



Project: **05CA45119**  
File: **MC15028**  
Report: **050110A**  
Date: **October 17, 2005**  
(Revised December 14, 2005)  
Model: **134 kHz RFID**  
(FCC ID: N6SGBIR15, IC: 827B-GBIR15)

# **Test Report**

## **On**

# **Electromagnetic Compatibility Testing**

**Gilbarco**  
**Greensboro, NC USA**

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## **Test Report Details:**

Tests Performed By: **Underwriters Laboratories Inc.  
12 Laboratory Drive  
Research Triangle Park, NC 27709**

Tests Performed For: **Gilbarco  
7300 W. Friendly Ave  
Greensboro, NC 27420 USA**

Applicant Contact: **Mr. Lester Ward  
Manager of Reliability Engineering  
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Test Report Number: **050110**

Test Report Date: **October 17, 2005**  
(Modified December 14, 2005 to omit overhead antenna measurements.  
Due to a change in business plans, this antenna won't be sold.)

Product Type: **RFID reader**

Model Number: **134 kHz RFID**

Sample Serial Number: **Unserialized, pre-production sample**

Sample Tag Number: **S05LB140**

EUT Category: **Transmitter - Low Powered**

EUT Type: **Component**

Sample Receive Date: **October 13, 2005**

Testing Start Date: **October 13, 2005**

Date Testing Complete: **October 14, 2015**

Underwriters Laboratories Inc. reports apply only to the specific samples tested under stated test conditions. All samples tested were in good operating condition throughout the entire test program. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. Underwriters Laboratories Inc. shall have no liability for any deductions, inferences or generalizations drawn by the client or others from Underwriters Laboratories Inc. issued reports. This report shall not be used to claim, constitute or imply product certification, approval, or endorsement by NVLAP or any agency of the US government.

This report may contain test results that are not covered by the NVLAP accreditation. The scope of accreditation is limited to the specific tests that are listed on the NVLAP certificates provided at the end of this report.

## **Summary of Testing:**

Test #	Test Name Test Requirement/Specification	Comply	Does Not Comply	See Remark
1	Radiated Disturbance Emissions - 100 kHz to 1.5 MHz 47 CFR Part 15, Subpart C / 47 CFR Part 15, Subpart C, Section 15.209	X	-	
2	Radiated Disturbance Emissions - 30 to 1000 MHz Electric Field 47 CFR Part 15, Subpart B, Class A / 47 CFR Part 15, Subpart B	X	-	
3	Conducted Disturbance Emissions - Voltage 47 CFR Part 15, Subpart B / 47 CFR Part 15, Subpart C, Class A 47 CFR Part 15, Subpart C / 47 CFR Part 15, Subpart C, Section 15.207	X	-	
4	Occupied Bandwidth 47 CFR Part 15, Subpart C / 47 CFR Part 15, Subpart C, Section 15.215	X	-	
5	Peak-to-Average Ratio 47 CFR Part 15, Subpart C / 47 CFR Part 15, Subpart C, Section 15.209	X	-	

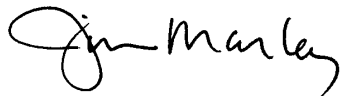
## **Remarks:**

- 1) Modifications required to comply: None.
- 2) Canada: Data may be applied to similar Canadian requirements as referenced in RSS-210, Issue 6, Section 2.6 (General Field Strength Limits). Unintentional Emissions data may be applied to similar Canadian requirements as referenced in ICES-003. All data was recorded on Industry Canada registered site, IC-2953, Canadian Emissions designator is L1D2K46.
- 3) Antennas: Antenna types, connectors, and installation details are provided in other exhibits.
- 4) RF Exposure: This device is categorically excluded from routine environmental evaluation for RF exposure (see FCC Part 2.1091).
- 5) Restricted Bands: Transmit frequency does not reside within a restricted band as defined in FCC Part 15.205. All harmonics comply with general limits found in FCC Part 15.209.

## **Conclusion:**

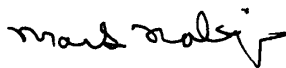
The tests listed in the Summary of Testing section of this report have been performed and the results recorded by Underwriters Laboratories Inc. in accordance with the procedures stated in each test requirement and specification. The test list was determined by the Applicant as being applicable to the Equipment Under Test. As a result, the subject product has been verified to comply or not comply as noted in the Summary of Testing with each test specification. The test results relate only to the items tested.

