3. Configuration and Identification of Device Under Test

The DUT was a 315.0 MHz superregenerative receiver developed by Lamson to perform like a conventional doorbell when activated by companion transmitter. Its dimensions are approximately 4 x 3 x 1.3 inches, and antenna is internal For power, it uses four AA-cells. There is no micro; decoding is done in analog circuitry.

The DUT was designed and manufactured by Lamson Home Products, 25701 Science Park Drive, Cleveland, OH 44122. It is identified as:

Visteon Ford Receiver
Model 3180R
SN: FCCTEST
FCC ID: DE43190R
CANADA: to be provided by IC

3.1 Modifications Made

There were no modifications made to the DUT by this laboratory.

4. Emission Limits

The DUT tested falls under Part 15, Subpart B, "Unintentional Radiators". The pertinent test frequencies, with corresponding emission limits, are given in Tables 4.1 and 4.2 below and Section 4.3.

4.1 Radiated Emission Limits

Table 4.1. Radiated Emission Limits (Ref: 15.33, 15.35, 15.109).

Freq. (MHz)	E_{lim} (3m) μV/m	E_{lim} dB(μV/m)
30-88	100	40.0
88-216	150	43.5
216-960	200	46.0
960-2000	500	54.0

Note: Quasi-Peak readings apply to 1000 MHz (120 kHz BW)
Average readings apply above 1000 MHz (1 MHz BW)

4.2 Line Conducted Emission Limits

Table 4.2. Conducted Emission Limits (Ref: 15.107).

Freq. (MHz)	μV	dB(μV)
0.450 - 1.705	250	48.0
1.705 - 30.0	250	48.0

Note: Quasi-Peak readings apply here

4.3 Antenna Power Conduction Limits
Ref: 15.111(a). Pmax = 2 nW; for frequency range see Table 4.1.

5. Emission Tests and Results

NOTE: Even though the FCC and/or Industry Canada specify that both the radiated and conductive emissions be measured using the Quasi-Peak and/or average detection schemes, we normally use peak detection since especially the Quasi-Peak is cumbersome to use with our instrumentation. In case the measurement fails to meet the limits, or the measurement is near the limit, it is remeasured using appropriate detection. We note, that since the peak detected signal is always higher or equal to the Quasi-Peak or average detected signal, the margin of compliance may be better, but not worse, than indicated in this report. The type of detection used is indicated in the data table, Table 5.1.

5.1 Anechoic Chamber Radiated Emission Tests
To familiarize with the radiated emission behavior of the DUT, it was studied and measured in the shielded anechoic chamber. In the chamber there is a set-up similar to that of an outdoor 3-meter site, with turntable, antenna mast, and a ground plane. Instrumentation includes spectrum analyzers and other equipment as needed.

To study and test for radiated emissions, the DUT was powered by a laboratory power supply at 13.6 VDC. A 315 MHz CW signal was injected (radiated) from a nearby signal generator using a short wire antenna. The DUT was placed on the test table on each of its three axis. For each placement, the table was rotated to obtain maximum signal for vertical and horizontal emission polarizations. This sequence was repeated throughout the required frequency range.

In the chamber we studied and recorded all the emissions using a ridge-horn antenna, which covers 200 MHz to 5000 MHz, up to 2 GHz. In scanning from 30 MHz to 2.0 GHz, there were no spurious emissions observed other than the LO, the injection signal, and the LO harmonics. Figures 5.1 and 5.2 show emissions measured 0-1000 MHz and 1000-2000 MHz, respectively. These measurements are made with a ridge-horn antenna at 3m, with spectrum analyzer in peak hold mode and the receiver rotated in all orientations. The measurements up to 1000 MHz (Fi.g. 5.1) are used for initial evaluation only, but those above 1000 MHz (Fig. 5.2) are used in final assessment for compliance.

5.2 Open Site Radiated Emission Tests
The DUT was then moved to the 3 meter Open Field Test Site where measurements were repeated up to 1000 MHz using a dipole. The DUT was excersized as described in Sec. 5.1 above. The measurements were made with a spectrum analyzer using 120 kHz IF bandwidth and peak detection mode, and, when appropriate, using Quasi-Peak or average detection (see 5.0). Figure 5.3 shows the close-up of the DUT on the test table, and figure 5.4 shows the overview of the site.

