Excellence in Compliance Testing

Certification Test Report

FCC ID: YWZ-NANOGATEAM
IC: 3356F-NANOGATEAM

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

ACS Report Number: 12-0033.W06.1A

Manufacturer: Alpha High Theft Solutions
Model: NANOGATE-AM

Test Begin Date: January 24, 2012
Test End Date: February 9, 2012

Report Issue Date: February 27, 2012

FOR THE SCOPE OF ACCREDITATION UNDER LAB Code 200612-0

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

Reviewed by:
Kirby Munroe
Director, Wireless Certifications
ACS, Inc.

This report contains 17 pages

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1 GENERAL

1.1 Purpose

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

1.2 Product description

The NANOGATE-AM provides simulation of the 58kHz AM Electronic Article Surveillance (EAS) gate. When the NANOGATE-AM is used in conjunction with Alpha High Theft Solutions 3Alarm AM Tags it provides a EAS barrier to prevent retail theft.

Technical Details:
Frequency Range: 58 kHz
Operating channels: 1
Modulation: AM
Operating Voltage: 120VAC / 60 Hz power supply (12VDC to EUT)

Manufacturer Information:
Alpha High Theft Solutions
10715 Sikes Place, Ste. 200
Charlotte, NC 28277

Test Sample Serial Number(s): C002, C003

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

1.3 Test Methodology and Considerations

The EUT was tested in a configuration representative of typical installation and use. The EUT configuration was adjusted for worst case radiated emissions. No deviations from the test specifications were made.

