EMISSIONS TEST REPORT

Report Number: 3139325BOX-011
Project Number: 3139325

RF Exposure Testing performed on the

VCA100 Radio

Model: BAEVCA100-81PCGX-LF

To

CFR47 "Telecommunications" Part 1.1307

For

BAE Systems – Homeland Security Solutions

Test Performed by:	Test Authorized by:
Intertek – ETL SEMKO	BAE Systems – Homeland Security Solutions
70 Codman Hill Road	2 Forbes Road
Boxborough, MA 01719	Lexington, MA 02420

Prepared by: _____ Date: 01/29/2009
Nicholas Abbondante

Reviewed by: _____ Date: 01/30/09
Jeff Goulet

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1.0 Job Description

1.1 Client Information

This EUT has been tested at the request of:

Company:	BAE Systems – Homeland Security Solutions 2 Forbes Road Lexington, MA 02420
Contact:	Mr. Ralph Lombardo
Telephone:	603-885-7172
Fax:	N/A
Email:	Ralph.lombardo@baesystems.com

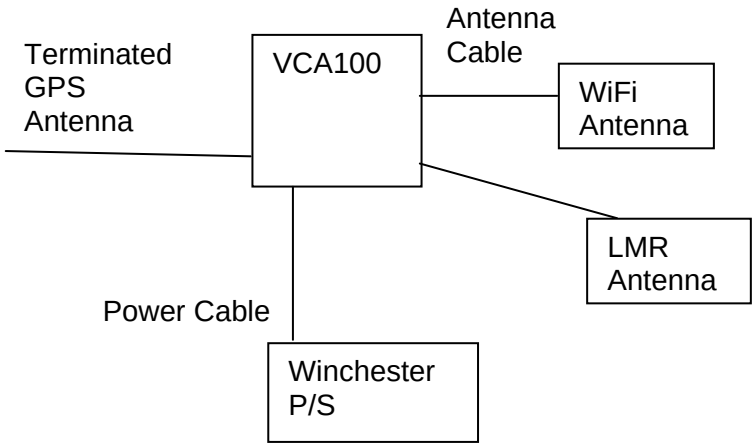
1.2 Equipment Under Test

Equipment Type:	VCA100 Radio
Model Number(s):	BAEVCA100-81PCGX-LF
Serial number(s):	0716HNH000092
Manufacturer:	BAE Systems – Homeland Security Solutions
EUT receive date:	11/05/2008
EUT received condition:	Prototype in Good Condition
Test start date:	01/29/2009
Test end date:	01/29/2009

1.3 Test Plan Reference: Tested according to the standards listed.

1.4 Test Configuration

1.4.1 Block Diagram



1.4.2. Cables:

Cable	Shielding	Connector	Length (m)	Qty.
WiFi Antenna Cable	Braid	SMA	4.2	1
GPS Antenna Cable	Braid	SMA	5.5	1
Power Cable	None	Plastic/Wire	3.25	1

1.4.3. Support Equipment:

Name: Antenex WiFi Antenna 2.4-2.5 GHz, 5 dBi/3 dBd
Model No.: A10245
Serial No.: N/L

Name: All-Start Winchester Portable Power Generator
Model No.: WPG103
Serial No.: N/L

Name: Antenex 5/8 Wave Antenna 806-866 MHz, 3 dBi
Model No.: B8063
Serial No.: N/L

Name: 1999 Toyota Corolla
Model No.: 1999 Corolla
Serial No.: N/A

1.5 Mode(s) of Operation:

During testing, the EUT was powered from a nominal 12V DC power supply. For the Land-Mobile Radio (LMR) testing, the EUT was fully powered and was transmitting an unmodulated one second burst with one second intervals. For the WiFi testing, the EUT was fully powered and was transmitting nearly continuously.