The emissions from digital circuitry were measured on the Open Site using a standard dipole. These results are also given in Table 5.1.

5.3 Computations and Results for Radiated Emissions
To convert the dBm's measured on the spectrum analyzer to dB(μV/m), we use expression

$$E_3(\text{dB}\mu\text{V/m}) = 107 + P_R + K_A - K_G$$

where P_R = power recorded on spectrum analyzer, dB, measured at 3m
K_A = antenna factor, dB/m
K_G = pre-amplifier gain, including cable loss, dB

When presenting the data, at each frequency the highest measured emission under all of the possible orientations is given. Computations and results are given in Table 5.1. There we see that the DUT meets the limit by 3.4 dB.

5.4 Conducted Emission Tests
These tests do not apply, since the DUT is powered from by four AA batteries.

6. Other Measurements

6.1 Emission Spectrum Near Fundamental

Near operating frequency the emission spectrum is measured typically over 50 MHz span with and without injection signal. These data are taken with the DUT close to antenna and, hence, amplitudes are relative. The plots are shown in Figure 6.1.

6.2 Effect of Supply Voltage Variation

The DUT has been designed to operate from 12 VDC power. Using a spectrum analyzer, relative radiated emissions were recorded at the "fundamental" (316 MHz) as voltage was varied from 3.0 to 9.0 VDC. Figure 6.2 shows the emission variation.

6.3 Operating Voltage and Current

V = 6.0 V
I = 0.2 mADC

The University of Michigan
Radiation Laboratory
3228 EECS Building
Ann Arbor, Michigan 48109-2122
(734) 647-1792

Table 5.1 Highest Emissions Measured

Radiated Emission - RF											Lamson 3180R RX; FCC/IC
#	Freq. MHz	Ant. Used	Ant. Pol.	Pr dBm	Det. Used	Ka dB/m	Kg dB	E3 dBµV/m	E3lim dBµV/m	Pass dB	Comments
1	313.6	SBic	H	-60.3	Pk	18.9	22.9	42.6	46.0	**3.4**	flat
2	313.6	SBic	H	-63.9	Pk	18.9	22.9	39.0	46.0	7.0	side
3	313.6	SBic	H	-64.5	Pk	18.9	22.9	38.4	46.0	7.6	end
4	313.6	SBic	V	-65.6	Pk	18.9	22.9	37.3	46.0	8.7	flat
5	313.6	SBic	V	-66.4	Pk	18.9	22.9	36.5	46.0	9.5	side
6	313.6	SBic	V	-64.3	Pk	18.9	22.9	38.6	46.0	7.4	end
7	630.0	SBic	V/H	-87.6	Pk	25.2	18.5	26.2	46.0	19.8	max. of all, noise; 10 kHz BW
8	945.0	SBic	V/H	-86.9	Pk	28.9	16.1	32.9	46.0	13.1	max. of all, noise; 10 kHz BW
9	1260.0	Horn	H	-64.0	Pk	20.4	28.0	35.4	54.0	18.6	max. of all, noise
10	1575.0	Horn	H	-63.5	Pk	20.6	28.0	36.1	54.0	17.9	max. of all, noise
11	1890.0	Horn	H	-63.5	Pk	20.8	28.2	36.1	54.0	17.9	max. of all, noise
12											
13											
14											
15											
16											
17											
18											

Radiated Emission - Digital (Class B)	
1	
2	
3	Digital Emissions more than 20 dB below FCC Class B limits
4	
5	
6	
7	
8	
9	
10	
11	
12	

Conducted Emissions							
#	Freq. MHz	Line Side	Det. Used	Vtest dBµV	Vlim dBµV	Pass dB	Comments
1							
2	Not applicable						
3							

Meas. 4/14/97; U of Mich.

