Lab Code: 200167-0

FCC PART 15.247

TEST AND MEASUREMENT REPORT

For

Coulomb Technologies, Inc.

1692 Dell Avenue, Campbell, CA95008, USA

FCC ID: W38-17-001002-01

Report Type:	**Product Type:**
Class II Permissive Change	802.15.4 Radio Transceiver

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Report Number:	R0901165-247
Report Date:	2009-02-10
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TABLE OF CONTENTS

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	R0901165-247	Original	2009-02-10

1 GENERAL INFORMATION

1.1 Product Description for Equipment under Test (EUT)

This test and measurement report has been compiled on behalf of *Coulomb Technologies, Inc.* and their product model: *CT1H00, FCC ID:W38-17-001002-01* which is a 2.4 GHz transceiver providing a solution for data links and wireless networks. The module is based on the Ember EM260 network processor providing an IEEE 802.15.4 radio transceiver with a SPI base interface. The SPI interface gives the flexibility to choose the external microprocessor to best fit the application.

1.2 Mechanical Description of EUT

The *Coulomb Technologies, Inc.* EUT measures approximately *40 mm L x 40 mm and 0.025 kg*
** The test data gathered are from typical production sample, serial number: 022699, provided by the manufacturer.*

1.3 EUT Photo

1.4 Objective

This test and measurement report is prepared on behalf of *Coulomb Technologies, Inc.* in accordance with Part 2, Subpart J, Part 15, Subparts A, B and C of the Federal Communication Commissions rules.

The objective is to determine compliance with FCC Class II Permissive Change rules for Radiated Spurious Emissions, Antenna Requirements, and Conducted Emissions. The purpose of this Class II Permissive Change report is to provide co-location testing of the 850 MHz CDMA transmitter with the RFID transmitter.

1.5 Related Submittal(s)/Grant(s)

Not Applicable.

1.6 Test Methodology

All measurements contained in this report were conducted in accordance with ANSI C63.4-2003, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.

1.7 Measurement Uncertainty

All measurements involve certain levels of uncertainties, especially in field of EMC. The factors contributing to uncertainties are spectrum analyzer, cable loss, antenna factor calibration, antenna directivity, antenna factor variation with height, antenna phase center variation, antenna factor frequency interpolation, measurement distance variation, site imperfections, mismatch (average), and system repeatability.

Based on NIS 81, The Treatment of Uncertainty in EMC Measurements, the values range from $\pm$2.0 for Conducted Emissions tests and $\pm$4.0 dB for Radiated Emissions tests are the most accurate estimates pertaining to uncertainty of EMC measurements at BACL.

Detailed instrumentation measurement uncertainties can be found in BACL report QAP-018.

All radiated and conducted emissions measurement was performed at Bay Area Compliance Laboratory, Corp. The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

1.8 Test Facility

The test site used by BACL Corp. to collect radiated and conducted emissions measurement data is located at its facility in Sunnyvale, California, USA.

The test sites at BACL have been fully described in reports submitted to the Federal Communication Commission (FCC) and Voluntary Control Council for Interference (VCCI). The details of these reports has been found to be in compliance with the requirements of Section 2.948 of the FCC Rules on February 11 and December 10, 1997 and Article 8 of the VCCI regulations on December 25, 1997. The facility also complies with the radiated and AC line conducted test site criteria set forth in ANSI C63.4-2003.

The Federal Communications Commission, Industry Canada, and Voluntary Control Council for Interference has the reports on file and is listed under FCC registration number: 90464, IC registration number: 3062A, and VCCI Registration Number: C-2463 and R-2698. The test site has been approved by the FCC, IC, and VCCI for public use and is listed in the FCC Public Access Link (PAL) database.

Additionally, BACL is a National Institute of Standards and Technology (NIST) accredited laboratory, under the National Voluntary Laboratory Accredited Program (Lab Code 200167-0). The current scope of accreditations can be found at http://ts.nist.gov/Standards/scopes/2001670.htm

2 SYSTEM TEST CONFIGURATION

2.1 Justification

The EUT and its host were configured for testing according to ANSI C63.4-2003.

The EUT was tested in a testing mode to represent *worst*-case results during the final qualification test.

The worst-case data rates are determined to be as follows for each mode based upon investigation by measuring the average power, peak power and PPSD across all data rates bandwidths, and modulations.

2.2 EUT Exercise Software

The software to exercise the unit was provided by the client.

2.3 Equipment Modifications

No modifications were made to the EUT.

2.4 Special Accessories

N/A

2.5 Power Supply and Line Filters

N/A

2.6 Interface Ports and Cabling

N/A

3 SUMMARY OF TEST RESULTS

Results reported relate only to the product tested.

