



Project: **07RT03348**
File: **MC15028**
Report: **R07RT03348-GBIR14**
Date: **August 24, 2007**
Model: **Contactless Smart Card**
13.56 MHz RFID Transmitter Module
(Part Number M0331)
FCC ID: **N6SGBIR14**
(Permissive Change for new antenna)
IC: **827B-GBIR14**

Test Report

On

Electromagnetic Compatibility Testing

Gilbarco Inc.
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 Inc.
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Greensboro, NC 27420 USA**

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Test Report Number: **R07RT03348-GBIR16**

Test Report Date: **August 24, 2007**

Product Type: **13.56 MHz RFID reader**

Model Number: **Part Number M0331**

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

Sample Tag Number: **S07LB075**

EUT Category: **Transmitter - Low Powered**

EUT Type: **Transmitter Module**

Sample Receive Date: **August 22, 2007**

Testing Start Date: **August 22, 2007**

Date Testing Complete: **August 23, 2007**

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 Power and Spurious Emissions - 13.56 MHz Devices 47 CFR Part 15, Subpart C / 47 CFR Part 15, Subpart C, Section 15.225 RSS-210, Issue 6 / RSS-210, Issue 6, Section A2.6	X	-	
2	Radiated Emissions (unintentional) - 30 to 1000 MHz Electric Field 47 CFR Part 15, Subpart B / 47 CFR Part 15, Subpart B, Class A ICES-003 Issue 4 / ICES-003 Issue 4, Class A	X	-	
3	Radiated Emissions - Restricted Bands 47 CFR Part 15, Subpart C / 47 CFR Part 15, Subpart C, Section 15.205 RSS-210, Issue 6 / RSS-210, Issue 6, Section 2.7	X	-	
4	Maximum Permissible Exposure 47 CFR Part 1 / 47 CFR Part 1, Section 1.1307	X	-	4

Remarks:

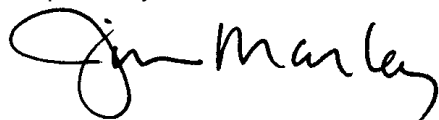
- 1) Modifications required to comply: None.
- 2) Operating Environment: This device is considered to operate in a Class A environment (non-residential).
- 3) Measurement Site: Measurements were performed on Industry Canada registered site IC-2953.
- 4) Canada RF Exposure: This device is exempt from routine evaluation to RF Exposure requirements from RSS-210 Issue 2, because this device operates at less than 2.5 W EIRP at a frequency of less than 1.5 GHz as detailed in RSS-210 Issue 2 section 2.5.2.
- 5) Measurements valid from previous testing: The scope of this testing is limited to the effects of a new antenna. For this reason the following tests were not performed:
 - a. Frequency Stability
 - b. Conducted Emissions
 - c. Occupied Bandwidth
 - d. Duty Cycle

Results from previous test may be found in UL Test Report 050006, UL Project 04RT57006.

Conclusion:

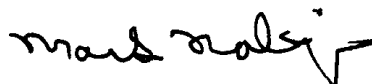
The tests listed in the Summary of Testing section of this report have been performed and the results recorded by Underwriters Laboratories Inc. in accordance with the procedures stated in each test requirement and specification. The test list was determined by the Applicant as being applicable to the 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, VCCI - R-722/C-2427)

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 partical 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 3-ft x 7-ft and 8-ft x 8-ft 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 B) Compact Anechoic Chamber

Constructed by Lindgren RF Enclosures, this room consists of a 6-m x 3-m x 2.9 m high (inside clearance) shielded room lined with TDK absorber material. The walls, floor, and ceiling are constructed of 0.75-mm thick galvanized sheet steel supported by ¾-inch thick partical 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 cover the floor between the EUT and antenna.

Room is provided with a 4-ft x 8-ft double knife-edge door for access. Also, the room is fed electrical EUT power via permanently installed filters and is provided with a video camera.

Test Location C) Ground Reference Plane

Horizontal floor ground reference plane constructed of 0.75-mm thick galvanized sheet steel supported by ¾-inch partical board and measures 10-ft x 12- ft.

Test Location D) Ground Reference Plane # 1 (VCCI - C-742/T-235)

Horizontal floor ground reference plane constructed of 0.75-mm thick galvanized sheet steel supported by ¾-inch partical board and measures 10-ft x 12-ft. It is located and bonded next to one vertical wall of the Control Room and is, therefore, provided with a 10-ft x 12-ft 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/T-236)

Horizontal floor ground reference plane constructed of 0.75-mm thick galvanized sheet steel supported by ¾-in partical board and measures 22-ft x 14-ft. Bonded along one edge is a vertical plane measuring 12-ft x 10-ft 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 F) Ground Reference Plane

Horizontal floor ground reference plane constructed of 0.75-mm thick galvanized sheet steel supported by ¾-inch partical board measuring 10-ft x 12-ft.

Test Location G) Outdoor Test Site

30-meter diameter non-reflective grassy area located behind the UL-RTP EMC Laboratory used primarily for emissions testing of spark-ignited engine devices to CISPR 12.

Test Location I) Harmonics/Flicker Test Station

Test area consisting of three-phase synthesized power source, power analyzer, and reference impedance for measurement of Harmonic Currents and Voltage Fluctuations and Flicker.

Test Location J) Non-ferromagnetic Ground Reference Plane

Horizontal floor ground reference plane constructed of 1.5-mm thick aluminum measuring 3.6-m by 1.2-m.

Test Location X) Other

As described in the Comments Section of Test Results.

EUT Information:

Equipment Used During Test:

Use*	Product Type	Manufacturer	Part Number	Comments
EUT	Contactless Smart Card - RFID Module	Gilbarco	M03311	13.56 MHz RFID reader
ACC	External Voltage Regulator Assembly	Gilbarco	M05186	
ACC	Antenna	Gilbarco	M07756	New antenna
ACC	Antenna Cable	Gilbarco	M04124	
ACC	ESD ground cable	Gilbarco	M02134	ESD ground.
ACC	Contactless Smart Card Interface Cable	Gilbarco	M04488	
ACC	Power Supply	Elpac Power Systems	WM063-1950	Representative AC-to-DC power supply.
SIM	Power/Data connection board	-	-	Small board used to provide data/DC power to RFID module (simulated host).

* 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 Mains	AC	No	No	To representative power supply.
2	Antenna	N/E	N/A	N/A	
3	Contactless Smart Card Interface	I/O	No	No	

AC = AC Power Port

N/E = Non-Electrical

I/O = Input/Output

EUT Operating Frequencies:

Frequency (MHz)	Description
13.56	Transmit Frequency. Measure spurious through 10 th harmonic.
< 108	Highest unintentional operating frequency

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 line voltage

EUT Operation Modes:

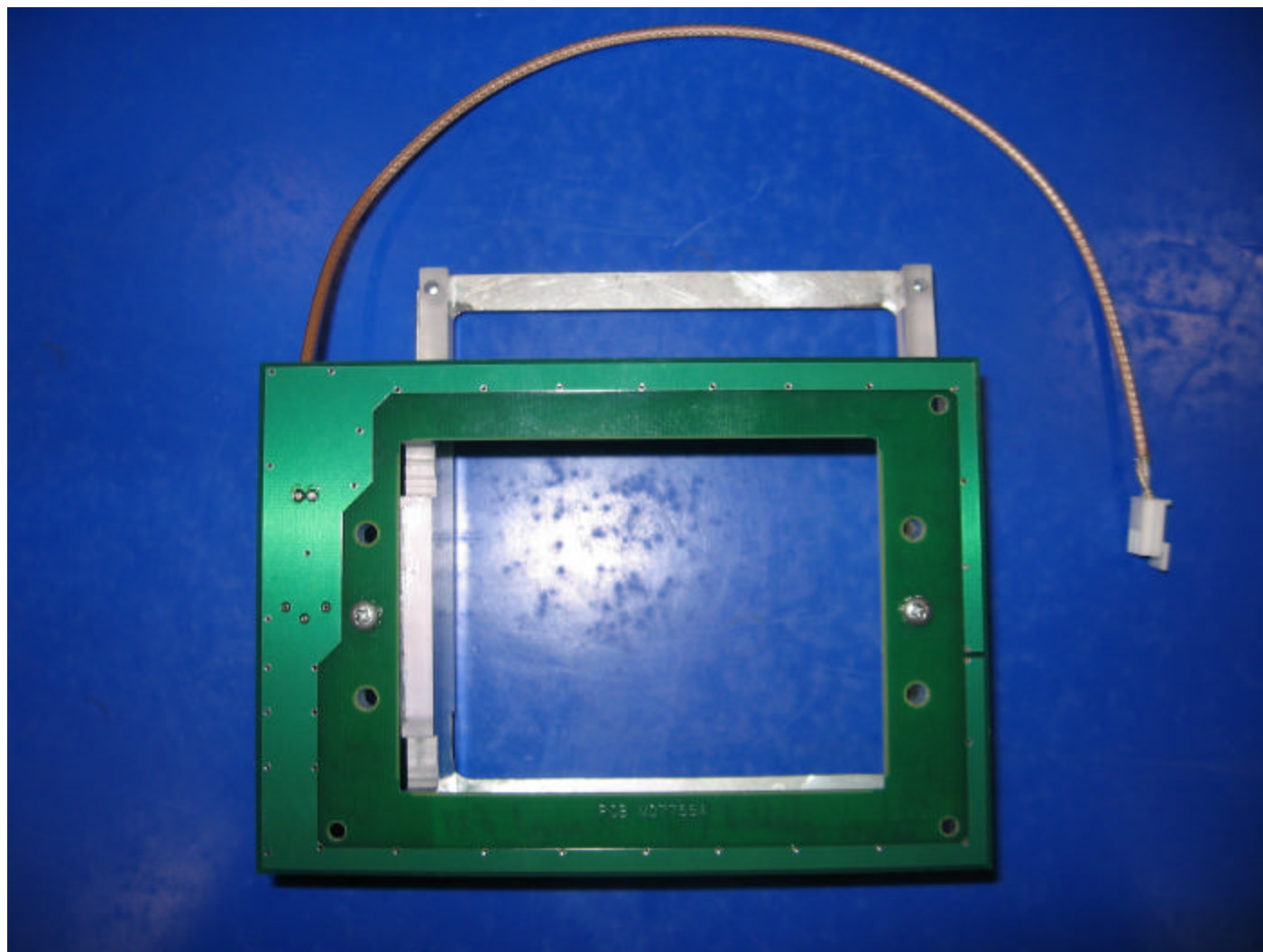
Mode #	Description
1	EUT operating normally – transmitting at 13.56 searching for RFID tag. Output power is fixed and not adjustable by the user.

EUT Configuration Modes:

Mode #	Description
1	RFID card reader module with representative power supply. Actual antenna is attached. Setup is placed on non-conductive, polystyrene foam table measuring 1.5m wide x 1.0m deep x 0.8m high.

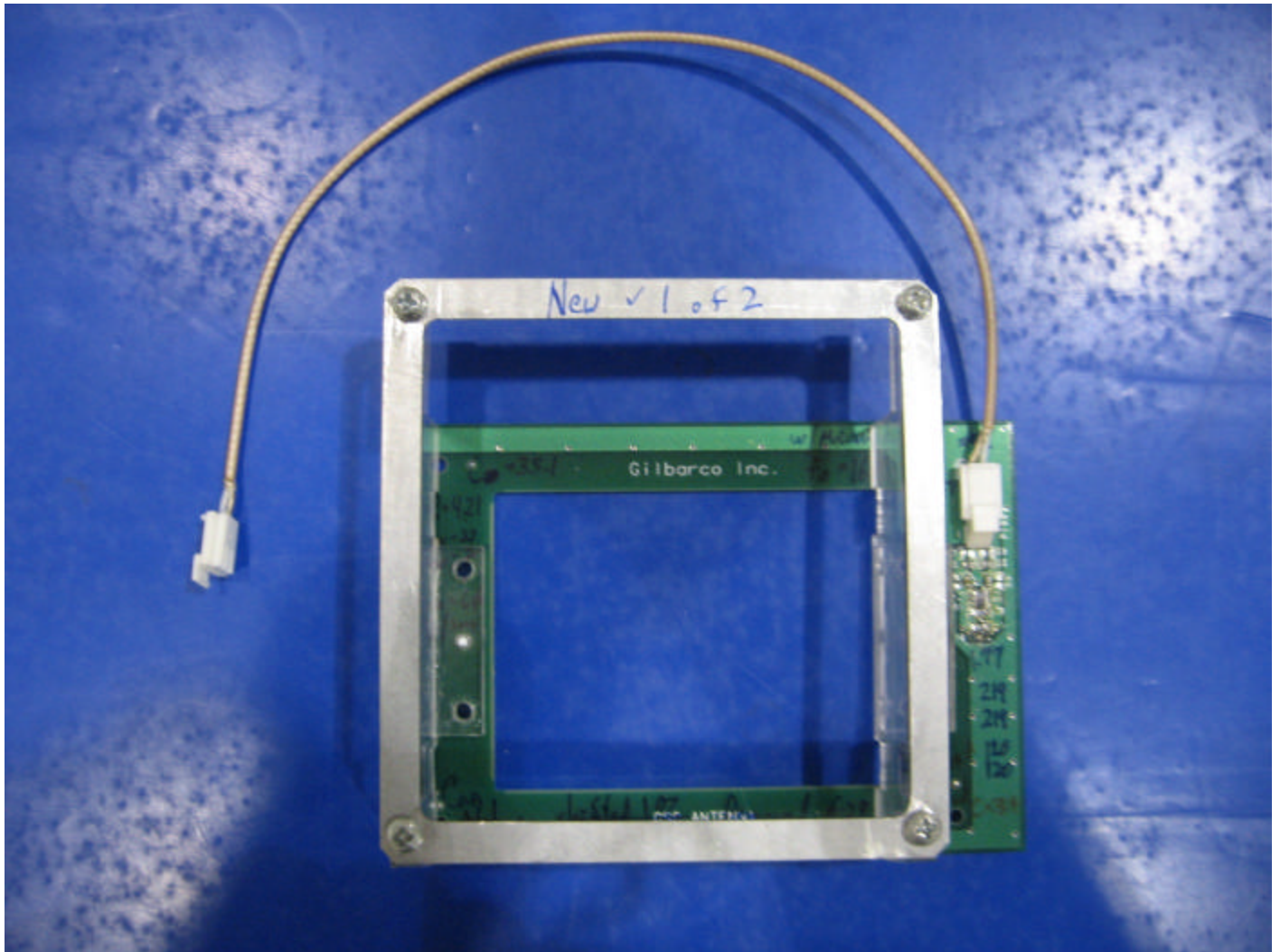
EUT Photo:

Antenna Assembly - Front



EUT Photo:

Antenna Assembly - Rear



Test 1: Radiated Power and Spurious Emissions - 13.56 MHz RFID Devices

Test Requirement: FCC Part 15, Subpart C
 RSS-210 Issue 6

Test Specification: FCC Part 15, Subpart C, Section 15.225
 RSS-210 Issue 6, Section A2.6

Test Procedure:

All testing was performed inside UL's 10-meter semi-anechoic chamber. The 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 placed on a non-conductive 1m x 1.5m table 80 cm above the ground plane.