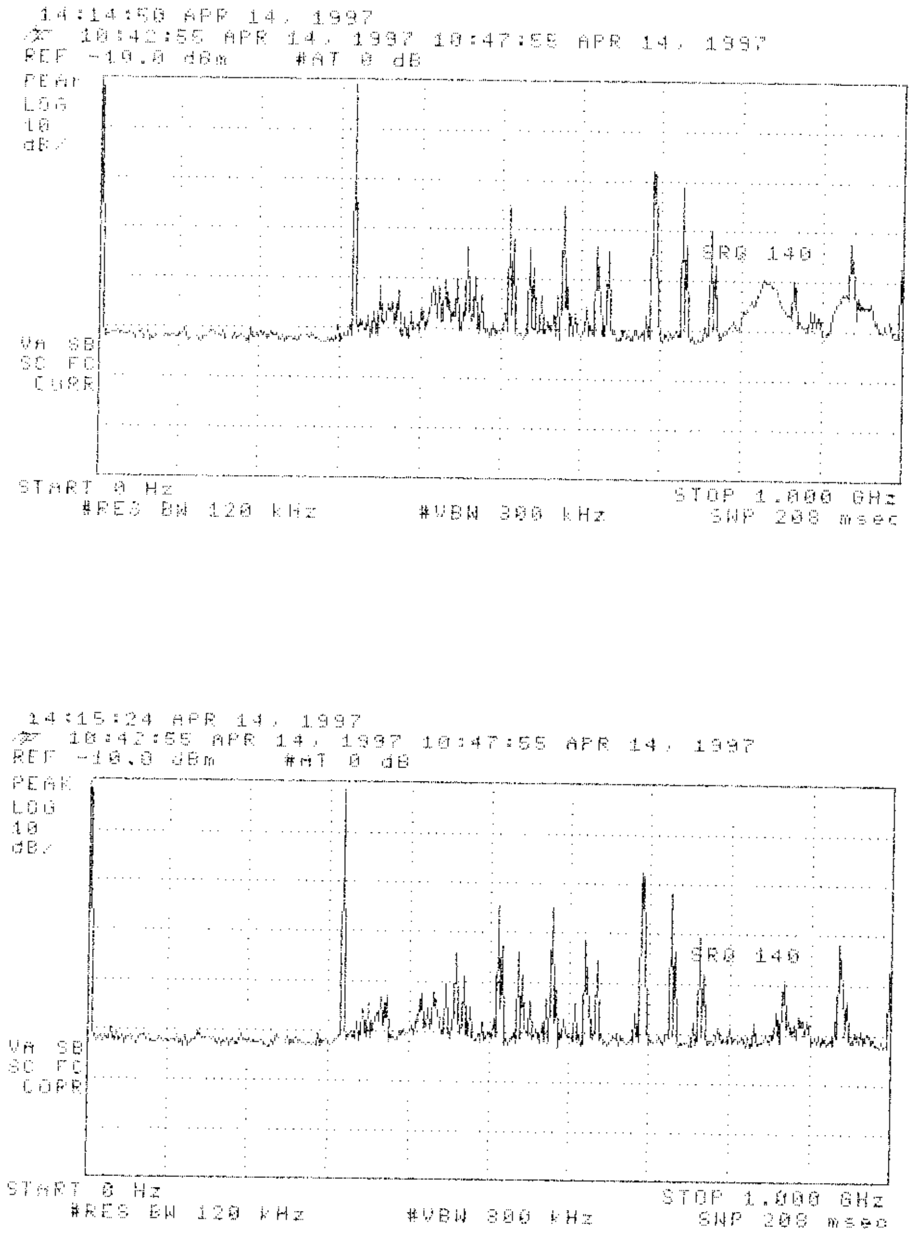
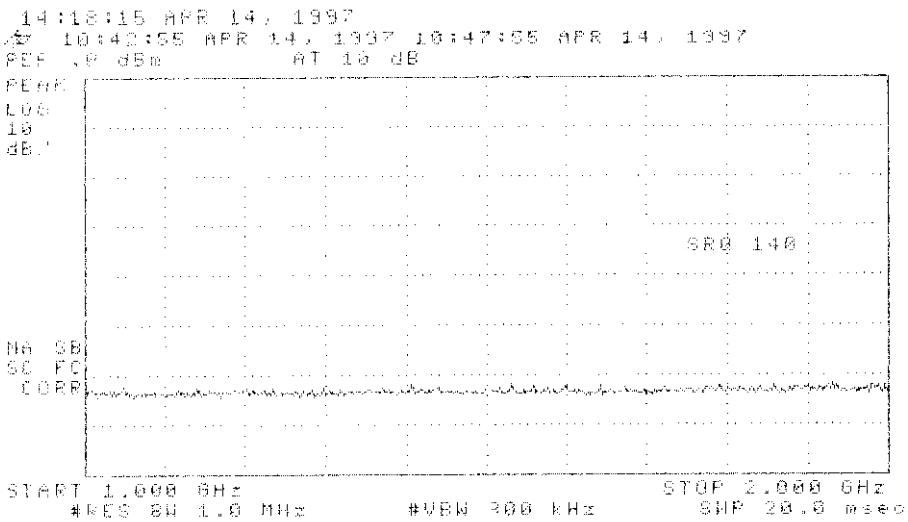