FCC Rules	Description of Test	Results
§15.247(i) §2.1091	RF Exposure	N/A*
§15.203	Antenna Requirement	Compliant
§ 15.207 (a)	Conducted Emissions	Compliant
§2.1051 & §15.247(d)	Spurious Emissions at Antenna Port	N/A*
§15.205	Restricted Bands	N/A*
15.209 (a) & §15.247(d)	Radiated Spurious Emissions	Compliant
§15.247 (a)(2)	6 dB Bandwidth	N/A*
§15.247 (b)(3)	Maximum Peak Output Power	N/A*
§ 15.247 (d)	100 kHz Bandwidth of Frequency Band Edge	N/A*
§15.247 (e)	Power Spectral Density	N/A*

*Note: Please refer to the FCC ID: TFB-APEXLT.

4 § 15.203 – ANTENNA REQUIREMENT

4.1 Applicable Standard

According to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

Refer to statement below for compliance.

“The antenna for this device is an integral antenna that the end user cannot access. Pleased refer to the EUT photos.

Result: Compliant.

5 §15.207 – CONDUCTED EMISSIONS

5.1 Applicable Standard

According to FCC §15.207 (a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequencies ranges.

Frequency of emission (MHz)	Conducted limit (dBµV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

**Decreases with the logarithm of the frequency*

EUT was tested with the Host system which contained the 13.56 MHz RFID and CDMA module.

The following quote is from "New Policies for Part 15 Devices" released TCB training on May 10-13, 2005;pg.12 "AC line-conducted emissions measurements of Part 15 transmitters that operate < 30 MHz."

"Although C63.4 is designed for Part 15 transmitters that operate above 30 MHz with a detachable antenna, we are willing to accept measurements on a 13.56 MHz transmitter done with a dummy load under the following conditions:

1)First, perform the AC line conducted tests with the antenna attached to make sure the device complies with the 15.207 limits outside the transmitter's fundamental emission band.

2) Second, retest with a dummy load to make sure the device complies with the 15.207 limits inside the transmitter's fundamental emission band. Only the fundamental TX emission band needs to be retested."

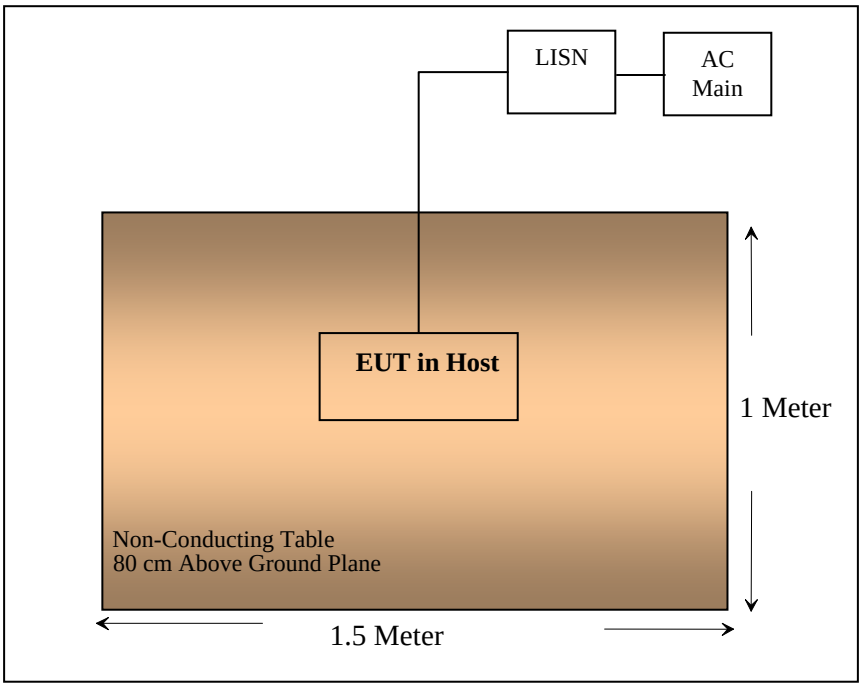
5.2 Test Setup

The measurement was performed in a shielded room, using the setup per ANSI C63.4 –2003 The specification used was FCC Part 15.207 limits.

External I/O cables were draped along the edge of the test table and bundled when necessary.

The host of the EUT was connected to LISN-1.

5.3 Test Setup Block Diagram



5.4 Test Equipment List and Details

Manufacturer	Description	Model	Serial Number	Calibration Date
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.5950K03	100337	2008-04-21
Solar Electronics	LISN	9252-R-24-BNC	511205	2008-07-31
Shanghai Qinjing Electronics	15 Ohm Loading	-	20	-

*** Statement of Traceability: BACL Corp.** attests that all calibrations have been performed per the NVLAP requirements, traceable to the NIST.

5.5 Test Procedure

During the conducted emissions test, the power cord of the host was connected to the mains outlet of the LISN-1.

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All data was recorded in peak detection, quasi-peak and average modes. Quasi-Peak readings are distinguished with a “QP”. Average readings are distinguished with an “Ave”.