2 TEST FACILITIES

2.1 Location

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

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

2.2 Laboratory Accreditations/Recognitions/Certifications

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

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

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

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

2.3 Radiated Emissions Test Site Description

2.3.1 Semi-Anechoic Chamber Test Site

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

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

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

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

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

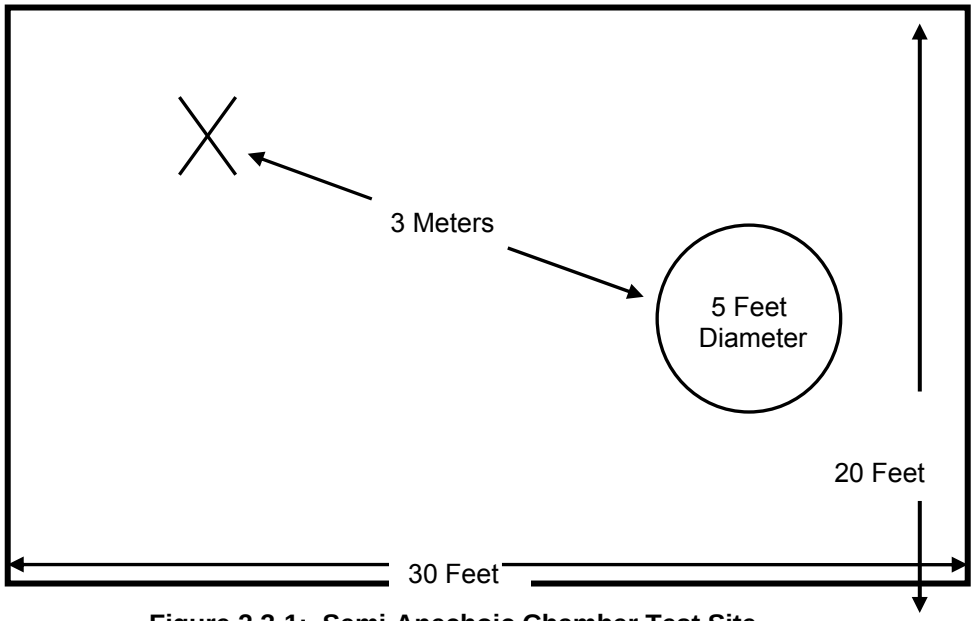


Figure 2.3-1: Semi-Anechoic Chamber Test Site

2.3.2 Open Area Tests Site (OATS)

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

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

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

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

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

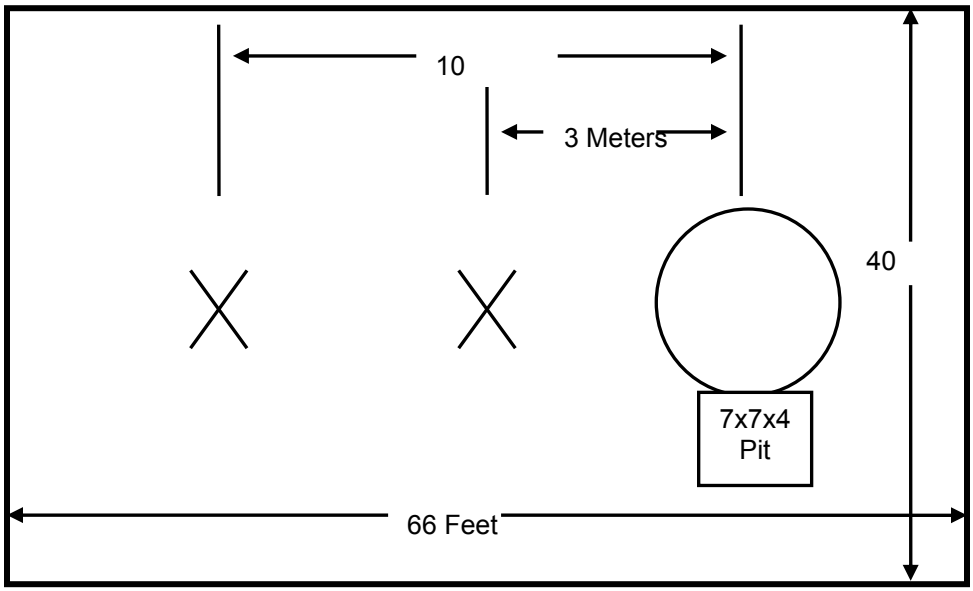


Figure 2.3-2: Open Area Test Site

2.4 Conducted Emissions Test Site Description

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

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

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

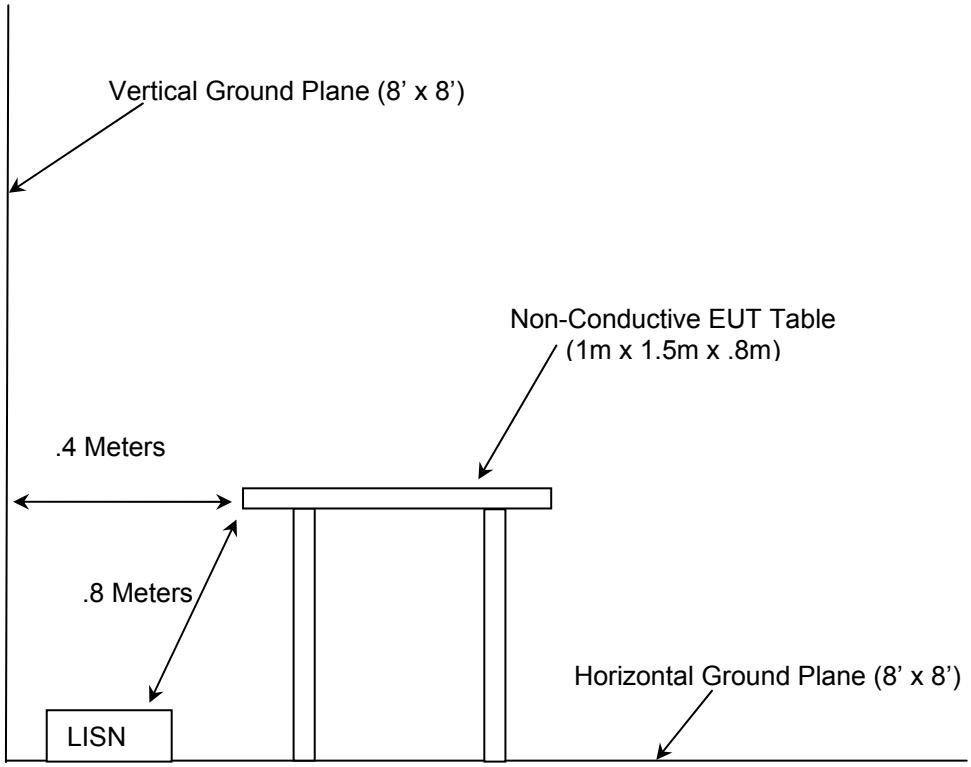


Figure 2.4-1: AC Mains Conducted EMI Site

3 APPLICABLE STANDARD REFERENCES

The following standards were used:

- ANSI C63.4-2003: Method of Measurements of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the 9KHz to 40GHz
- US Code of Federal Regulations (CFR): Title 47, Part 2, Subpart J: Equipment Authorization Procedures, 2011
- US Code of Federal Regulations (CFR): Title 47, Part 15, Subpart C: Radio Frequency Devices, Intentional Radiators, 2011
- Industry Canada Radio Standards Specification: RSS-210 - Low-power License-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment, Issue 8, Dec 2010
- Industry Canada Radio Standards Specification: RSS-GEN – General Requirements and Information for the Certification of Radiocommunication Equipment, Issue 3, Dec 2010.