1.6 Floor Standing Equipment: Applicable:____ Not Applicable:_X_

2.0 Test Summary

TEST STANDARD	RESULTS	
CFR47 Part 1.1307		
SUB-TEST	**TEST PARAMETER**	**COMMENT**
Human RF Exposure FCC 1.1307, 1.1310	The aggregate Maximum Permissible Exposure must not exceed 100% of the limits in 1.1310 Table 1	Pass

REVISION SUMMARY – The following changes have been made to this Report:

Date	Project No.	Project Handler	Page(s)	Item	Description of Change

3.0 Sample Calculations

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF - AG

Where FS = Field Strength in dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

RA = 52.0 dBμV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dBμV/m

Level in μV/m = [10(32 dBμV/m)/20] = 39.8 μV/m

The following is how net line-conducted readings were determined:

NF = RF + LF + CF + AF

Where NF = Net Reading in dBμV
RF = Reading from receiver in dBμV
LF = LISN Correction Factor in dB
CF = Cable Correction Factor in dB
AF = Attenuator Loss Factor in dB

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV

Example:

NF = RF + LF + CF + AF = 28.5 + 0.2 + 0.4 + 20.0 = 49.1 dBμV
$UF = 10^{(48.1\ dB\mu V / 20)}$ = 254 μV/m

3.1 Measurement Uncertainty

Compliance of the product is based on the measured value. However, the measurement uncertainty is included for informational purposes.
The expanded uncertainty (k = 2) for radiated emissions from 30 to 1000 MHz has been determined to be:

±3.5 dB at 10m, ±3.8 dB at 3m

The expanded uncertainty (k = 2) for mains conducted emissions from 150 kHz to 30 MHz has been determined to be:

±2.6 dB

The expanded uncertainty (k = 2) for telecom port conducted emissions from 150 kHz to 30 MHz has been determined to be:

±3.2 for ISN and voltage probe measurements
±3.1 for current probe measurements

3.2 Site Description

Test Site(s): Boxborough Parking Lot

Our OATS are 3m and 10m sheltered emissions measurement ranges located in a light commercial environment in Boxborough, Massachusetts. They meet the technical requirements of ANSI C63.4-2003 and CISPR 22:1993/EN 55022:1994 for radiated and conducted emission measurements. The shelter structure is entirely fiberglass and plastic, with outside dimensions of 33 ft x 57 ft. The structure resembles a quonset hut with a center ceiling height of 16.5 ft.

The testing floor is covered by a galvanized sheet metal groundplane that is earth-grounded via copper rods around the perimeter of the site. The joints between individual metal sheets are bridged with a 2 inch wide metal strips to provide low RF impedance contact throughout. The sheets are screwed in place with stainless steel, round-head screws every three inches. Site illumination and HVAC are provided from beneath the ground reference plane through flush entry ports, the port covers are electrically bonded to the ground plane.

A flush metal turntable with 12 ft. diameter and 5000 lb. load capacity (12,000 lb. in Site 3) is provided for floor-standing equipment. A wooden table 80 cm high is used for table-top equipment. The turntable is electrically connected to the ground plane with three copper straps. The straps are connected to the turntable at the center of it with ground braid. The copper strap is directly connected to the groundplane at the edges of the turntable. The turntable is located on the south end of the structure and the antennas are mounted 3 and 10 meters away to the north. The antenna mast is a non-conductive with remote control of antenna height and polarization. The antenna height is adjustable from 1 to 4 meters.

All final radiated emission measurements are performed with the testing personnel and measurement equipment located below the ground reference plane. The site has a full basement underneath the turntable where support equipment may be remotely located. Operation of the antenna, turntable and equipment under test is controlled by remote controls that manipulate the antenna height and polarization and with a turntable control. Test personnel are located below the ellipse when measurements are performed, however the site maintains the ability of having personnel manipulate cables while monitoring test equipment. Ambient radiated emissions are 6 dB or more below the relevant FCC emission limits.

AC mains power is brought to the equipment under test through a power line filter, to remove ambient conducted noise. 50 Hz (240 VAC single phase), 60 Hz power (120 VAC single phase, 208 VAC three phase), and 60 Hz (480 VAC three phase) are available. Conducted emission measurements are performed with a Line Impedance Stabilization Network (LISN) or Artificial Mains Network (AMN) bonded to the ground reference plane. A removable vertical groundplane (2 meter X 2 meter area) is used for line-conducted measurements for table top equipment. The vertical groundplane is electrically connected to the reference groundplane.