5.6 Environmental Conditions

Temperature:	22.3 °C
Relative Humidity:	42 %
ATM Pressure:	100.7 kPa

**The testing was performed by Victor Zhang on 2009-01-29.*

5.7 Summary of Test Results

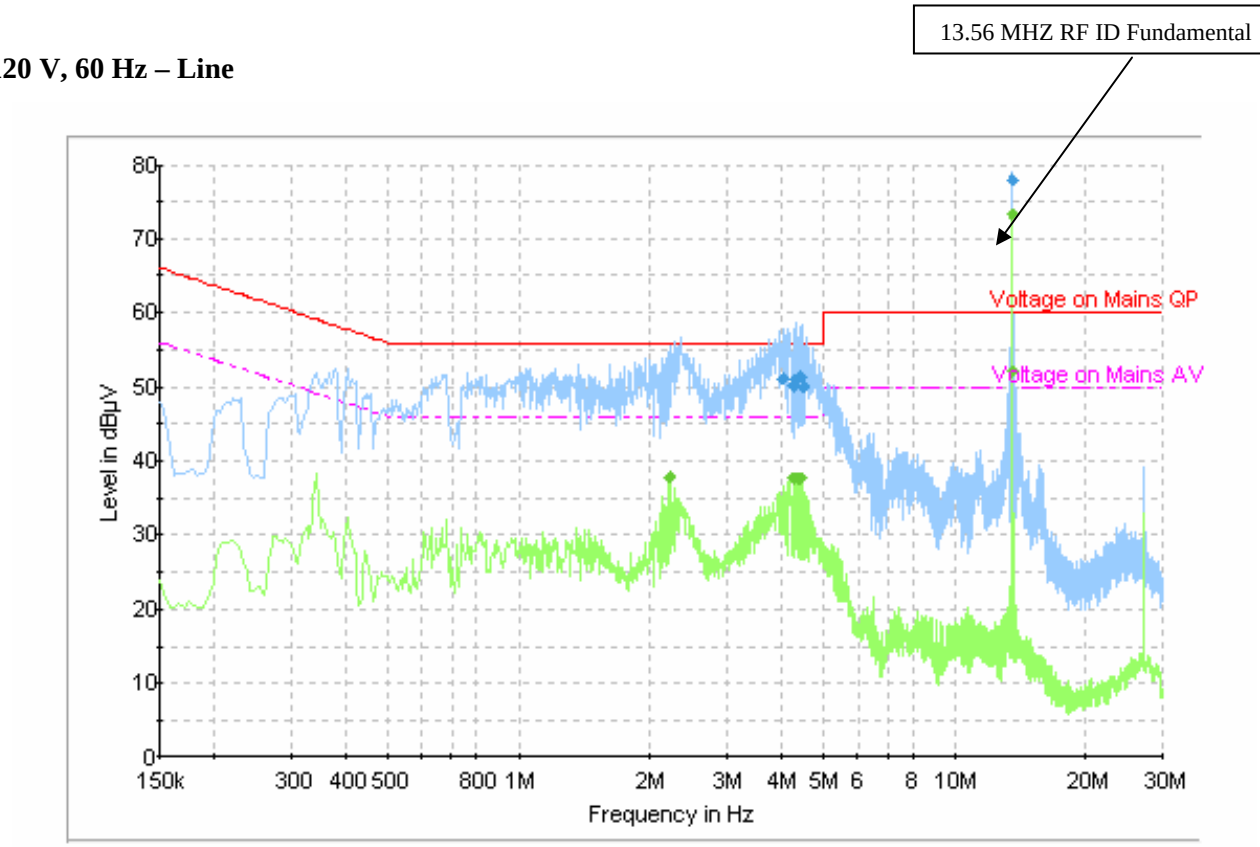
According to the recorded data in following table, the EUT complied with the FCC rule's for conducted emissions limits for Class B devices, with the *worst* margin reading of:

-4.7 dB at **4.414 MHz** in the **Line** Conductor
-4.2 dB at **4.185 MHz** in the **Neutral** Conductor