4 LIST OF TEST EQUIPMENT

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

Table 4-1: Test Equipment

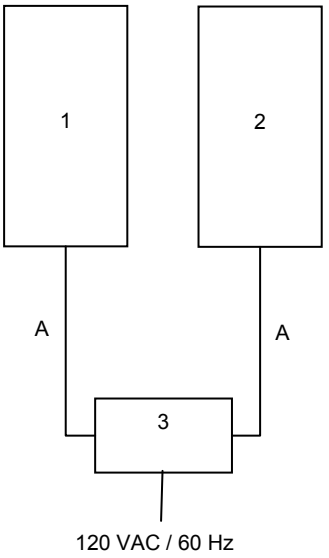
AssetID	Manufacturer	Model #	Equipment Type	Serial #	Last Calibration Date	Calibration Due Date
1	Rohde & Schwarz	ESMI - Display	Spectrum Analyzers	833771/007	9/23/2011	9/23/2012
2	Rohde & Schwarz	ESMI-Receiver	Spectrum Analyzers	839587/003	9/23/2011	9/23/2012
3	Rohde & Schwarz	ESMI - Display	Spectrum Analyzers	839379/011	5/26/2011	5/26/2013
4	Rohde & Schwarz	ESMI - Receiver	Spectrum Analyzers	833827/003	5/26/2011	5/26/2013
40	EMCO	3104	Antennas	3211	2/11/2011	2/11/2013
41	Electro-Metrics	BIA-25	Antennas	2925	12/21/2010	12/21/2012
73	Agilent	8447D	Amplifiers	2727A05624	9/30/2011	9/30/2012
78	EMCO	6502	Antennas	9104-2608	1/31/2011	1/31/2013
152	EMCO	3825/2	LISN	9111-1905	11/2/2010	11/2/2012
153	EMCO	3825/2	LISN	9411-2268	1/13/2011	1/13/2013
167	ACS	Chamber EMI Cable Set	Cable Set	167	12/21/2011	12/21/2012
168	Hewlett Packard	11947A	Attenuators	44829	2/1/2012	2/1/2013
168	Hewlett Packard	11947A	Attenuators	44829	2/4/2011	2/4/2012
193	ACS	OATS cable Set	Cable Set	193	1/9/2012	7/9/2012
211	Eagle	C7RFM3NFNM	Filters	HLC-700	12/1/2011	12/1/2012
213	TEC	PA 102	Amplifiers	44927	8/23/2011	8/23/2012
277	Emco	93146	Antennas	9904-5199	8/25/2010	8/25/2012
283	Rohde & Schwarz	FSP40	Spectrum Analyzers	1000033	8/26/2011	8/26/2012
324	ACS	Belden	Cables	8214	7/6/2011	7/6/2012
412	Electro Metrics	LPA-25	Antennas	1241	7/28/2010	7/28/2012

5 SUPPORT EQUIPMENT

Table 5-1: Support Equipment

Item #	Manufacturer	Equipment Type	Model / Assembly Number	Serial Number
1	Alpha High Theft Solutions	EUT	NANOGATE-AM / F1224101	C002
2	Alpha High Theft Solutions	EUT	NANOGATE-AM / F1224101	C003
3	Alpha High Theft Solutions	Power Supply	NANOGATE-AM-PWR / F1224102	C002

6 EQUIPMENT UNDER TEST SETUP BLOCK DIAGRAM



A: 3 conductor shielded power supply cable – 6.5m

7 SUMMARY OF TESTS

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

7.1 Antenna Requirement – FCC: Section 15.203

The antenna is a wound coil type which is non-detachable and integral in design.