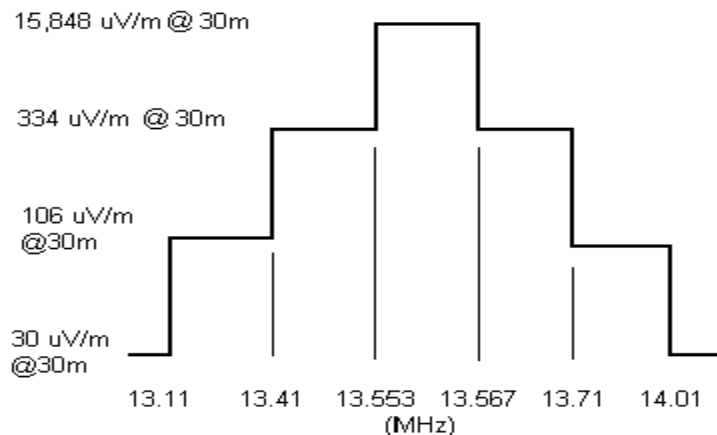
Below 30 MHz: The receiver resolution bandwidth was set to 9 kHz and video bandwidth was set to 100 kHz. The receive antenna used was a loop antenna placed 1 meter above the ground reference plane with the loop axis pointing toward the EUT. The turntable was rotated from 0° to 360° to determine the worst-case emissions angle for each frequency.

At the angle of highest emissions the loop antenna axis was rotated from -90° to +90° to capture the highest field strength. The peak field strength was recorded. For this device peak field strength is assumed to equal average field strength, because, except for short interruptions, the signal is transmitted constantly. Only peak data is presented.

All measurements were made at a 3-meter distance in an attempt to identify any emission produced by the EUT. 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).

30 MHz through 10th harmonic: The receiver resolution bandwidth was set to 120 kHz and video bandwidth was set to 1 MHz. The receive biconical antenna was placed three meters from the EUT. The turntable was rotated from 0° to 360° to determine the worst-case emissions angle for each frequency. Initial antennas heights of 1m, 2.5m, and 4 m are used for peak scan in both vertical and horizontal polarity. Any emission within 6 dB of the applied limit is investigated in detail with antennas scanned from 1 to 4 meters at worst-case turntable angle.

FCC Part 15, Section 15.225 / RSS-210 Issue 6, Section A2.6 Emissions Limit



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	1	1

Test 1 - Results: Radiated Power and Spurious Emissions - 13.56 MHz Devices

Test Results Summary:

Test Item	Test Location	Humidity (%)	Temperature (°C)	Pressure (kPa)	Pass/Fail (P/F)	Date Completed	Comment (#)
A	A	43	22	101	P	8/22/2007	1 - 4

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

Comments:

Comment #	Description
1	From preliminary tests, it was determined that worst-case orientation is with card slot vertical.
2	A -40 dB adjustment was applied where 3m-distance measurements were used to meet 30-m distance limit.
3	FCC Part 15/RSS-210 radiated emissions below 30 MHz: Magnetic Field measurements are converted to Electric Field assuming far field impedance of 377 ohms (51.5dBO).
4	For setup photo see section Test 2 on pages 18 and 19.

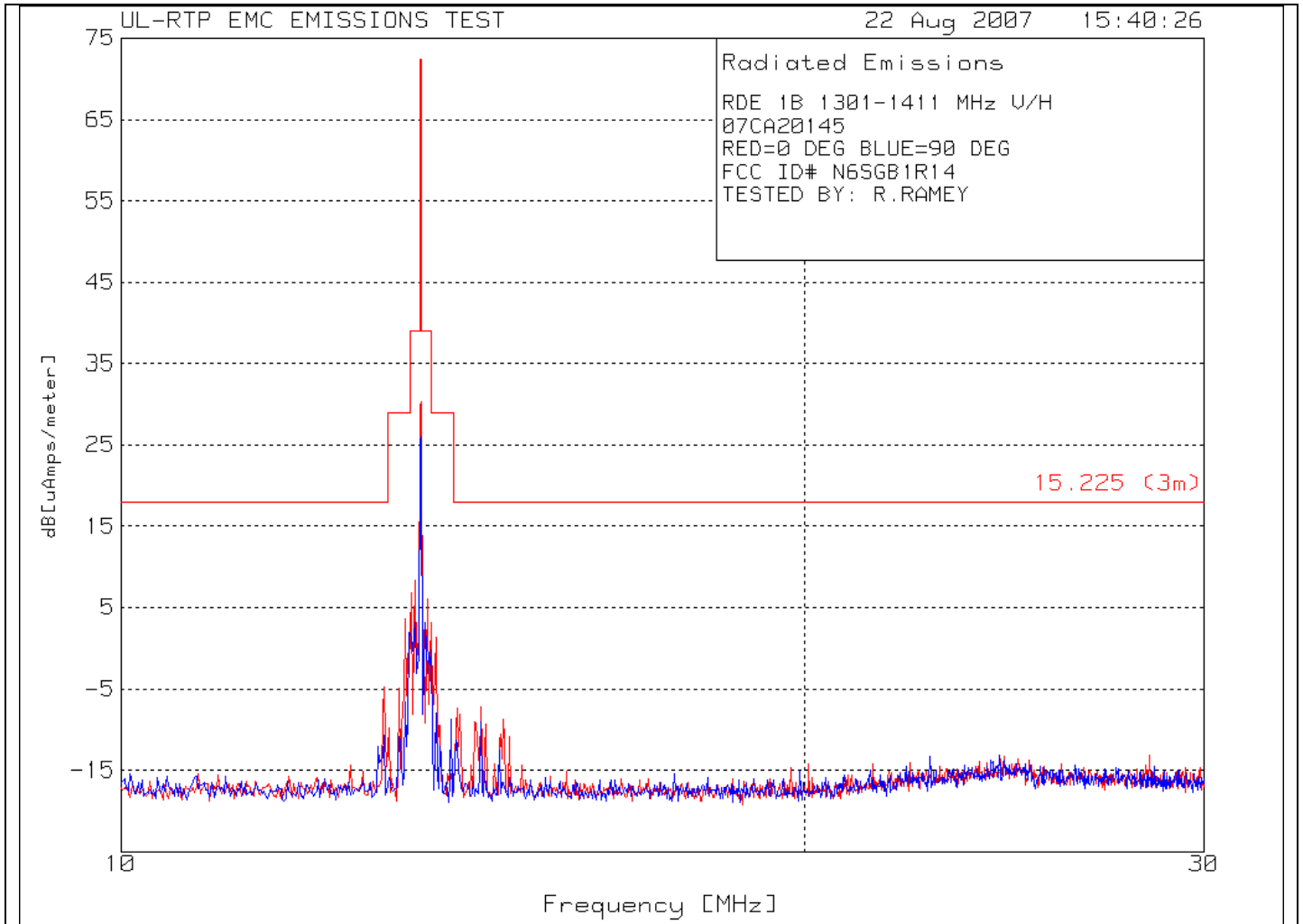
Test Equipment Used:

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
AT0006	Loop Antenna, .01 to 30 MHz	Electro-Metrics	EM-6879	5/29/07	5/31/08
ATA030	Coaxial Cable, 25ft, BNC	UL	-	3/1/07	3/31/08
ATA198	6-ft. flexible microwave cable	Micro-Coax	UFB293C-0-0720-5GU50U	3/1/07	3/31/08
ATA199	6-ft. flexible microwave cable	Micro-Coax	UFB293C-0-0720-5GU50U	3/1/07	3/31/08
ATA208	50ft coaxial cable, N-male to N-male, low-loss	Micro-Coax	UFB293C-0-0720-5GU50U	3/1/07	3/31/08
AT0021	Biconical Antenna, 20 to 300 MHz	Chase	VBA6106A	9/22/06	9/30/07
ATA084	Attenuator 6 dB, 2 GHz	Pasternack	PE7002-6	3/1/07	3/31/08
ATA124	RF Amplifier, 1 to 1000 MHz	Miteq	AM-3A-000110-N	3/1/07	3/31/08
ATA165	RG 214, Ferrite Cable	EMC Eupen	N/A	3/1/07	3/31/08
SAR001	Spectrum Analyzer / Receiver	Hewlett-Packard	8572A	3/23/07	3/31/08

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 - Peak Plot:

Radiated Power and Spurious Emissions - 13.56 MHz Devices (13 to 30 MHz)



Test 1, Item A – Emissions Table: Radiated Power and Spurious Emissions - 13.56 MHz Devices

Test Item (A-Z)	Detector Type* (P/Q/A)	Antenna Azimuth (0°/90°)	Antenna Distance (m)	Measured Frequency (MHz)	Measured Value (dBuV)	Equip Correction (dBA/Vm)	Corrected Magnetic Field @3m (dBuA/m)	Magnetic to Electric Field (377 O)	Distance Correction (3m to 30m)	Corrected E-Field @30m (dBuV/m)	Specified Limit** (dBuV/m)	Spec Margin (dB)	See Comment (#)***
Radiated Power and Spurious below 30 MHz (13 to 30 MHz)													
A	P	0	3	13.563	44.19	-13.9	30.29	+51.5	-40	41.79	84.0	-42.21	
A	P	90	3	13.563	39.89	-13.9	25.99	+51.5	-40	37.49	84.0	-46.51	

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

** The Specified Limit is for the type measurement indicated. When Peak data is indicated, the tightest limit applicable is indicated.

*** # = See Comment below.

Sample Calculation:

Electric Field Strength @ 30m = Receiver measurement + Loop Antenna Factor + cable loss + 51.5 dBV/A (magnetic to electric field conversion) – 40 dB (3m to 30m distance adjustment).

Comment #	Description
1	<p><u>Highest emission (transmit frequency) – magnetic field strength</u> 30.29 dBuA/m @ 3 meter distance, or 32.7 uA/m @ 3 meter distance Equivalent isotropic radiated power = 45.6 uW. See calculation below.</p> <p><u>Highest emissions (transmit frequency) – equivalent electric field strength and 30-m distance</u> 41.79 dBuV/m @ 30 meter distance, or 122.9 uV/m @ 30 meter distance</p>

Equivalent Isotropic Radiated Power Calculation:

$$EIRP = 0.3 * (\text{Electric Field Strength at 3m in V/m})^2$$

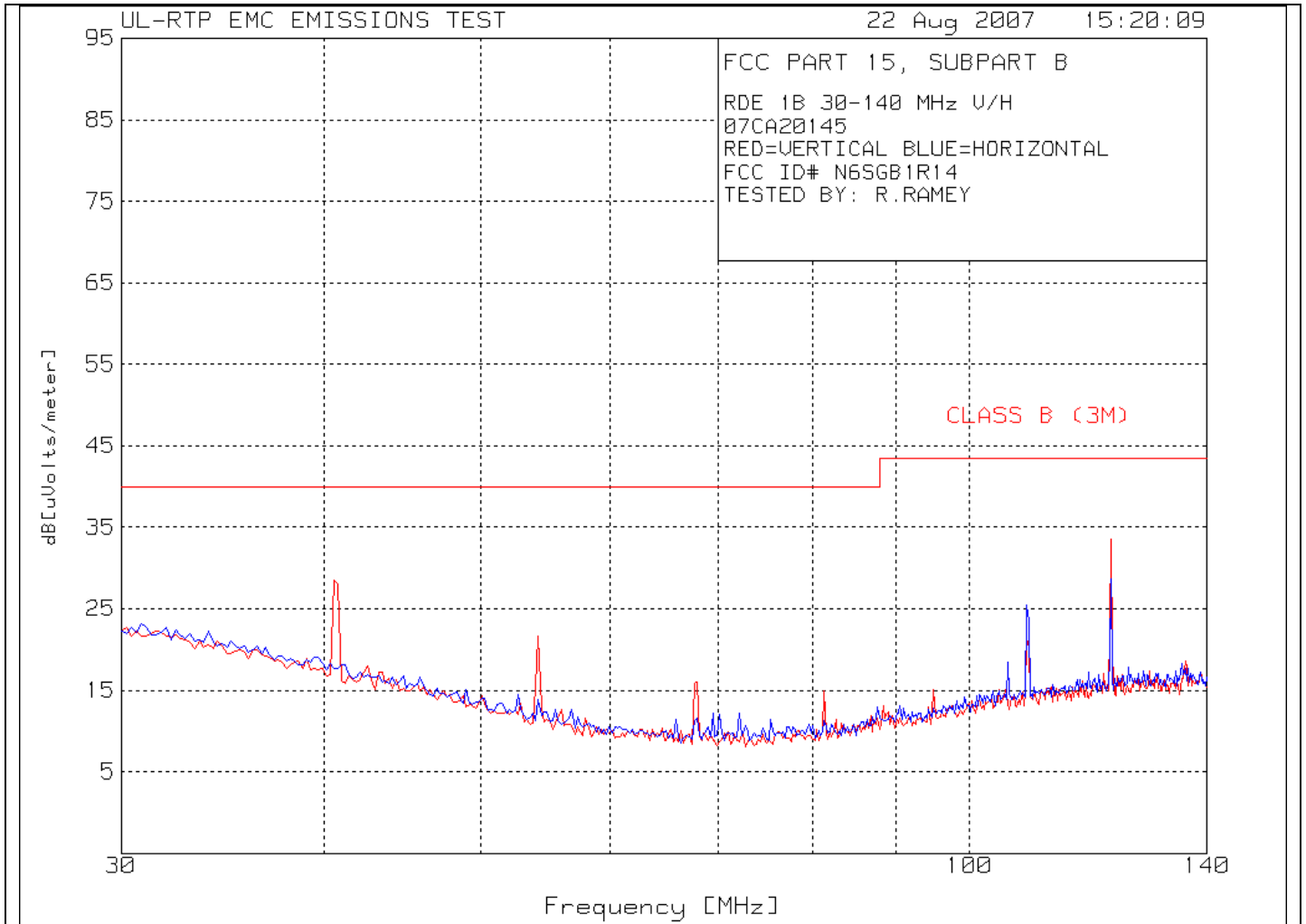
Substituting Measured Magnetic Field Strength (32.7×10^{-6} A/m) * Impedance of Free Space (377 ohms) for electric field:

$$EIRP = 0.3 * (.012327 \text{ V/m})^2$$

$$EIRP = 45.6 \text{ uW}$$

Test 1, Item A (radiated spurious through 10th harmonic - 3m) - Peak Plot:

Radiated Spurious Emissions - 30 to 140 MHz Electric Field



Test 1, Item A – Emissions Table: Radiated Spurious Emissions - 30 to 140 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)	Specified Limit** (dBuV/m)	Spec Margin (dB)	See Comment (#)***
Radiated Spurious (through 10th harmonic)										
A	P	V	3	40.581	40.68	-12.1	28.58	40	-11.42	
A	P	V	3	54.248	39.86	-18.2	21.66	40	-18.34	
A	P	V	3	67.916	36.71	-20.7	16.01	40	-23.99	
A	P	V	3	81.363	34.67	-19.7	14.97	40	-25.03	
A	P	V	3	122.144	47.28	-13.8	33.48	43.5	-10.02	2
A	P	H	3	108.477	40.65	-15.2	25.45	43.5	-18.05	

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

** The Specified Limit is for the type measurement indicated. When Peak data is indicated, the tightest limit applicable is indicated.

