Excellence in Compliance Testing

Certification Test Report

FCC ID: N6SLFECIM
IC: 827B-LFECIM

FCC Rule Part: 15.209
IC Radio Standards Specification: RSS-210

ACS Report Number: 13-0074.W06.1A

Manufacturer: Gilbarco Inc.
Model: LFECIM

Test Begin Date: February 23, 2013
Test End Date: March 6, 2013

Report Issue Date: March 22, 2013

FOR THE SCOPE OF ACCREDITATION UNDER LAB Code 200612-0

This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government.

Reviewed by:

Kirby Munroe
Director, Wireless Certifications
ACS, Inc.

This report contains 16 pages

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1 GENERAL

1.1 Purpose

The purpose of this report is to demonstrate compliance with Part 15 Subpart C of the FCC's Code of Federal Regulations and Industry Canada's Radio Standards Specification RSS-210 for modular approval certification.

1.2 Product description

The model LFECIM is a Radio Frequency Identification Device (RFID) which is designed for use in conjunction with passive transponders (not requiring a battery), Texas Instruments Part # RI-TRP-Series. The user carries the handheld transponder and the transmitter portion of the LFECIM operates at 134.2kHz.

Technical Information:
Band of Operation: 134 kHz
Number of Channels: 1
Modulation Format: FSK
Antenna Type: Integral Loop
Operating Voltage: 24 VDC (Host)

Manufacturer Information:
Gilbarco Inc.
7300 West Friendly Ave.
Greensboro NC 27420

Test Sample Serial Number(s): 64219196

Test Sample Condition: The test samples were provided in good working order with no visible defects.

1.3 Test Methodology and Considerations

The EUT was tested in an orientation of typical installation. A tag was presented to the EUT (i.e. tag reader) to provide continuous transmit functionality for test purposes. In order to comply with 15.209 regulations, the LFECIM needed a ferrite placed on the power/data cable. The part number of the ferrite used was Steward Ferrite 29A2025-0A0. See the external photo exhibit included in this filing for photographs of this modification.

2 TEST FACILITIES

2.1 Location

The radiated and conducted emissions test sites are located at the following address:

Advanced Compliance Solutions
5015 B.U. Bowman Drive
Buford, GA 30518
Phone: (770) 831-8048
Fax: (770) 831-8598

2.2 Laboratory Accreditations/Recognitions/Certifications

ACS is accredited to ISO/IEC 17025 by the National Institute of Standards and Technology under their National Voluntary Laboratory Accreditation Program (NVLAP), Lab Code 200612-0. Unless otherwise specified, all tests methods described within this report are covered under the ISO/IEC 17025 scope of accreditation.

The Semi-Anechoic Chamber Test Site, Open Area Test Site (OATS) and Conducted Emissions Site have been fully described, submitted to, and accepted by the FCC, Industry Canada and the Japanese Voluntary Control Council for Interference by information technology equipment.

FCC Registration Number: 511277
Industry Canada Lab Code: IC 4175A-1
VCCI Member Number: 1831

- VCCI OATS Registration Number R-1526
- VCCI Conducted Emissions Site Registration Number: C-1608

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

The Semi-Anechoic Chamber Test Site consists of a 20' x 30' x 18' shielded enclosure. The chamber is lined with Toyo Ferrite Grid Absorber, model number FFG-1000. The ferrite tile grid is 101 x 101 x 19mm thick and weighs approximately 550 grams. These tiles are mounted on steel panels and installed directly on the inner walls of the chamber.

The turntable is 150cm in diameter and is located 160cm from the back wall of the chamber. The chamber is grounded via 1 - 8' copper ground rod, installed at the center of the back wall, it is bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is all steel, flush mounted table installed in an all steel frame. The table is remotely operated from inside the control room located 25' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Behind the turntable is a 3' x 6' x 4' deep shielded pit used for support equipment if necessary. The pit is equipped with 1 - 4" PVC chases from the turntable to the pit that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit.