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

7.2.1 Measurement Procedure

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

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

7.2.2 Measurement Results

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

Table 7.2.2-1: Conducted EMI Results – Line 1

Frequency (MHz)	Level (dBuV)	Transducer (dB)	Limit (dBuV)	Margin (dB)	Line	PE	Detector
1.788	46.9	10	56	9.1	L1	GND	QP
1.908	46.5	10	56	9.5	L1	GND	QP
2.022	47.5	10	56	8.5	L1	GND	QP
2.142	48.6	10	56	7.4	L1	GND	QP
2.262	48	10	56	8	L1	GND	QP
2.442	48.1	10	56	7.9	L1	GND	QP
2.562	47.3	10	56	8.7	L1	GND	QP
2.682	46.7	10	56	9.3	L1	GND	QP
2.736	46.9	10	56	9.1	L1	GND	QP
2.976	46.7	9.9	56	9.3	L1	GND	QP
1.728	41.8	10	46	4.2	L1	GND	AVG
1.908	42.6	10	46	3.4	L1	GND	AVG
2.028	42.7	10	46	3.3	L1	GND	AVG
2.148	42.8	10	46	3.2	L1	GND	AVG
2.268	42.6	10	46	3.4	L1	GND	AVG
2.448	41.5	10	46	4.5	L1	GND	AVG
2.562	39.6	10	46	6.4	L1	GND	AVG
2.682	39.4	10	46	6.6	L1	GND	AVG
2.742	38.7	10	46	7.3	L1	GND	AVG
2.982	36.8	9.9	46	9.2	L1	GND	AVG

Table 7.2.2-2: Conducted EMI Results – Line 2

Frequency (MHz)	Level (dBuV)	Transducer (dB)	Limit (dBuV)	Margin (dB)	Line	PE	Detector
1.608	45.2	10	56	10.8	L2	GND	QP
1.668	46.1	10	56	9.9	L2	GND	QP
1.848	46.5	10	56	9.5	L2	GND	QP
2.142	48	10	56	8	L2	GND	QP
2.202	47.4	10	56	8.6	L2	GND	QP
2.382	47.3	10	56	8.7	L2	GND	QP
2.442	47.5	10	56	8.5	L2	GND	QP
2.616	47.3	10	56	8.7	L2	GND	QP
2.796	47.3	10	56	8.7	L2	GND	QP
2.976	46.2	9.9	56	9.8	L2	GND	QP
1.608	40.1	10	46	5.9	L2	GND	AVG
1.668	41	10	46	5	L2	GND	AVG
1.848	42	10	46	4	L2	GND	AVG
2.148	42.4	10	46	3.6	L2	GND	AVG
2.208	42.1	10	46	3.9	L2	GND	AVG
2.448	40.7	10	46	5.3	L2	GND	AVG
2.568	39.6	10	46	6.4	L2	GND	AVG
2.802	38.4	10	46	7.6	L2	GND	AVG
2.976	34.9	9.9	46	11.1	L2	GND	AVG

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

7.3.1 Measurement Procedure

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

Measurements below 30MHz were performed on the OATS with a 10 meter separation distance between the EUT and measurement antenna. The EUT was rotated 360º and the loop antenna rotated about the vertical axis to maximize each emission. The magnetic loop receiving antenna was positioned with its center 1 meter above the ground.

The spectrum analyzer's resolution and video bandwidth was set to 200 Hz and 3000 Hz respectively for frequencies below 150 kHz and 9 kHz and 30 kHz respectively for frequencies above 150 kHz and below 30 MHz. For measurements in the frequency bands 9-90 kHz and 110-490 kHz, an average detector was used. When average measurements are specified, the peak emissions were also compared to a limit corresponding to 20 dB above the maximum permitted average limit according to Part 15.35. All other emissions were measured using a Quasi-peak detector. The final measurements were then corrected by antenna correction factors and cable loss for comparison to the limits.

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

7.3.2 Distance Correction for Measurements Below 30 MHz – Part 15.31

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

Distance correction factor (300m Specified Test Distance) = 40*Log (Test Distance/300)
= 40*Log (10/300)
= - 59.08 dB

Distance correction factor (30m Specified Test Distance) = 40*Log (Test Distance/30)
= 40*Log (10/30)
= - 19.08 dB

The distance correction factor for the fundamental emission was determined by making measurements at two distances on one radial to determine the proper extrapolation factor. The extrapolation factor was calculated as follows:

P = Roll-off exponent = (Level @ Dist 1 – Level @ Dist 2) / 20 Log (Dist 2/Dist 1)
= (112.43 – 99.34) / (20*Log (7/13))
= 2.43

Distance correction factor = 20*Log (Test Distance/300)*P
= 20*Log (10/300)*2.43
= - 71.79 dB

The distance correction factor was included as an offset in the measurement equipment.