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## **Test Facilities:**

### **Test Location A) 10-Meter Anechoic Chamber (Industry Canada - IC 2953, NVLAP - 200246-0, VCCI - R-722)**

Constructed by Lindgren RF Enclosures, this room consists of a 17.9 by 12 by 8.3 m (inside clearance) shielded room lined with TDK absorber material. The walls, floor (conducting ground plane) and ceiling are constructed of double sided galvanized sheet steel supported by 19 mm thick particle board. The interior walls and ceiling are covered with 10 by 10 cm, 4.6 mm thick ferrite tiles and partially covered with polystyrene absorber cones. Removable floor tiles and cones covering the floor between the EUT and antenna are provided when RF immunity testing is performed.

Room is provided with a 4.0 m diameter embedded turntable and a 1.2 by 2.1 m and 2.4 by 2.4 m double knife edge doors for access. Also, the room is fed electrical EUT power via permanently installed filters and is provided with a permanently mounted video surveillance camera. A remotely controllable antenna mast is located in the room for positioning the measuring antenna from 1 to 4 m above the ground plane.

### **Test Location D) Ground Reference Plane # 1 (VCCI - C-742, NVLAP - 200246-0)**

Horizontal floor ground reference plane constructed of double sided galvanized sheet steel supported by 19 mm particle board and measures 3.6 by 3.0 m. It is located and bonded next to one vertical wall of the Control Room and is, therefore, provided with a 3.0 by 3.6 m vertical ground reference plane constructed of the same material. Power filters and LISNs, when required, are placed on top of and bonded to the horizontal floor ground reference plane.

### **Test Location E) Ground Reference Plane # 2 (VCCI - C-743, NVLAP - 200246-0)**

Horizontal floor ground reference plane constructed of double sided galvanized sheet steel supported by 19 mm particle board and measures 4.3 by 5.2 m. It is located and bonded next to one vertical wall of the RFD Shielded Room and is, therefore, provided with a 4.3 by 2.8 m vertical ground reference plane constructed of the same material. Power filters and LISNs, when required, are placed on top of and bonded to the horizontal floor ground reference plane.

**Test Location X) Other** - As described in the Comments Section of Test Results.

**EUT Information:**

**Equipment Used During Test:**

Use*	Product Type	Manufacturer	Model	Comments
EUT	RFID Module, Door-Mounted	Gilbarco	134 kHz RFID (door module)	RFID module for Door-mounted antennas and Power Supply,
ACC	Door Antenna	Gilbarco		
ACC	Control	Gilbarco		Communicates/Controls RFID module
ACC	Overhead Antenna	Gilbarco		Note: Overhead antenna was present in configuration, but not powered on for results presented with door antenna.

\* Use = EUT - Equipment Under Test, ACC - Accessory (Not Subjected to Test), or SIM - Simulator (Not Subjected to Test)

**Input/Output Ports:**

Port #	Name	Type*	Cable Max. >3m	Cable Shielded	Comments
0	Enclosure	N/E	No	No	
1	AC Power	AC	No	No	
2	Antenna	I/O	No	No	Door antenna
3	Communications Bus	I/O	No	No	Communicates between RFID module and host Controller

\* AC = AC Power Port                      DC = DC Power Port                      N/E = Non-Electrical  
 I/O = Signal Input or Output Port (Not Involved in Process Control)  
 PMC = Process Measurement and Control Port

**EUT Internal Operating Frequencies:**

Frequency (MHz)*	Description
0.134	Operating Frequency of RFID
< 108	All digital frequencies less than 108 MHz, hence highest frequency of test is 1 GHz.

**Power Interface:**

Mode #	Voltage (V)	Current (A)	Power (W)	Frequency (DC/AC-Hz)	Phases (#)	Comments
Rated	120	-	-	60	1	
1	120	-	-	60	1	North American nominal voltage

**EUT Operation Modes:**

Mode #	Description
1	RFID operating normally (attempting to read tag).

**EUT Configuration Modes:**

Mode #	Description
1	RFID using door antenna (normally located behind pump door) and associated RFID module. RFID linked to controller. Configuration is mounted to non-conductive frame consisting of PVC and 2x4 wood to simulate installation height.