*** # = 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)

Comment #	Description
2	<u>Highest spurious emission</u> 122.144 MHz. 33.48 dBuV/m @ 3 meter distance, or 47.2 uV/m @ 3 meter distance.

Test 2: Radiated Emissions (Unintentional) - 30 to 1000 MHz Electric Field

Test Requirement: 47 CFR Part 15, Subpart B
ICES-003 Issue 4

Test Specification: 47 CFR Part 15, Subpart B, Class A
ICES-003 Issue 4, Class A

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. The EUT was tested per ANSI C63.4:2001 test method placed on a non-conductive 1m x 1.5m table 80 cm above the ground plane. The receiver resolution bandwidth was set to 120 kHz and video bandwidth was set to 1 MHz. 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 with 6 dB of the applied test limit to verify each were below the limit. 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 $\mu\text{V}/\text{m}$	Quasi-Peak Limits $\text{dB}\mu\text{V}/\text{m}$
30 to 88	90	39.1
88 to 216	150	43.5
216 to 960	210	46.4
Above 960	300	49.5

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	1	1

Test 2 - Results: Radiated Emissions (Unintentional) - 30 to 1000 MHz Electric Field

Test Results Summary:

Test Item	Test Location	Humidity (%)	Temperature (°C)	Pressure (kPa)	Pass/Fail (P/F)	Date Completed	Comment #
A	A	43	22	101	P	8/22/2007	

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

Comments:

Comment #	Description

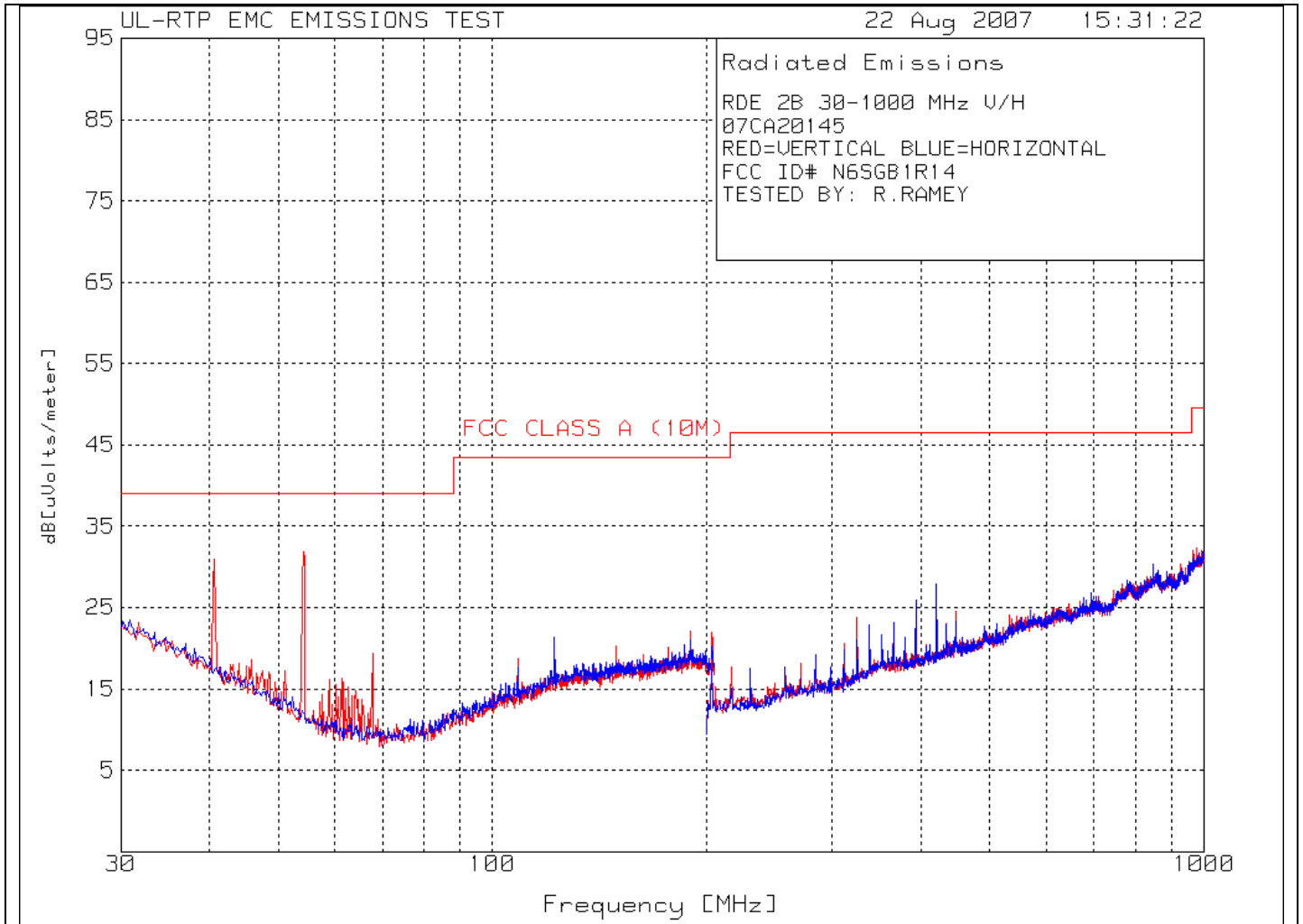
Test Equipment Used:

Equipment ID	Description	Manufacturer	Model Number	Last Cal.	Next Cal.
AT0021	Biconical Antenna, 20 to 300 MHz	Chase	VBA6106A	9/22/06	9/30/07
AT0022	Log Periodic Antenna, 200 to 1000 MHz	Chase	UPA6109	9/22/06	9/31/07
ATA084	Attenuator 6 dB, 2 GHz	Pasternack	PE7002-6	3/1/07	3/31/08
ATA085	Attenuator 6 dB, 2 GHz	Pasternack	PE7002-6	3/1/07	3/31/08
ATA108	10 m, N male - N male	UL	RG214	3/1/07	3/31/08
ATA124	RF Amplifier, 1 to 1000 MHz	Miteq	AM-3A-000110-N	3/1/07	3/31/08
ATA125	RF Amplifier, 1 to 1000 MHz	Miteq	AM-3A-000110-N	3/1/07	3/31/08
ATA165	RG 214, Ferrite Cable	EMC Eupen	N/A	3/1/07	3/31/08
ATA198	6-ft. flexible microwave cable	Micro-Coax	UFB293C-0-0720-5GU50U	3/1/07	3/31/08
ATA199	6-ft. flexible microwave cable	Micro-Coax	UFB293C-0-0720-5GU50U	3/1/07	3/31/08
SAR001	Spectrum Analyzer / Receiver	Hewlett-Packard	8572A	3/23/07	3/31/08