7.3.3 Duty Cycle Correction – Part 15.35

For radiated measurements compared to average limits, the measured level was reduced by a factor 27.49 dB to account for the duty cycle of the EUT. Transmit bursts of 1.41ms follow a 33.4ms, repetition rate. Therefore the maximum duty cycle occurs with a 1.4ms transmit burst occurring at a repetition rate of 33.4ms. The duty cycle is determined to be 4.22%. The duty cycle correction factor is determined using the following formula:

Duty Cycle = 20*log (1.41/33.4) = -27.49 dB.

The duty cycle is show in figures 7.3.3-1 and 7.3.3-2 below.

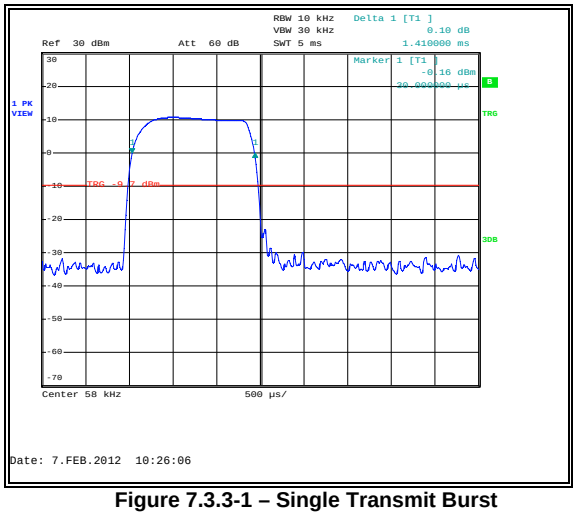


Figure 7.3.3-1 – Single Transmit Burst

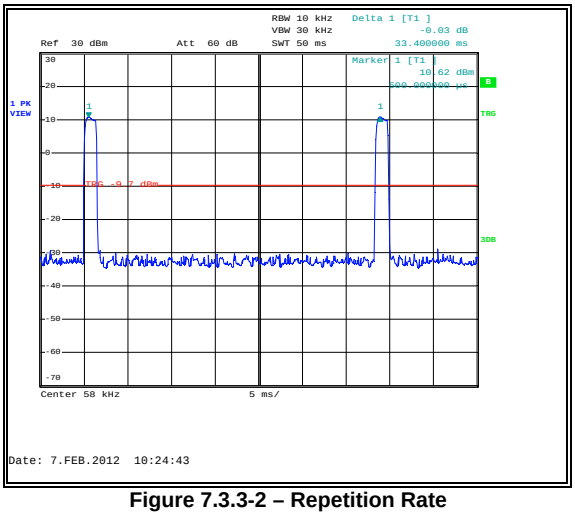


Figure 7.3.3-2 – Repetition Rate

7.3.4 Measurement Results

Results of the test are given in Tables 7.3.4-1 to 7.3.4-2.

Table 7.3.4-1: Fundamental Field Strength

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
0.058	30.93	30.93	H	11.30	42.23	14.74	52.3	32.3	10.1	17.6

Table 7.3.4-2: Radiated Emissions

Frequency (MHz)	Level (dBuV)		Antenna Polarity	Correction Factors	Corrected Level (dBuV/m)		Limit (dBuV/m)		Margin (dB)	
	pk	Qpk/Avg	(H/V)	(dB)	pk	Qpk/Avg	pk	Qpk/Avg	pk	Qpk/Avg
0.116	-12.76	-12.76	V	10.58	-2.18	-29.67	46.3	26.3	48.5	56.0
0.176	-0.89	-0.89	V	10.52	9.63	-17.86	42.7	22.7	33.1	40.6
0.2324	-3.88	-3.88	V	10.47	6.59	-20.91	40.3	20.3	33.7	41.2
0.2911	-10.93	-10.93	V	10.41	-0.52	-28.01	38.3	18.3	38.8	46.3
36.61	---------	51.04	V	-14.03	---------	37.01	--------	40.0	---------	3.0
46.24	---------	52.64	V	-13.95	---------	38.69	--------	40.0	---------	1.3
48.89	---------	50.28	V	-13.84	---------	36.44	--------	40.0	---------	3.6
524.44	---------	19.98	H	-5.68	---------	14.30	--------	46.0	---------	31.7
612.44	---------	19.80	H	-3.80	---------	16.00	--------	46.0	---------	30.0
843.56	---------	20.67	V	-0.03	---------	20.64	--------	46.0	---------	25.4