**Test 1: Radiated Disturbance Emissions - 100 kHz to 1.5 MHz**

**Test Requirement:** 47 CFR Part 15, Subpart C

**Test Specification:** 47 CFR Part 15, Subpart C, Section 15.209

**Test Procedure:**

All radiated emissions measurements were measured in UL's 10 meter semi-anechoic chamber. This chamber meets the FCC's site attenuation criteria for use as an alternative measurement site. The EUT was tested per ANSI C63.4:2001 test method mounted on a non-conductive frame to simulate installation height. The receive antenna used was a loop antenna mounted on a fixed non-conductive pedestal 1 meter above the reference plane or ground. Measurements were performed from transmit frequency through the tenth harmonic.

The loop antenna was rotated at 0° and 90° points about the vertical axis and peak scans were taken for each test configuration. For the transmit frequency and any harmonics close to the limit, the loop antenna was rotated 360° and tilted to obtain the maximum field strength. Average field strength was calculated using the peak-to-average ratio documented elsewhere within this report.

A 40 dB/decade adjustment was made to the signal for measurements below 30 MHz per FCC Section 15.31(f)(2). Magnetic Field to electric field conversion is made assuming the impedance of free space of 377Ω (or 51.5 dBΩ).

Receiver Resolution bandwidth used is 200 Hz (below 150 kHz) and 9 kHz (between 150 kHz and 1.5 MHz).

Radiated Disturbance Limits - General Requirements Section 15.209 and Canada RSS-210 Issue 6, Section 2.6.

Frequency Range MHz	Field Strength Limit $\mu\text{V/m}$	Field Strength Limit $\text{dB}\mu\text{V/m}$	Measurement Distance (m)
0.009 to 0.490	2400/F (kHz)	$20*\log(2400/F(\text{kHz}))$	300
0.490 to 1.705	24,000/F (kHz)	$20*\log(24,000/F(\text{kHz}))$	30
1.705 to 30	30	29.5	30

Limits adjusted to 3 meter measurement distance and converted to magnetic field

Frequency Range MHz	Field Strength Limit $\mu\text{V/m}$	Field Strength Limit $\text{dB}\mu\text{V/m}$	Field Strength Limit (magnetic) $\text{dB}\mu\text{A/m}$	Limit Range $\text{dB}\mu\text{A/m}$
0.009 to 0.490	$2400/F(\text{kHz}) * 10^4$	$20*\log(24,000,000/F(\text{kHz}))$	$20*\log(2400/F(\text{kHz}))+28.5$	77 to 42.3
0.490 to 1.705	$24,000/F(\text{kHz}) * 100$	$20*\log(2,400,000/F(\text{kHz}))$	$20*\log(24,000/F(\text{kHz}))-11.5$	22.3 to 11.4
1.705 to 30	$30 * 100$	69.5	18	18

**Test Deviations:**

None

**Test Setup:** Only the following ports were tested. See EUT Information for details.

Test Item	Port #	Port Name	EUT Operation Mode	EUT Configuration	Power Interface
A	0	Enclosure	1 (Normal)	1 (Door Antenna)	1 (120V/60Hz)

**Test 1 - Results:** Radiated Disturbance Emissions - 100 kHz to 1.5 MHz

**Test Results Summary:**

Test Item	Test Location	Humidity (%)	Temperature (°C)	Pass/Fail (P/F)	Date Completed	Comment #
A	A	50	23	P	10/13/05	

The EUT was considered to **Pass** the Requirements.