Please refer to the following plots and tables for complete test results

13.56 MHz RFID Antenna Attached:

120 V, 60 Hz – Line



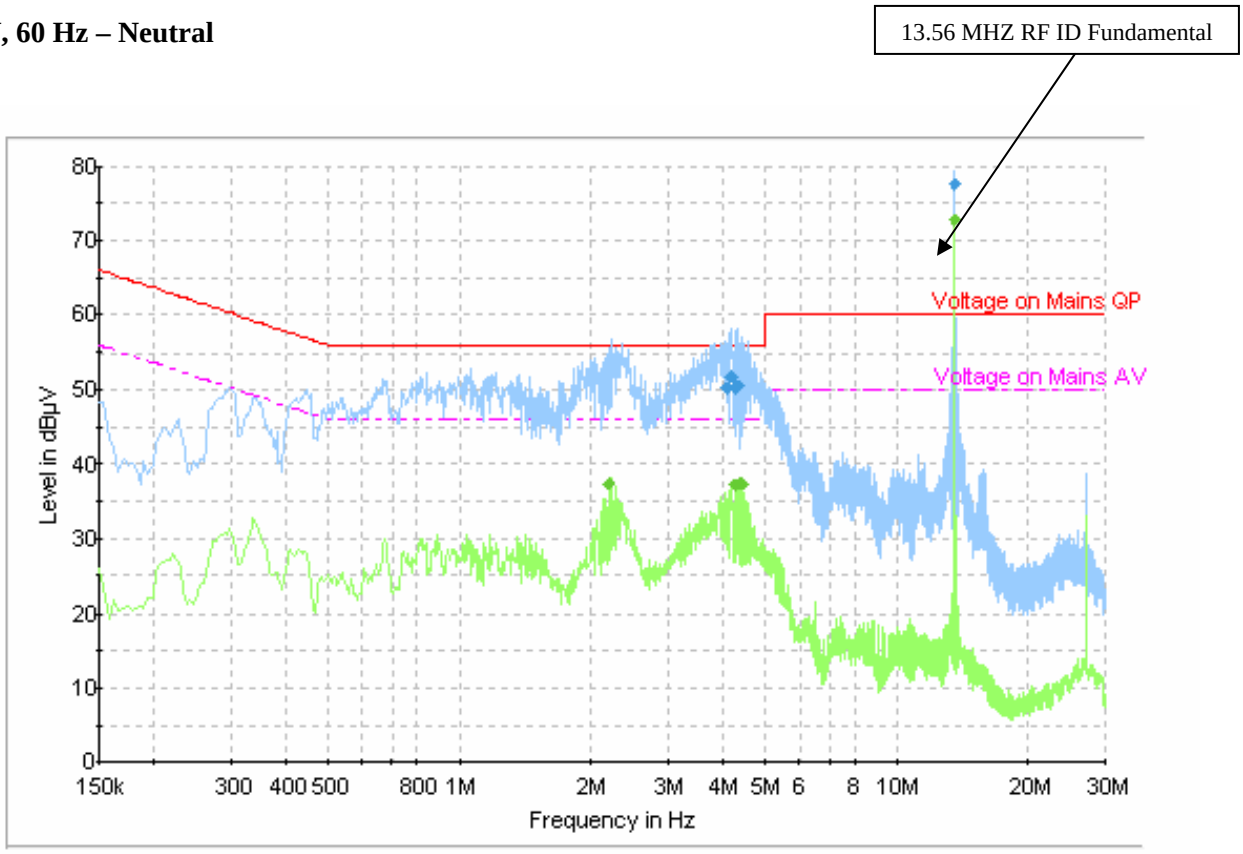
Quasi-Peak Measurement:

Frequency (MHz)	Quasi-Peak (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)
13.558	78.0	Line	60	18.0
4.414	51.3	Line	56	-4.7
4.034	51.1	Line	56	-4.9
4.338	51.0	Line	56	-5.0
4.262	50.2	Line	56	-5.8
4.490	49.9	Line	56	-6.1

Average Measurement:

Frequency (MHz)	Average (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)
13.558	73.3	Line	50	23.3
13.550	52.1	Line	50	2.1
2.206	37.9	Line	46	-8.1
4.346	37.6	Line	46	-8.4
4.274	37.5	Line	46	-8.5
4.414	37.6	Line	46	-8.5

120 V, 60 Hz – Neutral



Quasi-Peak Measurement:

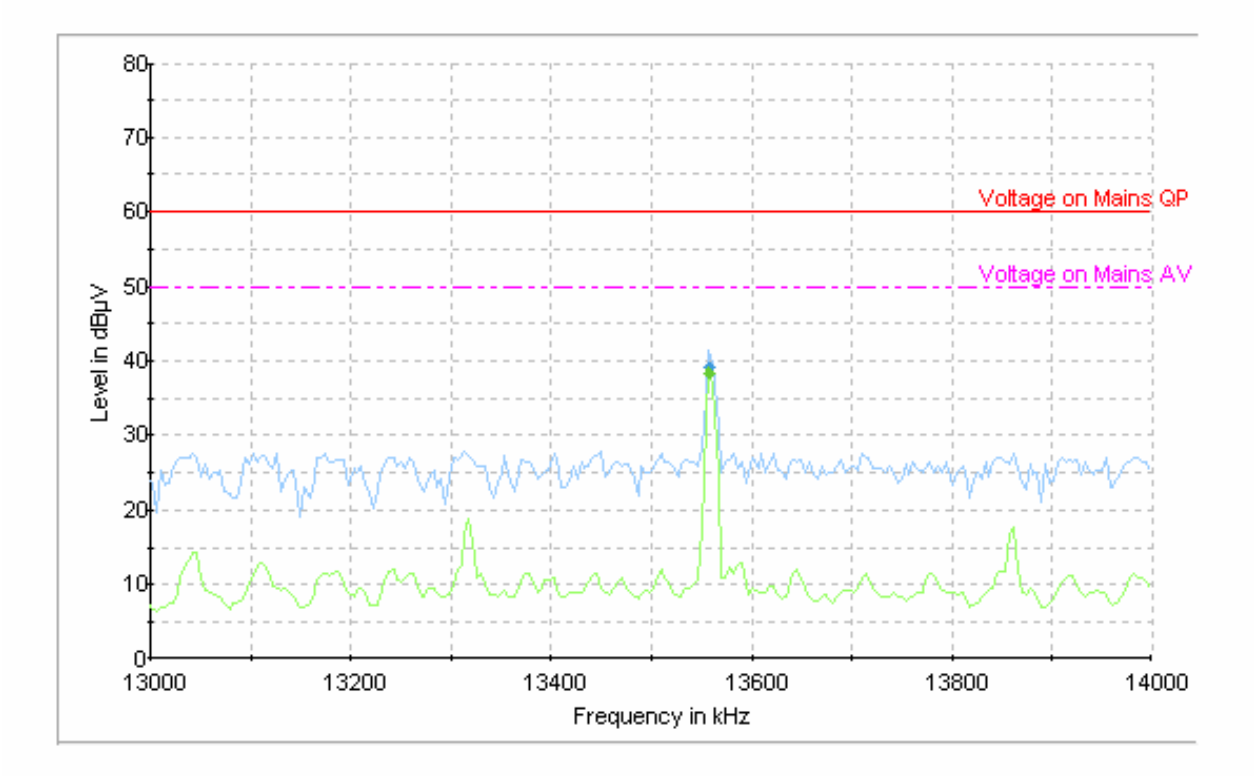
Frequency (MHz)	Quasi-Peak (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)
13.557	77.5	Neutral	60	17.5
4.185	51.8	Neutral	56	-4.2
4.337	50.6	Neutral	56	-5.4
4.109	50.1	Neutral	56	-5.9
4.277	50.1	Neutral	56	-5.9
13.557	77.5	Neutral	60	17.5