7.3.5 Sample Calculation

Example Calculation – Average / Quasi-Peak / Peak

Measurement Distance 300m @ 58kHz

Limit (dBuV/m) = 20*Log(2400/F(kHz))
Limit (dBuV/m) = 20*Log(2400/58)
Limit (dBuV/m) = 32.34dBuV/m
Corresponding Peak Limit (dBuV/m) = 52.34dBuV/m

Example Calculation - 58kHz Fundamental (See Table 7.3.4-1)

$R_C = R_U + CF_T$

Where:

CF_T	=	Total Correction Factor (AF+CA+AG)-DC (Average Measurements Only)
R_U	=	Uncorrected Reading
R_C	=	Corrected Level
AF	=	Antenna Factor
CA	=	Cable Attenuation
AG	=	Amplifier Gain
DC	=	Duty Cycle Correction Factor

Peak:
Corrected Level: 30.93 + 11.30 = 42.23dBuV
Margin: 52.34dBuV – 42.23dBuV = 10.1 dB

Average:
Corrected Level: 30.93 + 11.30 - 27.49 = 14.74dBuV
Margin: 32.34dBuV – 14.74dBuV = 17.6 dB

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

7.4.1 Measurement Procedure

The RF output port of the EUT was directly connected to the input of the spectrum analyzer. The span of the spectrum analyzer display was set between two times and five times the occupied bandwidth (OBW) of the emission. The resolution bandwidth was set to 200Hz. The video bandwidth was set to ≥ 3 times the resolution bandwidth. The trace was set to max hold with a peak detector active. The delta function of the analyzer was utilized to determine the 20 dB bandwidth of the emission.

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

7.4.2 Measurement Results

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

Table 7.4.2-1: 20dB / 99% Bandwidth

Frequency [kHz]	20dB Bandwidth [kHz]	99% Bandwidth [kHz]
58	3.24	3.46

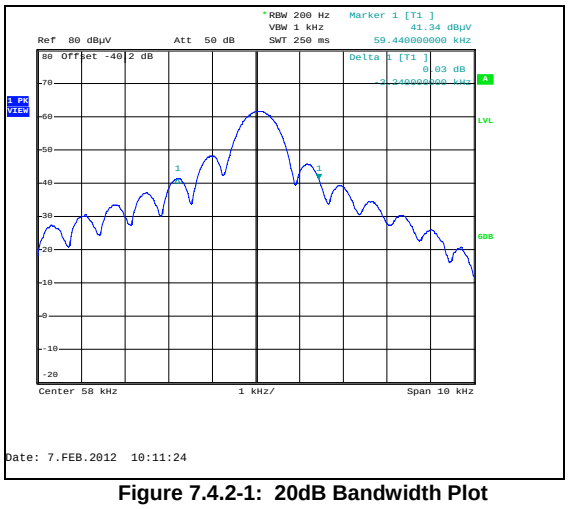


Figure 7.4.2-1: 20dB Bandwidth Plot

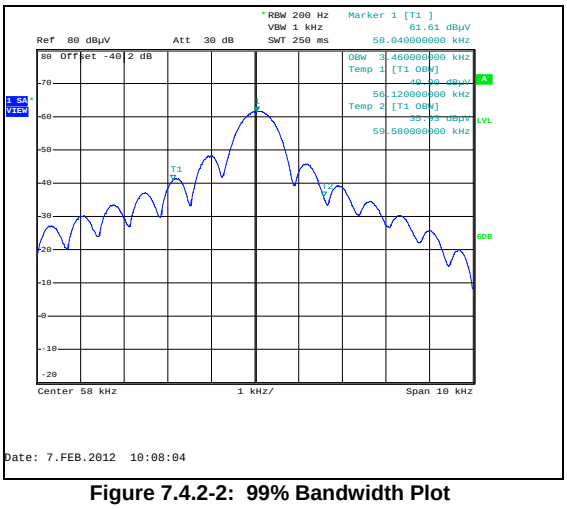


Figure 7.4.2-2: 99% Bandwidth Plot

8 CONCLUSION

In the opinion of ACS, Inc., the NANOGATE-AM, manufactured by Alpha - High Theft Solutions meet the requirements of FCC Part 15 subpart C and Industry Canada's Radio Standards Specification RSS-210.

END REPORT