Figure 5.1. Emissions measured at 3 meters in anechoic chamber, 0-1000 MHz.
(top) Receiver plus ambient
(bottom) Ambient



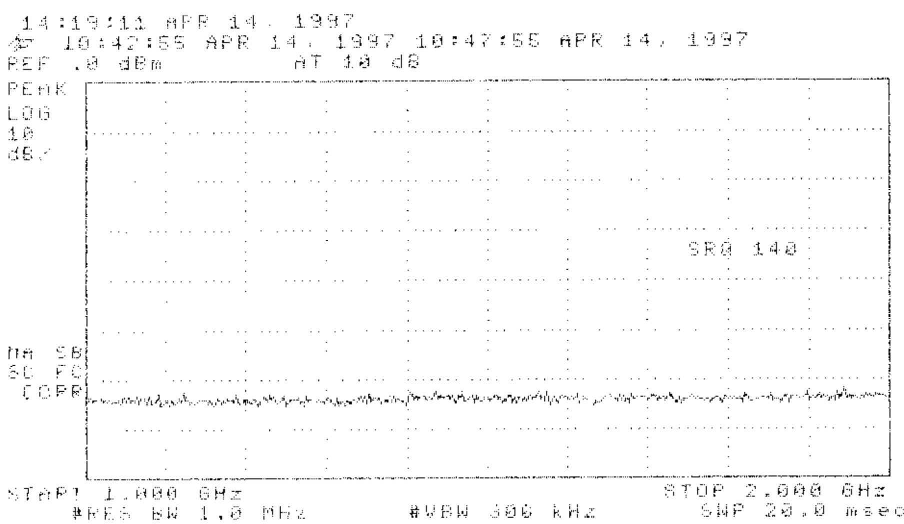


Figure 5.2. Emissions measured at 3 meters in anechoic chamber, 1000-2000 MHz.
(top) Receiver plus ambient
(bottom) Ambient

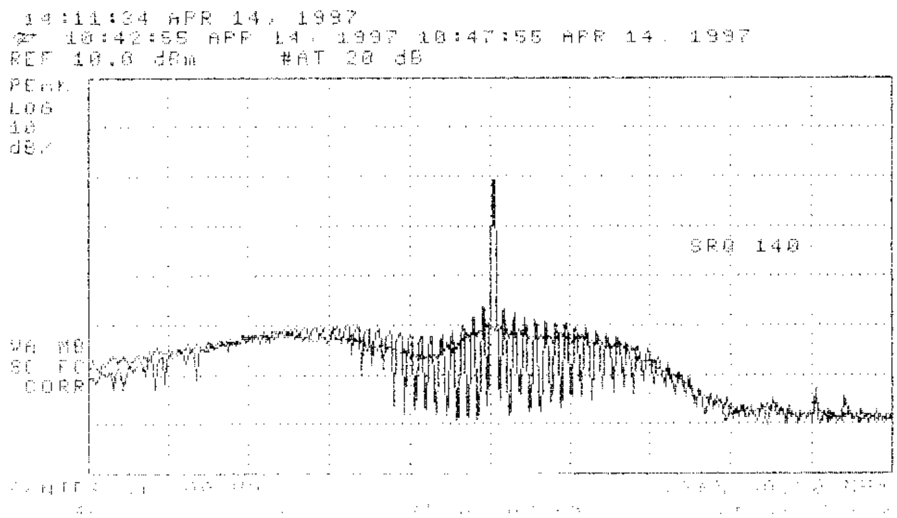


Figure 6.1. Relative receiver emissions in stand-by and "locked-in" modes. The final emission measurements were made with the receiver in "locked-in" mode.