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 B (10m distance) - Peak Plot:

Radiated Emissions (unintentional) - 30 to 1000 MHz Electric Field



Test 2, Item A – Frequency Table: Radiated Emissions (unintentional) - 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)	Specified Limit** (dBuV/m)	Spec Margin (dB)	See Comment (#)***
Unintentional (Class A - 10-m distance)										
A	P	V	10	40.686	43.09	-12.1	30.99	39.1	-8.11	
A	P	V	10	54.174	50.02	-18.1	31.92	39.1	-7.18	
A	P	V	10	67.838	39.91	-20.6	19.31	39.1	-19.79	
A	P	H	10	108.478	33.88	-15.2	18.68	43.5	-24.82	
A	P	V	10	121.967	35.17	-13.8	21.37	43.5	-22.13	
A	P	V	10	420.414	38.66	-10.8	27.86	46.4	-18.54	

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

** The Specified Limit is for the type measurement indicated. When Peak data is indicated, the tightest limit applicable is indicated.

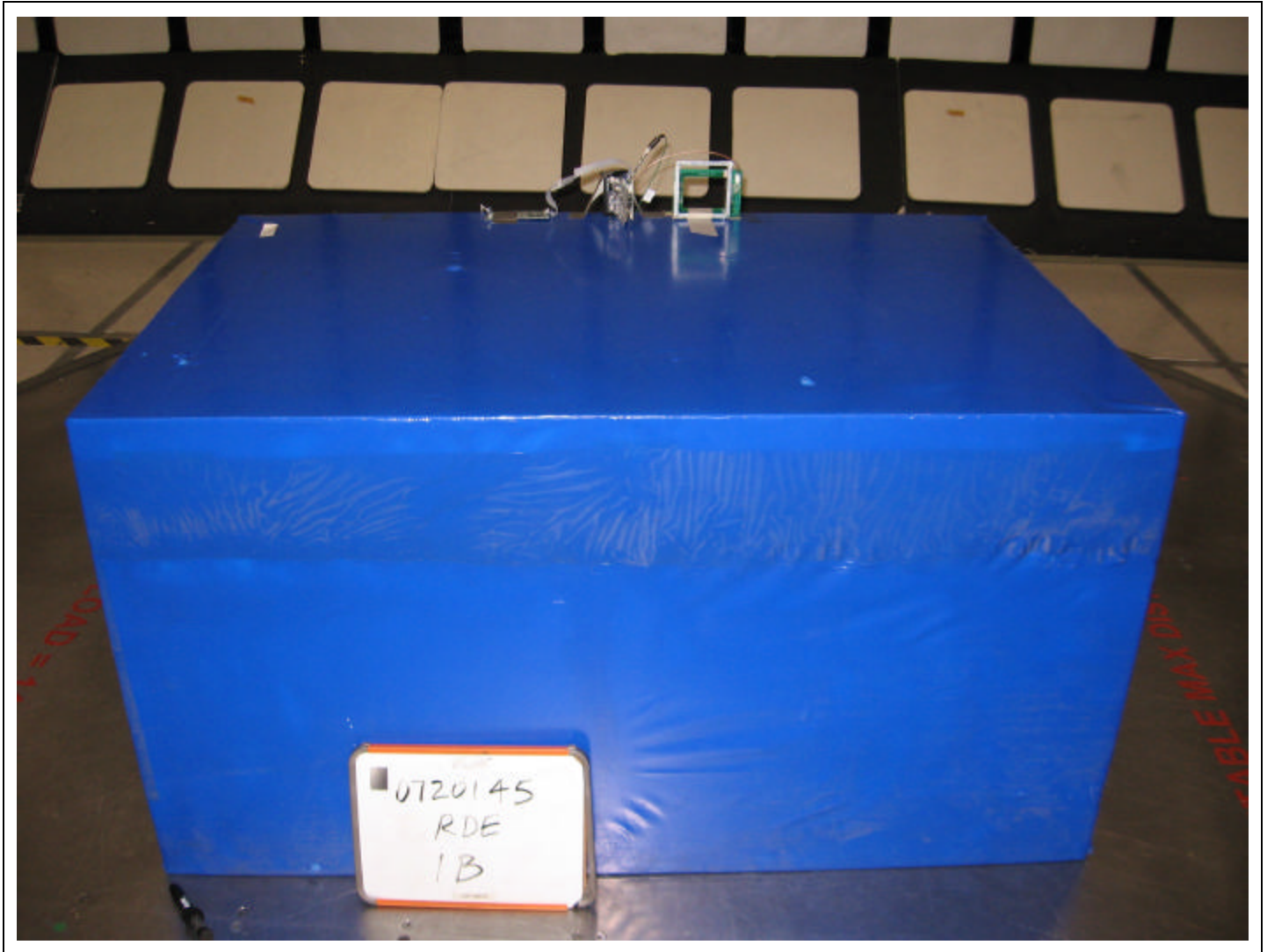
*** # = See Comment Number Under This Test's Comments Section.

Sample Calculation: Corrected Value = Measured Value + Equip Correction

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

Test 2, Item A - Test Set-Up Photo:

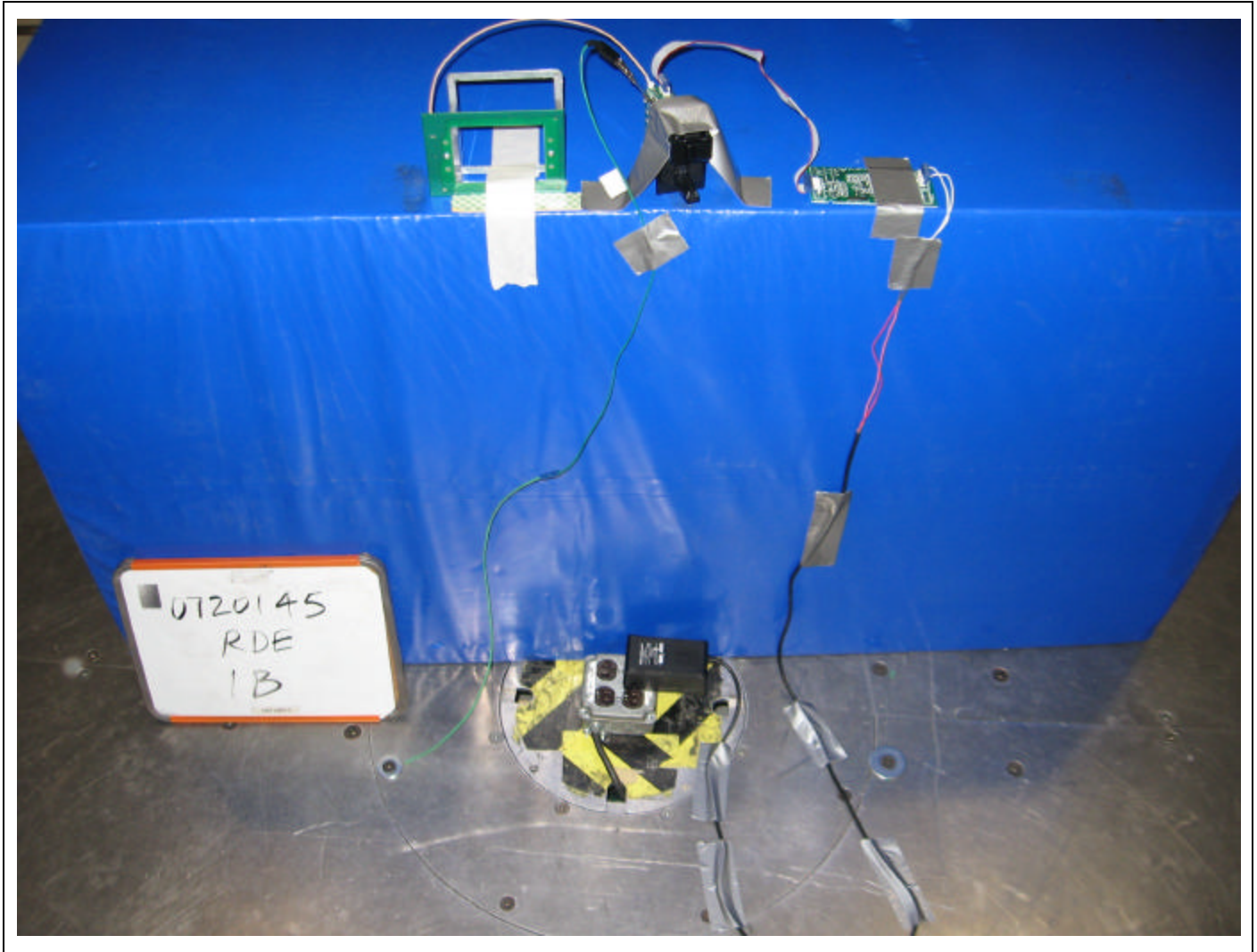
Radiated Disturbance Emissions - 30 to 1000 MHz Electric Field