**Comments:**

Comment #	Description

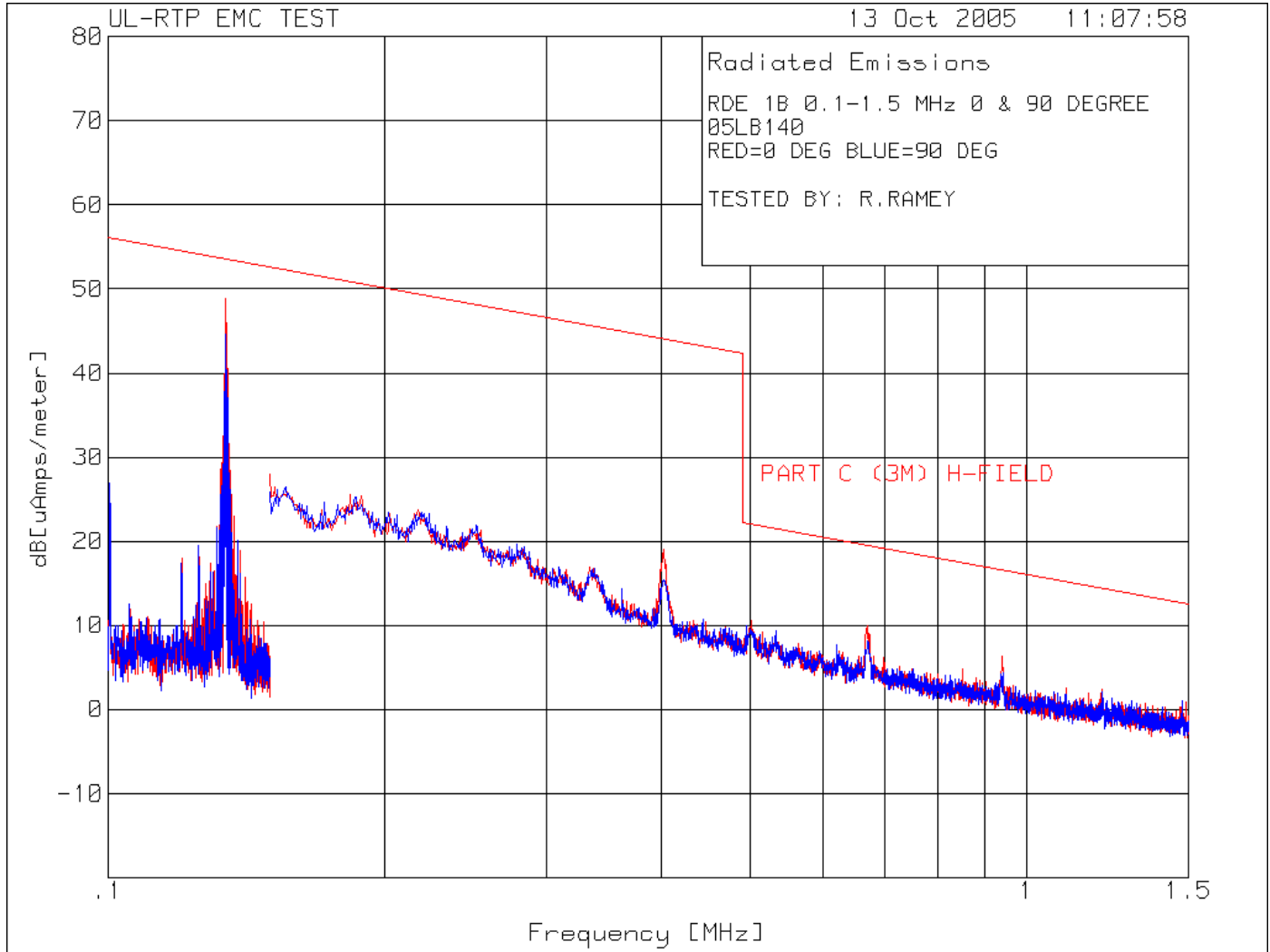
**Test Equipment Used:**

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
AT0036	Loop Antenna, 100 kHz to 30 MHz	Electro-Metrics	EM-6872	3/3/05	3/31/06
ATA017	13 ft Cable, BNC - N	UL	RG-223	2/22/05	2/28/06
ATA096	50 ft, N male - N male	Micro-Coax	Coaxial Cable	8/31/05	2/28/06
ATA143	Cable, 6ft., N-male to N-male	Micro-Coax	N/A	8/10/05	2/28/06
SAR003	EMC Receiver	Rohde & Schwarz	1088.7490K40	12/02/04	12/31/05

The above equipment has been calibrated and is within the manufacturer's published limit of error. Calibration is traceable to the National Institute of Standards & Technology(NIST) and conforms to ISO 17025:2005.

**Test 1, Item A (Door Antenna) – Peak Plot:**

Radiated Disturbance Emissions - 100 kHz to 1.5 MHz



Discontinuity at 150 kHz is result of receiver bandwidth change, as specified in ANSI C63.4, from 200 Hz to 9 kHz.