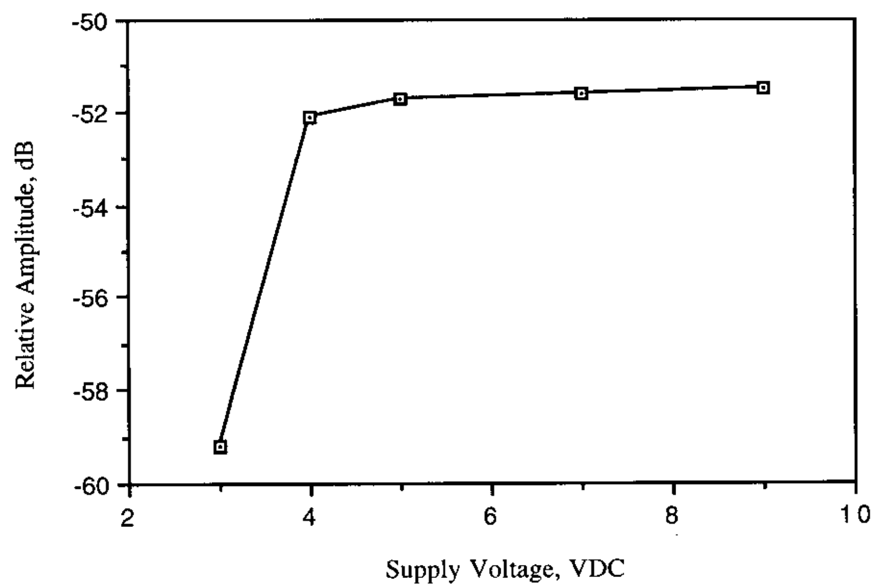


Figure 6.2. Relative emission at "fundamental" vs. supply voltage.

3190R(BM) Bill of Materials
Battery Door Bell

Preliminary:
Released: September 18, 1995
Revised: June 19, 1996 *

Line	Qty	Drawing No.+	Reference	Part Name
* 1	1	3190R-01-C		Cover
2	1	3190R-02-B1		PCB (See 3190R-02-B1(AB))
3		3190R-04		Base Assembly, consisting of:
	1	3150R-03-A(C)		Base
	1	3190R-05-B(A)		Product/FCC/UL Label (May be Engraved on Base)
		QC00-01-D(A)		QC/Date Code Label, 13mm
4	2	Carry On BH324A		Battery Holder, Dual AA, White
5				Screw Pack Contains:
	1			Screw,Steel,Bright Plated, Combination Filister Head,3.0mm dia. x 25mm, type AB Thread forming
	1	T1001-007		Wall Anchor, TP-1 Nylon. (Receiver Mounting)
	1			Screw,Steel,Black,Counter Sunk Cross Recess,3mm dia. x 18mm Long.
	1			Bag, Plastic,50 x 50mm
6	2			Board Screws,3mm dia. x 8mm Long, Round Head, Cross Recess
7	1	3150R-04-B(B)		Plastic Belt Clip
8	1	YD58-1	LS1	Speaker,.5W,8ohm,Paper Cone
9	1			Grill Cloth,White Double-Thick

+ IF THE NUMBER LISTED UNDER "DRAWING NO.+" CONTAINS NO SUFFIX IN BRACKETS ( ) THEN IT IS A PART NUMBER WITHOUT A DRAWING ON FILE.

EXHIBIT H
Page 2 of 5
U of Mich file 415031-908

3190R-02-B1(AB) Bill of Materials

Battery Doorbell PCB

Preliminary:
Released: March 21, 1996
Revised:

Line	Qty	Drawing No. +	Reference	Part Name
1	1		C1	10uF,6.3V min.,+/-20%,Electrolytic Capacitor
2	1		C2	100uF,6.3V min,+/-20%,Electrolytic Capacitor
3	1		C3	36pF,50V,+/-5%,NPO,Ceramic Disc Capacitor
4	1		C4	220pF,+/-20%,GP,Ceramic Disc Capacitor
5	3		C10,C14,C25	1pF,50V,+/-.25pF,NPO,Ceramic Disc Capacitor
6	1		C5	2pF,50V,+/-.25pF,NPO,Ceramic Disc Capacitor
7			C6	2pF,50V,+/-.25pF,NPO,Ceramic Disc Capacitor
8	1		C7	1uF,16V,+/-20%,Electrolytic Capacitor
9	3		C8,C9,C16	1nF,50V,+/-20%,GP,Ceramic Disc Capacitor
10	2		C11,C12	150pF,50V,+/-20%,GP,Ceramic Disc Capacitor
11	1		C18	100pF,50V,+/-20%,GP,Ceramic Disc Capacitor
12	1		C19	1uF,6.3V min,+/-20%,Electrolytic Capacitor
13	1		C20	1uF,6.3V min,+/-20%,Electrolytic Capacitor
14	1		C21	4.7uF,16V,+/-20%,Electrolytic Capacitor
15	1		D1	LED,T-1 3/4,Red
16	1		D5	1N4148, Diode
17	4			Jumper 22 Gauge Tinned Copper Wire
18	1 1		L1	Coil, 2 1/2 turn,Red in color Slug Aluminum

3190R-02-B1(AB) Bill of Materials
Battery Doorbell PCB

Preliminary:
Released: March 21, 1996
Revised:

Line	Qty	Drawing No.+	Reference	Part Name
19	1		L2	.9uH,RF Choke
20	1		P1	Wire,Red, 22 Gauge,O.D. should not exceed 1.45mm
21	1		P2	Wire,Blue,22 Gauge,O.D. should not exceed 1.45mm
22	1		Q1	9015C, PNP Transistor
23	2		Q2,Q3	9014C,NPN Transistor
24	6		Q5,Q6,Q7,Q9, Q11,Q12	2N3904, 2N4401or 9014C,NPN Transistor
25	1	Samsung S9018H or Motorola LM9018H	Q4	S9018H or LM9018H,NPN,RF Transistor
26	1		Q10	2N3906 or 9015C,PNP Transistor
27			Q13	2N4403 or 9012H,PNP Transistor
28	1		R1	2.2M,1/4W,5%,Carbon Film Resistor
29	5		R2,R3,R12 R14,R16	100K,1/4W,5%,Carbon Film Resistor
30	4		R4,R5,R24 R26	1M,1/4W,5%, Carbon Film Resistor
31	1		R6	130K,1/4W,5%,Carbon Film Resistor
32	1		R7	27K,1/4W,5%,Carbon Film Resistor
33	1		R8	3K,1/4W,5%,Carbon Film Resistor
34	1		R9	1.3K,1/4W,5%,Carbon Film Resistor
35	1		R10	4.7K,1/4W,5%,Carbon Film Resistor
36	3		R11,R13,R15	5.1M,1/4W,5%,Carbon Film Resistor

3190R-02-B1(AB) Bill of Materials
Battery Doorbell PCB

Preliminary:
Released: March 21, 1996
Revised:

Line	Qty	Drawing No. +	Reference	Part Name
37	1		R19	910K,1/4W,5%,Carbon Film Resistor
38	1		R20	150K, 1/4W,5%, Carbon Film Resistor
39	2		R21,R27	510K,1/4W,5%,Carbon Film Resistor
40	2		R22,R23	220K,1/4W,5%,Carbon Film Resistor
41	2		R25,R30	2.2M,1/4W,5% Carbon Film Resistor
42	1		R28	100K,1/4W,5%,Carbon Film Resistor
43	1		R29	2.2ohm,1/4W,5%,Carbon Film Resistor
44	1	Holtek HT-2810	U2	HT-2810,Sound Generator, IC
		Or		
		3190R-07-A0		Printed Circuit Board,XXXP, 1oz. Copper
		Holtek HT-2810	H1	HT-2810,Sound Generator, IC Die-Bonded
45	1		Y1	32.768KHz,Crystal
46				Solder and Flux
47				Hot Melt Glue
48	1	3190R-02-B1		Printed Circuit Board,XXXP, 1oz. Copper

DOCUMENTATION

Drawing No.	Part Name
3190R-02-B1(AW)	PCB Artwork
3190R-02-B1(SC)	PCB Schematic
3190R-02-B1(AD)	PCB Component Layout
3190R-02-B1(AB)	PCB Bill of Materials

+ If the number listed under "Drawing No.+" contains no suffix in brackets ( ) then we have used the part number.'