Average Measurement:

Frequency (MHz)	Average (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)
13.557	72.8	Neutral	50	22.8
4.345	37.5	Neutral	46	-8.5
2.205	37.4	Neutral	46	-8.6
4.413	37.4	Neutral	46	-8.6
4.273	37.2	Neutral	46	-8.8
13.557	72.8	Neutral	50	22.8

13.56 MHz RFID with Dummy Load TX band:

120 V, 60 Hz – Line (13 to 14 MHz)



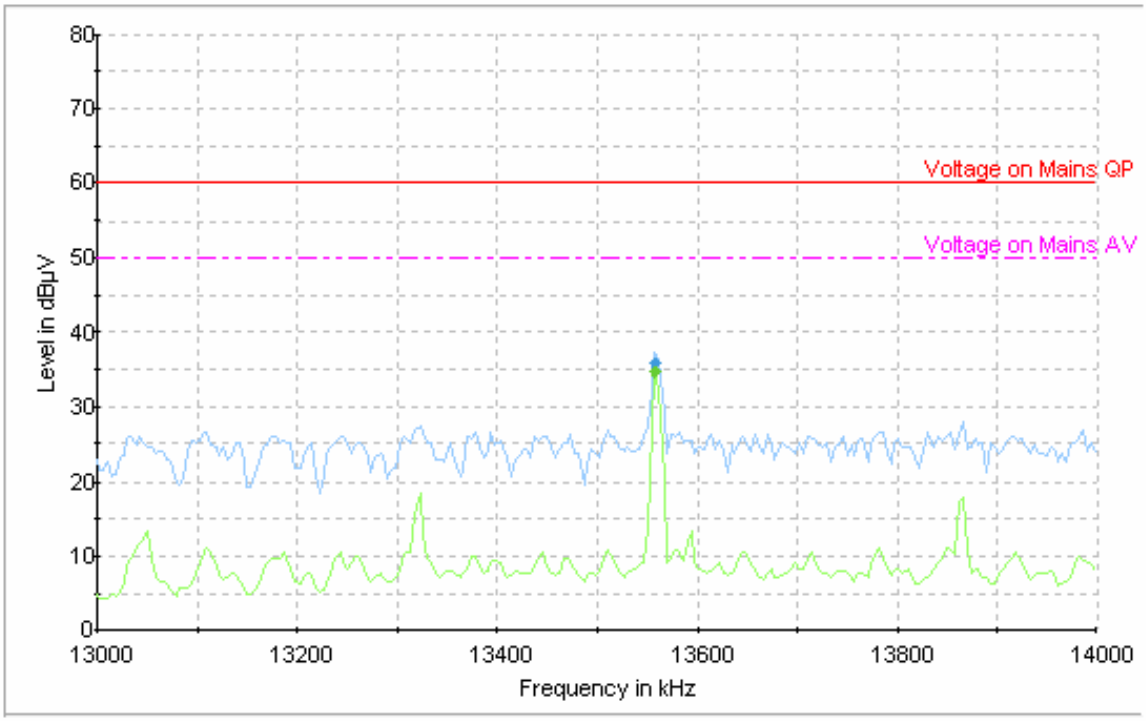
Quasi-Peak Measurement:

Frequency (MHz)	Quasi-Peak (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)
13.557000	39.0	Line	60.0	-21

Average Measurement:

Frequency (MHz)	Average (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)
13.557000	38.4	Line	50.0	-11.6

120 V, 60 Hz – Neutral (13 to 14 MHz)



Quasi-Peak Measurement:

Frequency (MHz)	Quasi-Peak (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)
13.558000	35.9	Neutral	60.0	-24.2

Average Measurement:

Frequency (MHz)	Average (dBµV)	Conductor (Line/Neutral)	Limit (dBµV)	Margin (dB)
13.558000	34.6	Neutral	50.0	-15.4

6 §15.205: Restricted Bands of Operation, §15.209: Radiated Emission Limits & §15.247(d): Out of Band Emission Limits

6.1 Applicable Standards

As per 15.35(d): Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz.