RFID Reader (EUT) in center with power/data connection board on left, antenna on right. From preliminary testing it was determined that the reader was worst in the upright position as shown.

Test 2, Item A - Test Set-Up Photo:

Radiated Disturbance Emissions - 30 to 1000 MHz Electric Field



Test 3: Radiated Disturbance Emissions - Restricted Bands

Test Requirement: 47 CFR Part 15, Subpart C
 RSS-210 Issue 6

Test Specification: 47 CFR Part 15, Subpart C, Section 15.205
 RSS-210 Issue 6, Section 2.7

Test Procedure:

The EUT is verified to produce only spurious emissions in the bands listed below. Where spurious emissions exist they must comply with the general limits from 47 CFR Part 15, Section 15.209 and RSS-210 Issue 5 Section 6.2.2(t1).

Results from measurements are examined to ensure that no spurious emission in a restricted band (below) exceeds the general limits. The restricted bands are:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	608 - 614	4.5 - 5.15
0.495 - 0.505	16.69475 - 16.69525	960 - 1240	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	1300 - 1427	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1435 - 1626.5	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1645.5 - 1646.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1660 - 1710	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1718.8 - 1722.2	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	2200 - 2300	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2310 - 2390	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2483.5 - 2500	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2655 - 2900	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	3260 - 3267	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3332 - 3339	23.6 - 24.0
12.29 - 12.293	127.72 - 167.17	3345.8 - 3358	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3600 - 4400	36.43 - 36.5
12.57675 - 12.57725	332-335.4		Above 38.6
13.36 - 13.41	399.9 - 410		

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
-	0	Enclosure	1	1	1

Test 3 - Results: Radiated Disturbance Emissions - Restricted Bands

Test Results Summary:

Test Item	Test Location	Humidity (%)	Temperature (°C)	Pressure (kPa)	Pass/Fail (P/F)	Date Completed	Comment #
-	-	-	-	-	P		

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

Comments:

Comment #	Description
1	From results found in Test 1: It is observed that transmit frequency of 13.56 MHz is not within a restricted band in 15.205.
2	From results found in Test 1: It is observed that all spurious emissions through 10 th harmonic comply with general limit in 15.207.

Test 4: Maximum Permissible Exposure Calculation

Test Requirement: 47 CFR Part 1

Test Specification: 47 CFR Part 1, Section 1.1307

Exposure Limits:

FCC Limits for Occupational/Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm ²)	Averaging Time E ² , H ² . or S (minutes)
0.3 – 3.0	614	1.63	(100)*	6
3.0 - 30	1824/f	4.89/f	(900/f ²)*	6
30 - 300	61.4	0.163	1.0	6
300 – 1500	-	-	f/300	6
1500 – 100,000	-	-	5.0	6

* Plane-wave equivalent power density. f in MHz.

FCC Limits for General Population/Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm ²)	Averaging Time E ² , H ² . or S (minutes)
0.3 - 1.34	614	1.63	(100)*	30
1.34 - 30	824/f	2.19/f	(180/f ²)*	30
30 - 300	27.5	0.073	0.2	30
300 – 1500	-	-	f/1500	30
1500 – 100,000	-	-	1.0	30

*Plane-wave equivalent power density. f in MHz.

Test Details: This device is considered to possibly be located in either environment, therefore the General/Uncontrolled limit is used during calculation.

Background: Per the following guidance from OET Bulletin 65 Supplement C required minimum spacings are provided to the professional installer.

Transmitter or Device Type ¹⁸	Output ¹⁹	Applicable Methods to Ensure Compliance ²⁰
Transmitters using indoor antennas that operate at 20 cm or more from nearby persons	>2.5 W at 915 MHz	If the MPE distance is greater than that required for normal operation of the device, operating instructions, warning instructions and/or warning labels may be used to ensure compliance by indicating the minimal separation distance to comply with MPE limits. If the antennas are professionally installed to ensure compliance, warning instructions and warning labels are not necessary.
	=< 2.5 W at 915 MHz or =< 4 W at 2450 MHz	Transmitters operating at 2.5 W EIRP (1.5 W ERP) or less at 915 MHz, or at 4 W EIRP (2.4 W ERP) or less at 2450 MHz, generally are not expected to exceed MPE limits when nearby persons are 20 cm or more from most antennas. Therefore, special instructions and warnings are normally not necessary to ensure compliance.

MPE Calculation:

As measurements were performed by radiated emissions in magnetic field, the magnetic field strength recorded at 3 meter distance is extrapolated to 20 cm. A 40 dB/decade factor is used. The result is compared against the magnetic field strength limit for general/uncontrolled environment.

Exposure Limit

Magnetic Field Strength Limit (from table) = $2.19/f$ A/m, where f = frequency in MHz.

Magnetic Field Strength Limit = $2.19/13.56$ A/m = **0.1615 A/m**

Field Produced at 20 cm (continuous exposure assumed)

Extrapolating from 3 meter distance to 20 cm:

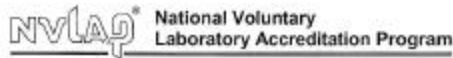
Magnetic Field Strength measured = 30.29 dBuA/m + $40 \cdot \text{Log}_{10}(300 \text{ cm}/20 \text{ cm})$

Magnetic Field Strength measured = 30.29 dBuA/m + 47.0 dB = 77.29 dBuA/m or in linear units = **0.007320 A/m @ 20cm.**

Result

It is demonstrated that the device complies with the magnetic field strength RF exposure limits for general/uncontrolled environment at a distance of 20 cm. Because the transmitting antenna is a loop antenna, only the magnetic field limit is considered. The electric field limit and power density limit are considered to be met without calculation.