The EMC Lab has two Semi-anechoic Chambers and one Shielded Chamber. AC Mains Power is available at 120, 230, and 277 Single Phase; 208, 400, and 480 3-Phase. Large reference groundplanes are installed in the general lab area to facilitate EMC work not requiring a shielded environment.

Test Results: Pass

Test Standard: CFR47 Part 1.1307

Test: Human RF Exposure

Performance Criterion: The aggregate exposure must not exceed 100% of the limits in 1.1310 Table 1

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/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	6
(B) Limits for General Population/Uncontrolled Exposure				
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

f = frequency in MHz
* = Plane-wave equivalent power density
NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.
NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

Test Environment:

Environmental Conditions During Testing:		Ambient (°C):	12	Humidity (%):	36	Pressure (hPa):	1002
Pretest Verification Performed		Yes		Equipment under Test:		BAEVCA100-81FCGX-LF	
Test Engineer(s):	Nicholas Abbondante			EUT Serial Number:		0716HNH000092	
Engineer's Initials:	NNA	Date Test Performed:	01/29/2008	Reviewer's Initials:		Date Reviewed:	01/30/09

Test Equipment Used:

TEST EQUIPMENT LIST					
Item	**Equipment Type**	**Make**	**Model No.**	**Serial No.**	**Next Cal. Due**
1	Digital 4 Line Barometer	Mannix	0ABA116	BAR1	06/01/2009
2	Electromagnetic Radiation Meter Set	Schaffner	EMC-20	AP-0183	12/02/2009

Test Details:

The EUT was activated at full power, and connected to each of the antennas listed in this report. Each antenna was placed at a typical mounting point. An isotropic electric field probe was used to take peak readings of the field strength at various test points outside and inside of the vehicle. The measurement probe position was varied at each point to produce the worst-case value. Below are diagrams showing the transmit antenna mounting point and the corresponding test point locations and designations. Mounting points were selected to provide the worst-case RF exposure results.

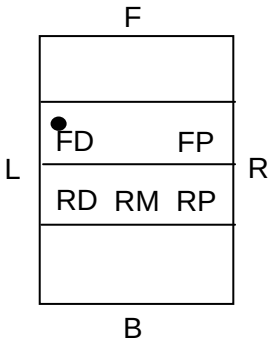
The readings from the field probe are in V/m. The limits are expressed in mW/cm^2. An equation that relates these two values is

$E = (377*10*P)^{1/2}$

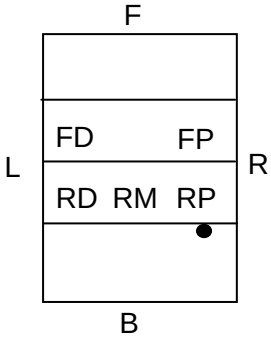
where E is the measured voltage in V/m, and P is the power density in mW/cm^2. The factor 377 is the impedance of free space, a constant. The obtained power density can then be compared to the limits.

The power density limit for uncontrolled exposure is 5.0 mW/cm^2 at 2.4 GHz and f/1500 at the LMR frequency, where f is the transmit frequency. The worst case limits are at the lowest transmit frequency, and the measured RF output power of the EUT at the antenna port was maximum at the lowest transmit frequency. Therefore the lowest transmit frequency of 806 MHz was selected as the worst case limit, and the limit for Maximum Permissible Exposure (MPE) was determined to be 0.537 mW/cm^2.

Front Left Mount



Rear Right Trunk @ Window Mount



F = Front
L = Left
R = Right
B = Back
FD = Front Driver Side
FP = Front Passenger Side
RD = Rear Driver Side
RM = Rear Middle
RP = Rear Passenger Side
● = Transmit Antenna

The Left, Right, Front, and Back locations were measured at the point adjacent to the antenna in order to maximize the results. At the internal vehicle locations, the entire volume that a passenger could occupy was investigated. Test distances are approximate.