**Test 1, Item A (Door Antenna) - Discrete Data:** Radiated Disturbance Emissions - 100 kHz to 1.5 MHz

Test Item (A-Z)	Detector Type <sup>1</sup> (P/Q/A)	Antenna Azimuth (0°/90°)	Antenna Distance <sup>2</sup> (m)	Measured Frequency (MHz)	Measured Value (dBuV)	Equip Correction <sup>3</sup> (dBA/Vm)	Corrected Magnetic Field <sup>4</sup> (dBuA/m)	Impedence of Free Space (dBohms)	Distance adjustment (dB)	Corrected Electric Field <sup>5</sup> (dBuV/m)	Specified Limit (dBuV/m)	Spec Margin (dB)	See Comment (#) <sup>6</sup>
Average detector limit applies for transmit frequency through 490 kHz. Peak limit applies 20 dB above average limit per 15.35.													
A	P	rotated	3	0.1342	36.7	12.0	48.7	51.5	-80.0	20.2	45.0	-24.8	
A	A	rotated	3	0.1342	-	-	-	-	-	15.8	25.0	-9.2	1, 3
A	P	0/90	3	0.4017	16.3	2.8	19.1	51.5	-80.0	-9.4	35.5	-45.0	
A	A	0/90	3	0.4017	-	-	-	-	-	-5.0	15.5	-10.5	3
Quasi-peak detector limit applies for the following harmonics. Peak measurements are used to satisfy this requirement.													
A	P	0/90	3	0.6697	11.5	-1.5	10.0	51.5	-40.0	21.5	31.1	-9.6	2
A	P	0/90	3	0.9392	10.5	-4.1	6.4	51.5	-40.0	17.9	28.1	-10.2	

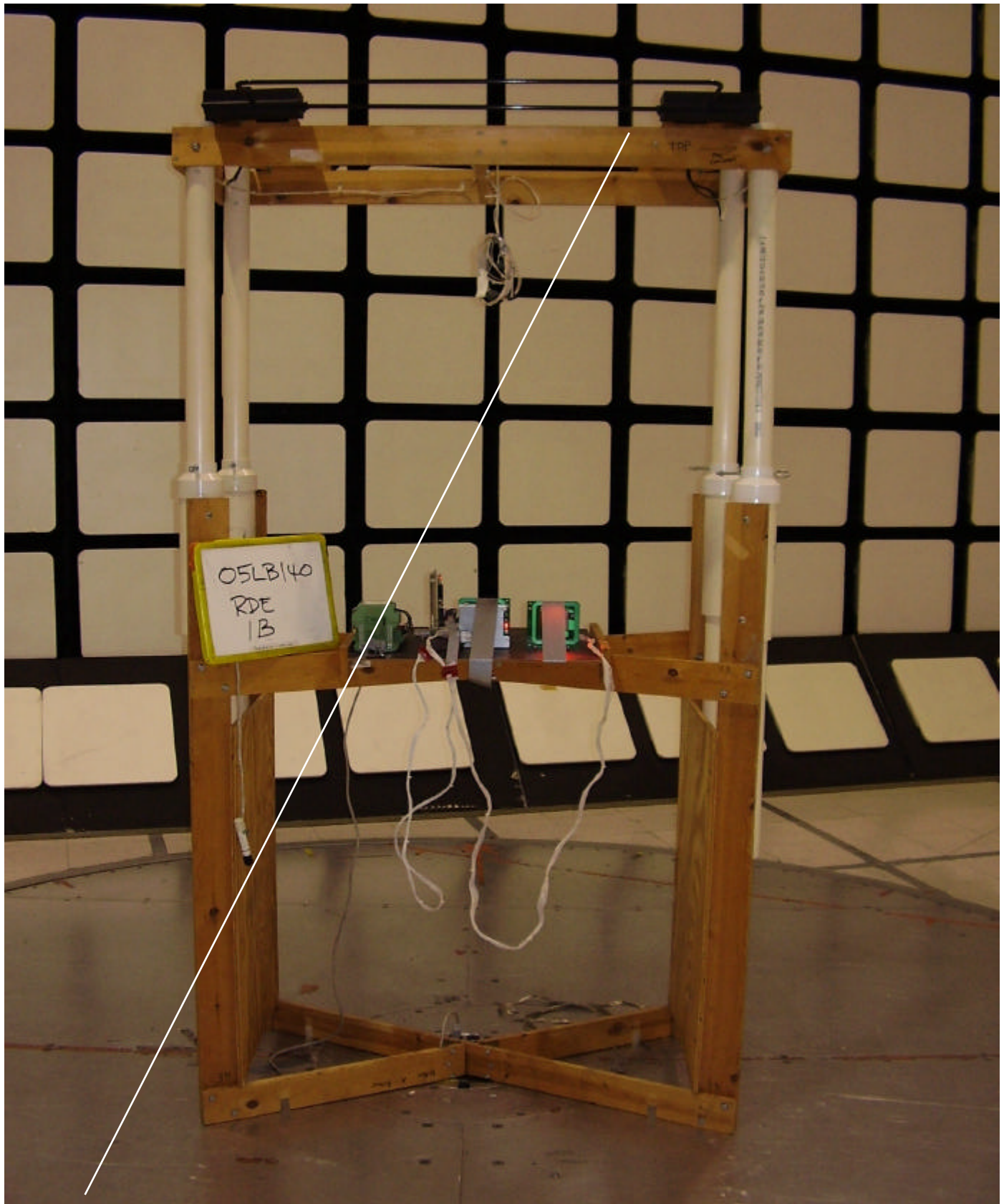
- 1 P = Peak, Q = Quasi-Peak, A = Average. Average value is calculated from peak measurement.
- 2 Measurements are measured at 3m in semi-anechoic chamber.
- 3 Equip Correction = Loop Factor (dBA/Vm) + Cable Loss (dB)
- 4 Corrected Magnetic Field = Measured Value + Equip Correction
- 5 Corrected Electric Field = Corrected Magnetic Field + Impedence of Free Space + Distance Adjustment (40 dB per decade)
- 6 # = See Comment Below.

