Emissions test data obtained during measurements.

Field Strength (dBµV/m) = Measured field strength(dBµV/m) + Antenna Factor(dB) + Cable Factor(dB)
Field Strength (dBµV/m) = 19.7dBµV/m + 12.5dB + 0.3dB
Field Strength (dBµV/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

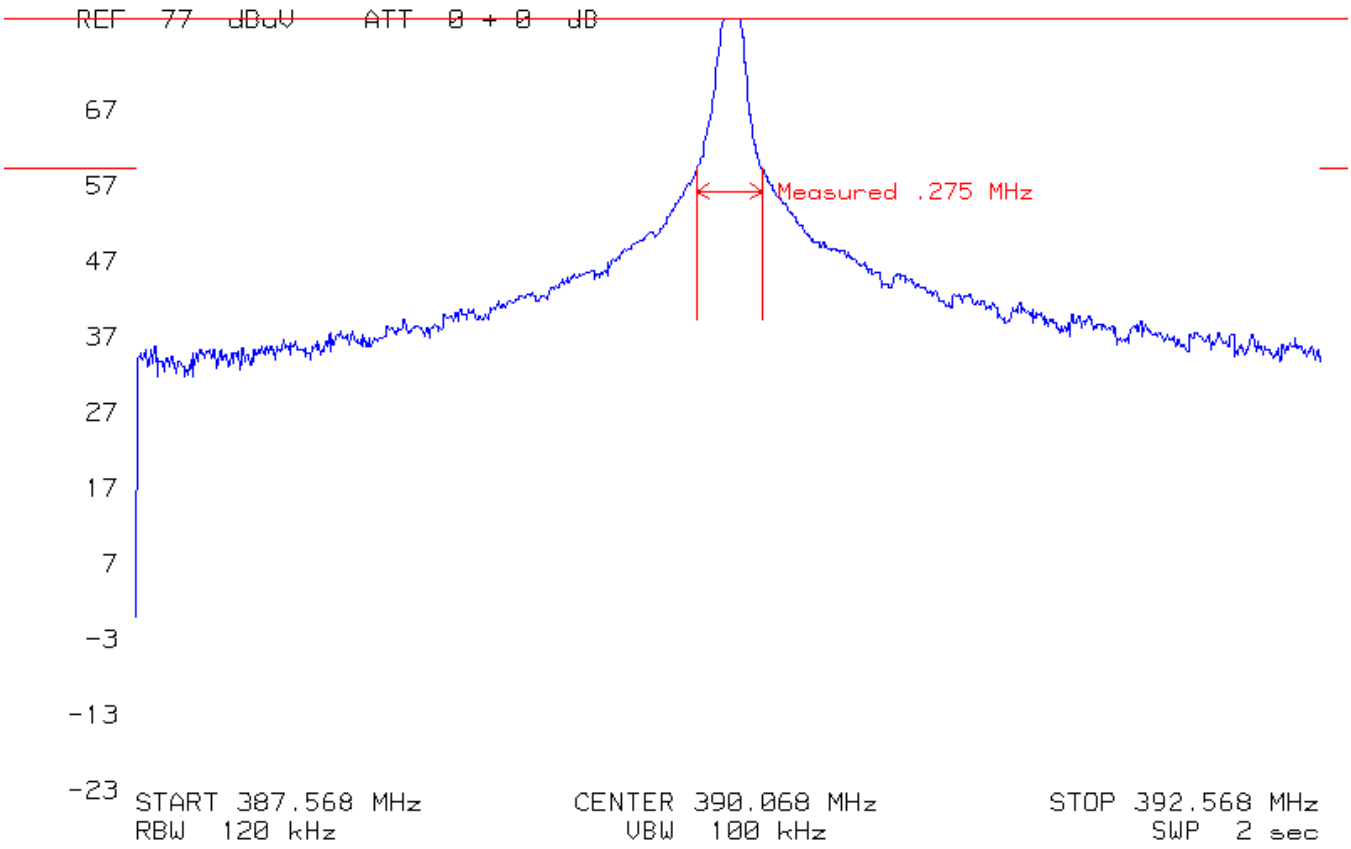


The data shown above illustrates the amount of time the device transmits by depressing the transmit button and releasing it. The amount of time is approximately 0.5 seconds.

Bandwidth Determination

- Max bandwidth (0.25% of Fundamental Frequency) = 390MHz * .0025 = 975Khz.

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.

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

Donald Lerner (Ext.22765)
Project Engineer
International EMC Services
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