As Per 15.205(a) except as show in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

f (MHz)	f (MHz)	f (MHz)	f (GHz)
0.090 – 0.110	16.42 – 16.423	960 – 1240	4. 5 – 5. 15
0.495 – 0.505	16.69475 – 16.69525	1300 – 1427	5. 35 – 5. 46
2.1735 – 2.1905	25.5 – 25.67	1435 – 1626.5	7.25 – 7.75
4.125 – 4.128	37.5 – 38.25	1645.5 – 1646.5	8.025 – 8.5
4.17725 – 4.17775	73 – 74.6	1660 – 1710	9.0 – 9.2
4.20725 – 4.20775	74.8 – 75.2	1718.8 – 1722.2	9.3 – 9.5
6.215 – 6.218	108 – 121.94	2200 – 2300	10.6 – 12.7
6.26775 – 6.26825	123 – 138	2310 – 2390	13.25 – 13.4
6.31175 – 6.31225	149.9 – 150.05	2483.5 – 2500	14.47 – 14.5
8.291 – 8.294	156.52475 – 156.52525	2690 – 2900	15.35 – 16.2
8.362 – 8.366	156.7 – 156.9	3260 – 3267	17.7 – 21.4
8.37625 – 8.38675	162.0125 –167.17	3.332 – 3.339	22.01 – 23.12
8.41425 – 8.41475	167.72 – 173.2	3 3458 – 3 358	23.6 – 24.0
12.29 – 12.293	240 – 285	3.600 – 4.400	31.2 – 31.8
12.51975 – 12.52025	322 – 335.4		36.43 – 36.5
12.57675 – 12.57725	399.9 – 410		Above 38.6
13.36 – 13.41	608 – 614		

As per 15.209(a): Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table

Frequency (MHz)	Field Strength (micro volts/meter)	Measurement Distance (meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

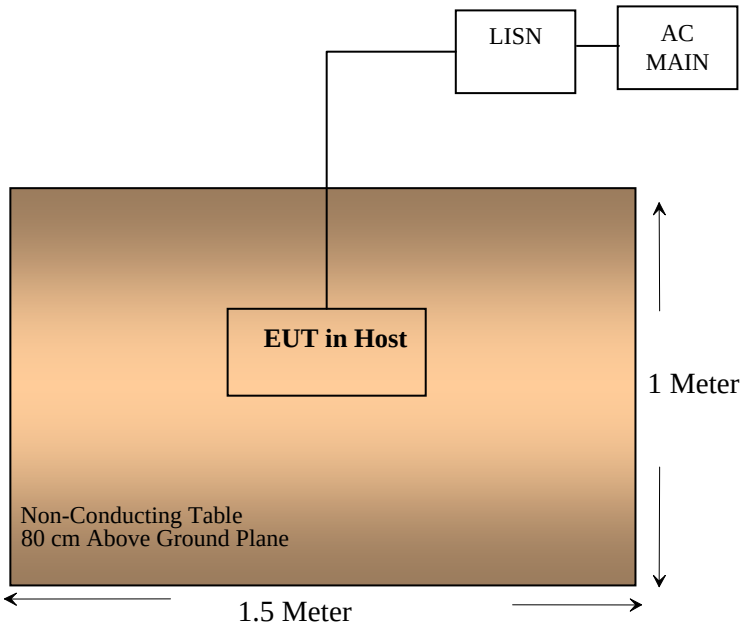
As Per 15.247(d), In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies

with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

6.2 Test Setup

The radiated emissions tests were performed in the 3-meter open area test site, using the setup in accordance with ANSI C63.4-2003. The specification used was the FCC Part 15 C limits.

6.3 Test Setup Block Diagram



6.4 EUT Setup

The radiated emissions tests were performed using the setup accordance with the ANSI C63.4-2003. The specification used was the FCC 15C limits.

The spacing between the peripherals was 10 centimeters.

External I/O cables were draped along the edge of the test table and bundle when necessary.

The EUT is powered by 120VAC power source.