**Comments:**

Comment #	Description
1	Transmit Field Strength = 15.8 dBuV/m (avg), or 6.2 uV/m @ 300 meters (extrapolated from 3 m measurement).
2	Highest Spurious Emission = 21.5 dBuV/m (peak), or 11.9 uV/m @ 30 meters at 669.7 kHz (extrapolated from 3 m measurement).
3	From Duty Cycle measurement, Average = Peak – 4.4 dB.

**Test 1, Item A (Door Antenna) - Test Set-Up Photo:**

Radiated Disturbance Emissions - 100 kHz to 1.5 MHz



Overhead antenna configuration is not part of this grant application.

**Test 1, Item A (Door Antenna) - Test Set-Up Photo:**

Radiated Disturbance Emissions - 100 kHz to 1.5 MHz



**Overhead antenna configuration is not part of this Grant application.**

## Test 2: Radiated Disturbance Emissions - 30 to 1000 MHz Electric Field

**Test Requirement:** 47 CFR Part 15, Subpart B, Class A

**Test Specification:** 47 CFR Part 15, Subpart B

**Test Procedure:**

The test was performed in accordance with the Test Requirement and Specification and configured as noted in the Test Setup. The EUT was placed inside the anechoic chamber and connected to the proper power supply source. A peak measurement was first made by scanning the entire test frequency range and maximizing the EUT emissions by rotating the EUT and raising the antenna height from 1 to 4 meters above the ground reference plane. Then, a measurement was taken for all peak emissions to verify each were below the Test Limits. In each case, all cables and equipment were adjusted and EUT orientation and antenna height were varied for maximum emissions.

Radiated Disturbance Limits for Class A Equipment  
at a measuring distance of 10m.

Frequency Range MHz	Quasi-Peak Limits $\mu\text{V/m}$	Quasi-Peak Limits $\text{dB}\mu\text{V/m}$
30 to 88	90	39.08
88 to 216	150	43.52
216 to 960	210	46.44
Above 960	300	49.54

**Test Deviations:**

None

**Test Setup:** Only the following ports were tested. See EUT Information for details.

Test Item	Port #	Port Name	EUT Operation Mode	EUT Configuration	Power Interface
A	0	Enclosure	1 (Normal)	1 (Door Antenna)	1 (120V/60Hz)

**Test 2 - Results:** Radiated Disturbance Emissions - 30 to 1000 MHz Electric Field

**Test Results Summary:**

Test Item	Test Location	Humidity (%)	Temperature (°C)	Pass/Fail (P/F)	Date Completed	Comment #
A	A	50	23	P	10/13/05	

The EUT was considered to **Pass** the Requirements.