A diagram of the Semi-Anechoic Chamber Test Site is shown in Figure 2.3-1 below:

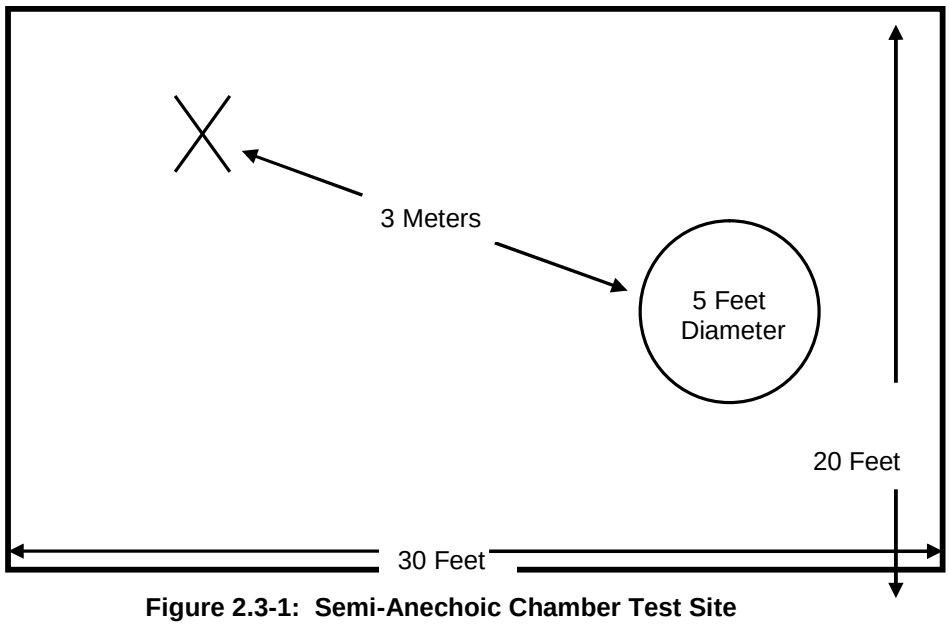


Figure 2.3-1: Semi-Anechoic Chamber Test Site

2.3.2 Open Area Tests Site (OATS)

The open area test site consists of a 40' x 66' concrete pad covered with a perforated electro-plated galvanized sheet metal. The perforations in the sheet metal are 1/8" holes that are staggered every 3/16". The individual sheets are placed to overlap each other by 1/4" and are riveted together to provide a continuous seam. Rivets are spaced every 3" in a 3 x 20 meter perimeter around the antenna mast and EUT area. Rivets in the remaining area are spaced as necessary to properly secure the ground plane and maintain the electrical continuity.

The entire ground plane extends 12' beyond the turntable edge and 16' beyond the antenna mast when set to a 10 meter measurement distance. The ground plane is grounded via 4 - 8' copper ground rods, each installed at a corner of the ground plane and bound to the ground plane using 3/4" stainless steel braided cable.

The turntable is an all aluminum 10' flush mounted table installed in an all aluminum frame. The table is remotely operated from inside the control room located 40' from the range. The turntable is electrically bonded to the surrounding ground plane via steel fingers installed on the edge of the turn table. The steel fingers make constant contact with the ground plane during operation.

Adjacent to the turntable is a 7' x 7' square and 4' deep concrete pit used for support equipment if necessary. The pit is equipped with 5 - 4" PVC chases from the pit to the control room that allow for cabling to the EUT if necessary. The underside of the turntable can be accessed from the pit so cables can be supplied to the EUT from the pit. The pit is covered with 2 sheets of 1/4" diamond style re-enforced steel sheets. The sheets are painted to match the perforated steel ground plane; however the underside edges have been masked off to maintain the electrical continuity of the ground plane. All reflecting objects are located outside of the ellipse defined in ANSI C63.4.

A diagram of the Open Area Test Site is shown in Figure 2.3-2 below:

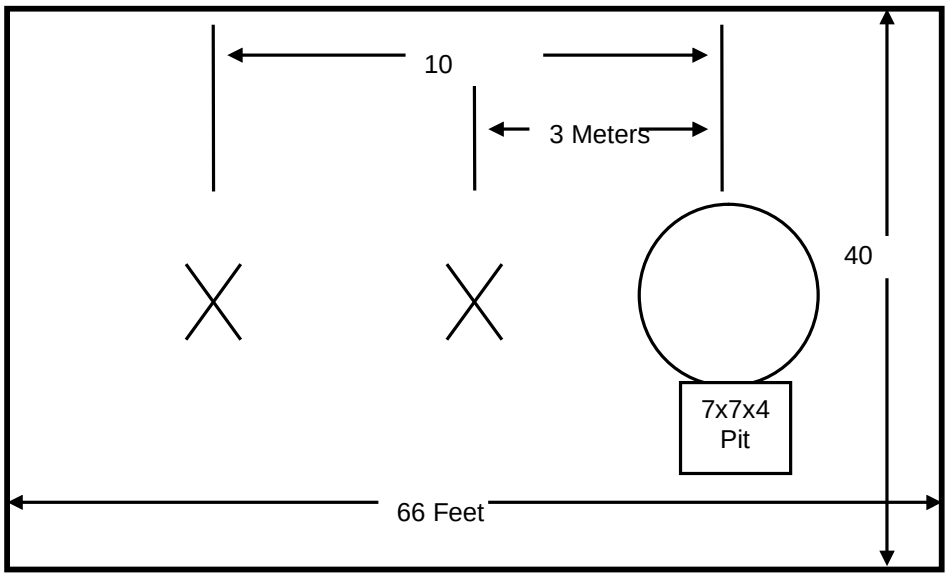


Figure 2.3-2: Open Area Test Site

2.4 Conducted Emissions Test Site Description

The AC mains conducted EMI site is located in the main EMC lab. It consists of an 8' x 8' solid aluminum horizontal ground reference plane (GRP) bonded every 3" to an 8' X 8' vertical ground plane.

The site is of sufficient size to test table top and floor standing equipment in accordance with section 6.1.4 of ANSI C63.4.

A diagram of the room is shown below in figure 4.1.3-1:

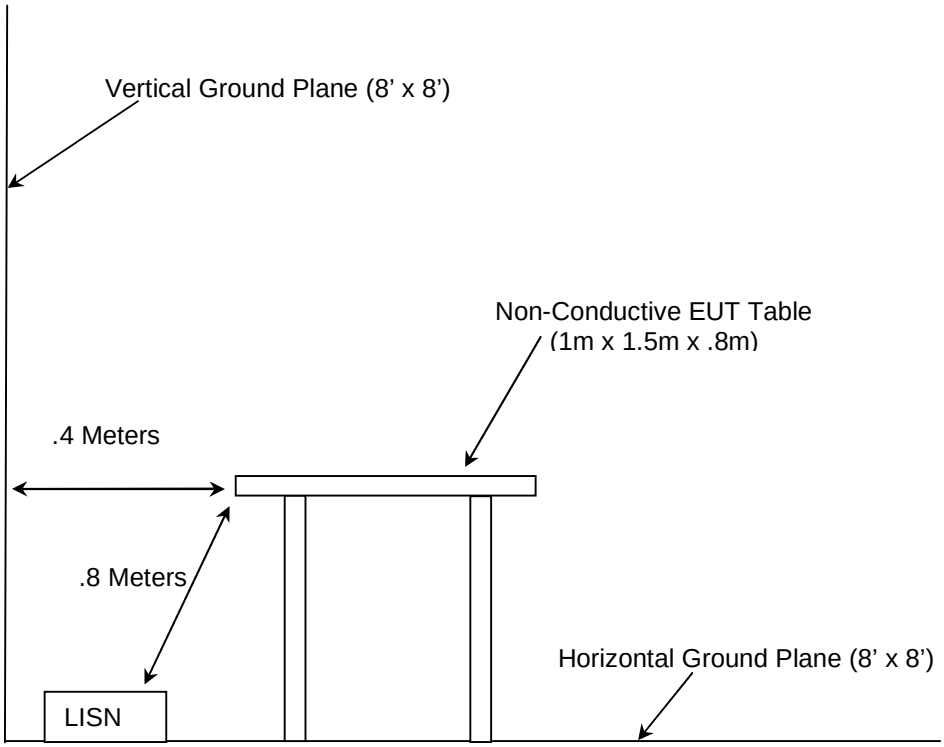


Figure 2.4-1: AC Mains Conducted EMI Site

3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.4-2003: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9KHz to 40GHz
- ANSI C63.10-2009: American National Standard for Testing Unlicensed Wireless Devices
- US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2013
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2013
- Industry Canada Radio Standards Specification: RSS-210 - Low-power License-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment, Issue 8, Dec 2010
- Industry Canada Radio Standards Specification: RSS-GEN – General Requirements and Information for the Certification of Radiocommunication Equipment, Issue 3, Dec 2010.