Accreditation Certificates:



SCOPE OF ACCREDITATION TO ISO/IEC 17025:1999

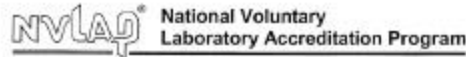
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ELECTROMAGNETIC COMPATIBILITY AND TELECOMMUNICATIONS NVLAP LAB CODE 200246-0

NVLAP Code	Designation / Description
Emissions Test Methods:	
12/CIS11f	AS/NZS CISPR 11 (2002): Industrial, scientific and medical (ISM) radio frequency equipment - Electromagnetic disturbance characteristics - Limits and methods of measurement
12/CIS11b	AS/NZS CISPR 11 (2004): Industrial, scientific and medical (ISM) radio frequency equipment - Electromagnetic disturbance characteristics - Limits and methods of measurement
12/CIS14	CISPR 14-1 (March 30, 2000): Limits and Methods of Measurement of Radio Interference Characteristics of Household Electrical Appliances, Portable Tools and Similar Electrical Apparatus - Part 1: Emissions
12/CIS14a	EN 55014-1 (1993), A1 (1997), A2 (1999);
12/CIS14b	AS/NZS 1044 (1993);
12/XS14B1	AS/NZS CISPR 14-1 (2000): Electromagnetic Compatibility - Requirements for household appliances, electric tools and similar apparatus - Part 1: Emission
12/CIS14c	CNS 13783-1: Electromagnetic Compatibility Requirements for household appliances, electric tools and similar apparatus - Part 1: Emissions

2007-07-01 through 2008-06-30
Effective dates

Sally A. Bruce
For the National Institute of Standards and Technology
NVLAP-016 (REV. 2005-05-19)



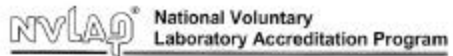
ELECTROMAGNETIC COMPATIBILITY AND TELECOMMUNICATIONS NVLAP LAB CODE 200246-0

NVLAP Code	Designation / Description
12/CIS22	IEC/CISPR 22 (1997) & EN 55022 (1998) + A1(2000): Limits and methods of measurement of radio disturbance characteristics of information technology equipment
12/CIS22a	IEC/CISPR 22 (1993) and EN 55022 (1994): Limits and methods of measurement of radio disturbance characteristics of information technology equipment, Amendment 1 (1995) and Amendment 2 (1996)
12/CIS22b	CNS 13478 (1997): Limits and Methods of Measurement of Radio Interference Characteristics of Information Technology Equipment
12/EM02a	IEC 61000-3-2, Edition 2.1 (2001-10), EN 61000-3-2 (2000), and AS/NZS 2279.1 (2000): Electromagnetic compatibility (EMC) Part 3-2: Limits - Limits for harmonic current emissions (equipment input current <= 16 A)
12/EM02b	IEC 61000-3-3, Edition 1.1(2002-03) & EN 61000-3-3, A1(2001): EMC - Part 3-3: Limits - Limitations of voltage changes, voltage fluctuations and flicker, in public low-voltage supply-systems, for equipment with rated current <= 16 A per phase and not subject to conditional connections
12/FCC15b	ANSI C63.4 (2003) with FCC Method 47 CFR, Part 15, Subpart B: Unintentional Radiators
12/E51	AS/NZS CISPR 22 (2002) and AS/NZS 1348 (1997): Electromagnetic Interference - Limits and Methods of Measurement of Information Technology Equipment

Immunity Test Methods:	
12/I01	IEC 61000-4-2, Ed. 1.2 (2001) + A1, A2; EN 61000-4-2: Electrostatic Discharge Immunity Test
12/I02	IEC 61000-4-3, Ed. 2.0 (2002-03); EN 61000-4-3 (2002): Radiated Radio-Frequency Electromagnetic Field Immunity Test
12/I03	IEC 61000-4-4(1995), A1(2000), A2(2001); EN 61000-4-4: Electromagnetic compatibility (EMC) - Part 4-4: Testing and measurement techniques - Electrical Fast Transient/Burst Immunity Test

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NVLAP Code	Designation / Description
12/I04	IEC 61000-4-5, Ed. 1.1 (2001-04); EN 61000-4-5: Electromagnetic compatibility (EMC) - Part 4-5: Testing and measurement techniques - Surge immunity test
12/I05	IEC 61000-4-6, Ed. 2.0 (2003-05); EN 61000-4-6: Electromagnetic compatibility (EMC) - Part 4-6: Testing and measurement techniques - Immunity to conducted disturbances, induced by radio-frequency fields
12/I06	IEC 61000-4-8, Ed. 1.1 (2001); EN 61000-4-8: Electromagnetic compatibility (EMC) - Part 4-8: Testing and measurement techniques - Power frequency magnetic field immunity test
12/I07	IEC 61000-4-11, Ed. 1.1 (2001-03); EN 61000-4-11: Voltage Dips, Short Interruptions and Voltage Variations Immunity Tests

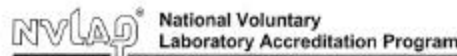
Product Safety Test Methods	
12/T41a	EN 60950-1, IEC 60950-1 & UL 60950-1 (1st edition) (2001): Information technology equipment - Safety - Part 1: General requirements
12/T30b	AS/NZS 60950.1 (2003): Information technology equipment - Safety - Part 1: General requirements (IEC 60950-1: 2001, MOD)

RF Exposure Test Methods (SAR & MPE)	
12/T41a	AS/NZS 60950 (2003): Safety of Information Technology Equipment (including Ansat)
12/T50	AS/NZS 3280 (1993) + Supplement 1 (1996): Safety of Information Technology Equipment Including Electrical Business Equipment

Telecommunications Test Methods:	
12/108M	GR-1089-CORE, Issue 3 (April 2002): EMC and Electrical Safety - Generic Criteria for Network Telecommunications Equipment (sections: 2.1.2.1, 2.1.2.2, 2.1.A, 2.2, 3.2, 3.3, 4.6.2, 4.6.5, 4.6.7-4.6.17, 4.7, 5.2, 5.3.1, 5.4, 6, 7.2-7.7, 8, and 9.2-9.42)
12/76200a	SBC-TP-76200, Issue 5 (May 2003): Network Equipment: Power, Grounding, Environmental, and Physical Design Requirements (sections: 6.1B, 7.1, 7.2, 7.5, 7.4, and 10.1-10.4B)

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NVLAP Code	Designation / Description
12/GR03a	GR-63-CORE, Issue 2 (April 2002): NEBS (TM) Requirements: Physical Protection (sections: 2, 3, 4.1, 4.2.3, 4.3, 4.4.1, 4.4.3, 4.4.4, 4.5, 4.6, and 4.7)

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Measurement Uncertainty Statement

Test	Expanded Estimate of Uncertainty (k = 2, for 95% of a normal distribution)	Units
Radiated Disturbance Emissions:	± 3.8 dB	Volts/meter
Conducted Disturbance Emissions (150 kHz – 30 MHz):	± 3.4 dB	Volts

CISPR 16-4:2000 Statement

The UL-RTP estimate of expanded measurement uncertainty listed above for Conducted Disturbance (+/- 3.4 dB) and Radiated Disturbance (+/-3.8 dB) are less than the Values of U_{CISPR} as listed in Table 1 of CISPR 16-4. Therefore:

- Compliance is deemed to occur if no measured disturbance reported exceeds the disturbance limits.
- Non-compliance is deemed to occur if any measured disturbance reported exceeds the disturbance limits.