**Comments:**

Comment #	Description

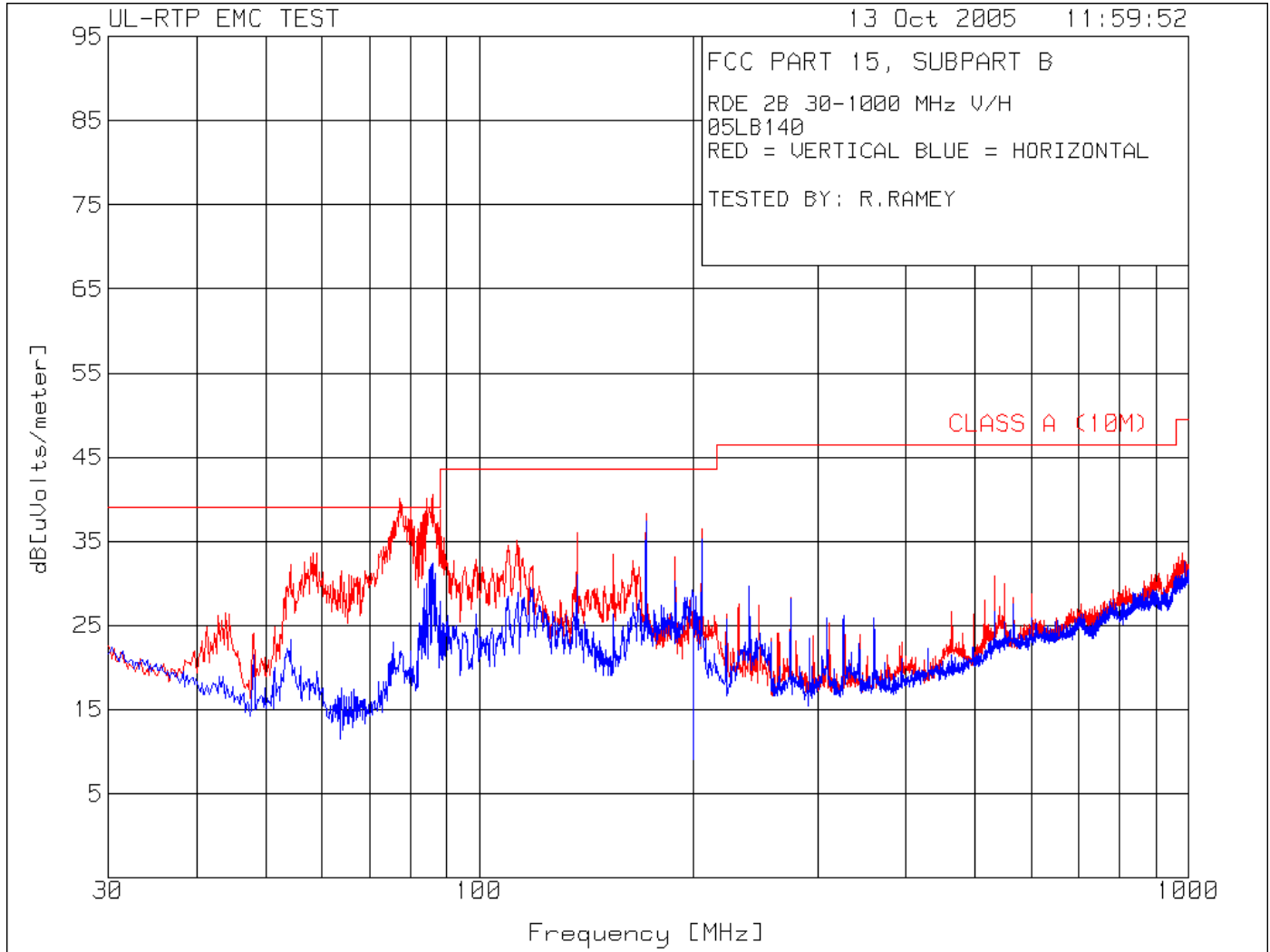
**Test Equipment Used:**

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
AT0025	Biconical Antenna, 30 to 300 MHz	Schaffner, EMC	VBA6106A	3/7/05	3/31/06
AT0030	Log periodic Antenna, 200 MHz to 1000 MHz	Schaffner, EMC	3160-07	3/4/05	3/31/06
ATA084	Attenuator 6 dB, 2 GHz	Pasternack	PE7002-6	3/11/05	3/31/06
ATA085	Attenuator 6 dB, 2 GHz	Pasternack	PE7002-6	3/11/05	3/31/06
ATA106	19 ft, N - N	Amplifier Research	Low Loss coaxial cable	2/22/05	2/28/06
ATA108	10 m, N male - N male	UL	RG214	3/31/05	3/31/06
ATA124	RF Amplifier, 1 to 1000 MHz	Miteq	AM-3A-000110-N	3/11/05	3/31/06
ATA125	RF Amplifier, 1 to 1000 MHz	Miteq	AM-3A-000110-N	3/11/05	3/31/06
ATA132	45ft. N-Male to N-Male	UL	Coaxial Cable	2/22/05	2/28/06
ATA140	RG214 Ferrite Cable	EMC Eupen	N/A	3/11/05	3/31/06
ATA143	Cable, 6ft., N-male to N-male	Micro-Coax	N/A	7/5/05	1/31/06
ATA169	Attenuator, 2W, 10 GHz, 10 dB, N-male to N-female	Pasternack	N/A	12/28/04	12/31/05
SAR003	EMC Receiver	Rohde & Schwarz	1088.7490K40	12/02/04	12/31/05