4 LIST OF TEST EQUIPMENT

The calibration interval of test equipment is annually or the manufacturer's recommendations. Where the calibration interval deviates from the annual cycle based on the instrument manufacturer's recommendations, it shall be stated below.

Table 4-1: Test Equipment

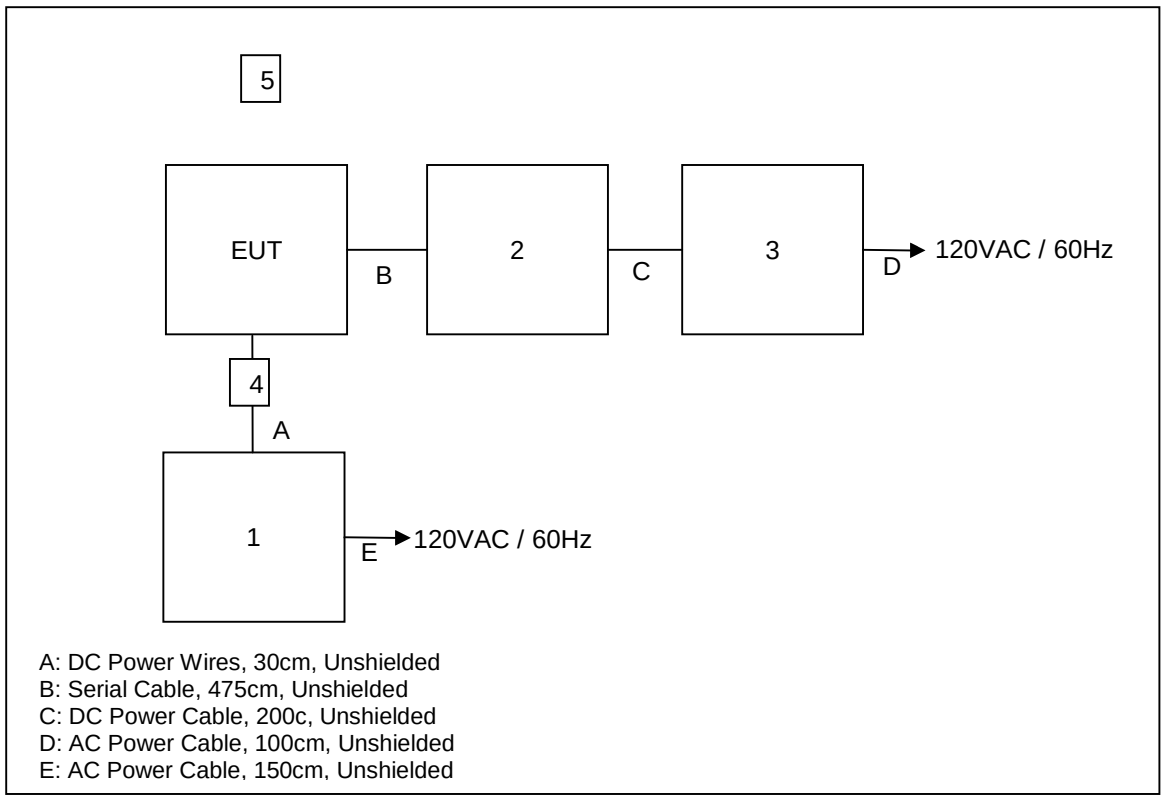
AssetID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
1	Rohde & Schwarz	ESMI - Display	Spectrum Analyzers	833771/007	8/2/2012	8/2/2014
2	Rohde & Schwarz	ESMI-Receiver	Spectrum Analyzers	839587/003	8/2/2012	8/2/2014
40	EMCO	3104	Antennas	3211	2/14/2013	2/14/2015
73	Agilent	8447D	Amplifiers	2727A05624	9/28/2012	9/28/2013
78	EMCO	6502	Antennas	9104-2608	2/5/2013	2/5/2015
153	EMCO	3825/2	LISN	9411-2268	7/31/2012	7/31/2014
167	ACS	Chamber EMI Cable Set	Cable Set	167	12/17/2012	12/17/2013
168	Hewlett Packard	11947A	Attenuators	44829	2/1/2013	2/1/2014
283	Rohde & Schwarz	FSP40	Spectrum Analyzers	1000033	8/1/2012	8/1/2013
324	ACS	Belden	Cables	8214	6/26/2012	6/26/2013
412	Electro Metrics	LPA-25	Antennas	1241	7/27/2012	7/27/2014
RE90	Agilent	E7404A	Analyzers	US40240143	11/28/2012	11/28/2013