Front Left Mount

Test Point	Test Point Distance (cm)
Front	211
Back	236
Left	25
Right	114
Front Driver	10
Front Passenger	51
Rear Driver	56
Rear Middle	69
Rear Passenger	91

Rear Right Trunk @ Window Mount

Test Point	Test Point Distance (cm)
Front	389
Back	53
Left	127
Right	31
Front Driver	163
Front Passenger	152
Rear Driver	97
Rear Middle	76
Rear Passenger	66

LMR Antenna Antenex B8063, 3 dBi Gain Front Left Mount on Sedan

Test Point	Field Strength Reading (V/m)	Field Strength Reading (mW/cm^2)	MPE Limit (mW/cm^2)	% of MPE Limit
Front	5.63	0.00841	0.537	1.6%
Front Driver	8.15	0.01762	0.537	3.3%
Rear Driver	4.23	0.00475	0.537	0.9%
Left	40.83	0.44220	0.537	82.3%
Back	5.50	0.00802	0.537	1.5%
Right	9.59	0.02439	0.537	4.5%
Rear Middle	4.41	0.00516	0.537	1.0%
Rear Passenger	3.87	0.00397	0.537	0.7%
Front Passenger	6.87	0.01252	0.537	2.3%

LMR Antenna Antenex B8063, 3 dBi Gain Rear Right Trunk @ Window Mount on Sedan

Test Point	Field Strength Reading (V/m)	Field Strength Reading (mW/cm^2)	MPE Limit (mW/cm^2)	% of MPE Limit
Front	1.77	0.00083	0.537	0.2%
Front Driver	8.24	0.01801	0.537	3.4%
Rear Driver	12.54	0.04171	0.537	7.8%
Left	9.26	0.02274	0.537	4.2%
Back	21.49	0.12250	0.537	22.8%
Right	19.96	0.10568	0.537	19.7%
Rear Middle	12.51	0.04151	0.537	7.7%
Rear Passenger	13.70	0.04979	0.537	9.3%
Front Passenger	7.03	0.01311	0.537	2.4%

WiFi Antenna Antenex A10245, 5 dBi Gain Front Left Mount on Sedan

Test Point	Field Strength Reading (V/m)	Field Strength Reading (mW/cm^2)	MPE Limit (mW/cm^2)	% of MPE Limit
Front	0.99	0.00026	5.0	<0.3%
Front Driver	1.62	0.00070	5.0	<0.3%
Rear Driver	1.44	0.00055	5.0	<0.3%
Left	2.42	0.00155	5.0	0.31%
Back	0.72	0.00014	5.0	<0.3%
Right	0.71	0.00013	5.0	<0.3%
Rear Middle	0.82	0.00018	5.0	<0.3%
Rear Passenger	0.72	0.00014	5.0	<0.3%
Front Passenger	0.94	0.00023	5.0	<0.3%

WiFi Antenna Antenex A10245, 5 dBi Gain Rear Right Trunk @ Window Mount on Sedan

Test Point	Field Strength Reading (V/m)	Field Strength Reading (mW/cm^2)	MPE Limit (mW/cm^2)	% of MPE Limit
Front	0.33	0.00003	5.0	<0.3%
Front Driver	0.60	0.00010	5.0	<0.3%
Rear Driver	1.32	0.00046	5.0	<0.3%
Left	0.48	0.00006	5.0	<0.3%
Back	2.12	0.00119	5.0	<0.3%
Right	2.36	0.00148	5.0	<0.3%
Rear Middle	1.13	0.00034	5.0	<0.3%
Rear Passenger	1.62	0.00070	5.0	<0.3%
Front Passenger	1.31	0.00046	5.0	<0.3%

This radio has been tested and complies with the FCC RF exposure limits for Uncontrolled Exposure and Occupational exposure. The maximum exposure from the LMR was 82.3%, and the WiFi exposure did not exceed 0.031%, therefore the maximum human RF exposure would be 82.33%, peak.

Results: Passed

Setup Photos

LMR General Test Setup

Setup Photos

Front Left Mounting (LMR and Wifi)

Setup Photos

Right Rear Trunk @ Window Mounting (LMR and Wifi)