The above equipment has been calibrated and is within the manufacturer's published limit of error. Calibration is traceable to the National Institute of Standards & Technology(NIST) and conforms to ISO 17025:2005.

**Test 2, Item A (Door Antenna):**

Radiated Disturbance Emissions - 30 to 1000 MHz Electric Field



**Test 2, Item A (Door Antenna) - Discrete Data:** Radiated Disturbance Emissions - 30 to 1000 MHz Electric Field

Test Item (A-Z)	Detector Type* (P/Q/A)	Antenna Polarity (H/V)	Antenna Distance (m)	Measured Frequency (MHz)	Measured Value (dBuV)	Equip Correction (dB/m)	Corrected Value (dBuV/m)	Quasi-Peak Limit (dBuV/m)	Spec Margin (dB)	See Comment (#)***
A	Q	V	10	80.094	54.5	-18.9	35.6	39.1	-3.5	1
A	Q	V	10	67.230	46.6	-18.8	27.8	39.1	-11.3	
A	Q	V	10	72.576	48.4	-19.3	29.1	39.1	-10.0	
A	Q	V	10	79.556	49.9	-18.9	31.0	39.1	-8.1	
A	Q	V	10	80.108	54.2	-18.9	35.3	39.1	-3.8	
A	Q	V	10	171.797	49.5	-10.7	38.8	43.5	-4.7	
A	Q	V	10	206.151	53.4	-15.4	38.0	43.5	-5.5	

\* P = Peak, Q = Quasi-Peak, A = Average.

\*\*\* # = See Comment Below.

Sample Calculation: Corrected Value = Measured Value + Equip Correction

Sample Calculation: Equip Correction = Antenna Factor (dB/m) + Cable Loss (dB) - Amplifier Gain (dB, if used)

Note: Cable emissions were tunable by moving cables. Worst-case cable arrangement results shown in table above.

**Comments:**

Comment #	Description
1	Closest to Limit Radiated Emissions (unintentional) = 35.6 dBuV/m, or 60.3 uV/m, at 80.094 MHz.

### Test 3: Conducted Disturbance Emissions - Voltage

**Test Requirement:** 47 CFR Part 15, Subpart B  
 47 CFR Part 15, Subpart C

**Test Specification:** 47 CFR Part 15, Subpart B, Class A (unintentional)  
 47 CFR Part 15, Subpart C, Section 15.207 (transmitter spurious)

**Test Procedure:**

The test was performed in accordance with the Test Requirement and Specification and configured as noted in the Test Setup. The EUT was connected to the proper supply source via a Line Impedance Stabilization Network (LISN). The Measuring Receiver was connected to the Port under test via the LISN. A peak measurement was first made at the test point across the test frequency range over a one minute test period. Then, Quasi-Peak or Average measurements were taken and recorded under Discrete Data. This was repeated for each conductor of the test port except for equipment grounding.

Conducted Disturbance Emission Limits For  
 Mains Terminals of Class A Equipment

Frequency (MHz)	Quasi-Peak Limit dB $\mu$ V	Average Limit dB $\mu$ V
0.15 to 0.50	79	66
0.50 to 5	73	60
5 to 30	73	60

Conducted Disturbance Emission Limits For  
 Mains Terminals of Transmitting Equipment – Section 15.207

Frequency (MHz)	Quasi-Peak Limit dB $\mu$ V	Average Limit dB $\mu$ V
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50

**Test Deviations:**

None

**Test Setup:** Only the following ports were tested. See EUT Information for details.

Test Item	Port #	Port Name	EUT Operation Mode	EUT Configuration	Power Interface
A	1	AC Power	1 (Normal)	1 (Door Antenna)	1 (120V/60Hz)