5 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item	Equipment Type	Manufacturer	Model Number	Serial Number
1	Power Supply	Phoenix Contact	MINI-PS-100-240AC/24DC/4	50013173
2	Laptop	Dell	D630 (PP18L)	N/A
3	Power Supply	Dell	PA-1650-05D2	CN-0F7970-71615-55M-6BF4
4	Clip-on Ferrite	Steward	29A2025-0A0	N/A
5	RFID Tag	TIRIS	N/A	N/A

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM



A: DC Power Wires, 30cm, Unshielded
B: Serial Cable, 475cm, Unshielded
C: DC Power Cable, 200c, Unshielded
D: AC Power Cable, 100cm, Unshielded
E: AC Power Cable, 150cm, Unshielded

7 SUMMARY OF TESTS

Along with the tabular data shown below, plots were taken of all signals deemed important enough to document.

7.1 Antenna Requirement – FCC: Section 15.203

The antenna is a loop antenna which is non-detachable and integral in design.

7.2 Power Line Conducted Emissions – FCC: Section 15.207 IC: RSS-Gen 7.2.4

7.2.1 Measurement Procedure

ANSI C63.4 sections 6 and 7 were the guiding documents for this evaluation. Conducted emissions were performed from 150kHz to 30MHz with the spectrum analyzer's resolution bandwidth set to 9kHz and the video bandwidth set to 30kHz. The calculation for the conducted emissions is as follows:

Corrected Reading = Analyzer Reading + LISN Loss + Cable Loss
Margin = Applicable Limit - Corrected Reading

7.2.2 Measurement Results

Results of the test are shown below in and Tables 7.2.2-1 and 7.2.2-2.

Table 7.2.2-1: Conducted EMI Results – Line 1

Frequency (MHz)	Uncorrected Reading		Total Correction Factor (dB)	Corrected Level		Limit		Margin (dB)	
	Quasi-Peak	Average		Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average
10.468	27.238	27.875	10.239	37.477	38.114	60	50	22.523	11.886
9.93209	27.384	28.45	10.178	37.562	38.628	60	50	22.438	11.372
9.66254	27.974	29.091	10.198	38.172	39.289	60	50	21.828	10.711
9.39409	28.136	28.798	10.218	38.353	39.016	60	50	21.647	10.984
8.85894	25.902	25.971	10.229	36.13	36.2	60	50	23.87	13.8
0.177069	34.415	29.151	9.964	44.379	39.115	65.227	55.227	20.848	16.111

Table 7.2.2-2: Conducted EMI Results – Line 2

Frequency (MHz)	Uncorrected Reading		Total Correction Factor (dB)	Corrected Level		Limit		Margin (dB)	
	Quasi-Peak	Average		Quasi-Peak	Average	Quasi-Peak	Average	Quasi-Peak	Average
8.85849	25.246	25.784	10.229	35.474	36.012	60	50	24.526	13.988
2.42909	25.971	26.187	10.004	35.975	36.191	56	46	20.025	9.809
2.33994	26.223	26.432	10.003	36.226	36.435	56	46	19.774	9.565
1.98757	25.246	26.356	9.999	35.245	36.355	56	46	20.755	9.645
0.221644	29.503	25.254	9.926	39.429	35.18	63.953	53.953	24.524	18.773
0.17585	33.899	29.303	9.967	43.866	39.27	65.261	55.261	21.396	15.991

7.3 Radiated Emissions – FCC CFR 47 Part 15.209 / RSS-210 Section 2.5

7.3.1 Measurement Procedure

Section 15.33(a)(4) specifies, if the intentional radiator contains a digital device, regardless of whether this digital device controls the functions of the intentional radiator or the digital device is used for additional control or function purposes other than to enable the operation of the intentional radiator, the frequency range shall be investigated up to frequency specified in 15.33(b)(1) for unintentional radiators. The upper frequency range for the digital device is 1000MHz which greater than the 10^{th} harmonic of the fundamental frequency. The upper frequency range measured was 1000MHz.