The University of Michigan
Radiation Laboratory
3228 EECS Building
Ann Arbor, MI 48109-2122
Tel: (734) 647-1792

Measured Radio Frequency Emissions
From

Lamson Battery Doorbell (Receiver) Models: 3180R/3190R

Report No. 415031-909
April 10, 1998

For:
Lamson Home Products
25701 Science Park Drive
Cleveland, OH 44122

EXHIBIT E
Page 1-10 of 10
U of Mich file 415031-908

Contact:
Tom Xydis
Tel: (734) 378-1169
Fax: (734) 677-2866
PO: verbal

Measurements made by:
Daliang Shi
Valdis Liepa

Tests supervised by:
Report approved by:
Valdis V. Liepa
Research Scientist

Summary

Tests for compliance with FCC Regulations subject to Part 15, Subpart B, were performed on Lamson Model 3180R superregenerative receiver. The receiver 3190R differs only in the "looks" of the case; everything inside is same. This device is subject to Rules and Regulations as a Receiver. As a Digital Device it is exempt, but such measurements were made to assess the receiver's overall emissions.

In testing performed on April 14, 1997, the device tested in the worst case met the specifications for radiated emissions by 3.4 dB (see p. 6). The line conductive emission tests do not apply, since the device is powered from an automobile 12 VDC system.

1. Introduction

Visteon Ford WIN126 receiver, PN: XF2F-15K602-AA, was tested for compliance with FCC Regulations, Part 15, adopted under Docket 87-389, April 18, 1989. The tests were performed at the University of Michigan Radiation Laboratory Willow Run Test Range following the procedures described in ANSI C63.4-1992 "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz". The attenuation characteristics of the Open Site facility are on file with FCC Laboratory, Columbia, Maryland. (FCC file 31040/SIT)

2. Test Procedure and Equipment Used

The test equipment commonly used in our facility is listed in Table 2.1 below. The second column identifies the specific equipment used in these tests. The HP 8593E spectrum analyzer is used for primary amplitude and frequency reference.

Table 2.1. Test Equipment.

Test Instrument	Eq'nt Used	Manufacturer/Model	Cal. Date/By
Spectrum Analyzer (9kHz-22GHz)		Hewlett-Packard 8593A SN: 3107A01358	July 1997/HP
Spectrum Analyzer (9kHz-26GHz)	X	Hewlett-Packard 8593E SN: 3107A01131	June 1997/HP
Spectrum Analyzer (0.1-1500 MHz)	X	Hewlett-Packard 182T/8558B SN: 1529A01114/543592	August 1996/U of M Rad Lab
Preamplifier (5-1000MHz)	X	Watkins-Johnson A11 -1 plus A25-1S	May 1997/U of M Rad Lab
Preamplifier (5-4000 MHz)	X	Avantek	Nov. 1992/ U of M Rad Lab
Power Meter		Hewlett-Packard 432A	August 1989/U of M Rad Lab
w/ Thermistor		Hewlett-Packard 478A	August 1989/U of M Rad Lab
Broadband Bicone (20-200 MHz)	X	University of Michigan	July 1996/U of M Rad Lab
Broadband Bicone (200-1000 MHz)	X	University of Michigan	June 1996/U of M Rad Lab
Dipole Antenna Set (25-1000 MHz)		University of Michigan	June 1996/U of M Rad Lab
Dipole Antenna Set (30-1000 MHz)		EMCO 3121C SN: 992	June 1996/U of M Rad Lab
Active Loop Antenna (0.090-30MHz)		EMCO 6502 SN: 2855	December 1993/ EMCO
Active Rod (30Hz-50 MHz)		EMCO 3301B SN: 3223	December 1993/EMCO
Ridge-horn Antenna (0.5-5 GHz)	X	University of Michigan	February 1991/U of M Rad Lab
LISN Box		University of Michigan	May 1994/U of M Rad Lab
Signal Cables	X	Assorted	January 1993/U of M Rad Lab
X-Y Plotter		Hewlett-Packard 7046A	During Use/U of M Rad Lab
Signal Generator (0.1-990 MHz)	X	Hewlett-Packard 8656A	January 1990/U of M Rad Lab
Printer	X	Hewlett-Packard 2225A	August 1989/HP