6.5 Test Equipment List and Details

Manufacturers	Description	Models	Serial Numbers	Calibration Dates
Antenna Research Association	Horn Antenna	DRG-1181A	1132	2008-07-28
AH Systems	Horn Antenna	SAS200/571	261	2008-07-01
Agilent	1-18GHz Pre-Amplifier	8449B	3008A01978	2008-10-21
Agilent	Spectrum Analyzer	E4440A	US45303156	2008-05-31
Rohde & Schwarz	EMI Test Receiver	ESCI 1166.595 0K03	100044	2008-03-26

* **Statement of Traceability:** BACL attests that all calibrations have been performed per the NVLAP requirements, traceable to NIST.

6.6 Test Procedure

For the radiated emissions test, the EUT, and all support equipment power cords was connected to the AC floor outlet.

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

The EUT is set 3 meter away from the testing antenna, which is varied from 1-4 mete, and the EUT is placed on a turntable, which is 0.8 meter above ground plane, the table shall be rotated for 360 degrees to find out the highest emission. The receiving antenna should be changed the polarization both of horizontal and vertical.

The spectrum analyzer or receiver is set as:

Below 1000 MHz:

RBW = 100 kHz / VBW = 300 kHz / Sweep = Auto

Above 1000 MHz:

(1) Peak: RBW = 1MHz / VBW = 1MHz / Sweep = Auto
(2) Average: RBW = 1MHz / VBW = 10Hz / Sweep = Auto

6.7 Corrected Amplitude & Margin Calculation

The Corrected Amplitude is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain from the Amplitude reading. The basic equation is as follows:

Corrected Amplitude = Indicated Reading + Antenna Factor + Cable Factor - Amplifier Gain

The "**Margin**" column of the following data tables indicates the degree of compliance with the applicable limit. For example, a margin of -7dB means the emission is 7dB below the maximum limit.
The equation for margin calculation is as follows:

Margin = Corrected Amplitude - Limit

6.8 Environmental Conditions

Temperature:	22.3 °C
Relative Humidity:	42 %
ATM Pressure:	100.7 kPa

**The testing was performed by Victor Zhang on 2009-01-29.*

6.9 Summary of Test Results

According to the data hereinafter, the EUT complied with the limits presented in FCC Title 47, Part 15, Subpart C, section 15.205, 15.209 and 15.247, and had the worst margin of:

Co-location with CDMA 850, RFID and 802.15.4 Radio (30 MHz-25 GHz):

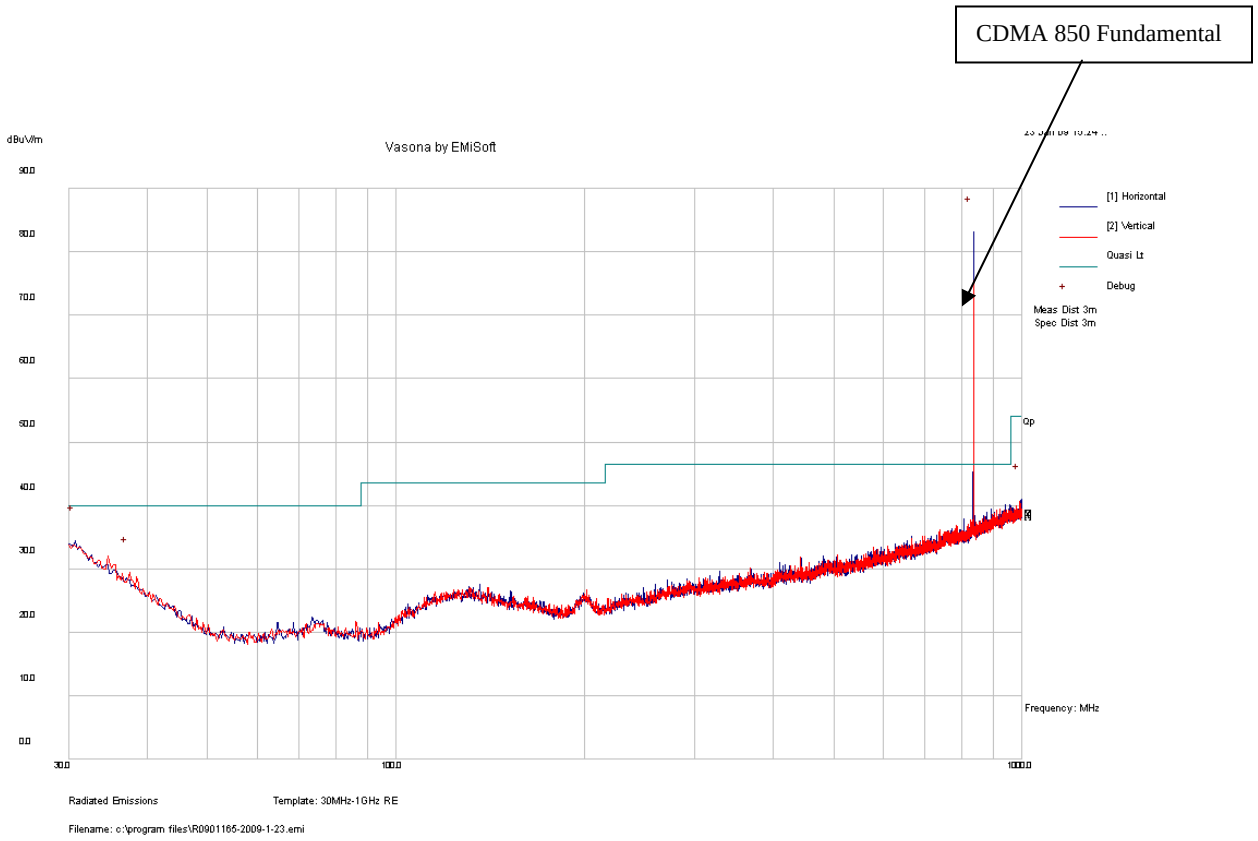
Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Range**
-14.7	30.779	Horizontal	30 MHz-25GHz