Measurements below 30MHz were performed in a semi-anechoic chamber with a 3 meter separation distance between the EUT and measurement antenna. The EUT was rotated 360º and the loop antenna rotated about the vertical axis to maximize each emission. The magnetic loop receiving antenna was positioned with its center 1 meter above the ground.

The spectrum analyzer's resolution and video bandwidth was set to 200 Hz and 1 kHz respectively for frequencies below 150 kHz and 9 kHz and 30 kHz respectively for frequencies above 150 kHz and below 30 MHz. For measurements in the frequency bands 9-90 kHz and 110-490 kHz, an average detector was used. When average measurements are specified, the peak emissions were also compared to a limit corresponding to 20 dB above the maximum permitted average limit according to Part 15.35. All other emissions were measured using a Quasi-peak detector.

Measurements above 30 MHz were performed in a semi-anechoic chamber with a 3 meter separation distance between the EUT and measurement antenna. The EUT was rotated through 360° and the receive antenna height was varied from 1m to 4m so that the maximum radiated emissions level would be detected. For frequencies below 1000 MHz, quasi-peak measurements were made using a resolution bandwidth (RBW) of 120 kHz and a video bandwidth (VBW) of 300 kHz.

For measurements of fundamental emissions where average measurements are specified, the spectrum analyzer's resolution bandwidth (RBW) was adjusted equal to or greater than the emission bandwidth (EBW).

7.3.2 Distance Correction for Measurements Below 30 MHz – Part 15.31

Radiated measurements were performed at a distance closer than 300 meters and 30m as required, according to Part 15.209. Therefore a correction factor was applied to account for propagation loss at the specified distance. The propagation loss was determined by using the square of an inverse linear distance extrapolation factor (40dB/decade) according to 15.31. A sample calculation of the distance correction factor is shown below for limits expressed at a 300m measurement distance and a 30m measurement distance.

Distance correction factor (300m Specified Test Distance) = 40*Log (Test Distance/300)
= 40*Log (3/300)
= - 80 dB

Distance correction factor (30m Specified Test Distance) = 40*Log (Test Distance/30)
= 40*Log (3/30)
= - 40 dB

7.3.3 Measurement Results

Results of the test are given in Tables 7.3.3-1 to 7.3.3-2.

Table 7.3.3-1: Fundamental Field Strength

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
0.134	91.80	91.71	H	10.77	102.57	102.48	125.1	105.1	22.5	2.6

Note: RBW set to 9kHz (RBW>>EBW).

Table 7.3.3-2: Radiated Emissions

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
0.402	56.43	56.10	H	10.60	67.03	66.70	115.5	95.5	48.5	28.8
0.06156	57.31	56.43	H	11.22	68.53	67.65	131.8	111.8	63.3	44.2
0.67	------	44.01	H	10.80	------	54.81	------	71.1	------	16.3
0.938	------	38.25	H	10.78	------	49.03	------	68.2	------	19.1
1.206	------	33.91	H	10.92	------	44.83	------	66.0	------	21.1
1.4768	------	30.53	H	10.95	------	41.48	------	64.2	------	22.7
1.7446	------	27.61	H	10.97	------	38.58	------	69.5	------	30.90
2.013	------	24.94	H	11.01	------	35.95	------	69.5	------	33.60
2.2814	------	23.09	H	11.17	------	34.26	------	69.5	------	35.20
19.1906	------	21.26	H	11.33	------	32.59	------	69.5	------	36.90
19.459	------	23.47	H	11.32	------	34.79	------	69.5	------	34.70
19.7274	------	22.53	H	11.31	------	33.84	------	69.5	------	35.70
19.9958	------	20.83	H	11.30	------	32.13	------	69.5	------	37.40
26.5716	------	25.93	H	10.15	------	36.08	------	69.5	------	33.40
26.84	------	25.27	H	10.10	------	35.37	------	69.5	------	34.10
27.1084	------	23.52	H	10.04	------	33.56	------	69.5	------	35.90
34.81	------	44.57	V	-13.75	------	30.82	------	40.0	------	9.20
57.53	------	49.47	V	-13.60	------	35.87	------	40.0	------	4.10
64.69	------	49.32	V	-14.53	------	34.79	------	40.0	------	5.20
215.38	------	45.94	H	-13.50	------	32.44	------	43.5	------	11.10
594.67	------	20.34	V	-4.70	------	15.64	------	46.0	------	30.40
677.33	------	20.83	V	-1.12	------	19.71	------	46.0	------	26.30

7.3.4 Sample Calculation

Example Calculation – Average/Quasi-Peak Limit < 30MHz

Measurement Distance 300m @ 134 kHz

Limit (dBuV/m) = 20*Log(2400/F(kHz)) - Distance Correction Factor (Section 7.3.2)
Limit (dBuV/m) = 20*Log(2400/134) + 80
Limit (dBuV/m) = 105.06

Example Calculation - 134 kHz (See Table 7.3.3-1)

$R_C = R_U + CF_T$

Where:

CF_T	=	Total Correction Factor (AF+CA+AG)
R_U	=	Uncorrected Reading
R_C	=	Corrected Level
AF	=	Antenna Factor
CA	=	Cable Attenuation
AG	=	Amplifier Gain

Peak:
Corrected Level: 91.80 + 10.77 = 102.57dBuV
Margin: 125.06dBuV – 102.57dBuV = 22.5 dB

Average:
Corrected Level: 91.71 + 10.77 = 102.48dBuV
Margin: 105.06dBuV – 102.48dBuV = 2.6 dB

7.4 20dB / 99% Bandwidth – FCC: Section 15.215, IC: RSS-Gen 4.6.1

7.4.1 Measurement Procedure

The span of the spectrum analyzer display was set between two times and five times the occupied bandwidth (OBW) of the emission. The RBW of the spectrum analyzer was set to 100Hz. The trace was set to max hold with a peak detector active. The Delta function of the analyzer was utilized to determine the 20 dB bandwidth of the emission.

The occupied bandwidth measurement function of the analyzer was used for the 99% bandwidth. The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1% of the selected span as is possible without being below 1%. The video bandwidth shall be set to > 3 times the resolution bandwidth. A sampling detector was used.

7.4.2 Measurement Results

Results are shown below in table 7.4.2-1 and figure 7.4.2-1 to 7.4.2-2:

Table 7.4.2-1: 20dB / 99% Bandwidth

Frequency [kHz]	20dB Bandwidth [kHz]	99% Bandwidth [kHz]
134	1.75	4.34

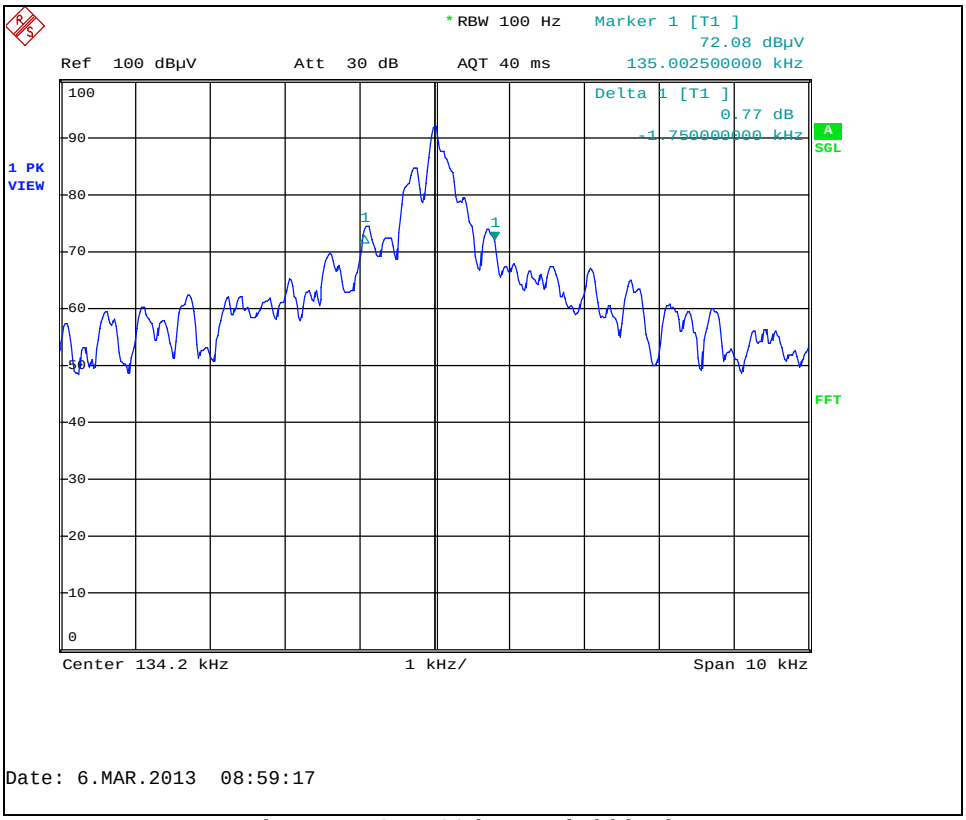


Figure 7.4.2-1: 20dB Bandwidth Plot

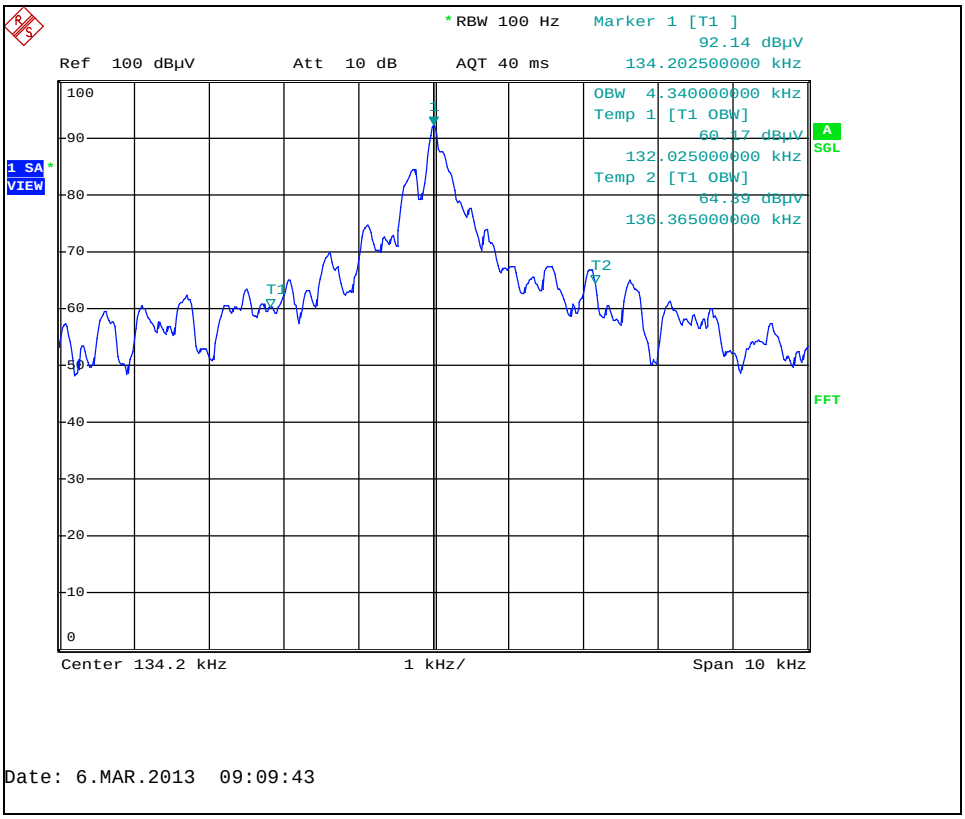


Figure 7.4.2-2: 99% Bandwidth Plot

8 CONCLUSION

In the opinion of ACS, Inc., the LFECIM, manufactured by Gilbarco Inc. meet the requirements of FCC Part 15 subpart C and Industry Canada's Radio Standards Specification RSS-210.

END REPORT