Co-location CDMA 1900, RFID and 802.15.4 Radio (30 MHz-25 GHz):

Mode: Transmitting			
Margin (dB)	**Frequency (MHz)**	**Polarization (Horizontal/Vertical)**	**Range**
-13.32	30	Horizontal	30 MHz-25GHz

6.10 Radiated Emissions Test plot & data:

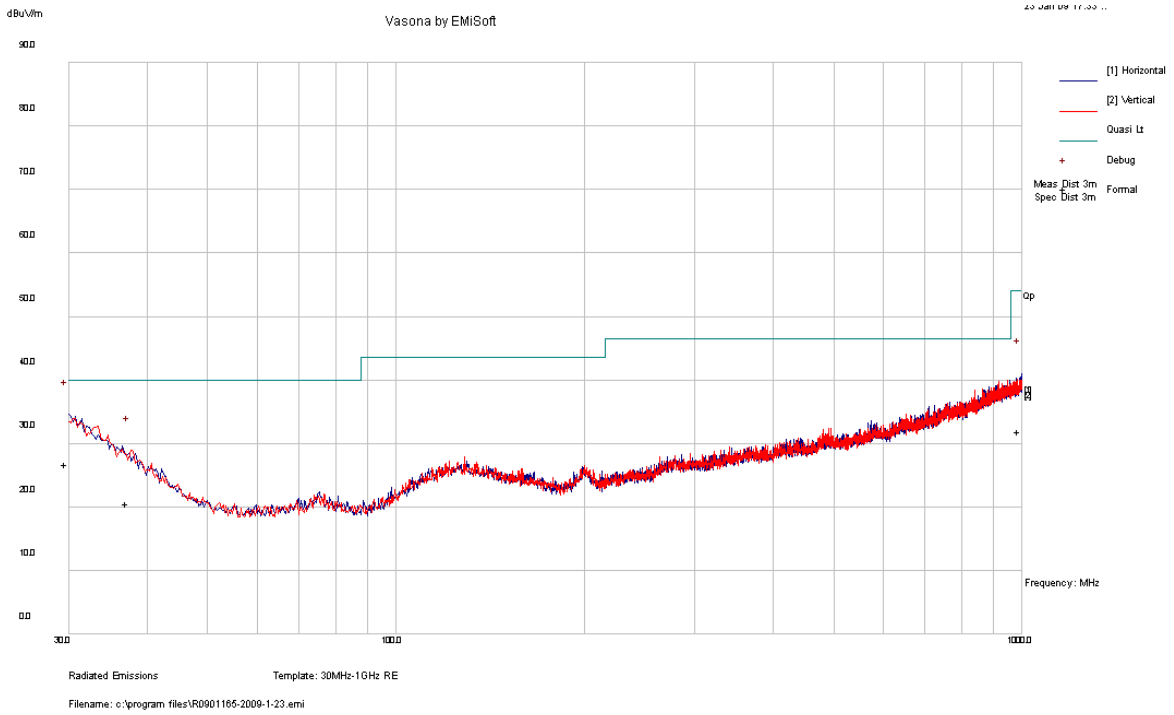
Co-location with CDMA 850, RFID and 802.15.4 Radio:



Frequency (MHz)	Corrected Quasi -Peak (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (deg.)	Corrected Factor (dB)	Limit (dBµV/m)	Margin (dB)
30.779	25.83	291	H	77	11.92	40	-14.17
37.685	20.49	198	V	173	6.59	40	-19.51
996.441	31.89	154	H	105	16.87	54	-22.11

Note: Above 1 GHz, all emission was at noise floor except for 2.4 GHz 802.15.4 fundamental.

Co-location with CDMA 1900, RFID and 802.15.4 Radio:



Frequency (MHz)	Corrected Quasi -Peak (dBµV/m)	Antenna Height (cm)	Antenna Polarity (H/V)	Turntable Azimuth (deg.)	Corrected Factor (dB)	Limit (dBµV/m)	Margin (dB)
30	26.68	110	H	113	12.54	40	-13.32
37.574	20.63	334	V	96	6.67	40	-19.37
1000	31.92	392	H	196	16.97	54	-22.08

Note: Above 1 GHz, all emission was at noise floor except for CDMA 1900 and 2.4 GHz 802.15.4 fundamental.

******* END OF REPORT *******